

Petition for *Inter Partes* Review of U.S. Patent No. 10,681,698 B2

UNITED STATES PATENT AND TRADEMARK OFFICE

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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TP-LINK CORPORATION LIMITED,  
Petitioner

v.

NETGEAR, INC.,  
Patent Owner

**U.S. PATENT NO. 10,681,698 B2**

Case IPR2023-TBD

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

## TABLE OF CONTENTS

|      |                                                                                                           |    |
|------|-----------------------------------------------------------------------------------------------------------|----|
| I.   | INTRODUCTION .....                                                                                        | 1  |
| II.  | OVERVIEW OF CHALLENGE AND RELIEF REQUESTED .....                                                          | 1  |
| III. | BACKGROUND OF THE '698 PATENT .....                                                                       | 2  |
| A.   | Specification .....                                                                                       | 2  |
| B.   | Prosecution History .....                                                                                 | 4  |
| IV.  | LEVEL OF ORDINARY SKILL IN THE ART .....                                                                  | 6  |
| V.   | CLAIM CONSTRUCTION .....                                                                                  | 6  |
| VI.  | OVERVIEW OF THE PRIOR ART .....                                                                           | 7  |
| A.   | Overview of Gatewood .....                                                                                | 7  |
| B.   | Overview of Ho .....                                                                                      | 9  |
| VII. | SPECIFIC GROUNDS FOR PETITION .....                                                                       | 13 |
| A.   | Ground I: Claims 1-6 and 12-17 Are Rendered Obvious by<br>Gatewood, Alone or in Combination With Ho ..... | 13 |
| 1.   | Reasons to Combine Gatewood and Ho .....                                                                  | 13 |
| 2.   | Independent Claims 1 and 12 .....                                                                         | 14 |
| 3.   | Dependent Claims 2 and 13 .....                                                                           | 35 |
| 4.   | Dependent Claims 3 and 14 .....                                                                           | 37 |
| 5.   | Dependent Claims 4 and 15 .....                                                                           | 38 |
| 6.   | Dependent Claims 5 and 16 .....                                                                           | 41 |
| 7.   | Dependent Claims 6 and 17 .....                                                                           | 43 |
| B.   | Ground II: Claims 1-22 Are Rendered Obvious by Ho .....                                                   | 44 |
| 1.   | Independent Claims 1 and 12 .....                                                                         | 44 |
| 2.   | Dependent Claims 2 and 13 .....                                                                           | 57 |
| 3.   | Dependent Claims 3 and 14 .....                                                                           | 60 |
| 4.   | Dependent Claims 4 and 15 .....                                                                           | 60 |
| 5.   | Dependent Claims 5 and 16 .....                                                                           | 62 |
| 6.   | Dependent Claims 6 and 17 .....                                                                           | 62 |
| 7.   | Dependent Claims 7 and 18 .....                                                                           | 65 |

Petition for *Inter Partes* Review of U.S. Patent No. 10,681,698 B2

|       |                                                                                           |    |
|-------|-------------------------------------------------------------------------------------------|----|
| 8.    | Dependent Claims 8 and 19 .....                                                           | 68 |
| 9.    | Dependent Claims 9 and 20 .....                                                           | 69 |
| 10.   | Dependent Claims 10 and 21 .....                                                          | 70 |
| 11.   | Dependent Claims 11 and 22 .....                                                          | 71 |
| C.    | Ground III: Claims 9 and 20 Are Rendered Obvious by Ho In<br>Combination with Farid ..... | 72 |
| 1.    | Dependent Claims 9 and 20 .....                                                           | 72 |
| VIII. | THE BOARD SHOULD INSTITUTE IPR .....                                                      | 75 |
| IX.   | MANDATORY NOTICES .....                                                                   | 76 |
| A.    | Real Party-In-Interest .....                                                              | 76 |
| B.    | Related Matters.....                                                                      | 76 |
| C.    | Counsel and Service Information.....                                                      | 77 |
| X.    | PAYMENT OF FEES UNDER 37 C.F.R. § 42.103 .....                                            | 77 |
| XI.   | CERTIFICATION OF GROUNDS FOR STANDING .....                                               | 78 |
| XII.  | CONCLUSION.....                                                                           | 78 |

**TABLE OF AUTHORITIES**

| <b>Cases</b>                                                                                               | <b>Page(s)</b> |
|------------------------------------------------------------------------------------------------------------|----------------|
| <i>CrowdStrike, Inc. v. Open Text Inc.</i> ,<br>IPR2023-00556, Paper 9 (PTAB Sept. 12, 2023).....          | 76             |
| <i>Fasteners for Retail, Inc. v. RTC Indus., Inc.</i> ,<br>IPR2019-00994, Paper 9 (PTAB Nov. 5, 2019)..... | 75             |
| <i>Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.</i> ,<br>868 F.3d 1013 (Fed. Cir. 2017) .....      | 6              |

## LIST OF EXHIBITS

| <b>Exhibit No.</b> | <b>Description</b>                                                                                                                               |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1001</b>        | U.S. Patent No. 10,681,698                                                                                                                       |
| <b>1002</b>        | Declaration of Dr. Zhi Ding for <i>Inter Partes</i> Review of U.S. Patent No. 10,681,698                                                         |
| <b>1003</b>        | <i>Curriculum Vitae</i> of Dr. Zhi Ding                                                                                                          |
| <b>1004</b>        | Certified File History of U.S. Patent No. 10,681,698                                                                                             |
| <b>1005</b>        | U.S. Patent 9,001,767 (“Gatewood”)                                                                                                               |
| <b>1006</b>        | U.S. Patent 7,366,120 (“Handforth”)                                                                                                              |
| <b>1007</b>        | U.S. Patent Application Publication No. 2013/0194948 (“Mallik”)                                                                                  |
| <b>1008</b>        | U.S. Patent Application Publication No. 2008/0304485 (“Sinha”)                                                                                   |
| <b>1009</b>        | U.S. Patent 9,247,440 (“Ho”)                                                                                                                     |
| <b>1010</b>        | <i>Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation</i> , Vidal (June 21, 2022) |
| <b>1011</b>        | ITC Complaint Exhibit 21 (’698 Patent Infringement Claim Chart)                                                                                  |
| <b>1012</b>        | IEEE 802.1D Spanning Tree Protocol Standard                                                                                                      |
| <b>1013</b>        | District Court Stay Order                                                                                                                        |
| <b>1014</b>        | U.S. Patent Application Publication No. 2016/0007273 (“Farid”)                                                                                   |
| <b>1015</b>        | U.S. Patent 8,023,478 (“Cam-Winget”)                                                                                                             |
| <b>1016</b>        | IEEE Std 802.11s <sup>TM</sup> -2011, Part 11, Amendment 10: Mesh Networking (“IEEE 802.11s”)                                                    |
| <b>1017</b>        | Amended Joint Chart of Agreed and Disputed Claim Terms for Construction                                                                          |
| <b>1018</b>        | Complainant Netgear Inc.’s Opening Claim Construction Brief                                                                                      |

Petition for *Inter Partes* Review of U.S. Patent No. 10,681,698 B2

| <b>Exhibit<br/>No.</b> | <b>Description</b>                                                                               |
|------------------------|--------------------------------------------------------------------------------------------------|
| <b>1019</b>            | TP-Link's Initial Claim Construction Brief                                                       |
| <b>1020</b>            | IEEE P802.11s <sup>TM</sup> /D2.02, Part 11, Amendment 10: Mesh Networking ("IEEE 802.11s-2008") |
| <b>1021</b>            | Channel Bonding in WiFi: Rules and Regulations (January 25, 2016)                                |

Petitioner TP-Link Corporation Limited (“TP-Link”) requests *inter partes* review (“IPR”) of claims 1-22 (the “Challenged Claims”) of U.S. Patent No. 10,681,698 (Ex.1001, “the ’698 Patent”).

## **I. INTRODUCTION**

The ’698 Patent claims establishing a backhaul communication among nodes of a wireless mesh network by first attempting to establish a backhaul connection using a channel of a default frequency band (e.g., the Wi-Fi 5 GHz band specified in the IEEE 802.11 standards) and, when that connection fails or falls below a quality threshold, attempting to establish a backhaul connection using a different channel of the default frequency band or a channel of a lower frequency band (e.g., the Wi-Fi 2.4 GHz band, also specified in the IEEE 802.11 standards). Ex.1001, claim 1. The Challenged Claims are unpatentable because such method of establishing backhaul connection was well-known in the art, as demonstrated in this Petition. Petitioner respectfully requests that the Challenged Claims be canceled.

## **II. OVERVIEW OF CHALLENGE AND RELIEF REQUESTED**

The claimed priority date of the ’698 Patent is November 10, 2015.<sup>1</sup> Ex.1001. Petitioner’s challenge is based on the following prior art references:

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<sup>1</sup> Petitioner reserves the right to challenge the claimed priority date.

- **Gatewood** – U.S. Patent 9,001,767 issued April 7, 2015, from an application filed March 6, 2013. Gatewood is AIA §§102(a)(1)-(2) prior art. Gatewood is cited art but was not discussed during original prosecution and thus is properly relied upon in this Petition, as discussed in Section VIII.B.
- **Ho** – U.S. Patent 9,247,440 issued January 26, 2016, from an application filed August 15, 2013. Ho is AIA §§102(a)(1)-(2) prior art. Ho is cited art but is properly relied upon in this Petition for reasons discussed in Section VIII.B.
- **Farid** – U.S. Patent Application Publication No. 2016/0007273 published on January 7, 2016 from an application filed July 2, 2014. Farid is AIA §102(a)(2) prior art. Farid is not cited art.

Petitioner requests cancellation of the Challenged Claims on the grounds below:

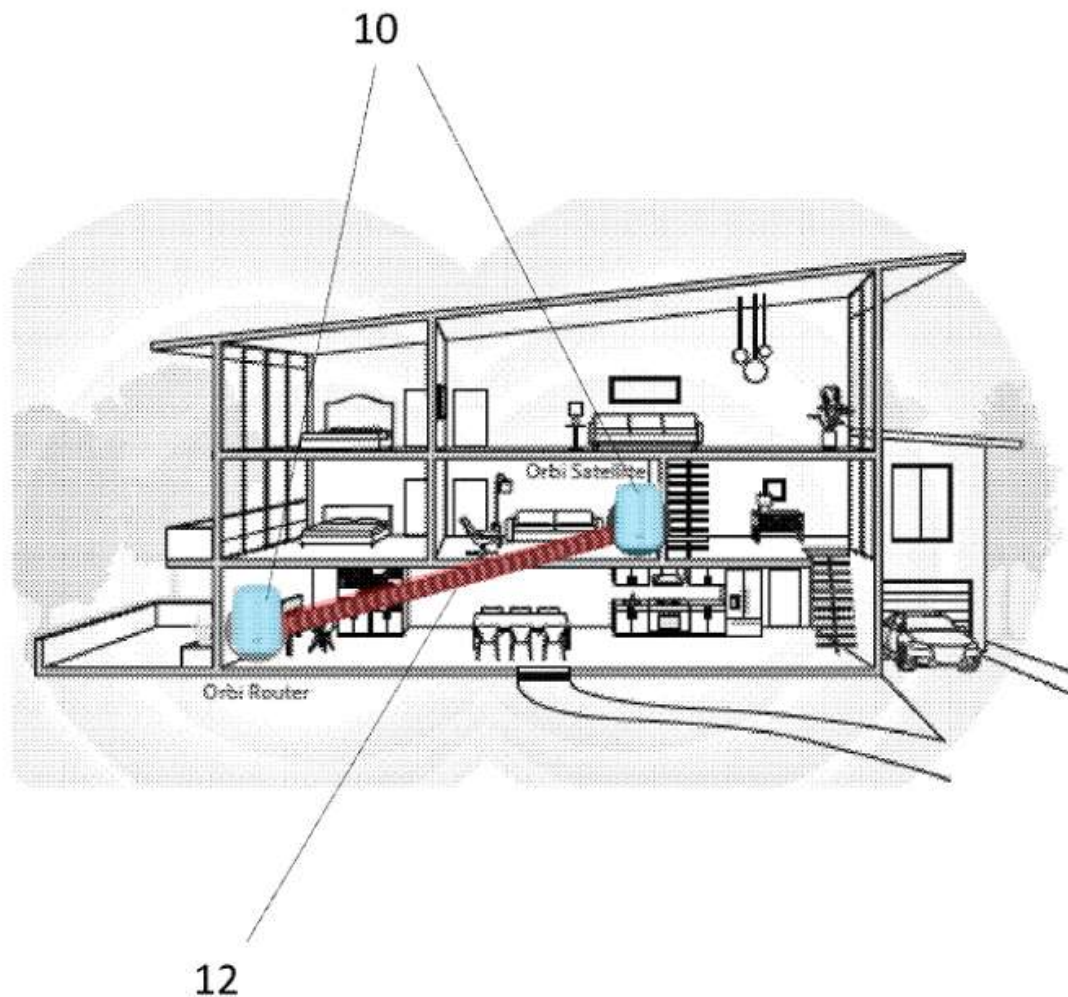
| Ground | Basis | Challenged Claims | Reference(s) |
|--------|-------|-------------------|--------------|
| I      | § 103 | 1-6, 12-17        | Gatewood, Ho |
| II     | § 103 | 1-11, 12-22       | Ho           |
| III    | § 103 | 9, 20             | Ho, Farid    |

### III. BACKGROUND OF THE '698 PATENT

#### A. Specification

The '698 Patent is directed to wireless mesh networks, which are wireless networks that deploy several mesh access points (MAPs) (blue) in a scattered

manner to provide coverage over a large area such as a home. Ex.1001, 1:27-38, 2:36-45; Ex.1002, ¶45.



Ex.1001, FIG. 1.<sup>2</sup> In a mesh network, a MAP-to-MAP communication (red) is referred to as backhaul communication, which can be established wirelessly, such as over the 2.4 GHz or 5 GHz Wi-Fi bands, or over a wired Ethernet connection. *Id.*,

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<sup>2</sup> All colors and colored annotations added unless otherwise noted.

2:48-54; Ex.1002, ¶46. The '698 Patent claims to have improved backhaul communication by first attempting to establish a backhaul connection using a channel of a default frequency band (*e.g.*, the 5 GHz band) and switching to another backup channel in the same or a different, lower, frequency band (*e.g.*, the 2.4 GHz band) if the initial channel fails or falls below a quality threshold. Ex.1001, claims 1 and 12. While the specification discusses that the default frequency band can be a band dedicated for backhaul communication (*i.e.*, it is not also used for front-haul client-facing communication), the claims do not claim a dedicated backhaul. *Id.*, 3:45-51; Ex.1002, ¶47.

This Petition demonstrates that the use of default, dedicated and redundant backhaul communications was well-known before the claimed priority date of the '698 Patent, rendering the Challenged Claims unpatentable. Ex.1002, ¶48.

## **B. Prosecution History**

The claims of the '698 Patent issued without amendment. The Examiner initially rejected claims 1-4, 10-15 and 21-22 as anticipated by Mallik. Ex.1004, 124. The Examiner rejected the 2 remaining claims, dependent claim 5 and 16, which claim the use of a spanning tree-based protocol, as rendered obvious by Mallik in view of Ho. *Id.*, 126. Examiner also rejected the claims for indefiniteness because of the use of “and/or” in the independent claims. *Id.*, 123; Ex.1002, ¶49.

In response, Applicant argued that Mallik is directed to handover, which is a different subject matter unrelated to backhaul establishment, and fails in particular to disclose claim element [1.2]/[12.2] of independent claims 1 and 12. Ex.1004, 168; *See* Section VII.A.1(c); Ex.1002, ¶50. According to Applicant, Mallik is “silent on ‘performing an attempt to utilize a different channel in the default frequency band’ and/or ‘a channel in a different frequency band that has a lower frequency range than the default frequency band,’ as recited in claim 1.” Ex.1004, 168 (emphasis in original). Applicant further contended that “Mallik does not talk about *the establishment of the backhaul* itself ... [and thus] fails to disclose the feature of ‘upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt ... to establish the backhaul with the second node,’ also recited in Applicant’s claim 1.” *Id.* (italics added, other emphasis in original).

Regarding the Examiner’s indefiniteness rejection, Applicant argued that “A and/or B” has an accepted meaning and “that meaning is A alone, B alone, or A and B together.” *Id.*, 167; Ex.1002, ¶51.

The Examiner then withdrew all rejections and allowed the claims. Ex.1004, 877. The Notice of Allowability notes that the claims are allowed in view of Applicant’s “remarks concerning switching for a mesh wireless network backhaul

communication, upon detection that the received signal strength of the first backhaul channel is below a threshold.” *Id.*; Ex.1002, ¶52.

#### **IV. LEVEL OF ORDINARY SKILL IN THE ART**

As Dr. Ding explains, a person of ordinary skill in the art (“POSITA”) of the subject matter of the ’698 Patent would have had a Bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field, and three years of experience in the design and analysis of wireless communication systems or equivalent work experience. Ex.1002, ¶¶53-56. Additional education might compensate for less experience, and vice-versa. *Id.*

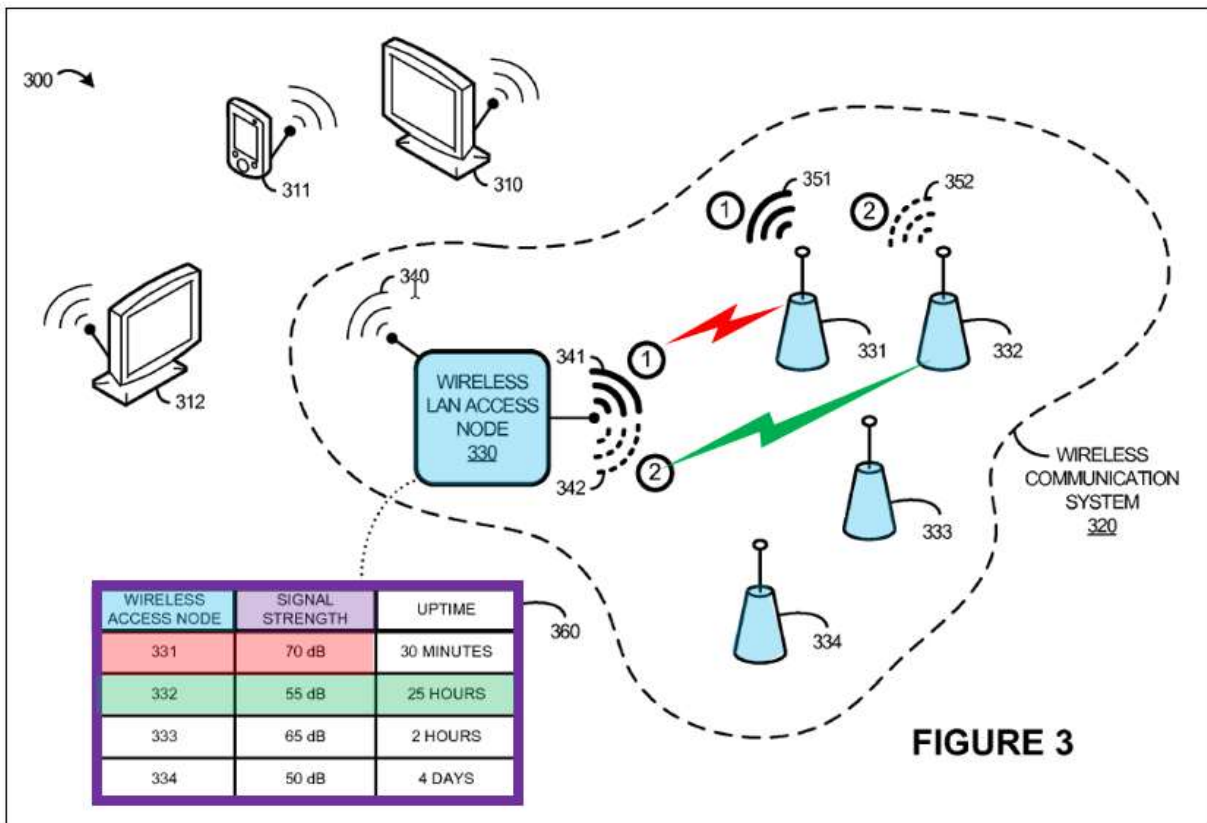
#### **V. CLAIM CONSTRUCTION**

Claims only need to be construed to the extent necessary to resolve a controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). Ex.1017 lists the parties’ disputed constructions in the currently pending parallel ITC litigation (*See* Section VII.B below). Ex.1017, Attachment A at 4 (disputed term, term #10, of the ’698 Patent highlighted). The only dispute involves the term “default frequency band.” *Id.* Under Patent Owner’s construction, this band is a preferred frequency band. *Id.* Under Petitioner’s construction, this band is a preset frequency band used automatically in the absence of a choice made by the user. *Id.* As detailed in Section VII, the prior art satisfies this claim term under either party’s construction. Ex.1002, ¶¶57-58.

