

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., and
SAMSUNG ELECTRONICS, AMERICA, INC.,

Petitioners

v.

FOUR BATONS WIRELESS, LLC,

Patent Owner

Case IPR2025-00496

U.S. Patent No. 8,798,006

**Declaration Of Sumit Roy, Ph.D.
In Support of Petition for Inter Partes Review of
U.S. Patent No. 8,798,006**

Samsung v. Four Batons IPR2025-00496 Exhibit 1002
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Table of Contents

I.	ASSIGNMENT.....	1
II.	BACKGROUND AND QUALIFICATIONS.....	1
III.	MATERIALS CONSIDERED.....	5
IV.	LEVEL OF ORDINARY SKILL IN THE ART.....	7
V.	LEGAL STANDARDS.....	8
VI.	SUMMARY OF OPINIONS.....	13
VII.	TECHNOLOGY OVERVIEW.....	13
	A. Wireless Communications Networks.....	13
	B. Wireless Network Measures.....	18
	C. Wireless Network Handoff.....	19
	D. Statistical Comparisons.....	22
VIII.	OVERVIEW OF THE '006 PATENT.....	26
	A. Specification.....	26
	B. Prosecution History.....	28
IX.	THE CHALLENGED CLAIMS.....	30
X.	OVERVIEW OF THE PRIMARY PRIOR ART REFERENCES.....	33
	A. <i>Guo</i>	34
	B. <i>Neave</i>	40
XI.	CLAIM CONSTRUCTION.....	45
XII.	DETAILED EXPLANATION OF GROUNDS.....	45

A.	Ground 1: <i>Guo</i> in combination with <i>Neave</i> Renders Obvious Claims 1-13, 16.....	45
1.	Claim 1	45
a.	1[pre]: “Method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:”	45
b.	1[a].....	46
	(i) “a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks”	46
	(ii) “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface”	51
	(iii) “using path quality metrics that are independent of how the QoI is measured,”	54
	(iv) “...whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network,”	56
c.	1[b]: “said method including said mobile device comparing path quality as a quickest change detection problem for observations from a new interface or comparing path quality based on sequential two sample tests,”	58
	(i) Motivation to combine <i>Guo</i> and <i>Neave</i>	58
	(ii) Teachings in <i>Guo-Neave</i> Combination	61
d.	1[c]: “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and”	63

e.	1[d]: “said mobile device selecting one of said interfaces based on said comparing.”	63
2.	Claim 2	64
a.	2[pre]: “A method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:”	64
b.	2[a]	64
	(i) “a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks”	64
	(ii) “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface”	65
	(iii) “using path quality metrics that are independent of how the QoI is measured,”	65
	(iv) “whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network,”	65
c.	2[b]: “said method including said mobile device performing a one-sample change point detection method or performing a non-parametric and on-line two-sample method,”	66
d.	2[c]: “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and”	69
e.	2[d]: “said mobile device selecting one of said interfaces based on said comparing.”	69
3.	Claim 3	69

a.	3[pre]: “A method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:”	69
b.	3[a]	70
	(i) “a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks”	70
	(ii) “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface”	70
	(iii) “using path quality metrics that are independent of how the QoI is measured,”	70
c.	3[b]: “said method including said mobile device comparing path qualities based on sequential two sample tests,”	70
d.	3[c]: “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and”	71
e.	3[d]: “said mobile device selecting one of said interfaces based on said comparing.”	71
4.	Claim 4: “The method of claim 3, further including the mobile device having limited knowledge of the quality of the current path.”	72
5.	Claim 5: “The method of claim 3, further including having insufficiently many measurements for an estimate of the mean quality of the current path and its variance and observations are not matched.”	75
6.	Claim 6: “The method of claim 5, further including without the mobile device knowing values for mean and median, performing a test of which interface has a higher mean or median.”	76

7.	Claim 7: “The method of claim 6, further including performing a test of the difference in average quality by testing for a difference in a location of samples.”	77
8.	Claim 8: “The method of claim 7, wherein said method is nonparametric, works for unequal sample sizes, and is performed on-line.”	79
9.	Claim 9: “The method of claim 7, wherein said method employs a Rosenbaum test.”	80
10.	Claim 10: “The method of claim 9, wherein a test statistic T_R includes a total number of a second interface’s data points which have a value larger than a largest value in a first interface’s data points.”	82
11.	Claim 11: “The method of claim 10, wherein if an overall maximum is not from a sample set from the second interface, then the test stops, and a null-hypothesis H_0 is not rejected in favor of H_1 , and otherwise H_0 is rejected in favor of H_1 if T_R is larger than a value $C(a, n_1, n_2)$, calculated using the distribution of T_R .”	83
12.	Claim 12: “The method of claim 7, wherein the method is based on the length of a high-end extreme run of samples for a second interface or a low-end extreme run of samples for a first interface.”	85
13.	Claim 13: “The method of claim 12, further including repeating the test for a new observation or a new batch of observations.”	87
14.	Claim 16: “The method of claim 3, further including performing the two sample test even when the mobile has more than two interfaces.”	88
XIII. SECONDARY CONSIDERATIONS		88
XIV. CONCLUSION.....		89

I, Sumit Roy, Ph.D., declare that:

I. ASSIGNMENT

1. I have been retained by Samsung Electronics Co., Ltd., Samsung Electronics America, Inc. (together “Samsung” or “Petitioners”) as an independent expert consultant in this proceeding before the United States Patent and Trademark Office (“PTO”).

2. I am being compensated for my work on this matter at a rate of \$625 per hour, plus expenses. My compensation is in no way contingent on the nature of my findings, the way I present my findings in testimony, nor the outcome of this or any other proceeding. I have no other interest in this proceeding.

3. I have been asked to consider whether certain references disclose and/or suggest the features recited in certain claims of U.S. Patent No. 8,798,006 (the “’006 Patent”) (EX1001).¹ My opinions are set forth below.

II. BACKGROUND AND QUALIFICATIONS

4. I am an expert in the field of wireless networks, a field in which I have studied, taught, practiced, and researched for over thirty years. I summarize in this section my educational background, work experience, and other relevant

¹ References to exhibit numbers are to the exhibits that I understand will be attached to the petition for *inter partes* review of the ’006 patent (the “Petition”).

qualifications. I understand that my curriculum vitae (CV) is being filed as EX1003 in this proceeding. I certify that EX1003 is a true and correct copy and sets forth the details of my educational history, work history, patents, and other related professional experience.

5. I earned my Bachelor of Technology degree in Electrical Engineering from Indian Institute of Technology in Kanpur, India in 1983. Subsequently, I earned my Master of Science (1985) and Doctor of Philosophy (1988) degrees in Electrical & Computer Engineering from University of California in Santa Barbara – with my dissertation being on “Estimation Strategies for a Network of Distributed Sensors.” I also earned a Master of Arts in Statistics & Applied Probability from University of California in Santa Barbara in 1988.

6. While a graduate student in 1983 through 1988, I worked on various projects related to wireless communication and radar systems using a mix of analytical modeling and computer simulation. Following this initial exposure to 3G cellular systems, my career traversed network evolution through 4G and 5G systems, giving me a working knowledge of the technology standards governing these systems. In July 1988, I joined the faculty of the University of Pennsylvania as an Assistant Professor in the Department of Electrical Engineering, where I taught an upper level undergraduate course on “Communication Systems” and graduate level courses on “Advanced Digital Signal Processing” and “Digital Communications”

and conducted further research in my area of specialization.

7. In January 1995, I became a tenured Associate Professor in the Division of Engineering at the University of Texas at San Antonio, in San Antonio, Texas. In April 1998, I transferred to a tenured Associate Professor position in the Department of Electrical Engineering, University of Washington (“UW”) in Seattle, Washington. I was promoted to Professor at UW in September 2002. As a faculty member at UW, I have taught graduate-level courses in wireless networks, random processes, and stochastic processes, among other topics. During this time, I have also directed research pertaining to wireless communications and networking, including 802.11 WLAN and cellular technologies. From September 2014 to September 2019, I was awarded Integrated Systems Term Professorship at UW in recognition of my leadership and national stature in these areas.

8. I took full-time leave from UW to serve as a Senior Staff Researcher at Intel Labs, Hillsboro, OR from September 2001 to December 2003. In that role, I served as Wireless Systems Architect researching IEEE 802.15.3a Ultra-Wideband PHY layer for Wireless Personal Area Networks and pre-802.11n (MIMO WiFi). I also represented Intel at IEEE Standards meetings and coordinated with other industry partners. My research resulted in several patents relating to the above, including design implementation of MIMO WiFi transceivers. More recently (July 2020 – Aug. 2022), I served as Program Lead for the U.S. Department of Defense,

Office of the Under Secretary of Defense's Innovate Beyond 5G program for research and experimentation within the 5G-toxG (now renamed FutureG) initiative, where I had responsibility for monitoring commercial 5G evolution via 3GPP standardization.

9. As a result of my academic teaching, research, industry, and federal government experience, I have significant knowledge of wireless networking technologies. Since 1988, I have served as Principal Investigator for multiple competitively awarded research projects (exceeding \$10M in net funding) from various national organizations (both federal government and private industry sources) to support my research, as listed in my CV. I have authored or coauthored over 320 journal publications, conference proceedings, technical papers, book chapters, and technical presentations in a broad array of communications-related technologies, including networking and wireless communication. My work on Radar-WiFi Spectrum Sharing was recognized as the best paper published in the IEEE Transactions on Aerospace and Electrical Systems with the annual Barry Carlton Award in 2016.

10. My professional affiliation with IEEE included serving in various professional societies as a reviewer for a number of technical publications, journals, and conferences. I have also received multiple awards and recognitions, most notably, elevation to IEEE Fellow in 2007 for "contributions to multi-user

communications theory and cross-layer design of wireless networking standards.” By IEEE bylaws, only 0.1% of IEEE membership is elevated to Fellow annually. See <https://www.ieee.org/membership/fellows/steps.html>. In addition, I was selected as IEEE Communications Society’s Distinguished Lecturer (2014-15, 2017-18), which are listed in my curriculum vitae.

11. In addition to advising and mentoring students at UW, I have served as an external dissertation reviewer for several reputed international universities (e.g., McGill University, Montreal, CA; National University of Singapore; and Australia National University). During my career, I have advised and supervised over 35 Ph.D. students and at least 20 visiting scholars.

12. I have been disclosed as a testifying expert in five cases (including *inter partes* review proceedings) in the past four years. Overall, I have been deposed six times and testified in trial three times.

III. MATERIALS CONSIDERED

13. The opinions that are set forth in this Declaration are based on documents that I have reviewed as well as on my professional judgement, education, experience, and knowledge relating to wireless mobile communications and applied statistics.

14. In arriving at my opinions contained herein, I have reviewed the following materials:

Ex. No.	Description
1001	U.S. Patent 8,798,006 (“’006 Patent”)
1003	Curriculum Vitae of Dr. Sumit Roy
1004	File History of U.S. Patent 8,798,006
1005	U.S. Patent Application 2004/0170191 (“ <i>Guo</i> ”)
1006	H.R. Neave, P.L. Worthington, DISTRIBUTION-FREE TESTS (“ <i>Neave</i> ”)
1007	F. Hargrave, HARGRAVE’S COMMUNICATIONS DICTIONARY (2001)
1008	IEEE 100: THE AUTHORITATIVE DICTIONARY OF IEEE STANDARDS TERMS (7 th Ed., 2000)
1009	B.R. Fay, JMASM4: CRITICAL VALUES FOR FOUR NONPARAMETRIC AND/OR DISTRIBUTION-FREE TESTS OF LOCATION FOR TWO INDEPENDENT SAMPLES (“ <i>Fay</i> ”)
1010	J. Geier, WIRELESS NETWORKS FIRST-STEP (1 st Ed., 2004)
1011	C. K. Toh, AD HOC MOBILE WIRELESS NETWORKS: PROTOCOLS AND SYSTEMS (1 st Ed., 2001)
1012	M. Stemm, <i>Vertical Handoffs in Wireless Overlay Networks</i> , MOBILE NETWORKS & APPLICATIONS 3, 334-50 (1998)
1013	U.S. Patent Application Publication 2002/0061748
1014	U.S. Patent Application Publication 2002/0167931
1015	U.S. Patent 6,728,208
1016	L. Benetazzo, C. Narduzzi, P.A. Pegoraro, R. Tittoto, <i>A Passive Measurement Tool for Monitoring Wireless Packet Network Performances</i> , IMTC INSTRUMENTATION & MEASUREMENT, 407-12 (2004)

15. I have also reviewed any other materials that I refer to in this

Declaration in support of the opinions contained herein.

16. The opinions set forth in this Declaration are based on the documents that I have reviewed and my professional judgment, knowledge, experience, and education. These opinions have also been guided by my appreciation and understanding of how a person of ordinary skill in the art (POSITA) at the time of the alleged invention would have understood the claims and the specification of the '006 patent, which I have been asked to consider to be no earlier than March 17, 2005 (the filing date of U.S. Provisional Patent Application No. 60/662,749, to which the '006 patent claims priority). The opinions set forth herein reflect how a POSITA would have understood the claims and specification of the '006 patent, the prior art to the '006 patent, and the state of the art at the time of the alleged invention.

17. Based on my judgment, experience, and expertise, it is my opinion that certain of the references discussed herein disclose and/or suggest all features recited in claims 1-13 and 16 (the "Challenged Claims") of the '006 patent, as further described below.

IV. LEVEL OF ORDINARY SKILL IN THE ART

18. I have been informed that, in the context of invalidity, a POSITA is a hypothetical person who reviews the prior art at the time of the alleged. I have been informed that factors considered in determining a POSITA's level of skill include: (1) the problems encountered in the art; (2) the prior art solutions to the problems

encountered in the art; (3) the rapidity of innovation; (4) the sophistication of the technology; and (5) the education level of active workers in the field. I have been informed that these factors do not all need to be considered for the analysis and that one or more of the factors may control the analysis.

19. I have been asked to provide my opinion as to the level of a POSITA with respect to the alleged invention of the '006 patent as of March 17, 2005. Based on my consideration of the factors above, my opinion is that a POSITA would have had at least a Bachelor's of Science Degree (or equivalent) in an academic area emphasizing electrical engineering, computer engineering, or a related technical field, coursework in statistics, applied math, or quantitative network analysis, and about two years of research or professional experience in mobile communications or a related field. Additional educational experience could compensate for having fewer years of work experience, and additional work experience could compensate for having less educational experience. A POSITA in March 2005 would have been familiar with the design and implementation of wireless network handoff systems in mobile devices.

20. As of March 17, 2005, I met the qualifications of a POSITA. Each of my opinions set forth below are from the perspective of a POSITA as defined herein.

V. LEGAL STANDARDS

21. I am not an attorney, and I do not offer any legal opinions. In the course

of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a POSITA.

22. Petitioners' counsel has informed me that a published nonprovisional application is entitled to claim priority to the filing date of its provisional application (as opposed to the filing date of the published non-provisional application) if (1) the provisional application discloses the portions of the published non-provisional application relied upon as prior art, and (2) at least one claim of the published non-provisional claim is supported by the provisional application, i.e., the provisional application must disclose the subject matter of the claim and enable a person of ordinary skill in the art to make and use the claim.

