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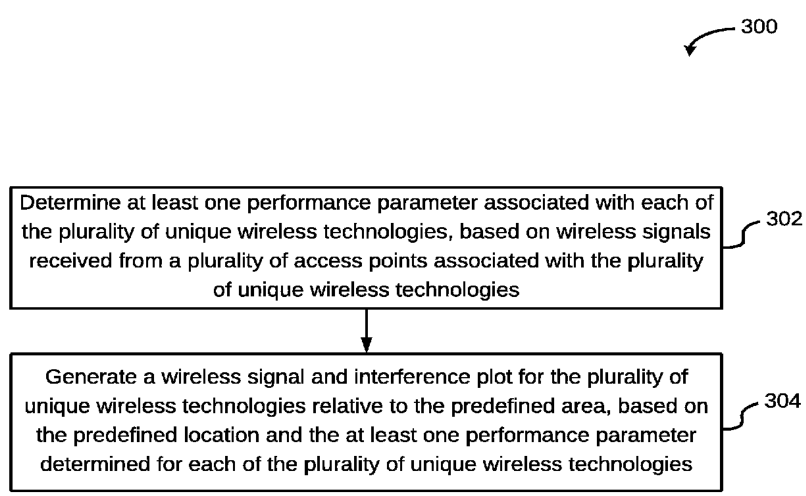

FIG. 3

(57) Abstract: This disclosure relates to devices and methods for analyzing a plurality of unique wireless technologies within a predefined area. In an embodiment, a method may include determining (302) at least one performance parameter associated with each of the plurality of unique wireless technologies, based on wireless signals received from a plurality of access points associated with the plurality of unique wireless technologies, such that each of the plurality of access points has a predefined location within the predefined area, and generating (304) a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area. In another embodiment, a method may be directed at determining an optimum location for each of the plurality of access points within the predefined area based on the iterative simulations and the layout map.

WO 2018/178892 A1

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Technical Field

[001] This disclosure relates generally to analyzing wireless technologies, and more particularly to analyzing multiple unique wireless technologies in an area.

Background

[002] Wireless technologies may be used to connect devices, such as, laptops, desktops, smartphones, and servers to a network or the Internet in order to set up a wireless environment. The wireless technologies do away with the requirement of wired connections in a network, and, therefore, provide for increased mobility. Examples of various wireless technologies may include, but are not limited to Wi-Fi, Bluetooth, WiMax, and Zigbee. The wireless environment may be set up through one or more access points, such as, routers, modems, and hotspot devices within a work area. Further, the access points may correspond to surveillance system, automobiles, lighting systems, Heating Ventilation, and Air Conditioning (HVAC), medical and diagnostic equipment, entertainment devices (such as TVs), and kitchen or laundry appliances.

[003] Further, for multiple unique wireless technologies, it may be a common practice to employ multiple wireless access points to cater to each unique wireless technology. A plurality of devices in the work area may then connect to the network or the Internet, via one or more these wireless access points.

[004] An access point may be able to provide connectivity to devices over a limited range of only a few meters, as the wireless signals may lose strength over long distances. Therefore, a work area may include a number of access points distributed over the entire work area to ensure uninterrupted connectivity to the devices. However, parameters associated with multiple wireless technologies, such as, strength of wireless signals and bandwidth of the wireless signals, may vary from one location to another in the work area, depending on the distance of a device from one or more access points.

[005] Further, presence of multiple access points in the work area may lead to interference amongst wireless signals associated with the multiple access points. It, therefore, becomes essential to plan efficient positioning of the devices and the access points within the work area. Various planning tools, such as signal strength meter, radio sniffers, and handheld spectrum analyzer may be used for planning the location of the devices and the access points within the area. Each of these tools may analyze a wireless technology, and may provide an indication about various parameters of that wireless technology at different locations within the work area.

[006] However, the existing tools are capable of analyzing only a single type of wireless technology, and are not able to provide information about all the unique wireless technologies being employed in a work area. Hence, multiple such tools, each being compatible with one particular wireless technology, may be required. As a result, the cost and time required for planning is high.

SUMMARY

[007] In one embodiment, a method for analyzing a plurality of unique wireless technologies within a predefined area is described. The method includes determining at least one performance parameter associated with each of the plurality of unique wireless technologies, based on wireless signals received from a plurality of access points associated with the plurality of unique

wireless technologies. Each of the plurality of access points has a predefined location within the predefined area. The method further includes generating a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area, based on the predefined location and at least one performance parameter determined for each of the plurality of unique wireless technologies.