## VI. OVERVIEW OF THE PRIOR ART

### A. Overview of Gatewood

Gatewood teaches forming redundant and dedicated backhaul paths between mesh access points (MAPs) (blue) of a wireless mesh network, such as the mesh network illustrated in Figure 3. Ex.1002, ¶¶59-62; Ex.1005, 3:45-54 (“FIG. 3 ... illustrat[es] communication system 300 ... [which] includes various user devices 310-312 and wireless local area network (WLAN) access nodes 330-334 ... [forming] a mesh wireless local area network.”).



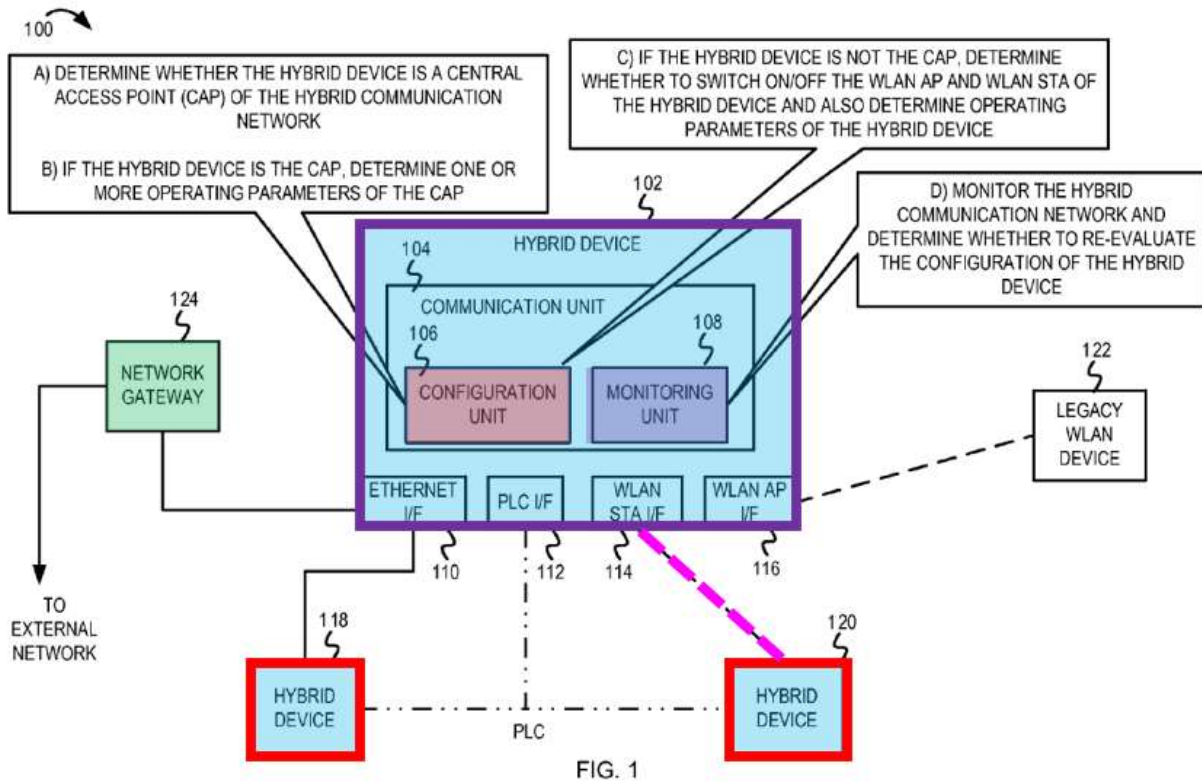
Ex.1005, FIG. 3. As Gatewood teaches, MAPs communicate with one another over dedicated and redundant backhaul communication links established using channels of the “5 Ghz IEEE 802.11 frequency spectrum.” *Id.*, 6:48-56. For example, access node 330 (MAP.330) uses “first wireless backhaul link 341” (red) as its primary dedicated backhaul link, and also maintains a “second wireless backhaul link 342” (green) in an active backup state, with both backhaul links established over channels of the 5-GHz band. *Id.*, 5:56-6:13, 6:1-13. Client-facing access communication (MAP.330-to-client) is over separate wireless links such as link 340 (140 in Figure 1) which “can be provided over at least 2.4, 3, 6, 5 and 60 GHz frequency bands[.]” *Id.*, 4:22-35, 9:55-65.

As Gatewood teaches and as shown in Figure 3, each MAP stores in its local table 360 (purple) a list of potential backhaul communication paths to other MAPs in the mesh network (column 1), together with their channel quality parameters such as signal strength (column 2) and uptime information (column 3). *Id.*, 5:4-28.

While Figure 3 illustrates split-path backhaul links, formed over different channels, that connect an access node (330) to two other access nodes (331 and 332), Gatewood also teaches forming parallel wireless channels/links between two access nodes, as detailed below. *See* Section VII.A.2.(c).

## **B. Overview of Ho**

Ho teaches a wireless mesh network, which Ho refers to as a home network or a hybrid communication network. Ex.1002, ¶¶63-69; Ex.1009, 1:8-13, 2:26-37. As illustrated in Figure 1, the network comprises multiple mesh access points (MAPs) (blue) and a gateway (green) that couples the hybrid communication network to an external network such as the Internet. Ex.1009, 3:24-54. The MAPs are called “hybrid devices” because each device supports multiple network communication technologies, such as 802.11 (Wi-Fi), powerline communications (PLC) and Ethernet, in compliance with the IEEE 1905.1 home networking standards. *Id.*, 2:26-37. In Figure 1, hybrid device 102 (purple outline) is the central access point (CAP or Root AP) because it is directly connected to the gateway (green), and other hybrid devices (118, 120) (red outline) are referred to as “non-CAP hybrid device[s].” *Id.*, 6:4-6.



Ex.1009, FIG. 1. As Ho teaches, the hybrid devices can have different radio configurations for supporting the 2.4 GHz and/or 5 GHz WLAN (Wi-Fi) frequency bands, such as “dual band dual concurrent radio” (DBDC), “dual band single radio” (DBSR) and “single band single radio” (SBSR). *Id.*, 2:33-37, 17:18-23. Notably, a “dual band dual concurrent (DBDC) device ... can simultaneously operate in the 2.4 GHz WLAN communication band and the 5 GHz WLAN communication band.” *Id.*, 18:18-22, 18:28-35.

As Ho teaches, each hybrid device includes a **configuration unit** 106 (red) that executes a “total configuration algorithm (TCA)” to automatically configure/re-configure the hybrid device at initialization and during its operation. *Id.*, 2:48-54. In

particular, the hybrid devices automatically determine the backhaul connections in the network, such as the connection highlighted in **magenta** in Figure 1.

To illustrate backhaul establishment among hybrid devices in the mesh network, Ho teaches that “the CAP [initially] selects one or more channels” in the 2.4 GHz or 5 GHz bands for backhaul communication and “broadcast[s] a message to indicate that it is in operation and to indicate the channel(s) it has selected.” *Id.*, 13:24-41. A non-CAP hybrid device then “attempt[s] to connect [(i.e., establish a backhaul connection)] to the CAP via the 2.4 GHz or the 5 GHz WLAN communication band (whichever has the better connectivity) ...”. *Id.*, 18:38-46. To ensure good backhaul connections to the CAP (root AP), Ho teaches that a non-CAP hybrid device (1) measures link quality parameters—including “***signal strength (e.g., RSSI)***”—on all communication bands that the CAP advertises as available for backhaul, (2) determines “candidate channels” that are capable of providing “preferred performance” in all such communication bands, and (3) selects a “***preferred channel***” having “***the highest RSSI***” among the candidate channels to establish backhaul connection with the CAP. Ex.1009, 14:11-27, 16:30-33 (“[T]he non-CAP hybrid device can also execute channel scan operations to select candidate channels (e.g., channels with the preferred performance) on each WLAN communication bands.”), 16:53-60 (“[T]he **configuration unit** 106 [(red)] can identify a ***preferred channel*** (e.g., a channel with the best performance, such as a

**highest RSSI**, lowest error rate, etc.) from the candidate channels” to establish backhaul with the CAP).

Each hybrid device (blue) also has a **monitoring unit** 108 (purple) that “can monitor (e.g., continuously, at periodic intervals, etc.) the hybrid communication network 100 and the device status to detect any changes that could affect the personality and configuration of the hybrid device []. For example, the user may unplug or move a network device in the hybrid communication network 100, radio conditions may change, the PLC [(powerline communication)] connection quality may change, the WLAN [(Wi-Fi)] **connection quality may change**, etc. ... As [an] example, the existing CAP of the hybrid communication network 100 may be unreachable or may change.” Ex.1009, 19:52-64.

As Ho teaches, if the **monitoring unit** detects that there are significant changes in the hybrid communication network—such as substantial changes in “performance measurements” including “WLAN data rate” changes—it triggers the **execution unit** to “**re-execute** the operations for determining the personality of the hybrid device”—which re-executes Ho’s procedure to establish backhaul connections discussed above. *Id.*, 19:64-20:17.

## VII. SPECIFIC GROUNDS FOR PETITION

### A. Ground I: Claims 1-6 and 12-17 Are Rendered Obvious by Gatewood, Alone or in Combination With Ho

#### 1. Reasons to Combine Gatewood and Ho

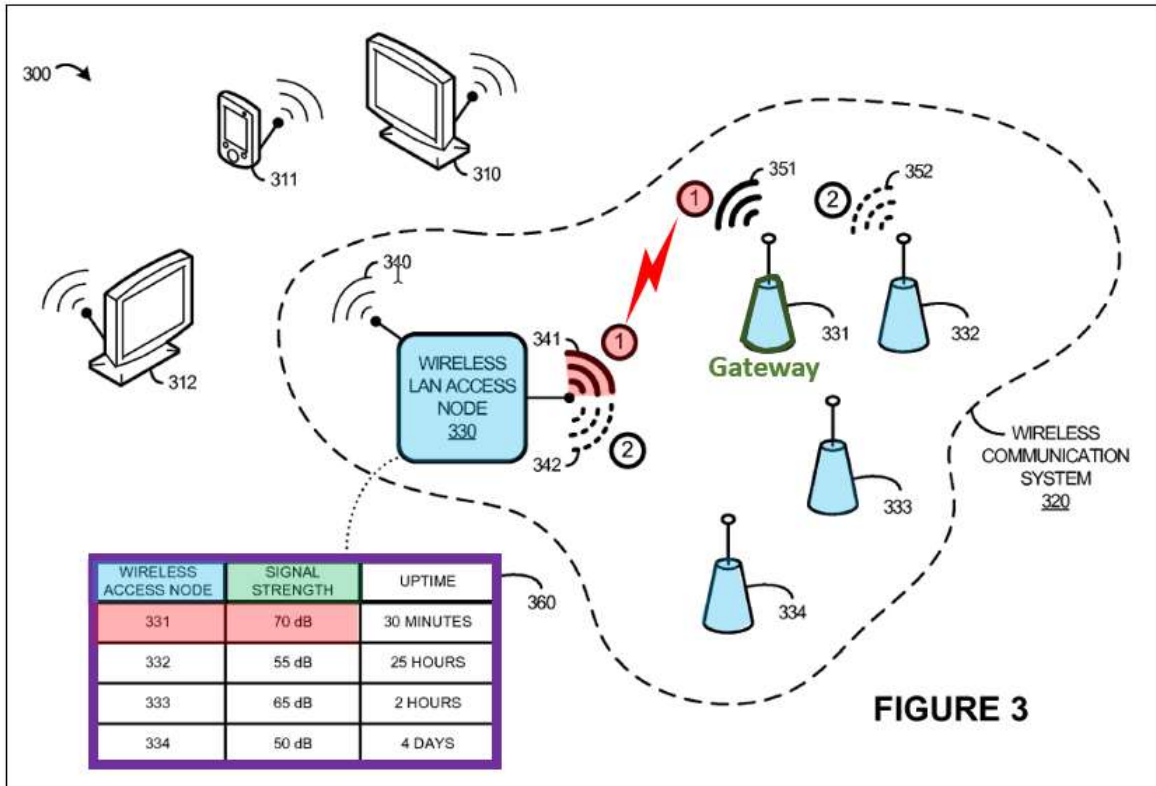
As Dr. Ding explains and as further detailed at the element-by-element level in Sections VII.A.2-7, a POSITA would have been motivated to combine the teachings of Gatewood and Ho. Ex.1002, ¶¶70-72. Gatewood and Ho are analogous references that both teach the establishment of backhaul paths in a wireless mesh network. *See* Section VII.A.2 and VII.B.1; *see also* III.A and III.B. Both references also teach establishing backhaul communication paths in channel(s) of the 5 GHz WLAN (Wi-Fi) communication band. *See* VII.A.2(b) and VII.B.1(b). And both teach selecting the channel in that frequency band having the highest measured received signal strength (RSSI) to establish backhaul communication. *Id.* Both Gatewood and Ho teach determining an alternative backhaul path, based again on measured received signal strength, if the established backhaul path fails or no longer provides adequate performance. *See* VII.A.2(c) and VII.B.1(c). Both references also use compatible processor-based architectures. *See* VII.A.2(a) and VII.B.1(a). A POSITA would therefore understand that Ho's teachings are compatible with and complementary to Gatewood's, and would naturally look to the teachings of one reference to improve the other as detailed at the element-by-element analysis below. Ex.1002, ¶72.

**2. Independent Claims 1 and 12**

- (a) *Claim 1 Preamble: “A computer-implemented method for establishing a backhaul communication among nodes in a mesh wireless network, the method comprising:”*

*Claim 12 Preamble: “A network device capable of establishing a backhaul communication among nodes in a mesh wireless network, the device including a network controller configured to perform operations comprising:”*

To the extent the preamble is limiting, Gatewood discloses or renders it obvious. Ex.1002, ¶¶73-78. Gatewood Figure 3 illustrates a wireless mesh network formed with multiple access nodes or mesh access points 330-334 (hereinafter, MAP.330, ... MAP.334) (blue). Ex.1005, 3:45-54 (“FIG. 3 is a system diagram illustrating communication system 300. Communication system 300 includes various user devices 310-312 and wireless local area network (WLAN) access nodes 330-334 ... [forming] a ***mesh wireless local area network***.”).



Ex.1005, FIG. 3. WLAN access node 330 (MAP.330) in Figure 3 is an example of the claimed network device recited in the preamble of claim 12. Ex.1002, ¶74. Claim 12 further requires that the network device establishes “a backhaul with a second node” of the wireless mesh network. *See* Section VII.A.2(b). WLAN access node 331 (MAP.331) is an example of the claimed second node. Ex.1002, ¶74. In Figure 3, MAP.331 (second node) is labeled a gateway, consistent with Gatewood’s teaching that any of the access points in Figure 3 can be a gateway. Ex.1005, 1:22-25 (“Access points can include router, **gateway**, or bridge functionality to connect user devices on the provided local area networks to other networks and systems, such as the Internet or other packet networks.”), 3:58-4:3 (“WLAN access nodes 331-334

are also communicatively coupled to further networks, ... such as the Internet ... Although not shown in FIG. 3, each of WLAN access nodes 331-334 can have one or more additional wired or wireless links for communication with these further networks ...”).

As shown in Figure 3 and discussed below in Section VII.A.2(b), MAP.330 (claimed network device) first attempts to establish a backhaul connection (labeled “1”) (red) with MAP.331 (claimed second node) because the wireless connection between those two nodes—which Gatewood refers to as the *“first wireless backhaul link”*—is the link with *“the highest [received] signal strength”* (RSSI) of 70 decibels (“70 dB”), as highlighted in red in the local “data structure 360” (purple) of MAP.330. Ex.1005, 4:41-53, 5:4-28.

**Computer-Implemented Method/Network Controller** – As Gatewood explains and as illustrated in Figure 5, each access node, such as MAP.330 (claimed network device), includes a processing system 520 and software 532 (claimed network controller) that operate to *“select a first wireless backhaul link* for communications of the wireless local area network *based on signal strength*, and [] a *second wireless backhaul link* as a *backup* for the first wireless backhaul link based on at least signal strengths and uptime information, among other operations.” Ex.1005, 8:12-21.