23. Petitioners' counsel has informed me that for the prior art to inherently disclose a claimed limitation, the prior art need not expressly disclose the limitation, so long as the claimed limitation necessarily flows from a disclosure in the prior art. I also understand that it is acceptable to examine evidence outside the prior art reference (extrinsic evidence) in determining whether a feature, while not expressly discussed in the reference, is necessarily present in that reference.

24. Petitioners' counsel has informed me that a patent claim can be considered to have been obvious to a POSITA at the time the application was filed. I am informed that this means that, even if all of the requirements of a claim are not found in a single prior art reference, the claim is not patentable if the differences

between the subject matter in the prior art and the subject matter in the claim would have been obvious to a POSITA at the time of the invention.

25. Petitioners' counsel has informed me that a determination of whether a claim would have been obvious should be based upon several factors, including, among others:

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

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

- whether the teachings of the prior art references disclose known concepts combined in familiar ways, and when combined, would yield predictable results;
- whether a POSITA could implement a predictable variation, and would

see the benefit of doing so;

- whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by those skilled in the art;
- whether a POSITA would have recognized a reason to combine known elements in the manner described in the claim;
- whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and
- whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

27. Petitioners' counsel has informed me that a POSITA has ordinary creativity and is not an automaton.

28. Petitioners' counsel has informed me that obviousness may not be determined using the benefit of hindsight, including hindsight derived from the patent being considered.

29. Petitioners' counsel has informed me that a POSITA is assumed to know and have all relevant prior art in the field of endeavor covered by the patent at issue. I have been informed that there are two criteria for determining whether prior art is analogous and thus can be considered prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference

is not within the field of the patentee's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the patentee is involved. I have also been informed that the field of endeavor of a patent is not limited to the specific point of novelty, the narrowest possible conception of the field, or the particular focus within a given field. I have also been informed that a reference is reasonably pertinent if, even though it may be in a different field from that of the patentee's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to a patentee's attention in considering their problem.

30. Petitioners' counsel has informed me that, in making a determination as to whether the claimed invention would have been obvious to a POSITA, certain objective factors may be considered if they are present, including: commercial success of products practicing the claimed invention; long-felt but unsolved need; teaching away; unexpected results; copying; and praise by others in the field. These factors are generally referred to as "secondary considerations" or "objective indicia" of nonobviousness. I understand that, for such objective evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a "nexus") between the claim and the evidence, and that this nexus must be based on a novel element of the claim rather than something in the prior art. I understand that even when secondary considerations are present, they may be unable to overcome primary

evidence of obviousness (such as a motivation to combine with predictable results) that is sufficiently strong.

VI. SUMMARY OF OPINIONS

31. Based on my analysis, and as explained in this Declaration, my opinion is that claims 1-13 and 16 of the '006 patent would have been obvious to a POSITA over *Guo* in view of *Neave*.

VII. TECHNOLOGY OVERVIEW

32. Below is set forth a brief overview of the background art, as it would have been understood by a POSITA as of March 17, 2005.

A. Wireless Communications Networks

33. A wireless communications network is a system of nodes consisting of client (end-user) devices and network elements that facilitates wireless communication from one point to another within the network's coverage area. An end-to-end network path between a source and a destination may consist of a direct connection or multiple steps ("hops" or "links"). A step may be, for example, from the transmitting device to a network element, from one network element to another, or from a network element to a receiving device. Each link in the network thus consists of a sender and a receiver, and may include a wireless or wired transmission step. Where any one communications link in the network path from one point to another consists of a wireless transmission step, the network tends to be referred to,

as a whole, as a wireless communications network.

34. Communications endpoints on wireless communications networks are the points at which network communications are transmitted from (i.e., originate) or are received. Typical endpoints on wireless communications networks include client or end-user devices, for example, laptop computers, mobile phones, tablets, wireless sensors, and servers (e.g., that host websites, databases, or other services). For example, a mobile phone may communicate with a web server over a wireless communications network, transmitting requests to visit web identified by particular uniform resource locators (URLs) and receiving responses to the requests from the web server containing, e.g., the requested web page or an error indicating that the page is not currently available.

35. When wireless communications are transmitted across a wireless communications link within a network, they are often transmitted as radiofrequency (or “RF”) signals. Radiofrequency signals travel through space (i.e., are propagated) as electromagnetic waves, which are waves that propagate through the air as a result of interactions between electric and magnetic fields. Electromagnetic waves are often characterized by their wavelength or frequency – for example, radio waves typically have wavelengths on the order of 1 meter to 100 megameters, whereas microwaves typically have wavelengths on the order of 1 millimeter to 1 meter. When the electromagnetic wave, which has been propagated (i.e., transmitted) from

a transmitter arrives at (i.e., is received by) a receiver, the wireless communications link has been traversed, and the wireless communication may proceed to the next communications link within the wireless communication network, until it arrives at its intended endpoint within the wireless communications network.

36. RF signals, such as those used in wireless communications, may be subject to interference from other nearby RF signals and other variations in radio conditions, sometimes resulting in variations in experienced communications quality. *See, e.g.*, EX1014 (discussing interfering radiofrequency signals: “[W]hen the Bluetooth terminal has a load of 100% to transmit an E-mail, the throughput of the wireless LAN system is reduced by half, to about 3.5 Mbps.”); *see also* EX1016, 407 (“Since wireless networks are particularly affected by radio condition variations, continuous monitoring becomes necessary to detect critical situations in the radio interface.”). The greater the number of communications links from the source transmitter to the destination receiver, the higher the expected volatility (i.e., spread) in the quality of service. Variations in quality of service are likely to be even more pronounced under worsened radio conditions. *See* EX1016, 409-10 (describing greater variability in network timing parameters as “a footprint of worsened radio conditions”).

37. Certain types of wireless networks are referred to as wireless local area networks (WLANs). WLANs tend to operate within a limited area, such as within a

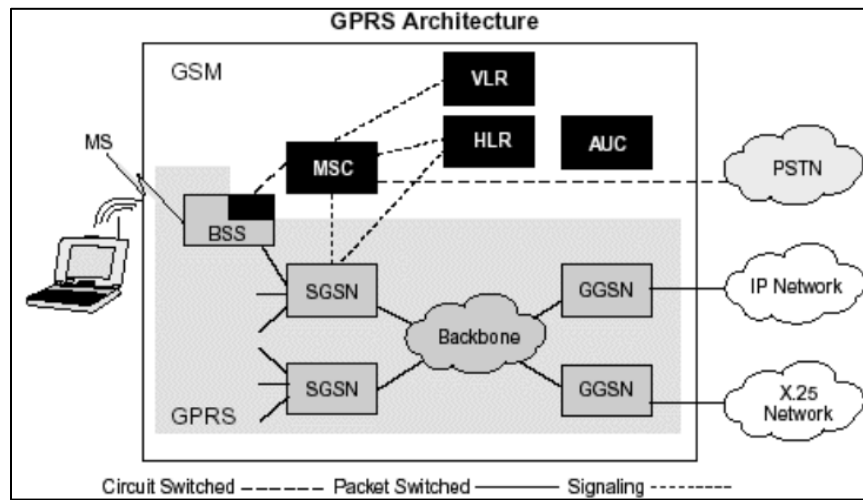
home, business, building, or campus. Exemplary WLANs include networks compliant with the IEEE 802.11 (“Wi-Fi”) standard and Bluetooth networks. For IEEE 802.11 networks, the relevant standard defines the communications protocol that is implemented at the wireless network’s endpoints and at the network’s access points. One aspect of the protocol, for example, concerns how data packets are routed through the wireless network from a source transmitter to a destination receiver (i.e., the selection of communications links, access nodes). Another aspect of the protocol concerns acknowledgement by the receiver back to the transmitter that the units of information (“packets”) were successfully received at the relevant endpoint. WLANs, such as those compliant with IEEE 802.11, are typically comprised of more than one communications link from source to destination and may include network elements such as base stations in between end-user devices. *See* EX1010, 9 (“The base station is a common infrastructure component that interfaces the wireless communications signals traveling through the air medium to a wired network—often referred to as a distribution system.”); *see also* EX1013, ¶[0004] (describing exemplary WLAN network structure including base station connecting multiple end-user devices to wired network components); EX1016, 408 (depicting “a typical topology in a mobile network scenario,” including mobile equipment connecting to the internet through base station and gateway elements).

38. Other types of wireless networks are referred to as wireless wide area

networks (WWANs). WWANs tend to have wider coverage areas than WLANs. Exemplary WWANs include General Packet Radio Service (GPRS) networks and Code-Division Multiple Access (CDMA) networks. GPRS networks, for example, which began to be commercially deployed in around 2001, implement the GPRS standard, which was promulgated by the European Telecommunications Standards Institute and defines, among other things, the frequency bands and communications protocols supported by GPRS-compliant wireless devices. As with WLANs, WWANs, such as GPRS networks, are typically comprised of more than one communications link from source to destination and may include network elements in between end-user devices. *See* EX1015, 1:21-44:

The GPRS operational environment comprises one or more subnetwork service areas, which are interconnected by a GPRS backbone network. A subnetwork comprises a number of packet data service nodes SN, which in this application will be referred to as serving GPRS support nodes SGSN, each of which is connected to the GSM mobile communication network (typically to base station systems) in such a way that it can provide a packet service for mobile data terminals via Several base Stations, i.e. cells.

See also EX1011, 6–7 (describing the role of Gateway GPRS Support Nodes (GGSN) and serving GPRS Support Nodes (SGSN) in GPRS networks). An exemplary GPRS network architecture is depicted in the figure below:



EX1011, 7 (Fig 1.3)

See also EX1016, 408.

B. Wireless Network Measures

39. Wireless communications networks may be characterized by their quality of service (QoS). QoS Measures may look to, for example, the overall capacity on the wireless network (“bandwidth”), the capacity of the wireless network to hand additional network traffic (“available bandwidth,” “residual bandwidth,” or “spare bandwidth”), the time required to transmit across the network (“delay” or “latency”), the variability in how long it takes to transmit across the network (“jitter”), or the ratio of the power of a wireless signal in comparison to background noise (“signal-to-noise ratio” or “SNR”). Where a wireless network is measured to have, for example, a higher bandwidth, a higher SNR, a lower delay, or a lower jitter, than another network, it may be said that the first network exhibits a higher QoS than the second network.

40. A wireless network's QoS may be measured in a number of ways. For example, when measuring bandwidth, the network's bandwidth may be measured across the full network (from one endpoint to another), across a subnetwork of the overall wireless network, or across one communications link (e.g., from a mobile device to a nearby WLAN access point). Certain QoS metrics may be measured in one direction, such as the delay in transmitting a communication from a transmitter to a receiver ("unidirectional delay"), or in a roundtrip ("roundtrip delay").

41. Wireless network measures, which are typically measured through various estimation techniques, are helpful to understand and compare the performance of wireless communications networks. A wireless network access point, for example, may use this information in determining the optimal route to direct communications through the network. Wireless network measures may also help identify critical errors and/or other issues within a wireless network that are likely to impact network performance. As described further below, wireless devices connected to the wireless network may rely upon wireless network measures in deciding whether and how to further communicate on the network.

C. Wireless Network Handoff

42. Handoff (or "handover") within a wireless network may refer to several related concepts. For example, a wireless device communicating over a wireless network through an access point (the device's first communications link) may

change which access point that it is in direct contact with (e.g., if the QoS being provided by the current access point is unsatisfactory). This type of handoff, between access points within the same network, is referred to as “horizontal handoff.” Horizontal handoff may be initiated by either a wireless device or by the network itself, but, in both cases, cooperation is required from both the wireless device and the network to successfully complete the handover. The term “horizontal handoff” may further be used to refer to handoff of a wireless device between two different networks implementing the same technology (e.g., two different IEEE 802.11 networks or two different WWAN networks).

43. Where a wireless device is able to access multiple different types of wireless networks (e.g., one 802.11 network and one GPRS network), the device may conduct a “vertical handoff” between different types of networks. Such vertical handoffs may be required where a user, for example, carries a mobile device connected to an 802.11 network outside of the network’s coverage area and the device is required to connect to a different type of network (e.g., a WWAN) to maintain coverage. A less common scenario is that vertical handoff may be required between different types of WWANs, where the wireless device has moved to an area in which the QoS of its current WWAN is no longer deemed to be adequate.

44. Where a wireless device initiates a handoff between wireless communications networks, there may be a delay between the time that the decision

is made and when communication may commence on the second network. First, the device must identify the second network to which it intends to handoff (the “discovery” phase). This may involve estimation and comparison of wireless QoS metrics for multiple networks, including the network on which the device is currently communicating. Second, after the second network is identified, the wireless device must initiate and complete wireless handoff. This may require, for example, reauthenticating the device on the second network through an exchange of authentication packets in accord with the relevant wireless protocol. For these reasons, where the device suspends communication on the first network while conducting wireless handoff, there may be a delay or disruption in communications.

45. Handoff decisions, whether initiated by the wireless device or by a network element, typically look to QoS measures, such as those described above, to determine which access points or networks are the best candidates for ongoing wireless network communications. Where a wireless device seeks to maintain a responsive connection to the wireless network, for example, it may compare the unidirectional delay, as estimated through various techniques, across the networks. A wireless device seeking to maintain responsive and consistent communication may look to a mixture of unidirectional delay and network jitter.

46. Wireless handoff decision algorithms may be implemented in a number of ways. Thresholding algorithms may look to a QoS measure of the current network

and decide to initiate wireless handoff where, for example, the signal-to-noise ratio falls below a certain level. Another type of handoff algorithm may look for the availability of a certain type of network (e.g., an IEEE 802.11 network) and preferentially connect to that network on the basis that it is expected to provide higher QoS, cost the user less, and/or maintain a higher level of security. A third type of algorithm, explored in further detail below, may directly compare multiple networks' QoS to determine the preferred network at that point in time.

D. Statistical Comparisons

47. Statistical tests provide a quantitative framework for making decisions. Statistical tests are often categorized by the number of underlying populations that the tests consider. One-sample tests, for example, may consider a single sample from a single underlying population and may be used to infer some property of that population. For example, sensor data corresponding to a single population may be analyzed to determine whether or not a particular event has occurred (e.g., safety thresholds have been exceeded). Two-sample tests, on the other hand, consider samples from two underlying populations and may be used to make a comparative assessment of some property of those populations. Two-sample tests, for example, may be used to determine which of the samples corresponds to a better alternative (e.g., higher performance, safety, or reliability).

48. Statistical tests may be defined as binary hypothesis tests, wherein the

test determines whether a default (“null”) hypothesis should be maintained or discarded in favor of an alternative hypothesis. For the one-sample test described above, the null hypothesis may be that current safety thresholds have not been exceeded, whereas the alternative hypothesis may be that current safety thresholds have been exceeded. For a two-sample test, the null hypothesis may be that, as to a certain characteristic (e.g., average performance), the two underlying populations are indistinguishable, whereas the alternative hypothesis may be that the two populations *are* distinguishable.

49. Statistical tests are also defined in terms of their significance level. For a binary hypothesis test, the significance level is defined to be the risk, assuming that the null hypothesis is true, that the statistical test wrongly rejects the null hypothesis in favor of the alternative hypothesis. A typical significance level may be 1%, 5%, or even 10%, depending on the application. That is, for a significance level of 5%, under the assumption that the null hypothesis is true, there is a 5% chance that the statistical test wrongly rejects the null hypothesis in favor of the alternative hypothesis.

