UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner

U.S. Patent No. 10,051,556

DECLARATION OF DR. CHRISTOPHER HANSEN, UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW

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I, Christopher Hansen, do hereby declare as follows:

I. INTRODUCTION

1. I am making this declaration at the request of Cisco Systems, Inc., in the matter of the *Inter Partes* Review of U.S. Patent No. 10,051,556 ("the '556 patent") to Yoon *et al*.

2. I am being compensated for my work in this matter at my usual hourly rate for this work. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this investigation. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

3. I have been asked to provide my opinions regarding whether claims 1-4 and 9-11 ("the Challenged Claims") of the '556 patent are unpatentable as they would have been obvious to a person having ordinary skill in the art ("POSITA") at the time of the alleged invention, in light of the prior art. It is my opinion that all of the limitations of the Challenged Claims would have been obvious to a POSITA.

4. In the preparation of this declaration, I have studied:

a. the '556 patent, Ex.1001;

b. the prosecution history of the '556 patent ("'556 File History"), Ex.1002;

c. U.S. Patent No. 9,161,293 to Choudhary ("Choudhary"), Ex.1005;

d. U.S. Patent No. 7,058,018 to Hasty ("Hasty"), Ex.1006;

e. U.S. Patent No. 8,503,390 to Chen ("Chen"), Ex.1007;

5. In forming the opinions expressed below, I have considered:

the documents listed above;

the relevant legal standards, including the standard for obviousness, and any additional authoritative documents as cited in the body of this declaration; and

my own knowledge and experience based upon my work in the field of optical communication as described below, as well as the following materials:

a. 802.11h-2003, Ex.1008;

b. 802.11k-2008, Ex.1009;

c. U.S. Patent No. 8,363,617 to Meyer ("Meyer"), Ex.1010;

6. Unless otherwise noted, all emphasis in any quoted material has been added.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

7. My qualifications and professional experience are described in my *Curriculum Vitae*, a copy of which can be found in Exhibit 1004. The following is a brief summary of my relevant qualifications and professional experience.

8. I am currently an independent technical consultant based in Los Altos, California. I work at Covariant Corporation, which is a consulting company that I own. My primary areas of expertise are in the fields of wireless networking, wireless standards development, and signal processing for wireless communications. I received a Bachelor of Science (B.S.) degree in Electrical Engineering from Rensselaer Polytechnic Institute in 1987, a Master of Science (M.S.) in Electrical Engineering from the University of Massachusetts, Amherst in 1989, and a Ph.D. in Electrical Engineering from the University of California, Los Angeles ("UCLA") in 1997.

9. I was employed by Broadcom Corporation ("Broadcom") in Sunnyvale, California from January 2000 to May 2012. From January 2000 to February 2011, I held several titles, including Sr. Staff Scientist, Engineering Manager, and Sr. Principal Scientist. My duties in these roles included, among other things, Institute of Electrical and Electronics Engineers ("IEEE") 802.11 (i.e., Wi-Fi) physical layer ("PHY") application-specific integrated circuit ("ASIC") development. I also participated in Bluetooth standard development during this timeframe. From March 2011 to May 2012, I served as an Associate Technical Director and my duties included, among other things, performing wireless communications technology research and development ("R&D") as well as standards and intellectual property development.

10. While employed at Broadcom, I regularly attended meetings for the IEEE 802.11 Working Group. I submitted technical contributions to Task Group E ("TGe"), Task Group H ("TGh"), and Task Group N ("TGn").

11. I served on the Board of Directors of the Wireless Gigabit Alliance ("WiGig Alliance") from March 2010 to March 2012. Specifically, I served as the Board's Secretary. The WiGig Alliance was a trade association focused on the development and promotion of high-speed wireless communications technology. The WiGig Alliance collaborated for multiple years with the Wi-Fi Alliance (an industry organization that owns the "Wi-Fi" brand and certifies devices for interoperability and security), and the two organizations eventually merged in 2013.

12. I served as the Vice Chair of the IEEE 802.11ad Task Group ("TGad") from May 2011 to March 2012. TGad developed an amendment to the IEEE 802.11 wireless networking standard focused on directional multi-gigabit (i.e., DMG) technology. In this role, I assisted the task group Chair, Eldad Perahia, and Technical Editor, Carlos Cordeiro, with the operation of the task group meetings and developing the 802.11ad draft standards amendment documents.

13. I was employed as a Senior Wireless System Architect by Apple Inc. ("Apple") in Cupertino, California from June 2012 to July 2013. During my tenure at Apple, I was responsible for, among other things, performing systems engineering for iPhone Operating System ("iOS") Wi-Fi functionality. During this time, I participated in multiple IEEE 802.11 groups, including Task Group AF ("TGaf") and the HEW Study Group, on behalf of Apple.

14. I served as a member of the Board of Directors for the Professional and Technical Consultants Association ("PATCA") in Silicon Valley, California from March 2017 to March 2024. I was President of the Board of Directors from June 2019 to March 2024. PATCA is a non-profit corporation that supports technical consultants in Silicon Valley and elsewhere.

15. Since June 2020, I have been employed as a Guest Instructor for the UCLA Department of Electrical and Computer Engineering. I teach classes on wireless communications for upper-level undergraduate students and graduate students in electrical engineering. In these classes, I use examples from the IEEE 802.11 standards.

16. I am a named inventor on over 100 issued United States patents related to wireless communications, signal processing, and integrated circuits.

17. I have been a member of the Institute of Electrical and Electronics Engineers ("IEEE") since 1983 (42 years) and am currently a Senior member. I have participated in the activities of the IEEE Standards Association ("IEEE-SA") continuously since 2000. I have participated in the IEEE 802.11 Wireless Local Area Networks ("WLAN") Working Group as a voting member since 2000.

III. RELEVANT LEGAL STANDARDS

18. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the ’556 patent, I am relying on certain basic legal principles that counsel have explained to me. These principles are discussed below.

19. I understand that prior art to the ’556 patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the ’556 patent. For purposes of this Declaration, I am applying June 28, 2012 as the earliest possible priority date of the ’556 patent.

20. I have been informed that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been informed by counsel that the obviousness analysis takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

21. I have been informed by counsel that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

IV. LEVEL OF ORDINARY SKILL IN THE ART

22. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

23. A person of ordinary skill in the art ("POSITA") in the field of the '556 patent, as of its earliest possible priority date of June 28, 2012, would have been someone knowledgeable and familiar with wireless communications including wireless networks and local area networks (WLAN) based on IEEE

802.11 standards. That person would have a bachelor's degree in electrical engineering, computer science, or equivalent training, and approximately two years of experience implementing IEEE 802.11. Lack of work experience can be remedied by additional education, and vice versa.

24. For purposes of this Declaration in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of the priority date of the '556 patent. Unless otherwise stated, when I provide my understanding and analysis below, it is consistent with the level of a POSITA prior to the priority date of the '556 patent.

V. BACKGROUND

1. Wireless Networks

25. In an 802.11 environment, client devices (mobile stations) connect to access points that provide connectivity to a fixed network. "An Access Point (AP) in 802.11 infrastructure mode (IBSS) operates at a fixed Radio Frequency (RF) frequency selected from one of the set of frequencies permitted in the country of operation." Choudhary, 1:8-11. These frequencies are often referred to as channels. Each wireless network is uniquely identified by a default alpha-numeric name called an SSID. An AP sends periodic 802.11 beacons to announce its presence on the medium in addition to other 802.11 specific purposes. *See* Choudhary, 1:11-14.

2. Active Scanning

26. "When a wireless computing device (also referred to as a "station" or "node") wants to access a WLAN, for example after power-up, sleep mode, or moving to a new area, the wireless computing device searches for access points (APs) by scanning." Meyer, 1:16-20. The client devices (mobile stations) such as a phone or laptop discover nearby APs using passive or active scanning. Client devices are commonly referred to by several names, including mobile unit (MU), mobile station (MS), and non-AP station (STA).[1] "In active probing, an MU sends an 802.11 broadcast probe request at a lowest supported data rate on a specific frequency and listens for a response from AP(s) on that frequency" Choudhary, 1:21-24. Those probe responses carry radio metrics so the MS can choose the best AP. Then, "the MS selects an AP corresponding to a channel with the best signal quality as a new AP based on the signal quality information in the probe response message," where the "signal quality information includes signal strength or a signal to noise ratio" Chen, 3:50-55.

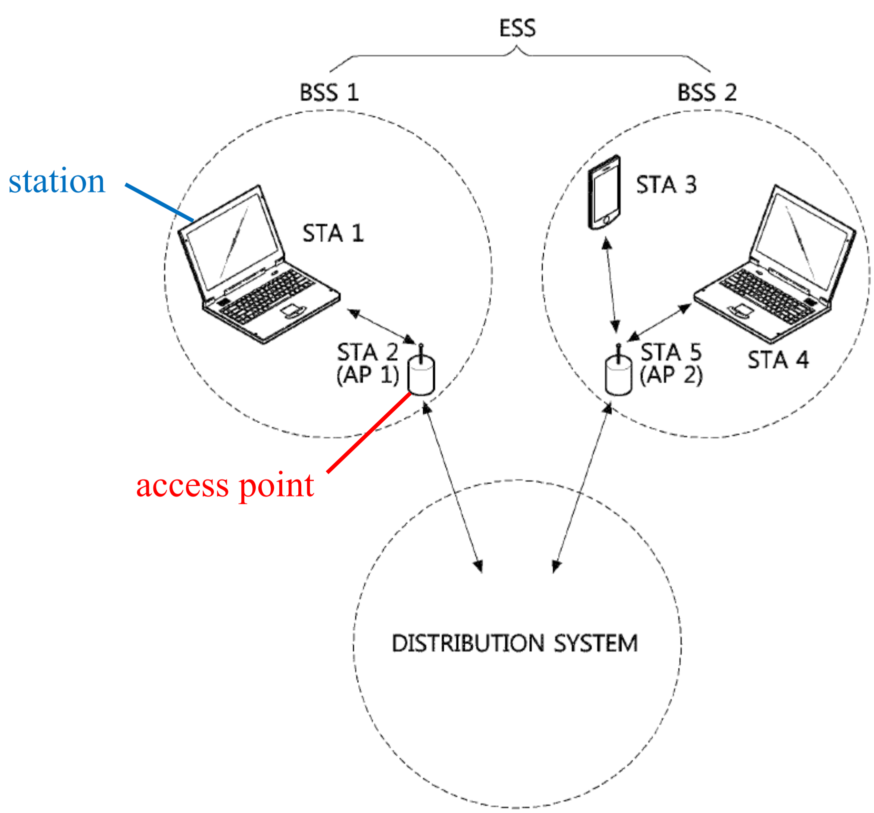
[1] Note that in the nomenclature of the IEEE 802.11 standard, an access point is also considered to be a station (STA).

VI. OVERVIEW OF THE ’556 PATENT

1. Summary of the ’556 patent

27. The ’556 patent “relate[s] in general to the field of an access point scan method, and more particularly, to an access point scan method using an active scan scheme in a wireless LAN system.” ’556 patent, 1:15-20. An exemplary access point and station (e.g., a mobile device) is shown in Fig. 1 below.

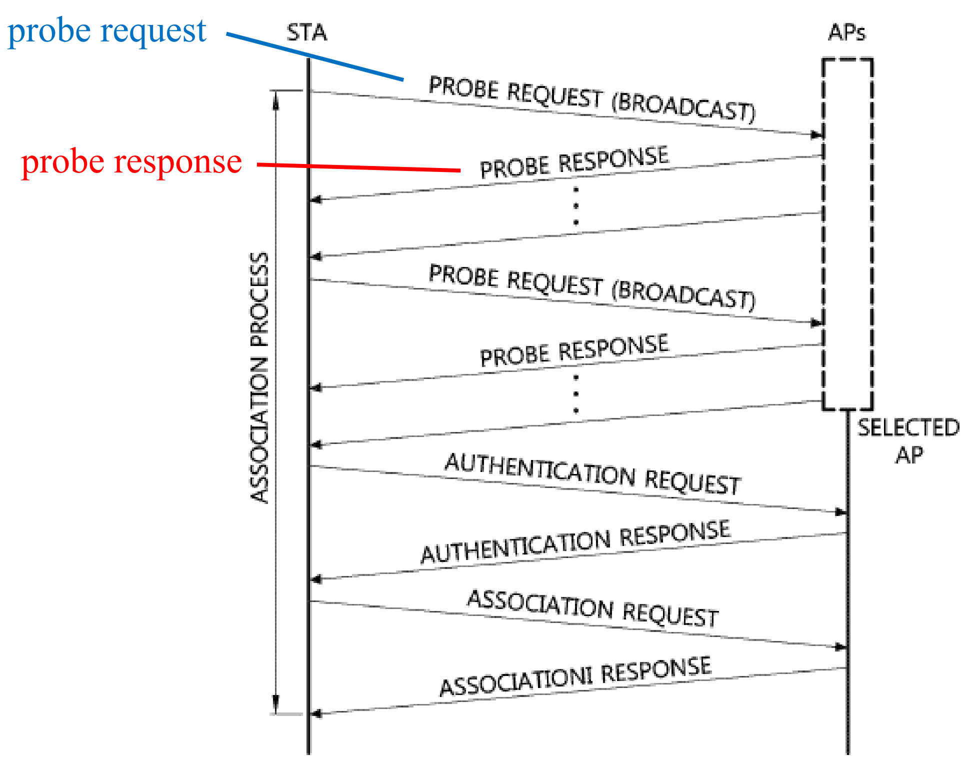
FIG. 1



’556 patent, Fig. 1 (annotated).

28. The ’556 patent describes a technique whereby an access point only responds to a station’s probe request that meets a quality threshold. In particular, the access point (AP) receives from a mobile station a probe request that includes "signal strength information of the station." '556 patent, 2:31. Using the signal strength information, the access point evaluates whether the "uplink quality" meets a "predetermined standard." '556 patent, 2:37-41. The access point then "transmit[s] a probe response frame to the station if the uplink quality satisfies a predetermined standard." '556 patent, 10:48-53. A probe request and response is illustrated in Fig. 2 below.

FIG. 2



'556 patent, Fig. 2 (annotated).

29. The "signal strength information" may include the station's transmit power. The STA "generat[es] a probe request frame including signal strength information of the station." '556 patent, 8:7-11. "The signal strength information may include information about transmission power of the station," and thus "the signal strength may represent transmission power." '556 patent, 7:66-8:5.

30. The AP uses the signal strength information from the probe request—specifically the STA's transmit power combined with the received signal strength at the AP—to compute uplink path loss and thereby evaluate uplink quality. The patent explains that the AP "acquir[es] information about uplink quality based on signal strength information of the station included in the probe request frame." '556 patent, 10:45-50. The "uplink quality information" includes "uplink path loss information." '556 patent, 10:60-68. The AP "may acquire an uplink path loss through a difference between the transmission power of the station included in the probe request frame and received signal strength of the probe request frame." '556 patent, 10:60-68.