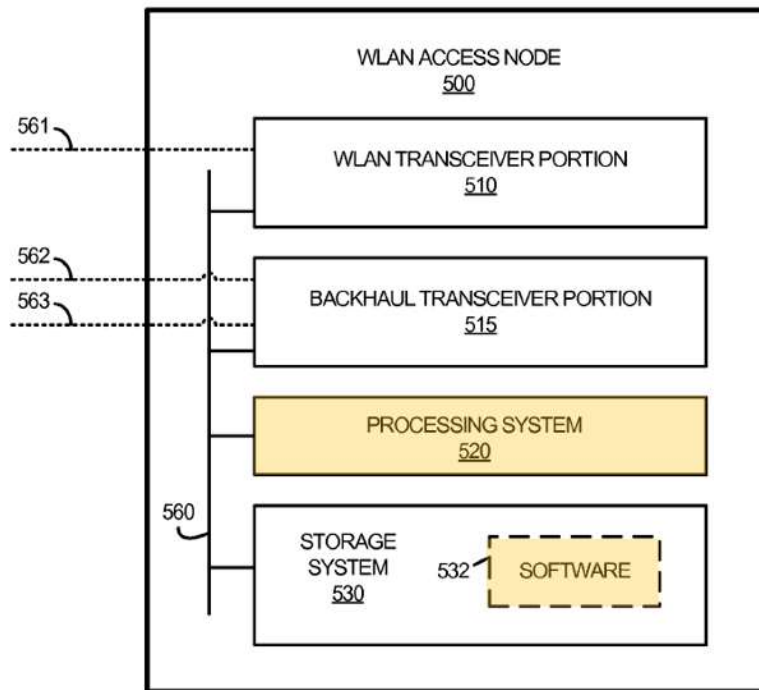
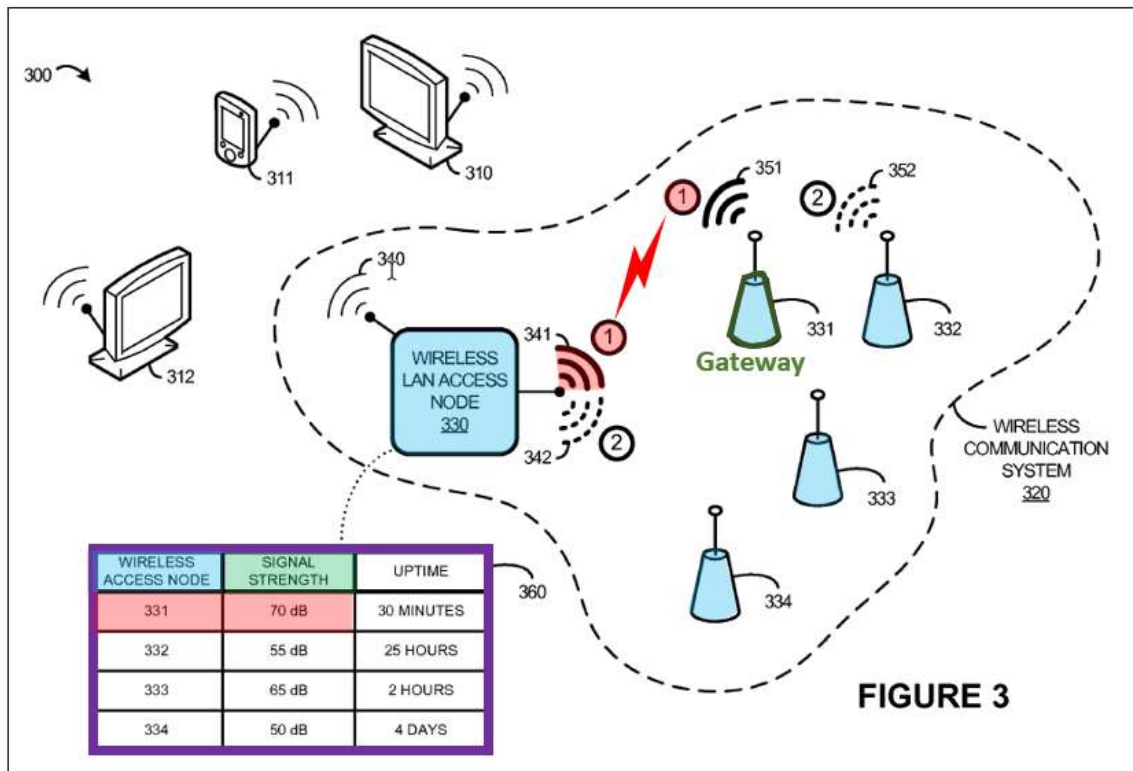


**FIGURE 5**

Ex.1005, FIG. 5; *id.*, 7:9-13 (“FIG. 5 is a block diagram illustrating WLAN access node 500, as an example of WLAN access node 120 found in FIG. 1 or WLAN access node 330 found in FIG. 3 ...”). As Gatewood teaches, software 520 executes in processing system 520 and can include “operating system software, database software, [] application software ... firmware or ... machine-readable processing instructions executable by processing system 520.” *Id.*, 8:12-29.

- (b) *Element [1.1]/[12.1]: “performing an attempt to utilize a first channel in a default frequency band as a backhaul with second node in the network, wherein the backhaul is to provide communication of management functions between the nodes in the network, as opposed to a front haul that provides wireless data communication to clients in the network; and”*

Gatewood discloses this element and, alone or in view of Ho, renders it obvious. Ex.1002, ¶¶79-88. As discussed above, Gatewood’s Figure 3 illustrates a wireless mesh network comprising access node 330 (MAP.330) (claimed network device) and access node 331 (MAP.331) (claimed second node). *See* Section VII.A.2(a); Ex.1005, 3:45-66. MAP.331 is labeled a gateway, consistent with Gatewood’s teachings. *Id.* Figure 3 also depicts the **“first wireless backhaul link”** (341, red) established between MAP.330 and the gateway/second node (MAP.331). Ex.1005, 4:49-53.



Ex.1005, FIG. 3. In more detail, as Gatewood explains and as shown at block 402 (red) in Figure 4, “WLAN access node 330 selects [] a **first wireless backhaul link**

for communication of WLAN 340 *based on signal strength* of wireless links provided by ones of WLAN access nodes 331-334. ... The *first wireless backhaul link* is selected from among a wireless link associated with WLAN access nodes 331-334 based on at least a signal strength of the associated wireless link as measured or detected by WLAN access node 330. Example signal strengths are indicated in data structure 360 [(purple)] in FIG. 3, namely 70 decibels (dB) for WLAN access node 331, ... ”. Ex.1005, 4:29-49. As Gatewood further explains, “[s]ince WLAN access node 331 has *the highest signal strength* in this example, WLAN access node 330 [(claimed network device)] selects WLAN access node 331 [(claimed second node)] for the *first wireless backhaul link*, as indicated by wireless link 341 and the ‘1’ indicator in FIG. 3.” *Id.*, 4:49-53.

The *first wireless backhaul link* is the claimed backhaul with the second node (gateway/MAP.331), and it is formed using a channel (claimed first channel) of “the 5 GHz IEEE 802.11 frequency spectrum.” Ex.1005, 6:48-52; Ex.1002, ¶82.

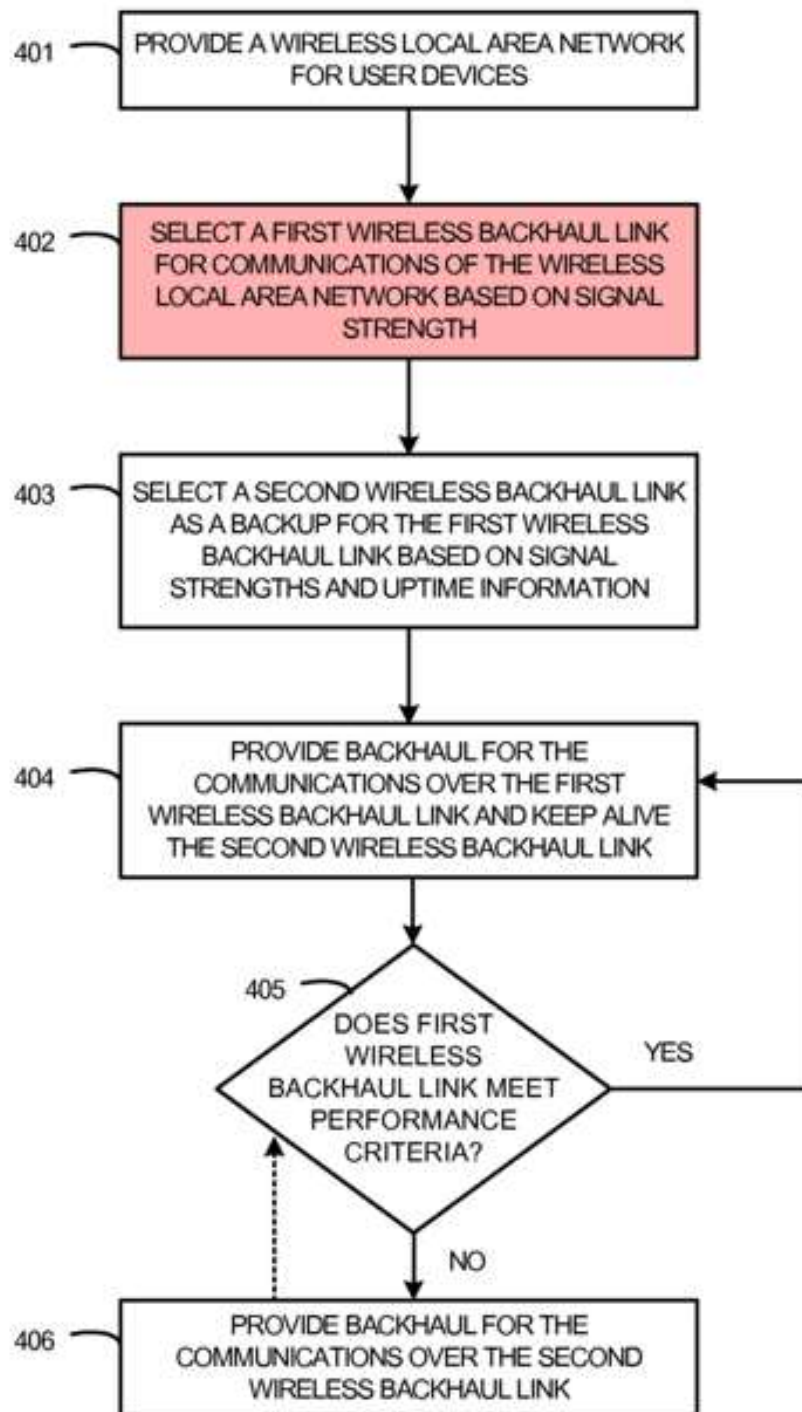


**FIGURE 4**

Ex.1005, FIG. 4.

**Claimed “default frequency band”** – Gatewood teaches that the “*first wireless backhaul link 341*” for the backhaul communications of WLAN 340 comprises a first IEEE 802.11 wireless link [(claimed first channel)] using a first wireless frequency spectrum, such as *the 5 GHz* IEEE 802.11 frequency spectrum ...” Ex.1005, 6:64-7:8.

The 5-GHz frequency band satisfies the claimed “default frequency band” under either party’s construction. Ex.1002, ¶84-85. It is a default frequency band under Petitioner’s construction because an attempt to use this band is made by default—automatically and without user input. *Id.* The 5 GHz band also satisfies Patent Owner’s construction because this band is tried first, and other bands are only used to set up alternative communication paths. *Id.* Indeed, Gatewood teaches that the access node 330 must establish the “*first wireless backhaul link 341*” in this band, though it has the choice to establish other alternate backhaul connections (such as the “*second wireless backhaul link 342*”) in the same 5 GHz band or in another “similar” frequency band, as discussed below in Section VII.A.2(c). Ex.1005, 6:48-56 (“Second wireless backhaul link 342 can comprise a second wireless link ... and can comprise the *same* or *similar* [] wireless frequency spectrum as first wireless backhaul link 341.”).

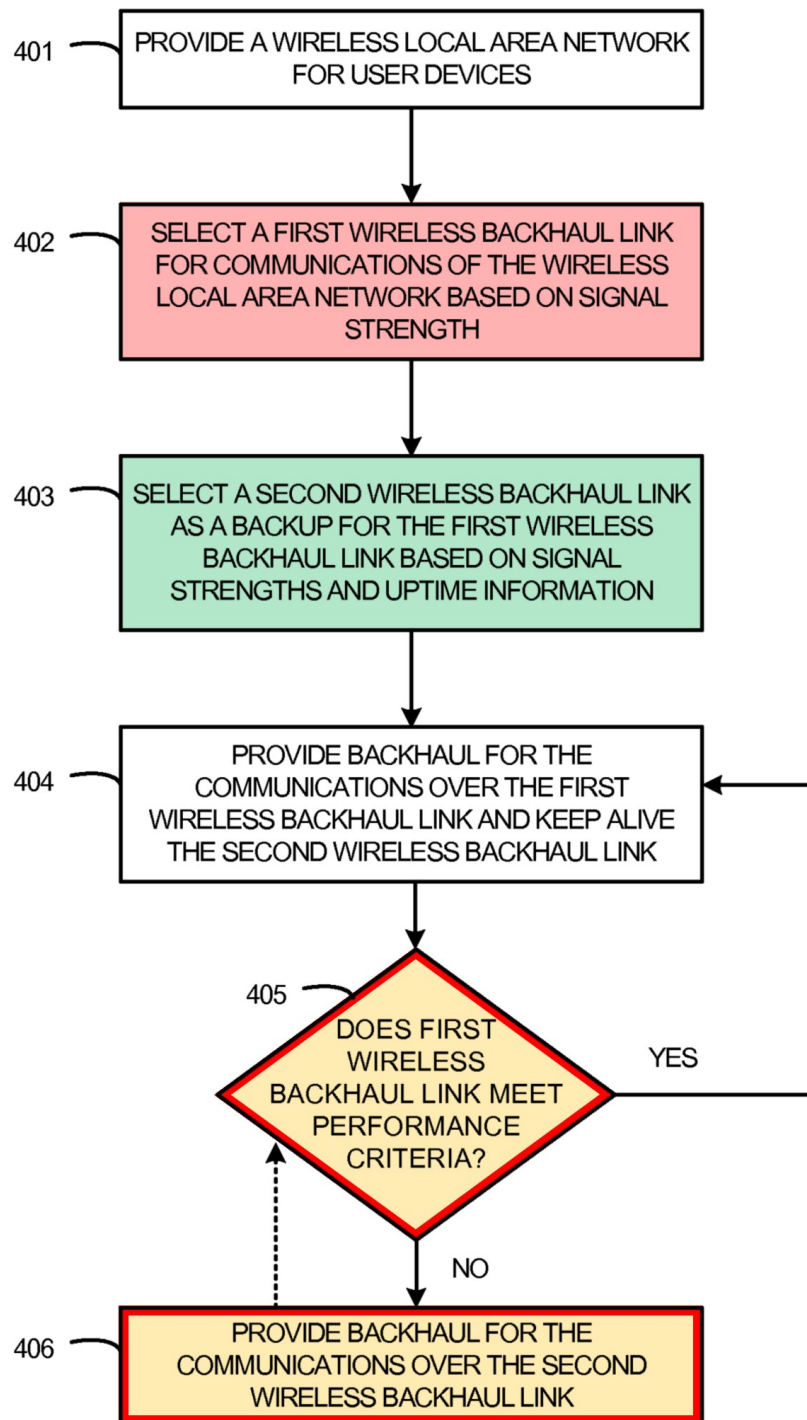
**Claimed “communication of management functions”** – As would be understood and found obvious by a POSITA, a backhaul communication provides

MAP-to-MAP communication and is not a front-haul client-facing communication that provides wireless data communication to clients in the network. Ex.1002, ¶86. A backhaul also carries control and management information that communicate management functions such as MAP coordination functions, which Gatewood refers to as “overhead communications,” between the nodes in the network. Ex.1005, 7:31-40. For example, as would be well-known in the art and described in the IEEE 802.11s mesh networking standards, many management messages (frames) are exchanged between access points (APs) of a wireless mesh network over the backhaul to convey management function information, such as Root Announcement, Path Request/Reply, Mesh Link Metric Report, Probe Request/Response frames, etc. Ex.1016, 30-38; Ex.1002, ¶87. Indeed, as also described in Ho, APs communicate with one another over the backhaul to identify themselves, to exchange capability and configuration information, and to coordinate their operations. Ex.1009, 13:39-41 (“After the CAP selects one or more channels, the CAP can broadcast a message to indicate that it is in operation and to indicate the channel(s) it has selected.”), 14:4-6 (“one or more messages are broadcast to identify the CAP and to determine WLAN credentials associated with the CAP.”), 4:46-55 (“The configuration unit 106 can also receive ... link metric information ... from one or more access points (APs) in the hybrid communication network”); Ex.1002, ¶88.

- (c) *Element [1.2]/[12.2]: “upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt to utilize a different channel in the default frequency band and/or a channel in a different frequency band that has a lower frequency range than the default frequency band, to establish the backhaul with the second node,”*

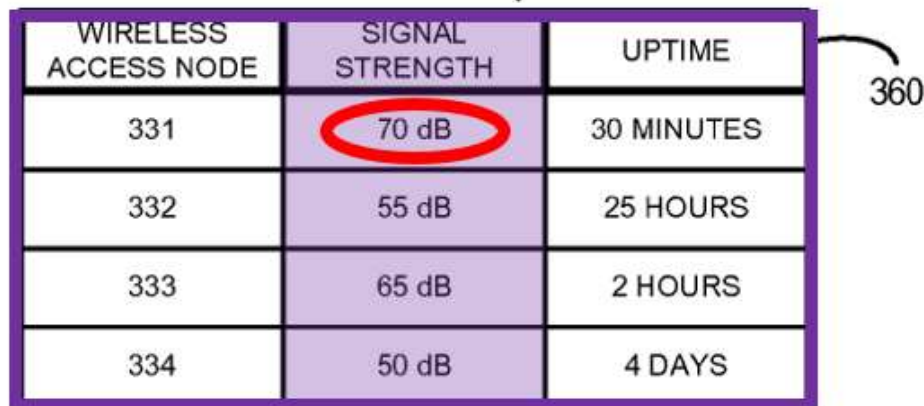
Gatewood discloses this element and, alone or in view of Ho, renders it obvious. Ex.1002, ¶¶89-108.

As Gatewood teaches and shown at block 403 (green) of Figure 4, MAP.330 (first node) “selects [] a **second wireless backhaul link** as a **backup** for first wireless backhaul link 341 based on signal strength and uptime information. The backup for first wireless backhaul link 341 is selected to provide failover or backup protection ... **when first wireless backhaul link 341 is unavailable, underperforming, or does not meet performance criteria**, among other scenarios.” Ex.1005, 4:59-66. This includes when the received signal strength drops below a threshold. Ex.1002, ¶89.



Ex.1005, FIG. 4.