[008] In another embodiment, a sniffer device for analyzing a plurality of unique wireless technologies within a predefined area is described. The sniffer device includes a plurality of antennas configured to receive wireless signals from a plurality of access points associated with the plurality of unique wireless technologies. Each of the plurality of access points has a predefined location within the predefined area, and each of the plurality of antennas corresponds to one of the plurality of unique wireless technologies. The sniffer device further includes at least one radio transceiver and microcontroller module communicatively coupled to the plurality of antennas. The at least one radio transceiver and microcontroller module is configured to determine at least one performance parameter associated with each of the plurality of unique wireless technologies, based on the wireless signals received from the plurality of access points. The at least one radio transceiver and microcontroller module is further configured to generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area, based on the predefined location and at least one performance parameter determined for each of the plurality of unique wireless technologies.

[009] In another embodiment, a transceiver module for analyzing a plurality of unique wireless technologies within a predefined area is described. The transceiver module includes a plurality of antennas configured to receive wireless signals from a plurality of access points associated with the plurality of unique wireless technologies, such that each of the plurality of access points has a predefined location within the predefined area, and each of the plurality of antennas corresponds to one of the plurality of unique wireless technologies. The transceiver module further includes at least one radio transceiver and microcontroller module communicatively coupled to the plurality of antennas. The at least one radio transceiver and microcontroller module is configured to determine at least one performance parameter associated with each of the plurality of unique wireless technologies, based on the wireless signals received from the plurality of access points, such that at least one performance parameter is used to generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area.

[010] In another embodiment, a non-transitory computer-readable storage medium having stored thereon, a set of computer-executable instructions is described. The computer-executable instructions cause a computer comprising one or more processors to receiving a layout map associated with the predefined area; iteratively simulating at least one performance parameter associated with each of the plurality of unique wireless technologies, based on simulated wireless signals received from the plurality of access points, wherein each of the plurality of access points is virtually placed at a predefined location within the predefined area based on the layout map; and determining an optimum location for each of the plurality of access points within the predefined area based on the iterative simulations and the layout map.

[011] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[012] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and, together with the description, serve to explain the disclosed principles.

[013] **FIG. 1** illustrates a schematic diagram of a sniffer device for analyzing a plurality of unique wireless technologies within a predefined area, in accordance with an embodiment;

[014] **FIG. 2** illustrates a schematic diagram of a transceiver module for analyzing a plurality of unique wireless technologies within a predefined area, in accordance with another embodiment;

[015] **FIG. 3** illustrates a flowchart of a method for analyzing a plurality of unique wireless technologies within a predefined area, in accordance with an embodiment.

[016] **FIG. 4** illustrates a flowchart of a method for analyzing a plurality of unique wireless technologies within a predefined area, in accordance with another embodiment.

[017] **FIG. 5** illustrates a flowchart of a method for placing a plurality of access points associated with a plurality of unique wireless technologies within a predefined area, in accordance with an embodiment.

[018] **FIG. 6** illustrates a flowchart of a method for iteratively simulating virtual locations of a plurality of access points on a layout map to determine optimum location for the plurality of access points within a predefined area, in accordance with an embodiment.

[019] **FIG. 7** illustrates an interactive GUI depicting simulation of virtual locations for a plurality of access points on a layout map associated with an office floor, in accordance with an embodiment.

[020] **FIG. 8** illustrates a block diagram of an exemplary computer system for implementing embodiments consistent with the present disclosure.

DETAILED DESCRIPTION

[021] Exemplary embodiments are described with reference to the accompanying drawings. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without departing from the spirit and scope of the disclosed embodiments. It is intended that the following detailed description be considered as exemplary only, with the true scope and spirit being indicated by the following claims.

[022] Referring now to FIG. 1, a schematic diagram of a sniffer device 100 for analyzing a plurality of unique wireless technologies within a predefined area is illustrated, in accordance with an embodiment. The sniffer device 100 may be a system on chip arrangement. In an embodiment, the sniffer device 100 may be a hand-held device. Examples of the plurality of unique wireless technologies may include, but are not limited to Wi-Fi, Worldwide Interoperability for Microwave Access (WiMAX), Long-Term Evolution (LTE), 5G, Wireless Personal Area Network (WPAN), Zigbee, Bluetooth, Near Field Communication (NFC), Industrial, Scientific and Medical (ISM) radio bands (for example, Sub-GHz and GHz ISM

band), wireless local area network (WLAN), Wireless Highway Addressable Remote Transducer Protocol (wiHART), Global Positioning System (GPS), Long range, low power wireless platform (LoRa®), Ultra-WideBand, Radio Frequency Identification (RFID), Enocean, Wireless Regional Area Network (WRAN), Digital Enhanced Cordless Telecommunication (DECT), TransferJet, Wireless Home Digital Interface (WHDI), Wireless Meter Bus (WMBus) and IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN).