50. Significance levels in statistical tests are often controlled by defining a test statistic and critical value. The definition of the test statistic varies greatly depending on the type of test being performed. For a two-sample test, a very simple example would be the difference in the mean values between the two samples. After

the test statistic has been calculated, it is compared to the critical value to determine whether the null hypothesis should be maintained or rejected in favor of the alternative hypothesis. Where the significance level is high, the critical value tends to be low, resulting in the null hypothesis being rejected more often. Where the significance level is low, the critical value tends to be higher, leading to fewer erroneous rejections of the null hypothesis where the null hypothesis is correct.

51. Statistical tests are required where the true characteristics of the distributions underlying the processes that resulted in the two samples are not known. In the example of a two-sample test above, the test statistic was defined to be the difference between the means of the two samples. If the true means of the distributions corresponding to the two samples was known in advance, testing the sample to calculate the means of the samples (“sample means”) would not have been necessary, and the statistical test would not have been required to infer which sample corresponded to higher values on average.

52. Two-sample tests are categorized into one-sided and two-sided tests. In both cases, the null hypothesis typically corresponds to an inference that the characteristics of the distribution correspond to the two-samples are similar in some way (e.g., that the true mean of the distribution corresponding to the two samples is approximately equal). For one-sided tests, the alternative hypothesis typically corresponds to one of the two samples (e.g., the second sample) corresponding to

different characteristics (e.g., “The true mean of the distribution underlying sample B is higher than that corresponding to sample A.”). For two sided tests, the alternative hypothesis corresponds to *either* of the two samples corresponding to different characteristics. For example, consider the hypotheses below:

Null Hypothesis	Samples A and B correspond to approximately equal levels of performance.
Alternative Hypothesis (One-Sided)	Sample B corresponds to a higher level of performance.
Alternative Hypothesis (Two-Sided)	Samples A and B do not correspond to approximately equal levels of performance.

53. Non-parametric tests are tests that do not make any detailed assumptions about the distributions underlying the samples being investigated. For example, the samples are not required to come from a certain type of statistical distribution (i.e., a normal distribution), or even from the same type of distribution. This is distinguished from parametric tests, which may assume, for example, that both samples come from normal distributions characterized by parameters that describe the distribution (e.g., mean and standard deviation).

54. An “online” statistical test is one that can be performed on an ongoing basis, as new sample data is received, without needing to store all previous values. For example, the two-sample test described above, wherein the test statistic is the difference between the means of the two samples, may be performed online. All that would need to be retained is the number of samples from each sample set and their

corresponding running means. When a new sample is received for either sample set, the mean may be updated by multiplying the current mean by the prior number of samples, adding the new observation, and dividing by the new number of samples. Thereafter, the means may be compared to update the test statistic, and the updated test statistic may be compared to the critical value to determine the test's outcome.

VIII. OVERVIEW OF THE '006 PATENT

A. Specification

55. The '006 patent is directed to a method in which mobile devices, such as cell phones, can compare the quality of different types of wireless networks. Two different types of wireless networks may be, for example, cellular networks and Wi-Fi (IEEE 802.11) networks. Comparing such networks allows mobile devices to determine whether they should continue to communicate on their current network, or consider "handing off" (changing to operate on) a different type of network.

56. Two categories of networks disclosed in the '006 patent are Wireless Local Area Networks (WLANs) and Wireless Wide Area Networks (WWANs). Exemplary WLANs disclosed include Bluetooth, IEEE 802.11, and Home RF. '006 Patent at 1:61-3:10. Exemplary WWANs disclosed include General Packet Radio Service (GPRS), 3G cellular networks, 2.5G cellular networks, and Global System for Mobile Communications (GSM) networks. *Id.*

57. The '006 patent discusses Multiple Interface Devices (MIDs), mobile

devices with two or more network interfaces. The '006 patent discloses, for example, MIDs with connections to Bluetooth and 802.11 interfaces. '006 Patent at 2L55-61.

58. The '006 patent purports to improve on prior art techniques for comparing the quality of different networks. It refers to the quality of a network as Quality of Interface ("QoI"). The '006 patent notes that prior art techniques for measuring the QoI for a network were "based on a very narrow set of criteria such as radio signal strength or signal to noise ratios," '006 Patent, 3:54-56, and that these metrics are often not suitable for comparing different types of wireless interfaces, such as cellular networks and WLANs. '005 Patent, 3:56-58, 9:55-57.

59. The '006 patent discloses a method that mobile devices can use to compare the QoI over different types of (i.e., "heterogeneous") networks. '006 Patent, 5:35-38. This method involves the mobile device comparing the QoI of multiple interfaces using path quality metrics that are independent of how the QoI is measured. '006 Patent, 5:38-40. The '006 patent identifies exemplary measurements that meet this requirement, such as round-trip available bandwidth, unidirectional available bandwidth, and end-to-end delay. '006 Patent at 5:5-12.

60. The method disclosed in the '006 patent requires performing this comparison "concurrently in real time during use of a current interface." '006 Patent, Cls. 1-3. That is, the comparison must be performed while the mobile device remains communicating on a wireless interface. After the comparison is performed, the

mobile device looks to the results to determine whether to: (i) continue to communicate on the current interface or (ii) switch (handover) to an alternative interface that provides a higher expected QoI. '006 Patent, 10:29-39, Cls. 1-3.

61. The '006 patent discloses performing the comparison between interfaces using a variety of different types of tests. Claim 1 of the '006 patent, for example, discloses performing the comparison with a quickest change detection problem or with sequential two-sample tests. Claim 2 of the '006 patent discloses performing the comparison with a one-sample change point detection method or with a non-parametric and online two-sample method. Claim 3 of the '006 patent discloses performing the comparison with sequential two-sample tests.

62. The '006 patent discloses several exemplary statistical tests, often by way of incorporating by reference publications themselves disclosing the tests in detail. One such test, Rosenbaum's test, is disclosed by reference to *Neave*. '006 Patent, 17:30-32. The '006 patent describes Rosenbaum's test as non-parametric, workable with unequal sample sizes, and online. *Id.*

B. Prosecution History

63. The application that issued as the '006 patent was filed on December 20, 2010. This application claimed the benefit of U.S. Patent Application No. 11/209,331, which was filed on August 23, 2005. U.S. Patent Application No. 11/209,331 itself claims priority to U.S. Provisional Application No. 60/662,749,

which was filed on March 17, 2005.

64. On December 7, 2012, the examiner issued a non-final office action rejecting all claims on the basis that they were directed to non-statutory subject matter and claims 1-10 and 14-16 as obvious over U.S. 2005/0002379 in view of the admitted prior art. EX1004, 82–87.

65. On May 7, 2013, the applicant submitted an amendment that amended all independent claims to add, among other limitations, the expression: “a mobile device ... including at least one cellular radio interface and at least one wireless local area network interface.” EX1004, 110–15. The applicant argued that the examiner’s proposed obviousness combinations under §103(a) did not render obvious all elements of the challenged claims and that they were improper as including references not “within the art,” including the background references, such as *Neave*, incorporated within the patent’s specification as describing the required statistical tests. *Id.*, 116–23.

66. On September 13, 2013, the examiner issued a final office action maintaining all grounds for rejection in the non-final office action. EX1004, 130–38.

67. On March 13, 2014, the applicant submitted a request for continued examination, in which the applicant amended all of the independent claims to require the following language: “said mobile device performing said comparing of said

multiple interfaces concurrently in real time during use of a current interface, and said mobile device selecting one of said interfaces based on said comparing.” EX1004, 159–68. In this paper, the applicant asserted that, in view of the amendments, each of the examiner’s rejections had been traversed and that, for this reason, the claimed invention was allowable. *Id.*, 169–78.

68. On April 2, 2014, the examiner issued a notice of allowance. EX1004, 184. The notice of allowance did not state reasons as to why the claimed invention was allowable despite the examiner’s prior rejections. Specifically, the notice of allowance did not concede that the background references, such as *Neave*, incorporated within the patent’s specification as describing the required statistical tests, were not prior art to the ’006 patent. The notice of allowance did not indicate that the background references, such as *Neave*, could not be combined with the examiner’s asserted primary reference, US 2005/0002379 (“*Bye*”).

IX. THE CHALLENGED CLAIMS

69. The table below identifies the Challenged Claims of the ’006 patent on a limitation-by-limitation basis:

Claim 1	
1[pre]	Method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:
1[a]	a mobile device comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at

	least one wireless local area network interface, of said mobile device that connect to heterogeneous networks using path quality metrics that are independent of how the QoI is measured, whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network,
1[b]	said method including said mobile device comparing path quality as a quickest change detection problem for observations from a new interface or comparing path quality based on sequential two sample tests,
1[c]	said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and
1[d]	said mobile device selecting one of said interfaces based on said comparing.
Claim 2	
2[pre]	A method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:
2[a]	a mobile device comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface, of said mobile device that connect to heterogeneous network using path quality metrics that are independent of how the QoI is measured, whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network,
2[b]	said method including said mobile device performing a one-sample change point detection method or performing a non-parametric and on-line two-sample method,
2[c]	said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and
2[d]	said mobile device selecting one of said interfaces based on said comparing.

Claim 3	
3[pre]	A method for substantially real-time comparison of quality of interfaces (Qols) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:
3[a]	a mobile device comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface, of said mobile device that connect to heterogeneous networks using path quality metrics that are independent of how a QoI is measured,
3[b]	said method including said mobile device comparing path qualities based on sequential two sample tests,
3[c]	said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and
3[d]	said mobile device selecting one of said interfaces based on said comparing.
Claim 4	
4	The method of claim 3, further including the mobile device having limited knowledge of the quality of the current path.
Claim 5	
5	The method of claim 3, further including having insufficiently many measurements for an estimate of the mean quality of the current path and its variance and observations are not matched.
Claim 6	
6	The method of claim 5, further including without the mobile device knowing values for mean and median, performing a test of which interface has a higher mean or median.
Claim 7	
7	The method of claim 6, further including performing a test of the difference in average quality by testing for a difference in a location of samples.

Claim 8	
8	The method of claim 7, wherein said method is nonparametric, works for unequal sample sizes, and is performed on-line.
Claim 9	
9	The method of claim 7, wherein said method employs a Rosenbaum test.
Claim 10	
10	The method of claim 9, wherein a test statistic T_R includes a total number of a second interface's data points which have a value larger than a largest value in a first interface's data points.
Claim 11	
11	The method of claim 10, wherein if an overall maximum is not from a sample set from the second interface, then the test stops, and a null-hypothesis H_0 is not rejected in favor of H_1 , and otherwise H_0 is rejected in favor of H_1 if T_R is larger than a value $C(a, n_1, n_2)$, calculated using the distribution of T_R .
Claim 12	
12	The method of claim 7, wherein the method is based on the length of a high-end extreme run of samples for a second interface or a low-end extreme run of samples for a first interface.
Claim 13	
13	The method of claim 12, further including repeating the test for a new observation or a new batch of observations.
Claim 16	
16	The method of claim 3, further including performing the two sample test even when the mobile has more than two interfaces.

X. OVERVIEW OF THE PRIMARY PRIOR ART REFERENCES

70. The prior art references that I have analyzed are described below.

Reference *Guo* is analogous to the '006 patent because it is within the same field of

endeavor as the '006 patent and reasonably pertinent to one or more problems addressed by the '006 patent. Like the '006 patent, *Guo* is directed to comparing mobile devices' wireless interfaces to determine which interface provides the highest quality of service. *Neave* is a general-purpose statistics text that has wide applicability, including to engineering. *Neave* is directed to methods for comparing two samples, including quality or performance-related data, to determine which sample corresponds to the better alternative.

A. *Guo*

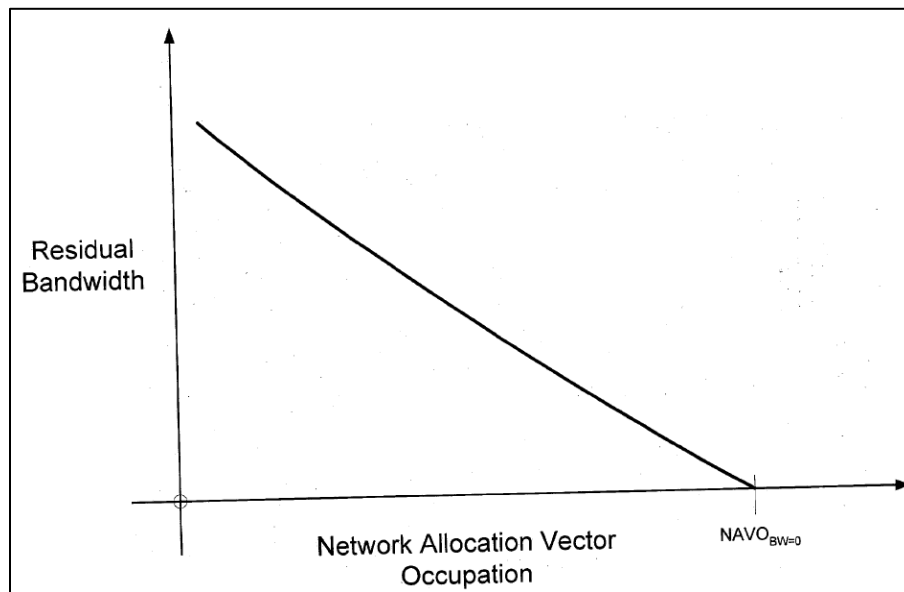
71. A POSITA would have recognized that *Guo* (EX1005) is directed to a system and method for handing off a device between different types of wireless networks, which *Guo* refers to as “vertical handoff” between the networks. *Guo*, Abstract. According to *Guo*, a challenge in deciding whether to initiate vertical handoff between different types of networks is that traditional measures of network quality, such as signal strength, are often not directly comparable to one another. *Id.*, ¶[0008] (“Wireless network standards such as CDMA and IEEE 802.11b, are generally incompatible and are not focused on supporting vertical handoffs.”). For this reason, according to *Guo*, “[n]ew handoff decision criteria are required.” *Id.*

72. *Guo* discloses two approaches for measuring handoff decision criteria. In the first approach, the mobile device samples a network allocation vector, which is information provided by the network's access point that indicates the network's

expected transmission time. *Guo*, ¶¶[0061] - [0063]. Such information is advertised by the network's access points in, for example, IEEE 802.11 networks.

73. The device uses these sampled network allocation vectors to calculate a network allocation vector *occupation*, which is the proportion of time that the network allocation vector is deemed to indicate that the network is "busy." *Guo*, ¶[0062]. The network allocation vector occupation can thereafter be used to calculate a wireless network quality of service (QoS) measure such as residual bandwidth. *Id.*, Cl. 1, FIG. 5, ¶¶[0064] - [0067].

74. Figure 5, depicted below, for example, shows an exemplary mapping from network allocation vector occupation to residual bandwidth. *Id.* ¶[0019]. Using a graph such as that depicted in Figure 5, a POSITA would be able map a calculated network allocation vector occupation to a value for the estimated residual bandwidth on the wireless network.