As shown at blocks 405-406 (tan/red), “WLAN access node 330 [(first node)] continues to monitor the performance criteria for *first wireless backhaul link 341* [(first channel)] when the first wireless backhaul link 341 is in use, such as *monitoring for disconnected states, performance below a performance threshold*, or other performance criteria.” *Id.*, 6:18-23. In particular, each access node monitors the signal strength of all of its possible backhaul links and stores the signal strength information in a local data structure (table). As shown under the column SIGNAL STRENGTH of that table (below), the signal strength of the *first wireless backhaul link* measured by access node 330—when that link is fully operational—is 70 decibels (dB) and is “the highest signal strength” of all possible backhaul links. Ex.1005, 4:45-53.



| WIRELESS ACCESS NODE | SIGNAL STRENGTH | UPTIME     |
|----------------------|-----------------|------------|
| 331                  | 70 dB           | 30 MINUTES |
| 332                  | 55 dB           | 25 HOURS   |
| 333                  | 65 dB           | 2 HOURS    |
| 334                  | 50 dB           | 4 DAYS     |

Ex.1005, FIG. 3 (excerpted). As Dr. Ding explains, a POSITA would understand and find obvious that, because access node 330 (claimed first node) continuously monitors backhaul signal strengths, it determines when the *first wireless backhaul*

**link** “is unavailable, underperforming, or does not meet performance criteria” and, in particular, that its “*performance [is] below a performance threshold*” by detecting that its signal strength has dropped below a signal strength threshold. Ex.1002, ¶91; Ex.1005, 4:61-66, 6:18-23.

Gatewood further teaches that “[t]he **second wireless backhaul link** is selected from among a wireless link associated with WLAN access nodes 331-334 based on at least a signal strength and uptime information of the associated wireless link.” Ex.1005, 5:6-10. Uptime information reflects the time period that the associated wireless link has been operational and thus reflects the reliability of that link. *Id.*, 5:18-28.

Gatewood further teaches that “[a] weighting calculation can be employed to balance signal strength and uptime considerations, such as giving an uptime measurement more weight in the selection process than a signal strength or vice versa.” *Id.*, 5:45-48.

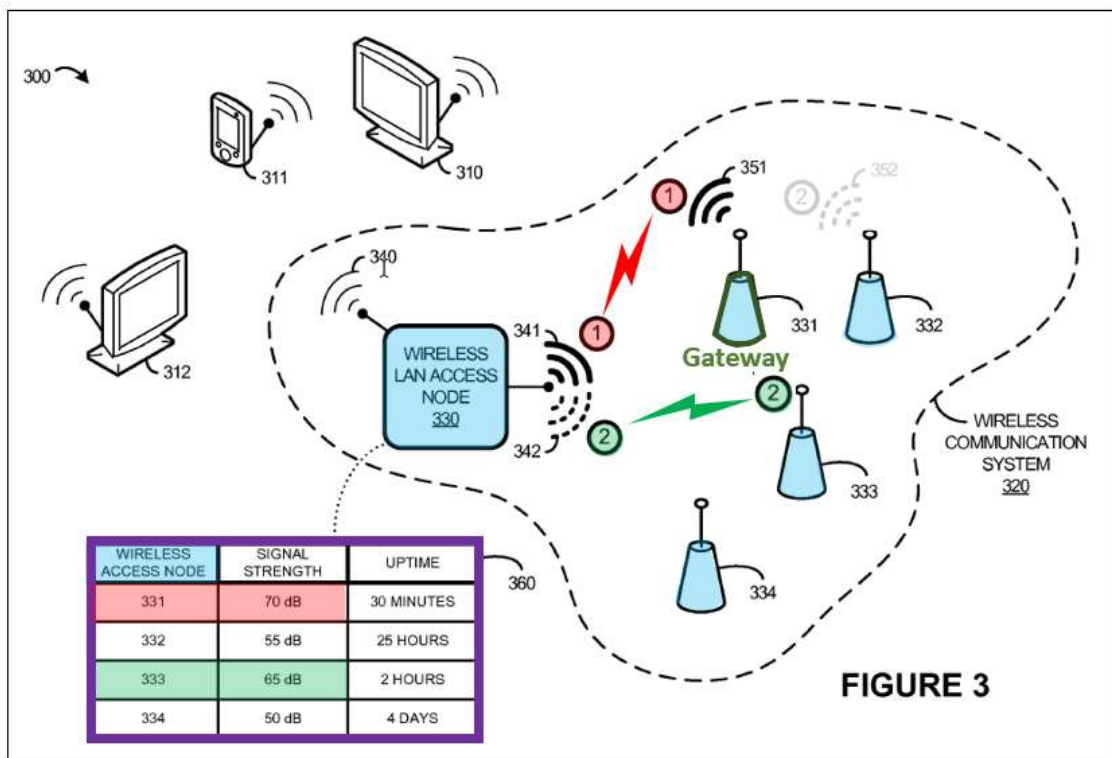
Thus, Gatewood teaches selecting the second wireless backhaul link based on signal strength alone, by giving no weight to uptime. Ex.1002, ¶94. In that case, as Gatewood teaches and as shown below right, “WLAN access node 333 is selected based on having the **highest signal strength** among WLAN access nodes 332-334.” Ex. 1005, 5:50-55.

| WIRELESS ACCESS NODE | SIGNAL STRENGTH | UPTIME     |
|----------------------|-----------------|------------|
| 331                  | 70 dB           | 30 MINUTES |
| 332                  | 55 dB           | 25 HOURS   |
| 333                  | 65 dB           | 2 HOURS    |
| 334                  | 50 dB           | 4 DAYS     |

→

| WIRELESS ACCESS NODE | SIGNAL STRENGTH  | UPTIME     |
|----------------------|------------------|------------|
| 331                  | <del>70 dB</del> | 30 MINUTES |
| 332                  | 55 dB            | 25 HOURS   |
| 333                  | 65 dB            | 2 HOURS    |
| 334                  | 50 dB            | 4 DAYS     |

Ex.1005, FIG. 3 (excerpted, duplicated). This *second wireless backhaul link*—selected based on signal strength alone and giving no weight to uptime—is a wireless backhaul link (green) connecting MAP.330 and MAP.333, as shown in modified Figure 3M below.



Ex.1005, FIG. 3M (modified Figure 3 according to Gatewood's teachings).

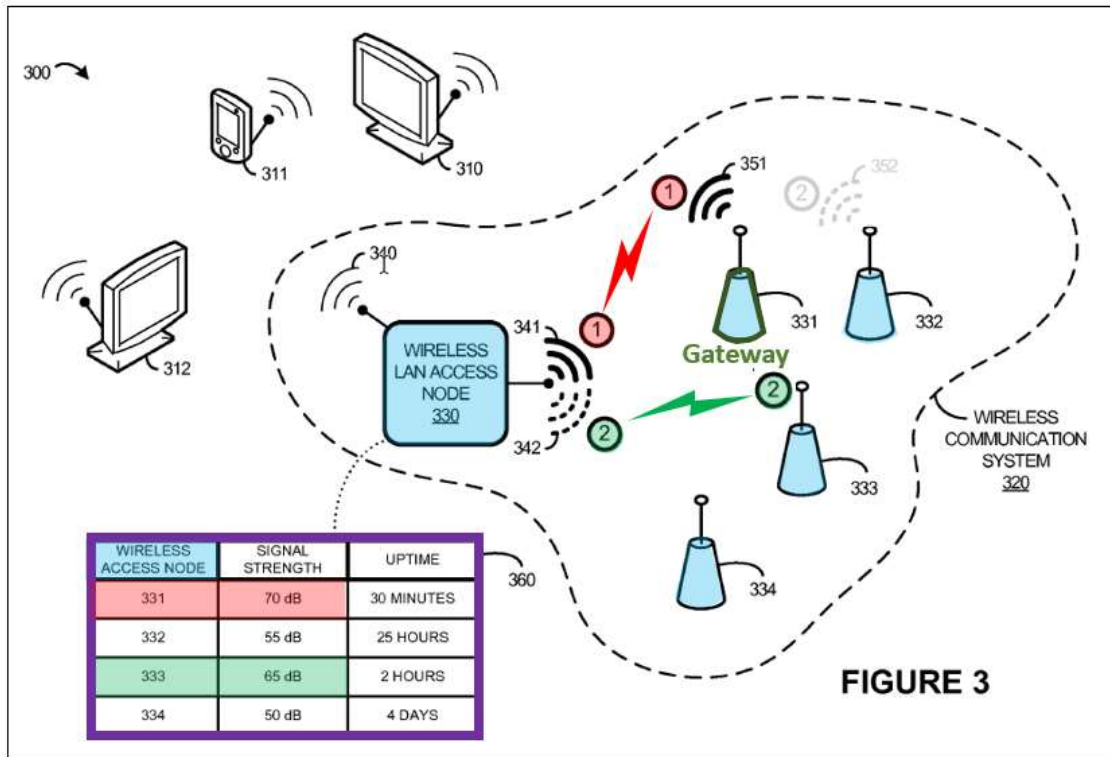
As Gatewood further teaches, “[w]hen **first wireless backhaul link** [(claimed first channel)] does not meet one or more of the performance criteria (405), WLAN access node 330 provides [] backhaul for the communications over **second wireless backhaul link** [(claimed different channel)].” Ex.1005, 6:33-36, FIG. 4 (at block 406). The **second wireless backhaul link** can be established using a different, better, channel of the same default 5 GHz band used to establish the **first wireless backhaul link**. Ex.1002 ¶96. Indeed, Gatewood teaches that the “first wireless backhaul link 341” is established “using a first wireless frequency spectrum, such as the **5 GHz** IEEE 802.11 frequency spectrum,” and that the “second wireless backhaul link 342 for the backhaul communications of WLAN 340 can comprise a second IEEE 802.11 wireless link using the same [(5 GHz band)] or similar first wireless frequency spectrum” as the first wireless backhaul link 341. Ex.1005, 6:64-7:8.

Because Gatewood teaches that the **second wireless backhaul link** is established using a different channel of the **default 5 GHz band**, Gatewood satisfies the requirement of “[A)] performing an attempt to utilize a different channel in the default frequency band **and/or** [(B)] a channel in a different frequency band that has a lower frequency range than the default frequency band” recited in this claim element. Ex.1002, ¶98. Indeed, as Patent Owner asserts during original prosecution, “A and/or B” has an accepted meaning and “that meaning is A alone, B alone, or A

and B together.” Ex.1004, 167; *see* Section III.B. Here, Gatewood teaches at least Option A. Ex.1002, ¶98.

**Claimed “to establish the backhaul with the second node”** – Gatewood satisfies the claim requirement that both the *first wireless backhaul link* (over the “first channel”) and the *second wireless backhaul link* (over the “different channel”) establish backhaul with the second node (gateway/MAP.331). Ex.1002, ¶99.

*First*, as shown in Figure 3M, the *first wireless backhaul link* and *second wireless backhaul link* connect MAP.330 to MAP.331 and MAP.333, respectively. Both establish a backhaul path with the second node MAP.331, which is the gateway to the Internet. Ex.1002, ¶100. The *first wireless backhaul link* establishes a single-hop backhaul path between MAP.330 (network device) and the gateway. *Id.* The *second wireless backhaul link* is part of a multi-hop backhaul path (*e.g.*, MAP.330-to-MAP.333-to-MAP.331) to the same gateway. *Id.* Indeed, MAP.330 establishes backhaul path(s) to reach the gateway and the Internet. *Id.*



Ex.1005, FIG. 3M.

**Second**, Gatewood teaches forming multiple parallel wireless links (channels) between any two MAPs—such as between MAP.330 (first node) and MAP.331 (second node). Ex.1005, 10:23-31 (“Although **one main** wireless link for each of [the backhaul] wireless links ... is shown in FIG. 1, it should be understood that [they] are merely illustrative to show communication modes or wireless access pathways ... In other examples, **further** wireless links can be shown ...”). Thus, as Gatewood teaches and as a POSITA would understand and find obvious, MAP.330 (network device) can establish **first wireless backhaul link** (over claimed “first channel”) and **second wireless backhaul link** (over claimed “different channel”) that

both terminate at *the same* MAP, such as MAP.331 (second node/gateway). Ex.1002, ¶¶101-02.

Ho also teaches forming multiple parallel backhaul connections (“upstream links”) between a non-CAP hybrid device and a CAP using different frequency channels and, thus, Ho further confirms Gatewood’s teachings. Ex.1009, 21:7-12 (“the non-CAP hybrid device may choose to establish redundant upstream links” to the CAP); Ex.1002, ¶103. Forming multiple redundant parallel backhaul links (over different frequency channels) between two nodes of a mesh network was in fact well-known and described in many other prior art references, and thus within the knowledge of a person of ordinary skill. Ex.1008 (Sinha), [0103] (“*Several* routes may be calculated between two end points, and ordered in order of preference.”); Ex.1006 (Handforh), 4:54-63 (“[T]he wireless links (W) in the meshed backhaul network may be dual redundant parallel links ... to form *multiple parallel wireless channels* between points on the network. These parallel links ... allow the simultaneous transmission of multiple signals between points on the network.”); Ex.1002, ¶104.

**Gatewood in View of Ho also renders “detecting that a received signal strength ... is below a threshold” obvious** – As Dr. Ding explains and as discussed above, a POSITA would understand and find obvious that Gatewood teaches “detecting that a received signal strength of the first channel from the second node

is below a threshold” in order to determine that the *first wireless backhaul link* (backhaul link established over the claimed first channel) “is unavailable, underperforming, or does not meet performance criteria” and that its “performance [has fallen] below a performance threshold.” Ex.1002, ¶105; Ex.1005, 4:61-66, 6:18-23.

Gatewood in view of Ho also renders this limitation obvious. Ex.1002, ¶106. Ho teaches determining whether a backhaul link is “inadequate” by detecting that its “signal strength (*e.g.*, RSSI)” has dropped below a “predetermined RSSI threshold”:

[T]he WLAN connection quality to the CAP can be a *signal strength (e.g., RSSI)* of a WLAN signal received (at a WLAN interface of the non-CAP hybrid device) from the CAP on all the communication bands on which the CAP is configured to operate (*e.g.*, 2.4 GHz WLAN communication band, 5 GHz WLAN communication band, etc.). ... The WLAN connection quality can be deemed ‘*inadequate*’ if the WLAN connection does not exist or is of a poor quality. ... [I]f the RSSI of the signal received from the CAP is *less than the predetermined RSSI threshold* ... the WLAN connection quality is deemed *inadequate*.

Ex.1009, 14:21-46. Thus, Ho further confirms Gatewood’s teachings and the knowledge of a POSITA. Ex.1002, ¶¶107-08. A POSITA would also have been motivated to implement Ho’s signal strength (RSSI) threshold monitoring to detect link failures. *Id.* This would have been obvious to try, with reasonable expectation

of success at least because any modification of Gatewood based on Ho would require common and routine software programming. *Id.* Additionally, as Dr. Ding explains, combination of Gatewood and Ho as proposed is a combination of prior art elements according to known methods, and also application of a known technique to a known system ready for improvement, both to yield predictable results, namely reliable and efficient way of detecting connection failure based on link quality information (signal strength) continuously monitored. *Id.*

- (d) *Element [1.3]/[12.3]: “wherein, in any of said attempts, channels in a given frequency band are prioritized based on a corresponding received signal strength.”*

Gatewood discloses or renders obvious this element. Ex.1002, ¶¶109-11. As Gatewood explains, backhaul candidates (formed over different frequency channels) are generally selected “based on at least a signal strength and uptime information.” Ex.1005, 5:4-28. Gatewood further teaches associating *a score* indicative of the channel (link) quality of each backhaul candidate—this score is “[a] weighting calculation [] employed to balance signal strength and uptime considerations, such as giving an uptime measurement more weight in the selection process than a signal strength or vice versa.” *Id.*, 5:45-48.

As Gatewood teaches, by assigning zero weight to uptime, each candidate backhaul link has a score that simply reflects *the signal strength* of the link/channel. *Id.*, 5:50-53. In that case, as Gatewood explains using the exemplary signal strengths

shown in table 360 of Figure 3, MAP.330 would select the MAP.330-to-MAP.333 backhaul link as the backup backhaul link because its signal strength—65 dB (green)—is “the highest signal strength among WLAN access nodes 332-334.” *Id.*, 5:50-53 (“In other examples [where uptime is given zero weight], WLAN access node 333 [(green below)] is selected based on having ***the highest signal strength*** among WLAN access nodes 332-334.”).

| WIRELESS ACCESS NODE | SIGNAL STRENGTH | UPTIME     |
|----------------------|-----------------|------------|
| 331                  | 60 dB           | 30 MINUTES |
| 332                  | 55 dB           | 25 HOURS   |
| 333                  | 65 dB           | 2 HOURS    |
| 334                  | 50 dB           | 4 DAYS     |

Ex.1005, FIG. 3 (excerpted).<sup>3</sup> In addition, as discussed above, Gatewood teaches an embodiment in which all backhaul communications are established over the same 5

<sup>3</sup> The data structure (table) 360 in Figure 3 lists the candidate backhaul links using a backhaul selection criteria in which “both signal strength and uptime information are given roughly equal weight.” Ex.1005, 5:53-55. In a selection criteria that only considers signal strength and gives no weight to uptime (which Ho expressly teaches), the candidate backhaul links would be listed in descending

GHz frequency band. *See* Section VII.A.2(c). Thus, Gatewood teaches that, in any attempt to establish a backhaul, channels in a given frequency band (*e.g.*, the 5 GHz band) can be prioritized based on received signal strength alone—with no weight given to uptime. Ex.1002, ¶111.

### 3. Dependent Claims 2 and 13

- (a) “[*The method of claim 1/The device of claim 12*], wherein said attempts are performed on a first radio, [*the method/the operations*] further comprising:”

Gatewood discloses this element or renders it obvious. Ex.1002, ¶¶112-13.

Gatewood teaches that the “first wireless backhaul link 341” is established “using a first wireless frequency spectrum, such as the **5 GHz** IEEE 802.11 frequency spectrum,” and that the “second wireless backhaul link 342 for the backhaul communications of WLAN 340 can comprise a second IEEE 802.11 wireless link [(channel)] using the same or similar first wireless frequency spectrum ...”. Ex.1005, 6:64-7:8. Thus, as Gatewood teaches, and as a POSITA would understand and find obvious, the first and second wireless backhaul links 341 and 342 can both be established over channels of the 5 GHz band using the 5 GHz radio (claimed first radio). Ex.1002, ¶113.

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order of signal strength instead: link 330-331 (**70 dB**), 330-333 (**65 dB**), 330-332 (**55 dB**), and link 330-334 (**50 dB**). Ex.1002, ¶110.

- (b) *Element [2.1]/[13.1]: “upon failure of all said attempts, performing an attempt to establish the backhaul with the second node utilizing a different radio.”*

Gatewood discloses this element and, alone or in view of Ho, renders it obvious. Ex.1002, ¶¶114-19. Gatewood teaches that the backhaul communications can also be established in frequency bands *other* than the default “5 GHz IEEE 802.11 frequency spectrum.” Ex.1005, 6:48-63. For example, as Gatewood teaches, alternative backhaul links can be established in a different but “similar” Wi-Fi frequency band than the 5 GHz band, and can also be established using links of different wireless technologies, such as a “cellular data link” or “different wireless technology link.” *Id.*, 6:52-63. A POSITA would understand and find obvious that these alternative wireless communication technologies discussed in Gatewood typically require the use of a different radio than the 5-GHz radio, since different hardware configurations are generally required to operate in different frequency bands, as Dr. Ding explains. Ex.1002, ¶115.

