

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TP-LINK CORPORATION LIMITED,
Petitioners

v.

NETGEAR, INC.,
Patent Owner

U.S. PATENT NO. 9,468,025

Case IPR2023-TBD

DECLARATION OF ZHI DING, PH.D.

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I, Dr. Zhi Ding, declare as follows:

1. My name is Zhi Ding.
2. I have been retained as an expert witness on behalf of TP-Link Corporation Limited (“TP-Link” or “Petitioner”) for the above-captioned Petition for Inter Partes Review (“Petition”) of U.S. Patent No. 9,468,025 (the “’025 Patent”) (Ex. 1001). I am being compensated for my time in connection with this Petition at my standard consulting rate of \$820 per hour. My compensation is not affected by the outcome of this matter.
3. I have been asked to provide my opinions regarding whether claims 1-21 of the ’025 Patent (the “Challenged Claims”) are invalid as obvious to a person having ordinary skill in the art at the time of the alleged invention.
4. The ’025 Patent issued on October 11, 2016, from Application No. 13/974,090, filed on August 23, 2013.
5. I am not currently, and have not at any time in the past been, an employee of TP-Link. I have no financial interest in TP-Link.

I. BACKGROUND AND QUALIFICATIONS

6. I presently hold the title of Distinguished Professor in the Department of Electrical and Computer Engineering at the University of California, Davis. Since my appointment on July 1, 2000, I have held the position of professor for the past 23 years at the present university and have served as a faculty member at several US

universities for over 32 years. I am also a private technical consultant on various technologies related to information systems. I have more than three decades of research experience on a wide range of topics related data communications and signal processing.

7. I earned my Bachelor of Science degree in 1982 in wireless engineering from the Nanjing Institute of Technology (later renamed as Southeast University) in Nanjing, China. I earned my Master of Science degree in 1987 in electrical engineering from the University of Toronto in Toronto, Canada. I earned my Ph.D. in 1990 in electrical engineering from Cornell University in Ithaca, New York.

8. My responsibilities as a Professor at University of California, Davis, include classroom instruction on various topics of communication systems and signal analysis, as well as mentoring undergraduate students and supervising graduate students in their research and development efforts on various topics related to digital communications. I have directly supervised such research and development works ranging from signal detection to wireless networking. As the chief academic advisor, I have also directly supervised the completion of over 20 Masters theses and 30 Ph.D. dissertations on various topics related to digital communications. I have served full time as a faculty member at three major research universities in the United States over the past 30 years, including Auburn University from 1990 to

1998, University of Iowa from 1999 to 2000, and University of California, Davis, from 2000 to present.

9. Since 1990, I have been selected as the principal investigator of multiple highly competitive federal and local research grants, including more than twenty major research projects supported by the National Science Foundation and two research projects funded by the U.S. Army Research Office. These competitive research projects focused on developing more efficient and effective digital communication transceivers, networks, and signal processing tools. I have also participated in several large-scale projects supported by the Defense Advanced Research Projects Agency (DARPA) with teams of researchers. I have applied for, and received support from, other federal, state, and industry sponsors.

10. I have published over 240 peer-reviewed research articles in premier international journals, in addition to over 250 refereed technical articles at top international conferences on communications and information technologies. According to Google Scholar, my published works have been cited by over 16,000 times by peers. I also authored two books on communications technologies. My most recent book, coauthored with B.P. Lathi, is entitled, “Modern Digital and Analog Communication Systems,” 5th edition, and was published by the Oxford University Press in 2018. The 4th edition of this book (published in 2009) had been widely adopted as an introductory textbook to communication systems.

11. In addition to the over 490 published technical papers that have been cited over 16,000 times according to Google Scholar, I am also co-inventor of 4 issued U.S. patents on communication technologies.

12. I am a member of the Institute of Electrical and Electronics Engineers (IEEE) and was elevated to the grade of Fellow in January 2003 for contributions made in signal processing for communication. The IEEE is the world's largest professional society of engineers, with over 400,000 members in more than 160 countries. The IEEE has led the development of many standards for modern digital communications and networking, most notably, the IEEE 802 series of network standards. The IEEE Grade of Fellow is conferred by the Boards of Directors upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. The total number selected in any one year does not exceed one-tenth of one percent of the total voting Institute membership.

13. I have served the IEEE in the following capacities:

- Chief Information Officer of the IEEE Communications Society from Jan. 2018 to present.
- Chief Marketing Officer of the IEEE Communications Society from Jan. 2020 to present.

- General Chair of the 2016 IEEE International Conference on Acoustics, Speech, and Signal Processing, the flagship conference of the IEEE Signal Processing Society.
- Chair of the Steering Committee for the IEEE Transactions on Wireless Communications from 2008 to 2010.
- Distinguished Lecturer of the IEEE Communications Society from January 2008 to December 2009.
- Technical Program Chair of the 2006 IEEE Globecom, one of two flagship annual IEEE Communication Society conferences.
- Distinguished Lecturer of the IEEE Circuits and Systems Society from 2004 to 2005.
- Associate Editor of the IEEE Transactions on Signal Processing from 1994 to 1997 and from 2001 to 2004.
- Member of the IEEE Statistical Signal and Array Processing for Communications Technical Committee from 1993 to 1998.
- Member of the IEEE Signal Processing for Communications Technical Committee from 1998 to 2004.

14. In 2012, I received the Wireless Communications Technical Committee Recognition Award from the IEEE Communications Society, an award given to a person with a high degree of visibility and contribution in the field of “Wireless and

Mobile Communications Theory, Systems, and Networks.” I received the 2020 Education Award from the IEEE Communications Society. According to the Society, this award “recognizes distinguished and significant contributions to education within the Society’s technical scope.”

15. I have also served as a technical consultant for the telecommunication industry. For example, in 1995 I consulted for Analog Devices, Inc., on the development of the first generation DOCSIS cable modem systems. I have also consulted for other companies, including Nortel Networks and NEC US Laboratories. I worked as a visiting faculty research fellow at NASA Glenn Research Center in 1992 and at U.S. Air Force Wright Laboratory in 1993. I have served on multiple review panels of the National Science Foundation to evaluate competitive research proposals in the field of communication. I have also reviewed a large number of research proposals at the request of the National Science and Engineering Research Council (NSERC) of Canada as an expert panelist from 2010 to 2013, and also at the request of the Research Grant Council (RGC) of Hong Kong as an external reviewer.

16. I have served as an expert witness or consulting expert on a number of matters related to intellectual property, mostly in the arena of telecommunications, including cellular communications, Wi-Fi technologies, Bluetooth, and optical communications. For example, since 2007, I have been engaged to work on various

litigations involving cellular, WiFi, Bluetooth, and optical communication networks.

17. Based on my above-described near three decades of experience in communications technologies, and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to be an expert in wireless communication systems, communication networks, and signal processing.

18. My qualifications and publications are set forth more fully in my curriculum vitae, attached.

II. MATERIALS AND OTHER INFORMATION CONSIDERED

19. In forming the opinions expressed in this Declaration, I relied upon my education and experience in the relevant field of the art and have considered the viewpoint of a person having ordinary skill in the art (POSITA) at the time of the alleged invention.

20. I have considered the materials referenced herein, including the '025 Patent (Ex. 1001), the file history of the '025 Patent (Ex. 1004), the Petition, and other documents listed in the Exhibit List of the Petition, including:

Description	Date of Public Availability
U.S. Patent Application Publication No. 2010/0322141 A1 ("Liu") (Ex. 1005)	Published December 23, 2010, from a PCT application filed March 11, 2008.

Description	Date of Public Availability
U.S. Patent Application Publication No. 2008/0080388 A1 (“Dean”) (Ex. 1006)	Published April 3, 2008, from an application filed October 2, 2006.
U.S. Patent No. 7,826,426 (“Bharghavan”) (Ex. 1007)	Issued November 2, 2010, from an application filed March 7, 2007, with priority to an application filed December 5, 2005.
IEEE 802.11-2008 Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications (“802.11k”) (2008) (Ex. 1008)	Published and publicly available no later than 2008.
Wiley Electrical and Electronics Engineering Dictionary (2004) (Ex. 1009)	Published and publicly available no later than 2004.
Microsoft Computer Dictionary (2002) (Ex. 1010)	Published and publicly available no later than 2002.
U.S. Patent Application Publication 2015/0043530 (“Bharghavan cited art”) (Ex. 1016)	Published and publicly available no later than 2015.

21. The references listed above include prior art to the ’025 Patent which is entitled to a priority date not earlier than August 23, 2013. Liu and Dean were not cited (Exs. 1005 and 1006) were not cited. Bhargavan (Ex. 1007) and the Bharghavan cited art (Ex. 1016) are related with essentially the same disclosure.

III. UNDERSTANDING OF PATENT LAW

22. I am not an attorney. For purposes of this declaration, I have been informed about certain aspects of the law that are relevant to my opinions. My understanding of the law is as listed below.

A. Claim Construction

23. I understand that in an IPR petition filed after November 13, 2018, a claim must be construed under the *Phillips* standard. Under that standard, words of a claim are given their plain and ordinary meaning as understood by a POSITA at the time of invention, in light of the specification and prosecution history, unless those sources show an intent to depart from such meaning, as well as pertinent evidence extrinsic to the patent.

B. Obviousness

24. I have been informed and understand that a patent claim can be considered to have been obvious to a POSITA at the time the application was filed. This means that, even if all of the requirements of a claim are not found in a single prior art reference, the claim is not patentable if the differences between the subject matter in the prior art and the subject matter in the claim would have been obvious to a POSITA at the time the application was filed.

25. I have been informed and understand that a determination of whether a claim would have been obvious should be based upon several factors, including, among others:

- the level of ordinary skill in the art at the time the application was filed;
- the scope and content of the prior art; and
- what differences, if any, existed between the claimed invention and the prior art.

26. I have been informed and understand that the teachings of two or more references may be combined in the same way as disclosed in the claims, if such a combination would have been obvious to a POSITA. In determining whether a combination based on either a single reference or multiple references would have been obvious, it is appropriate to consider at least the following factors:

- whether the teachings of the prior art references disclose known concepts combined in familiar ways, which, when combined, would yield predictable results;
- whether a POSITA could implement a predictable variation, and would see the benefit of doing so;
- whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by a POSITA;
- whether a POSITA would have recognized a reason to combine known elements in the manner described in the claim;
- whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and
- whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

27. I understand that a POSITA has ordinary creativity, and is not an automaton.

28. I understand that in considering obviousness, it is important not to determine obviousness using the benefit of hindsight derived from the patent being considered.

29. I understand that prior art to the '025 Patent includes patents and printed publications in the relevant art that predate the Priority Date of the '025 Patent.

30. I understand that certain factors—often called “secondary considerations”—may support or rebut an assertion of obviousness of a claim. I understand that such secondary considerations include, among other things, commercial success of the alleged invention, skepticism of those having ordinary skill in the art at the time of the alleged invention, unexpected results of the alleged invention, any long-felt but unsolved need in the art that was satisfied by the alleged invention, the failure of others to make the alleged invention, praise of the alleged invention by those having ordinary skill in the art, and copying of the alleged invention by others in the field.

31. I further understand that there must be a nexus—a connection—between any such secondary considerations and the alleged invention. I also understand that contemporaneous and independent invention by others is a secondary consideration tending to show obviousness.

IV. SUMMARY OF OPINIONS

32. It is my opinion that claims 1-21 are disclosed or, at a minimum, rendered obvious by Liu (Ground I).

33. It is my opinion that claims 7, 8-11, 13-15, **16**, and 17-21 are disclosed or, at a minimum, rendered obvious by Dean (Ground II).

34. It is my opinion that claims 1 and 2-6 are rendered obvious by Dean in combination with Bharghavan (Ground III).

35. It is my opinion that claims 1 and 2-6 are rendered obvious by Liu in combination with Bharghavan (Ground IV).

36. It is my opinion that Liu, Dean and the grounds relied on in this petition are not cumulative with prior art considered by the Examiner during the prosecution of the '025 Patent.

37. For the purposes of this proceeding, I have applied the claims to the prior art under Patent Owner's plain meaning constructions, set forth in the Amended Joint Chart of Agreed and Disputed Claim Terms for Construction (Ex. 1014). In addition, for claims 7-11 and 13-15, I have also applied Petitioner's construction for the "wherein" phase of claim 7.

V. OVERVIEW OF THE TECHNOLOGY

38. The '025 patent is directed at wireless technology and specifically to computer networking via wireless connections. Unlike wired connections, wireless networks provide convenience, flexibility, and mobility for computers to connect to a network. In wireless networks, wireless devices such as laptops and printers connect to the broader network through a wireless access device by using a standardized wireless protocol such as Bluetooth, or Wi-Fi which typically refer to the IEEE 802.11 series of standards. Wireless access devices utilize a wireless

connection between the wireless access device and a wireless device to transfer data.

A network device connected to an external network is referred to as a “gateway,” while a wireless access device connected to an external network may be referred to as a “gateway wireless access device.”

39. The area in which a wireless connection between the wireless device and the wireless access device (access point or AP) can be established and maintained is the wireless coverage area for the AP. Often, the area where a user wishes to use his or her wireless device is larger than the coverage area of a single AP because the signal strength and quality of a wireless connection generally degrade as the wireless device moves further away from the single AP. A common approach is to form a wireless mesh network or extended network that uses multiple APs that are deployed in a scattered manner to increase coverage. In such an extended network, APs also act as WiFi extenders, though one can add WiFi extenders that do not provide direct access to client devices. APs in a wireless mesh network are also called Mesh APs or MAPs.

40. A network is defined by its topology. A basic WiFi setup may have a single AP connected to a gateway or integrated with a gateway. A mesh network would typically have a root AP (which itself is connected to a gateway or integrated with a gateway) and a number of other APs scattered around. In one mesh network configuration, these secondary APs may be wirelessly but directly connected to the

root AP, forming a star topology network. In other configurations, some of the secondary APs may instead be connected indirectly but wirelessly to the root AP in a daisy chain fashion by directly connecting to other secondary APs which are in turn either directly or indirectly connected to the root AP, forming a tree topology. In a star topology, the backhaul paths to an integrated root AP/gateway are single-hop communication paths. In a tree topology, the backhaul paths include indirect, multi-hop communication paths.

41. To individual users (wireless devices), the quality of the wireless link/connection is important to his/her networking experience. Typical link/channel quality parameters or indicators include received signal strength indicator (RSSI), received channel power indicator (RCPI), and the number of AP-to-AP wireless connections, generally referred to as a hop-count, for a client to reach a gateway through one or more APs. For example, the RSSI and RCPI provide signal strength information that impacts link speed and/or packet loss rate. Generally, a stronger RSSI/RCPI allows for faster connection speed, and/or lower packet loss rate. Conversely, a large hop count may adversely affect data rate, latency, and packet loss rate.

42. Depending on the applications, different performance metrics may be important to the clients. Important performance metrics should describe the user experience when in connection. Typical metrics include throughput, packet

error/loss rates, connection speed, bandwidth efficiency, latency, and jitter. These metrics directly reflect and impact user experience, overall network capacity, and efficiency of resource usage.

43. One of the most important benefits of wireless networks is the ability to maintain good connectivity as a client wireless device moves from one location to another. Because the link quality with one mesh AP may deteriorate while the link quality with a different mesh AP improves, the decision to change the connection of a wireless client device from one AP to another AP allows the wireless client device to maintain strong link quality. This process is referred to as roaming. To achieve high-quality network performance, roaming relies on channel quality information between a wireless client device and available APs in a mesh network, and can also take into account the quality of the backhaul communication paths between the APs and a gateway. Roaming decisions based on link quality measurement are vital to the effectiveness of mesh networks.

VI. THE '025 PATENT

44. The '025 Patent issued on October 11, 2016, from Application No. 13/974,090, filed on August 23, 2013.

A. Claims

45. The '025 Patent has 21 claims, including three independent claims numbered 1, 7, and 16. Ex. 1001, 15:24-18:25. Claims 1-21 are the Challenged Claims.

46. Exemplary Claim 1 is reproduced below:

1. A gateway router configured to facilitate wireless connection management in an extended wireless network, comprising:
 - a network device input connected at least indirectly to an internal network and configured to communicate a plurality of data packets to and from at least one computer system;
 - a network device output connected at least indirectly to an external network and configured to communicate the plurality of data packets to and from at least one computer system; and
 - a computer processor configured to execute steps, including
 - receiving packets from a wireless device,
 - identifying the wireless device within a table of wireless devices connected to a wireless access device in an extended wireless network,
 - generating wireless connection quality information for the wireless device specific to the wireless access device, the wireless connection quality information including wireless connection quality information for at least one indirect communication path having at least one network extender device to establish the communication path between the gateway router and the wireless access device.

Ex. 1001, 15:24-48.

B. Summary of the Specification

47. The '025 Patent explains that, to facilitate wireless connection management for wireless devices operating in an extended wireless network such as a mesh network, it is advantageous that “each wireless access device [(e.g., an AP)] can contribute to the process of identifying the wireless access device providing the highest quality wireless connection [to a wireless device] based on wireless connection quality information transmitted by or exchanged among the wireless access devices.” Ex.1001, Abstract, 3:50-63. Such network operation, however, was in my opinion well-known in the art.

C. Summary of the Prosecution History

48. During prosecution, Applicants attempted to distinguish Bharghavan’s related application 2015/0043530 A1 on a narrow ground, alleging that the application does not teach wireless connection quality information of “indirect communication paths,” *i.e.*, multi-hop paths, between a gateway and a wireless access device. Ex.1004, 195 (“Nothing in Bharghavan teaches or suggests wireless connection quality information include information for *indirect communication paths* using network extenders between the gateway router and the wireless access device.”). Applicants also argued that “[t]he system coordinator [of] Bharghavan is NOT a gateway device that can itself provide a wireless connection and does not connect to an external network.” *Id.*, 196.

49. But, as I explain below, the Liu and Dean prior art references relied upon herein both disclose wireless mesh networks having indirect communication paths between its APs and gateway(s), and also teaches selecting the AP having the best link quality to associate with a client device based the path quality of such indirect communication paths.

VII. LEVEL OF ORDINARY SKILL IN THE ART

50. I understand that there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including the educational level of active workers in the field at the time of the alleged invention, the sophistication of the technology, the type of problems encountered in the art, and the prior art solutions to those problems.

51. In determining the characteristics of a hypothetical person of ordinary skill in the art of the '025 Patent at the time of the alleged invention, I considered several things, including the type of problems encountered in this field, and the rapidity with which innovations were made. I also considered the sophistication of the technology involved, and the educational background and experience of those actively working in the field, and the level of education that would be necessary to understand the '025 Patent. Finally, based on my own experience, I placed myself back in the relevant periods of time, and considered the state of the art and the level of skill of the engineers working in this field in those times.

52. It is my opinion that a POSITA at the time of the '025 Patent would have had a Bachelor's degree from an accredited program 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. Additional education might compensate for a deficiency in experience, and vice-versa.

53. I also note that my opinions provided in this Declaration would not change in view of any minor modifications to this level of skill.

VIII. CLAIM CONSTRUCTION

54. I understand the parties have set forth constructions in the currently pending parallel ITC litigation, which are listed in Ex.1014. Ex.1014, Attachment A at 2-3. According to Patent Owner, every disputed term of the '025 Patent (highlighted) should be accorded plain meaning. As I discuss below in Section X, it is my opinion that the Challenged Claims are unpatentable under Patent Owner's plain meaning constructions. In my opinion, claims 7-11 and 13-15 are also unpatentable under Petitioner's construction for the "wherein" phrase of claim 7, as I explain below in Section X.B.1-8.

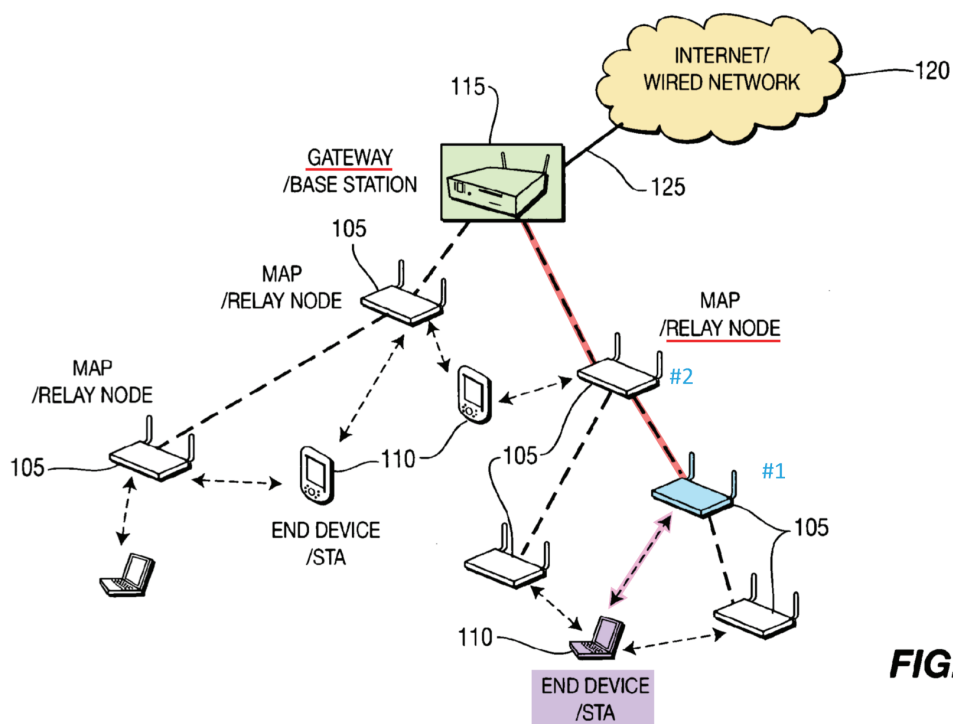
55. Nothing in this section should be construed as expressing any opinion as to whether the claims constitute patentable subject matter under 35 U.S.C. § 101,

or whether they satisfy the definiteness, enablement, best mode, or written description requirements under § 112.

IX. OVERVIEW OF THE PRIOR ART

A. Overview of Liu

56. Liu teaches a wireless mesh network (a network having multiple APs deployed in a scattered manner), illustrated in Figure 1, having indirect, multi-hop, backhaul communication paths. A backhaul path is a communication path between network devices. An example of such indirect path is the 2-hop backhaul path (red) between mesh access point (MAP) #1 (blue) and the gateway (green) that goes through a network extender (MAP/relay node #2).

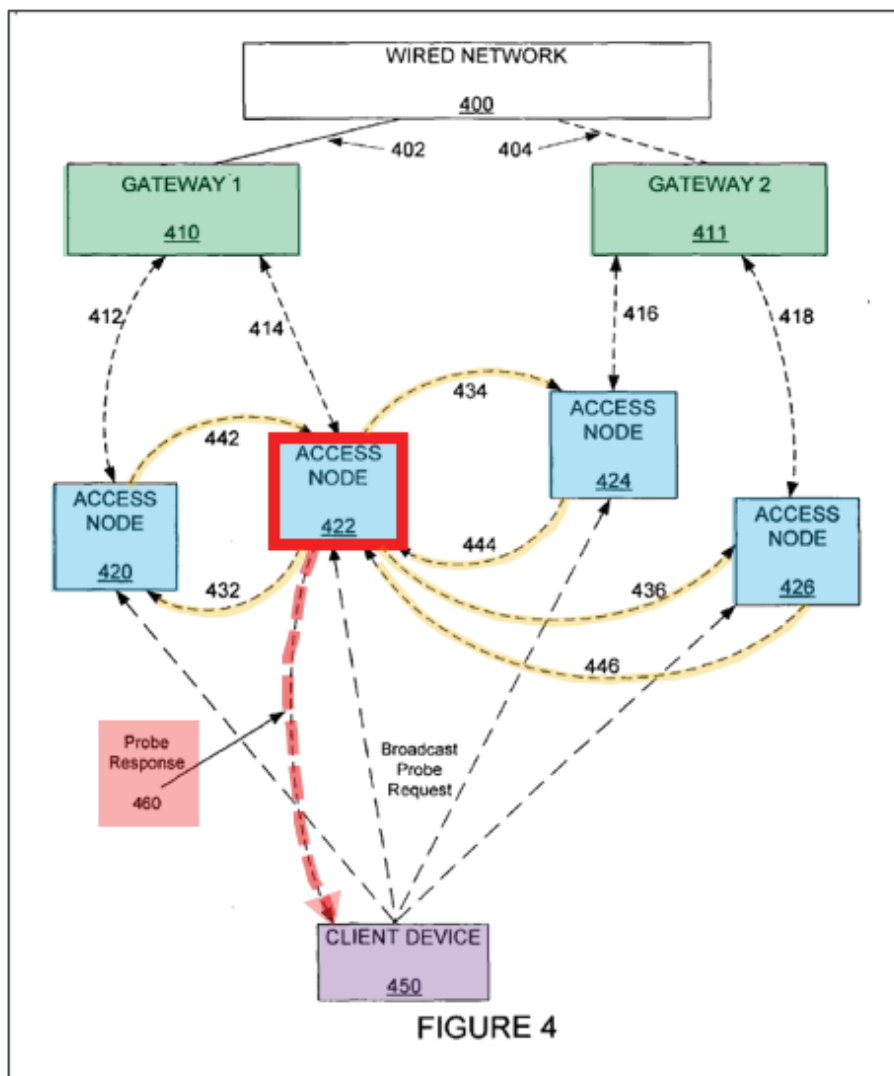


Ex.1005, FIG. 1.

57. Liu teaches that a central controller in the gateway selects the MAP (e.g., MAP#1) (blue) that provides “the optimal STA-MAP association” to associate with an STA (wireless device) (purple), taking into account the channel quality of the multi-hop backhaul path (red) to the gateway. Ex.1005, [0053] (“link data rate and channel conditions...[are] reported to the gateway, which...determine[s] the optimal STA-MAP association, backhaul routing, and bandwidth allocation to each STA[.]”).