[023] The sniffer device 100 may be used to analyze a plurality of unique wireless technologies within the predefined area. The predefined area, for example, may be an office floor, a commercial complex, a university campus, a house, a floor within a house, or an apartment. Based on the analysis, the sniffer device 100 may further generate a wireless signal plot for the plurality of unique wireless technologies in the predefined area. The sniffer device 100 may analyze the plurality of unique wireless technologies, based on wireless signals received from a plurality of access points associated with the plurality of unique wireless technologies.

[024] Each of the plurality of access points may have a predefined location within the predefined area. By way of an example, there may be three wireless technologies being used within an apartment, i.e., Wi-Fi, 4G hotspot, and Bluetooth. The apartment may include a Wi-Fi access point located within the living room of the apartment, a 4G access point in a bedroom of the apartment, or a Bluetooth access point in a Balcony of the apartment. Based on the predefined location and the one or more performance parameters determined for each of the plurality of unique wireless technologies, the sniffer device 100 may generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area. The wireless signal plot may also include a signal interference plot. The sniffer device 100 may then use the wireless signal plot to determine an optimum location for each of the plurality of access points within the predefined area.

[025] In order to analyze the wireless signals received for the plurality of unique wireless technologies, the sniffer device 100 may include an antenna 102a, an antenna 102b, an antenna 102c, and an antenna 102d, collectively referred to as a plurality of antennas 102. It will be apparent to a person skilled in the art that the number of antennas is not limited to the number depicted in FIG. 1 and may increase or decrease based on the number of unique wireless technologies available in the predefined area. Each of the plurality of antennas 102 may be configured to receive a wireless signal from one of a plurality of access points (not shown in Fig. 1) associated with one of the plurality of unique wireless technologies. In other words, each of the plurality of antennas 102 can only detect one unique wireless technology.

[026] As each of the plurality of antennas 102 detects a unique wireless technology, the sniffer device 100 is able to detect multiple unique wireless technologies without any manual intervention. The type of antennas used for the plurality of antennas 102 may include, but are not limited to broadband antennas, narrow band antennas, frequency independent antennas, smart antennas, active antennas, passive antennas, printed circuit board antennas, chip antennas, external metallic antennas, and carbon nanotube antennas.

[027] In order to affix or attach the plurality of antennas 102 to the sniffer device 100, a plurality of micro connectors 104 may be provided in the sniffer device 100. The plurality of micro connectors 104 may cooperate with the plurality of antennas 102. The plurality of micro connectors 104 include a micro connector 104a, a micro connector 104b, a micro connector 104c, and a micro connector 104d. In an embodiment, each of the plurality of micro connectors

104 may receive an antenna from the plurality of antennas 102. By way of an example, the micro connector 104a receives the antenna 102a, the micro connector 104b receives the antenna 102b, the micro connector 104c receives the antenna 102c, and the micro connector 104d receives the antenna 102d. In other words, an antenna from the plurality of antennas 102 may be plugged into an associated micro connector from the plurality of micro connectors 104. Each of the plurality of micro connectors 104 may include a provision to facilitate the same.

[028] Once an antenna is attached to the sniffer device 100, by way of being plugged into a micro connector, the antenna may later be detached from the micro connector without damaging the antenna or the sniffer device 100. By way of an example, after the antenna 102a has been plugged into the micro connector 104a, the antenna 102a may later be detached without damaging the antenna 102a or the sniffer device 100. Thus, the plurality of micro connectors 104 enables attachment and detachment of the plurality of antennas 102 from the sniffer device 100.

[029] With respect to antenna directions, the type of antennas used for the plurality of antennas 102 may include, but are not limited to omnidirectional antennas and directional antennas (for example, unidirectional antennas and bidirectional antennas). While the omnidirectional antennas may be able to detect wireless signals in all directions in one plane, the directional antennas (unidirectional antennas and bidirectional antennas) may be able to detect wireless signals only in a specific direction. As such, the capability of a directional antenna to receive wireless signals from a plurality of access points in the predefined area may be limited. Therefore, the directional antenna may be connected to the sniffer device 100, such that, the directional antenna can be rotated while being affixed to an associated micro connector from the plurality of micro connectors 104. This may improve the capability of the directional antenna to receive wireless signals.

[030] Thus, in an embodiment, each of the plurality of micro connectors 104 may additionally enable rotation and, hence, unrestricted orientations for each of the plurality of antennas 102, once received by the plurality of micro connectors 104. By way of an example, once the antenna 102b has been plugged into the micro connector 104b, the micro connector 104b may enable the antenna 102b to be rotated at various angles to receive wireless signals from one of the plurality of access points. The rotation may be controlled manually by a user. Alternatively, the rotation may be controlled by an electronically controlled ball joint. In this case, a Micro-Electro Mechanical Systems (MEMS) motor may be affixed within the micro connector 104b.