Gatewood in view of Ho also renders this element obvious. Ex.1002, ¶116-17. As Ho teaches, each access node can be a “dual band dual concurrent radio” (DBDC) device that can “simultaneously operate in the 2.4 GHz WLAN communication band and the 5 GHz WLAN communication band.” Ex.1009, 2:33-37, 18:18-22, 18:28-35. A POSITA would understand and find obvious that each MAP in Gatewood’s network can be implemented using Ho’s “dual band dual

concurrent radio” (DBDC) device which, as Ho teaches, has two radios, one operating at 5 GHz, the other at 2.4 GHz. Ex.1002, ¶117. The use of Ho’s DBDC devices in Gatewood’s network would satisfy Gatewood’s requirement of using different bands of “similar” technologies for backhaul. Ex.1005, 6:52-56. Additionally, as Dr. Ding explains, combination of Gatewood and Ho as proposed is a combination of prior art elements according to known methods, and also application of a known technique to a known system ready for improvement, both to yield predictable results, namely a wireless mesh network with multiple backhaul bands for higher bandwidth and better fault tolerance. Ex.1002, ¶118.

Ho further teaches that, using such dual band radio, an access point of the network (“non-CAP hybrid device”) “can attempt to connect [(establish a backhaul)] to the CAP [(central access point or root AP)] via the 2.4 GHz or the 5 GHz WLAN communication band (whichever has the better connectivity) ...”. Ex.1009, 18:38-46. In this case, consistent with Gatewood’s teachings, the claimed first radio is the 5 GHz radio (as discussed in Section VII.A.3) and the claimed second radio is the 2.4 GHz radio. Ex.1002, ¶119.

#### **4. Dependent Claims 3 and 14**

- (a) “[The method of claim 2/The device of claim 13], wherein said different radio is the same radio as the front haul.”

Gatewood discloses this element and, alone or in view of Ho, renders it obvious. Ex.1002, ¶¶120-21. As discussed above, the MAPs in Gatewood’s wireless mesh networks can be implemented using Ho’s “dual band dual concurrent radio” (DBDC) device, which operate in the 2.4 GHz and 5 GHz bands, as discussed above. Ex.1009, 2:33-37, 18:18-22, 18:28-35; Section VII.A.3. In this case, the first radio is the 5 GHz radio (as taught in Gatewood), and the second radio is the 2.4 GHz radio that is also used for front haul communication with client devices. Indeed, both Gatewood and Ho teach using the 2.4 GHz band for front haul communication, as was in fact well-known. Ex.1005, 9:55-65 (front haul communications “can be provided over at least 2.4, 3, 6, 5 and 60 GHz frequency bands”); Ex.1009, 15:5-14 (describing “2.4 GHz WLAN coverage”).

**5. Dependent Claims 4 and 15**

- (a) *Preamble: “[The method of claim 1/The device of claim 12, the operations] further comprising:”*

Gatewood, alone or in view of Ho, renders claims 1 and 12 obvious. Ex.1002, ¶122.

- (b) *Element [4.1]/[15.1]: “measuring received signal strengths of probes from all nodes within a communication range; and”*

Gatewood discloses or renders obvious this element. Ex.1002, ¶¶123-24. As discussed above in Section VII.A.2(b), each access node in Gatewood’s wireless mesh network measures the received signal strengths of signals received from all

nodes within a communication range. Ex.1005, 1:37-49 (“The method includes ... selecting a first wireless backhaul link for communications of the wireless local area network from among a plurality of wireless links provided by a plurality of wireless access nodes ***based on at least signal strengths of the wireless links ...***”), 5:10-12 (“The signal strengths can be measured or detected by WLAN access node 330 [(claimed first node)] ... Example signal strengths [(green)] are indicated in data structure 360 of FIG. 3.”).



The table, labeled 360, is enclosed in a purple border. It has three columns: 'WIRELESS ACCESS NODE', 'SIGNAL STRENGTH', and 'UPTIME'. The 'SIGNAL STRENGTH' column is highlighted in green. The data is as follows:

| WIRELESS ACCESS NODE | SIGNAL STRENGTH | UPTIME     |
|----------------------|-----------------|------------|
| 331                  | 70 dB           | 30 MINUTES |
| 332                  | 55 dB           | 25 HOURS   |
| 333                  | 65 dB           | 2 HOURS    |
| 334                  | 50 dB           | 4 DAYS     |

Ex.1005, FIG. 3 (excerpted).<sup>4</sup> Indeed, table 360 (above) lists the signal strength measured at access node 330 (claimed network device) of signals transmitted by other access nodes (331 through 334) in Gatewood’s wireless mesh network. A POSITA would understand and find obvious that those signals include probe requests that are broadcasted by every mesh point of a wireless mesh network (such

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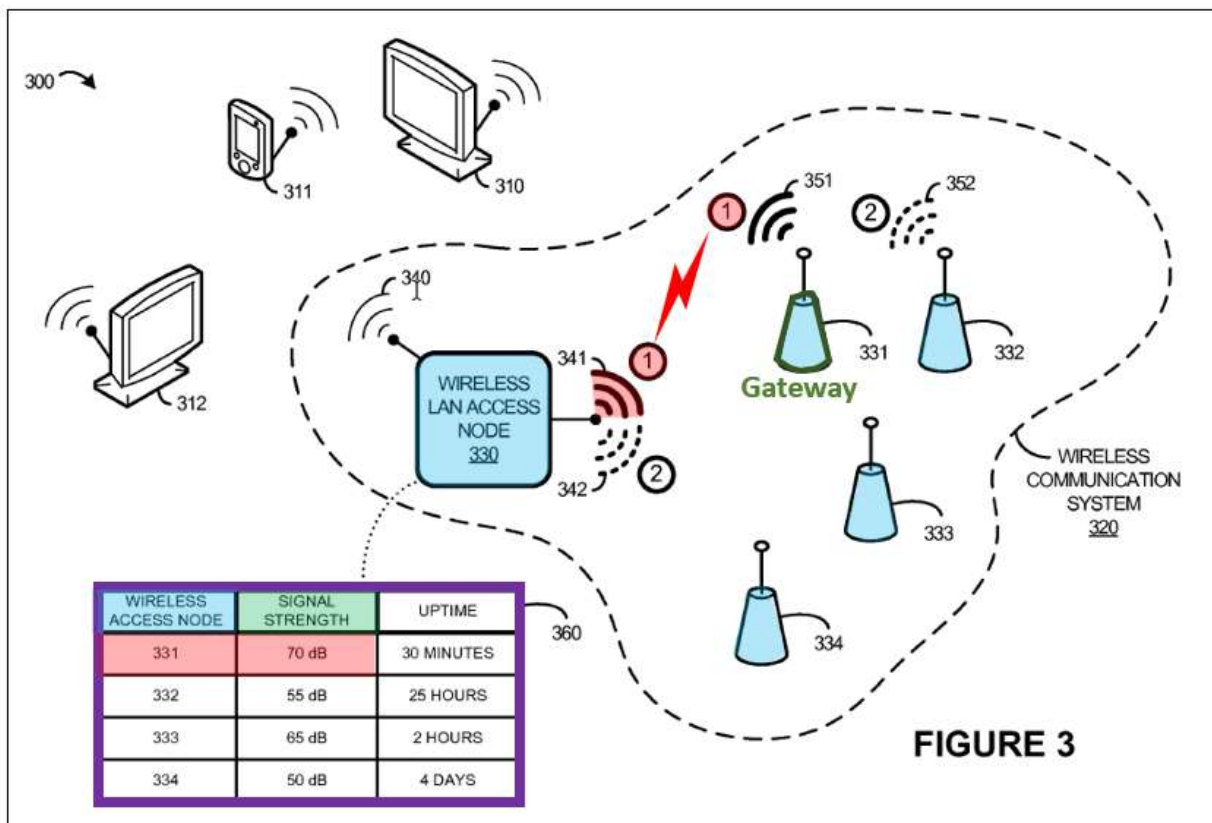
<sup>4</sup> See fn.3.

as Gatewood's mesh network) as part of the mesh discovery and backhaul peer link management process, as described in the IEEE mesh networking standards. Ex.1002, ¶124; Ex.1020, 109 ("Mesh discovery and peer link management require that MPs [(mesh points)] have sufficient information about themselves and potential neighbors. This process *requires* detection of potential mesh neighbors through Beacons or through *active scanning using Probe Requests*.").

- (c) *Element [4.2]/[15.2]: "selecting the second node based on the measured received signal strengths of the probes."*

Gatewood discloses or renders obvious this element. Ex.1002, ¶¶125-26. As discussed above in Section VII.A.2(b), access node 330 (first node) selects access node 331 (second node) to establish a backhaul communication because the measured received signal strength of signals from access node 331 is the highest, as shown in the table 360 (purple) in Figure 3 below. Ex.1005, 4:41-53 ("The first backhaul wireless link is selected from among a wireless link associated with WLAN access nodes 331-334 based on at least *a signal strength of the associated wireless link* as measured or detected by WLAN access node 330 [(claimed first node)]. Example signal strengths are indicated in data structure 360 in FIG. 3 [(under the SIGNAL STRENGTH column)] ... Since WLAN access node 331 has *the highest signal strength* in this example, WLAN access node 330 *selects WLAN access node 331* [(claimed second node)] for the first wireless backhaul link, as indicated by

wireless link 341 [(red)] and the “1” indicator in FIG. 3.”). And, as discussed above with regard to element [4.1], a POSITA would understand and find obvious that the measured received signal strengths include measured received signal strengths of the probe requests transmitted by other nodes (331-334) of Gatewood’s wireless mesh network and received at access node 330 (claimed network device). Ex.1002, ¶126.



Ex.1005, FIG. 3.

## 6. Dependent Claims 5 and 16

- (a) “[The method of claim 1/The device of claim 12, the operations] further comprising: utilizing a spanning tree based protocol to avoid loops in said attempts.”

Gatewood in view of Ho renders this claim obvious. Ex.1002, ¶¶127-29. Ho teaches the use of a “suitable loop avoidance mechanism (e.g., a hybrid spanning tree protocol (hSTP) ...”. Ex.1009, 5:18-21. A POSITA would have been motivated to incorporate the use of a spanning tree-based protocol, discussed in Ho, in Gatewood’s networks to create a loop-free network, thereby significantly improving network operations and reliability. Ex.1002, ¶127. Indeed, as was well-known in the art and explained in Ho, loops can be “catastrophic and cause failure” of the mesh network. Ex.1009, 7:53-57. Such a combination would have been obvious to try with reasonable expectation of success because the spanning tree protocol (STP) and later enhancements are defined in the IEEE standards, such as IEEE 802.1D, which provide algorithms and guidelines for ensuring loop-free topologies in networks, and because implementing a spanning tree-based protocol involves routine software programming. Ex.1002, ¶128; Ex.1012 (IEEE 802.1D), Chapter 17 at 137-179 (Rapid Spanning Tree Protocol (RSTP)). Additionally, as Dr. Ding explains, combination of Gatewood and Ho as proposed is a combination of prior art elements according to known methods, and also application of a known technique to a known system ready for improvement, both to yield predictable results, namely a reliable and conventional way of avoiding bridging loops that can be catastrophic to network operation. Ex.1002, ¶129.

**7. Dependent Claims 6 and 17**

- (a) *Preamble: “[The method of claim 1/The device of claim 12, the operations] further comprising:”*

Gatewood, alone or in view of Ho, renders claims 1 and 12 obvious. Ex.1002, ¶130.

- (b) *Element [6.1]/[17.1]: “measuring a link quality among one or more of the nodes in the network; and”*

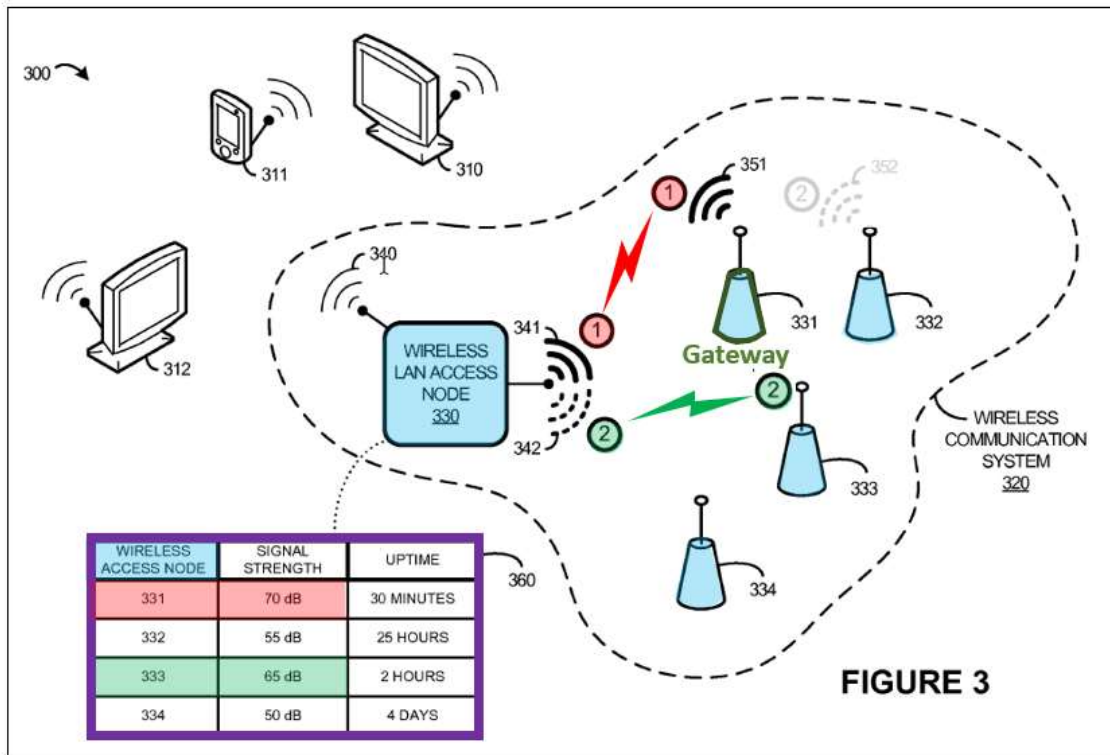
*See* Sections VI.A.2(d), VI.A.5 (claim 4). Ex.1002, ¶131.

- (c) *Element [6.2]/[17.2]: “selectively causing a number of nodes in the network to form a particular connection topology based on the measured link quality.”*

Gatewood discloses this element or renders it obvious. Ex.1002, ¶¶132-33.

As discussed above and illustrated in Figure 3M below, MAP.330 (claimed network device) selects MAP.331 as the preferred backhaul path to the gateway when the measured signal strength of signals received from MAP.331 is strong (70 dB) as shown in table 360 of Figure 3/3M. *See* Sections VII.A.2(b). In this case, the backhaul path to the gateway for MAP.330 is the single-hop path MAP.330-to-MAP.331. *Id.* On the other hand, when the signal strength of signals received from MAP.331 weakens and falls below a predetermined minimum RSSI threshold, MAP.330 selects MAP.333 to establish a two-hop backhaul path MAP.330-to-MAP.333-to-MAP.331 to the gateway. *See* Section VII.A.2(c). Thus, MAP.330 selectively causes a number of nodes (*e.g.*, MAP.330, MAP.331, and MAP.333) to

form a particular connection topology—*e.g.*, the single-hop path MAP.330-to-MAP.331 or the two-hop path MAP.330-to-MAP.333-to-MAP.331 connecting the network device to the gateway—based on measured link quality. Ex.1002, ¶133.



Ex.1005, FIG. 3M.

## B. Ground II: Claims 1-22 Are Rendered Obvious by Ho

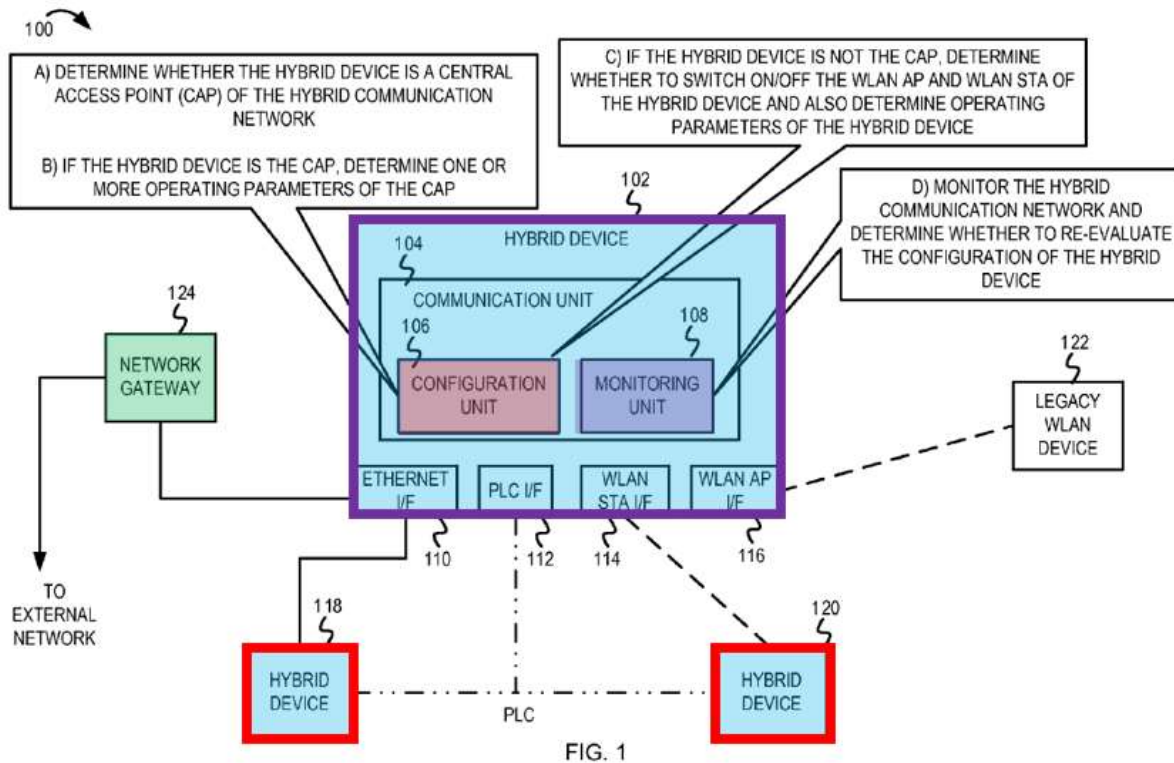
### 1. Independent Claims 1 and 12

- (a) *Claim 1 Preamble: “A computer-implemented method for establishing a backhaul communication among nodes in a mesh wireless network, the method comprising:”*

*Claim 12 Preamble: “A network device capable of establishing a backhaul communication among nodes in a mesh wireless network, the device including a network controller configured to perform operations comprising:”*

To the extent the preamble is limiting, Ho discloses or renders it obvious. Ex.1002, ¶¶134-41. Ho teaches a wireless mesh network, which Ho refers to as a home network or a hybrid communication network. Ex.1009, 1:8-13, 2:26-37. As illustrated in Figure 1, the network comprises multiple mesh access points (MAPs) (blue)—each of which is a claimed “node” and can also be the claimed “network device”—and a gateway (green) that couples the hybrid communication network to an external network such as the Internet. *Id.*, 3:24-54. The MAPs are called “hybrid devices” because each device supports multiple network communication technologies, such as 802.11 (Wi-Fi), powerline communications (PLC) and Ethernet, in compliance with the IEEE 1905.1 home networking standards. *Id.*, 2:26-37.