B. Overview of Dean

58. Dean discloses a wireless mesh network, such as the network illustrated in Figure 4, in which the access points (APs) and gateways exchange link quality information to determine “which of a plurality of access points has a *highest quality link* with a client device” so as to establish association with the client device. Ex.1006, [0007], [0016]. As shown in Figure 4 and explained in Dean, a client device (purple) initiates a wireless connection by broadcasting a probe request that is received by many neighboring APs (blue). *Id.*, [0002].



Ex.1006, FIG. 4.

59. Instead of every receiving AP responding to the probe request, Dean teaches a probe response suppression solution in which the APs (and gateways) measure and exchange link quality, and also perform a “comparative link quality analysis” to select a single AP—the one with “*the best link quality*”—to respond to the probe request, thereby ensuring that it will associate with the client device. *Id.*, [0015]-[0016]. In Figure 4, APs (blue) exchange link quality information through

the exemplary arrows highlighted in tan, resulting in the selection of AP422 (blue with red outline) as the AP with the best link quality. *Id.*, [0044]. AP422 is the only AP that sends a probe response (red) to the client device. *Id.*

X. SPECIFIC GROUNDS FOR PETITION

A. Ground I: Claims 1-21 Are Rendered Obvious by Liu

1. Independent Claim 1

- a. **Preamble: “A gateway router configured to facilitate wireless connection management in an extended wireless network, comprising:”**

60. In my opinion, Liu discloses the preamble or renders it obvious. Liu Figure 1 illustrates a wireless mesh network (claimed extended wireless network) comprising a gateway router (green) and mesh access points (MAPs)/relay nodes, a few of which are highlighted in blue. Ex.1005, [0006] (“Wireless municipal mesh (muni-mesh) networks are emerging as a promising solution for last-mile broadband Internet access...The upper layer (also referred to as relay layer) includes *mesh access points* (MAPs) [(blue)]. The MAPs are interconnected via wireless links to form a *multi-hop backhaul*, providing network access and data forwarding for the client stations (STAs) [(purple)]. Some of the MAPs connect to the wired Internet backbone [and] are referred to as *gateways* [(green)].”); *id.*, [0024] (explaining that MAPs also serve as “relay nodes (RNs)”).

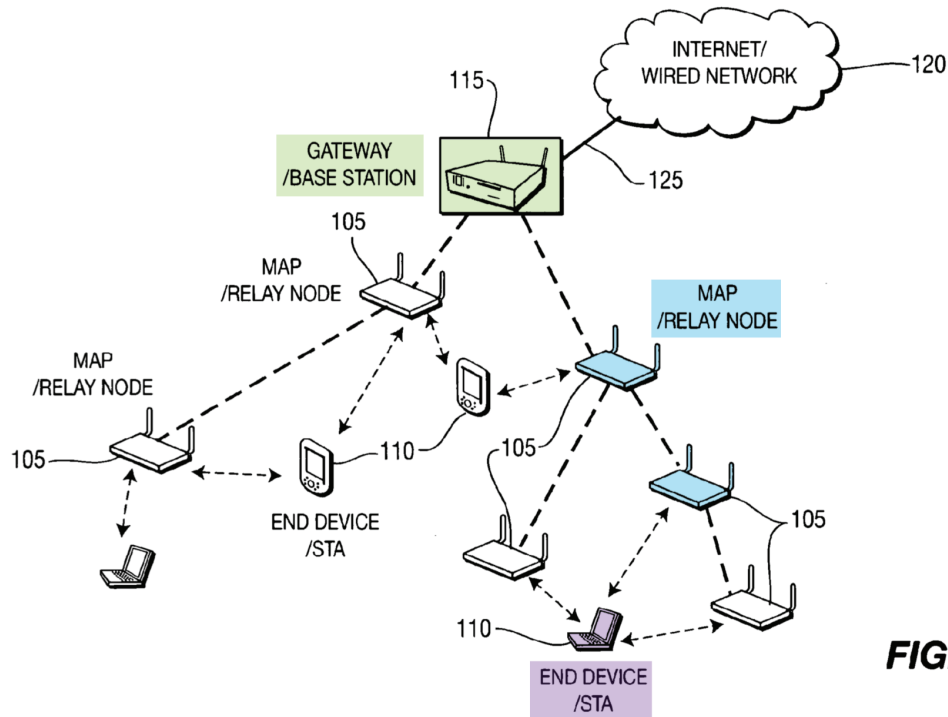


FIG. 1

Ex.1005, FIG. 1.

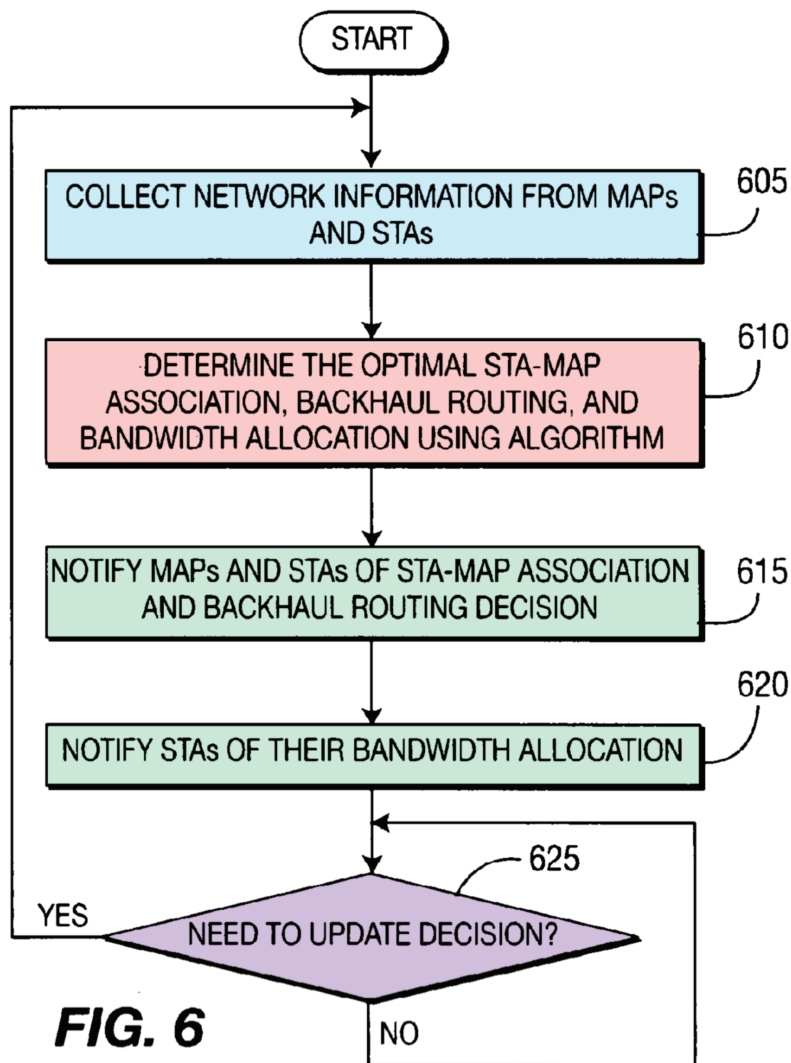
61. Liu’s wireless mesh network is an extended network consistent with the ’025 Patent because it has a gateway and one or more relay nodes. Ex.1001, 2:12-15 (“A network including both a gateway wireless access device and one or more extender wireless access devices [(relay nodes)] is referred to as an ‘extended network.’”).

62. Liu’s gateway (green) facilitates wireless connection management because a central controller in the gateway determines the best MAP (serving MAP) to associate with an STA, taking into consideration the backhaul path that provides end-to-end connection to the gateway (“optimal STA-MAP association”):

FIG. 6 is a flowchart of an exemplary embodiment of the method of the present invention for a *centralized controller* using a distributed MAC protocol. The *gateway* collects network information from the MAPs and STAs at 605 [(blue)]. The *gateway* then determines at 610 [(red)] the *optimal STA-MAP association backhaul routing* and *bandwidth allocation* using the method of the present invention. The method can either achieve maximum throughput rate allocation [] or max-min rate allocation [...]... At 615 the *gateway* then notifies the MAPs and STAs of the MAP-STA association and backhaul routing *that the gateway has determined* [(green)]. The *gateway* also notifies the STAs (via their associated MAPs) of their bandwidth allocation at 620 [(green)].

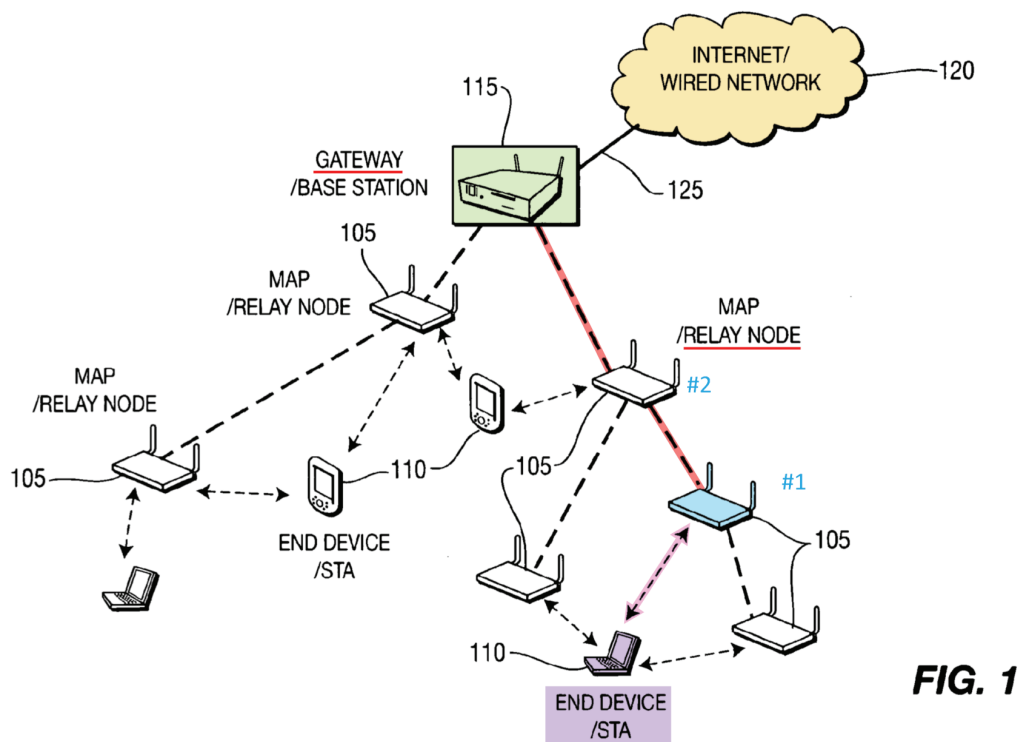
Ex.1005, [0059]; *id.*, [0056] (“the central controller [is] resident in the gateway”).

Figure 6 below is discussed in detail in Sections X.A.1(d)-(g).



Ex.1005, FIG. 6.

63. To illustrate Liu’s teachings, in Figure 1, the controller in Liu’s gateway (green) may determine that the “optimal STA-MAP association” for the STA highlighted in purple is to connect/associate with MAP#1 (blue), and that the optimal backhaul path to the gateway is the 2-hop path highlighted in red through MAP/RELAY NODE #2.



Ex.1005, FIG. 1.

- b. **Element [1.1]: “a network device input connected at least indirectly to an internal network and configured to communicate a plurality of data packets to and from at least one computer system”**

64. In my opinion, Liu discloses this element or renders it obvious. As shown in Figure 9, “[t]he gateway has a *radio interface 905* [(blue)] to communicate with the MAPs directly and with the STAs via their associated MAPs.” Ex.1005, [0062]. The gateway’s radio interface is the claimed network device input.

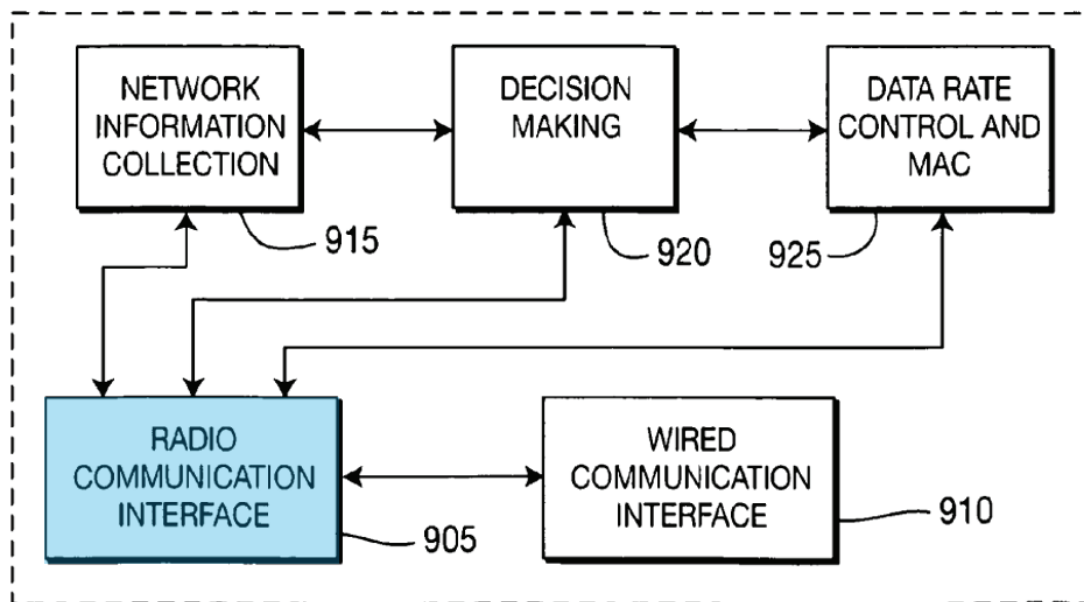


FIG. 9

Ex.1005, FIG. 9.

65. As shown in Figure 1, the gateway's radio interface (claimed network device input) is connected to a multi-hop network of MAPs (blue) (claimed internal network) and communicates data packets to/from STAs (purple), each of which is a claimed "at least one computer system", via their associated MAPs. *Id.*, [0006] ("The MAPs are interconnected via wireless links to form a **multi-hop backhaul** providing network access and data forwarding for the client stations (STAs)."), [0024] ("The STAs [] send (or receive) **packets** to (or from) their associated MAPs 105."), [0025] ("In the network, only STAs generate data/traffic. MAPs relay **packets** between the STAs and the gateway(s).").

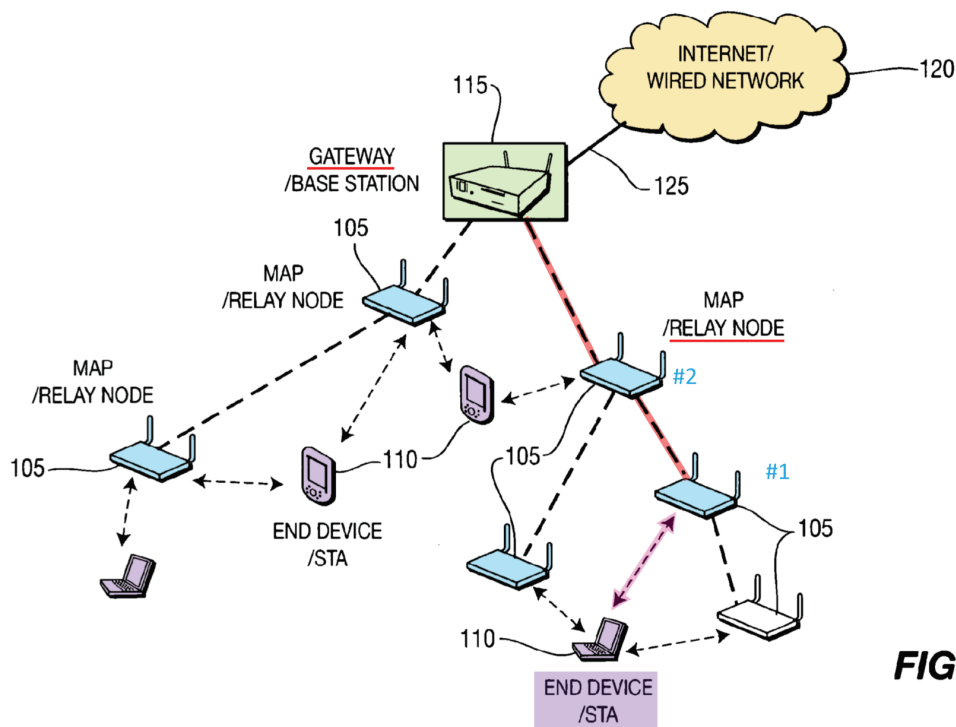


FIG. 1

Ex.1005, FIG. 1.

- c. **Element [1.2]: “a network device output connected at least indirectly to an external network and configured to communicate the plurality of data packets to and from at least one computer system; and”**

66. In my opinion, Liu discloses this element or renders it obvious. As shown in Figure 9, Liu’s gateway includes a “wired communication interface 910” (orange) (claimed network device output) connected at least indirectly to the Internet (claimed external network outside of the mesh network). Ex.1005, [0062] (“Radio interface 905 is also used to communicate *with the Internet* or any other wired [] network via *wired communication interface 910*.”).

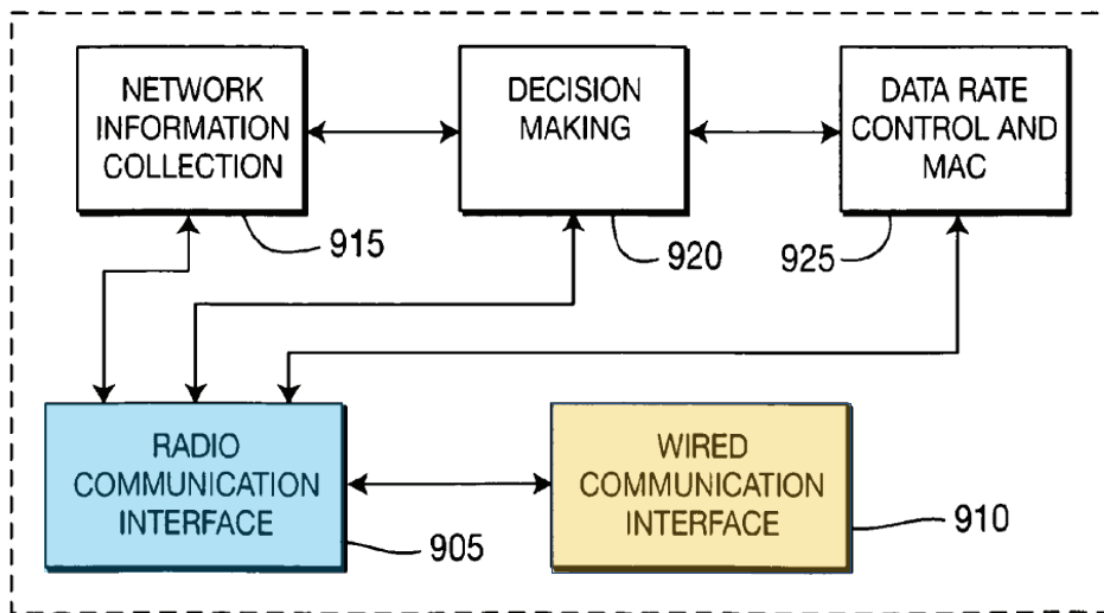


FIG. 9

Ex.1005, FIG. 9.

67. In my opinion a POSITA would understand and find obvious that the gateway's wired communication interface is configured to communicate data packets to/from servers on the Internet (claimed "at least one computer system.") (orange). *Id.*, [0025] ("It is expected that most of the traffic in an infrastructure multi-hop network will be traffic to/from the wired network or Internet."); [0006] ("A STA simply sends (or receives) packets to (or from) its associated MAP ... Packet delivery in the wireless backhaul is handled by the MAPs through backhaul routing."). This is because packetized protocols are used over the Internet.

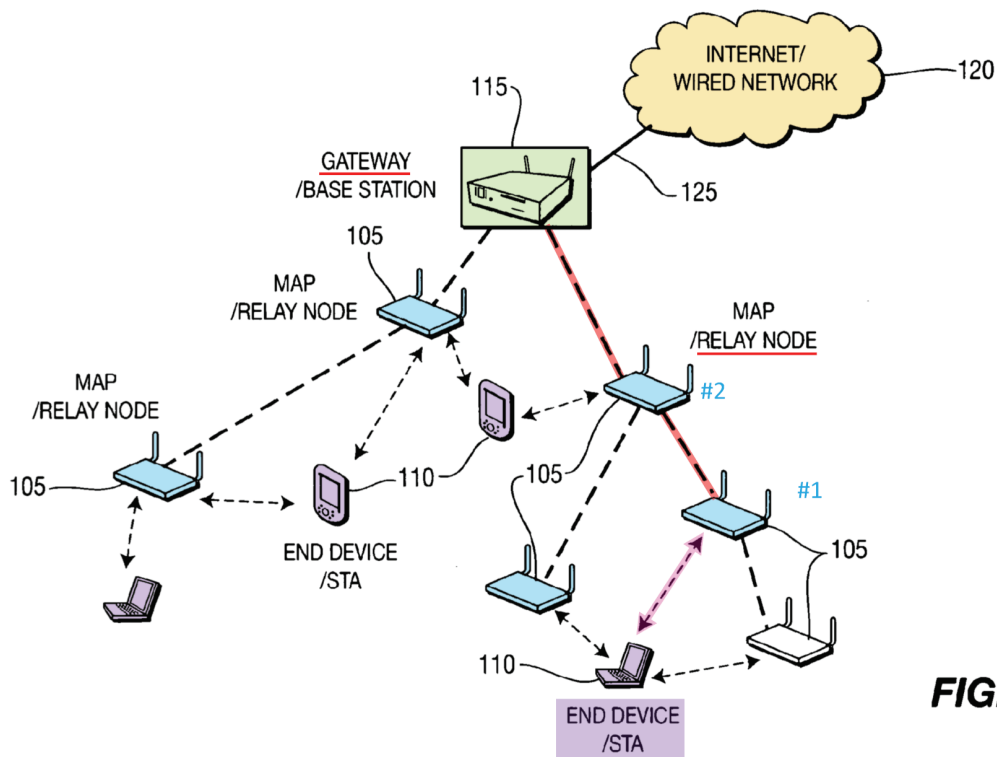


FIG. 1

Ex.1005, FIG. 1.

d. Element [1.3]: “a computer processor configured to execute steps, including”

68. In my opinion, Liu discloses or renders obvious this element. Liu’s gateway includes a centralized controller (claimed computer processor) configured to execute the steps illustrated in Figure 6. Ex.1005, [0059] (“FIG. 6 is a flowchart of an exemplary embodiment of the method of the present invention for a centralized controller ...”); *id.*, [0056] (“the central controller [is] resident in the gateway”). In my opinion, a POSITA would understand and find obvious that the centralized controller is a computer processor.

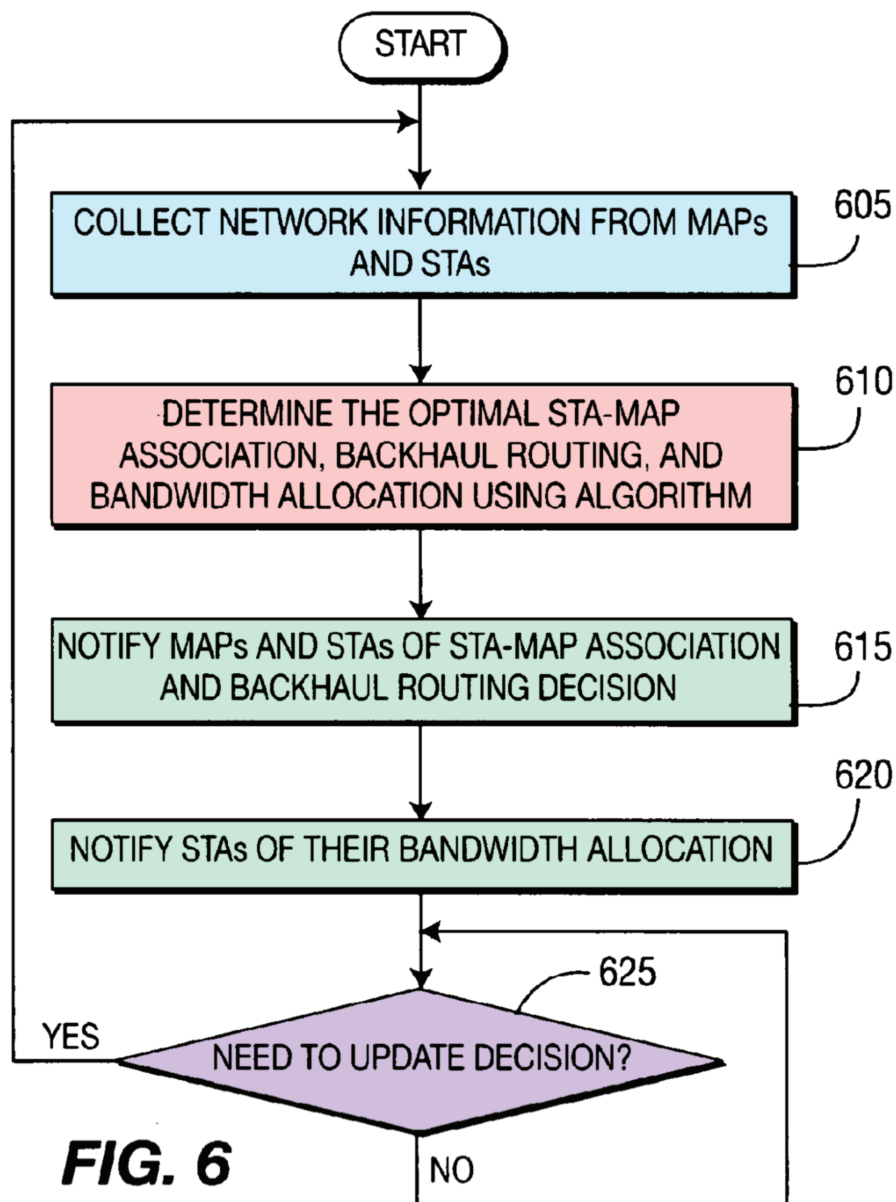


FIG. 6

Ex.1005, FIG. 6.