31. The background section of the '556 patent explains the timing of an active scan procedure according to the 802.11 standards. Conventionally, a station "receives a probe response frame from the access points during a maximum probe response time Max_Probe_Response_Time, and requests access" afterward. '556 patent, 1:63-2:8. The '556 patent disparages the concept of waiting until the timer expires as a "waste of time." '556 patent, 2:5-9. The purported novelty—as described in the specification—is that "[t]he station may perform an access to the certain access point ***before*** a preset maximum probe response time elapses." '556 patent, 10:32-37; Fig. 12.

32. Despite disparaging the concept of waiting until the probe timer expires before creating access, the '556 patent was allowed after adding this feature to the claims. The claims were allowed after the Applicant added the following limitation: "*wherein the station access the access point based on the probe response frame and a maximum probe response time*."

33. As I explain below, however, neither the reasons for allowance (waiting until the timer expires before access) or other claimed concepts (placing signal strength information in a probe request) were new as of the '556 patent's earliest possible priority date.

2. Prosecution History of the '556 patent.

34. The '556 patent was on June 9, 2017, and ultimately claims priority to two Korean applications—one filed on June 28, 2012, and the other filed on June 4, 2013. '556 patent, Face.

35. In a first Office Action, the claims were rejected as being obvious over U.S. Patent Publication No. 2016/0007386 to Park ("Park") in view of U.S. Patent No. 2009/004663 to Thomson ("Thomson"). Ex.1002, 64. In response, the Applicant amended the claims to recite "*wherein the station access the access point based on the probe response frame and a maximum probe response time*."

Ex.1002, 78. Applicant then argued that "Applicant respectfully submits that Thomson fails to teach or suggest a maximum probe response time **during which the station waits for a response**." Ex.1002, 45. The Office then allowed the claims finding that the arguments related to this amendment were persuasive. Ex.1002, 23.

36. However, the concept of waiting for a "*maximum probe response time*" for response frames from access points was well known. Indeed, the background section of the '556 patent states that this was part of the 802.11 standards. '556 patent, 1:16-2:14. The background section further disparages this concept as a "waste of time." In other words, the Examiner erroneously allowed the claims for reciting what the '556 patent itself acknowledges was already known.

VII. CLAIM CONSTRUCTION

37. It is my understanding that in order to properly evaluate the '556 patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be construed under the so-called *Phillips* standard, under which claim terms are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in light of the specification and prosecution history, unless the inventor has set forth a special meaning for a term. I do not believe any of the terms require express construction, and that the plain and ordinary meaning should be applied

VIII. DETAILED IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

38. I have been asked to provide my opinion as to whether the Challenged Claims of the ’556 patent would have been obvious in view of the prior art. The discussion below provides a detailed analysis of how the prior art references identified below teach the limitations of the Challenged Claims of the ’556 patent.

39. As part of my analysis, I have considered the scope and content of the prior art and any differences between the alleged invention and the prior art. I describe in detail below the scope and content of the prior art, as well as any differences between the alleged invention and the prior art, on an element-by-element basis for each Challenged Claims of the ’556 patent.

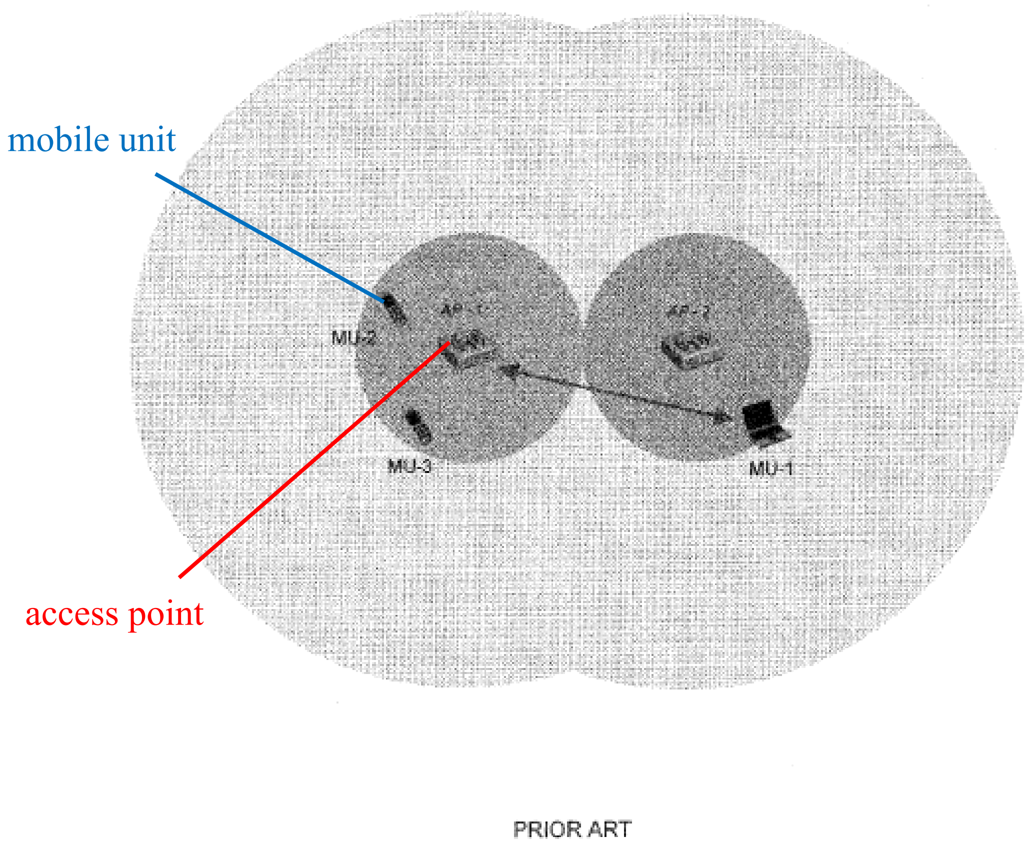
40. As described in detail below, the alleged invention of the Challenged Claims would have been obvious in view of the teachings of the identified prior art references as well as the knowledge of a POSITA.

A. Ground 1: Claims 1-4 and 9-11 are rendered obvious by Choudhary, Hasty, and Chen.

1. Summary of Choudhary

41. Like the ’556 patent, Choudhary relates to “active probing,” in which “an MU sends an 802.11 broadcast probe request at a lowest supported data rate on a specific frequency and listens for a response from AP(s) on that frequency.”

Choudhary, 1:22-25. Exemplary mobile units and access points are illustrated in Fig. 1 below.



Choudhary, Fig. 4 (annotated).

42. Also like the ’556 patent, Choudhary describes an access point that only responds to probe requests that meet certain criteria: “The presently disclosed invention utilizes RSSI [Received Signal Strength Indicator] filtering for selectively accepting or responding to an 802.11 frame **based on RSSI or some metric derived from RSSI**.” Choudhary, 7:4-6. Choudhary explains that an “AP [Access Point] radio is configured with an RSSI threshold for sending probe response. Probe responses are not sent if the received probe requests do not meet the required RSSI threshold." Choudhary, 7:16-18. The purpose of this is for "testing if the client is close enough to the AP to benefit from associating with the AP. If the client is not close enough then there is no point indicating anything to the client since it won't associate with the AP anyway." Choudhary, 7:18-23.

43. Accordingly, Choudhary shows that it was known for access points to only respond to probe requests that meet certain quality thresholds based on the RSSI or a metric derived from the RSSI.

2. Summary of Hasty

44. Hasty provides an example of using a link quality metric that is derived from the RSSI to calculate path loss as a measure of link quality. Hasty describes using the RSSI along with transmission power as a path loss metric: "An object of the present invention is to provide a system and method for computing the path loss along a link … using transmitted power level information contained in a received data packet and the receive signal strength indication (RSSI) at which the data packet is received." Hasty, 2:48-53. "Specifically, an embodiment of the present invention uses the available per-packet receive signal strength indication (RSSI) from an 802.11 physical layer combined with the per-packet transmitted power level to evaluate the path loss along a link for a packet sent within the network 100." Hasty, 4:39-45.

45. Accordingly, Hasty shows that it was known to use the transmission power of a station along with the RSSI to calculate path loss (i.e., a quality metric that is derived from the RSSI).

3. Reasons to Combine Choudhary and Hasty

46. A POSITA would have found it obvious for Choudhary's probe request to include a power transmit level to allow the access point to use path loss as a quality metric derived from RSSI for determining whether to respond to a probe request. Choudhary, 7:4-6; Hasty, 2:48-53. By comparing the transmit power level with the RSSI, the path loss provides a beneficial measure of the link quality, thereby aiding Choudhary's goal of not responding to low quality probe requests which are not likely to connect to the access point anyway. Choudhary, 7:18-23.

47. As explained above, Choudhary describes a method in which an access point selectively responds to probe requests: "An AP radio is configured with an RSSI threshold for sending probe response. Probe responses are not sent if the received probe requests do not meet the required RSSI threshold." Choudhary, 7:15-16. Choudhary describes this selective process as "filtering": "The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an 802.11 frame **based on RSSI or some metric derived from RSSI**." Choudhary, 7:4-6. Because Choudhary states that other metrics derived from RSSI would be suitable for filtering, a POSITA would have found it obvious to look to known metrics derived from the RSSI.

48. Hasty provides an example of a known metric derived from the RSSI. As described above, Hasty describes "an embodiment [that] uses the available per-packet **receive signal strength indication (RSSI)** from an 802.11 physical layer **combined with the per-packet transmitted power level** to evaluate the path loss along a link for a packet sent within the network 100." Hasty, 2:48-53.

49. Hasty describes various metrics that are derived from the RSSI. In one example, Hasty describes using path loss as a metric. Path loss is determined by the difference between the transmitted power and the power measured by the receiver (i.e., RSSI). As explained by Hasty, "[a]n object of the present invention is to provide a system and method for **computing the path loss** along a link between nodes in a wireless ad-hoc communications network using transmitted power level information contained in a received data packet and the receive signal strength indication (RSSI) at which the data packet is received." Hasty, 2:48-53.

50. In another example, Hasty describes using a link quality ratio (LQR) metric. Hasty provides an equation for calculating a link quality ratio (LQR) that uses both the transmit power level (TPL), measured RSSI, and the receiver sensitivity (which is the minimum power needed to successfully receive a transmitted packet). All of these values are represented in decibels (dBm). Hasty's LQR "equation represents an example of the manner in which the value of the link quality ratio (LQR) of the link … that yields a ratio which can be used to measure the per packet link quality between wireless nodes in the network 100." Hasty, 4:65-5:20.

51. Hasty's use of path loss or LQR as a quality metric provides various benefits. Hasty explains that "[t]he per-packet path loss is used as a metric that determines the integrity of a link between two 802.11-compliant nodes 102, 106 or 107, as well as the probability that future packets will be successfully transmitted on the link between the two nodes." Hasty, 4:46-48. This is consistent with Choudhary's goal of only responding to probe requests for mobile stations that are close enough for a quality connection. *See* Choudhary, 7:15-23.

52. A POSITA would have been motivated to use path loss rather than RSSI alone for various reasons. For example, an AP receiving a probe request with a low RSSI power level cannot distinguish between (1) a nearby client with a low transmission power, or (2) a distant client with a normal amount of signal attenuation. Using path loss as taught by Hasty facilitates providing service to a station that is nearby (there is relatively little path loss) but simply has a low-power transmitter. This is consistent with Choudhary's goal of "testing if the client is close enough to the AP to benefit from associating with the AP." Choudhary, 7:17-20. The AP may also ignore requests from distant clients that may be better served by a different access point. Again, this is consistent with Choudhary's explanation that "[i]f the client is not close enough then there is no point indicating anything to the client since it won't associate with the AP anyway." Choudhary, 7:19-22.

53. A POSITA would have understood that if a client device and an access point cannot successfully transmit packets to one another, then the client would not benefit from associating with that access point. This is because an important purpose in establishing an association with an access point is for the client device to communicate with other network devices by sending and receiving packets to and from the access point.

54. Moreover, a POSITA would have been motivated to use Hasty's RSSI-derived metrics at least as known, suitable options. Indeed, Choudhary explicitly identifies that there are other RSSI-derived metrics that are suitable options. Choudhary, 7:4-6.

55. A POSITA would have had a reasonable expectation of success because both Choudhary and Hasty seek to be compliant with IEEE 802.11. Choudhary, 7:4-6 ("The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an 802.11 frame based on RSSI or some metric derived from RSSI."); Hasty, 4:39-45 ("an embodiment of the present invention uses the available per-packet receive signal strength indication (RSSI) from an 802.11 physical layer combined with the per-packet transmitted power level to evaluate the path loss along a link for a packet sent within the network

100."). And Choudhary explicitly contemplates success with other RSSI-derived metrics like path loss or LQR. Choudhary, 7:5-6.

56. Indeed, IEEE 802.11 provides a frame structure that allows for sending a transmit power level. 802.11k-2008, 95 ("The Link Measurement Request frame uses the Action frame body format and is transmitted by a STA to request another STA to respond with a Link Measurement Report frame to enable measurement of link path loss and estimation of link margin. The format of the frame is shown in Figure 7-101c."); *see also* 802.11h-2003.

	Category	Action	Dialog Token	Transmit Power Used	Max Transmit Power	Optional sub-elements
Octets:	1	1	1	1	1	variable

Figure 7-101c—Link Measurement Request frame body format

802.11k-2008, 95.

57. Accordingly, implementing Choudhary's link quality measurement technique according to Hasty's known RSSI-derived metric would have been predictable. Hasty' technique of using RSSI-derived metrics functions in Choudhary in the same way—placing the transmit power in a packet so that the receiving entity can calculate path loss.

58. Accordingly, the combination of Choudhary and Hasty represents the use of known technique (Hasty's calculation of path loss or LQR for a quality metric) to improve similar methods (Choudhary's use of quality metrics for probe response filtering) in the same way (by placing the transmit power level in the probe request).

4. Summary of Chen

59. Chen's background section describes what was known in IEEE 802.11 with regard to probe response timing. Chen discusses the "802.11 specifications which suggests that when switching an AP, an MS should transmit a probe message on all channels one by one, and stop communicating with the original AP to wait for a probe response message. Only when all probe response messages are received, can the MS select a new AP among all the APs probed." Chen, 1:40-46. "the **Max Channel Time** for waiting for each of the probe response message is 10-100 ms, and the typical value of the **Max Channel Time** is 50 ms." Chen, 1:46-49. Chen explains an example scanning procedure as follows:

> Two time points for waiting for the probe response message are pre-set in the MS, they are the minimum waiting time (minReplyWait) and the **maximum waiting time (maxReplyWait)** respectively, and the minReplyWait is less than the maxReplyWait. In the step 104, when the timing by the timer reaches the minReplyWait, if the MS has not received any probe response message, which indicates that no available network has been found, the scanning is stopped in the step 105; if the MS has received a probe response message, then in the step 106 the received probe response message is buffered and the timing continues.

> Then, it is decided in the step 107 whether the timer has reached the **maxReplyWait**. If the timer has reached the maxReplyWait, the scanning stops in the step 109.

Chen, 2:4-23.

60. Chen then explains that "After the timer has reached the maxReplyWait, the scanning is stopped, and the … AP corresponding to the probe response message having the biggest SNR is selected as the new AP." Chen, 2:24-29. Accordingly, Chen provides an example of the timing used in scanning procedures for IEEE 802.11.