In Figure 1, hybrid device 102 (**purple border**) is the central access point (CAP or root AP) of the network because it is directly connected to the gateway (**green**); Ho refers to other hybrid devices (118, 120) (**red border**) as non-CAP hybrid devices. *Id.*, 6:4-6.



Ex.1009, FIG. 1. For claim mapping purposes, Petitioner maps the “network device” recited in the preamble of claim 12 to Ho’s non-CAP hybrid device 120 (**red border**). Ex.1002, ¶137. As discussed in more detail below, the non-CAP hybrid device 120 (network device) has a **configuration unit** 106 and **monitoring unit** 108 (not shown) that forms the claimed network controller. *Id.* Petitioner maps the claimed “second node” (see claim element [1.1]/[12.1]) to the CAP hybrid device 102 (**purple border**). *Id.*

In more detail, Ho teaches that each hybrid device (**blue**) includes a **configuration unit** 106 (red) that executes a “total configuration algorithm (TCA)” (claimed operations) to configure the device at initialization and during its

operation—which includes determining the band(s) and channel(s) the device uses for backhaul communication with other network devices. *Id.*, 2:48-3:14, 12:22-25 (“FIG. 4 is a flow diagram 400 illustrating example operations for selecting the **band**, **channel** and power of the central access point (CAP BCP selection),”), 13:52-55 (“FIG. 5 is a flow diagram 500 illustrating example operations for selecting the personality, **band**, **channel**, and power of the non-central access point device (non-CAP PBCP selection).”).

As Ho teaches, “[t]he hybrid devices can self-organize among themselves to discover each other and configure their personalities without user intervention.” *Id.*, 3:17-19. In particular, the hybrid devices automatically determine the backhaul connections in the network. Ex.1002, ¶139. To illustrate, “the CAP [initially] selects one or more channels” in the 2.4 GHz or 5 GHz bands for backhaul communication and “broadcast[s] a message to indicate that it is in operation and to indicate the channel(s) it has selected.” Ex.1009, 13:24-41. Non-CAP hybrid devices then “attempt to connect [(establish a backhaul connection)] to the CAP via the 2.4 GHz or the 5 GHz WLAN communication band (whichever has the better connectivity) ...”. *Id.*, 18:38-46.

Each hybrid device (blue) also has a **monitoring unit** 108 (purple) that “can monitor (e.g., continuously, at periodic intervals, etc.) the hybrid communication network 100 and the device status to detect any changes that could affect the

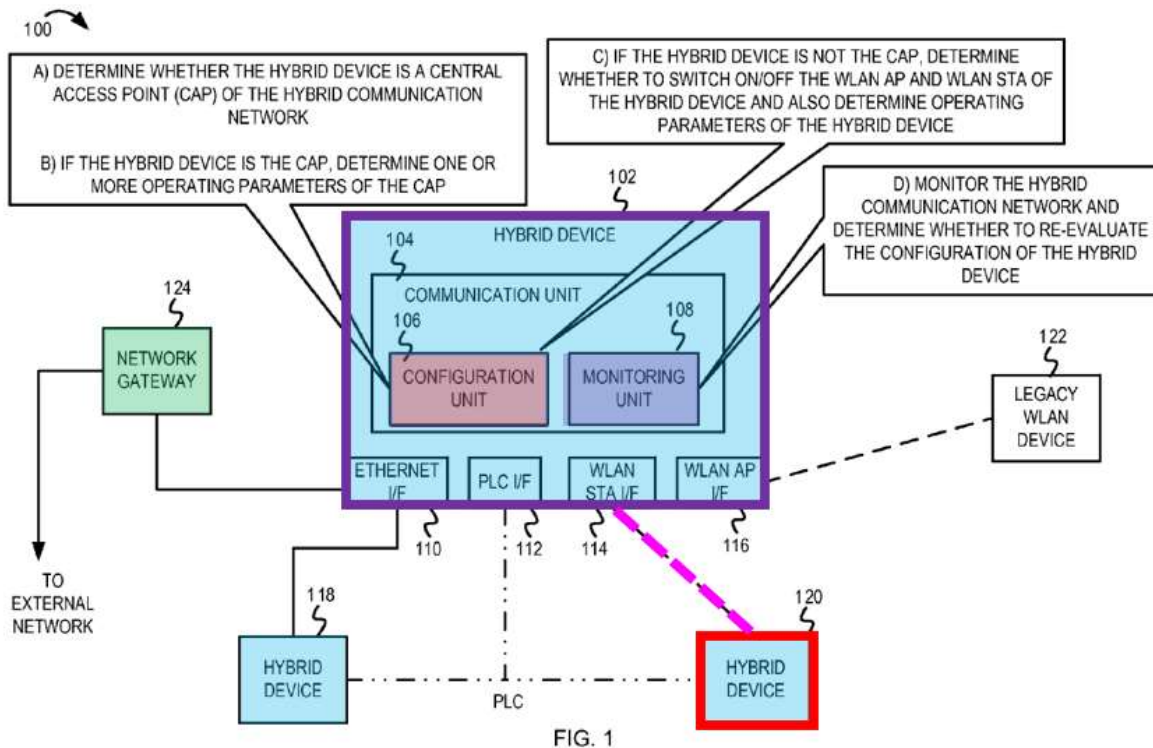
personality and configuration of the hybrid device []. For example, the user may unplug or move a network device in the hybrid communication network 100, radio conditions may change, ...”. Ex.1009, 19:52-60.

As Ho teaches, if the **monitoring unit** detects that there are significant changes in the hybrid communication network—such as substantial changes in “performance measurements” including “data rate” changes—it triggers the **execution unit** to “*re-execute* the operations for determining the personality of the hybrid device”—which includes re-executing Ho’s procedure to establish backhaul connections. *Id.*, 19:64-20:17; Ex.1002, ¶141.

- (b) *Element [1.1]/[12.1]: “performing an attempt to utilize a first channel in a default frequency band as a backhaul with second node in the network, wherein the backhaul is to provide communication of management functions between the nodes in the network, as opposed to a front haul that provides wireless data communication to clients in the network; and”*

Ho discloses this element or renders it obvious. Ex.1002, ¶¶142-52. Ho teaches that backhaul establishment in the network starts with “the CAP select[ing] one or more channels” in the 2.4 GHz or 5 GHz bands for backhaul communication and “broadcast[ing] a message to indicate that it is in operation and to indicate the channel(s) it has selected.” *Id.*, 13:24-41. A non-CAP hybrid device (claimed network device) then “attempt[s] to connect [(i.e., establish a backhaul connection)] to the CAP [(claimed second node)] via the 2.4 GHz or the 5 GHz WLAN communication band (whichever has the better connectivity) ...”. *Id.*, 18:38-46.

Ho's Figure 1 below illustrates Petitioner's claim mapping. Ex.1002, ¶143. The non-CAP hybrid device 120 (**red outline**) is the claimed network device, the central access point CAP 102 (**purple outline**) is the claimed second node, and the backhaul communication between the CAP and non-CAP devices is highlighted in **magenta**. *Id.*



Ex.1009, FIG. 1.

**Claimed default frequency band** – The frequency band (e.g., 5 GHz band) selected by the non-CAP hybrid device (network device) for backhaul communication with the CAP (second node) is the claimed “default frequency band” under Patent Owner’s construction of the term to mean “a preferred frequency

band.” Ex.1017, 4. This is because, as Ho teaches, this band is selected by the network device (non-CAP hybrid device) to provide “better connectivity” to the CAP (second node). Ex.1009, 18:38-46; Ex.1002, ¶144. Ho also teaches that the 5 GHz band is preferred over the 2.4 GHz band because, as was also well-known in the art, the 5 GHz band has wider channels such as “an 80 MHz WLAN operating channel or a 160 MHz operating channel” that are not available in the 2.4 GHz band. Ex.1009, 13:42-51; Ex.1002, ¶145; Ex.1021, 1, 3.

Petitioner’s construction is also met. Ex.1002, ¶146. Ho teaches embodiments in which the CAP (root AP) of the wireless network uses a single band for backhaul (*e.g.*, the 5 GHz band). *Id.* This would be the case for example if the CAP is a “dual band single radio (DBSR) device ... that can operate in either the 2.4 GHz WLAN communication band or the 5 GHz WLAN communication band, but not simultaneously.” Ex.1009, 17:61-65. This would also be the case if the CAP is a “single band single radio (SBSR) device ... that is configured only to operate in a single communication band (*e.g.*, either the 2.4 GHz WLAN communication band or the 5 GHz WLAN communication band).” *Id.*, 17:18-22.

For example, as shown in Ho’s Figure 4, the CAP may only be configured to use the 5 GHz band for backhaul, and therefore cannot use the 2.4 GHz band (“No” at block 402). Ex.1009, 1:54-56, 12:22-31, 12:58-61.

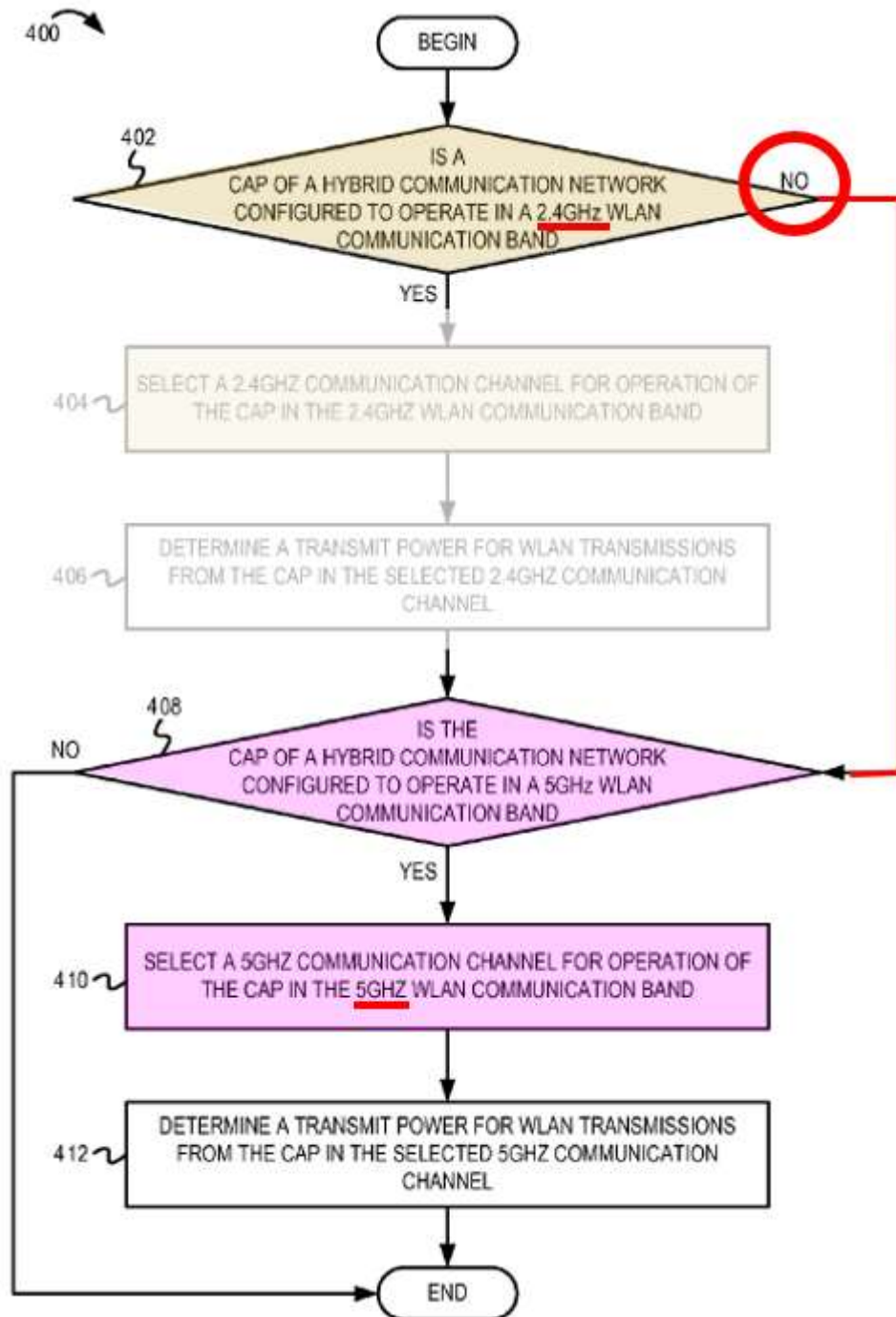


FIG. 4

Ex.1009, FIG. 4, 1:54-56 (“FIG. 4 is a flow diagram illustrating example operations for selecting the band, channel and power of the central access point (CAP)”). In

that case, a non-CAP hybrid device ***must*** choose the only band (5 GHz band) supported by the CAP to establish backhaul communication between itself and the CAP, and that band is therefore the claimed “default frequency band” under Petitioner’s construction of the term to mean “preset frequency band used automatically in the absence of a choice made by the user.” Ex.1017, 4.

**Claimed “first channel”** – As Ho teaches, the non-CAP hybrid device selects a “preferred channel” having the “highest RSSI” in the selected frequency band (*e.g.*, the 5 GHz band) to establish backhaul communication with the CAP. Ex.1009, 16:54-57. In more detail, Ho teaches that “the non-CAP hybrid device can also execute channel scan operations to ***select candidate channels*** (*e.g.*, channels with the preferred performance) on each WLAN communication bands.” *Id.*, 16:30-33. In addition, “the configuration unit 106 [of the non-CAP hybrid device] can identify a ***preferred channel*** (*e.g.*, a channel with the best performance, such as a ***highest RSSI***, lowest error rate, etc.) from the candidate channels” to use as backhaul to the CAP if “the preferred channel of the non-CAP hybrid device matches the channel on which the CAP currently operates ...”. *Id.*, 16:54-57.

**Claimed “communication of management functions”** –As would be understood by a POSITA, a backhaul communication provides MAP-to-MAP communication and is not a front-haul client-facing communication that provides wireless data communication to clients in the network. Ex.1002, ¶150. The

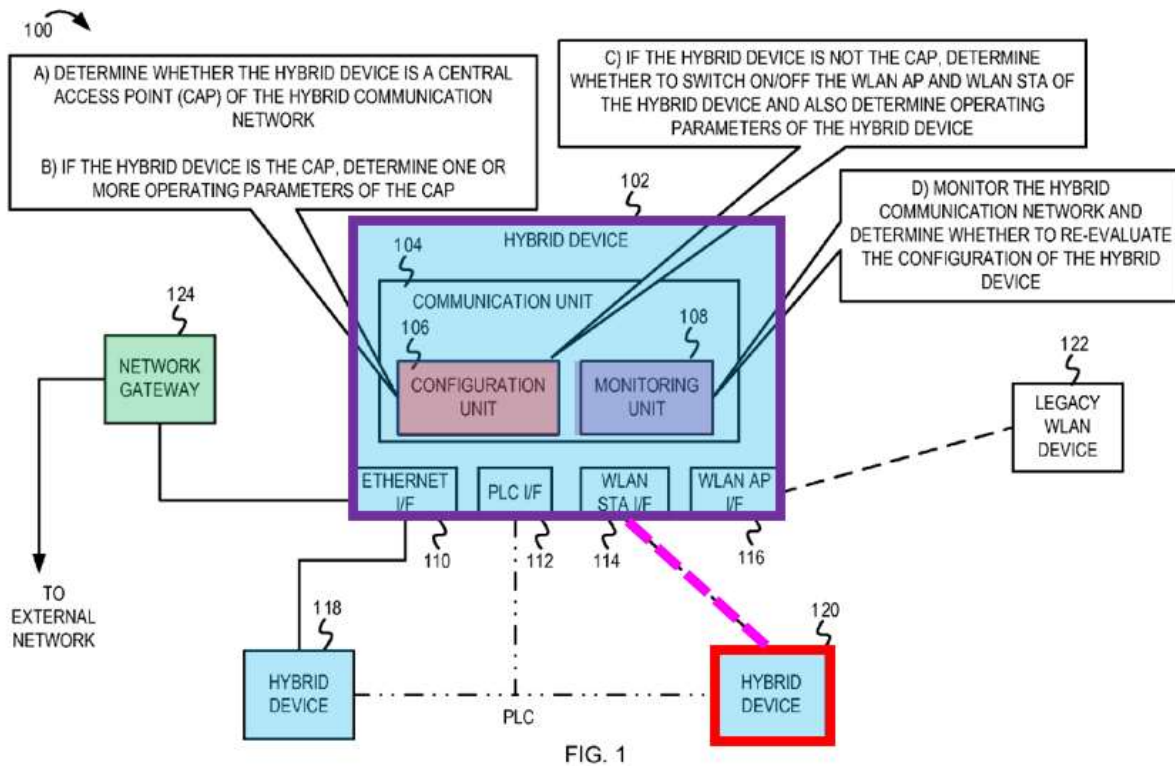
backhaul also provide communication of management functions between the nodes in the network, as claimed. *Id.* For example, as would be well-known in the art, Ho's hybrid devices (APs) communicate over the backhaul to identify themselves, to exchange capability and configuration information with other access nodes, and to coordinate their operations. Ex.1009, 13:39-41 ("After the CAP selects one or more channels, the CAP can broadcast a message to indicate that it is in operation and to indicate the channel(s) it has selected."), 14:4-4-6 ("one or more messages are broadcast to identify the CAP and to determine WLAN credentials associated with the CAP."), 4:46-55 ("The configuration unit 106 can also receive ... link metric information ... from one or more access points (APs) ..."); Ex.1002, ¶151. This is consistent with the IEEE 802.11s mesh networking standards, which describes management messages (frames) exchanged between mesh points over the backhaul to convey management function information such as Root Announcement, Path Request/Reply, Mesh Link Metric Report, Probe Request/Response frames, etc. Ex.1016, 30-38; Ex.1002, ¶152.

