(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 September 2006 (28.09.2006)

PCT

(10) International Publication Number
WO 2006/102505 A1

(51) International Patent Classification:
H04Q 7/34 (2006.01)

(21) International Application Number:
PCT/US2006/010583

(22) International Filing Date: 13 March 2006 (13.03.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/663,515 18 March 2005 (18.03.2005) US
60/664,669 22 March 2005 (22.03.2005) US

(71) Applicant *(for all designated States except US)*: **QUALCOMM Incorporated** [US/US]; 5775 Morehouse Drive, San Diego, California 92121 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CASSETT, Tia Manning** [US/US]; 4817 Fairport Way, San Diego, California 92130 (US). **FOK, Kenny** [CA/US]; 13126 Mesa Crest Place, San Diego, California 92129 (US). **YIP, Eric Chi Chung** [US/US]; 7958 Camino Tranquilo, San Diego, California 92122 (US).

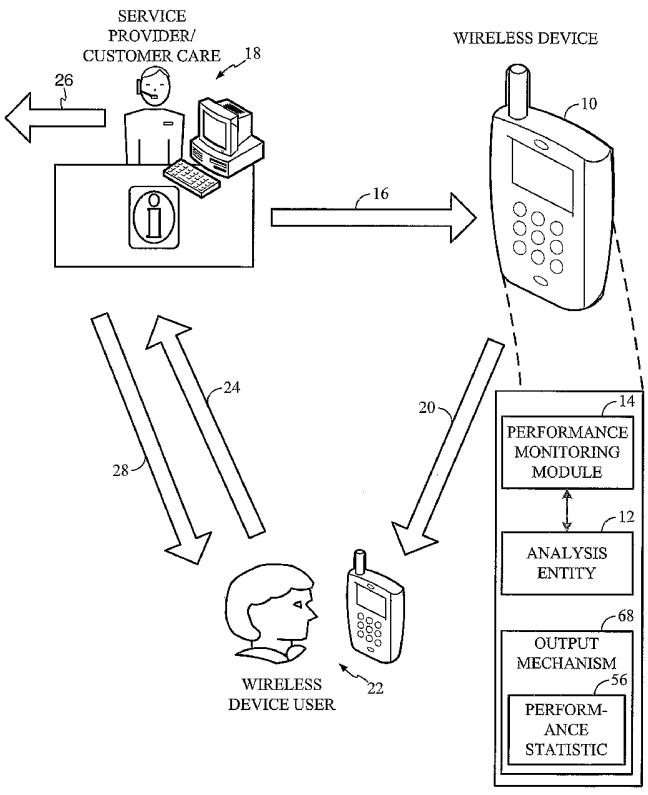
(74) Agents: **WADSWORTH, Philip R.** et al.; 5775 Morehouse Drive, San Diego, California 92121 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,

[Continued on next page]

(54) Title: APPARATUS AND METHODS FOR PROVIDING PERFORMANCE STATISTICS ON A WIRELESS COMMUNICATION DEVICE



(57) Abstract: Apparatus and methods for generating performance statistics and providing for the display of the performance statistics on the wireless device. The statistics can be generated at the wireless device or remotely, at a network device. Once the statistics are determined, they can be presented on the wireless device and can be accessible to either the user of the device and any other predetermined party. By providing for performance statistics at the wireless device, the user of the device or any other predetermined party, such as a service provider, can readily determine if a performance problem is related to the device or to the network.

WO 2006/102505 A1

RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

APPARATUS AND METHODS FOR PROVIDING PERFORMANCE STATISTICS ON A WIRELESS COMMUNICATION DEVICE

CLAIM OF PRIORITY UNDER 35 U.S.C. §119

[0001] The present Application for Patent claims priority to Provisional Application No. 60/663,515 entitled "Methods and Apparatus for Monitoring Configurable Performance Levels in a Wireless Device," filed March 18, 2005 and to Provisional Application No. 60/664,669 entitled "Methods and Apparatus for Displaying Long-Term Performance Parameters for a Wireless Device," filed March 22, 2005, both assigned to the assignee hereof and both hereby expressly incorporated by reference herein.

BACKGROUND

[0002] The disclosed aspects relate to wireless devices and wireless communication networks, and more particularly, to apparatus and methods for providing performance statistics on a wireless communication device.

[0003] Wireless communications devices, such as mobile phones, pagers, handheld computers, etc., are becoming increasingly popular for both business and personal use. One advantage of such devices is their "wireless" aspect, allowing them to be utilized whenever and wherever a user desires. As the use of wireless devices grow, and as the associated wireless communications networks grow, users have an ever-increasing expectation of being able to connect with a wireless network at any location. Thus, one aspect of user satisfaction when utilizing a wireless device deals with the ability of the wireless device to establish a communications connection with a wireless network, as well as the ability of the wireless device to maintain that connection.

[0004] The most prevalent communication problems are failure to establish a connection, referred to as an "access failure" and failure to maintain an established connection, referred to as a "call drop". Additionally, service degradation or temporary outages during an established connection may be experienced; typically a mobile wireless device experiences such service degradation outages as it moves between network communication links. Almost all of these communication problems can be classified as either network-related or wireless device-related. In general, network problems are a result of wireless communication having grown at such a rapid pace that the network hardware needed to support the infrastructure, such as base stations and the

like, have not been able to keep up with the demand for reliable service. Conversely, device problems can be attributed to an industry that demands affordable devices for the sake of insuring maximum market penetration, even if the trade-off is device reliability.

[0005] In many instances, if a wireless device user is confronted with persistent communication problems, the frustrated user will be left with no other option than to return the device to the network service provider (also referred to as the network carrier), claiming the device to be defective. In turn, the service provider will return the device to the Original Equipment Manufacturer (OEM) and the OEM will perform necessary failure analysis on the device to determine the cause of the communication problems. Statistics have consistently shown that of the devices returned to the OEM actual device defects are only present in between 20% and 50% of the devices. The remaining 50% to 80% are designated by the OEM as being "no trouble found" and returned to the service provider as functional devices. Hence, in these instances, the problems that the device user is experiencing are network related and not associated with the wireless device.

[0006] From the service provider perspective, returning suspect wireless devices to the OEM for failure analysis and repair is a very costly undertaking. The service provider absorbs the burden of an expensive failure analysis charge even if the device is found to be defect-free. Thus, service providers would greatly benefit from a mechanism that would allow for the performance of the device to be monitored during normal use, such that failure analysis can occur before the device is sent to the OEM for failure analysis and repair. A mechanism that would allow the service provider to gauge whether communication problems are attributable to the device or to the network would insure that only defective devices are sent to the OEM for repair, thus, eliminating avoidable costs related to sending out defect-free devices for failure analysis and repair.

[0007] In addition to service providers benefiting from a performance-monitoring mechanism, users of the wireless device may also benefit if the performance-monitoring results can be made readily available to the wireless device user. In such a scenario, the user of the wireless device would be able to deduce whether experienced problems are related to the device or the network. In this instance, the user would only return the device as being defective, or otherwise engage the service provider in faulty device discussion, if the performance-monitoring results justify such. In this regard, if the performance-monitoring is performed at the user level, the service provider can additionally benefit from less customer care involvement.

[0008] Thus a need exists to provide for systems, methods, devices and apparatus that provide wireless device performance-monitoring at the service provider and/or user level. Specifically, the need exists to provide for a mechanism that will allow for the service provider or the user to be able to readily understand whether the communication problems encountered by a user are device-related and/or network-related. Such a system will avoid unnecessary OEM involvement on behalf of the service providers and, potentially, less involvement by service provider customer care representatives. In addition, users may benefit from having the assurance that communication problems are network–related and not attributable to their device.

BRIEF SUMMARY

[0009] To address one or more of the drawbacks of the prior art, the disclosed aspects provide a system and method for providing network-related and/or network independent performance statistics based on information obtained from a wireless device. Performance data is collected and analysis is performed at the wireless device, or remotely at a network entity, to define the nature and cause of the defect (i.e., device-related or network-related). Once the performance problem and the cause have been determined, statistical analysis is performed for the purpose of generating performance-monitoring statistics, such as network versus device performance rates and the like. The statistical data is then processed into displayable data that can be accessed by a user or a service provider via the wireless device display. Thus, the aspects described herein provide for performance-monitoring to occur either at the user-level or the service provider level, thereby eliminating the need of, and the costs associated with, having failure analysis performed at the OEM level.

[0010] In one aspect, a method for remotely providing performance statistics to a wireless communication device is defined. The method includes the steps of receiving performance-related data from a wireless communication device, determining performance quality characteristics associated with the performance-related data, determining performance statistics associated with the performance quality characteristics and communicating the performance statistics to the wireless device. Additionally, the method may provide for determining if a performance statistic meets a predetermined performance threshold and, if so notifying the wireless device of such. The method may also provide for the processing of the performance statistics into displayable performance statistic information.

[0011] An alternate aspect is defined by a computer-readable medium for providing performance statistics on a wireless communication device. The computer-readable medium includes a sequence of instructions, such that execution of the instructions by a processor causes the processor to perform the steps of receiving performance-related data from a wireless communication device, determining performance quality characteristics associated with the performance-related data, determining performance statistics associated with the performance quality characteristics and communicating the performance statistic to the wireless device.

[0012] Another aspect is defined by a processor device, implemented in a wireless device, configured to perform the operations of receiving performance-related data from a wireless communication device, determining performance quality characteristics associated with the performance-related data, determining one or more performance statistics associated with the one or more performance quality characteristics and communicating the one or more performance statistics to the wireless device.

[0013] A further aspect includes a network device for providing performance statistics to a wireless communication device. The network device includes a communications module that receives performance-related data from a wireless device and a performance-monitoring module that is operable for determining performance quality characteristics associated with the performance-related data and determining performance statistics associated with the performance quality characteristics. Once the performance statistics have been determined, the communication module communicates the performance statistics to the wireless device. The performance-monitoring module may further determine if a performance statistics meets a predetermined performance threshold and, if so, the communication module may communicate a notification message to the wireless device. The network device may also include a display-programming module operable for processing the performance statistic into displayable performance statistic information.

[0014] Yet another aspect is defined by a method for locally providing performance statistics on a wireless communication device. The method includes the steps of collecting performance-related data at a wireless communication device, determining characteristics associated with the performance-related data, determining performance statistics associated with the performance quality characteristics, processing the performance statistics into displayable performance statistic information and storing the displayable performance statistics in wireless communication device memory.

[0015] A related aspect is defined by a computer-readable medium for providing performance statistics on a wireless communication device. The computer-readable medium includes a sequence of instructions, such that execution of the instructions by a processor causes the processor to perform the steps of collecting performance-related data at a wireless communication device, determining performance quality characteristics associated with the performance-related data, determining performance statistics associated with the performance quality characteristics, processing the performance statistics into displayable performance statistic information and storing the displayable performance statistics in wireless communication device memory.

[0016] An additional related aspect is defined by a processor device, implemented in a wireless device, and configured to perform the operations of collecting performance-related data at a wireless communication device, determining performance quality characteristics associated with the performance-related data, determining performance statistics associated with the performance quality characteristics, processing the performance statistics into displayable performance statistic information and storing the displayable performance statistics in wireless communication device memory.

[0017] According to yet another aspect, a wireless communication device is defined that includes a data storage having performance-related data and a performance-monitoring module in communication with the data storage. The performance-monitoring is operable to determine one or more performance quality characteristics associated with the performance-related data and to generate one or more performance statistics associated with the one or more performance quality characteristics. The performance-monitoring module may further be operable for determining if a performance statistic meets a predetermined performance threshold.

[0018] An alternate aspect is described by a method for providing performance statistics on a wireless communication device. The method includes the steps of collecting performance-related data at a wireless communication device, communicating the performance-related data to a network device, receiving, at the wireless communication device, wireless device performance statistics from the network device based on the collected performance-related data and providing for a displayable presentation of the one or more performance statistics.

[0019] Thus, the present aspects provide for a presentation of wireless device performance statistics, such as network performance related statistics and network independent statistics based on data collected from the wireless device. The statistics

can be determined at the wireless device or remotely, at a network device. Once the statistics are determined they can presented on the wireless device and can accessible to either the user of the device, the service provider or both. By providing for performance statistics at the wireless device, the user of the device or the service provider can readily determine if performance problems are related to the device or to the network. By providing such performance-monitoring at the device or service provider level, costly failure analysis at the OEM level can be avoided.