[031] The plurality of antennas 102 may detect frequencies within a plurality of frequency bands in order to analyze the plurality of unique wireless technologies within the predefined area. The range for the plurality of frequency bands may include, but is not limited to Hertz (Hz), Kilohertz (KHz), Megahertz, (MHz), Gigahertz (GHz), Petahertz (PHz), Terahertz (THz), and Exahertz (EHZ). By way of an example, the plurality of frequency bands, may include, but are not limited to 9KHz-MHz, 1MHz-30MHz, 30MHz-300MHz, and 300MHz-1GHz.

[032] The operation of the plurality of antennas 102 may be controlled by a radio transceiver and microcontroller module 106. It will be apparent to a person skilled in the art that the sniffer device 100 may include more than one radio transceiver and microcontroller module 106. In an embodiment, the sniffer device 100 may include one radio transceiver and microcontroller module 106 per antenna in the plurality of antennas 102. This is depicted in FIG. 2. The radio transceiver and microcontroller module 106 is considered as System on Chip (SoC). The radio transceiver and microcontroller module 106 may be communicatively coupled to the plurality of

antennas 102, and may selectively operate each of the plurality of antennas 102 to receive wireless signals associated with a unique wireless technology. By way of an example, the antenna 102a may be operated to receive wireless signal associated with a unique wireless technology that the antenna 102a is configured to receive. By way of an example, the antenna 102a may be configured to receive Wi-Fi signals. Similarly, the antenna 102b, antenna 102c and antenna 102d may be configured to receive Bluetooth signals, Zigbee signals, and 4G signals, respectively. Further, in order to operate an antenna from the plurality of antennas 102, a scanning functionality of the antenna may be activated by radio transceiver and microcontroller module 106.

[033] When directional antennas are being used in the sniffer device 100, the wireless signals may only be received in a specific direction. As a result, the performance parameters of the wireless signals as received by the plurality of directional antennas may vary with varying orientations of the sniffer device 100, thereby, not capturing accurate data. In this case, the orientation of the directional antennas may be remotely controlled by a user, in order to re-orient the directional antennas to capture accurate data.

[034] The user may access an interactive Graphical User Interface (GUI) through a computing device 108 communicatively coupled to the sniffer device 100 via a communication interface (not show in FIG. 1). The computing device 108, for example, may be a laptop, a desktop, a smartphone, a tablet, or a server. Examples of the communication interface may include but are not limited to Universal Serial Bus (USB), Ethernet, Universal Asynchronous Receiver-Transmitter (UART), Wi-Fi and Bluetooth. The interactive GUI may allow the user to change the orientation of the directional antennas. In one embodiment, the user may send instructions through the interactive GUI, which may be received by the radio transceiver and microcontroller module 106. The radio transceiver and microcontroller module 106 may then control MEMS motors, which may be affixed within the plurality of micro connectors 104. The plurality of micro connectors 104 may enable the plurality of antennas 102 to be rotated at various angles to receive wireless signals from one of the plurality of access points. Thus, the user may control orientation of the plurality of antennas 102 through the interactive GUI.

[035] In order to analyze the wireless signals, the sniffer device 100 may determine one or more frequencies and modulation techniques of the wireless signals received by the plurality of antennas 102. The modulation techniques may include but not limited to Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK) and their derivations and combinations, such as, Quadrature PSK (QPSK), Offset QPSK (OQPSK), Gaussian FSK (GFSK), Quadrature Amplitude Modulation (QAM), and others. In order to determine one or more frequencies of the wireless signals, the sniffer device 100 may include a filtering and matching module 124a, a filtering and matching module 124b, a filtering and matching module 124c and a filtering and matching module 124d, collectively referred to as filtering and matching modules 124. The filtering and matching modules 124 may be communicatively coupled to the plurality of antennas 102. A filtering circuit may filter out unwanted signals/frequencies and harmonics generated during transmission and reception. A matching circuit may be a lumped circuit (consisting of Inductor-capacitor combination or PCB) for matching impedance with external/internal antenna to deliver maximum radio frequency power transfer.

[036] In the current embodiment, a unique filtering and matching module is coupled to each of the plurality of antennas 102. Thus, the filtering and matching module 124a is communicatively coupled to the antenna 102a, the filtering and matching module 124b is communicatively

coupled to the antenna 102b, the filtering and matching module 124c is communicatively coupled to the antenna 102c, and the filtering and matching module 124d is communicatively coupled to the antenna 102d. In an embodiment, the sniffer device 100 may include a single filtering and matching module that is coupled to each of the plurality of antennas 102. In another embodiment, each of the one or more filtering and matching modules 124 may be implemented as a separate filtering module and a separate matching module.