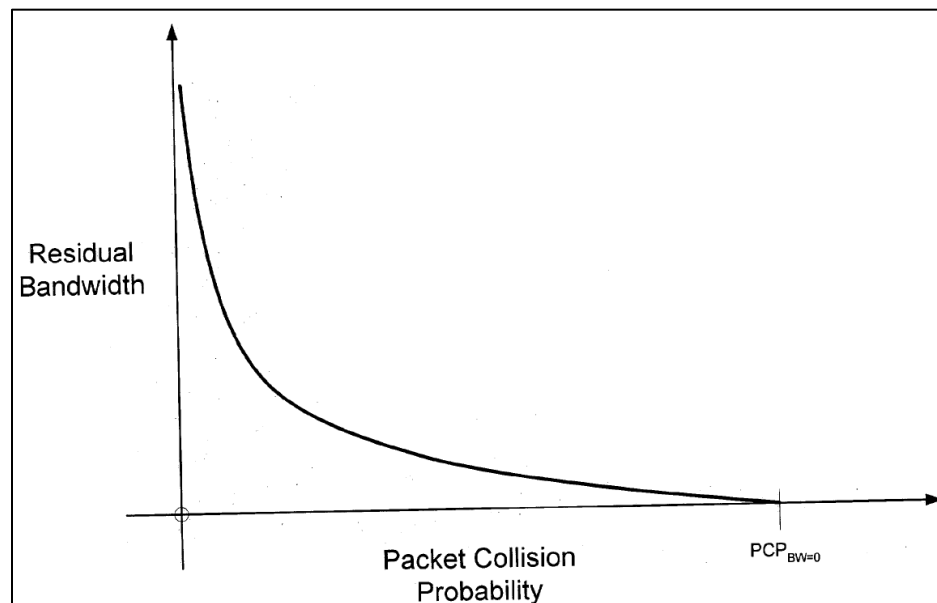
Guo, FIG. 5

75. Guo further discloses a method for converting network allocation vector occupations to estimated residual bandwidths with a lookup table. Guo, ¶[0066]. Guo further discloses that the network allocation vector occupation can “serve[] directly as a measure of the quality of service provided by a wireless network.” *Id.* ¶[0063].

76. In the second approach, the device transmits fixed-size probing packets into the wireless network at a fixed rate for a period of time. Guo, ¶[0069], Cl. 14. Guo suggests, for example, that 1000-byte packets may be transmitted 100 times per second for 1 second. *Id.*, ¶[0069]. Because transmission collision may cause data packet loss in wireless networks, the number of data packets transmitted by the transmitter but not acknowledged as received by the receiver (unacknowledged data packets) may be used as an estimate of data packet collision probability. *Id.* ¶¶[0068]

- [0069].

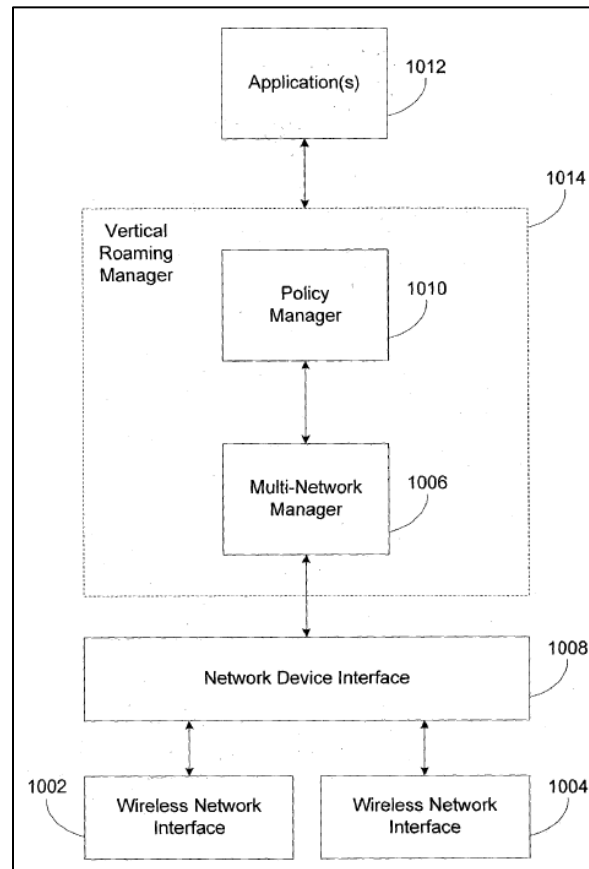
77. The mobile device then uses the packet collision probability to calculate a wireless network QoS measure, such as residual bandwidth. *Id.*, Cl. 14, FIG. 6, ¶[0072]. Using a graph such as that depicted in Figure 6, a POSITA would be able to map a packet collision probability to a value for the estimated residual bandwidth on the wireless network. *Id.*, ¶[0020] (“FIG. 6 is a graph illustrating a relationship between a measured data packet collision probability and available bandwidth in a wireless network ...”).



Guo, FIG. 6

78. Regardless of how the QoS (in the examples above, residual bandwidth) is estimated, *Guo*’s mobile device compares the QoS measurements between different networks to determine whether to remain on the device’s current network or handoff to an alternative network. *Guo*, ¶[0104], Cls. 8, 22. Network types

discussed in *Guo* include wireless wide area networks (WWAN), wireless local area networks (WLAN), General Packet Radio Service (GPRS), and IEEE 802.11. *Guo*, ¶[0006], Cls. 9-11, 23-25.

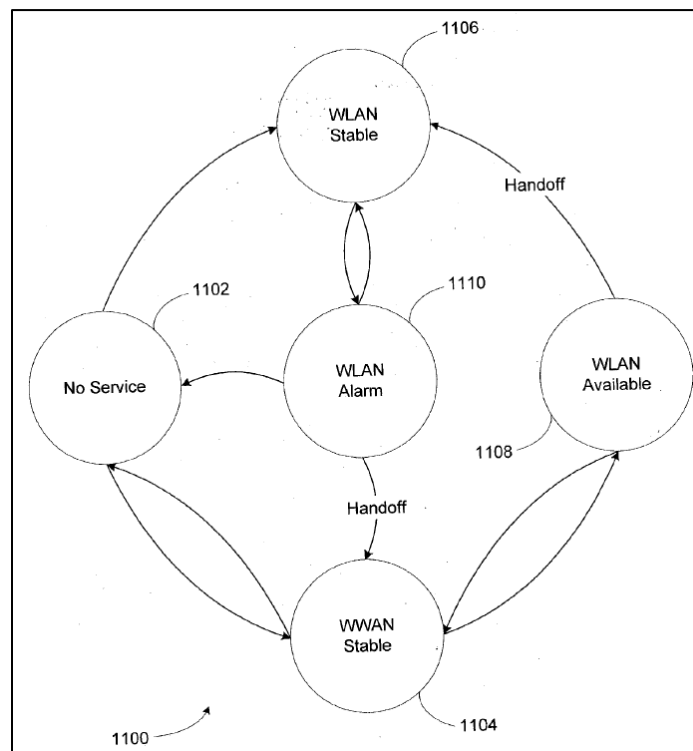


Guo, FIG 10.

79. Figure 10, reproduced above, depicts an exemplary device, with first and second wireless network interfaces 1002 and 1004. *Guo*, ¶[0086]. *Guo* notes that “architectures suitable for incorporating aspects of [*Guo*] may include more than two wireless network interfaces.” *Id.* Common network device interface 1008 connects wireless interfaces 1002 and 1004 with vertical roaming manager 1014. *Id.*, ¶¶[0087], [0093]. Vertical roaming manager 1014 comprises a multi-network

manager 1006 that transmits QoS statistics to the policy manager 1010, which makes handoff decisions. *Id.*, ¶[0091].

80. Figure 11, reproduced below, depicts an exemplary state machine corresponding to *Guo*'s vertical handoff decision process for a mobile device that can access both a WLAN and a WWAN.



Guo, FIG. 11

81. Figure 11 depicts five states. In the No Service state 1102, the mobile device is not actively communicating on either the WLAN or WWAN. *Guo*, ¶[0100]. In the WLAN Stable state 1106 and WWAN Stable state 1104, the mobile device is actively communicating on a WLAN and WWAN, respectively. *Id.*, ¶¶[0103], [0105]. In the WLAN Alarm state 1110, the mobile device is currently

communicating on the WLAN but monitoring the networks to determine whether a handoff to the WWAN has or will become necessary (e.g., due to an approaching cell boundary for the WLAN service area). *Id.*, ¶[0106].

82. In the WLAN Available state 1108, the mobile device is currently communicating on the WWAN, but a WLAN has become available. *Id.* ¶[0104]. In this state, the mobile device monitors both networks, determining, on a periodic basis, whether or not to initiate a vertical handoff to the WLAN. *Id.* The multi-network manager “periodically, (e.g., every 10 seconds)” sends notifications containing currently observed and estimated QoS statistics to the policy manager component, which then makes the periodic determination as to whether to stay on the WWAN or handoff to the WLAN. *Id.*

B. *Neave*

83. *Neave* describes distribution-free (“non-parametric”) statistical tests, which “make no detailed assumptions” about the distribution underlying the data. *Neave*, pp. 67, 348. For example, the data does not need to come from a particular statistical distribution (e.g., a normal distribution) or have any particular spread, bias, mean, median, or other distributional parameter.

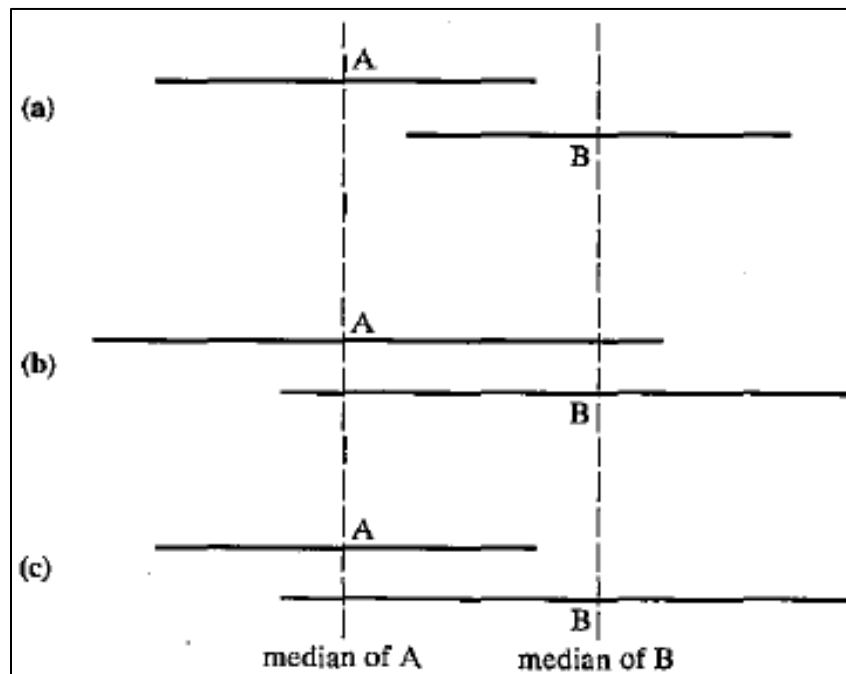
84. In my opinion, a POSITA would recognize that the principles taught in *Neave* have wide applicability to a variety of disciplines. That is, the statistical tests disclosed in *Neave* may be applied to any of a wide variety of domains, including

electrical engineering, communications, or other fields. Indeed, *Neave* states that its teachings are applicable to “a wide range of disciplines,” including engineering. *Id.*, Preface.

85. For the disclosed tests, *Neave* provides “[a]ll the necessary statistical background material.” *Neave*, Preface. *Neave* states that “no previous knowledge is required” to understand the material contained therein. *Id.* Where appropriate, a POSITA would be able to understand and apply the tests disclosed in *Neave* to problems arising in the various fields discussed above. Note that *Neave* is identified in the ’006 patent as a “background reference” showing “background technologies related to comparing qualities of interfaces ...” ’006 Patent, 4:13-14, 4:41-42.

86. Among other tests, *Neave* discloses two-sample tests. *See Neave*, Chps. 5-8. Certain two-sample tests are designed to discern differences in location (e.g., mean or median) between two datasets. *Neave* 143-44. Such tests may be effective where it is not guaranteed that the samples being tested arose from comparable underlying distributions. *Id.* For example, the distributions may vary in their spread (i.e., the values in one of the samples may tend to be farther from their mean than in the other sample). Two-sample tests are useful for comparing datasets corresponding to different underlying distributions (i.e., different sources) to discern differences between the sources (e.g., which source corresponds to better performance?). *See, e.g., id.*, pp. 146-47 (example application on battery performance data).

87. One such two-sample test *Neave* discloses is the “one-sided version of Rosenbaum’s test” (hereinafter “Rosenbaum’s test”), which *Neave* teaches is “very effective” in situations in which the distribution underlying the samples varies by more than just average and is “quick-and-easy” to implement. *Neave*, pp 143-49. For example, Rosenbaum’s test performs well where the two samples vary in spread as well as location, as depicted in Figure 7.1, reproduced below:



Neave, FIG. 7.1

88. Whereas other two-sample statistical tests, such as the Mann-Whitney and Tukey tests, may perform adequately in scenario (a), they are more likely to have difficulty quickly discerning the relative locations of the distributions underlying the samples in scenarios (b) and (c). *See Neave*, 144–45. In these cases, Rosenbaum’s test, which looks to the length of the “extreme run” of one sample

(number of values exceeding the other sample's maximum value), is likely the more powerful test for accurately discerning differences in location.

89. Rosenbaum's test considers two datasets, 'A' and 'B', to determine whether null-hypothesis H_0 ('A' and 'B' are equal on average) should be rejected in favor of alternative hypothesis H_1 ('A' is larger than 'B' on average). *Id.*, pp. 146-48. Such a test would be helpful where one seeks to identify whether an alternative (e.g., alternative network interface) offers better performance than the status quo.