[0020] Additional aspects and advantages of the disclosed aspects are set forth in part in the description which follows, and in part are obvious from the description, or may be learned by practice of the disclosed aspects. The aspects and advantages of the disclosed aspects may also be realized and attained by the means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The disclosed aspects will hereinafter be described in conjunction with the appended drawings provided to illustrate and not to limit the disclosed aspects, wherein like designations denote like elements, and in which:

[0022] Fig. 1 is a representative diagram of one aspect for providing performance statistics to a wireless device in wireless communication network;

[0023] Fig. 2 is a block diagram of one aspect of a communication network that includes a network device that provides performance statistics to wireless communication devices;

[0024] Fig. 3 is a block diagram illustrating one aspect of the architecture of a wireless device that provides for performance statistics;

[0025] Fig. 4 is a representative diagram of a cellular telephone network aspect of the system of Fig. 1, including one aspect of a computer platform of the computer device of Fig. 1;

[0026] Fig. 5 is a message flow diagram illustrating one aspect of communication between a network device and a wireless device, in which performance statistics are created at the network device and communicated to the ireless device;

[0027] Fig. 6 is flow diagram depicting one aspect of a method for determining performance statistics at a wireless device and subsequently presenting the statistics at the device, in accordance with an aspect;

[0028] Fig. 7 is a flow diagram depicting one aspect of method of collecting performance-related data at a wireless device, communicating the data to a network device and receiving, in return, performance statistics from the network device, in accordance with an aspect;

[0029] Fig 8 is a flow diagram depicting one aspect of a method for determining performance statistics at a network device and subsequently communicated the statistics to a wireless device, in accordance with an aspect.

DETAILED DESCRIPTION

[0030] The present devices, apparatus, methods, computer-readable media and processors now will be described more fully hereinafter with reference to the accompanying drawings, in which aspects of the invention are shown. The devices, apparatus, methods, computer-readable media and processors may, however, be embodied in many different forms and should not be construed as limited to the aspects set forth herein; rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0031] The present devices, apparatus, methods, computer-readable media and processors provide for performance statistics to be determined and displayed on a wireless device or a device associated with the wireless device. Performance statistics include information associated with the wireless device relating to device functionality and usage, including wireless network-related statistics and wireless network independent statistics. For example, in one aspect, by providing for performance statistics such as access failure statistics, call drop statistics, service degradation statistics and the like, either a device user or a service provider can readily determine if connection quality problems that are being encountered by the device are device-related and/or network-related. It should be understood, however, that the previous example is but one of many potential performance statistics that may be monitored and displayed. Thus, the described aspects allow for performance-monitoring to occur on the device at the user-level and/or the service provider-level and, as such, minimize the need to perform costly failure analysis by returning the device for service, such as to the original equipment manufacturer (OEM).

[0032] Referring to Fig. 1, according to one aspect, a schematic diagram of a method for providing performance-monitoring on a wireless device is illustrated. A wireless

communication device 10 having an analysis entity 12 executes a performance-monitoring module 14 to determine and display performance statistics. In the illustrated aspect, performance statistics are generated at the wireless device, in alternative aspects, as will be discussed at length below, the performance statistics associated with the wireless device may be generated at a network device and subsequently communicated to the wireless device.

[0033] As illustrated in Fig. 1, the performance-monitoring module 14 may be downloaded (Event 16), wirelessly or otherwise, to the device from a network service provider 18. Alternatively, the performance-monitoring module may be locally transferred to wireless device 10, such as through a serial connection, or may be preloaded on the wireless device 10. The performance-monitoring module may utilize performance data to determine performance quality characteristics. For example, performance data may include, but is not limited to, information such as: application usage data, such as video-related, text messaging-related, media player-related, call-related, and web-related data; air interface performance data, including service-related information, marketing-related information, communication log data, and communication event data, signal transmission-related data, signal receiving-related data, antenna-related data; and non-air interface performance data, including battery-related information, application usage information, device-component-related information, etc. Performance quality characteristics are defined by the performance-monitoring module and may include, but are not limited to, all of the performance-related data mentioned above, or some predetermined event or state of the performance-related data, such as usage information, expired timers, counter thresholds, access probe attempts, reverse channel log information, access channel log information, radio frequency-related log information and the like. Once relevant performance quality characteristics are determined, the performance-monitoring module uses the performance quality characteristics to determine performance statistics. Performance statistics may include, but are not limited to: application usage statistics, such as what applications are used, how often they are used, and when they are used; wireless device component usage and performance information, such as battery power, standby time, output mechanism information such as display or speaker quality, key or keypad-related information, such as what keys are used, how often, and when or in relation to what applications, etc.; transmit and/or receive chain information; network related information, such as what base stations are used, when and how often; and

communications-related statistics, such as the number of access failures, the number of call drops, the number of service degradations and corresponding access failure rates, call drop rates, service degradation rates and the like. Once performance statistics are determined a display-processing module will provide for processing the performance characteristics into displayable performance statistic information, which can subsequently be displayed on the wireless device or on a display associated with the wireless device.

[0034] In some aspects, if the wireless device 10 experiences a high volume or rate of performance-related problems (Event 20), such as, in a communications-related example, a high rate of access failures, call drops, service degradation or the like, the user 22 will desire to know if the problems are device-related or network-related. In some aspects, the wireless device may be configured to allow for the user to access the performance statistics on the device display. In this regard, the user 22 may be able to determine if the experienced problems are device-related and/or network related. In other aspects, such as shown in Fig. 1, access to the performance statistics may be protected and limited to access by the service provider. In such aspects, the user of the device will be required to return the wireless device 10 to the service provider 18 (Event 24) and the service provider will access the performance statistics to determine if the problems are device-related or network-related. If the problems are device-related the service-provider will send the wireless device to the OEM for repair (Event 26); however, if the problems are network-related, then the device is functional and no repair is required (Event 28).

[0035] Referring to Fig. 2, according to other aspects, a schematic diagram is illustrated that depicts a wireless network in which performance statistics are generated at a network device. The generation of performance statistics at a device remote from the wireless device is optional, and may or may not be utilized depending on, for example, device memory and processing power, among other factors. The wireless network includes a plurality of wireless devices 10A (cellular telephone), 10B (personal digital assistant (PDA)), 10C (handheld computing device), 10D (laptop computer), 10E (desktop computer) that each have a resident communication module 30 operable to transfer wireless device performance-related data, to a network device 38, such as performance-monitoring server 38. The performance-monitoring server will include a processing engine, such as analysis engine 40 configured to execute performance-monitoring module 14 for determining performance statistics.

[0036] Performance-monitoring server 38 may comprise at least one of any type of server, personal computer, mini computer, mainframe computer, or any computing device either special purpose or general computing device further comprising analysis engine 40. Further, there can be separate servers or computer devices associated with performance- monitoring server 38 that work in concert to provide data in usable formats to parties, and/or to provide a separate layer of control in the data flow between the wireless devices 10 and performance-monitoring server 38. Performance-monitoring server 38 (or plurality of servers) may, via communications module 42, send data, such as performance statistics, software agents or applications, such as any portion of performance-monitoring modules 16 to wireless device 10 across wireless network 46.

[0037] The performance-monitoring server 38 includes a data registry 44 that stores collected data 31 associated with the wireless device, which may be communicated from the wireless devices 10 across the wireless network 46 and received by the communication module 42. The data registry 44 may include any type of memory or storage device. The collected data 31 stored by registry 44 may include any data gathered from the wireless device and related to a predetermined performance statistic. For example, in some aspects where communications-related performance statistics are of interest, the collected data 31 may comprise communication event information and/or communication log data. Communication log data may be data that is stored in a wireless device subsystem register and may include, but is not limited to, communication characteristics such as reverse channel log information, access channel log information, radio frequency-related log information and the like. Communication event information may be data that is found in over-the-air (OTA) messages and may include, but is not limited to, communication characteristics, such as expired timers, counter thresholds, access probe attempts and the like. The collected data may have corresponding wireless device identifiers and, in some aspects, wireless-device type identifiers to identify the device corresponding to the data and in some aspects, the "type," i.e., manufacturer and model identification of the device. The performance-monitoring module 14 may use wireless device information to determine performance statistics based on the particular attributes of a given wireless device.

[0038] In some aspects, the performance-monitoring module may utilize position data in association with performance statistics. In these aspects, the collected data 31 may optionally include position data that may be used to correlate the performance

characteristics with the geographic position of the device or a network entity in communication with the device at the moment the performance characteristic occurred.

[0039] Performance-monitoring module 14 may further include software, hardware, data, and generally any executable instructions operable to manage determination of performance statistics. The performance-monitoring module will include performance quality characteristic module 50 for defining and determining performance quality characteristics 52 relevant to the determination of performance characteristics. In some aspects, the ability to define and determine performance quality characteristics 52 may be dependent upon the protocol used for wireless communication. For example, some communications protocols have developed standard mechanisms that define an event associated with a performance quality characteristic, such as an access failure and a call drop. For example, in the Code Division Multiple Access ("CDMA") protocol, such mechanisms include timers that are associated with an event that defines a failure, e.g. from the Interim Standard ("IS")-95 standard, time limit T_{5m} is associated with a call drop. As such, for example, in aspects in which the wireless device communicates using a protocol that incorporates a standardized connection-quality-related event mechanism, such as CDMA protocol or the like, the performance quality characteristic module 50 may identify relevant communication characteristics in the communication log data and the communication event data.

[0040] Other protocols, such as the Universal Mobile Telephone System ("UMTS") protocol, may not have all or some portion of such standard mechanisms that define a performance quality characteristic 52. In such protocols, any combination of the log data and/or the event data and/or a sequence of communications messages, such as Over-The-Air (OTA) messages, may be used to determine a performance quality characteristic. A suitable method, routine and/or apparatus for determining such sequences is disclosed in United States Patent Application No. 11/078,235, entitled, "Apparatus and Methods for Determining Connection Quality of a Wireless Device on a Wireless Communication Network", filed on March 10, 2005, assigned to the assignee of the present invention and hereby incorporated by reference as if set forth fully herein. As such, in aspects in which the wireless communication device communicates via a protocol that does not incorporate one or more standardized performance-quality-related event mechanisms, such as UMTS or the like, the performance quality characteristic module 50 may identify relevant message sequences and associated communications data that define a performance quality characteristic 52.

[0041] The performance-monitoring module 14 will additionally include performance statistic module 54 for generating performance statistics 56. The performance statistic module will rely on the performance quality characteristics to generate any beneficial performance statistic. The performance-monitoring module 14 will typically be configured, either by the device user, the service provider, or an authorized user, to generate performance statistics 56 of interest to the device user, the service provider, or the authorized user, such as a marketing representative. Examples of performance statistics include, but are not limited to, non-air interface statistics such as application usage information, device component usage/performance information, network component usage/performance information, and air interface information, such a connection quality statistics like the number of access failures, the number of call drops, the number of service degradations, the access failure rate (number of access failures versus total access attempts over a specified time period), the call drop rate (number of call drops versus total number of calls over a specified period), the service degradation rate (number of calls experiencing service degradation versus total number of calls over a specified time period). Performance rates may be based on one or more specified time periods, such as an hour, a day, a week, a month, a year or the like and/or the performance rates may be cumulative over the life of the wireless device. Additionally, performance statistics may be categorized based on a wireless device attribute, such as numbers or rates based upon the geographic position of the device at the time of the event, number or rates based on the "type" of wireless device and the like

[0042] The performance-monitoring module 14 may additionally include threshold module 58 for determining if a performance statistic meets a predetermined threshold 60. For example, predetermined thresholds 60 may include, but are not limited to, a specified number or rate of application usage metrics, device component metrics, network component metrics, and connection quality metrics such as access failures, call drops or service degradations. Predetermined threshold 60 may include one or more values corresponding to one or more conditions. For example, predetermined threshold 60 may include one or any combination of an upper limit value, a lower limit value, and a range of values relating to the corresponding performance statistic. Further, for example, predetermined threshold 60 may include one or more conditions such as equal to, less than, greater than, and combinations thereof in correspondence with one or more threshold values. As such, a given performance statistic may meet the predetermined threshold if the monitored value of the statistic achieves the threshold condition and the

threshold value, for example, if the monitored statistic is greater than (or greater than or equal to) the upper limit value, less than (or less than or equal to) the lower limit value, and/or inside or outside of the range of values. The threshold module 58 may additionally be configured to send, via the communication module 42, a "threshold exceeded" message/notification to the appropriate wireless device, service provider, OEM or any predetermined party. Such notification may serve to inform the user of a device problem, the service provider of a network or device problem and/or the OEM of a device component problem.

[0043] The performance-monitoring server 38 may additionally include a display-processing module 62 that provides for processing of the performance statistics into displayable performance statistic information. In alternate aspects, performance statistics 56 may be communicated to the wireless device and display processing may occur at the wireless device 10.