69. As shown in Figure 9, the computer processor (centralized controller) (magenta) in Liu's gateway includes decision making module 920 (red) and information collection module 915 (purple), implemented using processors and software. Ex.1005, [0062]; *see also id.*, [0065] ("[T]he present invention may be

implemented in various forms of hardware (e.g. ASIC chip), software, firmware, special purpose processors, or a combination thereof ... Preferably, the present invention is implemented as a combination of hardware and software.”).

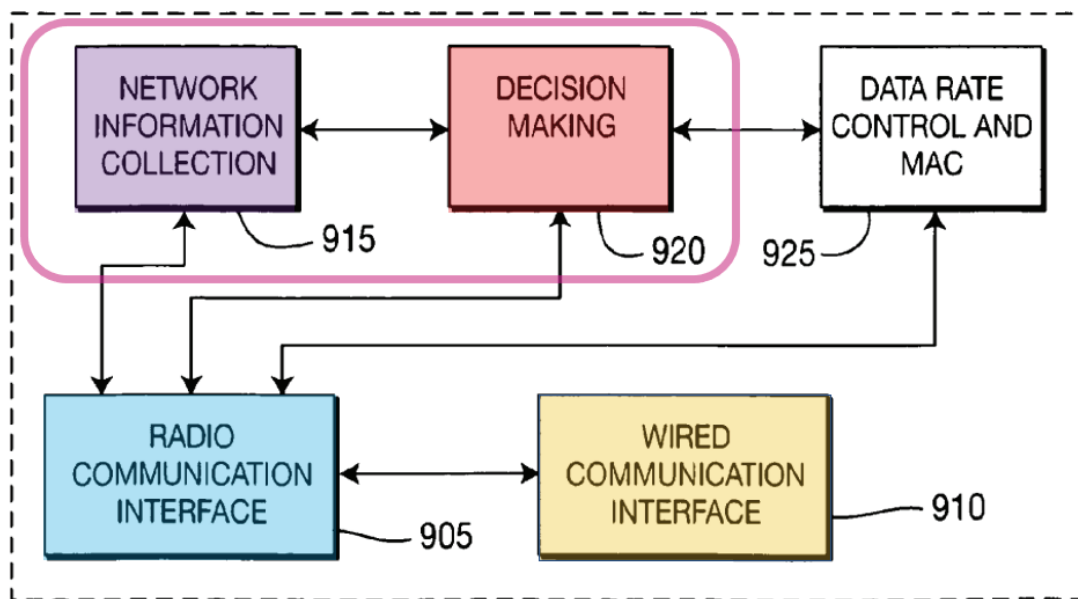


FIG. 9

Ex.1005, FIG. 9.

e. Element [1.4]: “receiving packets from a wireless device,”

70. In my opinion, Liu discloses or renders obvious this element. The gateway’s controller (computer processor) receives packets from user devices/STAs (claimed wireless device(s)), including packets carrying link quality and channel condition information. Ex.1005 [0062] (“[N]etwork information collection module 915 ... store[s] the link quality and channel condition information from the MAPs and STAs that the gateway *receives from the MAPs and STAs.*”), [0025] (“*STAs*

generate data/traffic [and] MAPs relay *packets* between the STAs and the gateway(s).”).

71. Liu’s wireless mesh network is a Wi-Fi network, and in my opinion a POSITA would have understood that link quality and channel condition information in a Wi-Fi network are carried in management frames/packets (*e.g.*, probe request/response frames) in compliance with the Wi-Fi standards. Ex.1005, [0044]-[0045]; Ex.1008 (802.11k-2008), Tables 7-14 and 7-15 at 10-11 (Probe Request /Response frames/packets), 109 (“STAs receiving Probe Request frames shall respond with a probe response ... [T]he STA shall include in the Probe Response [frame/packet] an RCPI element containing the measured RCPI value [(exemplary link quality information)] of the received Probe Request frame.”).

72. This is also consistent with the ’025 Patent which recognizes that management frames are packets. Ex.1001, 8:21-23 (“Establishing a wireless connection [involves] the exchange of *data packets* as is well known in the art.”).

f. Element [1.5]: “identifying the wireless device within a table of wireless devices connected to a wireless access device in an extended wireless network”

73. In my opinion, Liu renders obvious this element. Liu’s centralized controller “include[s] *one or more databases* ... to store the link quality and channel condition information [received] from MAPs and STAs” and used by the controller to identify the best MAP to associate with an STA (serving MAP). Ex.1005, [0062].

74. In my opinion, a POSITA would have understood and found obvious that Liu's network information databases use tables to store and retrieve the records of each STA, including the identity of the STA and the link quality and channel condition information that the STA measures and reports for every (nearby) MAP. Ex.1005, [0061] (“[T]he STA measures the link quality and channel conditions [and] reports (transmits/forwards) the measured link quality and channel conditions to the gateway[.]”).

75. Indeed, tables have long been commonly used in databases to store and retrieve (look up) relational data. Ex.1009, 649 (describing relational databases “in which data is stored in multiple tables, whose rows represent records, and whose columns represent fields”); Ex.1010, 510 (“The table is the underlying structure of a relation.”).

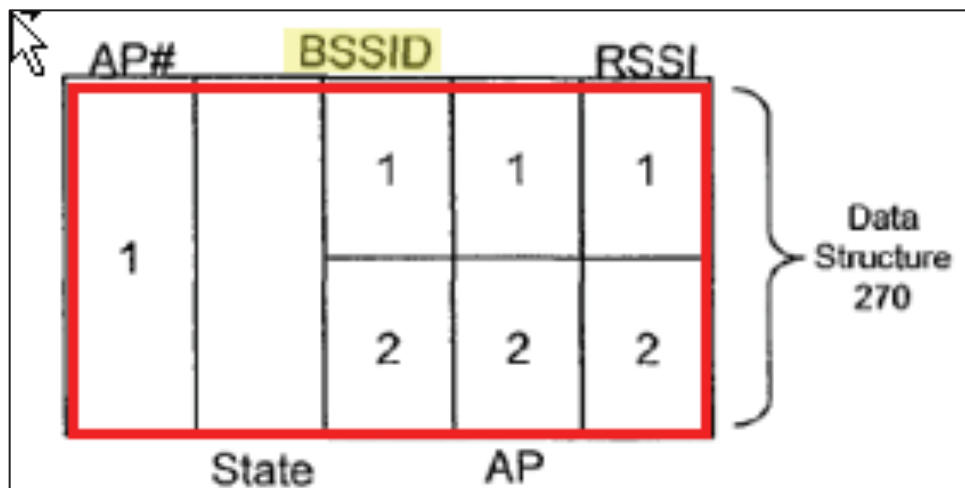
76. In my opinion, a POSITA would also have understood and found obvious that the record of each STA includes other important network information related to that STA, such as the identity of the serving MAP (claimed “wireless access device” connected to “the wireless device”) and the bandwidth that the controller allocates to the STA. Ex.1005, [0059] (“The gateway then determines at 610 the optimal STA-MAP association[,] backhaul routing and bandwidth allocation ... The gateway also notifies the STAs (via their associated MAPs) of their bandwidth allocation at 620.”).

77. For those reasons, it is my opinion that a POSITA would have understood and found obvious that Liu's network information databases include tables with data structures, e.g., where each row represents a record of an STA, and where the columns contain information *related* to that STA, such as (1) the identity of the STA, (2) the identity of the serving MAP, (3) the link quality and channel conditions measured and reported by the STA, and (4) the bandwidth allocated to the STA by the controller.

78. Further, in my opinion, a POSITA would have had a reasonable expectation of success using tables to store STA-related information in Liu's databases as tables have long been commonly used to store and retrieve (look up) relational data, as described in Bharghavan.¹ *Id.*; Ex.1009, 649; Ex.1010, 510; Ex.1007 (Barghavan), 7:1-8 ("Each AP maintains a data structure such as a data structure 270. The data structure 270 [(table)] preferably includes a set of entries, each entry [(row)] preferably including an AP identifier, [] a set of identifiers for wireless devices (here shown as BSSIDs), a value that identifies the AP currently actively communicating with each wireless device, and at least one value that

¹ Thus, it is my opinion that Liu in view of Bharghavan (Liu-Bharghavan) also renders obvious this element, as set forth under Ground IV. *See* Section X.D.

indicates a received signal strength indicator (RSSI) [] for that communication ...”),
id., 5:22-34.



Ex.1007, FIG. 2 (excerpted).

- g. **Element [1.6]: “generating wireless connection quality information for the wireless device specific to the wireless access device, the wireless connection quality information including wireless connection quality information for at least one indirect communication path having at least one network extender device to establish the communication path between the gateway router and the wireless access device.”**

79. In my opinion, Liu discloses or renders obvious this element. The centralized controller in Liu’s gateway determines the “**logical communication topology** including backhaul routing and STA-MAP association, and fair **bandwidth allocation** to each STA.” Ex.1005, [0052]- [0053]; *id.*, [0048] (“Association [of STAs and serving MAPs] and backhaul routing **define a logical topology** for communications in the network, i.e., indicating which links are actually used for

carrying traffic.”), [0008] (“[A]ll the nodes (MAPs and STAs) are organized into a logical topology for communications.”).

80. Because an STA is associate with at least one serving MAP, the logical communication topology (network topology) and bandwidth allocation of each STA described in Liu are examples of “wireless connection quality information for the wireless device [(STA)] specific to the wireless access device [(serving MAP)],” consistent with the ’025 patent. *See, e.g.*, Ex.1001, claim 6 (“wherein the wireless connection quality information includes at least one of a wireless signal strength, a **connection capability** [(e.g., bandwidth)], a utilization status, **a network topology**, and a connection path quality.”); *id.*, 11:26-28 (“The network topology may be generated based on exchanged messages communicated between the components of network 300.”); *id.*, 7:61-8:2 (“extended network [] may be configured to utilize [a] tree topology”).

81. The core of Liu’s logical network topology is the backhaul topology comprising indirect “multi-hop backhaul” communication paths between serving MAPs and the gateway, shown in Figure 1. Ex.1005, [0006] (“backhaul routing” through MAPs in the “backhaul topology”). As illustrated in Figure 1, Liu’s controller may select the indirect, two-hop backhaul communication path (red) through MAP/relay node #2 (claimed network extender) to carry traffic between serving MAP#1 and the gateway.

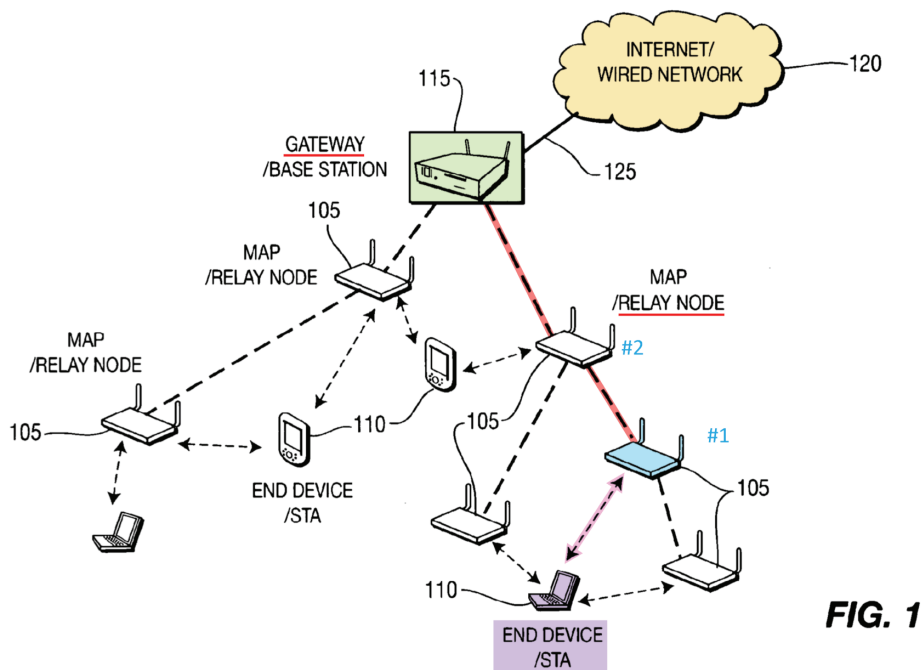


FIG. 1

Ex.1005, FIG. 1.

82. Liu’s backhaul topology is an example of the claimed “wireless connection quality information for at least one indirect communication path [(Liu’s multi-hop backhaul path)] having at least one network extender device [(MAP/relay node)] to establish the communication path between the gateway router and the wireless access device [(serving MAP)].”

83. As Liu teaches, the centralized controller resident in the gateway (gateway controller) generates additional wireless connection quality information for every direct or indirect communication path between a serving MAP and the gateway. *Id.* This is because, as Liu teaches, Liu’s gateway itself is a MAP and, like any other MAP, “mak[es] link quality and channel condition measurements” of the wireless links connected to it (including backhaul links) and

“forward[s]/transmit[s] the link quality and channel conditions to other MAPs.”

Ex.1005, [0063], [0006]. In Figure 1, the gateway measures/generates link quality and channel condition for at least the backhaul link between it and MAP #2, which is part of the multi-hop indirect communication path (red) between it and MAP#1.

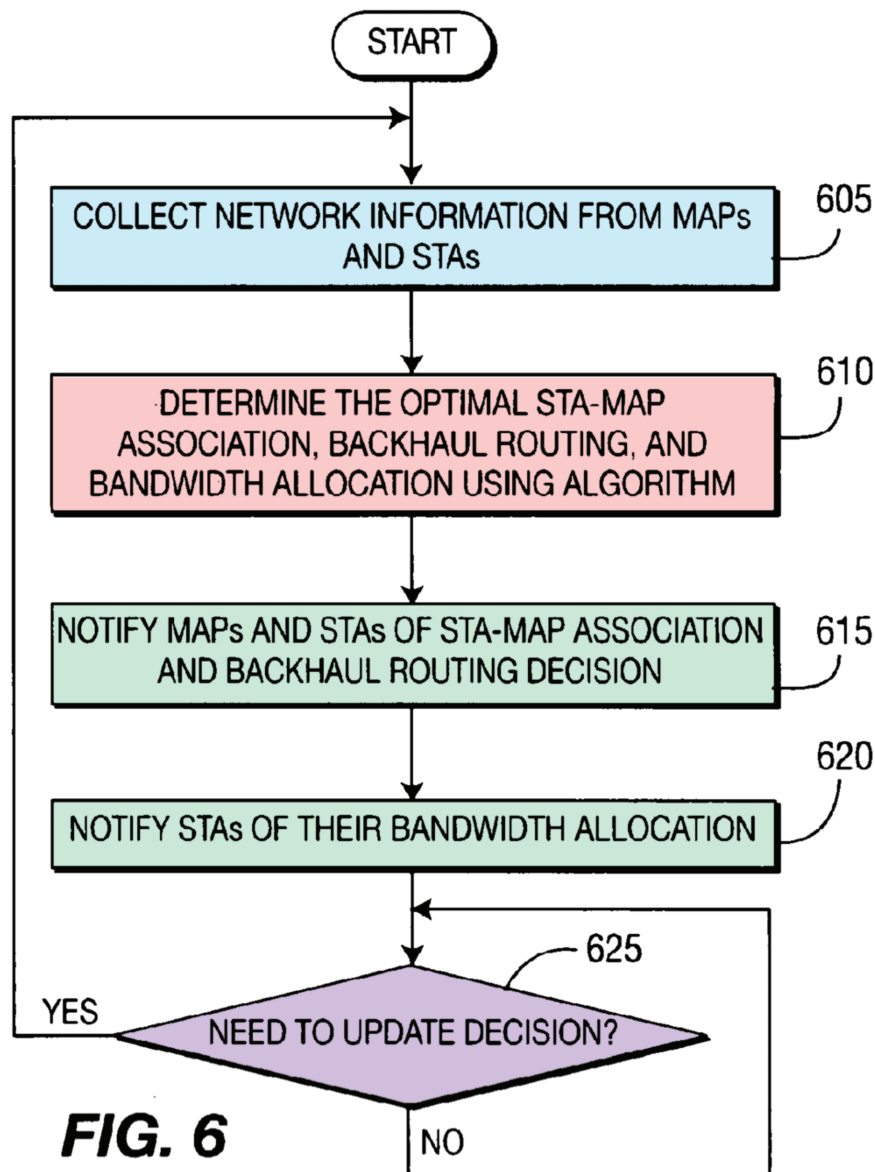
2. Dependent Claim 2

- a. **“The gateway router of claim 1, wherein the computer processor is further configured to transmit the wireless connection quality information to other wireless access devices in the extended network.”**

84. In my opinion, Liu discloses this element or renders it obvious. As discussed above regarding element [1.6], the centralized controller (computer processor) in Liu’s gateway determines wireless connection quality information such as the logical network topology (STA-MAP association and backhaul routing) and the bandwidth allocated to each STA. *See* Section X.A.1.g.

85. Liu further discloses that the gateway controller transmits the logical network topology and bandwidth information to other wireless access devices (MAPs) as shown at blocks 615 and 620 (green) in Figure 6 below. Ex.1005, [0059] (“At 615 the gateway [controller] notifies the MAPs and STAs of the MAP-STA association and backhaul routing [(topology)] that the gateway [controller] has determined. The gateway also notifies the STAs (via their associated MAPs) of their bandwidth allocation at 620.”). The logical network topology and bandwidth

information are exemplary wireless connection quality information as I discussed above.



Ex.1005, FIG. 6.

86. In addition, Liu teaches that the gateway is a MAP and, like any other MAP, it “mak[es] link quality and channel condition measurements” of the wireless

links connected to it (including backhaul links) and “forward[s]/transmit[s] the link quality and channel conditions to other MAPs.” Ex.1005, [0063], [0006].

3. Dependent Claim 3

- a. **“The gateway router of claim 1, wherein the computer processor is further configured to receive wireless connection quality information from a plurality of other network devices and to identify network device in the extended network providing the highest quality wireless connection for the wireless device.”**

87. In my opinion, Liu discloses or renders obvious this element. As shown at block 605 (blue) in Figure 6, Liu’s gateway controller/processor collects/receives network information from other MAPs in the network. Ex.1005, [0059] (“The gateway [controller] collects network information from the MAPs and STAs at 605.”).

88. The network information collected from other MAPs includes “link quality and channel conditions” (wireless connection quality information) measured by the MAPs. *Id.*, [0060] (“[T]he MAP measures the link quality and channel conditions. The MAP reports (transmits/forwards) the measured link quality and channel conditions to the gateway [controller][.]”).

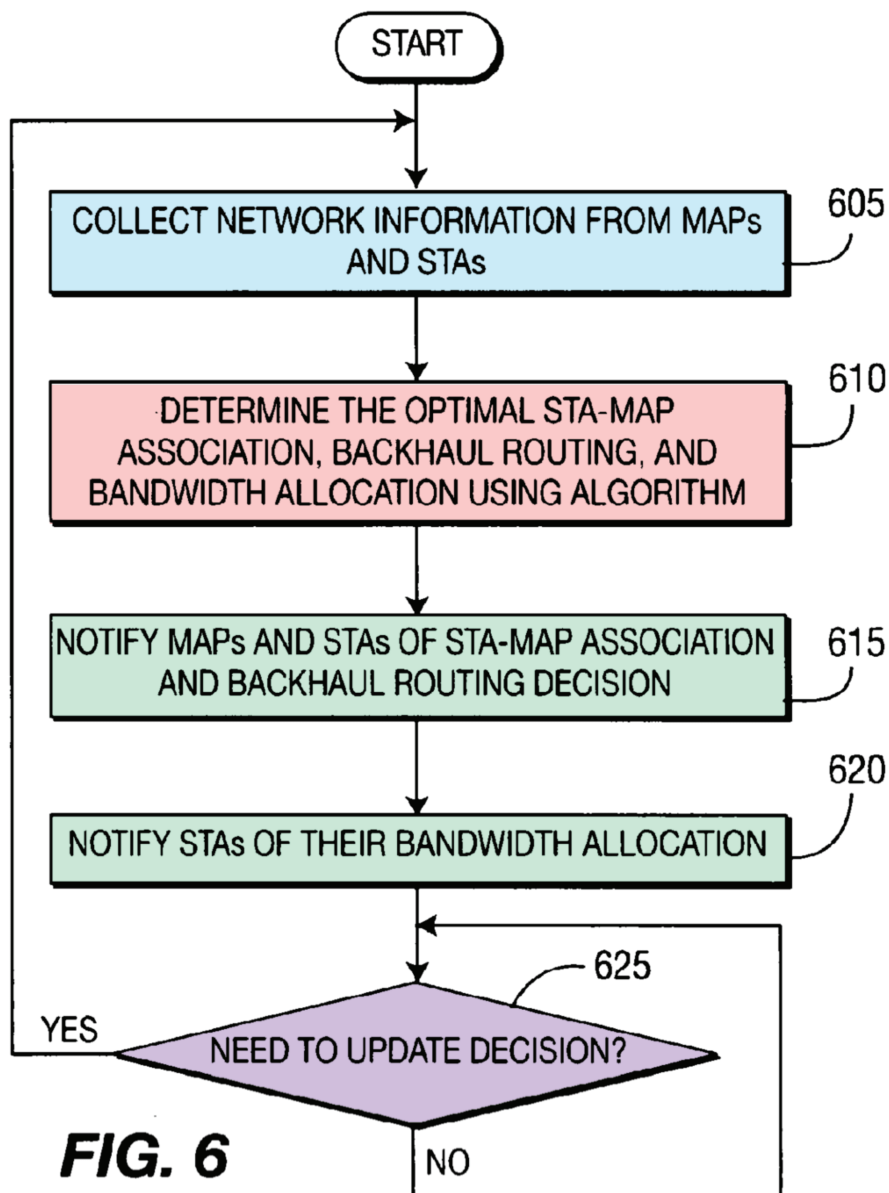


FIG. 6

Ex.1005, FIG. 6.

89. Liu's controller/processor uses the collected network information (wireless connection quality information) to determine the serving MAP (claimed wireless access device) that provides "the optimal STA-MAP association", as shown at block 610 (red) in Figure 6. *Id.*, [0059] ("The gateway [controller] determines at

610 *the optimal STA-MAP association*[,] backhaul routing and bandwidth allocation [to each STA] using the method of the present invention [which] ... can either achieve *maximum throughput rate allocation* ... or *min-max rate allocation* [(allocation based on fairness)][.]), [0053]-[0054].

90. As I discuss below regarding the preamble of claim 7, a MAP is selected by the gateway to associate with an STA so as to achieve “maximum throughput rate allocation” and thus it provides the highest quality wireless connection for the STA, as claimed. *See* Section X.A.7.(a).

91. In my opinion, each of Liu’s optimization algorithms provides the “highest quality wireless connection” for the wireless device (STA) when it is the only STA accessing the network, or when the total bandwidth demand of the STAs is less than what the network can provide.

92. Even when the total demand is high resulting in the need for a fair throughput allocation, Liu’s algorithms still provide the “highest quality wireless connection” because, as the patent explains, the term “highest quality wireless connection” is subjective, may be subject to certain constraints, and “may vary dependent upon the *intended use* of the wireless connection.” Ex.1001, 13:58-61.

93. For example, Liu’s Maximum Throughput Rate Allocation (MTRA) maximizes the total throughput in equation (1) but is subject to a long list of constraints in equations (2)-(10). As another example, since fairness is an important

consideration in Liu's network, maximizing throughput subject to fairness constraints as Liu teaches achieves the "highest quality wireless connection" achieved by applying the algorithm of equations (11)-(15).