90. In Rosenbaum's test, test statistic R is defined to be the "length of the extreme run ... at the right-hand end of the letter sequence." *Neave*, p. 146. "Identify the largest observation in each sample. Then if the largest overall observation is from A, R is the number of 'A's greater than the largest B." *Id.*, pp. 146-48. If the largest overall observation is *not* from A, then the test statistic R is zero and the test concludes that H_0 is preserved (because R will never reach the non-zero "critical value," described below, required to adopt the alternative hypothesis H_1). *Id.*

91. After Rosenbaum's test statistic R is calculated, it is then compared to a critical value C , which is determined based on the datasets' sizes and significance level α_1 (a measure of whether to error in favor of preserving or rejecting H_0). *Neave*, pp. 147. *Neave* provides exemplary tables for calculating C based on the above information. *Id.*, 383-86. For example, page 385, depicted below, shows the critical value table for various sample sizes (from 1 to 20 for each of the two sample sets)

for significance level $\alpha_1 = 1\%$ (we're willing to allow for a 1% risk that we reject the null hypothesis H_0 when it is true):

$\alpha_1=1\%, \alpha_2=2\%$																				
n_2	n_1																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2
3	-	-	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	-	-	-	-	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3
5	-	-	-	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3
6	-	-	-	6	6	5	5	5	5	4	4	4	4	4	4	4	4	3	3	3
7	-	-	7	7	6	6	6	5	5	5	5	4	4	4	4	4	4	4	4	4
8	-	-	8	8	7	6	6	6	5	5	5	5	4	4	4	4	4	4	4	4
9	-	-	9	8	8	7	7	6	6	6	5	5	5	5	5	4	4	4	4	4
10	-	-	10	9	8	8	7	7	6	6	6	5	5	5	5	5	5	5	4	4
11	-	-	11	10	9	8	8	7	7	6	6	6	6	5	5	5	5	5	5	5
12	-	-	11	10	9	9	8	8	7	7	6	6	6	6	5	5	5	5	5	5
13	-	13	12	11	10	9	9	8	8	7	7	6	6	6	6	6	5	5	5	5
14	-	14	13	12	11	10	9	8	8	7	7	7	6	6	6	6	6	5	5	5
15	-	15	14	12	11	10	10	9	8	7	7	7	6	6	6	6	6	6	6	5
16	-	16	15	13	12	11	10	9	9	8	8	7	7	7	7	6	6	6	6	6
17	-	17	15	14	12	11	10	10	9	9	8	8	7	7	7	7	6	6	6	6
18	-	18	16	14	13	12	11	10	10	9	9	8	8	7	7	7	7	6	6	6
19	-	19	17	15	14	12	11	11	10	9	9	8	8	8	7	7	7	7	6	6
20	-	20	18	16	14	13	12	11	10	10	9	9	8	8	8	7	7	7	7	7

Neave, p. 385

92. Where many samples are considered ($n_1, n_2 \rightarrow \infty$) and proportion p of samples are from dataset 'A,' *Neave* discloses that the probability, assuming H_0 , of $R \geq h$ (selected value) approaches p^h . *Neave*, pp. 148-49. This expression may be used to determine critical value C for large sample sizes. *Id.*

93. After R and C have been calculated, Rosenbaum's test asks whether $R \geq C$. If so, null hypothesis H_0 is rejected in favor of alternative hypothesis H_1 , and 'A' is larger than 'B' on average. *Neave*, pp. 147-48. Otherwise, the H_0 is preserved, and it is maintained that 'A' and 'B' are equal on average. *Id.*

XI. CLAIM CONSTRUCTION

94. Throughout this Declaration, for each claim term, I have applied the plain and ordinary meaning that a POSITA would have applied to that term at the time of the alleged invention. In so doing, I have considered the language of the claims themselves, the specification of the '006 patent, and the prosecution history of the application that issued as the '006 patent.

XII. DETAILED EXPLANATION OF GROUNDS

A. Ground 1: *Guo* in combination with *Neave* Renders Obvious Claims 1-13, 16.

1. Claim 1

- a. 1[pre]: “Method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:”

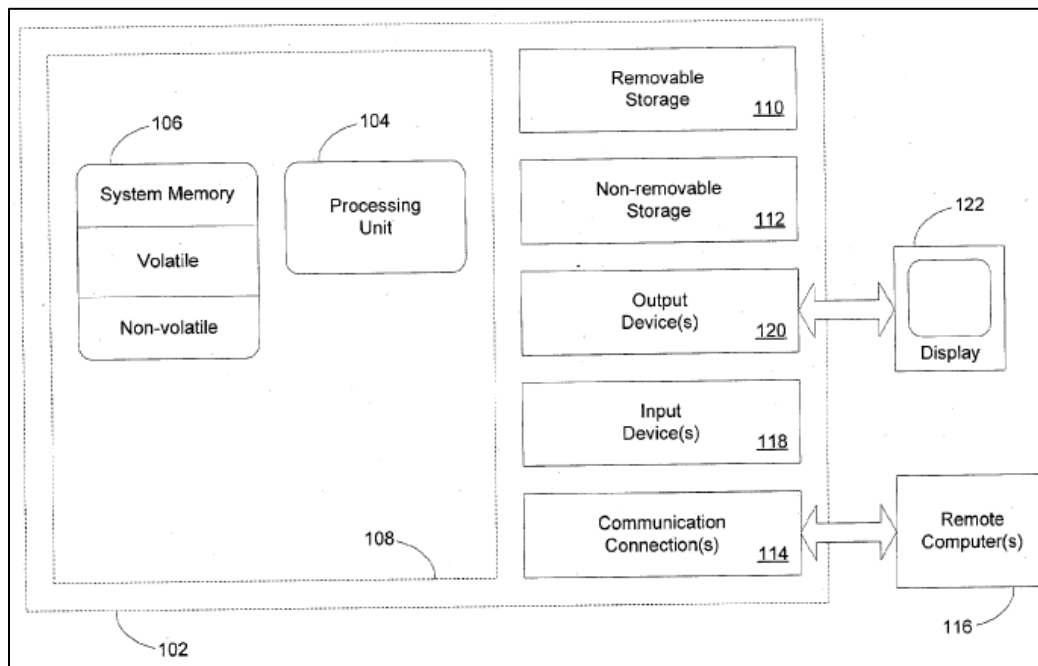
95. To the extent that the preamble is limiting, *Guo* teaches a “[m]ethod for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks.” As I explain in §XII.A.1.b(i), *Guo* teaches “a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks.” As I further explain in §XII.A.1.b(ii), *Guo* teaches “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface.”

96. For these reasons, it is my opinion *Guo* teaches a “[m]ethod for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks.”

b. 1[a]

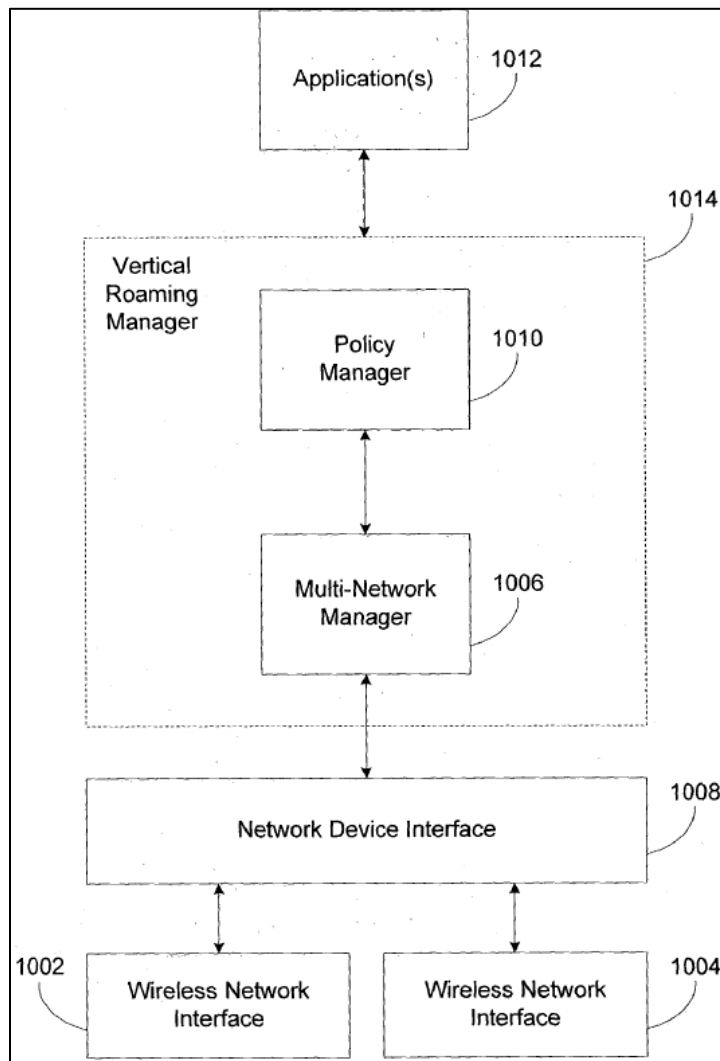
(i) “a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks”

97. *Guo* teaches this feature. This element requires “a mobile device.” *Guo* discloses a “mobile computing device 102,” as shown in Figure 1, depicted below. *Guo*, ¶[0035]. A POSITA would have understood that mobile computing device 102 corresponds to the ’006 patent’s “mobile device.” *See also id.*, ¶[0003] (“Each wireless network base station or access point, and each mobile device capable of communicating with the access point, is able to both transmit and receive radio signals.”).



Guo, FIG. 1

98. This element also requires “multiple interfaces.” Figure 10, depicted below, discloses an exemplary software architecture:

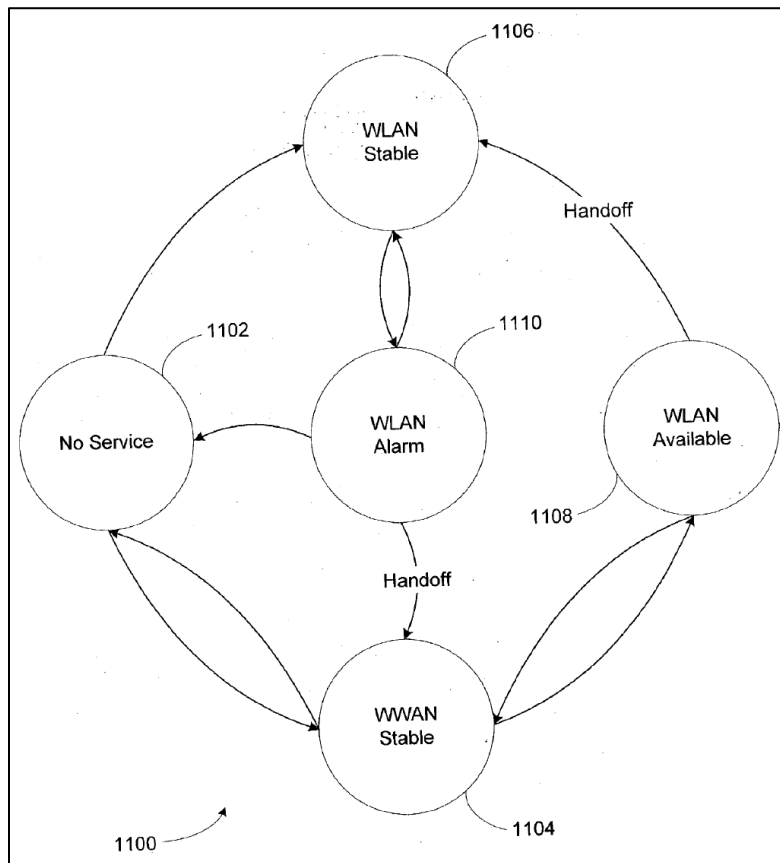


Guo, FIG. 10

99. Guo's software architecture includes wireless network interfaces 1002 and 1004, *see also Guo*, ¶[0086] ("The example architecture includes a first wireless network interface 1002 and a second wireless network interface 1004, however architectures suitable for incorporating aspects of the invention may include more than two wireless network interfaces."). A POSITA would have understood that wireless network interfaces 1002 and 1004 correspond to the '006 patent's "multiple

interfaces.”

100. This element further requires that the recited “multiple interfaces” “connect to heterogeneous networks.” *Guo*’s Fig. 11 is a state diagram showing its vertical handoff decision process (*see Guo*, ¶[0028]):



Guo, FIG. 11

101. In the WLAN Available state 1108, service is available from both a WLAN and WWAN. *Guo*, ¶[0104] (“In the WLAN Available state 1108, wireless network service is available from both the wireless wide area network and the wireless local area network, but the wireless wide area network is the current wireless network service provider.”). A POSITA would have recognized that WLAN

and WWAN networks constitute “heterogeneous,” or different types of, wireless networks. Indeed, the ’006 patent is the same as *Guo*, as it discloses cellular networks (also referred to as “cellular radio interfaces”) and WLANs as exemplary heterogeneous networks to which the disclosed invention may be applied. ’006 Patent, 13:55-14:04.

102. A POSITA would have understood that *Guo*’s WWAN network corresponds to a “cellular network,” as that term is used in the ’006 patent, and that *Guo*’s WLAN corresponds to a “WLAN,” as that term is used in the ’006 patent. For example, *Guo* discloses some of the same WWAN network types as the ’006 patent discloses correspond to cellular radio interfaces. *Compare Guo* ¶[0006] (disclosing GPRS and CDMA as exemplary WWAN interfaces) *with* ’006 Patent, 13:55-61 (disclosing GPRS, cdma2000, and WCDMA as exemplary cellular radio interfaces). Likewise, *Guo* discloses some of the same WLAN network types as the ’006 patent discloses correspond to local area network interfaces. *Compare Guo* ¶[0006] (disclosing IEEE 802.11 as an exemplary WLAN interface) *with* ’006 Patent, 13:55-61 (disclosing IEEE 802.11 as an exemplary local area network interface). Indeed, in certain passages, the ’006 patent refers to the wireless access to local area networks as “WLAN,” *see, e.g.*, ’006 Patent, 2:11-13, the same term as used in the *Guo* to refer to the same class of networks.

103. For these reasons, it is my opinion *Guo* teaches a “a mobile device ...

[having] multiple interfaces ... that connect to heterogeneous networks.”

(ii) “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface”

104. *Guo* teaches this feature. This element requires that “the qualities of multiple interfaces” be compared “in substantially real-time.” *Guo*’s multi-network manager 1006 “continuously monitors” wireless network interfaces 1002, 1004. *Guo*, ¶¶[0086] - [0088]. In *Guo*’s WLAN Available state 1108, multi-network manager 1008 periodically “(e.g., every 10 seconds)” provides policy manager 1010 the WLAN’s current QoS statistics. *Id.*, ¶[0104]. “If the Policy Manager component 1010 determines that the WLAN will provide a higher quality of wireless network service [i.e., QoS / QoI], for example, the estimated residual bandwidth in the WLAN is higher than the communications bandwidth currently being experienced in the WWAN, then the Policy Manager component 1010 sends a Handoff Now command to the Multi-Network Manager component 1006 to initiate entry into the WLAN.” *Id.* In my opinion, a POSITA would have understood that the policy manager 1010’s periodic decision as to whether to remain on the WWAN or handoff to the WLAN corresponds to the ’006 patent’s claimed “comparing in substantially real-time the qualities of multiple interfaces.”

105. A POSITA would have understood that *Guo*’s “quality of service”

(QoS) metrics correspond to the '006 patent's "quality of interface" (QoI) metrics. For example, *Guo* discloses use of the QoS statistic "residual bandwidth" and two methods for estimating residual bandwidth (the collision probability method and the allocation vector occupancy method). Whether measured by the collision probability method or allocation vector occupancy method, residual bandwidth is measure of the networks unused, or spare, capacity. Likewise, the '006 patent discloses use of the QoI statistic "available bandwidth." The '006 patent explains: "[A]vailable bandwidth of a link is the unused, 'spare' capacity of the link ..." '006 Patent, 11:63-65. As another example, *Guo* discloses "transmission delay" as an exemplary QoS metric, which a POSITA would understand to correspond to the '006 patent's "end-to-end delay." *Guo*, ¶¶[0011] - [0012], [0059]; '006 Patent, 5:5-12.

106. A POSITA would have understood that *Guo*'s comparison is performed in substantially real-time. A POSITA would have recognized that, during prosecution, the applicant for the '006Pat explained that, for the comparison to be real time, it must be performed while the device is communicating on a current interface. EX1004, 174. The applicant distinguished a prior art reference, *Bye*, on the basis that *Bye* taught "away from any such real time comparison because *Bye* only contemplates switching once a current interface cannot support communications." *Id.* The applicant further asserted that *Bye* "does **not** teach ... a comparison of heterogeneous interfaces in real time (e.g., concurrently during use

of the current network).” *Id.* (emphasis in original).

107. A POSITA that looked to contemporary electronics and communications dictionaries would have understood that this use of the term “real time” is consistent with the dictionaries’ corresponding entries. *See* EX1007, p. 430 (“**real time** Pertaining to ... The computation of control information during the time of an actual process so that the results may be used to direct the process.”); *see also* EX1008, p. 933 (similar).