[037] Each of the filtering and matching modules 124 may match a frequency with an associated antenna from the plurality of antennas 102 and may additionally provide maximum power at the output. By way of an example, the filtering and matching module 124a may match a frequency with the antenna 102a and may provide maximum power at the output of the filtering and matching module 124a. In an exemplary embodiment, each of the plurality of antennas 102 may be matched to 50 ohms with a coupled filtering and matching module.

[038] By way of an example, the antenna 102d may be matched to 50 ohms with the filtering and matching module 124d. Additionally, each of the one or more filtering and matching modules 124 may filter “Out of band” signals and spurious emissions. As a result, only the frequencies that are intended to be detected are left and passed on for further analysis. In an embodiment, a matching circuit within each of the one or more filtering and matching modules 124 may be active/passive or fixed/tunable. Similarly, a filter circuit within each of the one or more filtering and matching modules 124 may be fixed/tunable.

[039] The sniffer device 100 may include a Radio Frequency (RF) switch 126 and a pre-amplifier 128 communicatively coupled to and controlled by the radio transceiver and microcontroller module 106. It will be apparent to a person skilled in the art that the sniffer device 100 may include more than one RF switch 126 and more than one pre-amplifier 128. In an embodiment, the sniffer device 100 may include one RF switch 126 and one pre-amplifier 128 per antenna in the plurality of antennas 102. This embodiment is depicted in FIG. 2.

[040] In the current embodiment, after the filtering and matching modules 124, the wireless signals may pass through the RF switch 126. The radio transceiver and microcontroller module 106 may enable the RF Switch 126 to operate each of the plurality of antennas 102 individually one after the other. Additionally, the radio transceiver and microcontroller module 106 may enable the RF switch 126 to operate each of the plurality of antennas 102 based on a predefined sequence, which may be configured and later modified by a user. The wireless signals that are received as an output from the RF switch 126 may need amplification before being passed on for further analysis to the radio transceiver and microcontroller module 106. To this end, the pre-amplifier 128 may amplify output of the RF switch 126. The pre-amplifier 128 may be a broadband or narrowband pre-amplifier.

[041] The sniffer device 100 may further include other circuits (not shown in FIG. 1) to perform various functions. A BALUN circuit (which is a Balanced to Unbalanced and vice-versa network circuit) may be provided to convert differential radio signals to single ended signals and vice versa. The sniffer device 100 may further include various sensors, such as Ultra-Wideband (UWB) beaming sensor (based on radar technology), optical sensors (infrared, passive Infrared, passive, and active Radio Frequency Identification (RFID), Complementary Metal Oxide Semiconductor (CMOS), Advanced Photo System type-C (APS-C), full-frame sensor), Light-Fidelity (Li-Fi) or Visual Light Communication (VLC), altimeter and gyro-meter (to detect height and angle of the sniffer device 100 to develop 3D radiation pattern).

[042] The signals that are received as an output from the one or more filtering and matching modules 124 pass through the radio transceiver and microcontroller module 106 and may be buffered before being used for further analysis. To this end, the sniffer device 100 may include a memory 110 communicatively coupled to the radio transceiver and microcontroller module 106. The memory 110 is configured to buffer each of the wireless signals received by the plurality of antennas 102 through the radio transceiver and microcontroller module 106. In one embodiment, each of the plurality of antennas 102, through the radio transceiver and microcontroller module 106 may be communicatively coupled to an individual memory unit, such that, each of the individual memory unit is configured to buffer the wireless signals received by a respective antenna from the plurality of antennas 102, through the radio transceiver and microcontroller module 106. The wireless signals buffered in the memory 110 may then be used by the radio transceiver and microcontroller module 106 for further analysis.

[043] The wireless signals, whether received directly from the plurality of access points or from the memory 110 after buffering, are analyzed by the radio transceiver and microcontroller module 106. Based on the analysis, the radio transceiver and microcontroller module 106 determines one or more performance parameters associated with each of the plurality of unique wireless technologies. Based on the one or more performance parameters and the predefined location determined for each of the plurality of unique wireless technologies, the radio transceiver and microcontroller module 106 may generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area. By way of an example, the predefined area may correspond to an office space area or a residential housing space area in which a wireless network is to be established. In an embodiment, the wireless signal plot may also include a signal interference plot for the plurality of unique wireless technologies.