5. Reasons to Combine Chen with Choudhary and Hasty.

61. A POSITA would have found it obvious to implement Choudhary's active scanning procedures according to the known 802.11 standard's timing suggestions as evidenced by Chen.

62. Choudhary explains that its technique utilizes the 802.11 specifications: "The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an 802.11 frame based on RSSI or some metric derived from RSSI." Choudhary, 7:4-6. Choudhary describes probe requests and probe responses of the active scanning procedure generally. *See* Generally Choudhary. Choudhary also briefly mentions the timing associated with probe requests and probe responses: "probe responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes." Choudhary, 7:28-31. Accordingly, Choudhary assumes that a POSITA would be familiar with the overall timing structure of 802.11 scanning procedures. Since Choudhary does not describe modifying the timing aspect of sending probe requests and waiting for probe responses, a POSITA would have found it obvious to implement Choudhary's techniques using the timing provided for in the IEEE 802.11 standard as described in Chen.

63. Chen explains probe response timing according to the 802.11 specifications: "IEEE 802.11 specifications [suggest] that when switching an AP, an MS should transmit a probe message on all channels one by one, and stop communicating with the original AP to wait for a probe response message. Only when all probe response messages are received, can the MS select a new AP among all the APs probed." Chen, 1:40-46. Chen further explains that "Since the Max Channel Time for waiting for each of the probe response message is 10~100 ms, and the typical value of the Max Channel Time is 50 ms, then the time for waiting for all probe response messages is n*Max Channel Time, where n is the number of the channels probed." Chen, 1:46-52.

64. A POSITA would have thus found it obvious for Choudhary's access points to grant access based on the known 802.11 timing procedures for active scanning. Using standardized techniques would have ensured compatibility with a wide variety of products and increased the marketability of Choudhary's product.

Using these standardized techniques, a POSITA would have implemented Choudhary's devices to similarly wait until all probe responses had been received on the channels being probed before accessing the selected AP.

65. Even the background section of the '556 patent itself confirms that this timing procedure was known. "Upon requesting responses from a plurality of undesignated access points by setting a service set identifier (SSID) of a probe request frame in a state of null, the station receives a probe response frame from the access points during a maximum probe response time." '556 patent, 1:61-66. "Even after a probe response frame is received from an access point having a superior wireless environment, the station waits for the maximum probe response time to pass, and then requests an access at the access point." '556 patent, 2:2-5.

66. The combination of Choudhary and Chen thus predictably results in the mobile station waiting for probe responses until the Max Channel Time timer expires. *See* Chen, 1:40-52. Given that the IEEE 802.11 standards were well established and widely adopted, a POSITA would have had a reasonable expectation of success in implementing Choudhary's scanning procedure in accordance with the 802.11 timing.

67. Accordingly, the combination of Chen with Choudhary represents applying a known technique (Chen's 802.11 scanning procedure timing) to a known method (Choudhary's 802.11 scanning procedure) ready for improvement to yield predictable results (the mobile station waits for probe responses until a timer expires). Additionally, the combination merely represents the combination of prior art elements (probe request messages taught by Choudhary as modified by Hasty; waiting for probe response messages as taught by Chen) according to known methods (IEEE 802.11) to yield predictable results (an active scanning process where an access point filters probe requests based on a metric derived from RSSI, and where a client device waits until a timer expires before choosing whether to associate with the access point).

6. Claim 1

[1.0] ***A method for active scanning performed by a station, the method comprising:***

68. **First**, Choudhary describes "*active scanning.*" Consistent with IEEE 802.11, this scanning process is referred to in Choudhary as active probing.

> A wireless client (also referred to as a mobile device or mobile unit (MU)) **<u>scans the presence of desired SSID on a wireless medium on a given RF using active probing</u>** or passive scanning. A wireless device may include, but is not limited to a laptop computer, a cellular telephone, a tablet, a Personal Digital Assistant (PDA) or the like. **<u>In active probing, an MU sends an 802.11 broadcast probe request at a lowest supported data rate on a specific frequency and listens for a response from AP(s) on that frequency</u>**. The broadcast probe request may be heard by multiple APs on a given frequency. **<u>All the APs that hear the broadcast probe may send a unicast response to</u>**

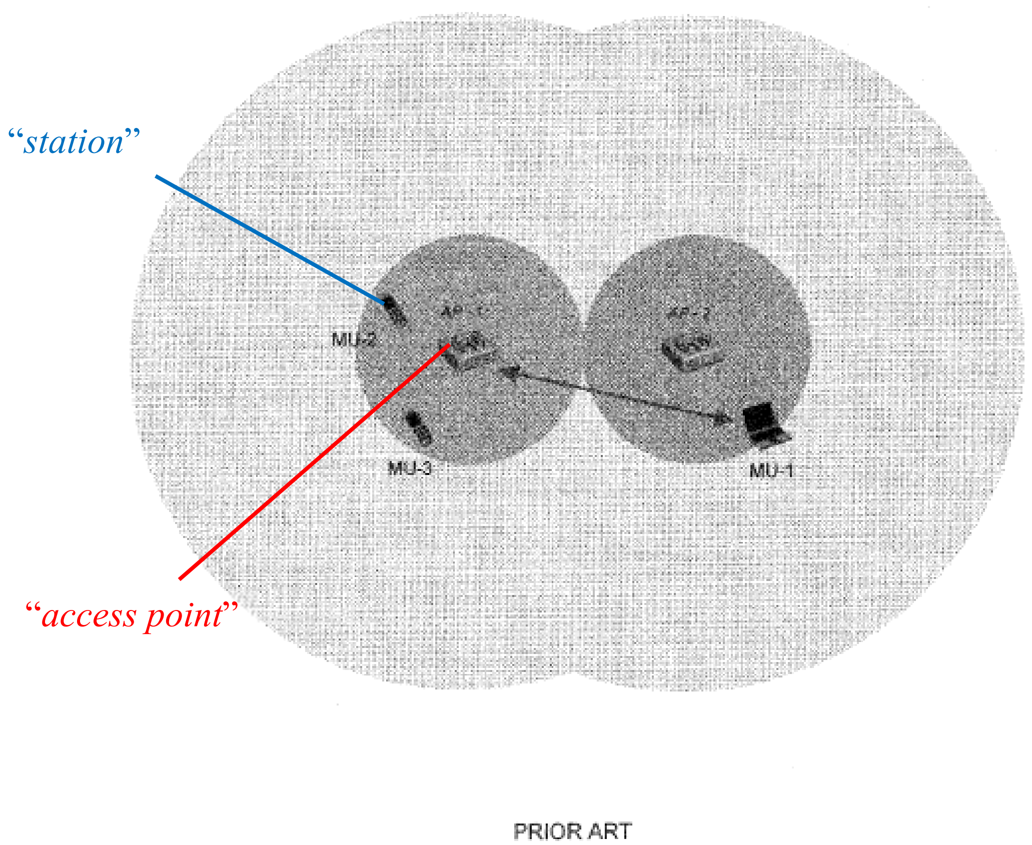
> **the wireless client that sent the probe request. Probe responses have almost the same information that is present in the AP beacon**. The SSID is always present in the probe response. Probe responses are sent at the same data rate as beacons so they take almost the same time to transmit on the air as beacons. Since the probe responses are unicast, an AP may send one or more retries if the probe response is not acknowledged by the client. Probe responses and probe response retries decrease the wireless medium airtime available for application data communication.

Choudhary, 1:16-36.

> FIG. 6 shows where an MU **scans all channels using active broadcast probing**. AP-1 does not respond to probe request since the received RSSI is below the configured threshold for probes. AP-2 responds to the probe request. The MU discovers only AP-2 by active probing. MU-1 authenticates and associates with AP-2 which is the desired AP for MU-1 in this case.

Choudhary, 7:50-56.

69. This is similar to how active scanning is described in the background section of the '556 patent: "According to the active access point scan method, a station transmits a probe request frame, and an access point having received the probe request frame transmits a probe response frame in response to the received probe request frame." '556 patent, 1:58-62. Choudhary illustrates an example environment in which active scanning occurs. This example environment is shown in Fig. 4 below.



Choudhary, Fig. 4 (annotated).

70. **Second**, Choudhary explains that the active scan method is performed in part by a mobile unit (MU) ("*station*"), which sends probe requests and receives responses to those probe requests.

> Embodiments of the invention significantly overcome such deficiencies and provide mechanisms and techniques that provide Received Signal Strength Indicator (RSSI) filtering to provide air-time optimization in wireless networks. **<u>In a particular embodiment the method includes receiving at the AP at least one message from a mobile unit (MU)</u>**.

> The method further includes determining whether an RSSI value associated with the at least one message from a MU is greater than a predetermined threshold. **The method additionally includes responding to the at least one message from a MU when the RSSI value associated with the at least one message** from a MU is greater than to the predetermined threshold.

Choudhary, 2:63-3:7.

> Referring to FIG. 10, a particular embodiment of a method 100 for using Received Signal Strength Indicator (RSSI) filtering to provide air-time optimization in wireless networks is shown. This method relates to APs and unassociated mobile units. **Method 100 begins with processing block 102 which discloses receiving at the AP at least one message from an unassociated mobile unit (MU) from which RSSI can be determined**. As shown in processing block 104, in this embodiment the message comprises **a probe request message and wherein the response comprises a probe response message**."

Choudhary, 9:60-10:3.

71. Thus, because Choudhary describes an active scanning procedure in which a station sends probe requests to initiate a connection with an AP, Choudhary renders obvious "*[a] method for active scanning performed by a station*."

[1.1] ***transmitting, to an access point, a probe request frame including information on a signal strength; and***

72. **First**, Choudhary describes that the station transmits a probe request message ("*probe request frame*") to the access point.

> Referring to FIG. 10, a particular embodiment of a method 100 for using Received Signal Strength Indicator (RSSI) filtering to provide air-time optimization in wireless networks is shown. This method relates to APs and unassociated mobile units. **Method 100 begins with processing block 102 which discloses receiving at the AP at least one message from an unassociated mobile unit (MU)** from which RSSI can be determined. As shown in processing block 104, in this embodiment **the message comprises a probe request message** and wherein the response comprises a probe response message.

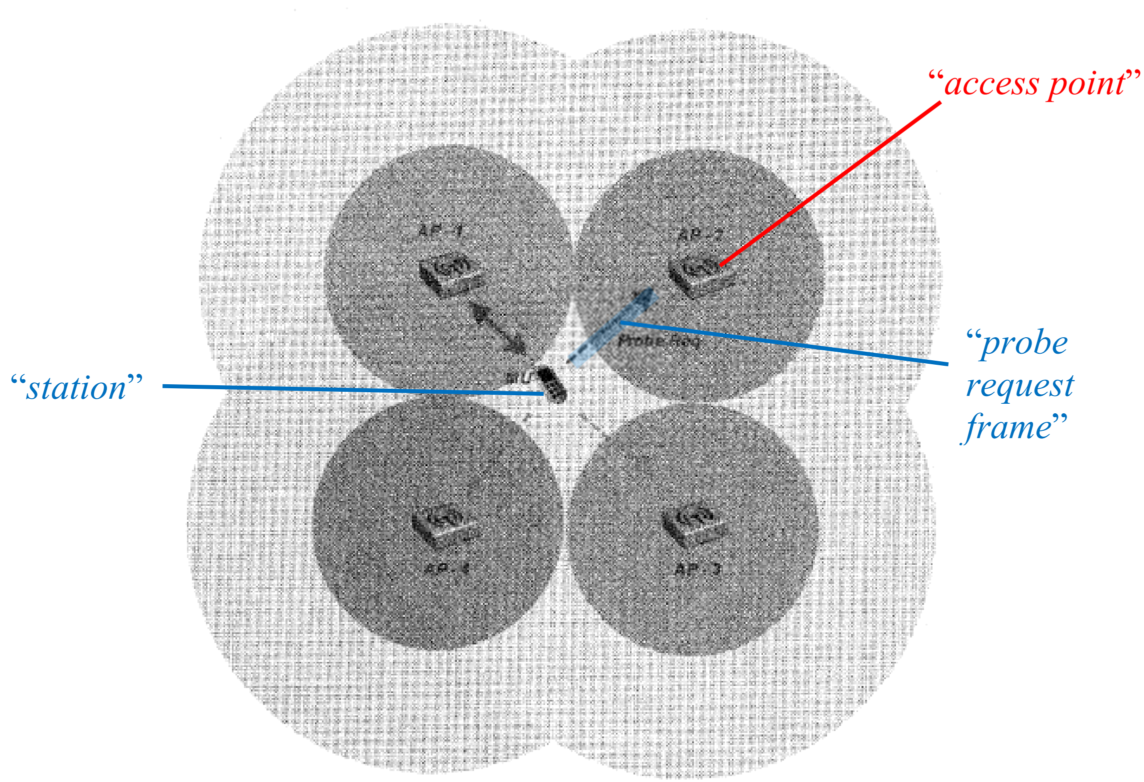
Choudhary, 9:60-10:3.

> Referring now to FIG. 5, the MU is associated with AP-1 but aggressively probes other channels. **The MU keeps sending broadcast/unicast probes to all APs (AP-2, AP-3, and AP-4) in the neighboring cells**. The APs send probe responses only if the received probe request is above a configured RSSI threshold. Since probe responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes. The AP radio is configured with an RSSI threshold for sending probe response. Additionally, it is possible to drop authentication requests that do not meet the required RSSI threshold at AP.
>
> **When a client sends active probes** it will receive responses from closest AP(s) only as defined by configured RSSI threshold. If client determines the AP(s) based on passive scanning, then the authentication attempt to a far-away AP would fail. When a client roams away from

> an AP its RSSI level at the AP would drop. An AP can accumulate an average of some consecutive samples of the RSSI for the received frames from the client. When this average drops below a threshold then the AP radio can dissociate a client or a more advanced radio can deliberately stop 802.11 ACK for uplink frames from the client. A client in this case would either immediately start looking for another AP in its neighborhood (increased retries due to ACK failures) or will be dissociated for bad behavior and discover another AP nearby.

Choudhary, 7:23-50.

73. Choudhary illustrates the probe request frame in Fig. 5 as shown below.



Choudhary, Fig. 5 (annotated).

74. Choudhary explains that the probe request message is an 802.11 "*frame*." "The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an **802.11 frame** based on RSSI or some metric derived from RSSI." Choudhary, 7:4-6.

75. **Second**, it would have been obvious for Choudhary's probe request from the station to include the station's transmit power level ("*information on a signal strength*") as taught by Hasty. As explained above at VIII.A.3, Choudhary evaluates link quality using the measured RSSI or metric derived from the RSSI, and Hasty describes a technique in which link quality is evaluated by both the RSSI and a transmit power level.

> The present invention relates to a system and method for using **a receive signal strength indication and a transmit power level to determine the integrity of a link** for use in Layer II routing in a network, **such as an 802.11 network**. More particularly, the present invention relates to a system and method for using **indications of per-packet receive signal strengths and per-packet transmit power levels to compute path losses for links between nodes in a communication network, such as an 802.11 network, in order to select the most suitable link** over which to send data packets between the nodes.

Hasty, 1:11-21.