[0044] Referring to Fig. 3, according to another aspect, a block diagram is depicted of a wireless communication device 10 for generating and displaying performance statistics. In some aspects, the wireless device 10 will include the processing and memory capability to implement the performance-monitoring module 14, while in alternate aspects, as shown in Fig. 2, some aspects of the performance-monitoring module 14 will be executed remotely at a network device. In those aspects in which a network device implements the performance-monitoring module, the wireless device is responsible for communicating the collected data 31, as collected by the performance monitoring module 14, to the network device 38 and receiving, in response to the transmitted collected data, performance statistics 56 that are stored at the wireless device and may be presented in displayable format on the wireless device.

[0045] The wireless device 10 may include computer platform 64 operable to transmit data, i.e., performance-related data, across wireless network 46 (Fig. 1), and receive and execute software applications and configurations, i.e. performance-monitoring module 14.

[0046] Wireless device 10 may include any type of computerized, wireless device, such as cellular telephone, personal digital assistant, two-way text pager, portable computer, and even a separate computer platform that has a wireless communications portal, and which also may have a wired connection to a network or the Internet. The wireless device can be a remote-slave, or other device that does not have an end-user

thereof but simply communicates data across the wireless network 46, such as remote sensors, diagnostic tools, and data relays.

[0047] Wireless device 46 may also include input mechanism 66 and output mechanism 68 interconnected to computer platform 64. Input mechanism 66 is operable to generate an input into wireless device 10, and may include a mechanism such as a key or keyboard, a mouse, a touch-screen display, and a voice recognition module. Output mechanism 68, may include a display, an audio speaker, and a haptic feedback mechanism, for example, for relaying information, such as performance statistics, to the user of the wireless device 10.

[0048] Computer platform 64 may also include a memory 70, such as data registry 70, which may comprise volatile and nonvolatile memory such as read-only and/or random-access memory (RAM and ROM), EPROM, EEPROM, flash cards, or any memory common to computer platforms. Further, memory 70 may include one or more flash memory cells, or may be any secondary or tertiary storage device, such as magnetic media, optical media, tape, or soft or hard disk. Additionally, memory 70 may be operable to store original equipment manufacturer supplied instructions as well as third party client applications downloaded via network 46 or loaded via a personal computer (PC).

[0049] Further, computer platform 60 includes a processing engine 72, which may be an application-specific integrated circuit ("ASIC"), or other chipset, processor, module circuit, or other data processing device. Processing engine 72 is operable to execute an application programming interface ("API") layer 74 that may interface with any resident programs, such as performance-monitoring module 14, stored in memory 70. In such aspects in which the processing engine and the API interface to operate the performance-monitoring modules, the processing engine 72 and API 70 serve as the requisite analysis entity. In alternate aspects, the computer platform may include a separate engine, analysis entity (AE) 12 that interfaces with the performance-monitoring module 14 to determine and generate performance statistics. The analysis entity 12 may be an application-specific integrated circuit ("ASIC"), or other chipset, processor, module circuit, or other data processing device.

[0050] In one aspect, API 74 is a runtime environment executing on the respective wireless device. One such runtime environment is Binary Runtime Environment for Wireless® (BREW®) software developed by Qualcomm, Inc., of San Diego, California.

Other runtime environments may be utilized that, for example, operate to control the execution of applications on wireless computing devices.

[0051] Processing engine 72 includes various processing subsystems 78 embodied in hardware, software, firmware, executable instructions, data, and combinations thereof, that enable the functionality of wireless device 10 and the operability of the wireless device on wireless network 46 (Fig. 1). For example, processing subsystems 78 allow for initiating and maintaining communications, and exchanging data, with other networked devices. In one aspect, such as in a cellular telephone, processing engine 72 may include one or a combination of processing subsystems 78, such as: sound, non-volatile memory, file system, transmit, receive, searcher, layer 1, layer 2, layer 3, main control, remote procedure, handset, power management, diagnostic, digital signal processor, vocoder, messaging, call manager, Bluetooth® system, Bluetooth® LPOS, position determination, position engine, user interface (UI), sleep, limited services, security, authentication, USIM/SIM, voice services, graphics, USB, multimedia such as MPEG, GPRS, etc.

[0052] For the disclosed aspects, processing subsystems 78 may include any subsystem components that interact with applications executing on computer platform 64. For example, processing subsystems 78 may include any subsystem components that receive data reads and data writes from API 74 on behalf of the resident performance-monitoring module 14. Further, at least a portion of information relating to performance-related data 32 and/or the other collected data 31 gathered by performance monitoring module 14 may be available from these subsystems 78.

[0053] In one example relating to associating air interface statistics with location information, the performance-monitoring module 14 may use OTA messages to determine when the wireless device is in a call. Once the wireless device 16 is in a call, the location of the wireless device 10 may be determined and logged, for example, using location determining information retrieved from processing engine 72 and/or one or more processing subsystems 78 and/or analysis entity 12. For example, location determining information, such as wireless device position data 48 and/or network position data 96, may be included in processing subsystems such as a global positioning system (GPS) system monitor, and a diagnostic system monitor. Such location determining information may include a GPS fix, such as longitude and latitude information, and cell site and/or network information such as pseudo noise (PN) offset, network identification (NID), system identification (SID), and base station identification

(BSID). In some aspects, wireless device 10 may include one or more modules, such as position module 86, that specifically function to determine location information. These modules including one or more of: a Global Positioning System (GPS); an Assisted GPS (A-GPS) system, such as the QPoint™ Positioning Software and gpsOne® hybrid Assisted GPS wireless location technology available from Qualcomm, Inc., San Diego, California; and Localization Based Systems (LBS) such as Cell-ID, Enhanced Observed Time Difference (E-OTD), and Observed Timed Difference of Arrival (OTDOA).

[0054] Computer platform 64 may further include a communications module 30 embodied in hardware, software, executable instructions, data, and combinations thereof, operable to enable communications among the various components of the wireless device 10 and wireless network 46. Communications module 30 may comprise any component/port/interface that may include any point of entry into, and/or any point of exit from wireless device. As such, communications module 30 may include interface components for hardwired communications and for wireless communications. Further, communications module 30 may include any transmit, receive, modulation, and demodulation components necessary to effect wireless communication exchanges.

[0055] In those aspects in which the performance statistics are generated at the wireless device, the memory 70 of the computer platform 64 will include the statistic determining portions of the performance-monitoring module 14. The performance-monitoring module 14 may further include software, hardware, data, and generally any executable instructions operable to manage determination of performance statistics. The performance-monitoring module will include performance quality characteristic module 50 for defining and determining performance quality characteristics 52 relevant to the determination of performance statistics.

[0056] For example, in aspects related to determining connection quality statistics, the performance quality module 50 may access the communication log data and communication event data stored in the communication database to determine performance quality characteristics 52, such as expired timers, counter thresholds, access probe attempts, reverse channel log information, access channel log information and radio frequency-related log information. The ability to define and determine performance quality characteristics 52, for example those characteristics relating to connection quality, may be dependent upon the protocol used for wireless communication. As such, in aspects in which the wireless device communicates using a protocol that incorporates a standardized performance-quality-related event mechanism,

such as CDMA protocol or the like, the performance quality characteristic module 50 may identify relevant communication characteristics based on the communication log data and the communication event data. In other aspects, in which the wireless communication device communicates via a protocol that does not incorporate one or more standardized connection-quality-related event mechanisms, such as UMTS or the like, the performance quality characteristic module 50 may identify relevant message sequences and data within OTA messages that define a performance quality characteristic 52.

[0057] In aspects where statistics are determined locally, the performance-monitoring module 14 will additionally include performance statistic module 54 for generating performance statistics 56. The performance statistic module may utilize the performance quality characteristics 52 to generate requisite performance statistics. The performance-monitoring module 14 will typically be configured, either by the device user or by the service provider, to generate performance statistics 56 of interest to the device user, the service provider, an OEM, or any other party interested in information stored on the wireless device. Examples of performance statistics 56 include, but are not limited to, non-air interface statistics, such as application usage statistics, and air interface statistics, such as the number of access failures, the number of call drops, the number of service degradations, the access failure rate (number of access failures versus total access attempts over a specified time period), the call drop rate (number of call drops versus total number of calls over a specified period), the service degradation rate (number of calls experiencing service degradation versus total number of calls over a specified time period). Performance rates may be based on a specified time period such as an hour, a day, a week, a month, a year or the like or the performance rates may be cumulative over the life of the wireless device.

[0058] Additionally, in some aspects, performance statistics 56 may be generated by the statistic module 54 that are associated with wireless device-related attributes. For example, performance statistics may be associated with wireless device position data 48 and/or network position data 96 stored in memory 70, such as in a device database 84. In some aspects, the position information is collected in association with the performance statistic, while in other aspects a predetermined position may function as a performance quality characteristic and trigger the collection of other characteristics and/or the determination of predetermined performance statistics. As discussed above, the wireless device position data 48 may correspond to device position data and be

generated internally from a position generating device, such as a GPS sensor or the like. Alternately, or in addition, the network position data 96 may correspond to the position of wireless network entities, such as base stations and the like. Position module 86, which may incorporate all or portions of the position-related systems discussed above, may be implemented to determine the position data 48 and/or 96. The device database 84 may also include the device identification (ID) 88, such as a name, make and/or model number, general wireless device information 90 and the like, which may be associated with the generated performance statistics and/or threshold values 60. For example, wireless device information 90 may include any information associated with the device that may be relevant to the performance data, including, but not limited to: software information, such as a list of applications stored on and/or running on the device, a software name, a software version, software registration and/or licensing related information; and hardware information, such as device hardware component names, model numbers, versions, capabilities etc. Further, for example, some threshold values 60 may correspond to particular wireless device information 90, such as having different thresholds for different device models and/or different model versions, among other things. In addition, the device id 88 and the device information 90 may be communicated to the performance-monitoring server 38 in aspects in which the performance statistics 56 are generated remote from the wireless device 10.

[0059] In addition, performance statistics may be generated by the statistic module 54 based on network data 94 communicated to the wireless device, such as via communication module 30 and stored in device database 84. Network data 94 may include, but is not limited to, performance data for other similar type wireless devices, and/or for geographical and/or network areas, e.g. statistics associated with a given region or statistics associated with a given based station. The network data 94 may be utilized by statistics module 54 to compare the performance statistics 56 of the given wireless device with the corresponding statistics of other devices, which may be useful in determining whether a given performance issue is network-related and/or device-related.

[0060] The performance-monitoring module 14 may additionally include threshold module 58 for determining if a performance statistic 56 meets a predetermined threshold 60, which may comprise one or more conditions and one or more corresponding values. The details of the functionality of threshold module 58 are discussed above. Additionally, the threshold module 58 may be configured to send, via the

communication module 30, a "threshold exceeded" message/notification to the wireless device, service provider, OEM or the like. Such notification may serve to inform the user of a device problem, the service provider of a network or device problem and the OEM of a device component problem.

[0061] The memory 70 of the computer platform 64 may additionally include a display-processing module 62 that provides for processing of the performance statistics into displayable performance statistic information 98 that may be presented to the device user via the output mechanism 68. For example, the computer platform may include a display module 100 for displaying the performance statistic information 98 on an output mechanism 68 such as a display.

[0062] Wireless network 46 includes any communications network operable, at least in part, for enabling wireless communications between the wireless device and any device connected to wireless network. Further, wireless network 46 may include all network components, and all connected devices that form the network. For example, wireless network 46 may include at least one, or any combination, of: a cellular telephone network; a multicast network such as a Forward Link Only (FLO) network, such as the MEDIAFLO™ System available from Qualcomm, Inc. of San Diego, California; a digital video broadcasting (DVB) network, such as DVB-S for satellite, DVB-C for cable, DVB-T for terrestrial television, DVB-H for terrestrial television for handhelds; a terrestrial telephone network; a satellite telephone network; an infrared network such as an Infrared Data Association ("IrDA")-based network; a short-range wireless network; a BLUETOOTH® technology network; a ZIGBEE® protocol network; an ultra wide band ("UWB") protocol network; a home radio frequency ("HomeRF") network; a shared wireless access protocol ("SWAP") network; a wideband network, such as a wireless Ethernet compatibility alliance ("WECA") network, a wireless fidelity alliance ("Wi-Fi Alliance") network, and a 802.11 network; a public switched telephone network; a public heterogeneous communications network, such as the Internet; a private communications network; and a land mobile radio network.