4. Dependent Claim 4

- a. **"The gateway router of claim 3, wherein the processor is farther configured to initiate a wireless connection between the network device having the highest wireless connection quality and the wireless device."**

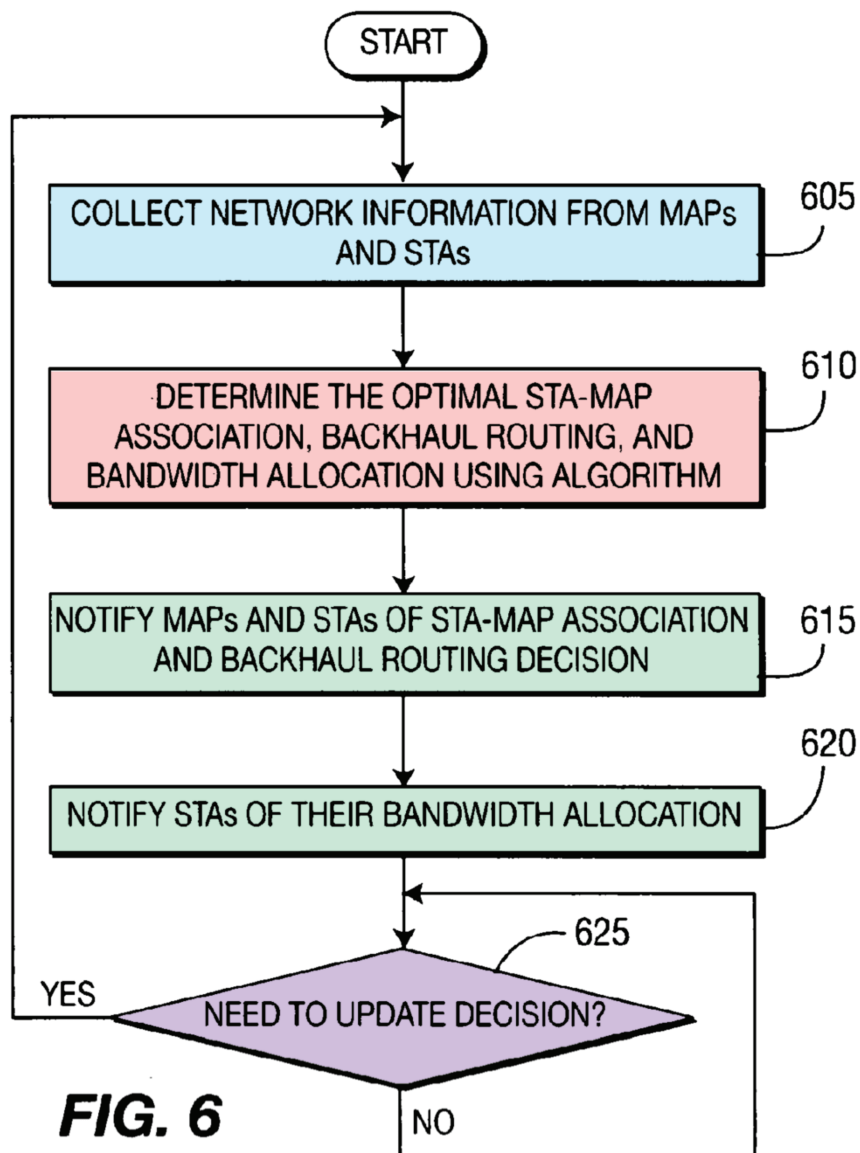
94. In my opinion, Liu discloses or renders obvious this element. Liu's gateway initiates a wireless connection between a serving MAP (network device)—which has the highest wireless connection quality as discussed in Section X.A.3—and an STA (wireless device) when it "notifies the MAPs and STAs of the MAP-STA association and backhaul routing that the gateway has determined." Ex.1005, [0053]-[0054]. Indeed, when the STA "receives the association instructions from the gateway[,]" it "establish[es] those connections via messages exchanged between itself and its associated MAPs." *Id.*, [0064].

5. Dependent Claim 5

- a. **"The gateway router of claim 4, wherein the processor is further configured to initiate the wireless connection with the network device having the highest wireless connection quality based on a connection check between the network device and the wireless device."**

95. In my opinion, Liu discloses or renders obvious this element. Liu's gateway controller periodically checks the link quality of the STA-MAP access link

(claimed “connection check between the network device [(MAP)] and the wireless device [(STA)]”) in its decision to associate a MAP—having the highest wireless connection quality as discussed in Section X.A.3—with an STA (“to initiate the wireless connection”), as shown in block 625 (purple) in Figure 6. Ex.1005, [0053] (“each MAP and STA *periodically* conducts local measurements and estimations of the necessary information such as its *link data rate and channel conditions*. The collected information is reported to the gateway, which executes the method of the present invention to determine the optimal STA-MAP association, backhaul routing, and bandwidth allocation to each STA[.]”), [0054], [0059] (“The gateway [controller] then performs a test at 625 to determine if it receives *new information* from the MAPs and the STAs and needs to *update any decision* it has made based on receiving new information from the MAPs and the STAs.”), [0007], [0061], [0064].



Ex.1005, FIG. 6.

96. Liu's periodic check of STA-MAP (and backhaul) link quality is consistent with the connection check discussed in the '025 patent specification.

Ex.1001, 7:24-31, 14:1-6.

6. Dependent Claim 6

- a. "The gateway router of claim 1, wherein the wireless connection quality information includes at least one of

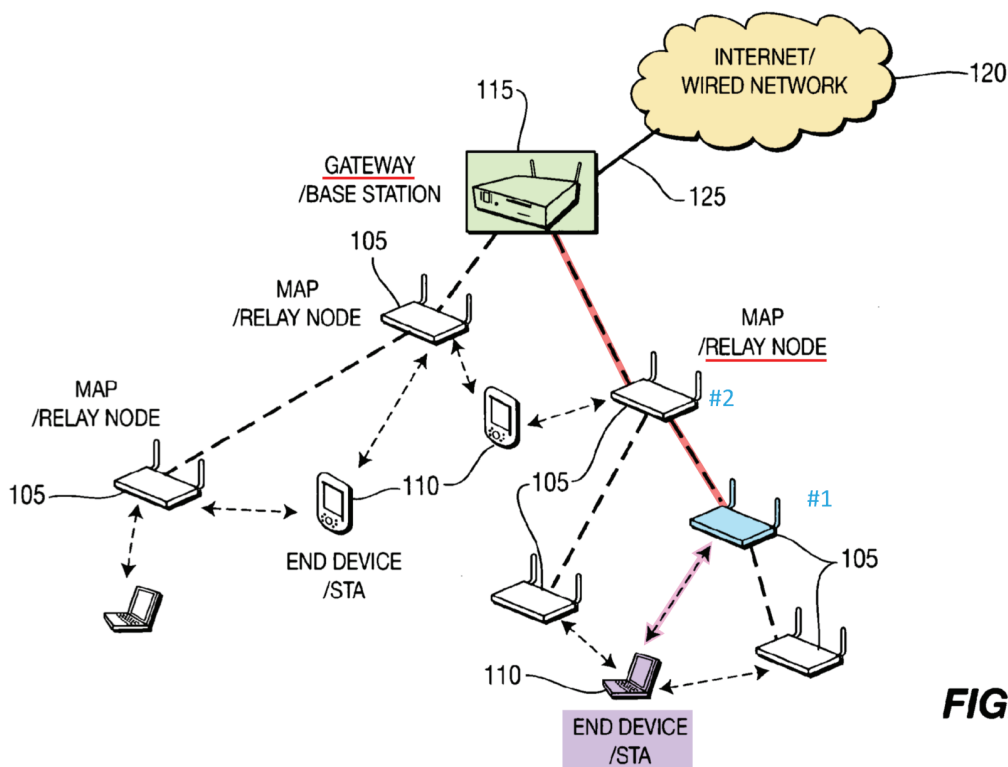
a wireless signal strength, a connection capability, a utilization status, a network topology, and a connection patch quality.”

97. In my opinion, Liu discloses this claim element. As discussed above regarding element [1.6], Liu’s gateway controller/processor determines wireless connection quality information such as the logical network topology (STA-MAP association and backhaul routing) (claimed network topology), the bandwidth allocated to each STA (claimed connection capability), as well as link quality and channel conditions of the gateway’s access and backhaul links (claimed connection path quality). Ex.1005, [0048], [0052]-[0053], [0063], FIG. 6; *See* Section X.A.1.g.

7. Independent Claim 7

a. Preamble: “An extended network configured to implement an extended management function to identify a wireless access device providing a highest quality wireless connection to a wireless device, comprising:”

98. In my opinion, Liu discloses the preamble or renders it obvious. As discussed above regarding the preamble of claim 1 and as shown in Figure 1, Liu discloses a “[w]ireless municipal mesh (muni-mesh) network” (claimed extended network). *See* Section X.A.1(a).



Ex.1005, FIG. 1.

99. Consistent with the '025 Patent, Liu's network implements an extended management function in which network devices contribute to the process of identifying the best wireless access device (serving MAP) to connect to an STA (wireless device) across an extended mesh network. Ex.1005, [0059] ("The gateway collects network information from the MAPs and STAs at 605. The gateway then determines at 610 the optimal STA-MAP association[,] backhaul routing and bandwidth allocation [to each STA] using the method of the present invention."), [0060]-[0061]; Ex.1001, 3:58-66.

100. **Claimed "highest quality wireless connection"** - As Liu teaches, the process of identifying MAPs to associate with STAs yields "optimal STA-MAP

association” and “achieve[s] ***maximum throughput rate allocation*** [(MTRA)]... or ***max-min rate allocation*** [(MMRA)] ...”. Ex.1005, *see also id.*, [0034], [0036]. In my opinion, each rate allocation method described in Liu determines “the highest quality wireless connection” under Patent Owner’s claim construction position that “the highest quality wireless connection is calculated by the system based on ‘certain objective criteria’ ...” because the rate allocated to each STA is calculated based on an objective criterion (such as maximizing throughput taking fairness into account). Ex.1015, 23.

101. With respect to MTRA, Liu explains that its objective is “to maximize the network throughput,” which is the total throughput of all STAs of the network. *Id.*, [0036], [0033]-[0035]. Because MTRA maximizes throughput without taking fairness into account, “***some STAs are allocated very high rates*** ...” *Id.*, [0036]. Thus, under MTRA, Liu’s method identifies serving MAPs providing a highest quality wireless connection (“very high rates”) to at least some STAs, which in my opinion is sufficient to satisfy the claim, consistent with Patent Owner’s claim construction position that “the highest quality wireless connection is calculated by the system based on ‘certain objective criteria’ ...”. Ex.1015, 23.

102. MMRA is another optimization technique that seeks to maximize throughput under fairness constraint. Ex.1005, [0036]-[0038]. MMRA “maximize[s] the minimum rate allocated to the STAs[,]” and “maximize[s] the [network]

throughput” while guaranteeing a minimum rate to each STA. *Id.* As Liu explains, this strategy is more suitable to “wireless muni-mesh networks [where] it is important to *fairly allocate resources* among STAs because users generally pay the same flat rate to get Internet access service.” *Id.*

103. I am of the opinion that, given the importance of fairness in Liu’s muni-mesh networks, the rate provided to each STA under MMRA is a “highest quality” wireless connection. This is because the ’025 Patent explains that the term “highest quality” depends on the “intended use” and is not absolute. Ex.1001, 13:58-61 (“It is important to recognize that the highest quality connection may vary dependent upon the *intended use* of the wireless connection.”).

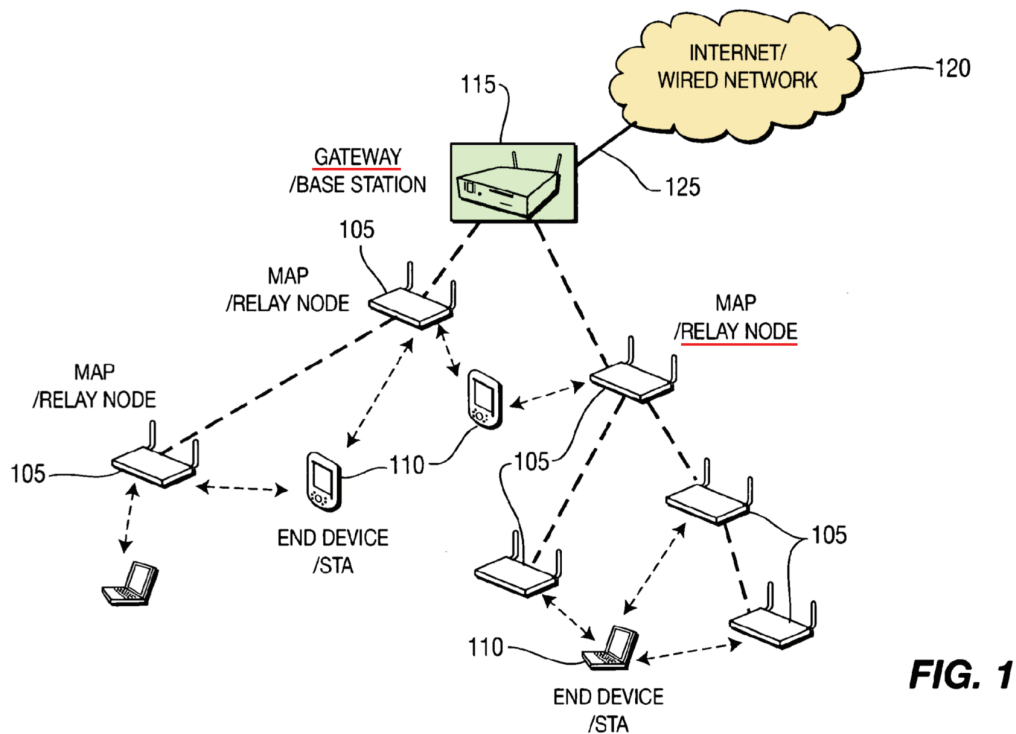
104. In Liu’s muni-mesh networks, throughput maximization that takes fairness into account is the intended use. Ex.1005, [0008] (“It is desirable that the total rate/bandwidth allocated to the STAs is *as large as possible* and the rate/bandwidth is allocated to each STA as *evenly as possible* in terms of fairness.”); *id.*, [0051] (“An objective is to improve the throughput *without sacrificing fairness*, i.e., maximizing the network throughput with guaranteed max-min rate allocation. ... The method described herein achieves long-term max-min fairness to all the STAs.”).

105. In any event, in my opinion, a POSITA would have understood that Liu’s methods (MTRA and MMRA) provide the highest quality wireless connection

(highest throughput/rate) to an STA when it is the only active STA in the network, or when the total throughput/rate demand from the STAs is relatively low compared to the network capacity.

b. Element [7.1]: “a gateway device configured to enable communication between the extended network and an external network;”

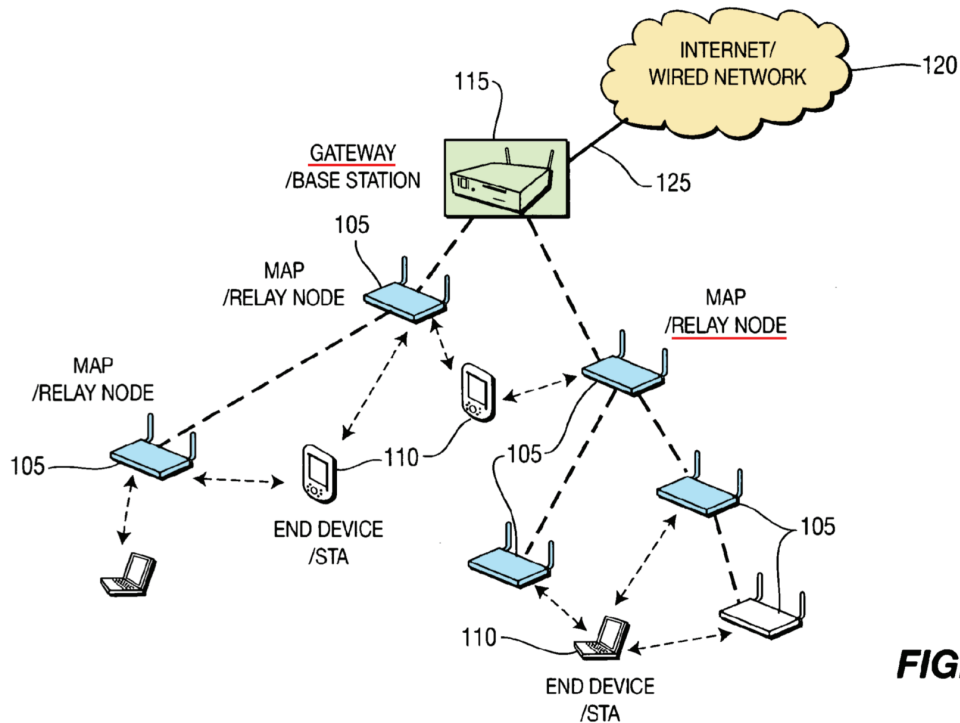
106. In my opinion, Liu discloses this claim element. Liu’s Figure 1 shows a gateway (green) that enables communication between Liu’s network system—*i.e.*, the “extended network”—and the internet/wired network 120—*i.e.*, “an external network” (orange)—through a wired Internet backhaul interface 125. Ex.1005 [0024]; *see also id.*, [0025] (“It is expected that most of the traffic in an infrastructure multi-hop network will be traffic to/from the wired network or Internet. ... MAPs relay packets between the STAs and the gateway(s).”).



Ex.1005, FIG. 1.

c. Element [7.2]: “at least two wireless access devices in the extended network; and”

107. In my opinion, Liu discloses this claim element. Liu’s wireless mesh network has multiple MAPs (wireless access devices) (blue). Ex.1005, [0006], [0024].



Ex.1005, FIG. 1.

d. Element [7.3]: “at least one wireless device having a wireless connection to at least one of the wireless access devices”

108. In my opinion, Liu discloses this claim element. Liu’s Figure 1 illustrates an STA (wireless device) (purple) having a wireless connection (magenta) to a serving MAP (wireless access device) (blue). Ex.1005, [0024] (“Clients/end devices/STAs 110 ... need to associate with one or more MAPs/RNs 105 to gain access to the network. The STAs ... send (or receive) packets to (or from) their associated MAPs[.]”).

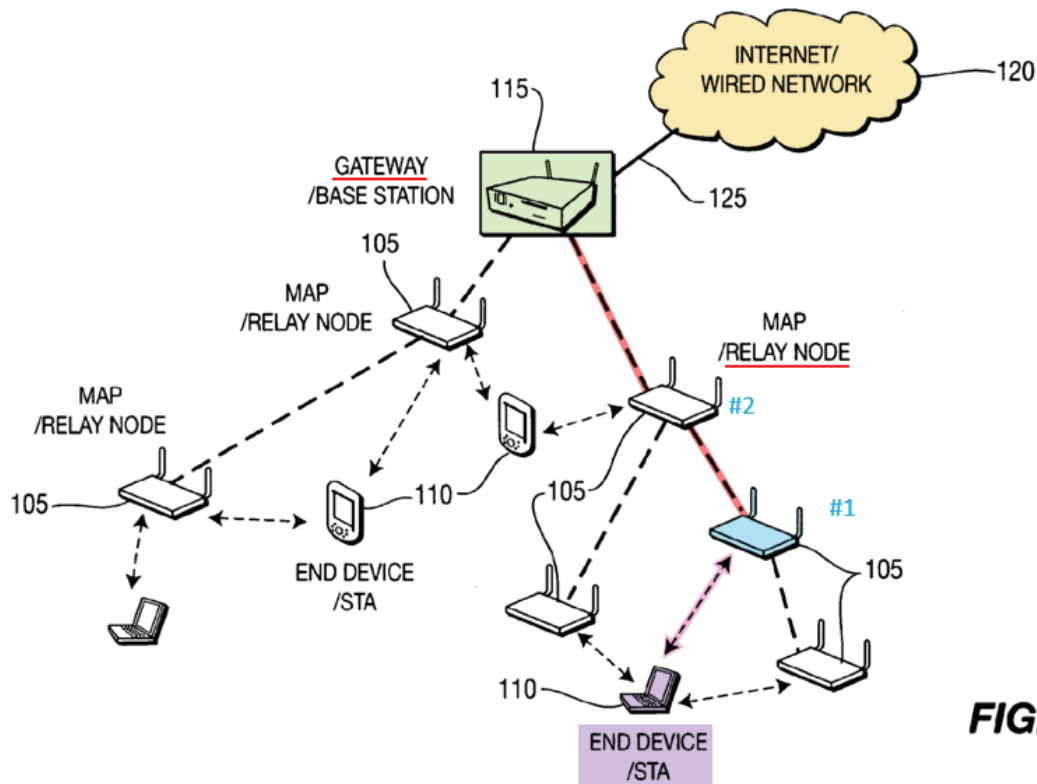


FIG. 1

Ex.1005, Fig. 1.

- e. Element [7.4]: “wherein the gateway device and the wireless access devices include a processor executing the extended management function to identify the wireless access device providing the highest quality wireless connection based on wireless connection quality information, the wireless connection quality information including wireless connection quality information for at least one indirect communication path having at least one network extender device to establish the communication path between the gateway device and the wireless access device, exchanged among the wireless access devices and the gateway device.”

109. In my opinion, Liu discloses or renders obvious this element.

110. **First**, Liu’s gateway and MAPs (wireless access devices) include processor(s), as required by the claim. As shown in Figure 9 and discussed above

regarding element [1.3], Liu's gateway has a controller (an example of the claimed processor) (magenta box) that includes decision making module 920 (red) and network information collection module 915 (purple). Section X.A.1.d.

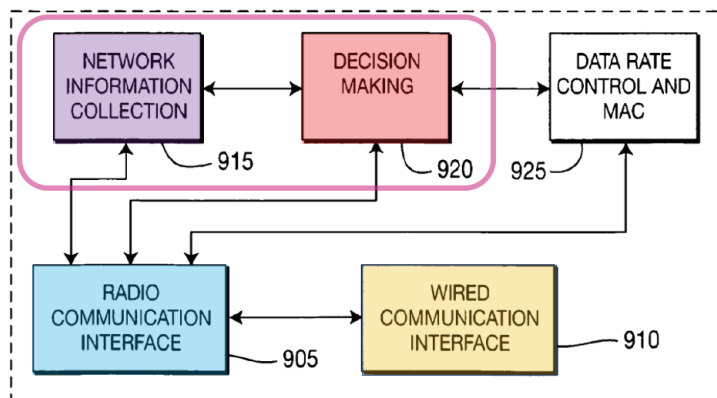


FIG. 9

Ex.1005, FIG. 9.

111. And, as shown in Figure 10, each MAP has a processor (magenta box) that includes at least the MAP's link measurement module 1025 (purple) ("LMM"). *Id.*, [0063], [0065] ("Preferably, the present invention is implemented as a combination of hardware [processor] and software.").

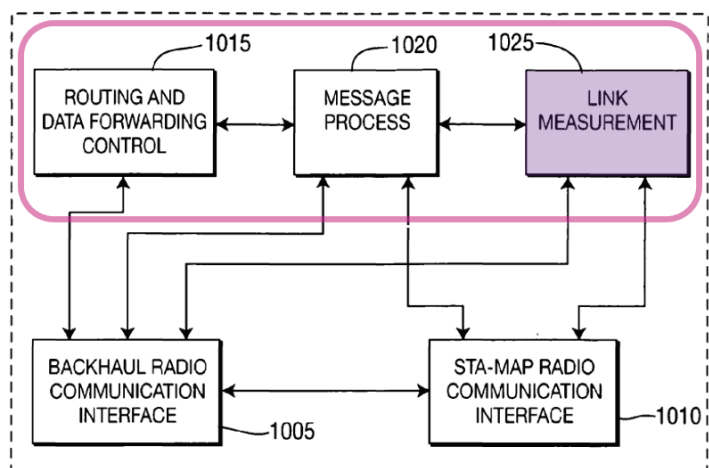
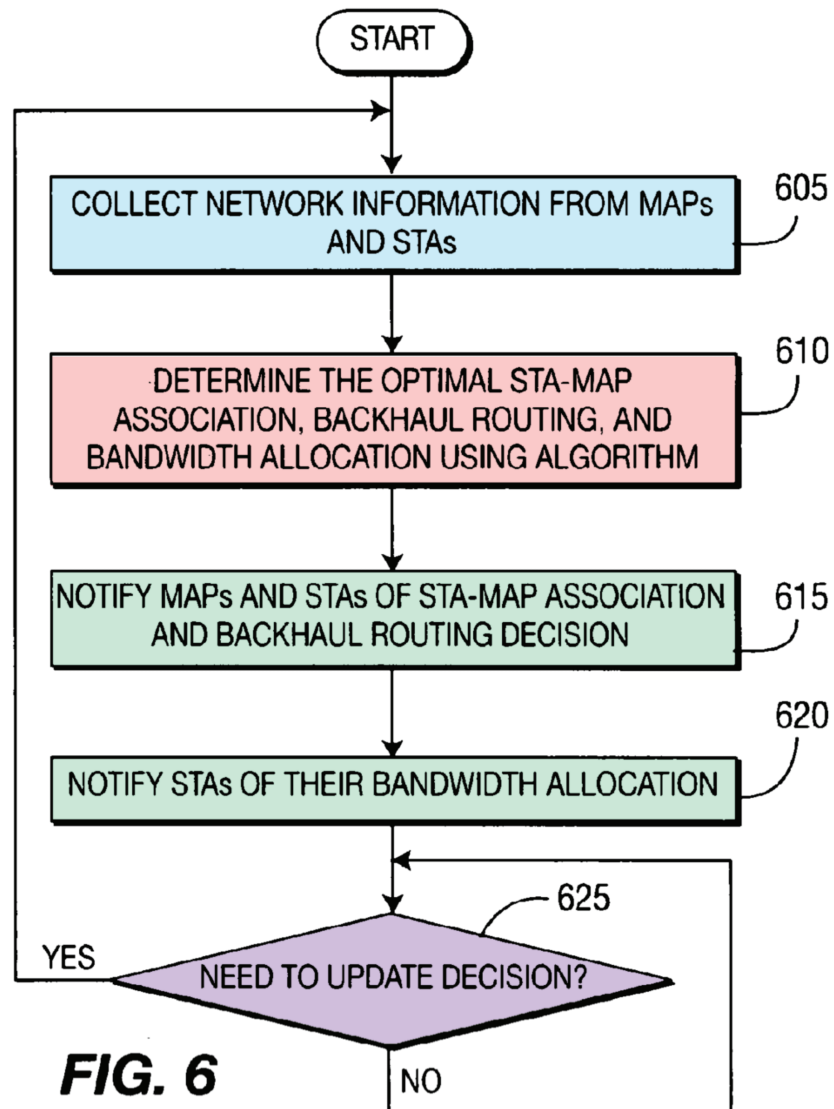


FIG. 10

Ex.1005, FIG. 10.

112. ***Second***, the processors in Liu’s gateway and MAPs cooperate (execute the extended management function) to identify the wireless access device (serving MAP) providing the highest quality wireless connection to an STA based on wireless connection quality information exchanged among the MAPs and the gateway—which satisfies Patent Owner’s interpretation of the “wherein” clause as set forth in its claim construction brief. Ex.1015, 19 (“the processors in different devices can ‘*contribute* to the process’ of identifying the highest quality wireless connection.”).² This is shown in the flowchart below.