76. Hasty describes various metrics that can be derived from the RSSI. In one example, Hasty describes using path loss as a quality metric. Path loss is the difference between the transmission power and the power measured by the receiver (i.e., RSSI). "An object of the present invention is to provide a system and method for computing the path loss along a link between nodes in a wireless ad-hoc communications network using transmitted power level information contained in a received data packet and the receive signal strength indication (RSSI) at which the data packet is received." Hasty, 2:48-53.

77. Additionally, Hasty gives an example of using a link quality ratio (LQR) metric, which is also derived from the RSSI. Hasty provides an equation for calculating a link quality ratio (LQR) that uses both the transmit power level (TPL), measured RSSI, and the receiver sensitivity (which is the minimum power needed to successfully receive a transmitted packet). All of these values are represented in decibels (dBm).

> As shown in FIGS. 4 and 5, each node N0 through N3 in the network 100 periodically broadcasts routing advertisements to other nodes within its broadcast range. In this example, node N3 broadcasts routing advertisements to nodes N2 and N1 which are within the broadcast range of node N3. A broadcast routing advertisement includes information in its header pertaining to the transmit power level (TPL) in Decibels (Dbm). That is, prior to transmitting a packet, the controller 112 of node N3 causes this information to be included in the header of the packet. The RSSI is available from the 802.11 physical layer

> implementation Also, each node knows its receive sensitivity (RS), which is the lowest level signal strength at which a received signal containing a data packet can be received in order for the node to be able to successfully recover data from the received data packet. In other words, any signal received with a value less than the threshold RS value will be viewed as noise. **The following equation represents an example of the manner in which the value of the link quality ratio (LQR) of the link from node N3 to node N2, and from node N3 to node N1, can be calculated that yields a ratio which can be used to measure the per packet link quality between wireless nodes in the network 100:**
>
> **LQR=1−(TPL(Dbm)−RSSI(Dbm))/(TPL(Dbm)−RS(Dbm))**

Hasty, 4:65-5:20.

78. The link quality ratio LQR, as defined in the above equation, is a ratio of path loss (transmission power – RSSI) over the largest acceptable path loss (transmission power – receive sensitivity). The receive sensitivity is "the lowest level signal strength at which a received signal containing a data packet can be received in order for the node to be able to successfully recover data from the received data packet." Hasty, 4:65-5:20. By calculating the ratio of the actual path loss to the largest acceptable path loss in which a packet can be successfully received, the receiving node can gauge the relative quality of the connection.

79. For the reasons explained above at VIII.A.3, a POSITA would have found it obvious for Choudhary's probe request to include a transmit power level to allow the AP to consider path loss as part of the quality metric, whether that path loss is considered alone or as a ratio (e.g., LQR). In other words, by knowing the power level at which the probe request was transmitted, the AP can determine path loss in addition to just the measured RSSI.

80. Thus, because Choudhary describes an access point that receives a probe request, which would have been obvious to include a transmit power level as taught by Hasty, Choudhary and Hasty render obvious "*transmitting, to an access point, a probe request frame including information on a signal strength.*"

[1.2] ***receiving, from the access point, a probe response frame in response to the probe request frame,***

81. Choudhary teaches that the mobile unit ("*station*") receives a probe response frame from one of the access points.

> **Probe responses are sent to MU(s) only when the probe requests from the MU(s) are received with RSSI above the RSSI_hi threshold**. This, coupled with the capability to hide SSID in the beacon that exits [*sic*] in the current WLAN products, essentially hides AP(s) that are further away from the client in the WLAN deployment. In other words, only the AP(s) that are in immediate neighborhood of the client will respond to the client's probe requests. This forces the client to join only the AP(s) in the neighborhood of the client and owing to the proximity it achieves connectivity at better PHY rates and hence reduces air-time utilization. Clients that probe aggressively will get probe responses from only closest AP(s). This will reduce the number

> of probe responses significantly in a pico-cell deployment where AP(s) are closely spaced. It will also show improvement in normal micro-cellular WLAN deployments.

Choudhary, 8:42-57.

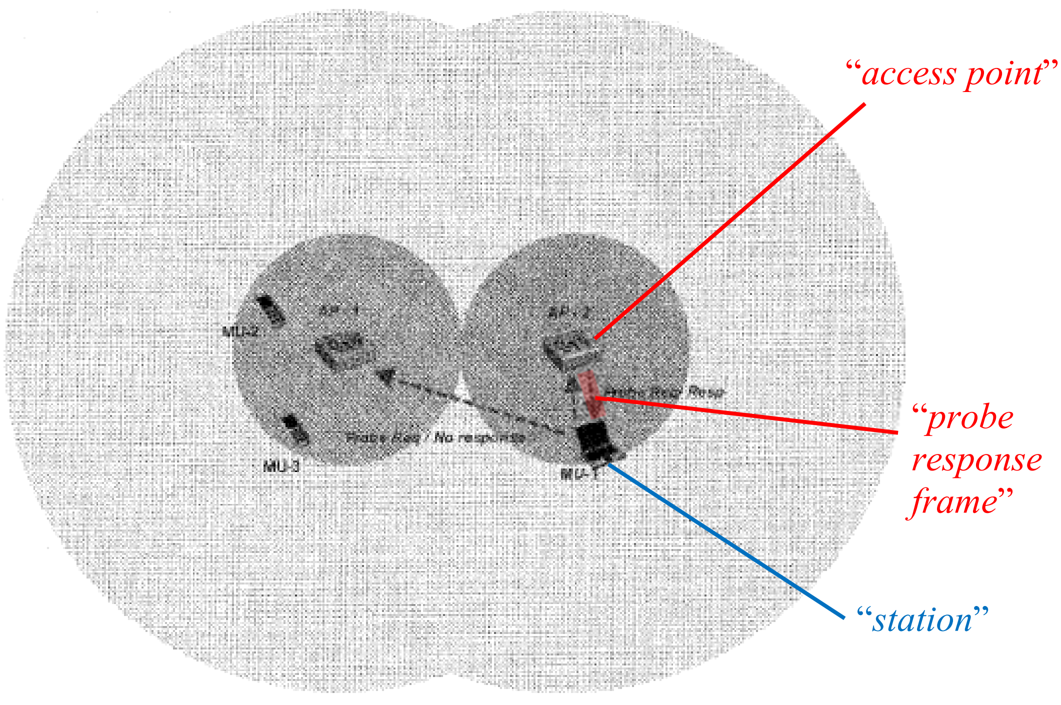
> Processing block 112 recites **responding to the at least one message from the unassociated MU when the RSSI value associated with the at least one message from the unassociated MU is greater than the predetermined threshold**.
>
> Processing block 114 discloses when the RSSI value associated with the at least one message from the unassociated MU is not greater than the predetermined threshold, refraining from responding. This will prevent the MU from associating with the AP.

Choudhary, 10:13-21.

> Referring now to FIG. 5, the MU is associated with AP-1 but aggressively probes other channels. The MU keeps sending broadcast/unicast probes to all APs (AP-2, AP-3, and AP-4) in the neighboring cells. **The APs send probe responses only if the received probe request is above a configured RSSI threshold**. Since probe responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes. The AP radio is configured with an RSSI threshold for sending probe response. Additionally, it is possible to drop authentication requests that do not meet the required RSSI threshold at AP.

> When a client sends active probes **it will receive responses from closest AP(s) only as defined by configured RSSI threshold**. If client determines the AP(s) based on passive scanning, then the authentication attempt to a far-away AP would fail. When a client roams away from an AP its RSSI level at the AP would drop. An AP can accumulate an average of some consecutive samples of the RSSI for the received frames from the client. When this average drops below a threshold then the AP radio can dissociate a client or a more advanced radio can deliberately stop 802.11 ACK for uplink frames from the client. A client in this case would either immediately start looking for another AP in its neighborhood (increased retries due to ACK failures) or will be dissociated for bad behavior and discover another AP nearby.
>
> FIG. 6 shows where an MU scans all channels using active broadcast probing. AP-1 does not respond to probe request since the received RSSI is below the configured threshold for probes. **AP-2 responds to the probe request**. The MU discovers only AP-2 by active probing. MU-1 authenticates and associates with AP-2 which is the desired AP for MU-1 in this case.

Choudhary, 7:23-56.



Choudhary, Fig. 6 (annotated).

82. Accordingly, because the probe responses sent by the access points are responsive to a particular probe request, those probe responses are "*in response to*" to that particular probe request. And Choudhary explains that the probe response message is an 802.11 "*frame*:" "The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an **802.11 frame** based on RSSI or some metric derived from RSSI." Choudhary, 7:4-6. A POSITA would have understood that probe responses are frames. *See e.g.,* Meyer, 1:45-47 ("APs that receive the probe request frame will respond by transmitting a probe response frame."); *see also* 802.11k-2008, 33 (describing the "probe response frame format.").

83. Thus, because Choudhary describes that the access points will respond to a probe request with a corresponding probe response, Choudhary renders obvious "*receiving, from the access point, a probe response frame in response to the probe request frame*."

[1.3] *wherein the probe response frame is transmitted by the access point based on the information on the signal strength,*

84. **First**, as described above at [1.2], Choudhary teaches that the access point transmits a probe response message ("*probe response frame*") to the mobile unit.

85. **Second**, Choudhary describes a filtering process in which an access point only responds to probe requests meeting a "predetermined threshold." In the proposed combination, that threshold is a path loss or LQR threshold that considers the station's transmission power ("*based on the information on the signal strength.*"). Choudhary, 10:13-21. Several instances of the filtering process are described in Choudhary:

> The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an 802.11 frame **based on RSSI or some metric derived from RSSI**. **An AP will respond to probes only when the probe request is received with sufficient RSSI**, will accept authentication only when the RSSI is sufficiently high, and will acknowledge received frames based on some criterion derived from

RSSI. RSSI filtering may also be used to dissociate clients based on some RSSI derived criterion. RSSI filtering provides additional control for the administrator besides those provided by eligible data rate set, AP power and directional antenna.

Choudhary, 7:4-14.

Probe responses are sent to MU(s) only when the probe requests from the MU(s) are received with RSSI above the RSSI_hi threshold. This, coupled with the capability to hide SSID in the beacon that exits in the current WLAN products, essentially hides AP(s) that are further away from the client in the WLAN deployment. In other words, only the AP(s) that are in immediate neighborhood of the client will respond to the client's probe requests. This forces the client to join only the AP(s) in the neighborhood of the client and owing to the proximity it achieves connectivity at better PHY rates and hence reduces air-time utilization. Clients that probe aggressively will get probe responses from only closest AP(s). This will reduce the number of probe responses significantly in a pico-cell deployment where AP(s) are closely spaced. It will also show improvement in normal micro-cellular WLAN deployments.

Choudhary, 8:42-57.

Processing block 112 recites **responding to the at least one message from the unassociated MU when the RSSI value associated with the at least one message from the unassociated MU is greater than the predetermined threshold**.

> Processing block 114 discloses when the RSSI value associated with the at least one message from the unassociated MU is not greater than the predetermined threshold, refraining from responding. This will prevent the MU from associating with the AP.

Choudhary, 10:13-21.

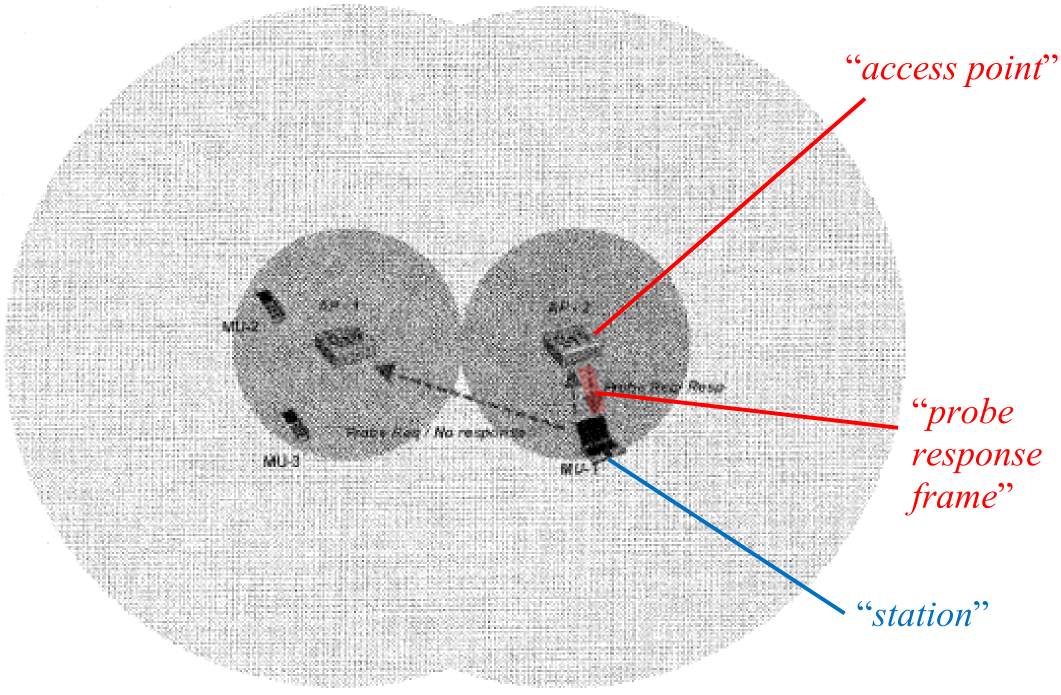
> Processing block 156 states **determining whether a Received Signal Strength indicator (RSSI) associated with the at least one message from the associated MU is greater than a predetermined threshold**. As shown in processing block 158, in one embodiment the determining whether an RSSI value associated with the at least one message from an associated MU is greater than a predetermined threshold comprises determining an average RSSI value of RSSI values associated with the predetermined number of consecutive frames from the AP and determining whether the average RSSI value is greater than the predetermined threshold. As shown in processing block 160, in certain deployments such as a pico-cell deployment the threshold is dependent upon a density of APs within an area. As shown in processing block 162, in certain embodiments the threshold is automatically tuned based on at least one criteria.

Choudhary, 10:32-47.

> Referring now to FIG. 5, the MU is associated with AP-1 but aggressively probes other channels. The MU keeps sending broadcast/unicast probes to all APs (AP-2, AP-3, and AP-4) in the neighboring cells. **The APs send probe responses only if the received probe request is above a configured RSSI threshold**. Since probe

> responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes. The AP radio is configured with an RSSI threshold for sending probe response. Additionally, it is possible to drop authentication requests that do not meet the required RSSI threshold at AP.
>
> When a client sends active probes **it will receive responses from closest AP(s) only as defined by configured RSSI threshold**. If client determines the AP(s) based on passive scanning, then the authentication attempt to a far-away AP would fail. When a client roams away from an AP its RSSI level at the AP would drop. An AP can accumulate an average of some consecutive samples of the RSSI for the received frames from the client. When this average drops below a threshold then the AP radio can dissociate a client or a more advanced radio can deliberately stop 802.11 ACK for uplink frames from the client. A client in this case would either immediately start looking for another AP in its neighborhood (increased retries due to ACK failures) or will be dissociated for bad behavior and discover another AP nearby.
>
> FIG. 6 shows where an MU scans all channels using active broadcast probing. AP-1 does not respond to probe request since the received RSSI is below the configured threshold for probes. **AP-2 responds to the probe request**. The MU discovers only AP-2 by active probing. MU-1 authenticates and associates with AP-2 which is the desired AP for MU-1 in this case.