[044] In order to generate the wireless signal plot relative to the predefined area, the sniffer device 100 may receive a layout map associated with the predefined area. Thus, the wireless signal plot may be generated relative to the layout map. The layout map may represent a floor plan of the predefined area, such as, an office space area and a residential housing space area. in which a wireless network involving the plurality of unique wireless technologies is to be established. By way of an example, the layout map may include a 2D image, a 3D image of floor plan, construction details like number of floors, concrete structures, pillars, wooden structures, glass structures, metal structures, false ceilings, fiber and polymer structures, power supply cabinet, electrical wiring details (for example, lighting or HVAC), ducts, existing radio devices, electricity generator, elevation above ground level, nearby radio towers, water bodies (for example, swimming pool), and outside and inside temperature.

[045] The layout map may be received by the sniffer device 100 in form of a digital map and the format may include, for example, PDF, JPG, or JPEG. In an embodiment, a physical map may be provided on a sheet of paper. In this case, the sniffer device 100 may scan the physical map to capture an image of the physical map. In another embodiment, multiple layout maps may be stored in the memory 110 and based on current location of the sniffer device 100, the sniffer device 100 may extract the relevant layout map from the memory 110.

[046] As the wireless signal plot is generated relative to the predefined area (for example, overlaid on the layout map of the predefined area), the wireless signal plot may be used to determine optimum locations for placing each of the plurality of access points within the predefined area. The optimum locations would be selected, such that, best connectivity is ensured to various computing devices accessing the plurality of access points.

[047] In an embodiment, the optimum placement location for each of the plurality of access points may be determined through simulation, performed via an interactive GUI of the computing device 108. By way of an example, the interactive GUI may allow a user to virtually add, modify, and delete an access point on a layout map of the predefined area. The GUI may also allow the user to virtually move an access point to an optimum location on the layout map, such that, computing devices connected to the access point are ensured good connectivity without interference. This is further explained in detail in conjunction with FIG. 5, FIG. 6, and FIG. 7.

[048] In an embodiment, to receive the wireless signals from the plurality of access points, the sniffer device 100 may be moved across the predefined area. The sniffer device 100 may be manually carried and moved within the predefined area. By way of an example, a user may carry the sniffer device 100 and walk through various sections of the predefined area (office space area or residential housing area). As the sniffer device 100 is moved across the predefined area, the plurality of antennas 102 may receive wireless signals from the plurality of access points associated with the plurality of unique wireless technologies. It may be noted that the plurality of access points may have a predefined location (fixed) within the predefined area.

[049] In another embodiment, the sniffer device 100 may automatically move within the predefined area. In an embodiment, a user may remotely control the sniffer device 100 through an interactive GUI or voice commands, via a smartphone, a laptop, or a tablet communicatively coupled with the sniffer device 100. To this end, the sniffer device 100 may include a mobility module 120 configured to automatically move the sniffer device 100 within the predefined area. The mobility module 120 may include a Global Positioning Sensor (GPS) sensor 122 configured to determine current location of the sniffer device 100 and to navigate the mobility module 120 for automatic movement of the sniffer device 100. The mobility module 120 may further use the layout map received by the sniffer device 100 to determine future navigation coordinates. It will be apparent to a person skilled in the art that the mobility module 120 may include any other type of navigation sensor. The sniffer device 100 may further include motor driven wheels (not shown in FIG. 1) for supporting the sniffer device 100 and enabling the movement of the sniffer device 100.

[050] The mobility module 120 may communicate with the motor-driven wheels and may cause the movement of the sniffer device 100 and navigate the sniffer device 100 across the predefined area. In an embodiment, the sniffer device 100 may be implemented as an Unmanned Air Vehicle (UAV), also known as a drone. In this case, the sniffer device 100 may include a propeller unit for lifting and propelling the sniffer device 100 in the air. The propeller unit may be communicatively coupled to the mobility module 120 which may cause the propeller unit to lift and move the sniffer device 100, and may further navigate the sniffer device 100 across the predefined area, based on the GPS sensor 122. This may enable the sniffer device 100 to generate a 3D wireless signal plot of the predefined area.

[051] Once the wireless signal plot has been generated, the radio transceiver and microcontroller module 106 may further be configured to create a report based on the wireless signal plot. The report may indicate relative performance of each of the plurality of unique wireless technologies in the predefined area. The report may include values of various performance parameters associated with each of the plurality of unique wireless technologies as determined by the radio transceiver and microcontroller module 106. By way of an example, the report may be indicative of the wireless signal strength associated with the plurality of wireless

technologies at various different locations in the predefined area. Additionally, the report may indicate the interference experienced by each of the plurality of unique wireless technologies in the predefined area. The report generated by the radio transceiver and microcontroller module 106 may be presented to a user in multiple formats. The user may select one of these multiple formats to view the report. By way of an example, the report may be in the form of a heat map overlaid over a layout map of the predefined area. The heat map may be used to indicate various performance parameters associated with a signal, for example, signal strength, interference, noise, or bandwidth.