[0063] Suitable examples of telephone networks include at least one, or any combination, of analog and digital networks/technologies, such as: code division multiple access ("CDMA"), wideband code division multiple access ("WCDMA"), universal mobile telecommunications system ("UMTS"), advanced mobile phone service ("AMPS"), time division multiple access ("TDMA"), frequency division

multiple access ("FDMA"), orthogonal frequency division multiple access ("OFDMA"), global system for mobile communications ("GSM"), single carrier ("1X") radio transmission technology ("RTT"), evolution data only ("EV-DO") technology, general packet radio service ("GPRS"), enhanced data GSM environment ("EDGE"), high speed downlink data packet access ("HSPDA"), analog and digital satellite systems, and any other technologies/protocols that may be used in at least one of a wireless communications network and a data communications network.

[0064] Referring to Fig. 4, an aspect of a cellular wireless system 110 comprises at least one wireless device 10 and a cellular telephone wireless network 112 connected to a wired network 114 via a carrier network 116. Cellular wireless system 110 is merely exemplary and may include any system whereby remote modules, such as wireless devices 10 communicate packets including voice and data over-the-air between and among each other and/or between and among components of wireless network 112, including, without limitation, wireless network carriers and/or servers.

[0065] According to system 110, performance-monitoring server 38 may communicate over a wired network 114 (e.g. a local area network, LAN) with data repository 44 for storing collected data 31, gathered from wireless devices 10. Further, a data management server 118 may be in communication with performance-monitoring server 38 to provide post-processing capabilities, data flow control, etc. performance-monitoring server 38, data repository 44 and data management server 118 may be present on the cellular telephone system 110 along with any other network components needed to provide cellular telecommunication services.

[0066] Performance-monitoring server 38, and/or data management server 118 may communicate with carrier network 116 through data links 120, such as the Internet, a secure LAN, WAN, or other network. Carrier network 116 controls messages (generally being data packets) sent to a mobile switching center ("MSC") 124. Further, carrier network 116 communicates with MSC 124 by a network 122, such as the Internet, and/or POTS ("plain old telephone service"). Typically, in network 122, a network or Internet portion transfers data, and the POTS portion transfers voice information. MSC 124 may be connected to multiple base stations ("BTS") 126 by another network 128, such as a data network and/or Internet portion for data transfer and a POTS portion for voice information. BTS 126 ultimately broadcasts messages wirelessly to the wireless devices, such as wireless device 10, by short messaging service ("SMS"), or other over-the-air methods.

[0067] Referring to Fig. 5, according to another aspect, a message flow diagram is illustrated for generating performance statistics at a network device and communicating the statistics to a wireless device. At Event 200, the wireless device 10 collects performance-related data from various wireless device databases. For example, in a connection quality determination aspect, the collected data may include communication log data, communication event data, position data 48, 96 and the like. At Event 210, the wireless device initiates the uploading of the collected data to a network device 38, such as a performance-monitoring server. Uploading of the collected data initiates the process that results in updating the performance statistics stored at the wireless device. The wireless device may be configured to upload collected data upon the occurrence of predetermined events, upon request, and/or at predetermined intervals, such as daily, weekly, monthly or like, thus resulting in updated performance statistics being provided to the wireless device at the corresponding interval. Alternatively, the wireless device may be configured to allow for user-initiated uploading of collected data. User-initiated uploading of collected data results in on-demand updating of the performance statistics at the wireless device.

[0068] At Event 220, uploading of the collected data is initiated by the wireless device 10, which establishes a network connection using an appropriate communication protocol, for example Hyper Text Transfer Protocol (HTTP). At Event 230, the collected data is uploaded to the performance-monitoring server 38 and, once the upload is successfully completed, at Event 240, the performance-monitoring server may return an acknowledgement message to the wireless device. The performance-monitoring server typically is configured to store the collected data in temporal storage while the performance statistics are being generated. In alternative aspects, the performance-monitoring server may be configured to store the collected data in a permanent database for future statistical processing.

[0069] At Event 250, the performance-monitoring server 38, specifically the performance-monitoring module 14 is executed by the analysis engine 40 to define and determine performance quality characteristics, which are then used to generate performance statistics. Once the performance-monitoring module 14 has generated updated performance statistics, at Event 260, the performance-monitoring server sends a bootstrap command to the wireless device notifying the device that updated performance statistics are available for downloading. The performance-monitoring

server typically uses an appropriate communication means to send the bootstrap command, such as Short Message Service (SMS), Auto Call Back (ACB) or the like.

[0070] At Event 270, the wireless device 10 establishes a network connection with the performance-monitoring server 38 using an appropriate communication protocol, for example Hyper Text Transfer Protocol (HTTP). At Event 280, the performance statistics are downloaded to the wireless device 10 and, once the download is successfully completed, at Event 290, the wireless device returns an acknowledgement message to the performance-monitoring server. At Event 300, the wireless device updates the performance statistics stored in an associated database and the newly updated performance statistics are available for display on the wireless device or on a display of a device in network communication with the wireless device.

[0071] Referring to Fig. 6, according to another aspect, a flow diagram is depicted of one aspect of a method for generating and displaying performance statistics at a wireless device. At Event 400, performance-related data is collected at the wireless device 10. Exemplary performance-related data includes, but is not limited to network-related data, device related data, air interface related data, non-air interface related data, and connection quality data such as communication event data; i.e., information in over-the-air messages and communication log data; i.e., information stored in subsystem registries. Additionally, the collected information may include positional data 48 and/or 96 or any other information related to the wireless device or related to other wireless devices in the communication network. At Event 410, the performance-monitoring module will use the collected data to define and determine performance quality characteristics 52; i.e., data that is associated with device and/or network performance and that is used to generate performance statistics. For example, in aspects relating to connection quality, performance quality characteristics include, but are not limited to, expired timers, counter thresholds, access probe attempts, reverse channel log information, access channel log information, radio frequency-related log information and the like. As previously noted, the ability to define and determine performance quality characteristics 52 may be dependent upon the protocol used for wireless communication. As such, in aspects in which the wireless device communicates using a protocol that incorporates a standardized performance-quality-related event mechanism, such as CDMA protocol or the like, relevant characteristics are identifiable in the communication log data and the communication event data. In other aspects, in which the wireless communication device communicates via a protocol that does not

incorporate one or more standardized performance-quality-related event mechanisms, such as UMTS or the like, relevant performance quality characteristics may be identified by locating message sequences and associated data in the communication logs that define a performance quality characteristic 52.

[0072] Additionally, at Event 420, the performance-monitoring module 14 will associate performance quality characteristic 52 with device-performance and/or network- performance. In this regard, the performance-monitoring module will associate certain predetermined performance quality characteristics with device-performance and certain predetermined performance quality characteristics with network-performance. By associating certain quality characteristics with device-performance and network-performance, the performance-monitoring module is able to generate performance statistics that are categorized according to being device-related or network-related.

[0073] At Event 430, the performance-monitoring module uses the quality characteristics to generate performance statistics. Based on association of the quality characteristics with the device and/or the network, the performance statistics may be device-related, network-related or generic statistics that account for both device-related and network-related performance. In addition, the performance statistics may be service provider-configured performance statistics or, in some aspects, user-configured performance statistics. For example, in a connection quality aspect, performance statistics may include, but are not limited to, one or more of numbers of access failures, call drops and service degradations, as well as, access failure rates, call drop rates, service degradation rates and the like. In addition to basing the performance statistics on the performance quality characteristics, performance statistics may be based on and/or associated with other wireless device attributes, such as position data (i.e., the geographical position of the wireless device or a network entity in communication with the wireless device at the point in time of a quality characteristic occurrence). Alternatively, the performance statistics may take into account performance attributes of other networked devices, such as all other wireless devices in the network or other wireless devices in the network of a like device "type."

[0074] At optional Event 440, the performance-monitoring module may determine if a statistic meets a predetermined threshold. If the threshold is met, at optional Event 450, the module may choose to notify a predetermined party, such as the user of the device and/or the service provider, that a performance threshold has been met. For example, if

the performance statistic is device-related and meets a threshold, the module may be configured to notify the user of the device and service provider that a device malfunction may be occurring. Further, for example, if the performance statistic is network-related and meets a threshold, the module may be configured to notify the service provider that the network is experiencing service-related problems. Typically, notifying the device user will involve internal communication, such as a displayed message, a haptic feedback, and/or an audio signal. Further, for example, notifying the service provider may entail sending an external communication, such as an SMS or ACB communication, to the service provider.

[0075] At Event 460, the generated performance statistics are processed into displayable performance statistic information and, at Event 470, the displayable performance statistic information is stored in wireless device memory. At Event 480, the performance statistic information is displayed either on the wireless device display or on a remote display associated with a device that has access to the wireless device.

[0076] Referring to Fig. 7, according to an alternate aspect, a flow diagram is illustrated of a method for receiving network device-generated performance statistics at a wireless device and subsequent display of the performance statistics. It should be noted that this aspect is optional, depending on the capabilities of a given wireless device. At Event 500, performance-related data are collected at the wireless device 10. For example, in a connection quality aspect, exemplary data includes, but is not limited to, communication event data; i.e., information in over-the-air messages, and communication log data; i.e., information stored in subsystem registries. Additionally, collected information may include positional data 48 and/or 96, or any other information related to any performance aspect of the wireless device. In addition, device-related data, such as device identification and device information may be collected. At Event 510, the performance data and the device-related data is communicated to a network device 38, such as a performance-monitoring server.

[0077] Once the performance-monitoring server has received the performance-related data, the server generates performance statistics and, at Event 520, the wireless device will receive performance statistics transmitted from the network device. If the performance statistics have not been processed at the network device into displayable performance statistic information then, at optional Event 530, the performance statistics will be processed into displayable performance statistic information. In some aspects, once the performance statistics have been properly processed into displayable

information, at Event 540, the displayable performance statistics information is stored in wireless device memory. It should be noted, however, that other forms of the performance statistics may be stored for later recall and presentation to the user. Optionally, at Event 550, the performance statistic information is displayed either on the wireless device display or on a display associated with a device that has remote-access to the wireless device.

[0078] Referring to Fig. 8, according to another aspect, a flow diagram is illustrated of a method for generating performance statistics at a network device and communicating the performance statistics to a wireless device. At Event 600, performance-related data and wireless device-related data may be received at a network device 38, such as performance-monitoring server. For example, in a connection quality determination aspect, Exemplary communication data includes, but is not limited to communication event data; i.e., information in over-the-air messages and communication log data; i.e., information stored in subsystem registries. Additionally, the collected information may include positional data 48, 96 or any other information related to the wireless device. In addition, the received data may include device-related data, such as device identification and device information. At Event 610, the network device performance-monitoring module 14 will use the received data to define and determine performance quality characteristics 52; i.e., data that is associated with device performance and that is used to generate performance statistics. For example, in the connection quality aspects, performance quality characteristics may include, but are not limited to, expired timers, counters, access probe attempts, reverse channel log information, access channel log information, radio frequency-related log information and the like.

[0079] Additionally, or alternately, at Event 620, the performance-monitoring module 14 may associate performance quality characteristics 52 with device-performance and/or network-performance. In this regard, the performance-monitoring module will associate certain predetermined performance quality characteristics with device-performance and certain predetermined performance quality characteristics with network-performance. By associating certain quality characteristics with device-performance and network-performance, the performance-monitoring module is able to generate performance statistics that are categorized according to being device-related or network-related.

[0080] At Event 630, the performance-monitoring module uses the quality characteristics to generate performance statistics. Based on association of the quality characteristics with the device and/or the network, the performance statistics may be

device-related, network-related or generic statistics that account for both device-related and network-related performance. In addition, the performance statistics may be service provider-configured performance statistics or, in some aspects, user-configured performance statistics. Performance statistics include, but are not limited to, numbers of access failures, call drops and service degradations, as well as, access failure rates, call drop rates, service degradation rates and the like. In addition to basing the performance statistics on the performance quality characteristics, performance statistics may be based on other wireless device attributes, such as position data (i.e., the geographical position of the wireless device or a network entity at the point in time of a quality characteristic occurrence). Alternatively, the performance statistics may take into account performance attributes of other networked devices, such as all other wireless devices in the network or other wireless devices in the network of a like device "type."

[0081] At optional Event 640, the performance-monitoring module may determine if a statistic meets a predetermined threshold. If the threshold is met, at optional Event 650, the module may choose to notify a predetermined party, such as the user of the device and/or the service provider, that a performance threshold has been met. If the performance statistic is device-related and meets a threshold, the module may be configured to notify the user of the device and service provider that a device malfunction may be occurring. If the performance statistic is network-related and meets a threshold, the module may be configured to notify the service provider that the network is experiencing service-related problems. Typically, notifying the user of the device and/or the service provider will involve external communication, such as an SMS or ACB communication, to the wireless device.