Choudhary, 7:23-56.



Choudhary, Fig. 6 (annotated).

86. For the reasons explained above at VIII.A.3, a system implementing the combined teachings of Choudhary and Hasty would use a “metric derived from RSSI” rather than the RSSI alone. Choudhary, 7:4-6. Again, Choudhary instructs a POSITA that metrics derived from RSSI can be used with Choudhary’s technique. Choudhary, 7:4-6. Hasty provides an example of a known and beneficial metric that is derived from the RSSI. Hasty, 2:48-53. Specifically, the combined system uses Hasty’s path loss or LQR metric rather than the RSSI alone. *See* [1.1]; VIII.A.3.

87. Because the proposed combination uses a path loss metric or LQR metric as a measure of link quality, the threshold for that link quality is likewise a path loss threshold or an LQR threshold. While Choudhary describes an example of using an "RSSI threshold" where RSSI is used, Choudhary also mentions compatibility with RSSI-derived metrics. In such cases (e.g., using Hasty's path loss or LQR) a threshold for the RSSI-derived metric is used—a path loss threshold or LQR threshold. Choudhary, 7:4-14.

88. Thus, Choudhary's access points respond only to probe requests that meet a certain quality metric derived from RSSI, which may include the path loss or LQR as taught by Hasty. The path loss or LQR consider the station transmission power level ("*information on the signal strength*") that was in a provided through the probe request. Accordingly, because the access point responds only to probe requests meeting a certain quality threshold based on signal strength information, the probe response is "*based on information on the signal strength*" as claimed.

89. Thus, because Choudhary describes that the access points will respond to a probe request meeting a quality threshold that is determined in part through the signal strength information in the probe request, Choudhary and Hasty render obvious "*wherein the probe response frame is transmitted by the access point based on the information on the signal strength*."

[1.4] ***wherein the station accesses the access point based on the probe response frame and a maximum probe response time.***

90. **First**, Choudhary's mobile station accesses a selected access point.

The "MU-1 **<u>authenticates and associates</u>** with AP-2 which is the desired AP for MU-1 in this case." Choudhary, 7:54-56. Choudhary's authentication and association is consistent with how the '556 patent describes "*accesses*": "[T]he station may perform an access (that is, an **authentication process and an <u>association process</u>**) to the certain access point." '556 patent, 9:34-36.

91. Indeed, the very purpose of Choudhary's scanning procedure is to associate the wireless device with the access point: "Effectively this is a way of testing if the client is close enough to the AP to benefit from associating with the AP. If the client is not close enough then there is no point indicating anything to the client since it won't associate with the AP anyway." Choudhary, 7:18-22. Consistent with IEEE 802.11, and as evidenced by Meyer, to associate with an access point, the access point grants access to the mobile station:

> When the wireless computing device decides to join a BSS associated with a particular one of the detected APs, the wireless computing device undergoes **<u>an authentication process with that AP.</u>**
> Once **<u>the authentication process is complete and the wireless computing device is authenticated with the AP, the wireless computing device must associate with the access point before sending data frames</u>.** The association process involves the exchange of information about capabilities of the wireless computing device and the AP Association is necessary to synchronize the wireless computing device and access point with important information, Such as supported data rates. The wireless computing device initiates the association by

> sending an association request frame containing elements such as SSID and supported data rates. The access point responds by sending an association response frame containing an association ID along with other information regarding the access point. **Once the wireless computing device and access point complete the association process, they can send data frames to each other**.

Meyer, 1:59-2:65.

92. Accordingly, Choudhary's authentication and association with the selected access point teaches "*the station accesses the access point*" as claimed.

93. **Second**, the access is "*based on the probe response*" because the mobile station uses the probe response to select the desired AP. As described above at VIII.A.5, a POSITA would have found it obvious for Choudhary to implement the scanning procedure according to known, standardized 802.11 techniques as evidenced by Chen. Chen explains that "[o]nly when all probe response messages are received, can the MS select a new AP among all the APs probed." Chen, 1:44-46. "[T]he MS selects an AP corresponding to a channel with the best signal quality as a new AP **based on the signal quality information in the probe response message**." Chen, 3:50-53. "After the scanning is finished, the MS can compare the signal quality information in all of the probe response messages, and select the AP corresponding to the probe response message with the best signal quality as a new AP." Chen, 2:34-37. Chen gives an example of selecting an AP based on the probe response message:

> In the MS1, if it reaches the maximum waiting time, then the MS1 finishes the scanning. Now it is assumed that the MS1 receives the probe response message from the channel 6, the channel 3 and the channel 14 after the scanning being finished. Wherein, the channel 6, the channel 3 and the channel 14 correspond to AP3, AP1 and AP4 respectively. **The MS1 will compare the signal quality information of each of the probe response message, assuming the signal quality of the probe response message from the channel 3 is the best, then the MS1 selects the AP1 corresponding to the probe response message from the channel 3 as a new AP**.

Chen, 9:1-11.

94. Accordingly, in Choudhary's 802.11 scanning procedure, the authentication and association process ("*access*") with the selected access point is "*based on*" the received probe responses ("*the probe response*").

95. **Third**, according to IEEE 802.11—evidenced by Chen—the AP grants access after the mobile station waits for a "Max Channel Time" or a MaxReplyWait time ("*maximum probe response time*"). As such, access is "*based on … a maximum probe response time.*" Chen gives example ranges for a Max Channel Time:

> Only when all probe response messages are received, can the MS select a new AP among all the APs probed. Since the **Max Channel Time** for waiting for each of the probe response message is 10~100 ms, and the

> typical value of the **<u>Max Channel Time</u>** is 50 ms, then the time for waiting for all probe response messages is n*Max Channel Time, where n is the number of the channels probed.

Chen, 1:44-51.

96. Chen also describes an example in which there are two timing mechanisms used: a minReplyWait and a maxReplyWait.

> Two time points for waiting for the probe response message are pre-set in the MS, they are the minimum waiting time (minReplyWait) and the **<u>maximum waiting time (maxReplyWait)</u>** respectively, and the minReplyWait is less than the maxReplyWait. In the step 104, when the timing by the timer reaches the minReplyWait, if the MS has not received any probe response message, which indicates that no available network has been found, the scanning is stopped in the step 105; if the MS has received a probe response message, then in the step 106 the received probe response message is buffered and the timing continues. Then, it is decided in the step 107 whether the timer has reached the **<u>maxReplyWait</u>**. If the timer has reached the maxReplyWait, the scanning stops in the step 109; otherwise it continues in the step 108 to decide whether the probe response message is received. If the probe response message is received, the received probe response message is buffered in the step 110; otherwise it returns to the step 107 and continues to decide whether the timer has reached the maxReplyWait. **<u>After the timer has reached the maxReplyWait, the scanning is stopped</u>**, and the signal to noise ratios (SNR) of the fast scan probe messages in all the probe response messages are compared, and the AP

> corresponding to the probe response message having the biggest SNR is selected as the new AP.

Chen, 2:4-24.

97. For the reasons explained above at X.B.5, it would have been obvious and beneficial for Choudhary's scanning procedure to use the standardized IEEE 802.11 timing as described by Chen (either the Max Channel Time or the maxReplyWait), either of which teach a "*maximum probe response time*."

98. Thus, because Choudhary's mobile station waits until a timer expires before selecting and accessing an access point, as evidenced by Chen, Choudhary and Chen render obvious "*wherein the station accesses the access point based on the probe response frame and a maximum probe response time*."

7. Claim 2

[2.1] *The method of claim 1, wherein the maximum probe response time comprises a preset maximum time period during which the station is required to wait for the probe response frame from the access point.*

99. **First**, as described above at [1.4], Choudhary and Chen teach that the mobile station waits until a timer expires before selecting an AP. Chen, 2:4-24 ("**<u>After</u>** the timer has reached the maxReplyWait, the scanning is stopped."). As such, Choudhary and Chen teach "*the station is required to wait for probe response frames from the access points*."

100. **Second,** the Max Channel Time or MaxReplyWait times are predetermined and are thus "preset." Chen gives a specific example in which the Max Channel Time is a fixed value (50 ms):

> Only when all probe response messages are received, can the MS select a new AP among all the APs probed. **Since the Max Channel Time for waiting for each of the probe response message is 10~100 ms, and the typical value of the Max Channel Time is 50 ms**, then the time for waiting for all probe response messages is n*Max Channel Time, where n is the number of the channels probed.

Chen, 1:44-51.

> Two time points for waiting for the probe response message are pre-set in the MS, they are the minimum waiting time (minReplyWait) and the maximum waiting time (maxReplyWait) respectively, and the minReplyWait is less than the maxReplyWait. In the step 104, when the timing by the timer reaches the minReplyWait, if the MS has not received any probe response message, which indicates that no available network has been found, the scanning is stopped in the step 105; if the MS has received a probe response message, then in the step 106 the received probe response message is buffered and the timing continues. Then, it is decided in the step 107 whether the timer has reached the maxReplyWait. If the timer has reached the maxReplyWait, the scanning stops in the step 109; otherwise it continues in the step 108 to decide whether the probe response message is received. If the probe response message is received, the received probe response message is buffered in the step 110; otherwise it returns to the step 107 and continues to decide whether the timer has reached the maxReplyWait.

> After the timer has reached the maxReplyWait, the scanning is stopped, and the signal to noise ratios (SNR) of the fast scan probe messages in all the probe response messages are compared, and the AP corresponding to the probe response message having the biggest SNR is selected as the new AP.

Chen, 2:4-24.

101. Accordingly, because Choudhary's mobile stations wait to receive probe responses from APs until a timer expires before selecting an AP, as evidenced by Chen, Choudhary and Chen render obvious "*wherein the maximum probe response time comprises a preset maximum time period during which the station is required to wait for the probe response frame from the access point*."

8. Claim 3

[3.1] ***The method of claim 1, wherein the information on the signal strength includes information about transmission power of the station.***

102. As explained above at [1.1], Choudhary and Hasty teach that the station transmits probe requests that include a "transmit power level" ("*information about transmission power of the station*"). As described above at VIII.A.3, it would have been obvious for Choudhary's probe requests from the station to include the transmit power level. This allows the AP to gauge the link quality to the station and only respond if the quality meets a certain threshold. As Hasty explains:

> The present invention relates to a system and method for using **a receive signal strength indication and a transmit power level to determine the integrity of a link** for use in Layer II routing in a network, **such as an 802.11 network**. More particularly, the present invention relates to a system and method for using **indications of per-packet receive signal strengths and per-packet transmit power levels to compute path losses for links between nodes in a communication network, such as an 802.11 network, in order to select the most suitable link** over which to send data packets between the nodes.

Hasty, 1:11-21.

> As shown in FIGS. 4 and 5, each node N0 through N3 in the network 100 periodically broadcasts routing advertisements to other nodes within its broadcast range. In this example, node N3 broadcasts routing advertisements to nodes N2 and N1 which are within the broadcast range of node N3. **A broadcast routing advertisement includes information in its header pertaining to the transmit power level (TPL) in Decibels (Dbm). That is, prior to transmitting a packet, the controller 112 of node N3 causes this information to be included in the header of the packet**.

Hasty, 4:65-5:23.

103. Thus, because Choudhary's method, implemented with Hasty's RSSI-derived metric as described at [1.1], includes transmitting from the station a probe request with the transmit power level of the station, Choudhary and Hasty render obvious "*wherein the information on the signal strength includes information about transmission power of the station.*"

9. Claim 4

[4.1] *The method of claim 1, wherein the access point is an access point satisfying a predetermined standard for an uplink quality with respect to the station.*

104. First, as described above at [1.4], Choudhary's station accesses a "*certain access point*."

105. Second, Choudhary describes a filtering process in which an access point only responds to probe requests meeting a "predetermined threshold" ("*satisfying a predetermined standard for an uplink quality with respect to the station*"). Choudhary, 10:13-21. Several instances of this concept are described in Choudhary:

> The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an 802.11 frame **based on RSSI or some metric derived from RSSI**. **An AP will respond to probes only when the probe request is received with sufficient RSSI**, will accept authentication only when the RSSI is sufficiently high, and will acknowledge received frames based on some criterion derived from RSSI. RSSI filtering may also be used to dissociate clients based on some RSSI derived criterion. RSSI filtering provides additional control for the administrator besides those provided by eligible data rate set, AP power and directional antenna.

Choudhary, 7:4-14.

> **<u>Probe responses are sent to MU(s) only when the probe requests from the MU(s) are received with RSSI above the RSSI_hi threshold</u>**. This, coupled with the capability to hide SSID in the beacon that exits in the current WLAN products, essentially hides AP(s) that are further away from the client in the WLAN deployment. In other words, only the AP(s) that are in immediate neighborhood of the client will respond to the client's probe requests. This forces the client to join only the AP(s) in the neighborhood of the client and owing to the proximity it achieves connectivity at better PHY rates and hence reduces air-time utilization. Clients that probe aggressively will get probe responses from only closest AP(s). This will reduce the number of probe responses significantly in a pico-cell deployment where AP(s) are closely spaced. It will also show improvement in normal micro-cellular WLAN deployments.

Choudhary, 8:42-57.

> Processing block 112 recites **<u>responding to the at least one message from the unassociated MU when the RSSI value associated with the at least one message from the unassociated MU is greater than the predetermined threshold</u>**.
>
> Processing block 114 discloses when the RSSI value associated with the at least one message from the unassociated MU is not greater than the predetermined threshold, refraining from responding. This will prevent the MU from associating with the AP.

Choudhary, 10:13-21.

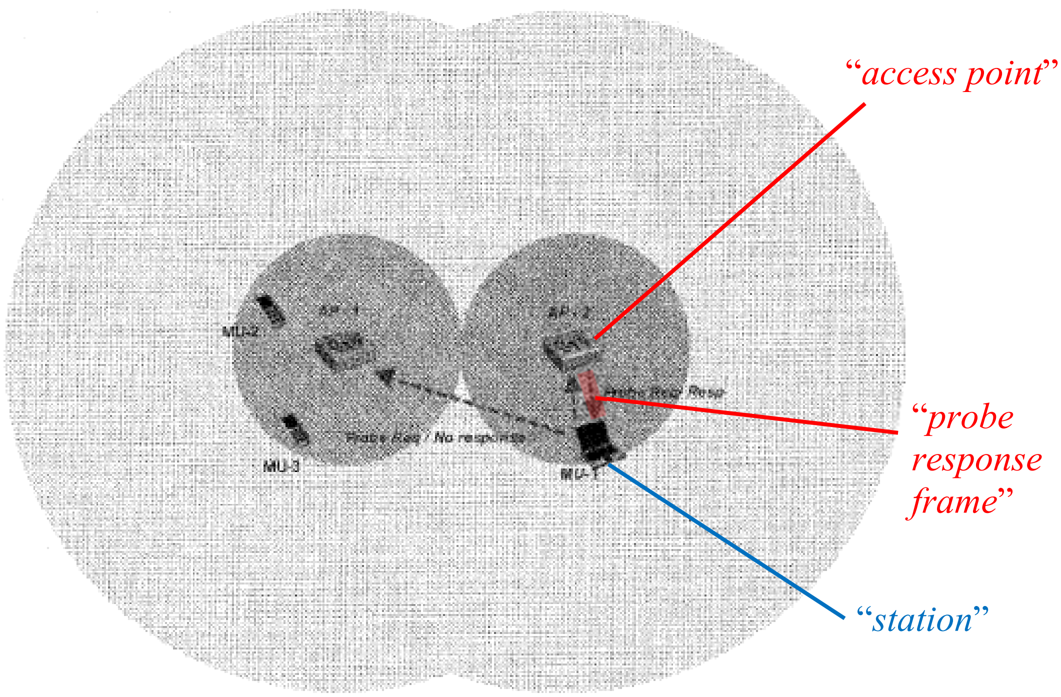
> Processing block 156 states **determining whether a Received Signal Strength indicator (RSSI) associated with the at least one message from the associated MU is greater than a predetermined threshold**. As shown in processing block 158, in one embodiment the determining whether an RSSI value associated with the at least one message from an associated MU is greater than a predetermined threshold comprises determining an average RSSI value of RSSI values associated with the predetermined number of consecutive frames from the AP and determining whether the average RSSI value is greater than the predetermined threshold. As shown in processing block 160, in certain deployments such as a pico-cell deployment the threshold is dependent upon a density of APs within an area. As shown in processing block 162, in certain embodiments the threshold is automatically tuned based on at least one criteria.