² In my opinion, this mapping is also consistent with Netgear’s infringement theory, which I have reviewed. According to Netgear, the accused Deco products infringe claim 7 “[b]ecause the ‘Deco units ***work together*** to form one unified network,’ ... [and] exchange wireless connection quality information ...”. Ex.1012, 44, 46.



Ex.1005, FIG. 6.

113. The exchange of wireless connection quality information among the MAPs and gateway (which itself is a MAP)—more precisely, among their respective processors—occurs at block 605 (blue), where each MAP sends wireless connection quality information (*e.g.*, link quality and channel conditions) to the gateway and to other MAPs:

[A MAP's] link measurement module 1025 [(processor)], which receives and stores link quality measurement and channel condition information from the STAs with which this MAP is associated [with,]...***mak[es] link quality and channel condition measurements for this MAP*** [and]...communicates with backhaul radio communication interface module 1005 in order to ***forward/transmit the link quality and channel conditions to other MAPs*** [and]... ***to the gateway***.

Ex.1005, [0063], [0059] (“The gateway collects network information from the MAPs and STAs at 605.”); *id.*, [0006] (“Some of the MAPs [are] gateways.”). As Liu teaches, the gateway is a MAP that also collects network information and transmits it to other MAPs. Ex.1005, [0063].

114. Liu explains that, at block 610 (red), the gateway's controller/processor uses the collected network information (wireless connection quality information) to determine the serving MAP that provides “the optimal STA-MAP association,” the “backhaul routing” between the serving MAP and the gateway, and “bandwidth allocation.” *Id.*, [0059], [0053]-[0054]. As explained above regarding the preamble of Claim 7, this process identifies the serving MAP (wireless access device) that provides the highest quality wireless connection to an STA. Section X.A.7.a.

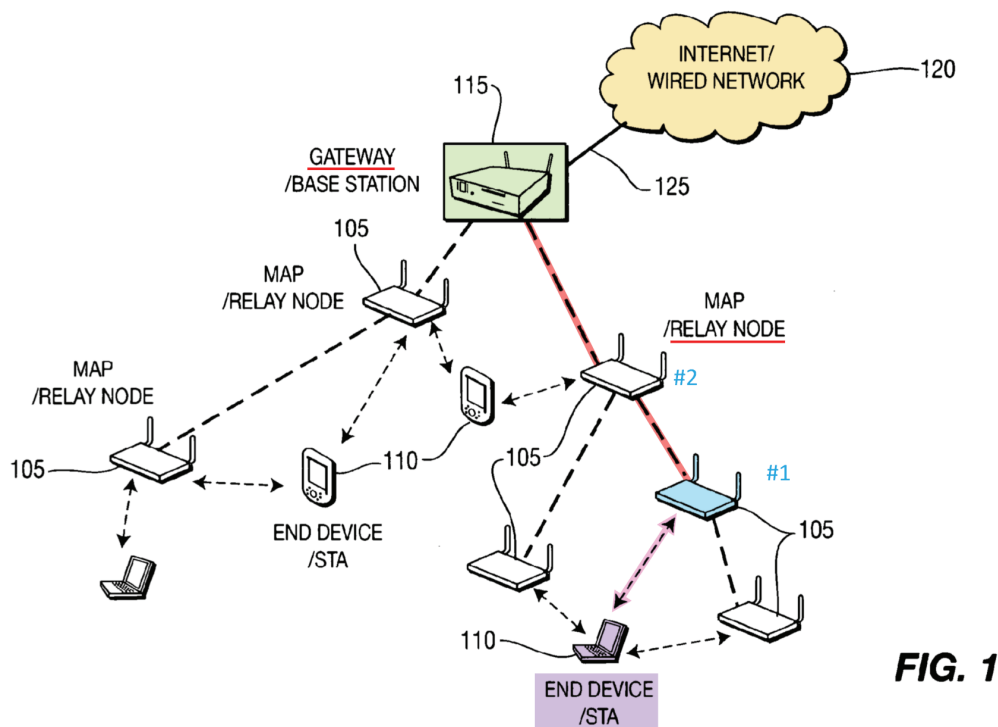
115. ***Third***, the wireless connection quality information exchanged among Liu's gateway and MAPs includes wireless connection quality information ***for at least one indirect communication path*** (Liu's multi-hop backhaul path) having at

least one network extender device (Liu's MAP/relay node) to establish the communication path between the gateway device and the wireless access device (serving MAP), as required by the claim.

116. Indeed, Liu teaches a multi-hop backhaul network. Ex.1005, [0006]-[0007] ("The MAPs are interconnected via wireless links to form a ***multi-hop backhaul***, providing network access and data forwarding for the client stations (STAs).").

117. Each multi-hop backhaul path is an indirect communication path passing through at least one MAP/relay node, and the link quality and channel condition of the backhaul path, measured by the MAPs/relay nodes on that path, are the claimed wireless connection quality information for at least one indirect communication path. Ex.1005, [0063] (each MAP processor/LMM "mak[es] link quality and channel condition measurements for this MAP.").

118. For example, in Figure 1, Liu's centralized controller may determine that MAP#1 is the serving MAP for the purple STA and that the best communication path between the gateway and MAP#1 is an indirect communication path ("multi-hop backhaul" path) (red) through MAP/relay node #2 (network extender).



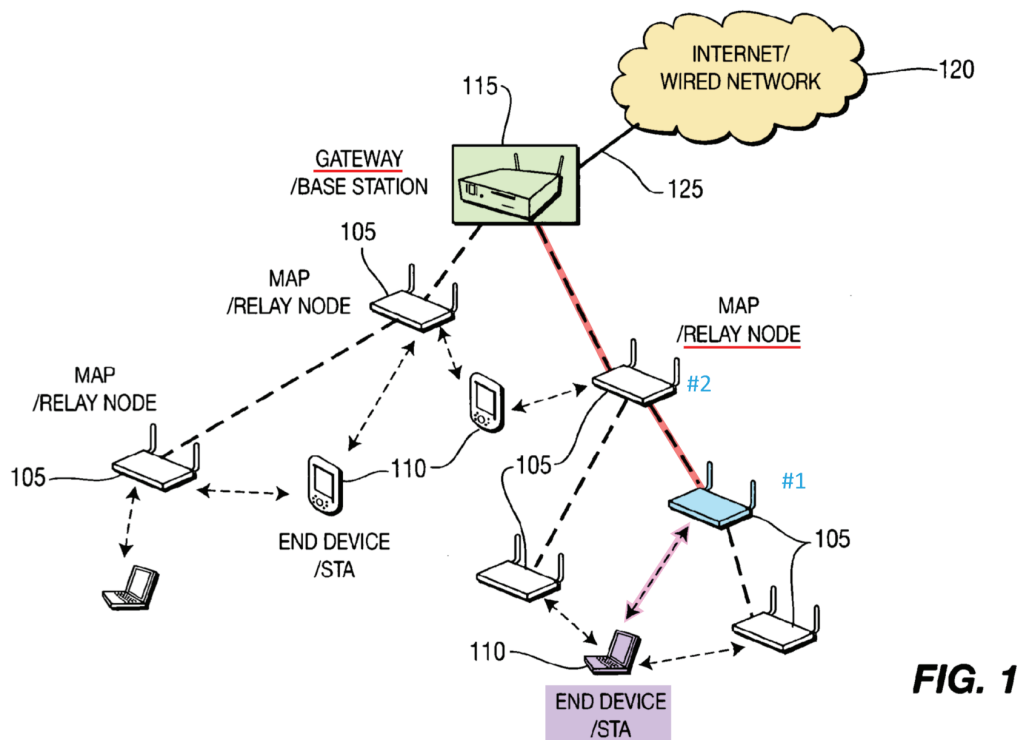
Ex.1005, Fig. 1.

119. Here, the link quality and channel conditions of the links that form this multi-hop path are wireless connection quality information of an indirect communication path that are measured by the MAPs on that path (MAP#1, MAP#2 and/or gateway) and exchanged among them. Ex.1005, [0063].

8. Dependent Claim 8

- a. “The extended network of claim 7, wherein the extended network is configured in a tree topology including the gateway device as a root, one or more wireless access devices as nodes in the tree, and a wireless device as a leaf.”

120. In my opinion, Liu renders obvious this element. Liu illustrates in Figure 1 a tree topology, which is a hierarchical structure in which its gateway is the “root,” the MAPs/relay nodes are the “nodes,” and each STA/end device is a “leaf”:



Ex.1005, FIG. 1; *id.*, [0006] (“Unlike flat ad hoc networks, a mesh network has a *hierarchical architecture*, as shown in FIG. 1.”).

9. Dependent Claim 9

- a. “The extended network of claim 7, wherein each wireless access device is configured to generate wireless connection quality information for received packets from the wireless device in consideration and to transmit the wireless connection quality information to one or more wireless access devices in the extended network.”

121. In my opinion, Liu renders obvious this element. Liu discloses that each MAP has a link measurement module that “mak[es] link quality and channel condition measurements for [that] MAP” (generate wireless connection quality information) and also “forward[s]/transmit[s] the link quality and channel conditions to other MAPs [and] ... to the gateway.”³ Ex.1005, [0063], [0060], [0056], [0053].

122. In my opinion, a POSITA would have understood (and found it obvious) that Liu’s MAPs can make link quality/channel conditions measurements on any of their wireless links, including on access links used for communication with STAs. Liu discloses that the MAPs forward or “transmit the wireless connection quality information to one or more wireless access devices in the extended network,” as claimed.

123. Indeed, Liu teaches that access and backhaul/relay interfaces are essentially the same type of interface. Ex.1005, [0024] (“One or more physical or logical radio interfaces [of a MAP] is an access interface. The other interfaces are relay interfaces.”).

10. Dependent Claim 10

- a. “The extended network of claim 7, wherein at least one wireless access device is configured to initiate a**

³ Liu’s gateway alone satisfies the claimed “to one or more wireless access devices” because it is a MAP. *Id.*, [0006].

connection between the wireless access device having the highest quality wireless connection for the wireless device and the wireless device.”

124. In my opinion, this element is substantively the same as the additional element of claim 4, except that it recites “at least one wireless access device” initiating an STA-serving MAP connection instead of the gateway’s processor initiating it. It is my opinion that Liu discloses the additional element of claim 8 for the same reason it discloses the additional element of claim 4 because Liu’s gateway is a wireless access device (MAP). Ex.1005, [0006]; *see* Section X.A.4.

11. Dependent Claim 11

- a. “The extended network of claim 10, wherein at least one wireless access device is further configured to initiate the connection to the wireless access device having the highest wireless connection quality based on a connection check between the at least one wireless access device and the wireless device.”**

125. In my opinion, this element is substantively the same as the additional element of claim 5, except that it recites “at least one wireless access device” instead of the gateway’s processor. It is my opinion that Liu discloses the additional element of claim 11 for the same reason it discloses the additional element of claim 5 because Liu’s gateway is a wireless access device. Ex.1005, [0006]; *see* Section X.A.5.

12. Dependent Claim 12

- a. “The extended network of claim 10, wherein the current wireless access device is further configured to check the connection quality for the wireless device on a periodic interval.”**

126. In my opinion, Liu discloses this element. As discussed above regarding claim 5, each MAP periodically checks the connection quality of its associated STA(s). Ex.1005, [0053] (“each MAP and STA *periodically* conducts local measurements and estimation of the necessary information such as its *link data rate and channel conditions*.”); *see* Section X.A.5.

13. Dependent Claim 13

- a. **“The extended network of claim 7, wherein the wireless connection quality includes at least one of a wireless signal strength, a noise level, a connection capability for a wireless device, a connection capability for a wireless access device, an extended network topology, a utilization status and a connection path quality.”**

127. This element is the same as the additional claim element of claim 6. In my opinion, for the reasons explained in Section X.A.6, Liu discloses this element.

14. Dependent Claim 14

- a. **“The connection quality of claim 13, wherein the connection path quality for a wireless device is the connection quality between the wireless device and the gateway device.”**

128. In my opinion, Liu discloses this element or renders it obvious. Liu teaches that every MAP (including the gateway) and STA in the network measures the link quality and channel conditions of its links—including links between the STA and the gateway. Ex.1005, [0060] (“[T]he MAP measures the link quality and channel conditions [and]...reports (transmits/forwards) the measured link quality and channel conditions to the gateway[.]”), [0006] (gateway is a MAP), [0061]

(“[T]he STA measures the link quality and channel conditions [and]... reports (transmits/forwards) the measured link quality and channel conditions to the gateway[.]”).

129. The gateway “collects [this] network information from the MAPs and STAs” and uses it to determine “the optimal STA-MAP association[,] backhaul routing[,] and bandwidth allocation ...”, *i.e.*, the end-to-end path between an STA and a gateway and associated connection quality. *Id.*, [0059], [0054]. The network information collected by the gateway is an example of the claimed “connection quality between the wireless device (STA) and the gateway device” because it contains the link quality/channel conditions of all STA-MAP, MAP-MAP and MAP-gateway links in the network.

15. Dependent Claim 15

- a. **“The extended network of claim 10, wherein a first wireless access device is further configured to initiate the connection between the wireless access device having the highest wireless connection quality and the wireless device based on a connection check between at least one wireless access device and the wireless device, wherein the wireless access device having the highest wireless connection quality may be the first wireless access device.”**

130. In my opinion, Liu discloses this element or renders it obvious, with the claimed “first wireless access device” mapped to Liu’s gateway. Ex.1005, [0006] (gateway is a MAP). Under this mapping, for the reasons explained in Sections

X.A.5 and X.A.11, Liu discloses “wherein a first wireless access device [(gateway)] is further configured to initiate the connection between the wireless access device [(serving MAP)] having the highest wireless connection quality and the wireless device [(STA)] based on a connection check between at least one wireless access device [(serving MAP and/or other MAPs)] and the wireless device [(STA)].”

131. The remainder of this element (“wherein the wireless access device [(serving MAP)] having the highest wireless connection quality *may be* the first wireless access device [(gateway)]”) does not impose any requirement on the wireless access device (serving MAP)—it may or *may not* be the same as the first wireless access device (gateway). Thus, in my opinion, it is met by Liu.

16. Independent Claim 16

- a. Preamble: “A computer implemented method for identifying a wireless access device providing a highest quality wireless connection to a wireless device, comprising:”**

132. In my opinion Liu discloses the preamble or renders it obvious for the reasons I explained in Section X.A.7.a.

- b. Element [16.1]: “receiving data at a plurality of wireless access devices in an extended network from a wireless device having a current wireless connection to a current wireless access device amongst the plurality of wireless access devices; and”**

133. In my opinion, Liu discloses or renders obvious this element. As illustrated in Figure 1, multiple MAPs (blue) can be associated with the same STA

(purple) and receive data from that STA. Ex.1005, [0064] (“STA can be associated with *multiple MAPs* and if so, *communicates with them* using a time division multiplexing scheme.”), [0033] (“STA can associate with multiple MAPs and in the backhaul[,] traffic flow can be routed through multiple paths to the gateway.”), [0024].

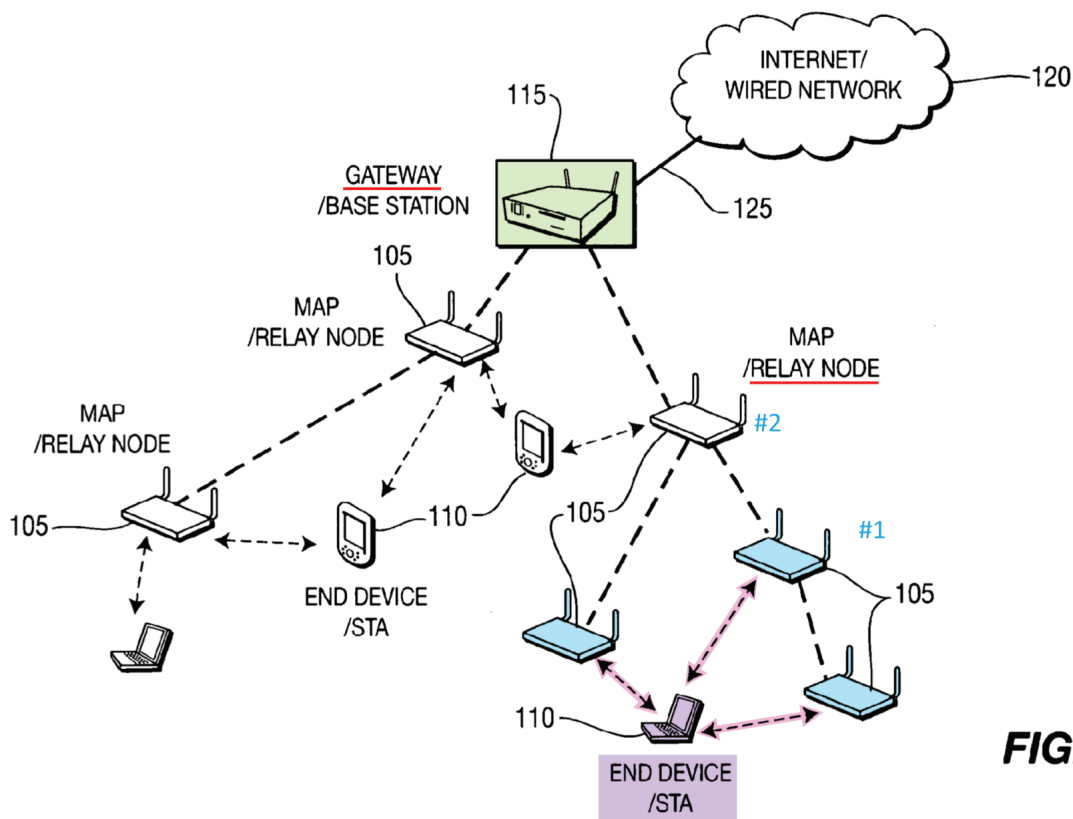


FIG. 1

Ex.1005, FIG. 1.

134. The STA (wireless device) (purple) has “a current wireless connection” (magenta) to “a current wireless access device amongst the plurality of wireless access devices” (one of the associated MAPs) (blue).

- c. **Element [16.2]: “generating wireless connection quality information at each wireless access device in**

the plurality of wireless access devices describing the quality of a wireless connection between the wireless device and the wireless access device generating the quality information”

135. In my opinion, Liu discloses or renders obvious this element. Liu discloses that each MAP has a link measurement module that “mak[es] link quality and channel condition measurements for [that] MAP” (generate wireless connection quality information at each wireless access device) and “forward[s]/transmit[s] the link quality and channel conditions to other MAPs [and] ... to the gateway.” Ex.1005, [0063], [0060], [0056], [0053]. Liu teaches embodiments in which “[e]ach MAP supports two interfaces. A MAP’s *access interface* provides network access for the STAs associated with the MAP and the MAP’s *relay interface* is used to construct and communicate over the backhaul relaying data/traffic between the gateway and the STAs associated with the MAP.” *Id.*, [0025]. In my opinion, a POSITA would have understood and found obvious that each MAP makes link quality/channel conditions measurements on both its access interface (to STAs) and its relay interface (to MAPs and/or the gateway).

136. Indeed, as Liu teaches, “the system and method of the present invention first need information on ... each STA such as the *access link* data rate that the STA experiences *to/from each MAP*.” *Id.*, [0052]. The uplink STA-to-MAP data rate is measured at the MAP which is the receiving end of the uplink communication (while the downlink MAP-to-STA data rate is measured at the STA). Link quality/channel

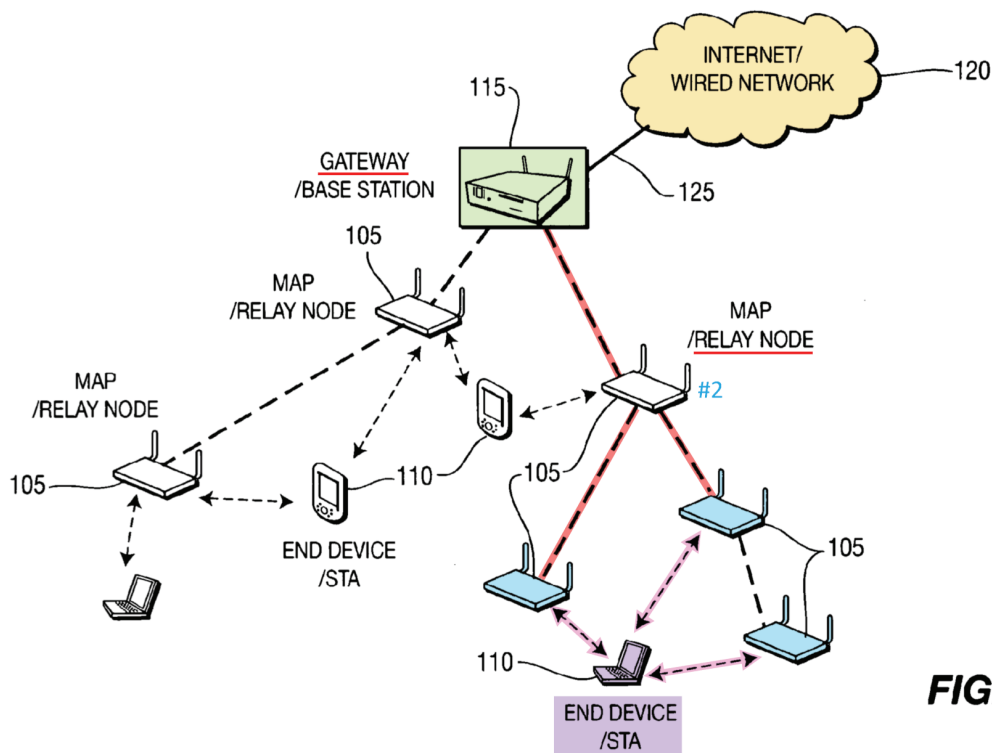
condition measurements of the MAP's access interface "describe[es] the quality of a wireless connection between the wireless device [(STA)] and the wireless access device generating the quality information [(MAP)]" as claimed.

- d. **Element [16.3]: "transmitting the wireless connection quality information from the wireless access device to at least a gateway router communicating indirectly using a network extender device to establish the communication path with the wireless access device and communicating with a network external to the extended network."**

137. In my opinion, Liu renders discloses or obvious this element. As discussed in Section X.A.16(c) above, each MAP in Liu's network "mak[es] link quality and channel condition measurements" (claimed wireless connection quality information) and "forward[s]/transmit[s] the link quality and channel conditions to other MAPs [and] ... *to the gateway*." Ex.1005, [0063]. The gateway uses this information to establish all backhaul communication paths in the wireless mesh network. Ex.1005, [0053] ("The collected information is reported to the gateway, which executes the method of the present invention to determine the optimal STA-MAP association, *backhaul routing*, and bandwidth allocation to each STA ...").

138. As illustrated in Figure 1, the information is used by the gateway (green) to establish an indirect, multi-hop, communication path (red) between itself and each serving MAP (blue) using a network extender device (MAP/RELAY NODE #2). In my opinion, each such path satisfies Patent Owner's construction of

“the communication path” as “the path for communications between the gateway router and the wireless access device [(serving MAP)].” Ex.1015, 27. The gateway also communicates with the Internet as shown below.



Ex.1005, FIG. 1.

17. Dependent Claim 17

- a. “The method of claim 16, further including transmitting or exchanging the wireless connection quality information from a wireless access device to/with other wireless access devices in the extended network.”

139. In my opinion, Liu discloses this element. Liu discloses that each MAP “mak[es] link quality and channel condition measurements” and

“forward[s]/transmit[s] the link quality and channel conditions to other MAPs [and] ... to the gateway.” Ex.1005, [0063], [0060], [0056], [0053].

18. Dependent Claim 18

- a. **“The method of claim 17, wherein at least one wireless access device is configured to initiate a wireless connection between the wireless access device having the highest quality wireless connection for the wireless device and the wireless device.”**

140. This element is the same as the additional element of claim 10. In my opinion, Liu discloses this element for the reasons I explained in Section X.A.10.

19. Dependent Claim 19

- a. **“The extended network of claim 18, wherein at least one wireless access device is further configured to initiate the wireless connection with the wireless device having the highest wireless connection quality based on a connection check between the at least one wireless access device and the wireless device.”**

141. This element is the same as the additional element of claim 11. In my opinion, Liu discloses this element for the reasons I explained in Section X.A.11.

20. Dependent Claim 20

- a. **“The method of claim 16, wherein the wireless connection quality includes at least one of a wireless signal strength, a noise level, a connection capability for a wireless device, a connection capability for a wireless access device, an extended network topology, a utilization status and a connection patch quality.”**

142. This element is the same as the additional element of claim 6. In my opinion, Liu discloses this element for the reasons I explained in Section X.A.6.

21. Dependent Claim 21

- a. **“The method of claim 17, wherein a first wireless access device is further configured to initiate the wireless connection between the wireless access device having the highest wireless connection quality and the wireless device based on a connection check between at least one wireless access device and the wireless device, wherein the wireless access device having the highest wireless connection quality may be the first wireless access device.”**

143. This element is the same as the additional element of claim 15. In my opinion, Liu discloses this element for the reasons I explained in Section X.A.15.

B. Ground II: Claims 7-11, 13-21 Are Rendered Obvious by Dean

1. Independent Claim 7

- a. **Preamble: “An extended network configured to implement an extended management function to identify a wireless access device providing a highest quality wireless connection to a wireless device, comprising:”**

144. In my opinion, Dean discloses the preamble or renders it obvious. As illustrated in Figure 4, Dean discloses a “wireless mesh network” that “can include any number of gateways [(green)] and any number of access nodes [(also known as access points or APs) (blue)].” Ex.1006, [0039], [0026]-[0029]. Dean’s mesh network is an extended network because the backhaul communication path between an AP and a gateway can be an indirect, multi-hop communication path passing through other AP(s) serving as network extenders/relay nodes.