[052] In order to present the report to the user, the sniffer device 100 may include a graphical representation module 118 coupled to the radio transceiver and microcontroller module 106, such that, the graphical representation module 118 is configured to render the report to a user. The graphical representation module 118, for example, may be a display module (for example, a Light Emitting Diode (LED) display, an Organic LED (OLED), or a Liquid Crystal Display (LCD)) or a printer module, which may be used to print the report directly from the sniffer device 100.

[053] In an embodiment, the sniffer device 100 may further interact with the computing device 108. In this case, the radio transceiver and microcontroller module 106 may only determine the one or more performance parameters based on the wireless signals received form the plurality of access points. The computing device 108 may thereafter generate the wireless signal plot and create the report for the wireless signal plot. The report may be displayed on a display screen of the computing device 108 or printed through a printer connected to the computing device 108.

[054] The sniffer device 100 may further include an indication module 112 configured to indicate a performance parameter associated with a unique wireless technology from the plurality of unique wireless technologies. The indication module 112 may further include one or more of a light source 114 and a buzzer 116. It will be apparent to a person skilled in the art that the indication module 112 may not be confined to a light source and a buzzer and may include any other type of indicator means. Light sources 114 may include a combination of a plurality of light sources, such as, Light Emitting Diode (LED) lights, which may provide an indication about strength of a wireless signal received by one or more of the plurality of antennas 102. By way of an example, multiple LED blinking patterns may be there, such that, one particular blinking pattern indicates a particular range or strength for a wireless signal. Similarly, the strength of the wireless signals received by the plurality of antennas 102 may be indicated by varying tones of the buzzer 116. In an embodiment, the light source 114 and/or the buzzer 116 may provide an indication about the power on and off status the sniffer device 100.

[055] The sniffer device 100 may need to be portable in order to freely move around in the predefined area. To this end, the sniffer device 100 may include a battery 130, which may be rechargeable or replaceable. The battery 130 may provide power to each component within the sniffer device 100. Alternatively, the sniffer device 100 may be directly connected to a power source by way of an adapter (not shown in FIG. 1). In this case, a long extension cord may be provided in order to facilitate the sniffer device 100 to move around within the predefined area.

[056] The operation of the sniffer device 100 may be controlled by a button 132, which may be a push button or a switch. The button 132 may further include multiple smaller buttons (not shown in FIG. 1). The button 132 may be configured to control at least one operation of the sniffer device 100, such as, switching on or switching off power of the sniffer device 100, signal

scanning rate of the sniffer device 100, and controlling signal reception sensitivity for one or more of the plurality of unique wireless technologies. By way of an example, the button 132 may be activated to turn on the sniffer device 100 and may be deactivated to turn off the sniffer device 100. When the button 132 is activated, the radio transceiver and microcontroller module 106 may get activated from sleep and initiate operating the plurality of antennas 102. The button 118 may thus facilitate in conserving the battery 130 by activating the radio transceiver and microcontroller module 106 only when required.

[057] Referring now to FIG. 2, a schematic diagram of a transceiver module 200 for analyzing a plurality of unique wireless technologies within a predefined area is illustrated, in accordance with another embodiment. The transceiver module 200 includes a plurality of antennas 202, i.e., antennas 202a to 202d. The plurality of antennas 202 are configured to receive wireless signals from a plurality of access points associated with the plurality of unique wireless technologies. Each of the plurality of antennas 202 and its associated circuitry corresponds to one of the plurality of unique wireless technologies. The plurality of antennas 202 may be received by a plurality of micro connectors 204, i.e., micro connectors 204a to 204d. This has already been explained in detail in conjunction with FIG. 1.

[058] The transceiver module 200 may be attached to a sniffer assembly, via a connecting interface (not show in FIG. 2). The connecting interface may further enable detachment of the transceiver module 200 from the sniffer assembly, without damaging either the transceiver module 200 or the sniffer assembly. Similarly, the sniffer assembly may also include a connecting interface that is configured to receive the transceiver module 200. The transceiver module 200 and the sniffer assembly may cooperate with each other in order to form a sniffer device. In other words, attaching the transceiver module 200 with the sniffer assembly may result in the sniffer device. The functionality of this sniffer device may be same as that of the sniffer device 100 of FIG. 1.