108. A POSITA would have understood that *Guo*’s comparison is performed in substantially real-time since *Guo*’s mobile device performs its comparison of residual bandwidth of the WLAN and WWAN interfaces while communicating on the WWAN. *Guo*, ¶[0104] (“In the WLAN Available state 1108, ... the [WWAN] is the current wireless network service provider.”); *id.* (consulting “the communications bandwidth currently being experienced in the WWAN”).

109. This claim element further requires that the multiple interfaces “include[] at least one cellular radio interface and at least one wireless local area network interface.” As I explain in §XII.A.1.b(i), a POSITA would have understood that *Guo*’s WWAN corresponds to the claimed “cellular radio interface” and that *Guo*’s WLAN corresponds to the claimed “wireless local area network interface.”

110. For these reasons, it is my opinion that *Guo* teaches “comparing in substantially real-time the qualities of multiple interfaces, including at least one

cellular radio interface and at least one wireless local area network interface.”

(iii) “using path quality metrics that are independent of how the QoI is measured,”

111. *Guo* teaches this feature. A POSITA would have understood that the term “path quality metric” refers to a measure of a network path that is indicative of a network’s performance. *See* ’006 Patent, 8:57-60 (“The preferred embodiments described herein solve existing problems in the art based on a unique understanding of computer networks, performance measurements, statistics and more.”).

112. A POSITA would have understood that the term “path” as used in the ’006 Patent (including in the phrase “path quality metric”) is not limited in terms of the number of path steps and may refer to any end-to-end network path, regardless of whether the path consists of a direct connection or of multiple steps. Even if the term was limited to multi-step paths, a POSITA would have recognized that the exemplary WLAN and WWAN network types disclosed in *Guo* are typically implemented as wireless networks containing multi-step paths, as I describe in §VII.A.

113. As I describe in §X.A, *Guo* discloses the measurement and comparison of “residual bandwidth.” A POSITA would have understood that residual bandwidth is a measure of a network path that is indicative of the network’s performance. As I describe in VII.B, residual bandwidth on a network path quantifies that path’s

capacity to handle additional network traffic.

114. A POSITA would have understood that the '006 patent uses the term “path quality metrics that are independent of how the QoI is measured” to refer to metrics that are comparable, even where they may be measured in multiple ways. *See, e.g.* '006 Patent, 5:5-13 (disclosing measurement of “round-trip available bandwidth” and “unidirectional available bandwidth”), 11:43-48 (disclosing measurement of measurement “by the path through the radio network alone or by an end-to-end path that includes both a path in the radio network and a path through a wired network.”). Specifically, the '006 patent discloses “available bandwidth,” or “unused, spare capacity,” as one such path quality metric. *Id.* 6:20-26, 11:63-65 (“[A]vailable bandwidth of a link is the unused, ‘spare’ capacity of the link ...”).

115. A POSITA would have understood that *Guo* discloses “using path quality metrics that are independent of how the QoI is measured.” *Guo* discloses the measurement and comparison of “residual bandwidth,” including multiple ways to measure residual bandwidth. As I describe in §X.A, *Guo* teaches estimating residual bandwidth by measuring the packet collision probability by transmitting probing data packets. *See also Guo*, ¶¶[0068] - [0069], Cl. 14. As I also describe in §X.A, *Guo* also teaches estimating residual bandwidth by calculating the network allocation vector occupation using the network’s advertised transmission times. *See also id.*, ¶¶[0060] - [0064], Cl. 1. When disclosing the comparison of network QoS

statistics such as residual bandwidth, *see, e.g. id.*, ¶[0104], *Guo* does not differentiate between QoS statistics depending on which method was used to estimate the statistic (“how the QoI was measured”). Whether measured by the collision probability method or allocation vector occupancy method, residual bandwidth is measure of the networks unused, or spare, capacity.

116. In my opinion, a POSITA would have understood that *Guo*’s disclosed QoS metrics correspond to some of the same QoI metrics disclosed in the ’006 patent as being “path quality metrics that are independent of how the QoI is measured.” For example, and as I further describe in §XII.A.1.b(ii), *Guo*’s “residual bandwidth” corresponds to the ’006 patent’s “available bandwidth.” *See* ’006 Patent, 11:63-65 (“[A]vailable bandwidth of a link is the unused, ‘spare’ capacity of the link ...”). As another example, *Guo* discloses “transmission delay” as an exemplary QoS metric, which a POSITA would understand to correspond to the ’006 Patent’s “end-to-end delay.” *Guo*, ¶¶[0011] - [0012], [0059]; ’006 Patent, 5:5-12.

117. For these reasons, it is my opinion that *Guo* teaches “using path quality metrics that are independent of how the QoI is measured.”

(iv) **“...whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network,”**

118. *Guo* teaches this feature. This element requires that the QoI be

“measured by a path through a wireless network alone *or* a path through both a wireless network and through a wired network,” emphasis added). I first note that I have been informed that, because the claim uses the word “or,” the prior art need only disclose one of these two alternatives.

119. *Guo* discloses that, in an IEEE 802.11 wireless network, the access point transmits the network allocation vector with advertised transmission times. *Guo*, ¶[0061]. A POSITA would have understood that a IEEE 802.11 network would constitute a “wireless network alone,” meeting this limitation. *Guo* discloses that, in this context, the mobile device may calculate the network allocation vector occupation, *id.*, ¶[0062], which is thereafter used to calculate the network QoS measure (e.g., residual bandwidth). *Guo*, Claim 1, FIG. 5, ¶¶[0064] - [0067]. Thus, *Guo* discloses that QoI is “measured by a path through a wireless network alone,” meaning it discloses this element.

120. For these reasons, it is my opinion that *Guo* teaches using path quality metrics that are independent of how the QoI is measured, “whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network.”

- c. 1[b]: “said method including said mobile device comparing path quality as a quickest change detection problem for observations from a new interface or comparing path quality based on sequential two sample tests,”

(i) Motivation to combine *Guo* and *Neave*

121. A POSITA would have been motivated to combine *Guo*’s mobile device with *Neave*’s disclosure of Rosenbaum’s test. In the WLAN Available state 1108, *Guo*’s policy manager 1010 receives periodic “(e.g., every 10 seconds)” QoS statistics from multi-network manager 1006 and compares QoS measurements from the WWAN, the “current wireless network service provider,” with QoS estimates for the WLAN network. *Guo*, ¶[0104]. “If the Policy Manager component 1010 determines that the WLAN will provide a higher quality of wireless network service, for example, the estimated residual bandwidth in the WLAN is higher than the communications bandwidth currently being experienced in the WWAN, then the Policy Manager component 1010 sends a Handoff Now command to the Multi-Network Manager component 1006 to initiate entry into the WLAN.” *Id.* *Guo*, however, does not explicitly state **how** policy manager 1010 compares the QoS data for the WWAN and WLAN to determine whether “the estimated residual bandwidth in the WLAN is higher than the communications bandwidth currently being experienced in the WWAN.” *Id.*

122. A POSITA would have understood that, where QoS measurements are

collected “e.g., every 10 seconds,” that the comparison algorithm must be quick to identify handover opportunities, so as to limit the amount of time that *Guo*’s device spends in the discovery phase (see §VII.C) before initiating wireless handoff. *See also* EX1012, 11 (“If the beacon spacing [(inter-update period in milliseconds)] is large, then [discovery latency] will be larger because the mobile will take longer to discover that it can no longer hear the current overlay.”). A POSITA would have understood that reducing the time spent in the discovery phase would have been essential to timely initiating vertical handoff so as to minimize any disruptions in the device’s connectivity. *See id.*, 1 (explaining that “handoff latency is bounded by the amount of time” that the mobile device spends in the discovery phase). Moreover, a POSITA would have known, in the wireless networking context, the distributions underlying the QoS data are unlikely to be known in advance. Thus, a POSITA would have been motivated to look to statistical tests that do not require any detailed assumptions about the distributions underlying the data - non-parametric statistical tests. *See* EX1016, 409 (“To compare statistical samples . . . whose distribution is unknown non parametric tests are necessary.”).

123. To fill this need, a POSITA would have looked to *Neave*’s disclosure of well-known non-parametric statistical methods of comparing two datasets, including Rosenbaum’s test. *Neave*’s methods constitute a finite number of identified, predictable potential solutions to the problem of comparing two datasets

where the underlying distributions are not known in advance to determine which sample corresponds to a better alternative, and a POSITA would have been motivated to pursue these known potential solutions with a reasonable expectation of success.

124. A POSITA would have understood that the one-sided form of Rosenbaum's test, which tests to determine whether one dataset corresponds to higher values on average than the other, *Neave*, p. 148, fits the problem of comparing interfaces in *Guo* to determine whether a second interface has higher estimated QoS values on average than the first interface. *See, e.g.*, EX1016, 409-10 (applying one-sided non-parametric test from which Rosenbaum's test derives, the Mann-Whitney-Wilcoxon test, to compare network quality of service measurements). A POSITA would have understood that a one-sided two-sample test, such as the one-sided form of Rosenbaum's test, which looks to differences in average value of the populations underlying two samples, can detect such differences quicker than methods that require first forming reliable estimates of the location (e.g., mean or median) of the populations underlying the two samples prior to making handoff decisions.

125. A POSITA would have further understood that Rosenbaum's test is more effective than alternative tests, such as the Mann-Whitney and Tukey tests, where, as in the wireless networking environment (*see* §VII.A), the underlying distributions vary both in spread and location. *See Neave*, 144 (“[T]he power of the

Mann-Whitney and Tukey tests would have been reduced because of the change in spread.”). A POSITA would have understood that where, as here, detecting differences in location quickly (i.e., with a minimal number of observations) is essential, it would have been important to use the more effective statistical test in this context, Rosenbaum’s test.

126. A POSITA would have been motivated to apply Rosenbaum’s test to *Guo*’s mobile device to determine whether the QoS dataset of the alternative interface (WLAN, dataset ‘A’ in *Neave*’s description) has higher values on average than the QoS dataset of the current interface (WWAN, dataset ‘B’). A POSITA would have been motivated to use Rosenbaum’s test as described in *Neave*, since a POSITA would have understood that Rosenbaum’s test is “quick,” “relatively compact,” and “somewhat portable,” making it well-suited for application to real time comparisons, such as those claimed in the ’006 patent. *See* EX1009, p. 491.

127. For these reasons, it is my opinion that a POSITA would have been motivated to combine *Guo*’s mobile device with *Neave*’s disclosure of Rosenbaum’s test.

(ii) Teachings in *Guo-Neave* Combination

128. The *Guo-Neave* combination teaches this feature. As I note above, I have been informed that, because the claim uses the word “or,” the prior art need only disclose one of these two alternatives.

129. A POSITA would have understood Rosenbaum's test to constitute a "two-sample test." Rosenbaum's test looks to two datasets (samples), 'A' and 'B,' and determines whether one sample's values are larger than the other's on average. Further Rosenbaum's test is described in a section of *Neave* titled "Tests involving two samples" (i.e., "two sample tests"). *Neave*, p. x. Indeed, the '006 patent refers to Rosenbaum's test, as described in *Neave*, as an exemplary two-sample test. '006 Patent, 19:21-26 ("The two-sample tests gave the following results. Listed in Table 1 below are the p-values for ... the Rosenbaum test ..."), 17:30-32 ("Rosenbaum's test (see Reference [9] incorporated above)."), 4:41-42 (identifying "Reference [9]" as *Neave*).

130. A POSITA would have recognized that the *Guo-Neave* combination performs "sequential" two-sample tests. In *Guo*'s WLAN Available state 1108, *Guo*'s multi-network manager 1106 "periodically (e.g., every 10 seconds)" transmits QoS statistics to policy manager 1010, *Guo*, ¶[0104], which then (i.e., "periodically," or "sequentially") determines whether "the WLAN will provide a higher quality of wireless network service" than the WWAN by use of Rosenbaum's test. *Id.* A POSITA would have understood that the described "periodic" use of Rosenbaum's test constitutes use of "sequential two sample tests."

131. For these reasons, it is my opinion that the *Guo-Neave* Combination teaches "said method including said mobile device comparing path quality as a

quickest change detection problem for observations from a new interface or comparing path quality based on sequential two sample tests.”

d. 1[c]: “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and”

132. *Guo* teaches this feature. As I describe in §XII.A.1.b(ii), *Guo* teaches a mobile device “comparing in substantially real-time the qualities of multiple interfaces.” As I also explain in that section, the comparison occurs “while *Guo*’s mobile device communicates on the WWAN.” Thus, a POSITA would have understood that this comparison is performed “concurrently in real time during the use of a current interface.

133. For these reasons, it is my opinion that the *Guo-Neave* Combination teaches “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface.”

e. 1[d]: “said mobile device selecting one of said interfaces based on said comparing.”

134. *Guo* teaches this feature. As I describe in §XII.A.1.b(ii), *Guo* teaches “comparing in substantially real-time the qualities of multiple interfaces.” As I also explain in that section, if the policy manager component 1010 determines that the WLAN will provide a higher QoS than currently experienced on the WWAN, then the policy manager 1010 initiates a vertical handoff from the WWAN to the WLAN.

See also Guo, ¶[0104]. A POSITA would have understood that the policy manager 1010's periodic decision as to whether to remain on the WWAN or initiate a vertical handoff to the WLAN corresponds to the '006 patent's claimed "said mobile device selecting one of said interfaces based on said comparing."

135. For these reasons, it is my opinion that the *Guo-Neave* Combination teaches "said mobile device selecting one of said interfaces based on said comparing."

2. Claim 2

a. 2[pre]: "A method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:"

136. *Guo* teaches 2[pre] for the same reasons I discuss in §XII.A.1.a.

137. For these reasons, it is my opinion that *Guo* teaches "[a] method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks."

b. 2[a]

(i) "a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks"

138. *Guo* teaches 2[a](i) for the same reasons I discuss in §XII.A.1.b(i).

139. For these reasons, it is my opinion that *Guo* teaches "a mobile device

... [having] multiple interfaces ... that connect to heterogeneous networks.”

(ii) “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface”

140. *Guo* teaches 2[a](ii) for the same reasons I discuss in §XII.A.1.b(ii).

141. For these reasons, it is my opinion that *Guo* teaches “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface.”

(iii) “using path quality metrics that are independent of how the QoI is measured,”

142. *Guo* teaches 2[a](iii) for the same reasons I discuss in §XII.A.1.b(iii).

143. For these reasons, it is my opinion that *Guo* teaches “using path quality metrics that are independent of how the QoI is measured.”

(iv) “whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network,”

144. *Guo* teaches 2[a](iv) for the same reasons I discuss in §XII.A.1.b(iv).

145. For these reasons, it is my opinion that *Guo* teaches using path quality metrics that are independent of how the QoI is measured, “whether measured by a path through a wireless network alone or a path through both a wireless network and through a wired network.”