[0082] At optional Event 660, the generated performance statistics are processed into displayable performance statistic information. If the generated performance statistics are not processed into displayable performance statistic information at the network device then, such processing may occur at the wireless device. At Event 670, the performance statistics are communicated to the wireless device for subsequent display on the wireless device or display by a device having remote-access to the wireless device.

[0083] The various illustrative logics, logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other

programmable module device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but, in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0084] Further, the steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor, such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

[0085] While the foregoing disclosure shows illustrative aspects and/or aspects, it should be noted that various changes and modifications could be made herein without departing from the scope of the described aspects as defined by the appended claims. Furthermore, although elements of the described aspects may be described or claimed in the singular, the plural is contemplated unless limitation to the singular is explicitly stated. Additionally, all or a portion of any aspect may be utilized with all or a portion of any other aspect, unless stated otherwise.

[0086] Thus, the present aspects provide for a presentation of wireless device performance statistics, such as access failure-related statistics, call drop-related statistics, service degradation-related statistics and the like. The statistics can be determined at the wireless device or remotely, at a network device. Once the statistics are determined they can presented on the wireless device and can accessible to either the user of the device, the service provider or both. By providing for performance statistics at the wireless device, the user of the device or the service provider can readily determine if performance problems are related to the device and/or to the network. By

providing such performance-monitoring at the device or service provider level, costly failure analysis by having to return the device to the OEM can be avoided.

[0087] Many modifications and other aspects of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific aspects disclosed and that modifications and other aspects are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

CLAIMS:

What is claimed is:

1. A method for remotely providing performance statistics to a wireless communication device, the method comprising the steps of:

receiving performance-related data from a wireless communication device;

determining one or more performance quality characteristics associated with the performance-related data;

determining one or more performance statistics associated with the one or more performance quality characteristics; and

communicating the one or more performance statistics to the wireless device.

2. The method of claim 1, wherein the step of receiving performance-related data from a wireless communication device further comprises the step of receiving at least one of network-related data and network independent data.

3. The method of claim 1, wherein the step of determining one or more performance quality characteristics associated with the performance-related data further comprises the step of determining one or more characteristics associated with a usage of an application resident on the wireless device.

4. The method of claim 1, wherein the step of determining one or more performance quality characteristics associated with the performance-related data further comprises the step of determining one or more air interface characteristics associated with the wireless device.

5. The method of claim 1, wherein the step of determining one or more performance quality characteristics associated with the performance-related data further comprises the step of determining at least one of an access failure, a call drop and a service degradation associated with the wireless device.

6. The method of claim 1, wherein the step of determining one or more performance statistic associated with the one or more performance quality characteristics further comprises determining at least one performance statistic chosen

from the group consisting of an application usage statistic, a device component statistic, a network-related statistic, and a connection quality statistic.

7. The method of claim 1, further providing the step of determining if at least one of the one or more performance statistics meets a corresponding one or more predetermined performance thresholds.

8. The method of claim 7, further comprising the step of receiving an identification of a device type associated with the wireless device, wherein the one or more predetermined performance thresholds are device-specific based on the device type.

9. The method of claim 1, further comprising the steps of:

receiving an identification of a device type associated with the wireless device; and

determining if the wireless device has a performance problem based on a comparison of the one or more performance statistics for the wireless device to a corresponding one or more standard performance statistics associated with the device type.

10. The method of claim 7, further providing the step of communicating a notification to the wireless communication device if one or more predetermined performance thresholds are met.

11. The method of claim 1, further comprising the step of processing the one or more performance statistics into displayable performance statistic information.

12. The method of claim 1, further comprising the steps of receiving position data from the wireless communication device, the position data corresponding to the one or more performance quality characteristics.

13. The method of claim 12, wherein the step of determining one or more performance statistics associated with the one or more performance quality characteristics further comprises determining an area-specific performance statistic for

the wireless communication device based on the performance-related data and the position data.

14. The method of claim 13, further comprising the steps of

comparing the area-specific performance statistic for the wireless device to a cumulative area-specific performance statistic for a plurality of wireless devices; and

determining if the wireless device has a performance problem based on the comparison.

15. The method of claim 14, wherein the step of comparing the area-specific performance statistic for the wireless device to a cumulative area-specific performance statistic for a plurality of wireless devices further comprises comparing the area-specific performance statistic for the wireless device to a cumulative area-specific performance statistic for a plurality of wireless devices having like device type.

16. The method of claim 12, wherein the step of receiving position data from the wireless communication device further comprises receiving position data from the wireless communication device that corresponds to at least one of a geographic position of the wireless communication device and a geographic position of a network component in communication with the wireless device.

17. The method of claim 12, wherein the step of determining one or more performance statistics associated with the one or more performance quality characteristics further comprises determining one or more performance statistics associated with the one or more performance quality characteristics and associated position data.

18. The method of claim 1, wherein the step of receiving performance-related data from a wireless communication device further comprising receiving performance-related data chosen from the group consisting of an expired timer, a counter threshold, an access probe attempt, reverse channel log information, access channel log information and radio frequency-related log information.

19. A computer-readable medium for providing performance statistics on a wireless communication device, comprising at least one sequence of instructions, wherein execution of the instructions by a processor causes the processor to perform the steps of:

receiving performance-related data from a wireless communication device;

determining one or more performance quality characteristics associated with the performance-related data;

determining one or more performance statistics associated with the one or more performance quality characteristics; and

communicating the one or more performance statistics to the wireless device.

20. At least one processor device, implemented in a network device, configured to perform the operations of:

receiving performance-related data from a wireless communication device;

determining one or more performance quality characteristics associated with the performance-related data;

determining one or more performance statistics associated with the one or more performance quality characteristics; and

communicating the one or more performance statistics to the wireless device.

21. A network device for providing performance statistics to a wireless communication device, the network device comprising:

a communications module that receives performance-related data from a wireless device; and

a performance-monitoring module hat is operable for determining one or more performance quality characteristics associated with the performance-related data and determining one or more performance statistics associated with the one or more performance quality characteristics,

wherein the communication module communicates the one or more performance statistics to the wireless device.

22. The network device of claim 21, wherein the performance-monitoring module further comprises at least one of a call drop definition, an access failure

definition and a service degradation definition, and wherein the one or more performance quality characteristics comprise at least one of a call drop, an access failure, and a service degradation respectively corresponding to the call drop definition, the access failure definition and the service degradation definition.

23. The network device of claim 21, wherein the one or more performance statistics comprise a statistic chosen from the group consisting of a number of access failures, a number of call drops, a number of service degradations, an access failure rate, a call drop rate and a service degradation rate.

24. The network device of claim 21, further comprising a data repository having a predetermined performance threshold, and wherein the performance-monitoring module is further operable to determine if at least one of the one or more performance statistics meets the corresponding predetermined performance threshold.

25. The network device of claim 21, further comprising a data repository having a user notification message, and, wherein the communication module is configured to communicate the user notification message to a predetermined party when at least one of the predetermined performance statistics meets the corresponding predetermined performance threshold.

26. The network device of claim 21, further comprising a display programming module operable for processing the one or more performance statistics into displayable performance statistic information.

27. The network device of claim 15, wherein the communication module further receives position data from the wireless communication device that corresponds to one or more performance quality characteristics and determines one or more performance statistics corresponding to at least one predetermined geographical area, wherein the predetermined geographical area is based on the position data.

28. The network device of claim 27, wherein the step of receiving position data from the wireless communication device further comprises receiving position data from the wireless communication device that corresponds to at least one of a geographic

position of the wireless communication device and a geographic position of a network component in communication with the wireless device.

29. A network device for providing performance statistics to a wireless communication device, the network device comprising:

a means for receiving performance-related data from a wireless device;

a means for determining one or more performance quality characteristics associated with the performance-related data;

a means for determining one or more performance statistics associated with the one or more performance quality characteristics; and

a means for communicating the one or more performance statistics to the wireless device.

30. A method for locally providing performance statistics on a wireless communication device, the method comprising the steps of:

collecting performance-related data at a wireless communication device;

determining one or more performance quality characteristics associated with the performance-related data;

determining one or more performance statistics associated with the one or more performance quality characteristics;

processing the one or more performance statistics into displayable performance statistic information; and

storing the displayable performance statistics in wireless communication device memory.

31. The method of claim 30, wherein the step of collecting performance-related data at a wireless communication device further comprises the step of collecting at least one of network-related data and network independent data.

32. The method of claim 30, wherein the step of determining one or more performance quality characteristics associated with the performance-related data further comprises the step of determining one or more of an application usage characteristic, a device component usage characteristic, and an air interface characteristic.

33. The method of claim 30, wherein the step of determining one or more performance statistic associated with the one or more performance quality characteristics further comprises determining at least one performance statistic chosen from the group consisting of an application statistic, a device component statistic, and an air interface statistic.

34. The method of claim 30, further providing the step of determining if at least one of the one or more performance statistics meets one or more predetermined performance thresholds.

35. The method of claim 34, wherein at least one of the predetermined performance thresholds are device-specific based on the device type.

36. The method of claim 30, further comprising the step of determining if the wireless device has a performance problem based on a comparison of the one or more performance statistics for the wireless device to a corresponding one or more standard performance statistics associated with a device type associated with the wireless device.

37. The method of claim 34, further providing the step of communicating a notification to a predetermined party if one or more predetermined performance thresholds are met.

38. The method of claim 30, further comprising the steps of collecting position data and associating the position data with the one or more performance quality characteristics.

39. The method of claim 38, wherein the step of determining one or more performance statistics associated with the one or more performance quality characteristics further comprises determining an area-specific performance statistic for the wireless communication device based on the performance-related data and the position data.

40. The method of claim 39, further comprising the steps of

comparing the area-specific performance statistic for the wireless device to a cumulative area-specific performance statistic for a plurality of wireless devices; and

determining if the wireless device has a performance problem based on the comparison.

41. The method of claim 40, wherein the step of comparing the area-specific performance statistic for the wireless device to a cumulative area-specific performance statistic for a plurality of wireless devices further comprises comparing the area-specific performance statistic for the wireless device to a cumulative area-specific performance statistic for a plurality of wireless devices having a like device type.

42. The method of claim 38, wherein the step of collecting position data further comprises collecting position data that corresponds to at least one of a geographic position of the wireless device and a geographic position of a network component in communication with the wireless device.

43. The method of claim 38, wherein the step of determining one or more performance statistic associated with the one or more performance quality characteristics further comprises determining one or more connection quality statistics associated with the one or more performance quality characteristics and the associated position data.

44. The method of claim 30, further comprising the step of displaying the displayable performance statistics on a display associated with the wireless device.

45. A computer-readable medium for providing performance statistics on a wireless communication device, comprising at least one sequence of instructions, wherein execution of the instructions by a processor causes the processor to perform the steps of:

collecting performance-related data at a wireless communication device;

determining one or more performance quality characteristics associated with the performance-related data;

determining one or more performance statistics associated with the one or more performance quality characteristics;

processing the one or more performance statistics into displayable performance statistic information; and

storing the displayable performance statistics in wireless communication device memory.

46. At least one processor device, implemented in a wireless device, configured to perform the operations of:

collecting performance-related data at a wireless communication device;

determining one or more performance quality characteristics associated with the performance-related data;

determining one or more performance statistics associated with the one or more performance quality characteristics;

processing the one or more performance statistics into displayable performance statistic information; and

storing the displayable performance statistics in wireless communication device memory.

47. A wireless communication device, the device comprising:

a data storage having performance-related data; and

a performance-monitoring module in communication with the data storage, the performance-monitoring module being operable to determine one or more performance quality characteristics associated with the performance-related data and generate one or more performance statistics associated with the one or more performance quality characteristics.

48. The wireless communication device of claim 47, wherein the performance-related data comprises at least one of air interface data and non-air interface data associated with the wireless device.

49. The wireless communication device of claim 47, wherein the one or more performance quality characteristics comprise at least one of an access failure, a call drop and a service degradation.

50. The wireless communication device of claim 47, wherein the one or more performance statistics further comprise at least one of a number of access failures, a number of call drops, a number of service degradations, an access failure rate, a call drop rate and a service degradation rate.

51. The wireless communication device of claim 47, wherein the data storage further comprises at least one predetermined performance threshold, and, wherein the performance-monitoring module is further operable for determining if at least one of the one or more performance statistics meets the predetermined performance threshold.

52. The wireless communication device of claim 47, wherein the data storage further comprises a display programming module operable for processing the one or more performance statistic into displayable performance statistic information.

53. The wireless communication device of claim 52, further comprising a display module operable for presenting the displayable performance statistic information.

54. The wireless communication device of claim 47, wherein the data storage further comprises position data corresponding to one or more of the performance quality characteristics.