145. Indeed, Dean explains that “[t]he number of wireless hops ... within the wireless mesh network is not limited.” Ex.1006, [0039]; *id.*, [0038] (“hop count indicates the number of wireless links an access node is from a gateway.”); Ex.1001, 2:12-15 (“A network including both a gateway wireless access device and one or more extender wireless access devices [(relay nodes)] is referred to as an ‘extended network.’”).

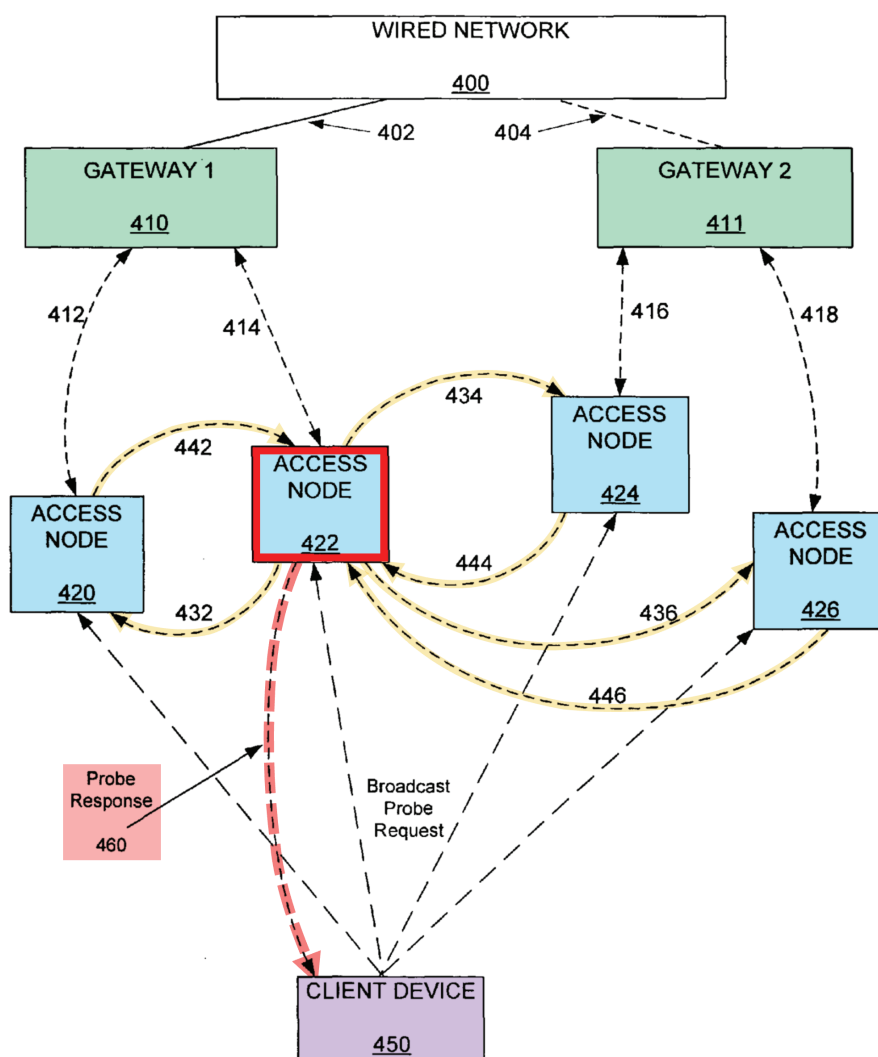


FIGURE 4

Ex.1006, FIG. 4.

146. In addition, Dean teaches “a method of determining which of a plurality of access points has a ***highest quality link*** with a client device,” which is the claimed “extended management function to identify a wireless access device providing a highest quality wireless connection to a wireless device.” Ex.1006, [0007], [0016], [0026]-[0029]. As shown in Figure 4 and explained in Dean, a client device (purple) initiates a wireless connection by broadcasting a probe request that is received by several neighboring APs (blue). *Id.*, [0002].

147. In a conventional Wi-Fi network, all APs that receive the probe request will respond with a probe response. *Id.* In contrast, Dean teaches an extended network management operation called “probe response suppression” (Ex.1006, Title), whereby the network devices cooperate to determine which AP provides the “***highest quality link***” to the client device and that AP alone—*e.g.*, AP422 (red outline)—would respond to the probe request:

[T]he access nodes [APs] can receive a probe request from the client device 450. Each access node can estimate a ***link quality*** between the access node and the client device 450 by measuring, for example, a receive signal strength of the probe request. The link quality can be communicated to the neighboring access nodes by broadcasting a ***received signal strength indicator*** (RSSI) to the neighboring access nodes [] as indicated by the [tan] arrow[s]. ... If, for example, the ***link quality indicator*** of the access node 422

is ***determined to be the best***, the access node 422 responds to the probe request with a probe response 460 [(red)].

Ex.1006, [0044], [0042] (“Generally, the greater the received signal strength, the better the quality of the link between the client device and the receiving device [(AP)].”). In my opinion, Dean’s teaching that the “highest quality link” is the link with the highest RSSI is consistent with Patent Owner’s claim construction position because it is based on objectively comparing RSSI numbers. Ex.1015, 23 (“the highest quality wireless connection is calculated by the system based on ‘certain objective criteria’ ...”).

b. Element [7.1]: “a gateway device configured to enable communication between the extended network and an external network;”

148. In my opinion, Dean discloses this element. As shown in Figure 4, “[t]he wireless mesh network includes ***gateways*** 410, 411 [(green)] that . . . provide the access nodes [of the extended network] [(blue)] with access to the wired network 400. The wired network [(external network) (tan)] can be connected, for example, to the internet.” Ex.1006, [0026]-[0027].

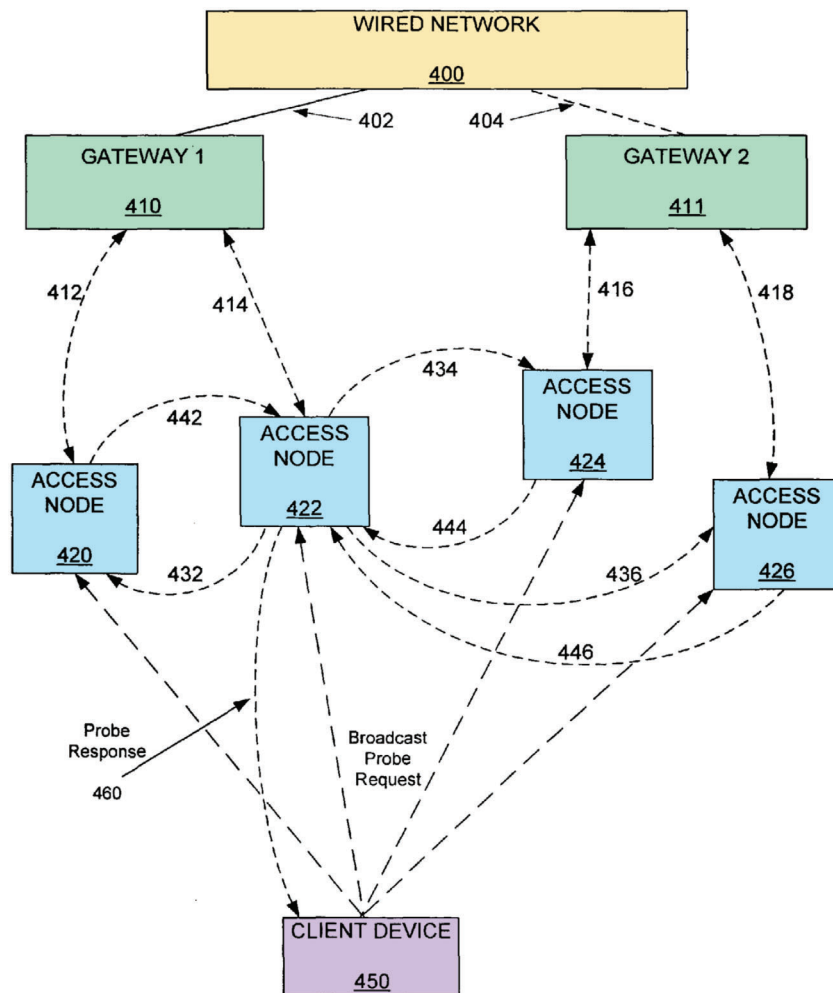


FIGURE 4

Ex.1006, FIG. 4; *id.*, [0027] (“A **default gateway** of an access node [(AP)] is the gateway that the access node has select[ed] as having the **best routing path**.”), [0028] (“The methods of probe response suppression described for access node[s] are applicable to **gateways** as well.”).

c. **Element [7.2]: “at least two wireless access devices in the extended network; and”**

149. In my opinion, Dean discloses this element or renders it obvious.

Figure 4 illustrates four APs (wireless access devices) (blue). Ex.1006, [0026]-

[0029], [0039] (“The mesh network can include any number of gateways and any number of access nodes.”).

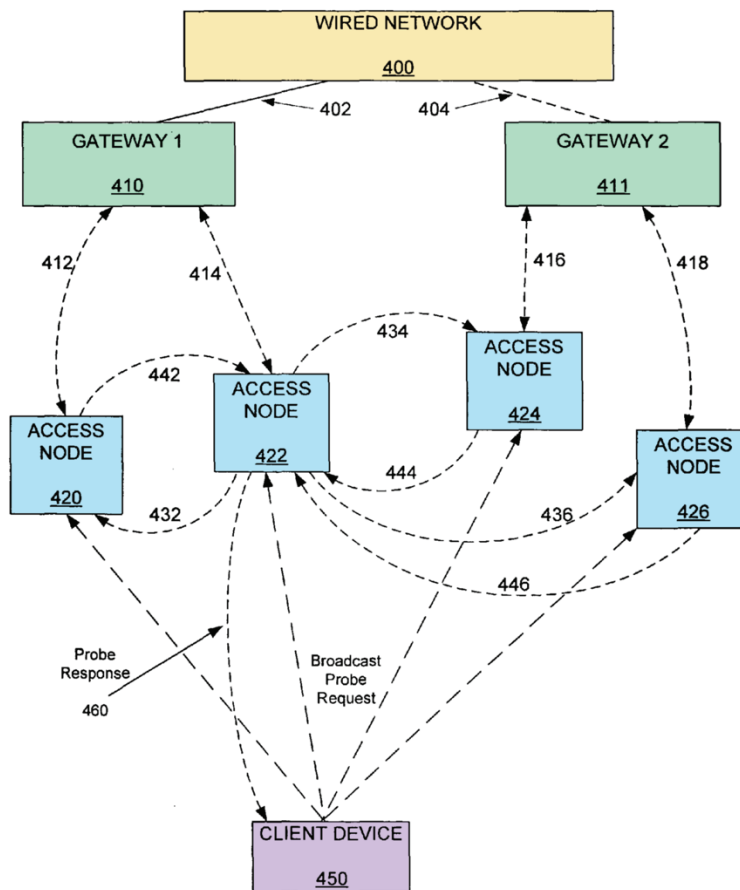


FIGURE 4

Id., FIG. 4; *see also* FIG. 2.

- d. **Element [7.3]: “at least one wireless device having a wireless connection to a at least one of the wireless access devices”**

150. In my opinion, Dean discloses this element or renders it obvious. As discussed above in Section X.B.1(a) (preamble of claim 7), Figure 4 illustrates a wireless client device 450 (purple) receiving a probe response (red) to its probe request from only AP422 (wireless access device) (red outline). Ex.1006, [0044].

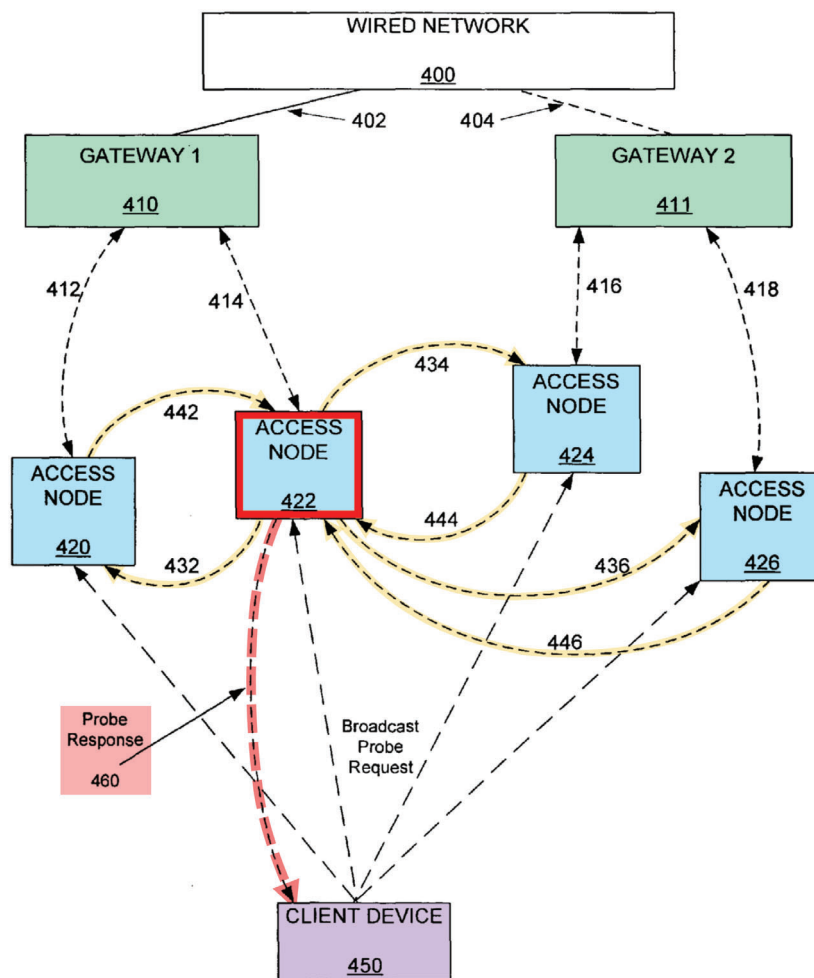


FIGURE 4

Id., FIG. 4.

151. Because the client device 450 receives a response to its probe request from only AP422, it initiates the connection to or maintains its wireless connection (association) with AP422. *Id.*, [0015] (“The embodiments disclosed aid, among other things, a client device in *maintaining an association* with an access point or access node of a wireless network. Maintenance of associations is desirable because it helps prevent client devices from roaming excessively.”).

- e. **Element [7.4]: “wherein the gateway device and the wireless access devices include a processor executing the extended management function to identify the wireless access device providing the highest quality wireless connection based on wireless connection quality information, the wireless connection quality information including wireless connection quality information for at least one indirect communication path having at least one network extender device to establish the communication path between the gateway device and the wireless access device, exchanged among the wireless access devices and the gateway device.”**

152. In my opinion, Dean discloses or renders obvious this element.

153. *First*, Dean discloses a “probe response suppression” method (claimed extended management function) performed by each network device, including gateways and APs, in cooperation with other network devices, to identify “*the access point with the best link quality*” (claimed “wireless access device providing the highest quality wireless connection”) “to respond to [a client] probe request.” Ex.1006, [0016], [0026]-[0029], [0007]. The network devices that participate in Dean’s probe response suppression are APs (wireless access devices) and gateways. *Id.*, [0028] (“The methods of probe response suppression described for *access node* [(APs)] are applicable for *gateways* as well.”).

154. To identify the AP with “the best link quality,” the network devices “share the link quality with neighboring access points” and gateways, and “perform a comparative link quality analysis” based on the exchanged link quality (claimed

“based on wireless connection quality information ... exchanged among the wireless access devices and the gateway device”):

[A] wireless network ... includes access points ... that perform a ***comparative link quality analysis*** [to] suppress[] probe responses. Each access point that receives a probe request, estimates a ***link quality*** between the access point and the client device. The receiving access points then ***share the link quality with neighboring access points*** enabling the access point with ***the best link quality*** to respond to the probe request.

Ex.1006, [0016]; *id.*, [0026]-[0029].

155. ***Second***, the link quality information exchanged amongst Dean’s network devices (APs and gateways) includes “an indicator of the path quality” of indirect, multi-hop communication paths between APs and gateway(s). As Dean teaches, “[t]he number of wireless hops [in] the wireless mesh network is not limited” and thus there are indirect, multi-hop communication paths having network extender device(s) between APs and gateway(s) in the network. Ex.1006, [0039]; *id.*, [0038] (“hop count indicates the ***number of wireless links*** an access node [(AP)] is ***from a gateway***”).

156. Dean’s teaching is illustrated in the modified Figure 4 below (hereinafter, FIG. 4M) which shows AP422 (red outline) communicating with gateway 410 (green) through ***an indirect, two-hop communication path*** (magenta) having another AP acting as network extender or relay node (RN).

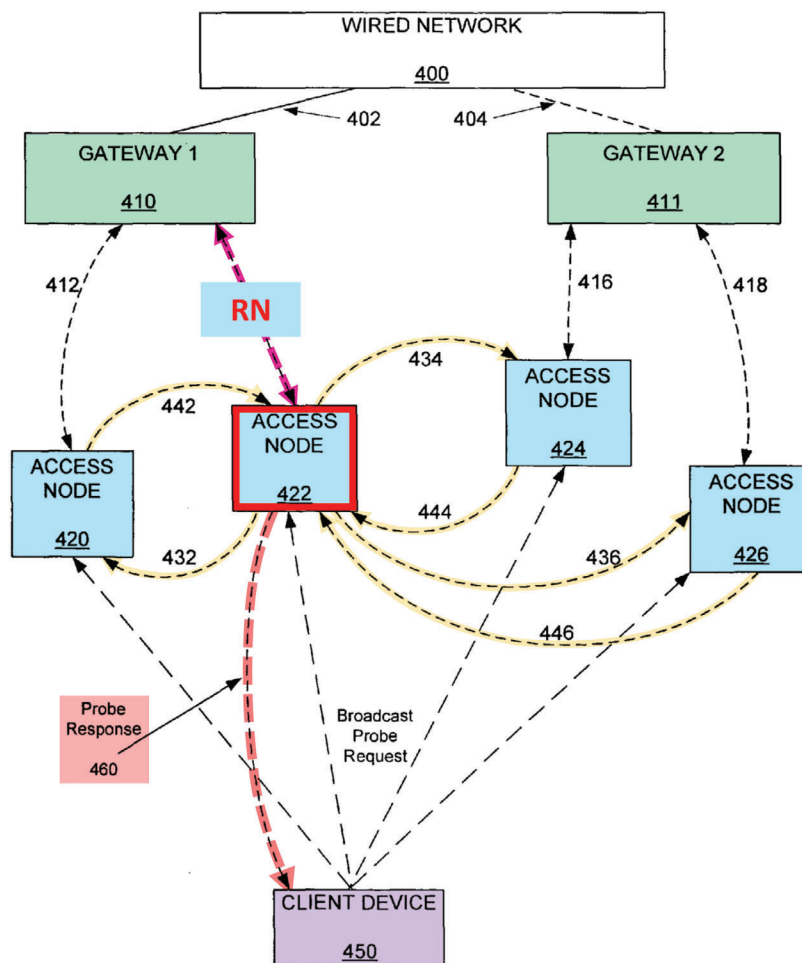


FIGURE 4

Ex.1006, FIG. 4M.

157. Dean teaches that the link quality information determined by each AP and exchanged with other network devices includes the “network quality parameters” indicative of the path quality of the communication path between that AP and a gateway:

[E]ach access node estimates the quality of the wireless [access] link between the access node and the client device by measuring the signal strength of probe requests received from the client device 450. The link quality estimates can also include *wireless*

mesh network quality parameters of the access nodes within the wireless mesh network. ... One example of a mesh network quality parameter is an indicator of *a path quality of the access node [(AP)] to a gateway* of the mesh network.

Ex.1006, [0029]-[0031]; *id.*, [0027] (“A *default gateway* of an access node is the gateway that the access node has select[ed] as having the *best routing path*.”). The information exchanged amongst network devices includes path quality information determined by a gateway. *Id.*, [0041] (“The *upstream [routing path] quality* can be determined by an upstream device (access node or *gateway*)”).

158. To illustrate Dean’s teachings, in Figure 4M above, AP422 estimates the path quality (“wireless mesh network quality parameters”) of the indirect, two-hop communication path between itself and gateway 411 (highlighted in magenta) and shares that information with other network devices through the exemplary arrows highlighted in yellow.

159. Dean explains that sharing such “network quality parameters” amongst network nodes is important to correctly identify the AP that provides “*the best link quality*” to a client device:

As shown in FIG. 4, routing paths exist between access nodes of a mesh network and default gateways. ... The quality of the routing path can influence, for example, the *data throughput* and *latency* for data communication *between* the access node and the gateway. This in turn, effects the data communication of any client

that associates with the access node. Therefore, *providing the mesh network path quality of each access node* within communication between neighboring access nodes *allows for a better selection of which access node has the best quality link with a client device*.

Ex.1006, [0031]; *id.*, [0043] (Exemplary network quality parameters are “data throughput, latency, backhaul bandwidth and stability of the access node”).

160. Thus, Dean teaches that the link quality information exchanged amongst network devices (gateway(s) and APs) includes “wireless connection quality information for at least one indirect communication path [(e.g., the network quality parameters of the indirect, two-hop communication path highlighted in magenta in Figure 4M)] having at least one network extender device [(e.g., RN)] to establish the communication path between the gateway device [(e.g., gateway 410)] and the wireless access device [(e.g., AP422)],” as required by the claim.

161. **Third**, in my opinion, a POSITA would have understood and found it obvious that Dean’s gateways and APs include processors to perform Dean’s network-wide probe response suppression. Processors were routinely used to perform computational-intensive network management functions, as described in Liu and Bharghavan. Ex.1005, [0065] (“Preferably, the present invention is implemented as a combination of hardware [processor] and software.”); Ex.1007, 6:17-19 (“The AP control circuit 131 includes a computing device, such as a

processor ...”), 5:13-18 (“The system coordinator ... includes a computing device, such as a processor ...”).

162. In my opinion, a POSITA would have been further motivated to use processors and software because that would provide greater flexibility to implement different ways of estimating link quality parameters and packaging them for transmission to other network devices, and to implement the different routing algorithms taught in Dean. Ex.1006, [0030]-[0035] (different ways of estimating path quality), [0036]-[0041] (different routing algorithms), [0021] (different ways to package/transmit network quality parameters). Finally, Dean’s system satisfies Patent Owner’s construction of the “wherein” clause because, in Dean, as detailed above, “the processors in different devices can ‘*contribute* to the process’ of identifying the highest quality wireless connection.” Ex.1015, 19. In my opinion, Dean’s system also satisfies Petitioner’s construction requiring each of the gateway and wireless access devices to include a processor executing the extended network management function, as I discussed above. Ex.1014, 2.

2. Dependent Claim 8

- a. **“The extended network of claim 7, wherein the extended network is configured in a tree topology including the gateway device as a root, one or more wireless access devices as nodes in the tree, and a wireless device as a leaf.”**

163. In my opinion, Dean discloses this element. Dean's Figure 4 illustrates a mesh network configured in a tree topology, with each gateway (green) as a root, APs (blue) as nodes in the tree, and a client device (purple) as a leaf. Exemplary communication links 416 and 418 between the client device (leaf) and gateway 411 (root) through APs (nodes) are highlighted in yellow.

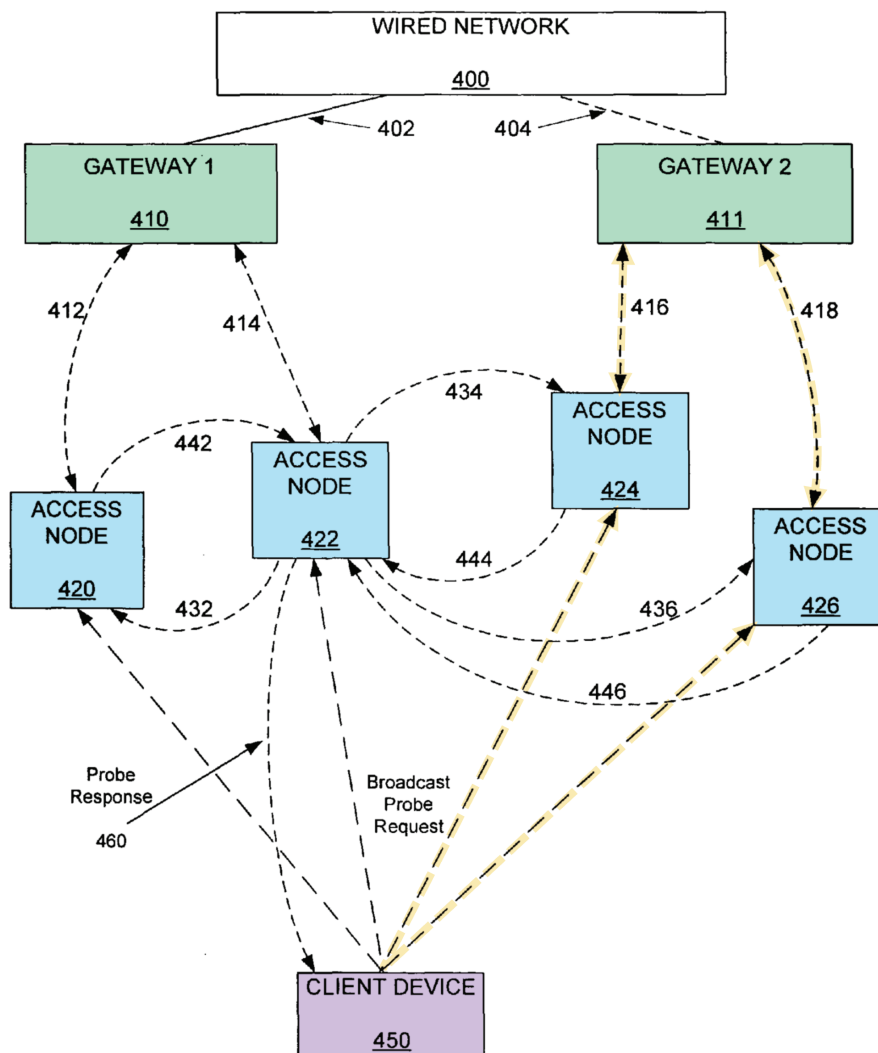


FIGURE 4

Ex.1006, FIG.4.