- (c) *Element [1.2]/[12.2]: "upon detecting that a received signal strength of the first channel from the second node is below a threshold, performing an attempt to utilize a different channel in the default frequency band and/or a channel in a different frequency band that has a lower frequency range than the default frequency band, to establish the backhaul with the second node,"*

Ho discloses this element or renders it obvious. Ex.1002, ¶¶153-58. As Ho teaches, to establish a backhaul connection to the CAP (root AP), a "non-CAP hybrid

device can determine ... [the] WLAN *connection quality* to the CAP on all the communication bands, ... [the] *candidate channels* selected by channel scan operations on all WLAN communication bands, and [the] number of communication hops (or communication links) between the non-CAP hybrid device and the CAP.” Ex.1009, 14:11-20. As Ho further teaches, “the WLAN connection quality to the CAP can be a *signal strength (e.g., RSSI)* of a WLAN signal received [at] ... the non-CAP hybrid device[] from the CAP on all the communication bands on which the CAP is configured to operate (e.g., 2.4GHz WLAN communication band, 5 GHz WLAN communication band, etc.).” *Id.*, 14:21-27.

In addition, as Ho teaches, each hybrid device (blue) has a **monitoring unit** (purple) that “can monitor (e.g., continuously, at periodic intervals, etc.) the hybrid communication network 100 and the device status to detect any changes that could affect the personality and configuration of the hybrid device []. For example, the user may unplug or move a network device in the hybrid communication network 100, radio conditions may change, ... *the WLAN connection quality may change*, etc.” Ex.1009, 19:52-60.



Ex.1009, FIG. 1. Thus, a non-CAP hybrid device (claimed network device) can continuously monitor the RSSI of wireless signals received from the CAP (claimed second node), and uses that information to continuously assess the backhaul connection quality to the CAP. Ex.1002, ¶155.

Notably, as Ho teaches, “if the RSSI of the signal received from the CAP is less than the *predetermined RSSI threshold* (e.g., the RSSI\_moderate\_threshold) the WLAN connection quality is deemed *inadequate*.” *Id.*, 14:38-41. When the **monitoring unit** 108 (purple) detects such a change, it will trigger the **configuration unit** 106 (red) of the non-CAP hybrid device to re-execute the same sequence of operations to select the backhaul. *Id.*, 19:64-20:3 (triggering the configuration unit

to “*re-execute* the operations” based on detecting a change in “*the WLAN connection quality*”). As a result, and as discussed above in Section VII.B.1(b), the non-CAP hybrid device will again attempt to select another “*preferred channel*” (claimed different channel) having the “*highest RSSI*” to re-establish backhaul communication with the CAP. Ex.1009, 16:30-33, 16:54-57; *See* Section VII.B.1(b). The new “preferred channel” (different channel) is in the default frequency band (*e.g.*, 5 GHz) if the CAP only establishes backhaul in a single frequency band (the 5 GHz band), as discussed above in Section VII.B.1(b), and thus Ho discloses or renders obvious this element. Ex.1002, ¶157.

If the CAP establishes backhaul in both the 2.4 GHz and 5 GHz bands, and the non-CAP established backhaul with the CAP over the 5 GHz band in its first attempt, as discussed above, the new “preferred channel” is a channel in the 5 GHz band or in the lower 2.4 GHz band. Ex.1009, 18:38-46 (“the non-CAP hybrid device can attempt to connect to the CAP via the 2.4 GHz or the 5 GHz WLAN communication band (whichever has the better connectivity) ...”). Thus, Ho again satisfies this element. Ex.1002, ¶158.

- (d) *Element [1.3]/[12.3]: “wherein, in any of said attempts, channels in a given frequency band are prioritized based on a corresponding received signal strength.”*

Ho discloses this element or renders it obvious. Ex.1002, ¶¶159-60. As discussed above under Sections VI.B.1(b)-(c), in any of said attempts, Ho’s non-

CAP hybrid device (claimed network device) selects, based on a prioritization of candidate channels, a “***preferred channel***” having the “***highest RSSI***” to establish or re-establish backhaul communication with the CAP. Ex.1009, 16:30-33, 16:54-57; *see* Sections VI.B.1(b)-(c).

Indeed, as Ho teaches, to ensure good backhaul connections to the CAP (root AP), a non-CAP hybrid device performs the same backhaul selection procedure in each such attempt: (1) measures link quality parameters—including “***signal strength (e.g., RSSI)***”—on all communication bands that the CAP advertises as available for backhaul, (2) prioritizes “candidate channels” that can provide “preferred performance” in all such communication bands, and (3) selects a “***preferred channel***” having “***the highest RSSI***” among the candidate channels to establish backhaul connection with the CAP. Ex.1009, 14:11-27, 16:30-33 (“[T]he non-CAP hybrid device can also execute channel scan operations to select candidate channels (e.g., channels with the preferred performance) on each WLAN communication bands.”), 16:53-60 (“[T]he configuration unit 106 can identify a ***preferred channel*** (e.g., a channel with the best performance, such as a ***highest RSSI***, lowest error rate, etc.) from the candidate channels” to establish backhaul with the CAP).

## **2. Dependent Claims 2 and 13**

- (a) “[The method of claim 1/The device of claim 12], wherein said attempts are performed on a first radio, [the method/the operations] further comprising:”

Ho discloses or renders obvious this element. Ex.1002, ¶¶161-64. As Ho teaches, each access node can be a “dual band dual concurrent radio” (DBDC) device that can “simultaneously operate in the 2.4 GHz WLAN communication band and the 5 GHz WLAN communication band.” Ex.1009, 2:33-37, 18:18-22, 18:28-35. A DBDC’s 5 GHz radio is an example of the claimed first radio. Ex.1002, ¶161.

Ho teaches that, using such dual band radio, an access point of the network (“non-CAP hybrid device”) “can attempt to connect [(establish a backhaul)] to the CAP [(central access point or root AP)] via the 2.4 GHz or the 5 GHz WLAN communication band (whichever has the better connectivity) ...”. Ex.1009, 18:38-46. As Dr. Ding explains, the 5 GHz generally provides better connectivity than the 2.4 GHz, and thus the claimed first radio is typically the 5 GHz radio. Ex.1002, ¶¶163-64. For example, the 2.4 GHz band is also used for client-facing communication and thus its resource availability for backhaul may be lower compared to the 5 GHz band. *Id.* In addition, the channels in the 5 GHz band are wider, thus providing higher communication bandwidth, as Ho recognizes. *Id.*; Ex.1009, 13:42-51 (“[T]he CAP [and non-CAP hybrid devices] may be configured to select an 80 MHz WLAN operating channel or a 160 MHz WLAN operating channel” available in the 5 GHz band, instead of the lower “20 MHz WLAN operating channel” of the 2.4 GHz band); Ex.1021, 1-3.

- (b) *Element [2.1]/[13.1]: “upon failure of all said attempts, performing an attempt to establish the backhaul with the second node utilizing a different radio.”*

Ho discloses or renders obvious this element. Ex.1002, ¶¶165-67. As Ho teaches, each access node can be a “dual band dual concurrent radio” (DBDC) device that has a 2.4 GHz radio and a 5 GHz radio. Ex.1009, 2:33-37, 18:18-22, 18:28-35. As discussed above in Section VII.B.2(a), the access node will attempt to establish backhaul with the CAP over the higher bandwidth 5 GHz band using the 5 GHz radio (claimed first radio). *See* Section VII.B.2(a).

If and when those attempts fail because of poor connectivity to the 5 GHz band, Ho teaches that the access node attempts to establish backhaul with the CAP over the 2.4 GHz band using the 2.4 GHz radio (claimed different radio). Indeed, as Ho teaches, an access node will “attempt to connect to the CAP via the 2.4 GHz or the 5 GHz WLAN communication band (whichever has the better connectivity) ...”. Ex.1009, 18:38-46; Ex.1002, ¶166. As an example, if the user moves the dual-band dual-concurrent radio (DBDC) CAP behind a wall such that the 5 GHz signal becomes weaker compared to the 2.4 GHz signal, or if the user replaces such dual-radio CAP with a single-radio CAP (DBSR or SBSR) configured to operate in the 2.4 GHz band, the access node will attempt to re-connect to the CAP over the 2.4 GHz band using the 2.4 GHz radio. Ex.1009, 19:62-64 (the monitoring unit triggers

the execution unit to “***re-execute*** the [backhaul establishment] operations” if “the existing CAP [becomes] unreachable or may [have] change[d].”); Ex.1002, ¶167.

### 3. Dependent Claims 3 and 14

- (a) “[*The method of claim 2/The device of claim 13*], wherein said different radio is the same radio as the front haul.”

Ho discloses or renders obvious this element. Ex.1002, ¶168. The 2.4 GHz radio (claimed different radio) is also used for client-facing front haul communication, as was well-known in the art. *Id.*

### 4. Dependent Claims 4 and 15

- (a) *Preamble*: “[*The method of claim 1/The device of claim 12*, the operations] further comprising:”

Ho renders obvious claims 1 and 12. Ex.1002, ¶169.

- (b) *Element [4.1]/[15.1]*: “*measuring received signal strengths of probes from all nodes within a communication range; and*”

Ho discloses or renders obvious this element. Ex.1002, ¶¶170-71. As Ho teaches, a non-CAP hybrid device (claimed network device) determines “WLAN connection quality to the CAP on all communication bands,” and that “the WLAN connection quality to the CAP can be a ***signal strength (e.g., RSSI)*** of a WLAN signal received (at a WLAN interface of the non-CAP hybrid device) from the CAP on all the communication bands on which the CAP is configured to operate” such as the 2.4 GHz and/or 5 GHz bands. Ex.1009, 14:11-27. A POSITA would understand and find obvious that the signals received at a non-CAP hybrid device include probe

requests that are broadcasted by every mesh point of a wireless mesh network (such as Ho's mesh network) as part of the mesh discovery and backhaul peer link management process, as described in the IEEE mesh networking standards. Ex.1002, ¶171; Ex.1020, 109 ("Mesh discovery and peer link management require that MPs [(mesh points)] have sufficient information about themselves and potential neighbors. This process *requires* detection of potential mesh neighbors through Beacons or through *active scanning using Probe Requests.*").

- (c) *Element [4.2]/[15.2]: "selecting the second node based on the measured received signal strengths of the probes."*

Ho discloses or renders obvious this element. Ex.1002, ¶172. As Ho teaches, a non-CAP hybrid device (claimed network device) establishes a backhaul connection with the CAP (it selects the CAP) if the measured received signal strengths of signals (including probe signals) from the CAP indicate that the connection is adequate. Ex.1009, 14:32-38 ("The WLAN connection quality can be deemed 'adequate' if the WLAN connection is of a good quality. In some embodiments, if the *RSSI* of the signal received from the CAP is greater than a *predetermined RSSI threshold* (e.g., an *RSSI\_moderate\_threshold* ...), the WLAN connection quality is deemed *adequate.*"), 17:25-29 ("In general, the WLAN STA module of the non-CAP hybrid device can be switched ON if the WLAN connection

to the CAP is adequate (e.g., if the **signal strength** detected from the CAP at the non-CAP hybrid device is greater than a threshold signal strength).”).

## **5. Dependent Claims 5 and 16**

- (a) “[The method of claim 1/The device of claim 12, the operations] further comprising: utilizing a spanning tree based protocol to avoid loops in said attempts.”

Ho discloses or renders obvious this element. Ex.1002, ¶173. Ho teaches the use of a “suitable loop avoidance mechanism (e.g., a hybrid spanning tree protocol (hSTP) ...”. Ex.1009, 5:18-21.

## **6. Dependent Claims 6 and 17**

- (a) *Preamble*: “[The method of claim 1/The device of claim 12, the operations] further comprising:”

Ho renders obvious claims 1 and 12. Ex.1002, ¶174.

- (b) *Element [6.1]/[17.1]*: “measuring a link quality among one or more of the nodes in the network; and”

Ho discloses or renders obvious this element. Ex.1002, ¶175. As Ho teaches, a non-CAP hybrid device (claimed network device) determines “WLAN connection quality to the CAP on all communication bands,” and that “the WLAN **connection quality** to the CAP can be a **signal strength (e.g., RSSI)** of a WLAN signal received (at a WLAN interface of the non-CAP hybrid device) from the CAP on all the communication bands on which the CAP is configured to operate” such as the 2.4

GHz and/or 5 GHz bands. Ex.1009, 14:11-27. As Dr. Ding explains, Ho's "WLAN connection quality" is a "link quality" as claimed. Ex.1002, ¶175.

- (c) *Element [6.2]/[17.2]: "selectively causing a number of nodes in the network to form a particular connection topology based on the measured link quality."*

Ho discloses or renders obvious this element. Ex.1002, ¶¶176-79. As discussed above in Section VII.B.4(b) and as Ho teaches, a non-CAP hybrid device (claimed network device) establishes a direct backhaul connection with the CAP if the measured received signal strengths of signals from the CAP indicate that such a direct connection provides adequate connection quality (measured link quality). Ex.1009, 14:32-38 ("[I]f the RSSI of the signal received from the CAP is greater than a predetermined RSSI threshold ..., *the WLAN connection quality* [between the CAP and the non-CAP hybrid device] is deemed *adequate*"). Ho refers to this mode of operation in which a network device is directly connected to the CAP as "mode A," in contrast to "mode B" where the network device is indirectly connected to the CAP through another non-CAP network device acting as a relay/network extender: "if ... the non-CAP hybrid device is connected to and associated with an access point that is *not* the CAP of the hybrid communication network, the non-CAP hybrid device is deemed to be operating in *mode B*. Otherwise, the non-CAP hybrid device is deemed to be operating in *mode A*." Ex.1009, 19:39-44.

Ho's "mode B" is discussed in detail below regarding claims 8 and 19. *See* Section VII.B.8. As a POSITA would understand and find obvious, Ho teaches that a network device would connect to another non-CAP network device acting as a relay/network extender ("mode B") if the signal strengths of signals it receives from the CAP are too weak, indicating that a direct connection with the CAP ("mode A") is not possible because of inadequate connection quality. Ex.1009, 14:38-41 ("[I]f the RSSI of the signal received from the CAP is less than the predetermined RSSI threshold (e.g., the RSSI\_moderate\_threshold) **the WLAN connection quality** [of a direct connection between the CAP and the non-CAP hybrid device] is deemed **inadequate.**"); *id.*, 19:62-64 ("the existing CAP of the hybrid communication network 100 may be unreachable"); *id.*, 21:65-22:4 ("[T]he non-CAP hybrid device may not necessarily associate with the CAP. In other embodiments, (e.g., if a non-CAP access point provides better performance than the CAP), ... the non-CAP hybrid device may associate with the non-CAP access point that provides the best performance."); *id.*, claim 5 ("determining whether to configure the first network device as ... a relay device.").

Thus, Ho teaches that the network device selectively causes a number of nodes in the network (*e.g.*, the network device, the CAP, and one or more access points acting as relay devices) to form a particular connection topology—a "mode A"

single-hop backhaul connection to the CAP, or a “mode B” multi-hop connection to it—that is based on measured link quality. Ex.1002, ¶179.

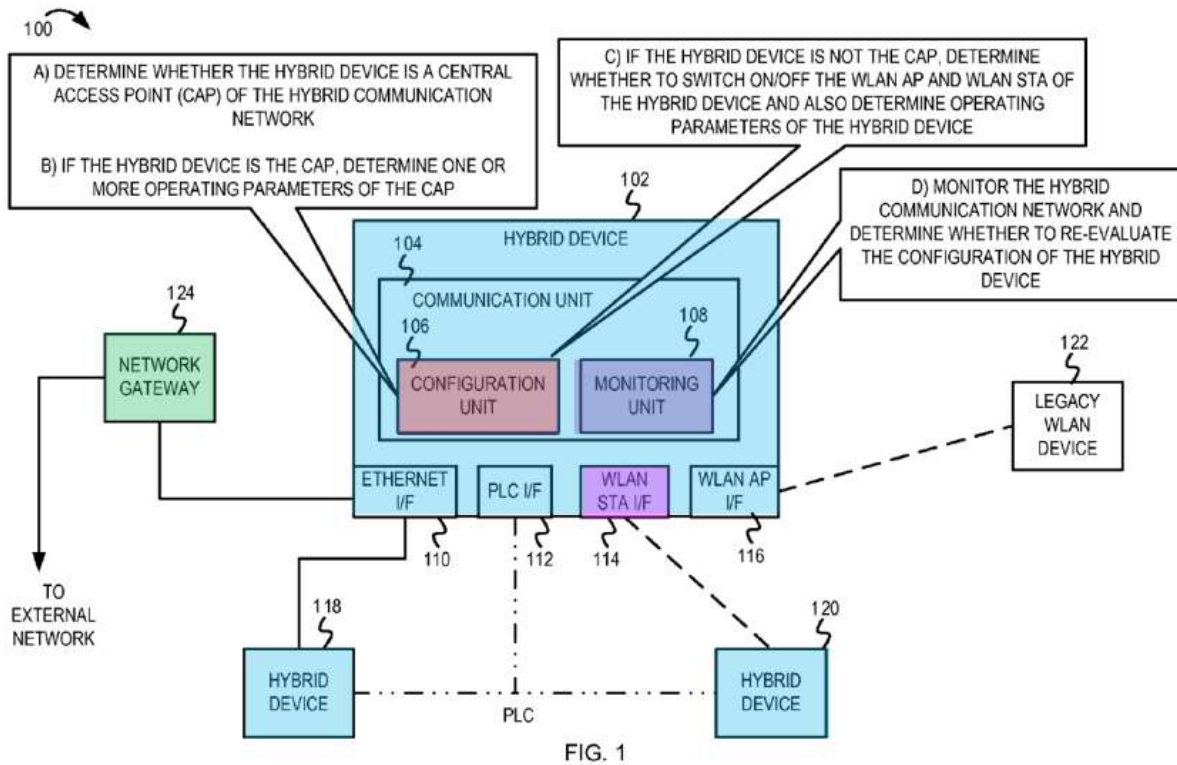
## **7. Dependent Claims 7 and 18**

- (a) *“[The method of claim 6/The device of claim 17], wherein the formed connection topology is a star topology if the link quality exceeds a predetermined threshold.”*

Ho discloses or renders obvious this element. Ex.1002, ¶¶180-86. As Ho teaches, if the link quality of the communication link between a non-CAP hybrid device (network device) and the CAP (root AP) exceeds a predetermined threshold (“RSSI\_moderate\_threshold”), the network device operates in “mode A” and is directly connected to the CAP, as detailed below. Ex.1009, 14:32-38 (“[I]f the RSSI of the signal received from the CAP is greater than a predetermined RSSI threshold (e.g., an RSSI\_moderate\_threshold ...), the WLAN connection quality is deemed adequate.”). When all non-CAP hybrid devices in Ho’s home network operate in “mode A,” for example because the devices are placed sufficiently close to the CAP, they all form direct connections with the CAP, thereby forming a star topology. Ex.1001, 4:21-23 (“Star topology is an arrangement in which all the nodes are directly connected to the base node.”).