Choudhary, 10:32-47.

> Referring now to FIG. 5, the MU is associated with AP-1 but aggressively probes other channels. The MU keeps sending broadcast/unicast probes to all APs (AP-2, AP-3, and AP-4) in the neighboring cells. **The APs send probe responses only if the received probe request is above a configured RSSI threshold**. Since probe responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes. The AP radio is configured with an RSSI threshold for sending probe response. Additionally, it is possible to drop authentication requests that do not meet the required RSSI threshold at AP.

> When a client sends active probes **it will receive responses from closest AP(s) only as defined by configured RSSI threshold**. If client determines the AP(s) based on passive scanning, then the authentication attempt to a far-away AP would fail. When a client roams away from an AP its RSSI level at the AP would drop. An AP can accumulate an average of some consecutive samples of the RSSI for the received frames from the client. When this average drops below a threshold then the AP radio can dissociate a client or a more advanced radio can deliberately stop 802.11 ACK for uplink frames from the client. A client in this case would either immediately start looking for another AP in its neighborhood (increased retries due to ACK failures) or will be dissociated for bad behavior and discover another AP nearby.
>
> FIG. 6 shows where an MU scans all channels using active broadcast probing. AP-1 does not respond to probe request since the received RSSI is below the configured threshold for probes. **AP-2 responds to the probe request**. The MU discovers only AP-2 by active probing. MU-1 authenticates and associates with AP-2 which is the desired AP for MU-1 in this case.

Choudhary, 7:23-56.



Choudhary, Fig. 6 (annotated).

106. For the reasons explained above at VIII.A.3, a system implementing the combined teachings of Choudhary and Hasty would use a "metric derived from RSSI" rather than the RSSI alone. Choudhary, 7:4-6. In particular, the combined system uses Hasty's path loss or LQR metric rather than the RSSI alone. *See* [1.1]; VIII.A.3.

107. Because the proposed combination uses a path loss metric or LQR metric as a measure of link quality, the threshold for that link quality is likewise a path loss threshold or an LQR threshold. In other words, instead of using an "RSSI threshold" as described in Choudhary's example, the proposed combination uses a threshold for the RSSI-derived metric—a path loss threshold or LQR threshold. Choudhary, 7:4-14.

108. Additionally, because the access point is measuring the quality of a frame transmitted from the mobile unit to the access point, it is measuring "*uplink*" quality. Choudhary refers to transmissions in this direction as "**uplink** frames from the client." Choudhary, 7:23-56.

109. Thus, because Choudhary's access points respond only to probe requests that meet a certain quality metric derived from RSSI, which may include the path loss quality information as taught by Hasty, Choudhary and Hasty render obvious "*wherein the access point is an access point satisfying a predetermined standard for an uplink quality with respect to the station.*"

10. Claim 9

110. Claim 9 recites substantially similar subject matter as claim 1. The difference between them is that where claim 1 recites a method "performed by a station" seeking to associate itself with an access point, claim 9 recites a corresponding method "performed by an access point." Because the two claims recite steps in the same overall process from two related perspectives, claim 9 would have been obvious for the same reasons discussed above for claim 1. Although partly redundant of the discussion of claim 1, a detailed discussion of claim 9 follows.

[9.0] ***A method for active scanning performed by an access point, the method comprising:***

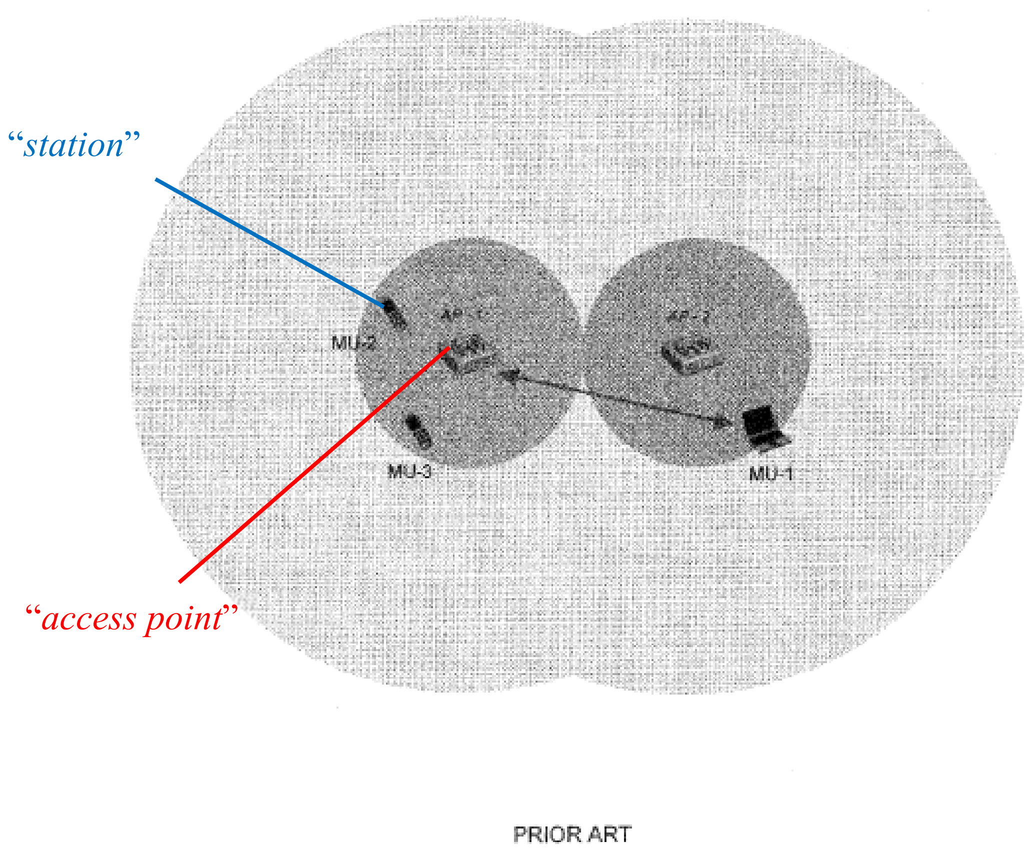
111. First, Choudhary describes "*active scanning.*" Consistent with IEEE 802.11, this scanning process is referred to in Choudhary as active probing.

> A wireless client (also referred to as a mobile device or mobile unit (MU)) **scans the presence of desired SSID on a wireless medium on a given RF using active probing** or passive scanning. A wireless device may include, but is not limited to a laptop computer, a cellular telephone, a tablet, a Personal Digital Assistant (PDA) or the like. **In active probing, an MU sends an 802.11 broadcast probe request at a lowest supported data rate on a specific frequency and listens for a response from AP(s) on that frequency**. The broadcast probe request may be heard by multiple APs on a given frequency. **All the APs that hear the broadcast probe may send a unicast response to the wireless client that sent the probe request. Probe responses have almost the same information that is present in the AP beacon**. The SSID is always present in the probe response. Probe responses are sent at the same data rate as beacons so they take almost the same time to transmit on the air as beacons. Since the probe responses are unicast, an AP may send one or more retries if the probe response is not acknowledged by the client. Probe responses and probe response retries decrease the wireless medium airtime available for application data communication.

Choudhary, 1:16-36.

> FIG. 6 shows where an MU **scans all channels using active broadcast probing**. AP-1 does not respond to probe request since the received RSSI is below the configured threshold for probes. AP-2 responds to the probe request. The MU discovers only AP-2 by active probing. MU-1 authenticates and associates with AP-2 which is the desired AP for MU-1 in this case.

Choudhary, 7:50-56.



Choudhary, Fig. 4 (annotated).

112. Second, the active probing process is performed in part by an access point, which receives and responds to probe requests from a mobile unit.

> Embodiments of the invention significantly overcome such deficiencies and provide mechanisms and techniques that provide Received Signal Strength Indicator (RSSI) filtering to provide air-time optimization in wireless networks. **<u>In a particular embodiment the method includes receiving at the AP at least one message from a mobile unit (MU)</u>**. The method further includes determining whether an RSSI value associated with the at least one message from a MU is greater than a predetermined threshold. **<u>The method additionally includes responding to the at least one message from a MU when the RSSI value associated with the at least one message</u>** from a MU is greater than to the predetermined threshold.

Choudhary, 2:63-3:7.

> Referring to FIG. 10, a particular embodiment of a method 100 for using Received Signal Strength Indicator (RSSI) filtering to provide air-time optimization in wireless networks is shown. This method relates to APs and unassociated mobile units. **<u>Method 100 begins with processing block 102 which discloses receiving at the AP at least one message from an unassociated mobile unit (MU) from which RSSI can be determined</u>**. As shown in processing block 104, in this embodiment the message comprises a probe request message and wherein the response comprises a probe response message."

Choudhary, 9:60-10:3.

113. Thus, because Choudhary describes an access point that performs an active scanning procedure that includes receiving and responding to active probe requests, Choudhary teaches "*[a] method for active scanning performed by an* *access point*." *See also* [1.0].

[9.1] ***receiving, from a station, a probe request frame including information on a signal strength; and***

114. First, Choudhary describes that the access point receives a probe request message ("*probe request frame*") from a mobile unit ("*station*").

> Referring to FIG. 10, a particular embodiment of a method 100 for using Received Signal Strength Indicator (RSSI) filtering to provide air-time optimization in wireless networks is shown. This method relates to APs and unassociated mobile units. **Method 100 begins with processing block 102 which discloses receiving at the AP at least one message from an unassociated mobile unit (MU)** from which RSSI can be determined. As shown in processing block 104, in this embodiment **the message comprises a probe request message** and wherein the response comprises a probe response message.

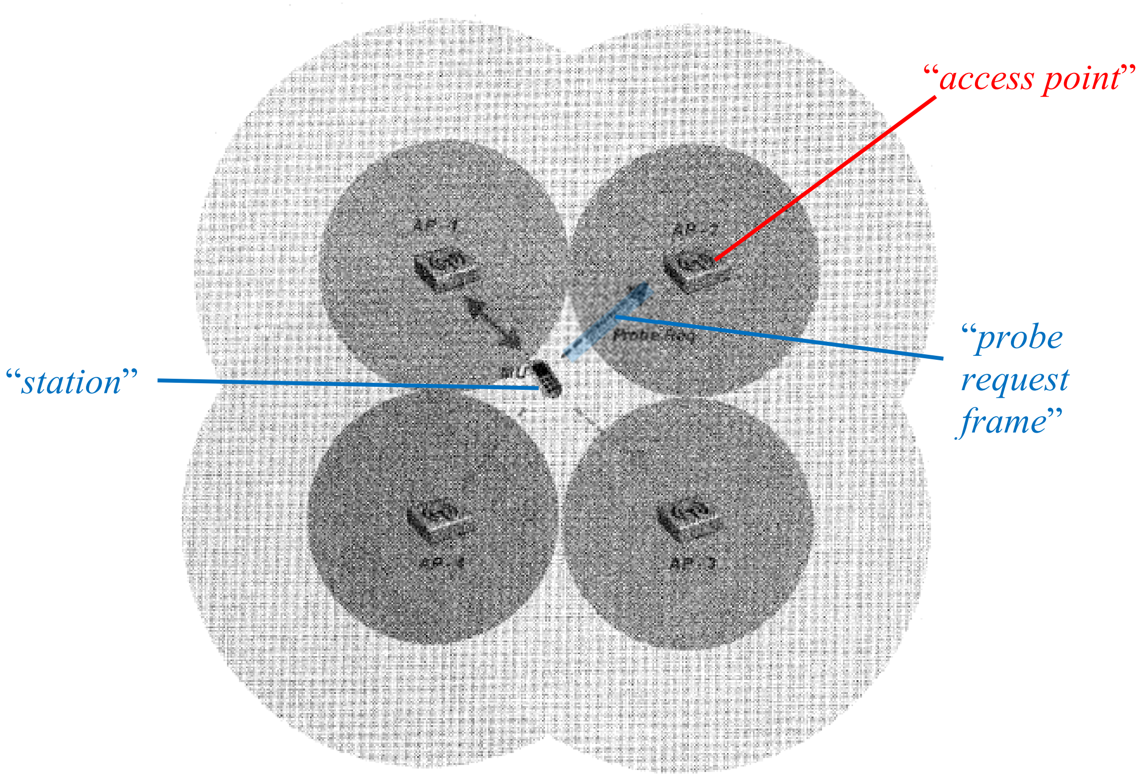
Choudhary, 9:60-10:3.

> Referring now to FIG. 5, the MU is associated with AP-1 but aggressively probes other channels. **The MU keeps sending broadcast/unicast probes to all APs (AP-2, AP-3, and AP-4) in the neighboring cells**. The APs send probe responses only if the received probe request is above a configured RSSI threshold. Since probe responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes. The AP radio is configured with an RSSI threshold for sending probe response. Additionally, it is possible to drop

> authentication requests that do not meet the required RSSI threshold at AP.
>
> **<u>When a client sends active probes</u>** it will receive responses from closest AP(s) only as defined by configured RSSI threshold. If client determines the AP(s) based on passive scanning, then the authentication attempt to a far-away AP would fail. When a client roams away from an AP its RSSI level at the AP would drop. An AP can accumulate an average of some consecutive samples of the RSSI for the received frames from the client. When this average drops below a threshold then the AP radio can dissociate a client or a more advanced radio can deliberately stop 802.11 ACK for uplink frames from the client. A client in this case would either immediately start looking for another AP in its neighborhood (increased retries due to ACK failures) or will be dissociated for bad behavior and discover another AP nearby.

Choudhary, 7:23-50.

115. Choudhary illustrates the probe request frame in Fig. 5 as shown below.



Choudhary, Fig. 5 (annotated).

116. Choudhary explains that the probe request message is an 802.11 “*frame*.” “The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an **802.11 frame** based on RSSI or some metric derived from RSSI.” Choudhary, 7:4-6.