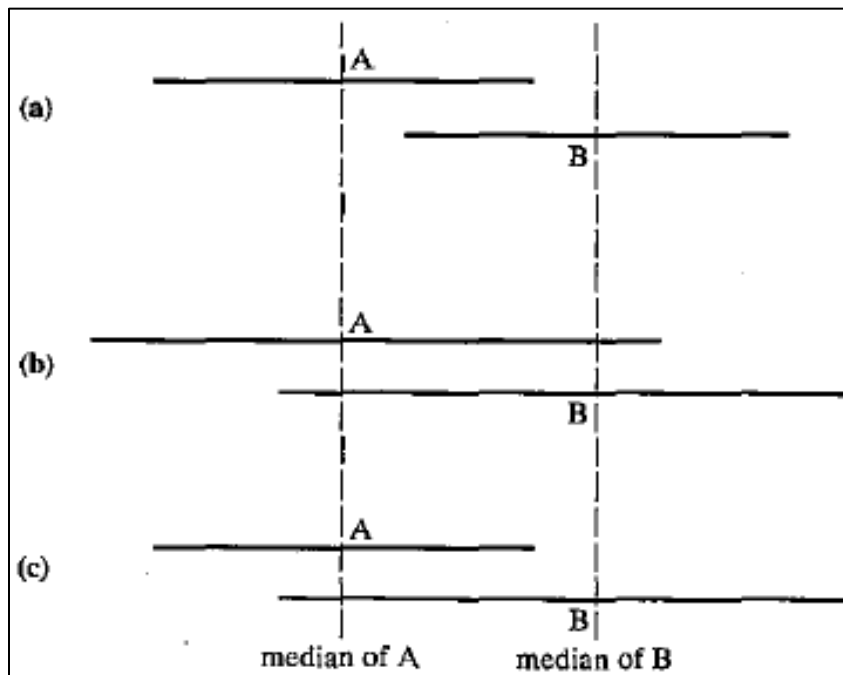
c. 2[b]: “said method including said mobile device performing a one-sample change point detection method or performing a non-parametric and on-line two-sample method,”

146. The *Guo-Neave* combination teaches this feature. As I have previously noted, I have been informed that, because the claim uses the word “or,” the prior art need only disclose one of the two recited alternatives.

147. As I describe in §XII.A.1.c(i), a POSITA would have been motivated to implement *Guo*’s comparison of the WWAN and WLAN QoS datasets to determine whether “the estimated residual bandwidth in the WLAN is higher than the communications bandwidth currently being experienced in the WWAN,” *Guo*, ¶[0104], using Rosenbaum’s test. *Neave*, 144-49; *see also* §X.B (describing Rosenbaum’s test). As I describe in §XII.A.1.c(ii), a POSITA would have understood that Rosenbaum’s test is a “two-sample” method.

148. A POSITA would have understood that Rosenbaum’s test, as described in *Neave*, is a “non-parametric” and “on-line” method. As explained in the ’006 patent, a “non-parametric” test (a/k/a “distribution free” test, ’006 Patent, 7:34-39) is one in which “the precise statistical distribution of the quality indicator, e.g. available bandwidth,” is not known. *Id.*, 17:14-16. A POSITA would have understood that Rosenbaum’s test does not require knowledge of the precise statistical distribution of the quality indicator. It is, for example, designed to work

with datasets with varying medians and spreads, as depicted in Figure 7.1:



Neave, FIG. 7.1

149. Rosenbaum’s test makes no assumption about the type of distribution underlying the data – it may be applied where the data is generated from various distributions, including, e.g., a Poisson distribution, an exponential distribution, a gamma distribution, or an Erlang distribution. *Neave*, pp. 147-48. Thus, a POSITA would have understood that Rosenbaum’s test is non-parametric. Indeed, the ’006 patent identifies Rosenbaum’s test as a “non-parametric” test. ’006 Patent, 17:14-33.

150. According to the ’006 patent, an “on-line” method is “quick to compute, and essentially independent of the length of the available samples.” *Id.*, 17:22-25 (“In particular, we do not want to keep around all past data values.”). A POSITA

would have understood that Rosenbaum's test is quick to compute and would not require the storage of all past values. Where a new value is received for dataset 'A' (corresponding to WLAN) and this value is less than the maximum value of dataset 'B' (WWAN), it need not be retained (it is not counted in test statistic R). Otherwise, the new value should be retained, but only until either a state change occurs (*see Guo*, FIG. 11) or a higher value is received for dataset 'B,' meaning R will no longer count this value in 'A.' *See Neave*, p. 146 ("As with the previous quick tests, it is of course unnecessary to derive the complete letter sequence."). A POSITA would have understood that the rules for updating R in view of new values in 'A' and 'B' would be quick to compute, often consisting of a simple, conditional statement (i.e., how does the new value compare to the current maximum in 'B'?). Thus, a POSITA would have understood that Rosenbaum's test is also an "on-line test." Indeed, the '006 patent identifies Rosenbaum's test as an "on-line" test, as that term is used in the patent. '006 Patent, 17:14-33.

151. For these reasons, it is my opinion that the *Guo-Neave* combination teaches "said method including said mobile device performing a one-sample change point detection method or performing a non-parametric and on-line two-sample method."

d. 2[c]: “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and”

152. *Guo* teaches 2[c] for the same reasons I discuss in §XII.A.1.d.

153. For these reasons, it is my opinion that *Guo* teaches “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface.”

e. 2[d]: “said mobile device selecting one of said interfaces based on said comparing.”

154. *Guo* teaches 2[d] for the same reasons I discuss in §XII.A.1.e.

155. For these reasons, it is my opinion that *Guo* teaches “said mobile device selecting one of said interfaces based on said comparing.”

3. Claim 3

a. 3[pre]: “A method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks, comprising:”

156. *Guo* teaches 2[pre] for the same reasons I discuss in §XII.A.1.a.

157. For these reasons, it is my opinion that *Guo* teaches “[a] method for substantially real-time comparison of quality of interfaces (QoIs) by mobile devices having multiple heterogeneous interfaces that communicate over heterogeneous wireless networks.”

b. 3[a]

(i) “a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks”

158. *Guo* teaches 3[a](i) for the same reasons I discuss in §XII.A.1.b(i).

159. For these reasons, it is my opinion that *Guo* teaches “a mobile device ... [having] multiple interfaces ... that connect to heterogeneous networks.”

(ii) “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface”

160. *Guo* teaches 3[a](ii) for the same reasons I discuss in §XII.A.1.b(ii).

161. For these reasons, it is my opinion that *Guo* teaches “comparing in substantially real-time the qualities of multiple interfaces, including at least one cellular radio interface and at least one wireless local area network interface.”

(iii) “using path quality metrics that are independent of how the QoI is measured,”

162. *Guo* teaches 3[a](iii) for the same reasons I discuss in §XII.A.1.b(iii).

163. For these reasons, it is my opinion that *Guo* teaches “using path quality metrics that are independent of how the QoI is measured.”

c. 3[b]: “said method including said mobile device comparing path qualities based on sequential two sample tests,”

164. The *Guo-Neave* combination teaches 2[b] for the reasons I discuss in §XII.A.1.c, which describes how the combination discloses “said method including

said mobile device ... comparing path quality based on sequential two sample tests.”

165. In my opinion, a POSITA would have recognized that use of the singular/plural “quality”/”qualities” in 1[b] and 2[b] does not alter the scope of this limitation. In both cases, the policy manager 1010 employs sequential two sample tests to compare two path quality datasets (corresponding to the WWAN and WLAN).

166. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “said method including said mobile device comparing path qualities based on sequential two sample tests.”

d. 3[c]: “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface, and”

167. *Guo* teaches 2[a](i) for the same reasons I discuss in §XII.A.1.d.

168. For these reasons, it is my opinion that *Guo* teaches “said mobile device performing said comparing of said multiple interfaces concurrently in real time during use of a current interface.”

e. 3[d]: “said mobile device selecting one of said interfaces based on said comparing.”

169. *Guo* teaches 2[a](i) for the same reasons I discuss in §XII.A.1.e.

170. For these reasons, it is my opinion that *Guo* teaches “said mobile device selecting one of said interfaces based on said comparing.”

4. Claim 4: “The method of claim 3, further including the mobile device having limited knowledge of the quality of the current path.”

171. The *Guo-Neave* combination teaches this feature. When describing the “two-sample statistical test[s],” the ’006 patent explains what it means by “having limited knowledge of the quality of the current path”:

Suppose now that we do not have extensive knowledge of the quality of the current path. For example, we do not have sufficiently many measurements to have a reliable estimate of the mean quality of the current path and its variance, and we do not have matched observations.

’006 Patent, 16:60-65.

172. A POSITA would have understood that Rosenbaum’s test, as incorporated into the *Guo-Neave* combination, would perform the claimed comparison between the WLAN and WWAN QoS datasets when it does not have sufficiently many measurements to have a reliable estimate of the mean quality of the current path and its variance.

173. When *Guo*’s device enters the WLAN Available state 1108, the multi-network manager *begins* to periodically collect and transmit to the policy manager QoS statistics pertaining to the WLAN and WWAN. *Guo*, FIG. 11, ¶0104. A POSITA would have recognized that, at this time – when *Guo*’s mobile device begins to collect its first QoS samples – *Guo*’s mobile device would not have sufficiently many measurements to form a reliable estimate of either network’s QoS

(mean or variance). Where QoS samples are collected “e.g., every 10 seconds,” *Id.*, ¶[0104], *Guo*’s device would potentially not have sufficiently many measurements to form reliable measurements for an extended period of time.

174. The *Guo-Neave* combination would, upon collecting initial measurements, compare the WLAN and WWAN by applying Rosenbaum’s test to their respective QoS datasets, a test which detects *differences* in mean values. *Neave*, p. 143-46. A POSITA would have understood that, where reliable estimates of the mean QoS are available, such statistical methods would be unnecessary, as the device could subtract the means to more efficiently detect a difference in the means. Indeed, the methods disclosed in *Neave*, including Rosenbaum’s test, are non-parametric methods, meaning they require “no detailed assumptions” about the distribution underlying the data, including its mean or variance. *Neave*, pp. Cover, 67; *see also* ’006 Patent at 20:40-42 (“In the absence of prior knowledge of path quality over the current path, a simple non-parametric test provided good results.”).

175. A POSITA would have understood that the *Guo-Neave* combination would not have matched observations, just as described in the ’006 patent. In the WLAN Available state 1108, multi-network manager 1006 would collect and transmit to policy manager 1010 WLAN QoS measurements. *Guo*, ¶[0104]. Policy manager 1010 would thereafter compare these estimates to the experienced QoS on the WWAN, but there is no disclosure that the WLAN and WWAN measurements

would correspond to one another on a one-to-one basis (i.e., be matched). *Id.*

176. A POSITA would have further understood that *Guo*'s disclosed methods for estimating WLAN QoS may be very difficult to synchronize with regular WWAN QoS measurements. For example, where *Guo* calculates the network allocation vector occupation, it would need to wait to receive the network allocation vector from the network prior to forming its estimate. *Id.*, ¶¶[0061] - [0063]. Where *Guo* implements probing data packets, it would need to wait to receive / not receive packet acknowledgement information from the network. *Id.*, ¶¶[0069] - [0070]. A POSITA would have understood that, in both cases, the timing of WLAN estimate formation may be highly unpredictable, making it infeasible for the combination to produce matched observations.

177. To be sure, Rosenbaum's test, as incorporated into the *Guo-Neave* combination does not require that the WLAN and WWAN datasets even be of the same size, let alone matched. *Neave*, p. 146-47 (disclosing exemplary application of Rosenbaum's test with unequal dataset sizes).

178. To the extent that having "matched" observations means that the comparison algorithm itself identifies corresponding observations between the two sample sets (i.e., "matches" them), a POSITA would have understood that Rosenbaum's test does not perform such matching. *Neave*, p. 146-47 (exemplary application of Rosenbaum's test with unmatched observations).

179. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “mobile device having limited knowledge of the quality of the current path.”

5. Claim 5: “The method of claim 3, further including having insufficiently many measurements for an estimate of the mean quality of the current path and its variance and observations are not matched.”

180. The *Guo-Neave* combination teaches this feature for the reasons I discuss in §XII.A.4, which describes how the combination discloses not having “sufficiently many measurements to have a reliable estimate of the mean quality of the current path and its variance” and “not hav[ing] matched observations.”

181. A POSITA would have understood that there is no material difference between an insufficient number of measurements “for an estimate” and “to have a reliable estimate,” as the ’006 patent uses those terms. In both cases, more measurements would be required to form an estimate that may be relied upon. *See* ’006 Patent, 16:61-17:03 (“Suppose now that we do not have extensive knowledge of the quality of the current path. For example, we do not have sufficiently many measurements to have a reliable estimate of the mean quality of the current path and its variance, and we do not have matched observations. ... However, suppose we do have several measurements for both paths. Then, we may use a two-sample statistical test [(i.e., Rosenbaum’s test)] to compare the quality of the two paths.”).

182. For these reasons, it is my opinion that the *Guo-Neave* combination

teaches “having insufficiently many measurements for an estimate of the mean quality of the current path and its variance and observations are not matched.”

6. Claim 6: “The method of claim 5, further including without the mobile device knowing values for mean and median, performing a test of which interface has a higher mean or median.”

183. The *Guo-Neave* combination teaches this feature. Claim 6 requires that the mobile device not know the values for the mean or median of the QoS measures of the WLAN or WWAN. As described in §X.A, *Guo* discloses methods for *estimating* the residual bandwidth of the WLAN. Also, in the WLAN Available state 1108, *Guo*’s device assesses the “communications bandwidth currently being experienced in the WWAN.” *Guo*, ¶[0104]. A POSITA would have understood that *Guo*’s disclosure of these methods would not be required if the mobile device knew values for the mean and median of the networks’ QoS distributions: there would be no need to estimate residual bandwidth or monitor experienced residual bandwidth.

184. A POSITA would have further understood that Rosenbaum’s test, as incorporated into the *Guo-Neave* combination, does not *require* knowledge of the datasets’ means or medians. Rosenbaum’s test requires only samples from datasets ‘A’ and ‘B.’ See *Neave*, pp. 146-47 (describing test statistic *R*). Indeed, when introducing two-sample tests (including Rosenbaum’s test), the ’006 patent characterizes the test as applicable where the “exact values of the mean/median” are

unknown. '006 Patent, 17:3-5.

185. The claim requires that the mobile device perform “a test of which interface has a higher mean or median.” Rosenbaum’s test identifies differences in the datasets’ “location” (mean or median) of two datasets where they may differ in both location and spread. *See Neave*, pp. 143-44, 10-11 (providing exemplary “locations”).

186. I further note that the '006 patent admits that a device using Rosenbaum’s test meets the additional limitations of claim 6, as claim 9, which depends on claim 6, further requires that “said method employ[] a Rosenbaum test.” '006 Patent, Claims 6, 7, 9.

187. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “without the mobile device knowing values for mean and median, performing a test of which interface has a higher mean or median.”

7. Claim 7: “The method of claim 6, further including performing a test of the difference in average quality by testing for a difference in a location of samples.”

188. The *Guo-Neave* combination teaches this feature. In WLAN Available state 1108, policy manager 1010 periodically determines whether “the WLAN will provide a higher quality of wireless network service” than the WWAN. *Guo*, ¶[0104]. As shown in §XII.A.1.c(i), the *Guo-Neave* combination would perform this step by applying Rosenbaum’s test to the WLAN and WWAN datasets.