3. Dependent Claim 9

- a. **“The extended network of claim 7, wherein each wireless access device is configured to generate wireless connection quality information for received packets from the wireless device in consideration and to transmit the wireless connection quality information to one or more wireless access devices in the extended network.”**

164. In my opinion, Dean discloses or renders obvious this element. Dean teaches that “[e]ach access point that receives a *probe request* [from a client device] estimates a *link quality* [(wireless connection quality information)] between the access point and the client device [and] ... *share[s] the link quality with neighboring access points* ...” Ex.1006, [0016]. “For each receiving access point, the quality of the link can be determined, for example, by measuring the *received signal strength of the probe request*.” *Id.*, [0018]; *see also id.*, [0023]-[0024], [0026]-[0029]. Dean discloses that the MAPs forward or “transmit the wireless connection quality information to one or more wireless access devices in the extended network,” as claimed.

165. In my opinion, a POSITA would have understood that probe requests are management frames/packets defined in the Wi-Fi standards. Ex.1008 (802.11k-2008), Table 7-14 at 10 (Probe Request frame body); Ex.1001, 8:21-23 (“Establishing a wireless connection [involves] ... the exchange of *data packets* as is well known in the art.”).

4. Dependent Claim 10

- a. **“The extended network of claim 7, wherein at least one wireless access device is configured to initiate a connection between the wireless access device having the highest quality wireless connection for the wireless device and the wireless device.”**

166. In my opinion, Dean discloses or renders obvious this element. As Dean explains, APs that receive a probe request (receiving APs) exchange link quality information to enable selection of the current/serving AP—the AP with the highest link quality. Ex.1006, [0016] (“The receiving access points then share the [measured/estimated] link quality with neighboring access points[,] *enabling* [selection of] the access point with the best link quality to respond to the probe request.”); *id.*, [0026]-[0029].

167. Each receiving AP thus “initiates a connection” between the serving AP and the client, as required by the claim and as the term “initiate a connection” is used in the ’025 patent specification. Ex.1001, 4:35-39 (network devices are “configured to exchange messages with other network devices to *initiate a connection* between the wireless device [(client)] and the network device [(serving AP)] having the highest wireless connection quality.”).

5. Dependent Claim 11

- a. **“The extended network of claim 10, wherein at least one wireless access device is further configured to initiate the connection to the wireless access device having the highest wireless connection quality based on a connection check between the at least one wireless access device and the wireless device.”**

168. In my opinion, Dean discloses this element or renders it obvious. As Dean teaches, each AP that receives a probe request (receiving AP) performs a connection check of the access link between it and the client device “by measuring the *received signal strength of the probe request*.” Ex.1006, [0042]. “Generally, the greater the received signal strength, the better the quality of the link *between* the client device and the receiving device [(AP)].” *Id.*; Ex.1001, 7:24-31 (describing “connection check”). The receiving AP initiates the claimed connection as discussed above in Section X.B.4.

6. Dependent Claim 13

- a. **“The extended network of claim 7, wherein the wireless connection quality includes at least one of a wireless signal strength, a noise level, a connection capability for a wireless device, a connection capability for a wireless access device, an extended network topology, a utilization status and a connection path quality.”**

169. In my opinion, Dean discloses this element or renders it obvious. As Dean teaches, “the quality of the [access] link can be determined ... by measuring the *received signal strength* of the probe request.” Ex.1006, [0042]. Dean also teaches determining the connection “*path quality*” of the communication paths between APs and gateway(s), which Dean refers to as mesh “network quality parameters,” such as their “data throughput, latency, backhaul bandwidth and stability of the access node.” *Id.*, [0030]-[0035], [0043].

7. Dependent Claim 14

- a. **“The connection quality of claim 13, wherein the connection path quality for a wireless device is the connection quality between the wireless device and the gateway device.”**

170. In my opinion, Dean discloses this claim element or renders it obvious. As discussed above in Section X.B.6, Dean teaches determining the connection quality of the end-to-end connection between a client device and a gateway. *Id.* Indeed, each receiving AP estimates the quality of the access link between the client device and itself, as well as the path quality of the communication path between itself and the gateway (“network quality parameters”). Ex.1006, [0029]-[0035], [0042]-[0043].

8. Dependent Claim 15

- a. **“The extended network of claim 10, wherein a first wireless access device is further configured to initiate the connection between the wireless access device having the highest wireless connection quality and the wireless device based on a connection check between at least one wireless access device and the wireless device, wherein the wireless access device having the highest wireless connection quality may be the first wireless access device.”**

171. In my opinion, Dean discloses this claim element or renders it obvious. As discussed above in Sections X.B.4 (claim 10) and X.B.5 (claim 11), Dean teaches that each AP that receives a probe request (receiving AP) (claimed first wireless access device) initiates the connection (as the term is used in the '025 Patent specification, as I explained above under claim 10) between the current/serving AP

(claimed wireless access device having the highest wireless connection quality) and the client device (wireless device) by measuring the received signal strength of the probe request (claimed “based on a connection check between the at least one wireless access device and the wireless device”) and broadcasting it to neighboring APs. Ex.1006, [0016], [0026]-[0029].

172. The remainder of this element (“wherein the wireless access device [(current/serving AP)] having the highest wireless connection quality *may be* the first wireless access device [(receiving AP)]”) does not impose any requirement on the wireless access device (current/serving AP)—it may or *may not* be the same as the first wireless access device (receiving AP). Thus, in my opinion, it is met by Dean.

9. Independent Claim 16

- a. **Preamble: “A computer implemented method for identifying a wireless access device providing a highest quality wireless connection to a wireless device, comprising:”**

173. The preamble of claim 16 is substantively the same as the preamble of claim 7. It is my opinion that Dean discloses or renders it obvious, as I discussed in Section X.B.1(a). *See also* X.B.1(e) (discussing computer processors).

- b. **Element [16.1]: “receiving data at a plurality of wireless access devices in an extended network from a wireless device having a current wireless connection to a current wireless access device amongst the plurality of wireless access devices; and”**

174. In my opinion, Dean discloses this element or renders it obvious. As Dean explains and as was well-known in the art, when a client device that is associated/connected to a current AP searches for a potentially better AP to roam to, it “broadcast[s] a probe request [(data)] *received* by *multiple* access points[.]”.⁴ Ex.1006, [0002]; *see also* Ex.1007, 13:41-44 (to initiate roaming, a wireless device “sends a ‘probe request’ message. *Every AP in the neighborhood of the wireless device receives this message.*”).

175. Dean explains that its probe response suppression technique improves roaming by “aid[ing] ... a client device in maintaining an association with [its current] access point ... Maintenance of associations is desirable because it helps prevent client devices from roaming excessively.” Ex.1006, [0015]. This is because “client devices may not do a very good job at selecting which access point to associate with.” *Id.*, [0003].

c. Element [16.2]: “generating wireless connection quality information at each wireless access device in the plurality of wireless access devices describing the quality of a wireless connection between the wireless

⁴ As I discussed above, probe requests/responses are data packets exchanged to establish a wireless connection. Ex.1001, 8:21-23 (“Establishing a wireless connection may include ... the exchange of *data packets* as is well known in the art.”); Ex.1008, 10-11 (Probe Request/Response frames/packets), 109.

device and the wireless access device generating the quality information”

176. In my opinion, Dean discloses this element or renders it obvious. Dean teaches that “*each access node* [(AP)] estimates the quality of the wireless link *between* the access node [(wireless access device)] and the client device [(wireless device)] by measuring the *received signal strength of probe requests* received from the client device 450.” Ex.1006, [0029], [0018]. The quality of the wireless link “between the access node and the client device,” quoted in this paragraph, is the claimed “quality of a wireless connection between the wireless device and the wireless access device generating the quality information.”

- d. **Element [16.3]: “transmitting the wireless connection quality information from the wireless access device to at least a gateway router communicating indirectly using a network extender device to establish the communication path with the wireless access device and communicating with a network external to the extended network.”**

177. In my opinion, Dean discloses this element or renders it obvious.

178. **First**, Dean discloses that each network device (AP or gateway) that receives a client device’s probe request estimates the link quality of the access link between it and the client device and broadcasts the link quality information to other network devices, such as a gateway:

Each access point that receives a probe request, estimates a link quality between the access point and the client device. The

receiving access points then *share the link quality with neighboring access points* enabling the access point with the best link quality to respond to the probe request.

Ex.1006, [0016]; *id.*, [0046] (“The link quality can be communicated to neighboring access node[s] b[y] transmitting the RSSI of the probe request.”); *id.*, [0028] (“The methods of probe response suppression described for access node[s] are applicable for gateways as well.”).

179. ***Second***, Dean’s extended network includes indirect, multi-hop communication paths having network extender device(s) because “[t]he number of wireless hops [in] the wireless mesh network is not limited.” Ex.1006, [0039], [0038] (“hop count indicates the *number of wireless links* an access node [(AP)] is from a gateway”). Dean’s teaching is illustrated in the modified Figure 4M below, which shows AP422 (blue with red outline) communicating with gateway 410 (green) through *an indirect, two-hop communication path* (magenta) having another intermediate AP acting as network extender or relay node (RN).

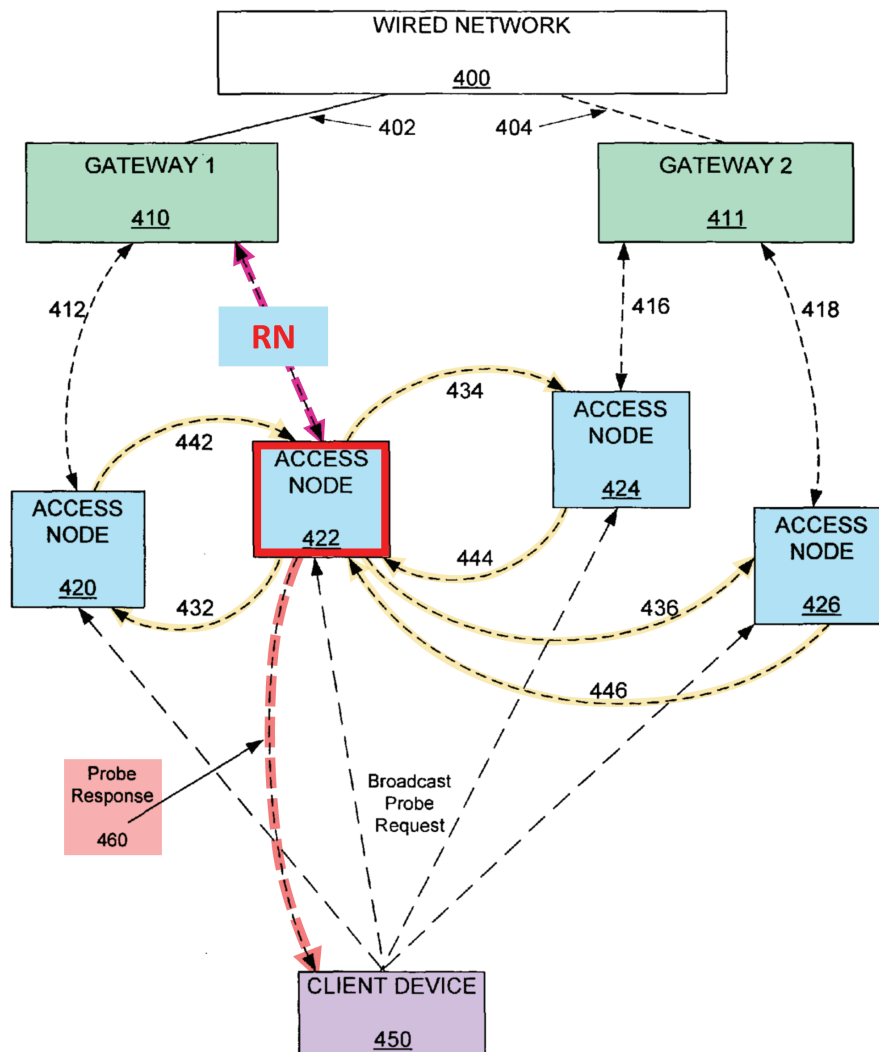


FIGURE 4

Ex.1006, FIG. 4M.

180. To illustrate Dean’s teachings, in Figure 4M above, AP422 estimates the path quality (“wireless mesh network quality parameters”) of the indirect, two-hop communication path between itself and gateway 411 (highlighted in magenta) and shares that information with other network devices including the gateway. Ex.1006, [0037], [0041]. Likewise, AP420 estimates the quality of the backhaul

path between itself and the gateway and transmits it to other network devices such as the gateway 410 and AP422. Ex.1006, [0042]-[0044].

10. Dependent Claim 17

- a. **“The method of claim 16, further including transmitting or exchanging the wireless connection quality information from a wireless access device to/with other wireless access devices in the extended network.”**

181. In my opinion, Dean discloses this element or renders it obvious Ex.1006, [0016] (“Each access point that receives a probe request, estimates a link quality between the access point and the client device. The receiving access points then *share the link quality with neighboring access points* enabling the access point with the best link quality to respond to the probe request.”).

11. Dependent Claim 18

- a. **“The method of claim 17, wherein at least one wireless access device is configured to initiate a wireless connection between the wireless access device having the highest quality wireless connection for the wireless device and the wireless device.”**

182. In my opinion, Dean discloses this element for the same reasons it discloses the additional element of claim 10. *See* Section X.B.4.

12. Dependent Claim 19

- a. **“The extended network of claim 18, wherein at least one wireless access device is further configured to initiate the wireless connection with the wireless device having the highest wireless connection quality based on**

a connection check between the at least one wireless access device and the wireless device.”

183. In my opinion, Dean discloses this element for the same reasons it discloses the additional element of claim 11. *See* Section X.B.5.

13. Dependent Claim 20

- a. **“The method of claim 16, wherein the wireless connection quality includes at least one of a wireless signal strength, a noise level, a connection capability for a wireless device, a connection capability for a wireless access device, an extended network topology, a utilization status and a connection patch quality.”**

184. In my opinion, Dean discloses this element for the same reasons it discloses the additional element of claim 13. *See* Section X.B.6.

14. Dependent Claim 21

- a. **“The method of claim 17, wherein a first wireless access device is further configured to initiate the wireless connection between the wireless access device having the highest wireless connection quality and the wireless device based on a connection check between at least one wireless access device and the wireless device, wherein the wireless access device having the highest wireless connection quality may be the first wireless access device.”**

185. In my opinion, Dean discloses this element for the same reasons it discloses the additional element of claim 15. *See* Section X.B.8.

C. Ground III: Claims 1-6 Are Rendered Obvious by Dean in View of Bharghavan

1. Independent Claim 1

- a. **Preamble: “A gateway router configured to facilitate wireless connection management in an extended wireless network, comprising:”**

186. In my opinion, Dean discloses the preamble or renders it obvious.

Dean’s Figure 4 illustrates gateway(s) (green) in a wireless mesh network. *See also* Section X.B.1(b).

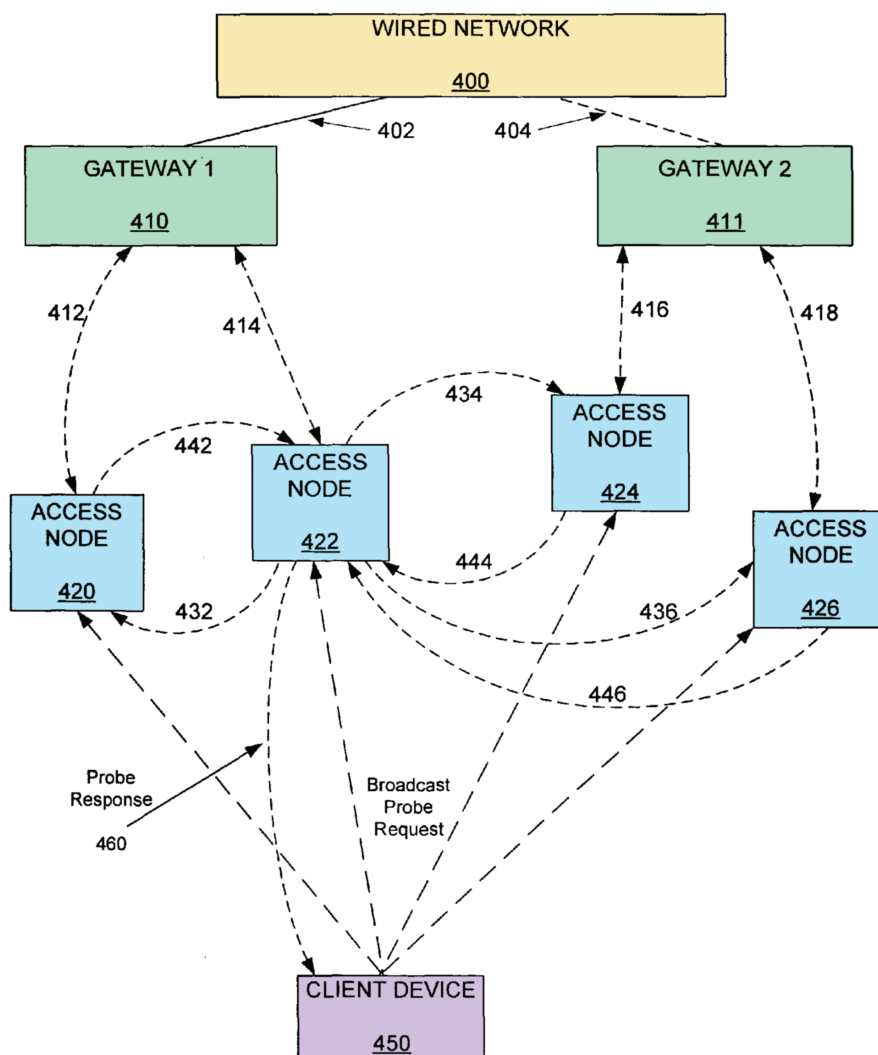


FIGURE 4

Ex.1006, FIG. 4.

187. As Dean explains, all network devices (APs and gateways) cooperate to suppress probe responses, thereby “enabling the access point with *the best link quality* to respond to the [client] probe request” and effectively pre-selecting that AP for association with the client device. Ex.1006, [0015]-[0016], [0028].

b. Element [1.1]: “a network device input connected at least indirectly to an internal network and configured to communicate a plurality of data packets to and from at least one computer system”

188. In my opinion, Dean discloses or renders obvious this element. In my opinion, a POSITA would understand and find it obvious that, as illustrated in Figure 4, each gateway (green) has interface circuitry (network device input) (magenta) to connect wirelessly to the internal network of APs (blue) and to communicate data packets to and from client devices (claimed “at least one computer system”) (purple) via their associated APs.

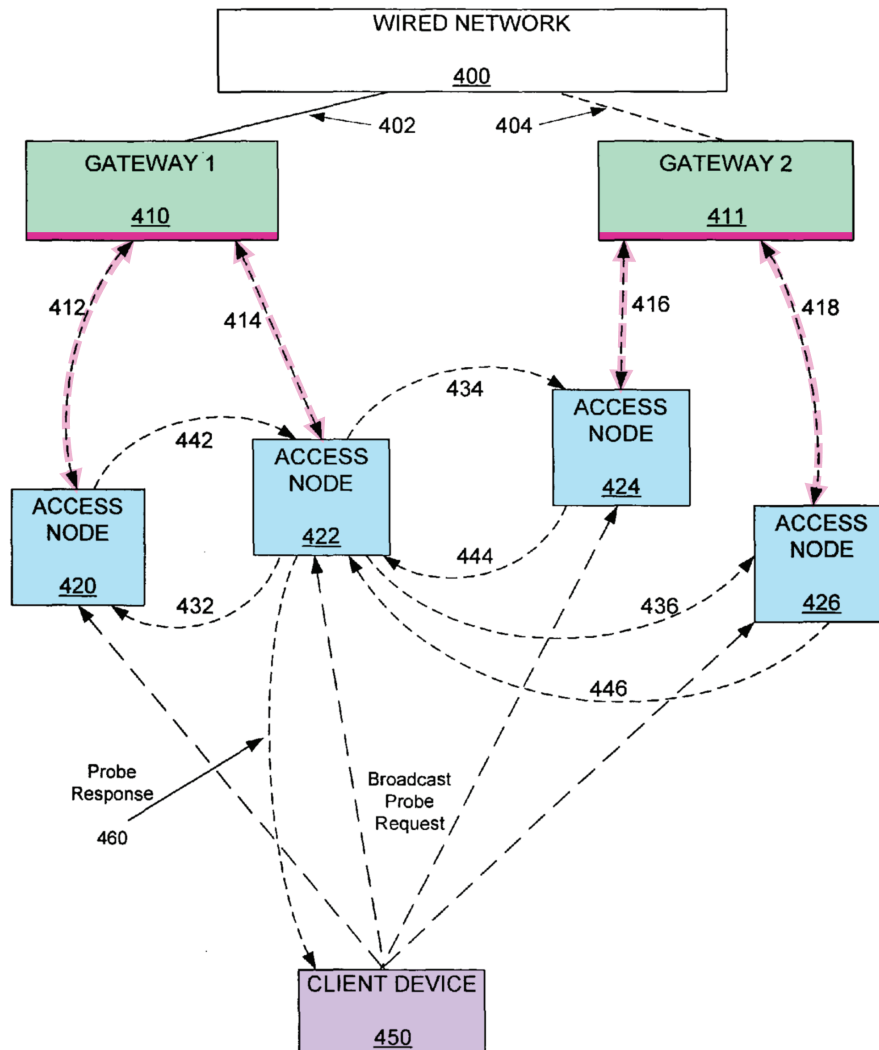


FIGURE 4

Ex.1006, FIG. 4, [0027] (“[each] access node [(blue)] is wirelessly connected through a link [(magenta)] to [its default] gateway. ... A default gateway of an access node is the gateway that the access node has select[ed] as having the best routing path.”), [0028] (“[T]he gateways ... and the access nodes [(APs)] provide a client device (such as, client device 450) [(purple)] with wireless access to the wired network 400.”).

- c. **Element [1.2]: “a network device output connected at least indirectly to an external network and configured to communicate the plurality of data packets to and from at least one computer system; and”**

189. In my opinion, Dean discloses or renders obvious this element. In my opinion, a POSITA would have understood and found obvious that, as illustrated in Figure 4, each gateway (green) has interface circuitry (network device output) (tan) to connect to an external “wired network” (tan) and to communicate data packets to and from at least one computer system, such as a computer server in the Internet.

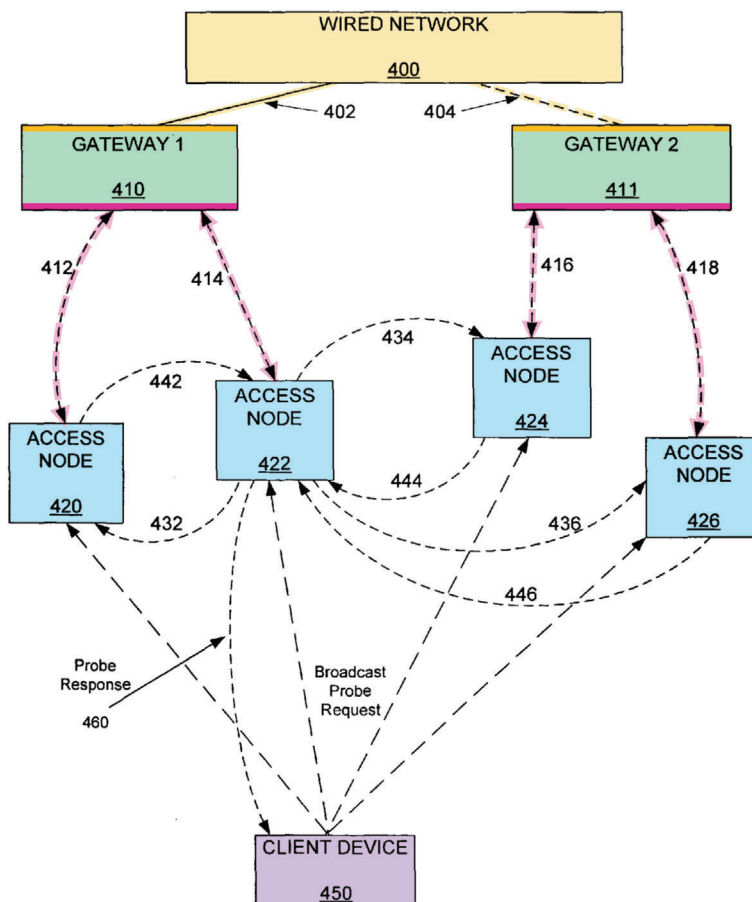


FIGURE 4

Ex.1006, FIG. 4, [0026] (“The wireless mesh network includes gateways 410, 411 that can be wire or wirelessly connected (connections 402, 404) to a wired network 400, and provide the access nodes 420, 422, 424, 426 with access to the wired network 400. The wired network 400 can be connected, for example, to the internet.”).

d. Element [1.3]: “a computer processor configured to execute steps, including”

190. In my opinion, Dean, alone or in combination with Bharghavan, renders obvious this element. As I discussed above in Section X.B.1(e) (claim element [7.4]), and as Dean explains, its “methods of probe response suppression described for access node[s] are applicable to gateways as well.” Ex.1006, [0028].