55. The wireless communication device of claim 54, wherein the performance-monitoring module determines an area-specific performance statistic for the wireless communication device based on the performance-related data and the position data.

56. The wireless communication device of claim 55, wherein the performance-monitoring module is further operable to compare the area-specific performance statistic for the wireless device to a corresponding cumulative area-specific

performance statistic for a plurality of wireless devices and to determine if the wireless device has a performance problem based on the comparison.

57. The wireless communication device of claim 56, wherein the wireless device comprises a device type, and wherein the cumulative area-specific performance statistic for the plurality of wireless devices comprises a statistic for wireless devices having a corresponding device type.

58. The wireless communication device of claim 47, wherein the position data is based on at least one of a geographic position of the wireless communication device and a geographic position of a network component in communication with the wireless device.

59. A wireless communication device, the device comprising:

a means for analyzing data; and

a means for storing performance-related data; and

a means for determining one or more performance quality characteristics associated with the performance-related data and determining one or more performance statistics associated with the one or more performance quality characteristics.

60. A method for providing performance statistics on a wireless communication device, the method comprising the steps of:

collecting performance-related data at a wireless communication device;

communicating the performance-related data to a network device;

receiving, at the wireless communication device, one or more wireless device performance statistics from the network device based on the collected performance-related data; and

providing for a displayable presentation of the one or more performance statistics.

61. The method of claim 60, wherein the step of collecting performance-related data at a wireless communication device further comprises the step of collecting at least one of data relating to an expired timer, a counter threshold, an access probe attempt, a reverse channel log, an access channel log and a radio frequency-related log.

62. The method of claim 60, wherein the step of receiving, at the wireless communication device, one or more wireless device performance statistics from the network device further comprises receiving, at the wireless device, at least one of an application usage characteristic, a device component usage characteristic, and an air interface characteristic.

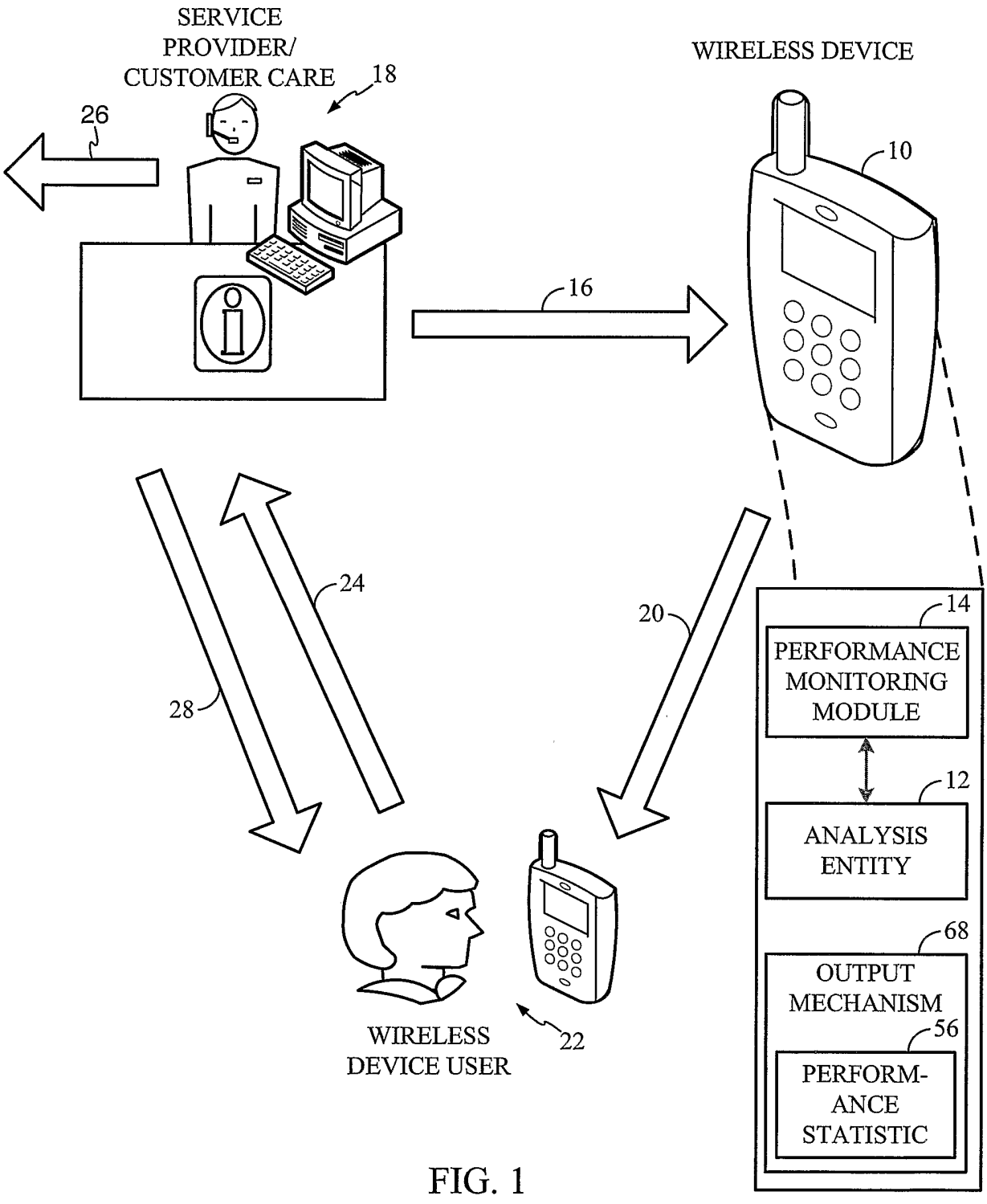

SERVICE PROVIDER/ CUSTOMER CARE
18
26
WIRELESS DEVICE
10
16
24
28
20
14
PERFORMANCE MONITORING MODULE
12
ANALYSIS ENTITY
68
OUTPUT MECHANISM
56
PERFORM-ANCE STATISTIC
WIRELESS DEVICE USER
22

FIG. 1

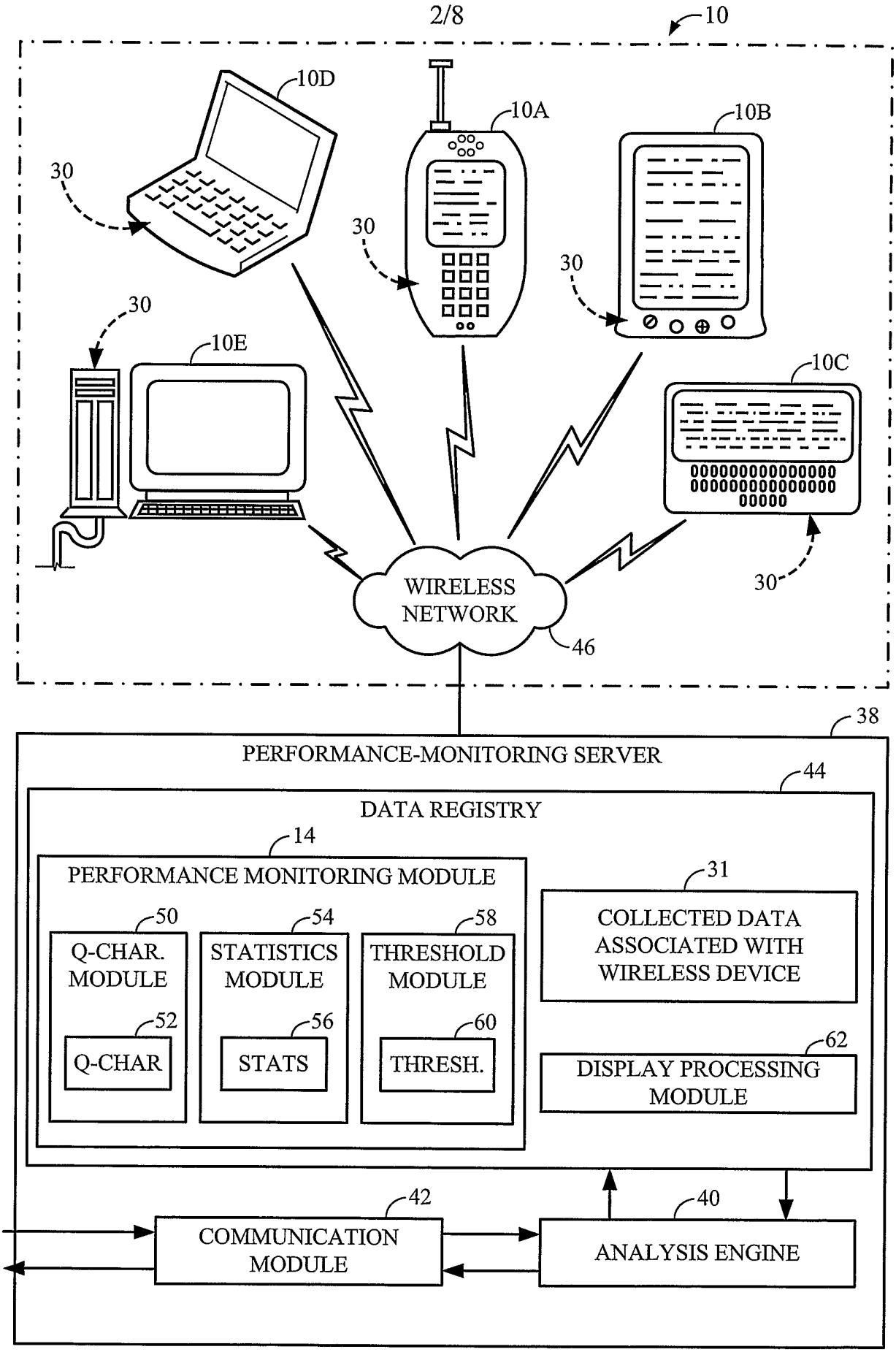

10
10D
10A
10B
30
30
30
30
10E
10C
WIRELESS NETWORK
46
30
38
PERFORMANCE-MONITORING SERVER
44
DATA REGISTRY
14
PERFORMANCE MONITORING MODULE
50
Q-CHAR. MODULE
52
Q-CHAR
54
STATISTICS MODULE
56
STATS
58
THRESHOLD MODULE
60
THRESH.
31
COLLECTED DATA ASSOCIATED WITH WIRELESS DEVICE
62
DISPLAY PROCESSING MODULE
42
COMMUNICATION MODULE
40
ANALYSIS ENGINE