189. Claim 7 requires “performing a test of the difference in average quality by testing for a difference in a location of samples.” As I describe in §§X.B, XII.A.1.c(i), Rosenbaum’s test, as incorporated into the *Guo-Neave* combination, considers the WLAN and WWAN QoS (“Quality of Service”) datasets and determines whether null hypothesis H_0 (‘A’ and ‘B’ are equal *on average*) should be rejected in favor of alternative hypothesis H_1 (‘B’ is larger than ‘A’ *on average*). *Neave*, pp. 146-47. A POSITA would have understood this to be “a test of the difference in average quality” of the WLAN and WWAN. Further, a POSITA would have understood that a mean (average) is a “location” of a sample. *See Neave*, pp. 10-11; ’006 Patent, 8:9-13 (identifying “mean or median” as exemplary “location[s]”).

190. I note that the ’006 patent admits that a device implementing Rosenbaum’s test meets the additional limitations of claim 7, as claim 9, which depends on claim 7, further requires that “said method employ[] a Rosenbaum test.” ’006 Patent, Claims 7, 9.

191. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “performing a test of the difference in average quality by testing for a difference in a location of samples.”

8. Claim 8: “The method of claim 7, wherein said method is nonparametric, works for unequal sample sizes, and is performed on-line.”

192. The *Guo-Neave* combination teaches this feature. In WLAN Available state 1108, policy manager 1010 periodically determines whether “the WLAN will provide a higher quality of wireless network service” than the WWAN. *Guo*, ¶[0104]. As I discuss in §XII.A.1.c(i), the combination would perform this by applying Rosenbaum’s test to the two WLAN and WWAN QoS datasets.

193. As I discuss in §XII.A.2.c, a POSITA would have understood that Rosenbaum’s test, as incorporated into the *Guo-Neave* combination, is “non-parametric” and “on-line.”

194. A POSITA would have further understood that, as applied in the *Guo-Neave* combination, Rosenbaum’s test is “performed on-line.” A test “performed on-line,” as claimed, “implies repetition of the test for every new observation or every new batch of observations.” ’006 Patent, 8:14-16, 18:20-22. In the WLAN Available state, the multi-network manager “periodically (e.g., every 10 seconds)” transmits current network QoS statistics to the policy manager 1010, *Guo*, ¶[0104], which thereafter (i.e., periodically) determines whether “the WLAN will provide a higher quality of wireless network service” than the WWAN by applying Rosenbaum’s test to the WLAN and WWAN QoS statistics. *Id.* A POSITA would have understood that this periodic test is performed for every new observation or batch of

observations and would therefore have been “performed on-line.”

195. The claim requires that Rosenbaum’s test would work for unequal sample sizes. Rosenbaum’s test does not require that the samples be the same size – the maximum value of one dataset is compared to the high-end extreme run of the other dataset, regardless of the datasets’ sizes. *Neave*, pp. 144-49. Indeed, *Neave*’s exemplary calculation compares dataset ‘A’ of size 6 with dataset ‘B’ of size 8. *Id.*, pp. 146-47; *see also id.*, pp. 383-86 (critical value tables for unequal samples sizes n_1, n_2).

196. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “wherein said method is nonparametric, works for unequal sample sizes, and is performed on-line.”

9. Claim 9: “The method of claim 7, wherein said method employs a Rosenbaum test.”

197. The *Guo-Neave* combination teaches this feature. In WLAN Available state 1108, policy manager 1010 periodically determines whether “the WLAN will provide a higher quality of wireless network service” than the WWAN. *Guo*, ¶[0104]. As shown in §XII.A.1.c(i), the combination would perform this step by applying Rosenbaum’s to the WLAN and WWAN QoS datasets.

198. A POSITA would have understood that Rosenbaum’s test, as applied in the *Guo-Neave* combination, is substantially identical to Rosenbaum’s test as

described in the '006 patent. As I describe in §X.B, Rosenbaum's test calculates R , the number of values in 'A' larger than the maximum value in 'B.' *Neave*, pp. 146-48. If $R \geq C$ (critical value based on the dataset size and the desired significance level), null hypothesis H_0 is rejected in favor of H_1 , and the test concludes that the WLAN has higher QoS on average than the WWAN. *Id.*, pp. 146-48, 383-86 (critical value table). Otherwise (and if the largest value is in 'B'), null hypothesis H_0 is maintained, and the test concludes that the WLAN and WWAN have equal QoS on average. *Id.*, pp. 146-48, 383-86.

199. This description of Rosenbaum's test is substantially identical to that in the '006 patent. '006 Patent, 17:45-55 ("Rosenbaum's test statistic T_R involves the total number of B's data points, which have a value larger than the largest value in A."), 17:55-58 ("If the overall maximum is not from sample set B, then the test stops immediately, and the null-hypothesis H_0 is not rejected in favor of H_1 . Otherwise, H_0 is rejected in favor of H_1 if T_R is larger than a critical value $C(\alpha, n_1, n_2)$."), 17:56-18:09 (disclosing same formula as *Neave* for critical values for large sample sizes). Indeed, the '006 patent incorporates *Neave* in its disclosure of Rosenbaum's test. *Id.*, 17:26-32.

200. For these reasons, it is my opinion that the *Guo-Neave* combination teaches "wherein said method employs a Rosenbaum test."

10. Claim 10: “The method of claim 9, wherein a test statistic T_R includes a total number of a second interface’s data points which have a value larger than a largest value in a first interface’s data points.”

201. The *Guo-Neave* combination teaches this feature. In WLAN Available state 1108, policy manager 1010 periodically determines whether “the WLAN will provide a higher quality of wireless network service” than the WWAN. *Guo*, ¶[0104]. As I show in §XII.A.1.c(i), the combination would perform this step by applying Rosenbaum’s test to the WLAN and WWAN datasets.

202. As I describe in §X.B, Rosenbaum’s test looks to test statistic R , which a POSITA would have understood corresponds to claimed test statistic T_R . As I describe in §XII.A.1.c(i), the *Guo-Neave* combination would apply Rosenbaum’s test, wherein the ‘A’ dataset corresponds to WLAN QoS (“second interface”) and the ‘B’ dataset corresponds to WWAN QoS (“first interface”). Test statistic R (“ T_R ”) is the number of values in ‘A’ (corresponding to the second interface’s) that are greater than the largest value in dataset ‘B’ (first interface). *Neave*, pp. 146-48 (“ R is the number of ‘A’s greater than the largest B.”).

203. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “wherein a test statistic T_R includes a total number of a second interface’s data points which have a value larger than a largest value in a first interface’s data points.”

- 11. Claim 11: “The method of claim 10, wherein if an overall maximum is not from a sample set from the second interface, then the test stops, and a null-hypothesis H_0 is not rejected in favor of H_1 , and otherwise H_0 is rejected in favor of H_1 if T_R is larger than a value $C(a, n_1, n_2)$, calculated using the distribution of T_R .”**

204. The *Guo-Neave* combination teaches this feature. In WLAN Available state 1108, policy manager 1010 periodically determines whether “the WLAN will provide a higher quality of wireless network service” than the WWAN. *Guo*, ¶[0104]. As I show in §XII.A.1.c(i), the combination would perform this step by applying Rosenbaum’s to the WLAN and WWAN QoS datasets.

205. As I describe in §X.B, Rosenbaum’s test looks to test statistic R , which a POSITA would have understood corresponds to claimed test statistic T_R . As I describe in §XII.A.1.c(i), the *Guo-Neave* combination would apply Rosenbaum’s test to the WLAN (“second interface,” ‘A’) and WWAN (“first interface,” ‘B’) QoS statistics and calculate R (“ T_R ”), the number of ‘A’s greater than the maximum ‘B.’ *Neave*, pp. 146-48.

206. A POSITA would have understood that, where the largest value is from ‘B’ (“first interface”), then the “overall maximum is not from a sample set from the second interface.” A POSITA would have understood that, in this case, $R = 0 < C$ and the test stops, maintaining null hypothesis H_0 (‘A’ and ‘B’ are equal on average). *See Neave* 146-48 (“But if the overall maximum is from B, the value of R is taken

as 0 and we are unable to reject H_0 in favour of this H_1 .”), 383-86 (all critical values C greater than 0).

207. A POSITA would have understood that, “otherwise” (largest value is from ‘A,’ the “second interface”), $T_R > 0$ and the test proceeds. A POSITA would have understood that, in this case, H_0 would be rejected in favor of H_1 (‘A’ is larger than ‘B’ on average) if $T_R \geq C(a, n_1, n_2)$. *Neave*, pp. 146-48.²

208. A POSITA would have understood that $C(a, n_1, n_2)$ is calculated using the distribution of T_R . *Neave*’s critical values are determined using “knowledge of the null distribution of” the test statistic. *Neave*, p. 50 (the null distribution assumes H_0 is valid); *see also, e.g., id.*, pp. 148-49 (calculating critical values for Rosenbaum’s test using null distribution of test statistic R), 383-86 (table showing critical values derived from null distribution of R). A POSITA would have understood that, in the *Guo-Neave* combination, the critical value $C(\alpha, n_1, n_2)$ would have been calculated using the distribution of test statistic R (“ T_R ”).

209. For these reasons, it is my opinion that the *Guo-Neave* combination

² Claim 11 requires that the null hypothesis H_0 be rejected in favor of the alternative hypothesis H_1 where test statistic T_R is greater than critical value C , whereas Rosenbaum’s test, as disclosed in *Neave*, rejects H_0 in favor of H_1 where the test statistic is greater than *or equal to* the critical value. The *Guo-Neave* combination still teaches this limitation of claim 11, for claim 11 does not specify whether the H_0 should be rejected in favor of H_1 when the test statistic is equal to the critical value.

teaches “wherein if an overall maximum is not from a sample set from the second interface, then the test stops, and a null-hypothesis H_0 is not rejected in favor of H_1 , and otherwise H_0 is rejected in favor of H_1 if T_R is larger than a value $C(a, n_1, n_2)$, calculated using the distribution of T_R .”

12. Claim 12: “The method of claim 7, wherein the method is based on the length of a high-end extreme run of samples for a second interface or a low-end extreme run of samples for a first interface.”

210. The *Guo-Neave* combination teaches this feature. I have been instructed that, because the claim uses the word “or,” the prior art need only disclose one of these two alternatives.

211. A POSITA would have understood that the length of an “extreme run,” as used in the context of two-sample statistical tests, refers to the number of values in a first sample that lie either below the minimum value (a “low-end extreme run”) or above the maximum value (a “high-end extreme run”) of a second sample. *See Neave*, 120 (“[T]he test statistic T_y is simply defined as: the number of ‘A’s that are less than the smallest value in sample B plus the number of ‘B’s that are greater than the largest value in sample A” – “In other words, ... T_y is the sum of the lengths of the two extreme runs.”).

212. In WLAN Available state 1108, policy manager 1010 periodically determines whether “the WLAN will provide a higher quality of wireless network

service” than the WWAN. *Guo*, ¶[0104]. As I describe in §XII.A.1.c(i), the *Guo-Neave* combination would perform this step with Rosenbaum’s test as applied to the two datasets: ‘A’ corresponding to the WLAN interface and ‘B’ corresponding to the WWAN interface. As I describe in §XII.A.10, ‘A’ corresponds to the claimed “second interface,” and ‘B’ corresponds to the claimed “first interface.”

213. A POSITA would have understood that sRosenbaum’s test, as incorporated into the *Guo-Neave* combination, would be based on the length of a high-end extreme run of samples for a second interface. As described in *Neave*, Rosenbaum’s test statistic *R* “is the number of ‘A’s greater than the largest B.” *Neave*, p. 146; *see also id.*, p. 145 (“Rosenbaum’s test is ... based on the length of extreme runs in the letter sequence ...”). A POSITA would have understood that this test looks to the number of ‘A’ values that lie above the maximum value of ‘B’ and is therefore “based on the length of a high-end extreme run of samples” for dataset ‘A,’ which corresponds to QoS measurements from the second interface (WLAN). *See* ’006 Patent, 8:4-6 (“[T]he Rosenbaum test is based on the length of the high-end ‘extreme run’ of the samples in B ...”).³

³ The ’006 patent refers to the candidate alternative interface’s QoI dataset as B, whereas *Neave* refers to the dataset being investigated for having higher values on average as ‘A.’ Accordingly, the ’006 patent’s reference to B in the quoted excerpt corresponds to dataset ‘A’ in *Neave*.

214. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “wherein the method is based on the length of a high-end extreme run of samples for a second interface or a low-end extreme run of samples for a first interface.”

13. Claim 13: “The method of claim 12, further including repeating the test for a new observation or a new batch of observations.”

215. The *Guo-Neave* combination teaches this feature. In the WLAN Available state 1108, policy manager component 1010 “periodically (e.g., every 10 seconds)” determines whether “the WLAN will provide a higher quality of wireless network service” than the WWAN. Guo, ¶[0104]. As I show in §XII.A.1.c(i), the *Guo-Neave* combination would perform this comparison with Rosenbaum’s test as applied to the two datasets (one each for the WLAN and WWAN). Each time that the policy manager 1010 performs this test, it will have been provided new QoS measurements for the WLAN from the multi-network manager 1006. *Id.* A POSITA would have understood that the new QoS measurements would constitute “a new observation or a new batch of observations.” A POSITA would have further understood that, when the “periodic” decision as to whether the WLAN or WWAN will provide a higher quality of service would have been performed, it would have been repeated “for a new observation or a new batch of observations.”

For these reasons, it is my opinion that the *Guo-Neave* combination teaches “repeating the test for a new observation or a new batch of observations.”

14. Claim 16: “The method of claim 3, further including performing the two sample test even when the mobile has more than two interfaces.”

216. The *Guo-Neave* combination teaches this feature. Note that Claim 16 does not recite limitations that I can see purporting to require that the two-sample tests be performed with regard to each of the more than two interfaces, and I have been informed that, where the prior art discloses performing the two-sample test when the mobile device *has* more than two interfaces, it discloses this limitation.

217. As I describe in §XII.A.1.c, *Guo* discloses a mobile device comparing path quality “based on sequential two sample tests.” *Guo* further discloses that “architectures suitable for incorporating aspects of the invention may include more than two wireless network interfaces.” *Guo*, ¶[0086].

218. For these reasons, it is my opinion that the *Guo-Neave* combination teaches “performing the two sample test even when the mobile has more than two interfaces.”

XIII. SECONDARY CONSIDERATIONS

219. I have not, in the disclosure or prosecution history of the ’006 patent or elsewhere, identified any evidence that would support a secondary considerations argument as to the ’006 patent or its claims. Nor have I identified any evidence of

any nexus of any such evidence to the Challenged Claims. To the extent that such evidence is set forth by the patent owner, their expert, or any other person in these proceedings, I reserve the right to address the purported evidence.

XIV. CONCLUSION

220. The findings, and opinions set forth in this Declaration are based on my analysis and work to date.

221. I may continue to analyze the above issues. I may also receive further documents or other evidence to review throughout the course of these proceedings. In case of these events, I reserve the right to amend, supplement, or withdraw my opinions and my Declaration as appropriate.

222. With my signature below, I recognize that this Declaration will be filed in an inter partes review proceeding before the Patent Trial and Appeal Board. I recognize that I may be subject to cross-examination, and that such cross-examination will take place within the United States. If I am required to undergo cross-examination, I will appear for cross-examination within the United States in the time that the Patent Trial and Appeal Board allots for cross-examination.

223. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under

§1001 of Title 18 of the United States Code.

Dated: January 28, 2025

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Sumit Roy', is written above a horizontal line.

Sumit Roy, Ph.D.