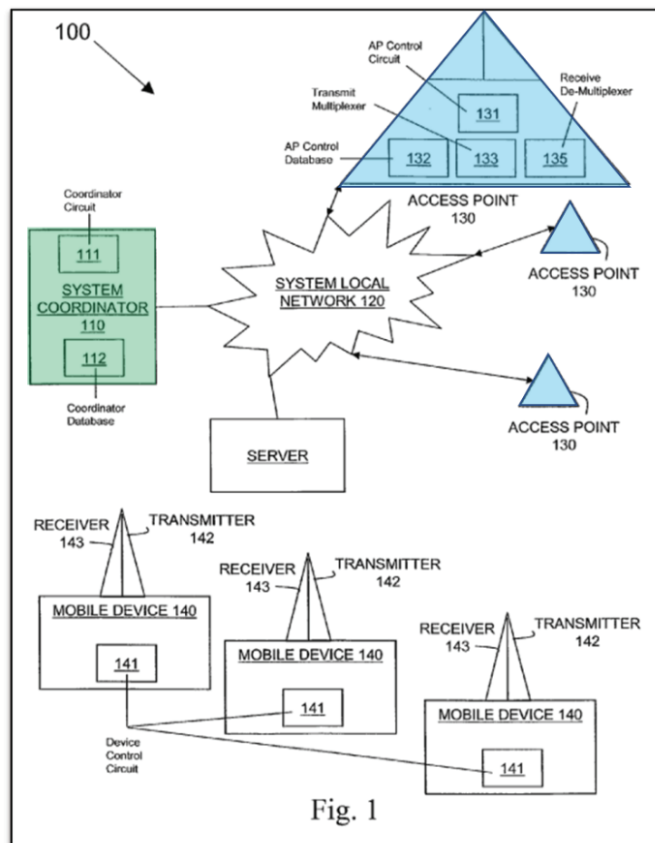
191. Dean’s probe response suppression involves substantial computations and requires each network device (gateways and APs) to efficiently estimate link qualities, exchange them with other network devices, and perform a comparative link quality analysis to select the AP having the best link quality, as I discussed above in Sections X.B.1(a) and X.B.1(e) (claim 7, preamble and element [7.4]). Ex.1006, [0016], [0026]-[0029].

192. In my opinion, a POSITA would have understood (and found it obvious) that Dean’s gateways (and APs) use processors to handle the requisite computations. Processors were in fact routinely used in APs and gateways to perform computational-intensive network management functions, as described in

Liu and Bharghavan. Ex.1005, [0065] (“Preferably, the present invention is implemented as a combination of hardware [processor] and software.”); Ex.1007, 5:13-18 (“The system coordinator ... includes a computing device, such as a processor ...”), 6:17-19 (“The AP ... includes a computing device, such as a processor ...”).

193. In my opinion, a POSITA would have been further motivated to use processors and software in Dean’s network devices because that would provide greater flexibility, instead of purely relying on hardware, to handle the different methods of estimating and transmitting link quality parameters and the different routing algorithms taught in Dean. Ex.1006, [0030]-[0035] (different ways of estimating path quality), [0036]-[0041] (different routing algorithms), [0021] (different ways to package/transmit network quality parameters).

194. In my opinion, a POSITA would also have been motivated to consult Bharghavan, which teaches using processors to perform virtually the same probe response suppression discussed in Dean. Bharghavan’s figure below illustrates a wireless network with a system coordinator (green) and APs (blue), and each of these network devices includes a computer processor. Ex.1007, 5:13-21, 6:17-22.



Ex.1007, FIG. 1.

195. Significantly, Bharghavan’s system coordinator uses a processor to select a single AP to respond to a client probe request—just like Dean. *Id.*, [0038] (“The system coordinator selects **one** of the AP’s for actually communicating with the wireless device ...”). In light of Bharghavan’s teachings, in my opinion a POSITA would have found it obvious to try using computers in Dean’s gateways (and APs) to handle probe response suppression, with good expectation of success. Additionally, in my opinion, the combination of Dean and Bharghavan 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 roaming functionality.

e. Element [1.4]: “receiving packets from a wireless device,”

196. In my opinion, Dean discloses this element or renders it obvious. As shown in Figure 4 and discussed above, a gateway (and its processor) receives packets from client devices and sends them to an external network such as the Internet.

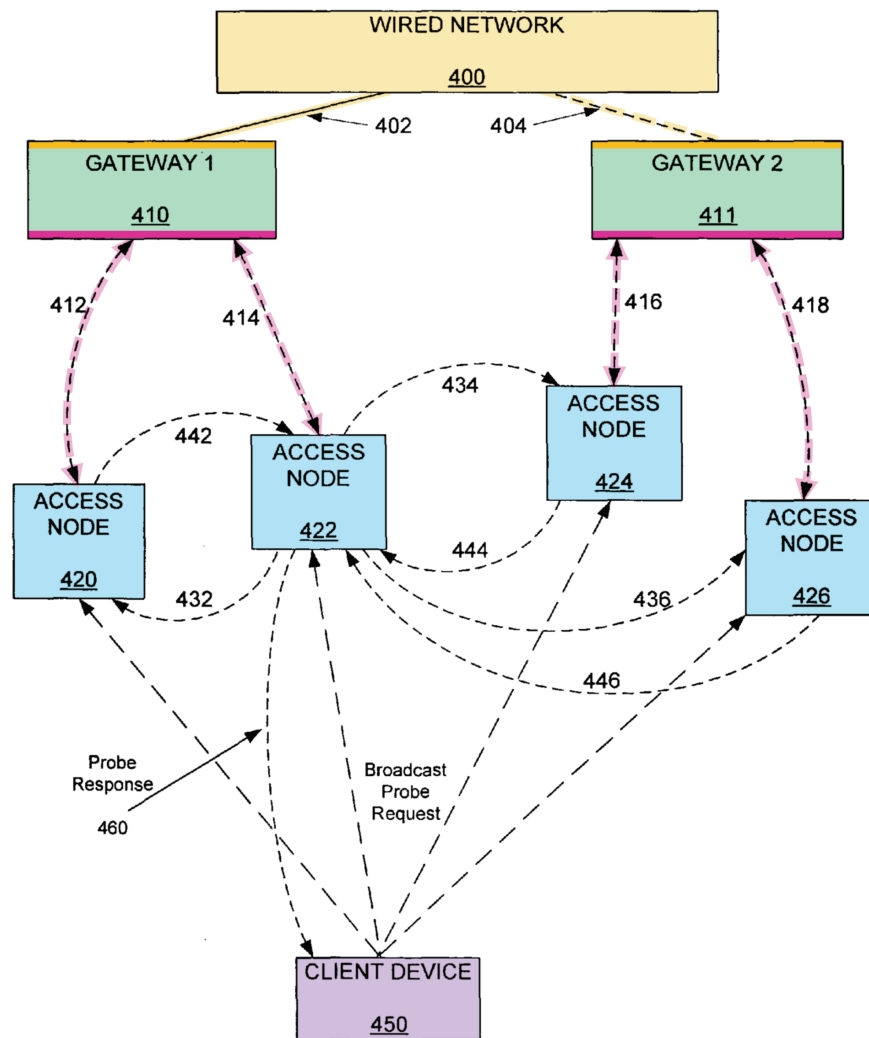


FIGURE 4

Ex.1006, FIG. 4; *see also* Section X.C.1(c) (gateway's connection to the Internet).

f. Element [1.5]: “identifying the wireless device within a table of wireless devices connected to a wireless access device in an extended wireless network”

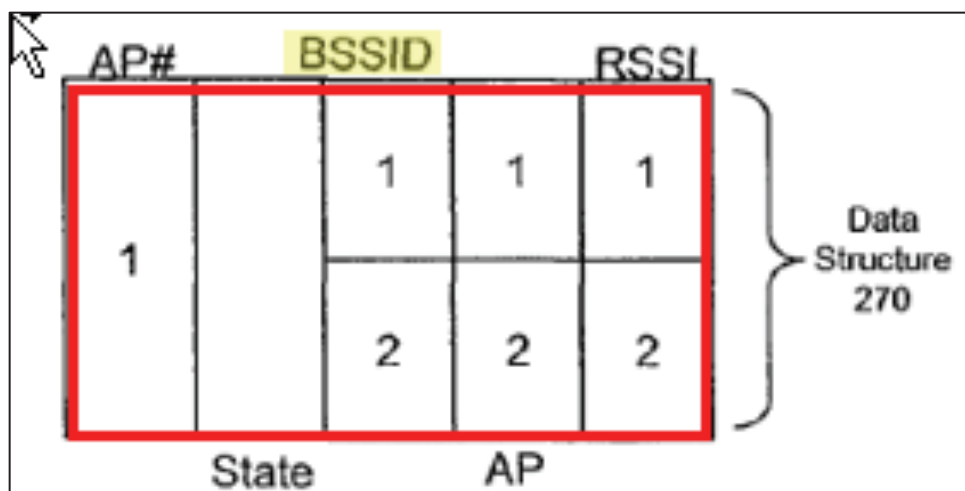
197. In my opinion, Dean, alone or in view of Bharghavan, renders obvious this element. As Dean explains, each AP that receives a probe request (receiving AP) from a client device estimates the link quality for that device—*e.g.*, by measuring the received signal strength (RSSI) of the probe request—and transmits that information (together with other network quality parameters) to other network devices, including to gateway(s). Ex.1006, [0015]-[0016], [0028].

198. In my opinion, a POSITA would have understood and found obvious that each gateway in Dean's network uses tables to conveniently store the records of wireless client devices that communicate with the network, including the identity of the device and other information *related* to that device, such as the device-to-receiving AP link quality (*e.g.*, RSSI) sent to the gateway by each receiving AP, and the identity of that receiving AP.

199. Indeed, tables have long been commonly used to store and retrieve such relational data. Ex.1009, 649 (describing relational databases “in which data is stored in multiple tables, whose rows represent records, and whose columns represent fields”); Ex.1010, 510 (“The table is the underlying structure of a relation.”). For example, in my opinion a POSITA would have understood (and

found it obvious) that a gateway includes tables with data structure, e.g., where each row represents a record of a wireless client device, and where the columns contain information *related* to that device, such as (1) the identity of the wireless device, (2) the identity of the current/serving AP, (3) the link quality measured and reported by the serving AP, (4) the link quality measured and reported by other receiving APs, and (5) the identity of those receiving APs.

200. In any event, in my opinion a POSITA would have looked for ways to efficiently store and quickly access (look up) the relational network information discussed in Dean and would have been motivated to consult Bharghavan, which teaches the use of tables for the same purpose. Ex.1007, 7:1-8 (“Each AP maintains a data structure such as a data structure 270. The data structure 270 [(table)] preferably includes a set of entries, each entry [(row)] preferably including an AP identifier, ... a set of identifiers for wireless devices (here shown as BSSIDs), a value that identifies the AP currently actively communicating with each wireless device, and at least one value that indicates a received signal strength indicator (RSSI) [] for that communication.”), *id.*, 5:22-34.



Ex.1007, FIG. 2 (excerpted).

201. In my opinion, a POSITA would have found the use of tables obvious to try with good expectation of success because tables have long been used to store the type of relational information discussed in Dean and Bharghavan. Ex.1009, 649; Ex.1010, 510.

- g. **Element [1.6]: “generating wireless connection quality information for the wireless device specific to the wireless access device, the wireless connection quality information including wireless connection quality information for at least one indirect communication path having at least one network extender device to establish the communication path between the gateway router and the wireless access device.”**

202. In my opinion, Dean discloses or renders obvious this element.

203. **First**, as discussed above under Section X.B.1(e), Dean’s extended network includes indirect, multi-hop communication paths having network extender device(s) because “[t]he number of wireless hops [in] the wireless mesh network is

not limited.” Ex.1006, [0039], [0038] (“hop count indicates the *number of wireless links* an access node [(AP)] is from a gateway”).

204. Dean’s teaching is illustrated in the modified Figure 4M below, which shows AP422 (red outline) (claimed wireless access device) communicating with gateway 410 (green) through *an indirect, two-hop communication path* (magenta) having another intermediate AP acting as network extender or relay node (RN).

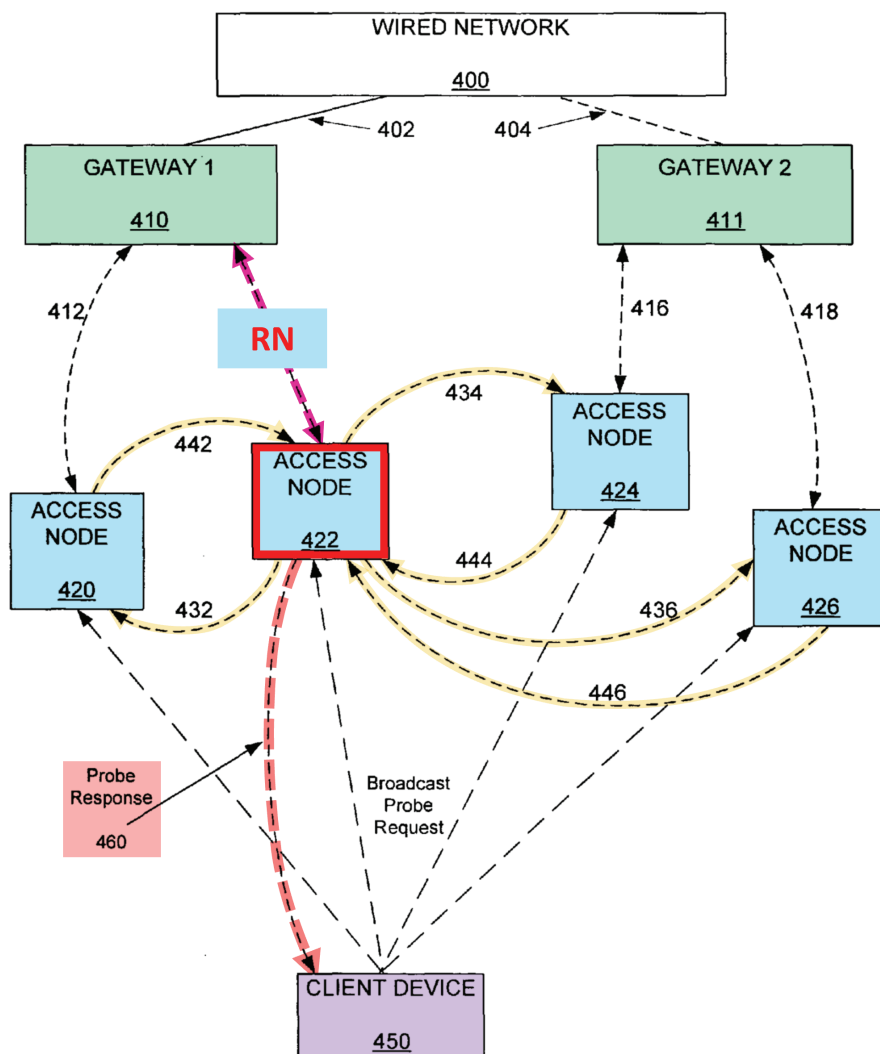


FIGURE 4

Ex.1006, FIG. 4M.

205. In Figure 4M, client device 450 (purple) is associated with AP422 (red outline), the only AP that responds to its probe request, and is the claimed “wireless device specific to the wireless access device [(AP422)].”

206. **Second**, as Dean teaches, gateway 410 (green)—more precisely, the computer processor in the gateway—generates network quality parameters (claimed wireless connection quality information) that are indicative of the quality of the indirect communication path (magenta) between the gateway and AP422 associated with the client device (purple). Ex.1006, [0041].

207. For example, the gateway’s processor determines the “upstream direction path quality” of that indirect communication path, from AP422 to the gateway. Ex.1006, [0041] (“The routing path quality can be determined in both the downstream direction (away from the default gateway) and the upstream direction (towards the default gateway). ... The **upstream quality** can be determined by an upstream device (access node or **gateway**)”), [0031]-[0032] (“The quality of the routing path can influence ... the data throughput and latency for data communication between the access node and the gateway [and]... effects the data communication of any client that associates with the access node.”).

2. Dependent Claim 2

- a. **“The gateway router of claim 1, wherein the computer processor is further configured to transmit the wireless connection quality information to other wireless access devices in the extended network.”**

208. In my opinion, Dean discloses this element or renders it obvious. As Dean explains, like any other network device, the gateway's processor transmits the wireless connection quality information it has determined to other network devices so that all devices can "perform a comparative link quality analysis and suppresses probe responses." Ex.1006, [0016], [0028] (gateways and APs perform probe response suppression).

3. Dependent Claim 3

- a. **"The gateway router of claim 1, wherein the computer processor is further configured to receive wireless connection quality information from a plurality of other network devices and to identify network device in the extended network providing the highest quality wireless connection for the wireless device."**

209. In my opinion, Dean discloses this element or renders it obvious. As discussed above in Section X.B.9(d), Dean teaches that each AP that receives a client device's probe request (receiving AP) estimates the link quality of the access link between it and the client device and broadcasts the link quality information to other network devices, including gateway(s), to perform probe response suppression. Ex.1006, [0016], [0028] (APs and gateways all perform probe response suppression).

210. Thus, as illustrated in Figure 4M, the processor in gateway 410 (green) is configured to receive wireless connection quality information (link quality information) from a plurality of other network devices (*e.g.*, AP420 and AP422) and

to identify network device (AP422) in the extended network providing the highest quality wireless connection for the wireless device.

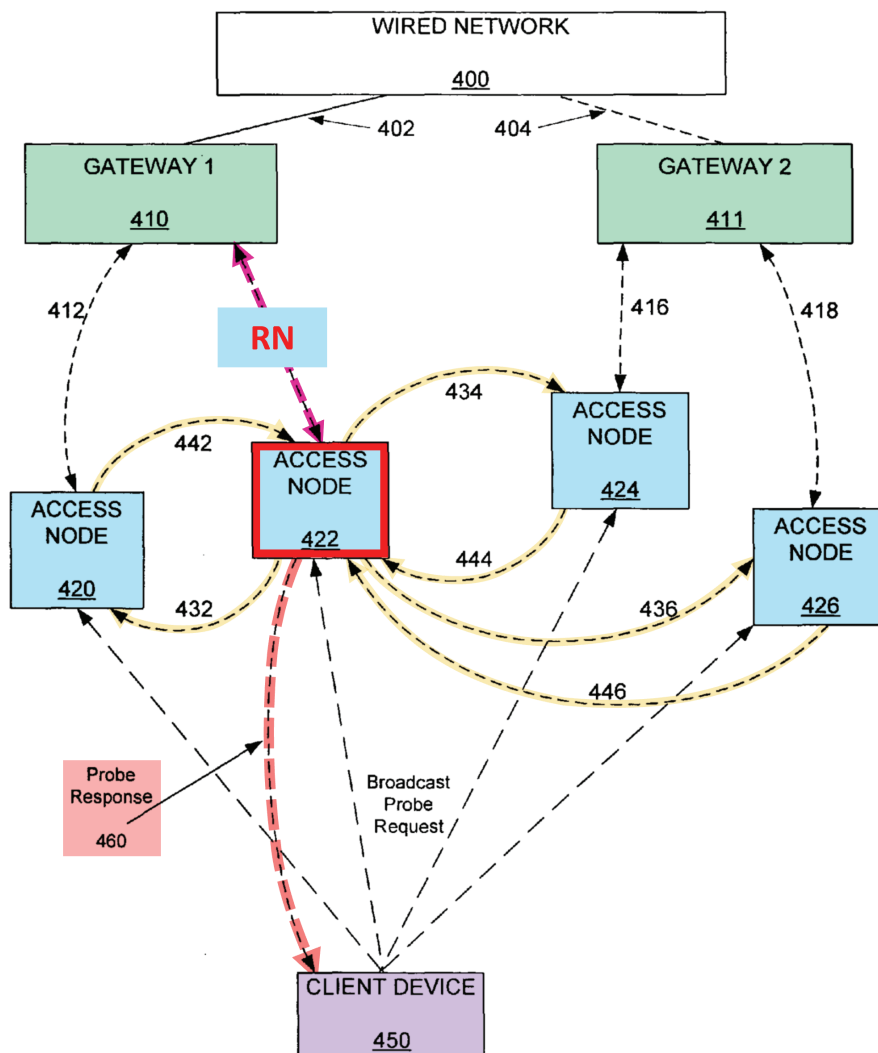


FIGURE 4

Ex.1004, FIG. 4M.

4. Dependent Claim 4

- a. “The gateway router of claim 3, wherein the processor is farther configured to initiate a wireless connection between the network device having the highest wireless connection quality and the wireless device.”

211. In my opinion, Dean discloses this element for the same reasons it discloses the additional limitation of claim 10. Section X.B.4. As the specification explains, each network device that exchanges link quality information with other network devices to select the AP having the highest connection quality, such as Dean's gateway, initiates the claimed connection. Ex.1001, 4:35-39.

5. Dependent Claim 5

- a. **“The gateway router of claim 4, wherein the processor is further configured to initiate the wireless connection with the network device having the highest wireless connection quality based on a connection check between the network device and the wireless device.”**

212. In my opinion, Dean discloses this element for the same reasons it discloses the additional limitation of claim 11. Section X.B.5.

6. Dependent Claim 6

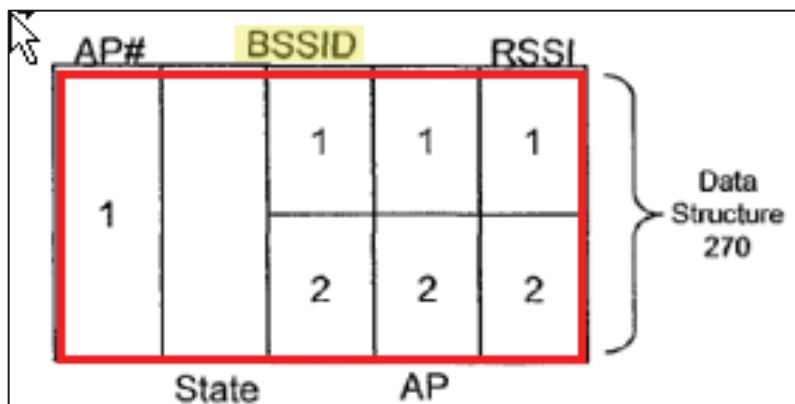
- a. **“The gateway router of claim 1, wherein the wireless connection quality information includes at least one of a wireless signal strength, a connection capability, a utilization status, a network topology, and a connection patch quality.”**

213. In my opinion, Dean discloses this element for the same reasons it discloses the additional limitation of claim 13. Section X.B.6. As discussed above in Section X.B.1(e), the gateway's processor determines for example the upstream link quality of the communication path between a serving AP and the gateway, which is the claimed connection path quality and/or connection capability. Ex.1006, [0031]-[0032], [0041].

D. Ground IV: Claims 1-6 Are Rendered Obvious by Liu in View of Bharghavan

214. As I discussed in Ground I, it is my opinion that Liu renders obvious all Challenged Claims. This ground further addresses element [1.5] of claim 1, which claims the use of a “table” in a gateway to store and retrieve (look up) relational network information, such as STA-MAP association. As I explained in Section X.A.1.f, Liu renders obvious the use of such a table.

215. In any event, in my opinion a POSITA would have looked for ways to efficiently store and access (look up) the relational network information discussed in Liu and would have been motivated to consult Bharghavan, which teaches the use of tables for that purpose. Ex.1007, 7:1-8 (“Each AP maintains a data structure such as a data structure 270. The data structure 270 [(table)] preferably includes a set of entries, each entry [(row)] preferably including an AP identifier,... a set of identifiers for wireless devices (here shown as BSSIDs), a value that identifies the AP currently actively communicating with each wireless device, ...”).



Ex.1007, FIG. 2 (excerpted).

216. In my opinion, a POSITA would have found the use of tables obvious to try with good expectation of success because tables have long been used to store the type of relational information discussed in Liu and Bharghavan. Ex.1009, 649; Ex.1010, 510. Additionally, in my opinion, the combination of Liu and Bharghavan 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 management of network information. Thus, in my opinion, Liu-Bharghavan renders obvious element [1.5] and, therefore, renders obvious claims 1-6 as detailed under Ground I.

XI. CUMULATIVENESS

217. In my opinion, the prior art references in this Petition are not cumulative of the references cited by the Examiner during prosecution of the '025 Patent. I note that the primary prior art references relied on in this Petition (Liu and Dean) were not cited or discussed during prosecution.

218. Moreover, the closest art discussed during prosecution, an application related to Bharghavan, was distinguished on the ground that it does not teach the use of quality information of an “indirect communication path.” Ex.1004, 52.

219. As discussed in Section X, both Liu and Dean teach network devices generating and broadcasting quality information of indirect, multi-hop communication paths and therefore, in my opinion, they are not cumulative with

Bharghavan. In the instant Petition, Bharghavan is used in Grounds III and IV for a limited purpose—to confirm the prevalent, well-known, use of processors and tables in network devices such as gateways and APs.

XII. CONCLUSION

220. For the aforementioned reasons, in my opinion, to a person of ordinary skill in the art, the Challenged Claims of the '025 Patent are rendered obvious by the prior art.

221. I understand that the Patent Owner has not asserted secondary considerations of non-obviousness. I reserve the right to respond to any such assertions.

222. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of the proceedings.

Declaration of Dr. Ding for *Inter Partes* Review of U.S. Patent No. 9,468,025

Date: September 8, 2023

Respectfully submitted,



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Date: 2023.09.08 18:48:38
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Zhi Ding, Ph.D.