FIG. 2

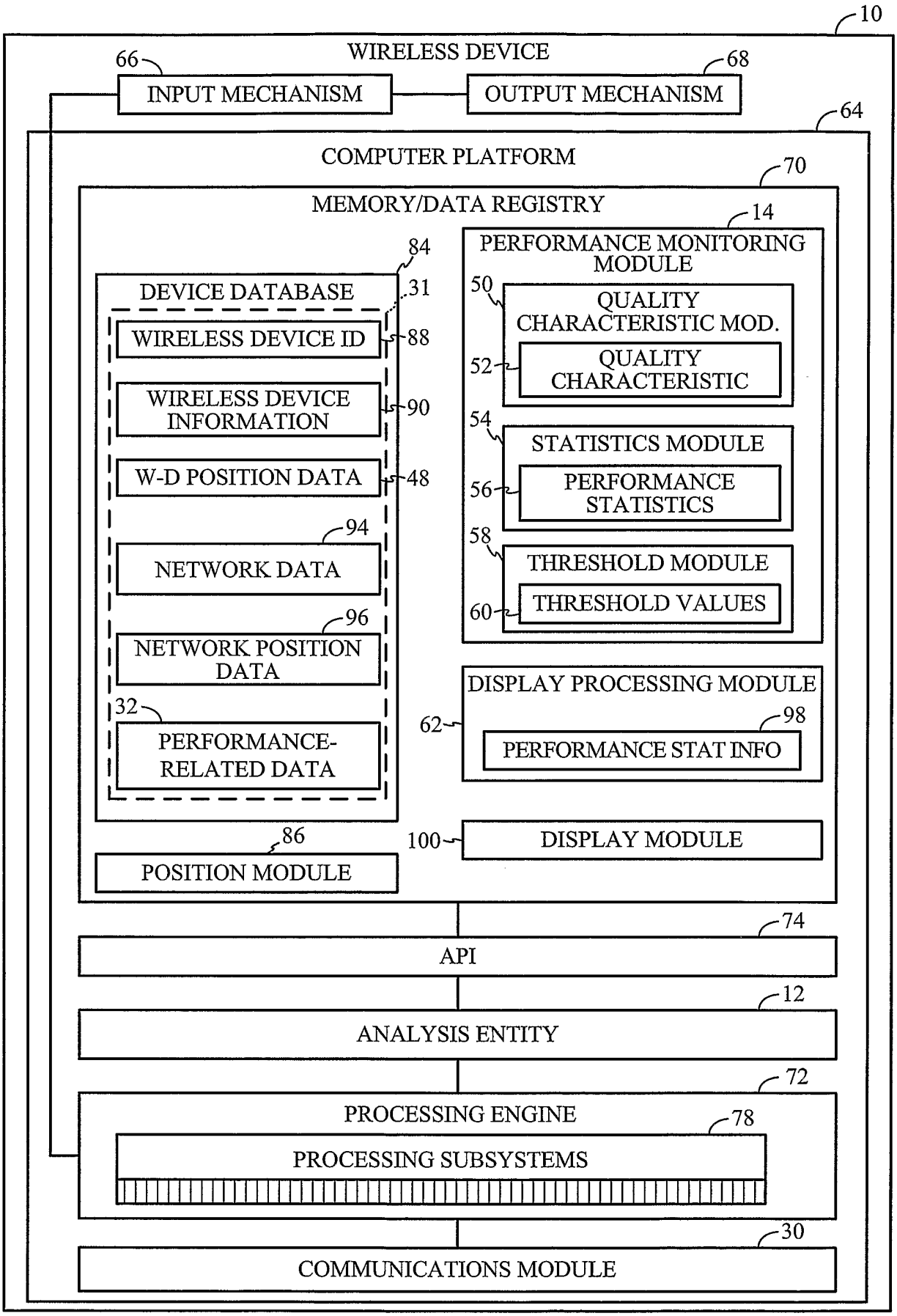

10
WIRELESS DEVICE
66
INPUT MECHANISM
68
OUTPUT MECHANISM
64
COMPUTER PLATFORM
70
MEMORY/DATA REGISTRY
14
PERFORMANCE MONITORING MODULE
84
DEVICE DATABASE
31
WIRELESS DEVICE ID
88
WIRELESS DEVICE INFORMATION
90
W-D POSITION DATA
48
94
NETWORK DATA
96
NETWORK POSITION DATA
32
PERFORMANCE-RELATED DATA
50
QUALITY CHARACTERISTIC MOD.
52
QUALITY CHARACTERISTIC
54
STATISTICS MODULE
56
PERFORMANCE STATISTICS
58
THRESHOLD MODULE
60
THRESHOLD VALUES
DISPLAY PROCESSING MODULE
62
98
PERFORMANCE STAT INFO
86
POSITION MODULE
100
DISPLAY MODULE
74
API
12
ANALYSIS ENTITY
72
PROCESSING ENGINE
78
PROCESSING SUBSYSTEMS
30
COMMUNICATIONS MODULE

FIG. 3

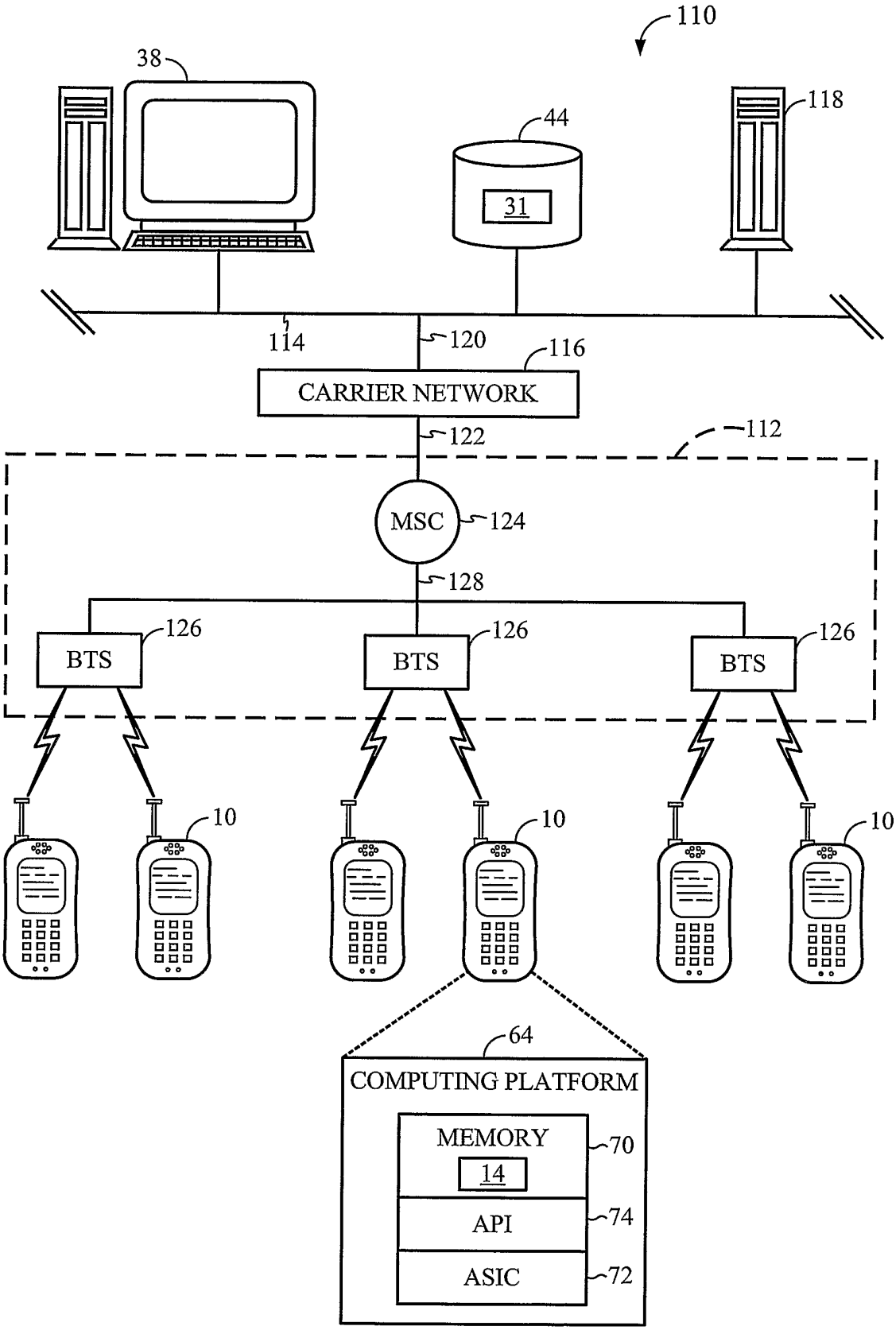

110
38
44
31
118
114
120
116
CARRIER NETWORK
122
112
MSC
124
128
126
BTS
126
BTS
126
BTS
10
10
10
64
COMPUTING PLATFORM
MEMORY
14
70
API
74
ASIC
72