117. **Second**, it would have been obvious for Choudhary’s probe request to include a transmit power level (“*information on a signal strength*”) as taught by Hasty. As explained above at VIII.A.3, Choudhary evaluates link quality using the measured RSSI or metric derived from the RSSI, and Hasty describes a technique in which link quality is evaluated by both the RSSI and a transmit power level.

> The present invention relates to a system and method for using **a receive signal strength indication and a transmit power level to determine the integrity of a link** for use in Layer II routing in a network, **such as an 802.11 network**. More particularly, the present invention relates to a system and method for using **indications of per-packet receive signal strengths and per-packet transmit power levels to compute path losses for links between nodes in a communication network, such as an 802.11 network, in order to select the most suitable link** over which to send data packets between the nodes.

Hasty, 1:11-21.

118. As explained above at [1.1], Hasty describes various metrics that can be derived from the RSSI. In one example, Hasty describes using path loss as a quality metric. Path loss is the difference between the transmission power and the power measured by the receiver (i.e., RSSI). "An object of the present invention is to provide a system and method for computing the path loss along a link between nodes in a wireless ad-hoc communications network using transmitted power level information contained in a received data packet and the receive signal strength indication (RSSI) at which the data packet is received." Hasty, 2:48-53.

119. Additionally, Hasty gives an example of using a link quality ratio (LQR) metric, which is also derived from the RSSI. Hasty provides an equation for calculating a link quality ratio (LQR) that uses both the transmit power level

(TPL), measured RSSI, and the receiver sensitivity (which is the minimum power needed to successfully receive a transmitted packet). All of these values are represented in decibels (dBm).

> As shown in FIGS. 4 and 5, each node N0 through N3 in the network 100 periodically broadcasts routing advertisements to other nodes within its broadcast range. In this example, node N3 broadcasts routing advertisements to nodes N2 and N1 which are within the broadcast range of node N3. A broadcast routing advertisement includes information in its header pertaining to the transmit power level (TPL) in Decibels (Dbm). That is, prior to transmitting a packet, the controller 112 of node N3 causes this information to be included in the header of the packet. The RSSI is available from the 802.11 physical layer implementation Also, each node knows its receive sensitivity (RS), which is the lowest level signal strength at which a received signal containing a data packet can be received in order for the node to be able to successfully recover data from the received data packet. In other words, any signal received with a value less than the threshold RS value will be viewed as noise. **The following equation represents an example of the manner in which the value of the link quality ratio (LQR) of the link from node N3 to node N2, and from node N3 to node N1, can be calculated that yields a ratio which can be used to measure the per packet link quality between wireless nodes in the network 100:**
> **LQR=1−(TPL(Dbm)−RSSI(Dbm))/(TPL(Dbm)−RS(Dbm))**

Hasty, 4:65-5:20.

120. The link quality ratio LQR, as defined in the above equation, is a ratio of path loss (transmission power – RSSI) over the largest acceptable path loss (transmission power – receive sensitivity). The receive sensitivity is "the lowest level signal strength at which a received signal containing a data packet can be received in order for the node to be able to successfully recover data from the received data packet." Hasty, 4:65-5:20. By comparing the actual path loss with the largest acceptable path loss in which a packet can be successfully received, the receiving node can gauge the relative quality of the connection.

121. For the reasons explained above at VIII.A.3, a POSITA would have found it obvious for Choudhary's probe request to include a transmit power level to allow the AP to consider path loss or LQR as a quality metric. In other words, by knowing the power level at which the probe request was transmitted, the AP can determine path loss in addition to just the measured RSSI.

122. Thus, because Choudhary describes an access point that receives a probe request, which would have been obvious to include a transmit power level as taught by Hasty, Choudhary and Hasty render obvious "*receiving, from a station, a probe request frame including information on a signal strength.*" *See also* [1.1].

[9.2] ***transmitting, to the station, a probe response frame in response to the probe request frame based on the information on the signal strength,***

123. **First**, as explained above at [1.3], Choudhary teaches that an access point responds to a probe request frame from a station by transmitting a "*probe* *response frame*" to the station. Several instances of this concept are described in Choudhary:

> The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an 802.11 frame based on RSSI or some metric derived from RSSI. An **AP will respond to probes** only when the probe request is received with sufficient RSSI, will accept authentication only when the RSSI is sufficiently high, and will acknowledge received frames based on some criterion derived from RSSI. RSSI filtering may also be used to dissociate clients based on some RSSI derived criterion. RSSI filtering provides additional control for the administrator besides those provided by eligible data rate set, AP power and directional antenna.

Choudhary, 7:4-14.

> **Probe responses are sent to MU(s) only when the probe requests from the MU(s) are received with RSSI above the RSSI_hi threshold**. This, coupled with the capability to hide SSID in the beacon that exits in the current WLAN products, essentially hides AP(s) that are further away from the client in the WLAN deployment. In other words, only the AP(s) that are in immediate neighborhood of the client will respond to the client's probe requests. This forces the client to join only the AP(s) in the neighborhood of the client and owing to the proximity it achieves connectivity at better PHY rates and hence reduces air-time utilization. Clients that probe aggressively will get probe responses from only closest AP(s). This will reduce the number of probe responses significantly in a pico-cell deployment where AP(s)

> are closely spaced. It will also show improvement in normal micro-cellular WLAN deployments.

Choudhary, 8:42-57.

> Processing block 112 recites **responding to the at least one message from the unassociated MU when the RSSI value associated with the at least one message from the unassociated MU is greater than the predetermined threshold**.
> Processing block 114 discloses when the RSSI value associated with the at least one message from the unassociated MU is not greater than the predetermined threshold, refraining from responding. This will prevent the MU from associating with the AP.

Choudhary, 10:13-21.

> Processing block 156 states **determining whether a Received Signal Strength indicator (RSSI) associated with the at least one message from the associated MU is greater than a predetermined threshold**.
> As shown in processing block 158, in one embodiment the determining whether an RSSI value associated with the at least one message from an associated MU is greater than a predetermined threshold comprises determining an average RSSI value of RSSI values associated with the predetermined number of consecutive frames from the AP and determining whether the average RSSI value is greater than the predetermined threshold. As shown in processing block 160, in certain deployments such as a pico-cell deployment the threshold is dependent upon a density of APs within an area. As shown in processing block

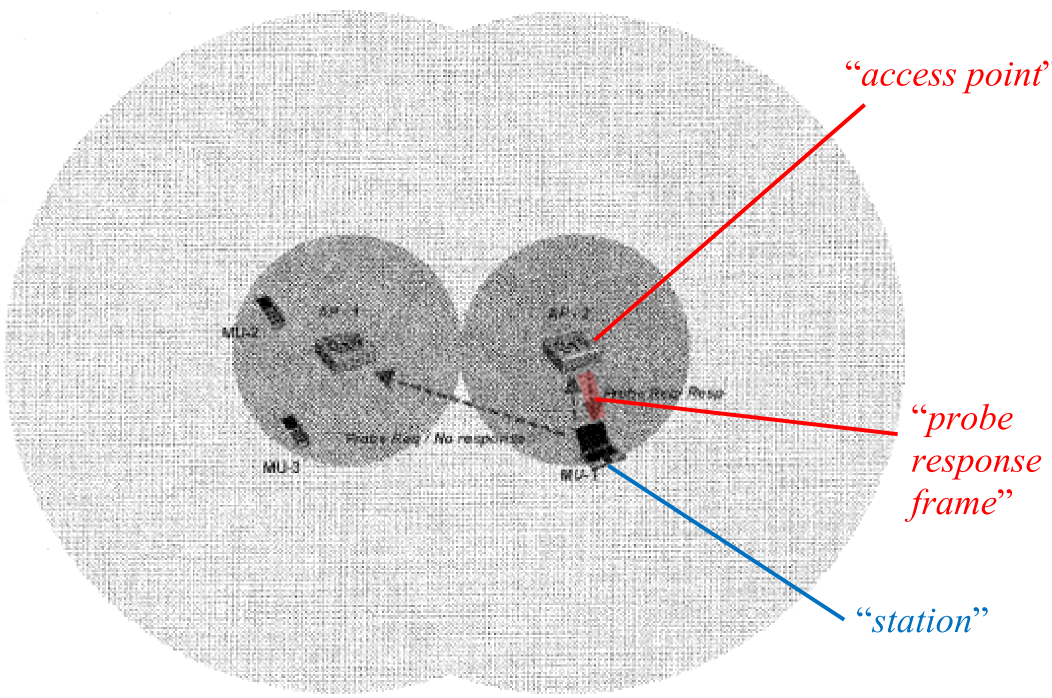
> 162, in certain embodiments the threshold is automatically tuned based on at least one criteria.

Choudhary, 10:32-47.

> Referring now to FIG. 5, the MU is associated with AP-1 but aggressively probes other channels. The MU keeps sending broadcast/unicast probes to all APs (AP-2, AP-3, and AP-4) in the neighboring cells. **The APs send probe responses** only if the received probe request is above a configured RSSI threshold. Since probe responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes. The AP radio is configured with an RSSI threshold for sending probe response. Additionally, it is possible to drop authentication requests that do not meet the required RSSI threshold at AP.
>
> When a client sends active probes **it will receive responses from closest AP(s)** only as defined by configured RSSI threshold. If client determines the AP(s) based on passive scanning, then the authentication attempt to a far-away AP would fail. When a client roams away from an AP its RSSI level at the AP would drop. An AP can accumulate an average of some consecutive samples of the RSSI for the received frames from the client. When this average drops below a threshold then the AP radio can dissociate a client or a more advanced radio can deliberately stop 802.11 ACK for uplink frames from the client. A client in this case would either immediately start looking for another AP in its neighborhood (increased retries due to ACK failures) or will be dissociated for bad behavior and discover another AP nearby.

> FIG. 6 shows where an MU scans all channels using active broadcast probing. AP-1 does not respond to probe request since the received RSSI is below the configured threshold for probes. **<u>AP-2 responds to the probe request</u>**. The MU discovers only AP-2 by active probing. MU-1 authenticates and associates with AP-2 which is the desired AP for MU-1 in this case.

Choudhary, 7:23-56.



Choudhary, Fig. 6 (annotated).

124. Choudhary explains that the probe response message is an 802.11 "*frame*:" "The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an **<u>802.11 frame</u>** based on RSSI or some metric derived from RSSI." Choudhary, 7:4-6. A POSITA would have understood that probe responses are frames. *See e.g.,* Meyer, 1:45-47 ("APs that receive the probe request frame will respond by transmitting a probe response frame."); *see also* 802.11k-2008, 33 (describing the "probe response frame format.").

125. Second, Choudhary describes a filtering process in which an access point only responds to probe requests meeting a "predetermined threshold." In the proposed combination, that threshold is a path loss or LQR threshold that considers the station's transmission power ("*based on the information on the signal strength.*"). Choudhary, 10:13-21. Several instances of the filtering process are described in Choudhary:

> The presently disclosed invention utilizes RSSI filtering for selectively accepting or responding to an 802.11 frame **based on RSSI or some metric derived from RSSI**. **An AP will respond to probes only when the probe request is received with sufficient RSSI**, will accept authentication only when the RSSI is sufficiently high, and will acknowledge received frames based on some criterion derived from RSSI. RSSI filtering may also be used to dissociate clients based on some RSSI derived criterion. RSSI filtering provides additional control for the administrator besides those provided by eligible data rate set, AP power and directional antenna.

Choudhary, 7:4-14.

> **Probe responses are sent to MU(s) only when the probe requests from the MU(s) are received with RSSI above the RSSI_hi threshold**. This, coupled with the capability to hide SSID in the beacon

> that exits in the current WLAN products, essentially hides AP(s) that are further away from the client in the WLAN deployment. In other words, only the AP(s) that are in immediate neighborhood of the client will respond to the client's probe requests. This forces the client to join only the AP(s) in the neighborhood of the client and owing to the proximity it achieves connectivity at better PHY rates and hence reduces air-time utilization. Clients that probe aggressively will get probe responses from only closest AP(s). This will reduce the number of probe responses significantly in a pico-cell deployment where AP(s) are closely spaced. It will also show improvement in normal micro-cellular WLAN deployments.

Choudhary, 8:42-57.

> Processing block 112 recites <u>**responding to the at least one message from the unassociated MU when the RSSI value associated with the at least one message from the unassociated MU is greater than the predetermined threshold**</u>.
> Processing block 114 discloses when the RSSI value associated with the at least one message from the unassociated MU is not greater than the predetermined threshold, refraining from responding. This will prevent the MU from associating with the AP.

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> Processing block 156 states <u>**determining whether a Received Signal Strength indicator (RSSI) associated with the at least one message from the associated MU is greater than a predetermined threshold**</u>.
> As shown in processing block 158, in one embodiment the determining

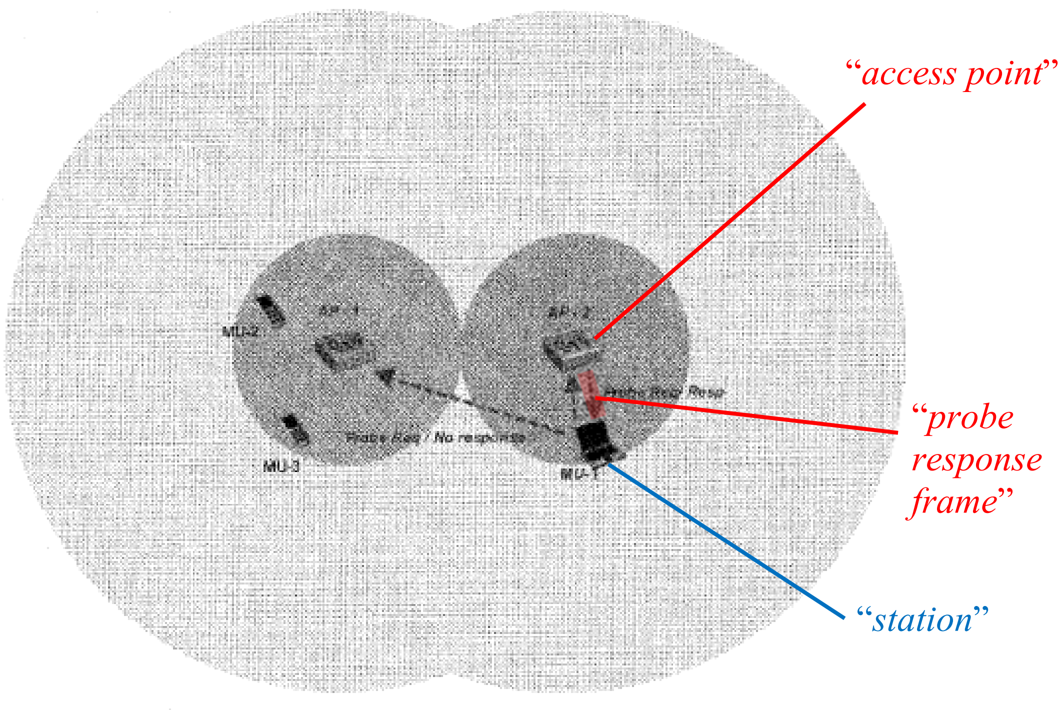
> whether an RSSI value associated with the at least one message from an associated MU is greater than a predetermined threshold comprises determining an average RSSI value of RSSI values associated with the predetermined number of consecutive frames from the AP and determining whether the average RSSI value is greater than the predetermined threshold. As shown in processing block 160, in certain deployments such as a pico-cell deployment the threshold is dependent upon a density of APs within an area. As shown in processing block 162, in certain embodiments the threshold is automatically tuned based on at least one criteria.