In more detail, as Ho teaches, when the link quality (e.g., RSSI) of signals transmitted by the CAP and received at a non-CAP hybrid device (network device) exceeds a predetermined threshold (“RSSI\_moderate\_threshold”), “the WLAN STA

module of the non-CAP hybrid device can be switched ON.” *Id.*, 17:25-29 (“In general, the WLAN STA module of the non-CAP hybrid device can be switched ON if the WLAN connection to the CAP is adequate (e.g., if the signal strength detected from the CAP at the non-CAP hybrid device is greater than a threshold signal strength).”). The WLAN STA module 114 (magenta) of a hybrid device (blue) is a Wi-Fi (WLAN) interface that allows the hybrid device to connect to another hybrid device (such as the CAP) over WLAN communication bands, as illustrated in Figure 1 below. Ex.1009, 3:35-41, 3:58-60.



Ex.1009, FIG. 1.

As Ho teaches, switching on the “WLAN STA module” of a non-CAP hybrid device (network device) allows that network device to form a direct wireless connection with the CAP. *Id.*, 14:27-30, 18:38-47 (“[T]he **WLAN STA module** of the non-CAP hybrid device **can attempt to connect to the CAP** via the 2.4 GHz or the 5 GHz WLAN communication band ...”). Notably, Ho refers to this direct mode of backhaul connection whereby a non-CAP hybrid device (network device) is directly connected to a CAP as “mode A,” in contrast to “mode B” where the network device is indirectly connected to the CAP through another access point acting as a relay:

[I]f the WLAN STA module of the non-CAP hybrid device is switched ON, and if the WLAN STA module of the non-CAP hybrid device is connected to and associated with an access point that is **not** the CAP of the hybrid communication network, the non-CAP hybrid device is deemed to be operating in **mode B**. Otherwise, the non-CAP hybrid device is deemed to be operating in **mode A**.

Ex.1009, 19:37-44. As Dr. Ding explains, a POSITA would understand and find obvious that the network devices in Ho’s home network can all operate in Ho’s “mode A” and be directly connected to the CAP, forming a star topology—this would be the case when a user places her network devices sufficiently close to the

CAP, resulting in received signal strengths of CAP signals that all exceed Ho's RSSI\_moderate\_threshold. Ex.1002, ¶186.

**8. Dependent Claims 8 and 19**

- (a) *“[The method of claim 6/The device of claim 17], wherein the formed connection topology is a daisy chain topology if the link quality does not exceed a predetermined threshold.”*

Ho discloses or renders obvious this element. Ex.1002, ¶¶187-89. As Ho teaches, “if the RSSI of the signal received from the CAP is less than the predetermined RSSI threshold (e.g., the RSSI\_moderate\_threshold) the WLAN connection quality is deemed inadequate.” Ex.1009, 14:38-41. As would be well-known in the art, this would be the case for example if the CAP is placed too far from a non-CAP hybrid device and is thus “unreachable.” Ex.1009, 19:62-64 (“[T]he existing CAP ... may be unreachable ...”). In that case, the non-CAP hybrid device cannot connect directly to the CAP but would connect in a daisy-chain fashion to the CAP through another network device acting as a relay, as Ho teaches and as would be well-known in the art. Ex.1009, 21:65-22:4 (“In some embodiments, the WLAN STA module of the non-CAP hybrid device may not necessarily associate with the CAP. In other embodiments, (e.g., if a non-CAP access point provides better performance than the CAP), the WLAN STA module of the non-CAP hybrid device may associate with the non-CAP access point that provides the best performance.”); Ex.1002, ¶188. Ho refers to this daisy-chain mode

of backhaul connection as mode B: “if the WLAN STA module of the non-CAP hybrid device is connected to and associated with an access point that is **not** the CAP of the hybrid communication network, the non-CAP hybrid device is deemed to be operating in **mode B**. Otherwise, the non-CAP hybrid device is deemed to be operating in **mode A**.” Ex.1009, 19:39-44.

### 9. Dependent Claims 9 and 20

- (a) *“[The method of claim 8/The device of claim 19, the operations] further comprising: maintaining a hop count for nodes connected in the daisy chain topology, wherein whether a given node can be added to the daisy chain topology as an extra hop is further based on the hop count.”*

Ho discloses or renders obvious this element. Ex.1002, ¶¶190-92. As Ho teaches, a non-CAP hybrid device may operate in “mode B” whereby it is indirectly connected to the CAP through a multi-hop backhaul path that relies on a relay/network extender: “if the WLAN STA module of the non-CAP hybrid device is connected to and associated with an access point that is **not** the CAP of the hybrid communication network, the non-CAP hybrid device is deemed to be operating in **mode B**. Otherwise, the non-CAP hybrid device is deemed to be operating in **mode A**.” Ex.1009, 19:39-44. Ho further teaches that the non-CAP hybrid device determines and maintains “one or more performance measurements” including a hop count, which is “a number of communication hops (or communication links) between the non-CAP hybrid device and the CAP.” *Id.*, 14:11-20, 16:33-36. As Dr.

Ding explains and as also described in prior art references, a POSITA would understand and find obvious that a higher hop-count reduces end-to-end path performance and, thus, whether the non-CAP hybrid device can be added to a daisy chain topology as an extra hop would take into account the hop count. Ex.1002, ¶192; Ex.1014 (Farid), [0063] (“The MAP determines the best route based on signal-to-noise ratios (SNRs) and *hop counts* associated with each of the neighbor APs. ... Neighbor APs associated with higher SNRs and *lower hop counts are favored* for a best route over neighbor APs associated with lower SNRs and higher hop counts.”); Ex.1015, 15:1-60 (explaining that “a mesh AP chooses a parent based on two measurements: the *hop count* and SNR” and teaching a link metric that favors low hop count); Ex.1006 (Handforth), 3:62-4:10 (setting up one-hop backhaul routes in a wireless mesh network because “[t]his enables signals ... to have a rapid (*without an excessive number of hops*) route to fixed network access ...” and using multi-hop routes only in the event of a failure on the one-hop routes).

#### 10. Dependent Claims 10 and 21

- (a) “[The method of claim 1/The device of claim 12, the operations] further comprising: receiving, via the backhaul, a configuration from the second node.”

Ho discloses or renders obvious this element. Ex.1002, ¶193. As Ho teaches, the CAP (claimed second node) can determine “WLAN credentials (e.g., SSID and WLAN passphrase)” (claimed configuration), “configure itself using the WLAN

credentials ... and distribute the WLAN credentials ... to other hybrid devices in the communication network 100.” Ex.1009, 7:16-20, 8:30-50. Thus, as Ho teaches, a non-CAP hybrid device (claimed network device) receives, via the backhaul, a configuration (*e.g.*, WLAN credentials) from the CAP (claimed second node). Ex.1002, ¶193.

#### **11. Dependent Claims 11 and 22**

- (a) *“[The method of claim 10/The device of claim 21, the operations] further comprising: causing the configuration from the second node to be pushed through the backhaul to a target node, wherein said causing is triggered by an initiation from a user.”*

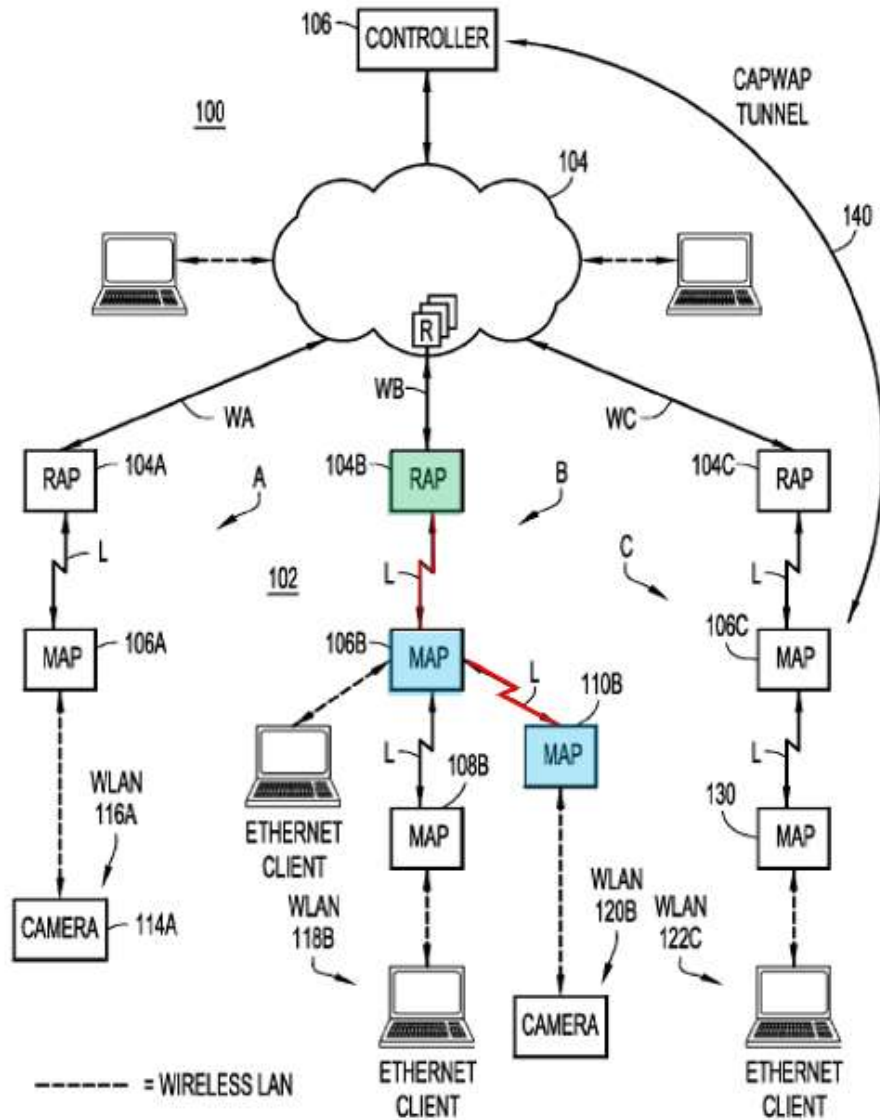
Ho discloses or renders obvious this element. Ex.1002, ¶194. As Ho teaches, the hybrid devices can be configured using “push button connection (PBC) procedures” described in the IEEE 1905.1 home networking standard. Ex.1009, 7:37-48. Under push button configuration (PBC) procedures, a non-CAP hybrid device must wait for the user to push a button associated with it before the WLAN credentials can be transferred from the CAP to it. Ex.1009, 11:46-12:6. The non-CAP hybrid device can then transmit the WLAN credentials to one or more network devices (claimed target node) connected to it via a push operation, *i.e.*, without the target node requesting the credentials.

**C. Ground III: Claims 9 and 20 Are Rendered Obvious by Ho In Combination with Farid**

**1. Dependent Claims 9 and 20**

As discussed above in Section VII.B.9, Ho renders obvious claims 9 and 20. Ho teaches network devices that may be indirectly connected to the CAP in a daisy chain topology, and further teaches that each network device determines and maintains the hop-count of the backhaul path between itself and the central access point (CAP). *See* Section VII.B.9; Ex.1002, ¶195. A POSITA would understand and find obvious that the hop-count is used in determining whether the network device can be added to a daisy chain. Ex.1002, ¶196. This is because high hop-count is detrimental to end-to-end backhaul performance, as described in numerous prior art references, including Farid. *Id.*

Ho in view of Farid also renders claims 9 and 20 obvious, for the reasons discussed in Section VII.B.9 and further detailed below. Ex.1002, ¶¶197-201. Like Ho, Farid is directed to establishing wireless backhaul links between mesh access points (MAPs) in a wireless mesh network. Ex.1014, [0002]. Such a network is illustrated in Figure 1 below. Also like Ho, Farid teaches establishing backhaul links over selected channels of the 5 GHz frequency band. *Id.*



Ex.1014, FIG. 1. Farid focuses in particular on selecting a backhaul communication path between a MAP (blue) and a Root AP (RAP) (green). *Id.*, [0063]. The process involves in particular the selection of a “parent AP” for a MAP to connect to in a daisy chain fashion. *Id.* For example, as shown in Figure 1, MAP 110B is connected to parent AP 106B which is directly connected to RAP 104B (green), and thus MAP

110B is indirectly connected to that Root AP over a two-hop backhaul path highlighted in red. Ex.1002, ¶198. To select a suitable parent AP, Farid teaches that a MAP “determines which of the neighbor APs provides a best route to a RAP (and thus will serve as a next parent AP to the MAP.” Ex.1014, [0063]. As Farid further teaches, “[t]he MAP determines the best route based on signal-to-noise ratios (SNRs) and **hop counts** associated with each of the neighbor APs. ... The hop count is a number of hops (i.e., links) from the neighbor AP to a RAP, and may be broadcasted by the neighbor AP.” *Id.* Significantly, Farid teaches that “[n]eighbor APs associated with high SNRs and **lower hop counts** are favored for a best route over neighbor APs associated with lower SNRs and higher hop counts.” *Id.* As Dr. Ding explains, a POSITA would understand and find obvious to implement Farid’s use of hop count in Ho’s backhaul path selection method to ensure that the backhaul paths have as few hops as possible for improved performance. Ex.1002, ¶¶199-200. Additionally, as Dr. Ding explains, combination of Ho and Farid as proposed is a combination of prior art elements according to known methods, and also application of a known technique to a known system ready for improvement, both to yield predictable results, namely improved network performance. *Id.*, ¶201. The results of combining Ho and Farid would have been predictable, and there would have been a reasonable expectation of success, because the modification of Ho based on Farid would require common and routine software programming. *Id.*

## VIII. THE BOARD SHOULD INSTITUTE IPR

The Board should decline to exercise its discretion to deny institution.

**No Discretionary Denial under *Fintiv*** - “The PTAB will not discretionarily deny petitions based on applying *Fintiv* to a parallel ITC proceeding.” Ex.1010, at 7. As explained below in Section IX.B, the only active parallel proceeding involving the ’698 Patent is ITC Investigation No. 337-TA-1361.

**No Discretionary Denial under §325(d)** - The Board has consistently “held that a reference that ‘was neither applied against the claims nor discussed by the Examiner’ does not weigh in favor of exercising [] discretion under §325(d).” *Fasteners for Retail, Inc. v. RTC Indus., Inc.*, IPR2019-00994, Paper 9 at 7-11 (PTAB Nov. 5, 2019). Here, though cited, Gatewood was neither applied against the claims nor discussed by the Examiner. Moreover, the Gatewood-Ho combination of Ground I was not in front of the Examiner. Ex.1002, ¶202.

Ho was only used as a secondary reference, in combination with the primary Mallik reference, and only to satisfy the “spanning tree based protocol” claim element of mirror dependent claims 5 and 16: “In regards to claims 5 and 16, Mallik teaches all the limitations of the parent claims [1 and 12] as stated above. However, Mallik fails to teach utilizing a spanning tree based protocol to avoid loops in said attempts. Ho however teaches, utilizing a spanning tree based protocol to avoid loops in said attempts (see paragraph 17).” Ex.1004, 126; Section III.B. The Examiner

did not identify Ho as disclosing any particular limitation of the independent claims or of other dependent claims. Ex.1004; Ex.1002, ¶¶203-04. Thus, Ho is properly considered as a primary reference in the instant Petition to challenge all claims of the '698 Patent, as set forth in Grounds II (Ho) and III (Ho-Farid). *CrowdStrike, Inc. v. Open Text Inc.*, IPR2023-00556, Paper 9, at 10-12 (PTAB Sept. 12, 2023) (declining to exercise discretion to deny institution where prior art reference relied on as a primary reference in the IPR petition had only been applied as a secondary reference against few dependent claims during original prosecution).

Gatewood and Ho are also not cumulative with the closest art (Mallik) discussed during original prosecution which, according to Applicant, “does not talk about the establishment of the backhaul itself” and fails to disclose multiple claimed features. Section III.B; Ex.1002 ¶205.

## **IX. MANDATORY NOTICES**

### **A. Real Party-In-Interest**

TP-Link Corporation Limited, f/k/a/ TP-Link International Ltd., TP-Link Technologies Co., Ltd., TP-Link USA. Corp. and TP-Link Institute USA Corp. d/b/a TP-Link Research America Corp. are the real parties-in-interest.

### **B. Related Matters**

The '698 Patent is the subject of an investigation in the International Trade Commission, Inv. No. 337-TA-1361, filed April 3, 2023 (“ITC Investigation”).

The '698 Patent is also subject of Civil Action No. 2:23-cv-2540 in the Central District of California ("District Court Case"), filed April 4, 2023. The District Court Case is stayed pending outcome of the ITC Investigation. Ex.1013.

**C. Counsel and Service Information**

| Lead Counsel                                                                                                                                                                                        | Back-Up Counsel                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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Individual attorney contact information is in the signature block below.

Petitioner concurrently submits a Power of Attorney, 37 C.F.R. § 42.10(b), and consents to electronic service directed to the following email address: TP-Link\_ITC@kirkland.com.

**X. PAYMENT OF FEES UNDER 37 C.F.R. § 42.103**

Petitioner authorizes the Office to charge the filing fee and any other necessary fee to Deposit Account No. 506092. Review of 22 claims is requested. The undersigned further authorizes payment for any additional fees that may be due in connection with this Petition.

## **XI. CERTIFICATION OF GROUNDS FOR STANDING**

Petitioner certifies pursuant to Rule 42.104(a) that the '698 Patent is available for IPR and that Petitioner is not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified in this Petition.

## **XII. CONCLUSION**

Petitioner requests institution of an IPR and cancellation of the Challenged Claims.

Date: September 29, 2023

Respectfully submitted,

*/s/ Todd M. Friedman*

Todd M. Friedman, P.C.

Counsel for Petitioner

Reg. No. 42,559

**CERTIFICATE OF COMPLIANCE**

This Petition complies with the type-volume limitations as mandated in 37 C.F.R. § 42.24, totaling 13,991 words. Counsel has relied upon the word count feature provided by Microsoft Word.

/s/ Todd M. Friedman  
Todd M. Friedman

**CERTIFICATE OF SERVICE**

Pursuant to 37 C.F.R. § 42.6(e), I certify that I caused to be served on September 29, 2023 a true and correct copy of the foregoing **PETITION FOR *INTER PARTES* REVIEW UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104** by overnight carrier to the Patent Owner at the correspondence address of record for the Patent Owner's Attorneys as follows:

22918 - PERKINS COIE LLP - PAO General  
P.O. Box 1247  
Seattle, WA 98111-1247  
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A courtesy copy was also served via electronic mail on Patent Owner's counsel of record in the investigation before the International Trade Commission, Inv. No. 337-TA-1361.

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