FIG. 4

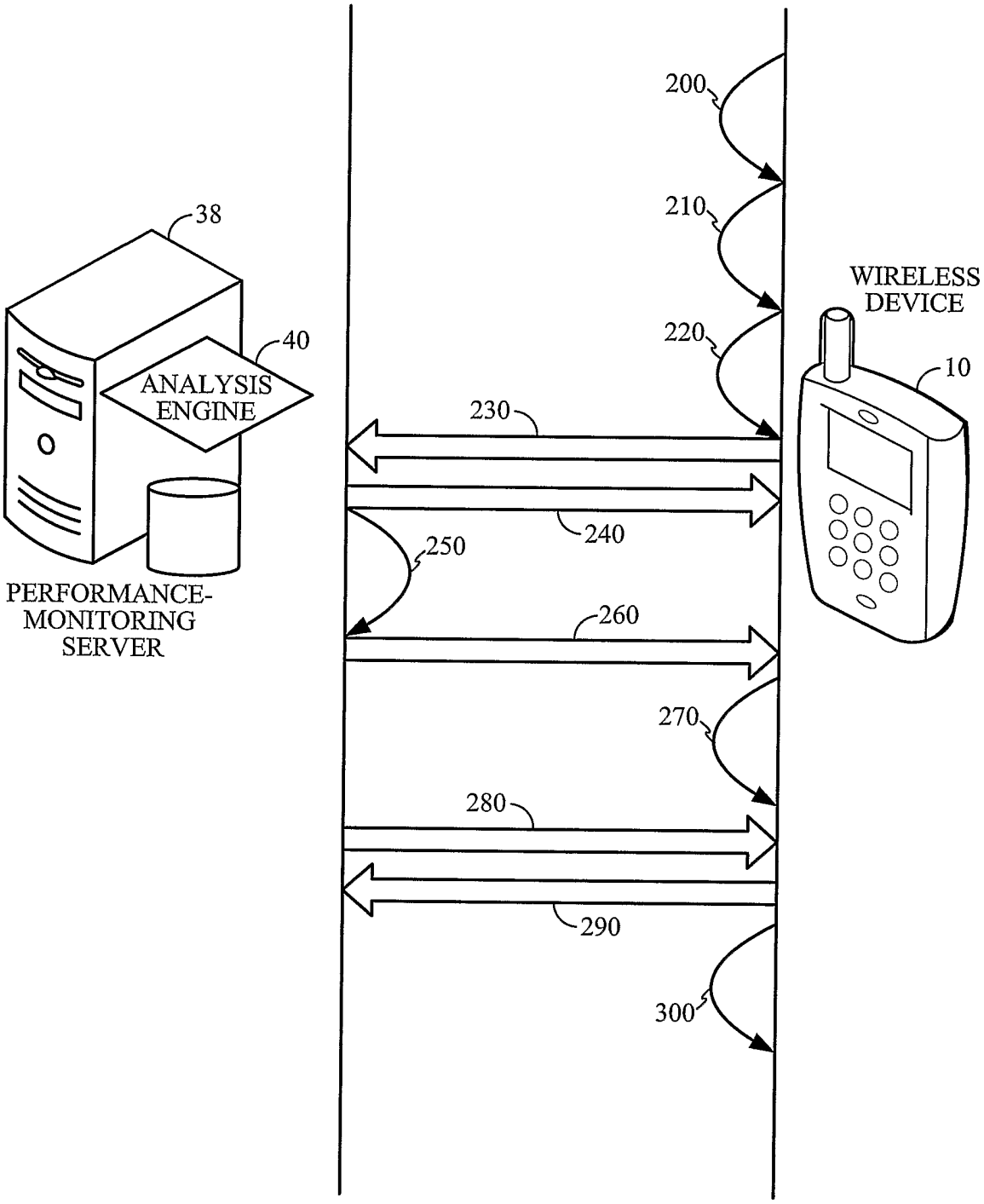

38
40
ANALYSIS ENGINE
PERFORMANCE-MONITORING SERVER
200
210
220
WIRELESS DEVICE
10
230
240
250
260
270
280
290
300

FIG. 5

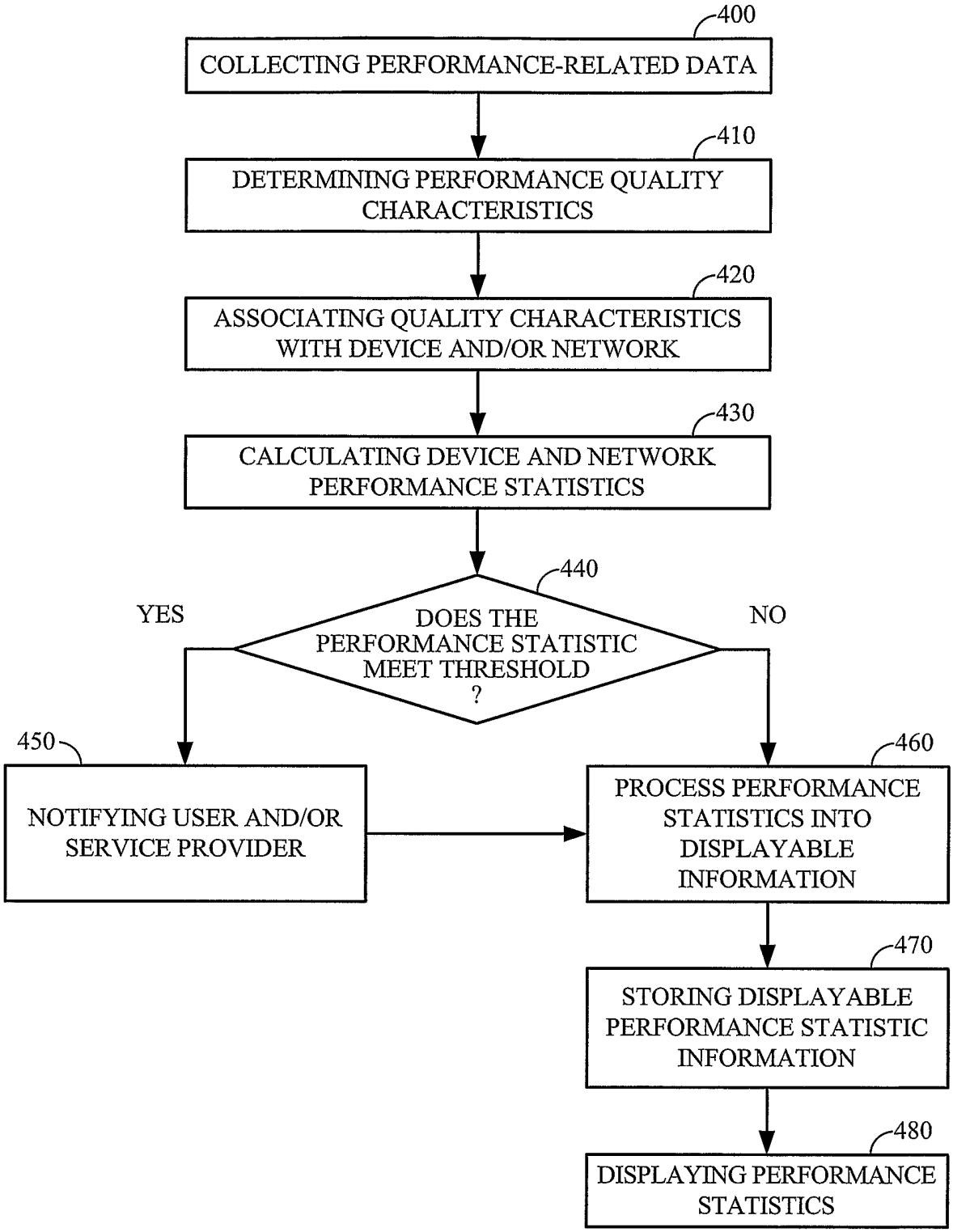

400
COLLECTING PERFORMANCE-RELATED DATA
410
DETERMINING PERFORMANCE QUALITY CHARACTERISTICS
420
ASSOCIATING QUALITY CHARACTERISTICS WITH DEVICE AND/OR NETWORK
430
CALCULATING DEVICE AND NETWORK PERFORMANCE STATISTICS
440
DOES THE PERFORMANCE STATISTIC MEET THRESHOLD ?
YES
NO
450
NOTIFYING USER AND/OR SERVICE PROVIDER
460
PROCESS PERFORMANCE STATISTICS INTO DISPLAYABLE INFORMATION
470
STORING DISPLAYABLE PERFORMANCE STATISTIC INFORMATION
480
DISPLAYING PERFORMANCE STATISTICS

FIG. 6

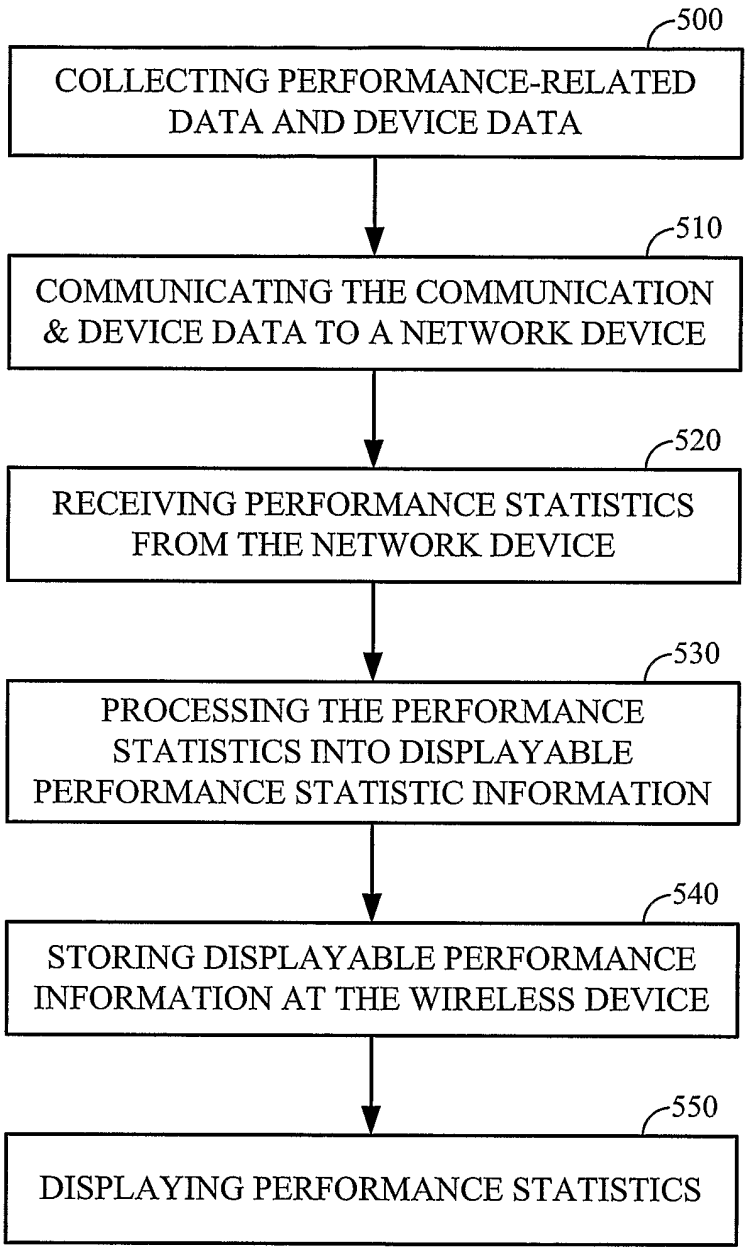

500
COLLECTING PERFORMANCE-RELATED DATA AND DEVICE DATA
510
COMMUNICATING THE COMMUNICATION & DEVICE DATA TO A NETWORK DEVICE
520
RECEIVING PERFORMANCE STATISTICS FROM THE NETWORK DEVICE
530
PROCESSING THE PERFORMANCE STATISTICS INTO DISPLAYABLE PERFORMANCE STATISTIC INFORMATION
540
STORING DISPLAYABLE PERFORMANCE INFORMATION AT THE WIRELESS DEVICE
550
DISPLAYING PERFORMANCE STATISTICS

FIG. 7

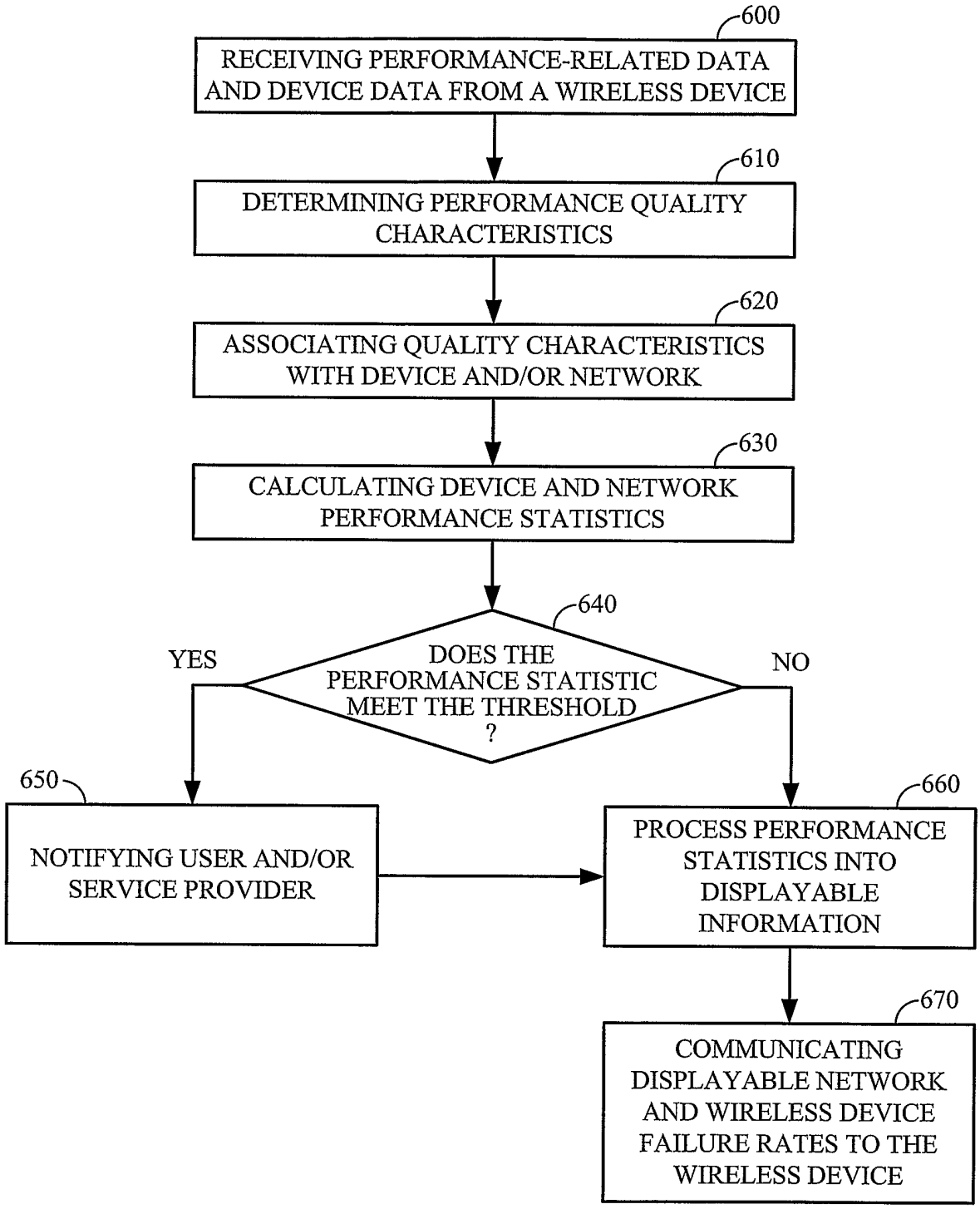

600
RECEIVING PERFORMANCE-RELATED DATA AND DEVICE DATA FROM A WIRELESS DEVICE
610
DETERMINING PERFORMANCE QUALITY CHARACTERISTICS
620
ASSOCIATING QUALITY CHARACTERISTICS WITH DEVICE AND/OR NETWORK
630
CALCULATING DEVICE AND NETWORK PERFORMANCE STATISTICS
640
DOES THE PERFORMANCE STATISTIC MEET THE THRESHOLD ?
YES
NO
650
NOTIFYING USER AND/OR SERVICE PROVIDER
660
PROCESS PERFORMANCE STATISTICS INTO DISPLAYABLE INFORMATION
670
COMMUNICATING DISPLAYABLE NETWORK AND WIRELESS DEVICE FAILURE RATES TO THE WIRELESS DEVICE

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/010583

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q7/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 309 214 A (NOKIA CORPORATION) 7 May 2003 (2003-05-07) paragraph [0010] paragraph [0012] paragraph [0022] - paragraph [0024] paragraph [0026] - paragraph [0027] figures 1-3 paragraph [0032] - paragraph [0033]	1-62
A	US 6 088 588 A (OSBORNE ET AL) 11 July 2000 (2000-07-11) abstract column 1, line 66 - column 3, line 9 column 8, line 10 - line 54 column 10, line 51 - line 62 column 11, line 4 - line 6 figure 5	1-62

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 August 2006	24/08/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Bittermann, J

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/010583

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 987 306 A (NILSEN ET AL) 16 November 1999 (1999-11-16) abstract figure 1 column 2, line 5 - line 26 column 4, line 26 - line 44 column 5, line 60 - column 6, line 21 column 9, line 7 - line 14 column 12, line 49 - line 57 column 13, line 21 - column 14, line 24	1-62

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/010583

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1309214 A	07-05-2003	BR 0213873 A	26-04-2005
		CA 2465747 A1	15-05-2003
		CN 1611088 A	27-04-2005
		WO 03041422 A2	15-05-2003
		JP 2005509380 T	07-04-2005
		US 2005113029 A1	26-05-2005
US 6088588 A	11-07-2000	CA 2231954 A1	25-09-1998
		WO 9843455 A2	01-10-1998
US 5987306 A	16-11-1999	AT 249131 T	15-09-2003
		AU 2632395 A	21-12-1995
		DE 69531689 D1	09-10-2003
		DE 69531689 T2	15-07-2004
		EP 0772946 A2	14-05-1997
		NO 942031 A	04-12-1995
		WO 9533352 A2	07-12-1995