Choudhary, 10:32-47.

> Referring now to FIG. 5, the MU is associated with AP-1 but aggressively probes other channels. The MU keeps sending broadcast/unicast probes to all APs (AP-2, AP-3, and AP-4) in the neighboring cells. **The APs send probe responses only if the received probe request is above a configured RSSI threshold**. Since probe responses consume more air-time than probe request, selectively pruning out probe responses reduces airtime consumed by aggressive clients for probes. The AP radio is configured with an RSSI threshold for sending probe response. Additionally, it is possible to drop authentication requests that do not meet the required RSSI threshold at AP.
>
> When a client sends active probes **it will receive responses from closest AP(s) only as defined by configured RSSI threshold**. If client determines the AP(s) based on passive scanning, then the authentication attempt to a far-away AP would fail. When a client roams away from

> an AP its RSSI level at the AP would drop. An AP can accumulate an average of some consecutive samples of the RSSI for the received frames from the client. When this average drops below a threshold then the AP radio can dissociate a client or a more advanced radio can deliberately stop 802.11 ACK for uplink frames from the client. A client in this case would either immediately start looking for another AP in its neighborhood (increased retries due to ACK failures) or will be dissociated for bad behavior and discover another AP nearby.
>
> FIG. 6 shows where an MU scans all channels using active broadcast probing. AP-1 does not respond to probe request since the received RSSI is below the configured threshold for probes. **AP-2 responds to the probe request**. The MU discovers only AP-2 by active probing. MU-1 authenticates and associates with AP-2 which is the desired AP for MU-1 in this case.

Choudhary, 7:23-56.



Choudhary, Fig. 6 (annotated).

126. For the reasons explained above at VIII.A.3, a system implementing the combined teachings of Choudhary and Hasty would use a "metric derived from RSSI" rather than the RSSI alone. Choudhary, 7:4-6. Again, Choudhary instructs a POSITA that metrics derived from RSSI can be used with Choudhary's technique. Choudhary, 7:4-6. Hasty provides an example of a known and beneficial metric that is derived from the RSSI. Hasty, 2:48-53. Specifically, the combined system uses Hasty's path loss or LQR metric rather than the RSSI alone. *See* [1.1]; VIII.A.3.

127. Because the proposed combination uses a path loss metric or LQR metric as a measure of link quality, the threshold for that link quality is likewise a path loss threshold or an LQR threshold. While Choudhary describes an example of using an "RSSI threshold" where RSSI is used, Choudhary also mentions compatibility with RSSI-derived metrics. In such cases (e.g., using Hasty's path loss or LQR), a threshold for the RSSI-derived metric is used—a path loss threshold or LQR threshold. Choudhary, 7:4-14.

128. Thus, Choudhary's access points respond only to probe requests that meet a certain quality metric derived from RSSI, which may include the path loss or LQR as taught by Hasty. The path loss or LQR consider the station transmission power level ("*information on the signal strength*") that was in a provided through the probe request. Accordingly, because the access point responds only to probe requests meeting a certain quality threshold based on signal strength information, the probe response is "*based on information on the signal strength*" as claimed.

129. Thus, because Choudhary describes that the access points will respond to a probe request meeting a quality threshold that is determined in part through the signal strength information in the probe request, Choudhary and Hasty render obvious "*transmitting, to the station, a probe response frame in response to the probe request frame based on the information on the signal strength*." *See also* [1.3].

[9.3] ***wherein an access of the station to the access point is based on the probe response frame and a maximum probe response time.***

130. First, Choudhary's mobile station accesses a selected access point. The "MU-1 **authenticates and associates** with AP-2 which is the desired AP for MU-1 in this case." Choudhary, 7:54-56. Choudhary's authentication and association is consistent with how the '556 patent describes "*access*": "[T]he station may perform an access (that is, an **authentication process and an association process**) to the certain access point." '556 patent, 9:34-36.

131. Indeed, the very purpose of Choudhary's scanning procedure is to associate the wireless device with the access point: "Effectively this is a way of testing if the client is close enough to the AP to benefit from associating with the AP. If the client is not close enough then there is no point indicating anything to the client since it won't associate with the AP anyway." Choudhary, 7:18-22. Consistent with IEEE 802.11, and as evidenced by Meyer, to associate with an access point, the access point grants access to the mobile station:

> When the wireless computing device decides to join a BSS associated with a particular one of the detected APs, the wireless computing device undergoes **an authentication process with that AP.**
> Once **the authentication process is complete and the wireless computing device is authenticated with the AP, the wireless computing device must associate with the access point before sending data frames.** The association process involves the exchange of information about capabilities of the wireless computing device and the AP Association is necessary to synchronize the wireless computing

> device and access point with important information, Such as supported data rates. The wireless computing device initiates the association by sending an association request frame containing elements such as SSID and supported data rates. The access point responds by sending an association response frame containing an association ID along with other information regarding the access point. **Once the wireless computing device and access point complete the association process, they can send data frames to each other**.

Meyer, 1:59-2:65.

132. Accordingly, Choudhary's authentication and association with the selected access point teaches "*an access of the station to the access point*" as claimed.

133. Second, the access is "*based on the probe response*" because the mobile station uses the probe response to select the desired AP. As described above at VIII.A.5, a POSITA would have found it obvious for Choudhary to implement the scanning procedure according to known, standardized 802.11 techniques as evidenced by Chen. Chen explains that "[o]nly when all probe response messages are received, can the MS select a new AP among all the APs probed." Chen, 1:44-46. "[T]he MS selects an AP corresponding to a channel with the best signal quality as a new AP **based on the signal quality information in the probe response message**." Chen, 3:50-53. "After the scanning is finished, the MS can compare the signal quality information in all of the probe response messages, and select the AP corresponding to the probe response message with the best signal quality as a new AP." Chen, 2:34-37. Chen gives an example of selecting an AP based on the probe response message:

> In the MS1, if it reaches the maximum waiting time, then the MS1 finishes the scanning. Now it is assumed that the MS1 receives the probe response message from the channel 6, the channel 3 and the channel 14 after the scanning being finished. Wherein, the channel 6, the channel 3 and the channel 14 correspond to AP3, AP1 and AP4 respectively. **The MS1 will compare the signal quality information of each of the probe response message, assuming the signal quality of the probe response message from the channel 3 is the best, then the MS1 selects the AP1 corresponding to the probe response message from the channel 3 as a new AP**.

Chen, 9:1-11.

134. Accordingly, in Choudhary's 802.11 scanning procedure, the authentication and association process ("*access*") with the selected access point is "*based on*" the received probe responses ("*the probe response*").

135. **Third**, according to IEEE 802.11—evidenced by Chen—the AP grants access after the mobile station waits for a "Max Channel Time" or a MaxReplyWait time ("*maximum probe response time*"). As such, access is "*based on … a maximum probe response time.*" Chen gives example ranges for a Max Channel Time:

> Only when all probe response messages are received, can the MS select a new AP among all the APs probed. Since the **Max Channel Time** for waiting for each of the probe response message is 10~100 ms, and the typical value of the **Max Channel Time** is 50 ms, then the time for waiting for all probe response messages is n*Max Channel Time, where n is the number of the channels probed.

Chen, 1:44-51.

136. Chen also describes an example in which there are two timing mechanisms used: a minReplyWait and a maxReplyWait.

> Two time points for waiting for the probe response message are pre-set in the MS, they are the minimum waiting time (minReplyWait) and the **maximum waiting time (maxReplyWait)** respectively, and the minReplyWait is less than the maxReplyWait. In the step 104, when the timing by the timer reaches the minReplyWait, if the MS has not received any probe response message, which indicates that no available network has been found, the scanning is stopped in the step 105; if the MS has received a probe response message, then in the step 106 the received probe response message is buffered and the timing continues. Then, it is decided in the step 107 whether the timer has reached the **maxReplyWait**. If the timer has reached the maxReplyWait, the scanning stops in the step 109; otherwise it continues in the step 108 to decide whether the probe response message is received. If the probe response message is received, the received probe response message is buffered in the step 110; otherwise it returns to the step 107 and continues to decide whether the timer has reached the maxReplyWait.

> **After the timer has reached the maxReplyWait, the scanning is stopped**, and the signal to noise ratios (SNR) of the fast scan probe messages in all the probe response messages are compared, and the AP corresponding to the probe response message having the biggest SNR is selected as the new AP.

Chen, 2:4-24.

137. Thus, because Choudhary's mobile station waits until a timer expires before selecting and accessing an access point, as evidenced by Chen, Choudhary and Chen render obvious "*wherein an access of the station to the access point is based on the probe response frame and a maximum probe response time*." *See also* [1.4].

11. Claim 10

[10.0] ***A station configured to perform an active scanning, the station comprising: a transceiver; and a processor, wherein the processor is configured to:***

138. First, for the reasons explained above at [1.0], Choudhary teaches a "*station configured to perform an active scanning*."

139. Second, Choudhary's mobile unit includes an antenna ("transceiver") along with the hardware, software, and circuitry used to perform the transmitting and receiving steps described above at [1.1] and [1.2]. *See* Choudhary, 3:36-4:22. These components teach a "*transceiver*" as claimed.

> An AP cell is a neighborhood around the AP over which a client can demodulate the received signal from the AP cleanly. Referring to FIG. 1A, an AP 10 is shown with its corresponding cell. A first part of the cell 12 Supports a higher data rate, while the cell portion further away 14 supports a lower data rate. The size of the AP cell is determined by the radiated power, the transmit antenna, **the MU receive antenna**, the MU receiver sensitivity and the modulation scheme. Larger radiated power can be received much further away at a given RSSI. Directional antenna's focus the radiated power in a smaller region of space and therefore it can be received further away at a given RSSI in the direction of the antenna. A receivers antenna can also determine the amount of radiated power that is captured and hence the RSSI at a given distance. Higher data rate modulation schemes are more sensitive to noise and therefore require higher RSSI for clean reception. Thus at higher data rates the effective cell size is smaller.

Choudhary, 5:20-37.

140. Third, Choudhary explains that the methods it describes are performed using a "*processor*."

> Alternatively, the processing blocks represent steps performed by functionally equivalent circuits such as **a digital signal processor circuit or an application specific integrated circuit (ASIC)**. The flow diagrams do not depict the syntax of any particular programming language. Rather, the flow diagrams illustrate the functional information one of ordinary skill in the art requires to fabricate circuits or to generate computer software to perform the processing required in

> accordance with the present invention. It should be noted that many routine program elements, such as initialization of loops and variables and the use of temporary variables are not shown. It will be appreciated by those of ordinary skill in the art that unless otherwise indicated herein, the particular sequence of steps described is illustrative only and can be varied without departing from the spirit of the invention.

Choudhary, 9:42-60; *see also* Choudhary, 10:59-11:22.

141. Thus, because Choudhary describes a mobile unit with an antenna and processor, and the mobile unit performs a scanning method, Choudhary renders obvious "*[a] station configured to perform an active scanning, the station comprising: a transceiver; and a processor, wherein the processor is configured to:*"

[10.1] *cause the transceiver to transmit, to an access point, a probe request frame including information on a signal strength; and*

142. *See* [1.1]; *see also* [10.0] (transmitting the probe request utilizes an antenna ("*transceiver*")).

[10.2] *cause the transceiver to receive, from the access point, a probe response frame in response to the probe request frame, and*

143. *See* [1.2]; *see also* [10.0] (receiving the probe response utilizes an antenna ("*transceiver*")).

[10.3] *wherein the probe response frame is transmitted by the access point based on the information on the signal strength,*

144. *See* [1.3].

[10.4] ***wherein the station accesses the access point based on the probe response frame and a maximum probe response time.***

145. *See* [1.4].

12. Claim 11

[11.0] ***An access point configured to perform an active scanning, the access point comprising: a transceiver; and a processor, a [sic] wherein the processor is configured to:***

146. First, for the reasons explained above at [9.0], Choudhary teaches "*[a]n access point configured to perform an active scanning*."

147. Second, Choudhary's access point includes an antenna ("*transceiver*") along with the hardware, software, and circuitry used to perform the transmitting and receiving steps described above at [1.1] and [1.2]. *See* Choudhary, 3:36-4:22, 5:20-37. These components teach a "*transceiver*" as claimed.

> An AP cell is a neighborhood around the AP over which a client can demodulate the received signal from the AP cleanly. Referring to FIG. 1A, an AP 10 is shown with its corresponding cell. A first part of the cell 12 Supports a higher data rate, while the cell portion further away 14 supports a lower data rate. The size of the AP cell is determined by the radiated power, **the transmit antenna**, the MU receive antenna, the MU receiver sensitivity and the modulation scheme. Larger radiated power can be received much further away at a given RSSI. **Directional antenna's focus the radiated power in a smaller region of space and therefore it can be received further away at a given RSSI in the direction of the antenna**. A receivers antenna can also determine the

> amount of radiated power that is captured and hence the RSSI at a given distance. Higher data rate modulation schemes are more sensitive to noise and therefore require higher RSSI for clean reception. Thus at higher data rates the effective cell size is smaller.

Choudhary, 5:20-37.

148. Third, Choudhary explains that the methods it describes are performed using a "*processor*."

> Alternatively, the processing blocks represent steps performed by functionally equivalent circuits such as **a digital signal processor circuit or an application specific integrated circuit (ASIC)**. The flow diagrams do not depict the syntax of any particular programming language. Rather, the flow diagrams illustrate the functional information one of ordinary skill in the art requires to fabricate circuits or to generate computer software to perform the processing required in accordance with the present invention. It should be noted that many routine program elements, such as initialization of loops and variables and the use of temporary variables are not shown. It will be appreciated by those of ordinary skill in the art that unless otherwise indicated herein, the particular sequence of steps described is illustrative only and can be varied without departing from the spirit of the invention.

Choudhary, 9:42-60; *see also* Choudhary, 10:59-11:22.

149. Thus, because Choudhary describes an access spoint with an antenna and processor, and the mobile unit performs a scanning method, Choudhary renders obvious "*An access point configured to perform an active scanning, the* *access point comprising: a transceiver; and a processor, a [sic] wherein the processor is configured to:"*

[11.1] cause the transceiver to receive, from a station, a probe request frame including information on a signal strength; and

150. *See* [9.1]; *see also* [11.0] (receiving the probe request utilizes an antenna ("*transceiver*")).

[11.2] cause the transceiver to transmit, to the station, a probe response frame in response to the probe request frame based on the information on the signal strength,

151. *See* [9.2]; *see also* [11.0] (transmitting the probe response utilizes an antenna ("*transceiver*")).

[11.3] wherein an access of the station to the access point is based on the probe response frame and a maximum probe response time.

152. *See* [9.3].

IX. CONCLUSION

153. This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare that all statements made herein on 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 or Title 18 of the United States Code.

Date: January 6, 2026

Christopher Hansen