[059] In order to analyze the wireless signals, the transceiver module 200 may determine one or more frequencies, modulation of the wireless signals received by the plurality of antennas 202. The transceiver module 200 includes a plurality of filtering and matching modules 206 communicatively coupled to the plurality of antennas 202 to determine the one or more frequencies of the wireless signals. The plurality of filtering and matching modules 206 include filtering and matching modules 206a to 206d. This has already been explained in detail in conjunction with FIG. 1. The transceiver module 200 may further include an RF switch 212a, an RF switch 212b, an RF switch 212c, and an RF switch 212d, collectively referred to as a plurality of RF switches 212. As is apparent from FIG. 2, each of the plurality of RF switches 212 may be communicatively coupled to one of the plurality of filtering and matching modules 206. Functionality of each of the plurality of RF switches 212 is same as that of the RF switch 126 described in FIG. 1. It will be apparent to a person skilled in the art that the transceiver module 200 may include more than or less than four RF switches. Once such implementation is depicted in FIG. 1.

[060] The transceiver module 200 may also include a pre-amplifier 214a, a pre-amplifier 214b, a pre-amplifier 214c, and a pre-amplifier 214d, collectively referred to as a plurality of pre-amplifiers 214. As is apparent from FIG. 2, each of the plurality of pre-amplifiers 214 may be communicatively coupled to one of the plurality of RF switches 212. The functionality of each of the plurality of pre-amplifiers 214 is same as that of the pre-amplifier 128 described in FIG. 1. It

will be apparent to a person skilled in the art that the transceiver module 200 may include more than or less than four pre-amplifiers. Once such implementation is depicted in FIG. 1.

[061] The transceiver module 200 further includes a radio transceiver and microcontroller module 208a, a radio transceiver and microcontroller module 208b, a radio transceiver and microcontroller module 208c, and a radio transceiver and microcontroller module 208d, collectively referred to as a plurality of radio transceiver and microcontroller modules 208. As is apparent from FIG. 2, each of the plurality of radio transceiver and microcontroller modules 208 is communicatively coupled to one of the plurality of antennas 202, one of the plurality of filtering and matching modules 206, one of the plurality of RF switches 212, and one of the plurality of pre-amplifiers 214. The functionality of each of the plurality of radio transceiver and microcontroller modules 208 is same as that of the radio transceiver and microcontroller module 106 described in FIG. 1. In an embodiment, a master microcontroller 210 in transceiver module 200 may control and coordinate functioning of the plurality of radio transceiver and microcontroller modules 208.

[062] Each of the plurality of radio transceiver and microcontroller modules 208 may be configured to determine one or more performance parameters associated with each of the plurality of unique wireless technologies, based on the wireless signals. This has already been explained in detail in conjunction with FIG. 1.

[063] The one or more performance parameter determined by the plurality of radio transceiver and microcontroller modules 208 may then be used to generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area. The one or more performance parameters determined by the plurality of radio transceiver and microcontroller modules 208 may be further analyzed by the sniffer assembly, when the transceiver module 200 is attached with the sniffer assembly and results into a sniffer device. The sniffer device may then generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area, based on the location of the plurality of access points and the one or more performance parameters determined for each of the plurality of unique wireless technologies. This has been explained in detail in conjunction with FIG. 1.

[064] Referring now to FIG. 3, a flowchart of a method 300 for analyzing a plurality of unique wireless technologies within a predefined area is illustrated, in accordance with an embodiment. The plurality of wireless technologies may include, but not limited to Wi-Fi, Worldwide Interoperability for Microwave Access (WiMAX), Long-Term Evolution (LTE), 5G, Wireless Personal Area Network (WPAN), Zigbee, Bluetooth, Near Field Communication (NFC), Industrial, Scientific and Medical (ISM) radio bands (for example, Sub-GHz and GHz ISM band), wireless local area network (WLAN), Wireless Highway Addressable Remote Transducer Protocol (wiHART), Global Positioning System (GPS), Long range, low power wireless platform (LoRa®, Ultra Wideband, radio frequency identification (RFID), Enocean, Wireless Regional Area Network (WRAN), Digital Enhanced Cordless Telecommunication (DECT), TransferJet, Wireless Home Digital Interface (WHDI), Wireless Meter Bus (WMBus) and IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN).

[065] At step 302, the sniffer device 100 determines one or more performance parameters associated with each of the plurality of unique wireless technologies. The sniffer device 100 determines one or more performance parameters based on wireless signals received from a

plurality of access points associated with the plurality of unique wireless technologies. Each of the plurality of access points may have a predefined location within the predefined area.

[066] The parameters associated with a unique wireless technology may include, but not limited to power of the wireless signal received from an associated access point, strength of the wireless signal, bandwidth associated with the wireless signal, noise in the wireless signal, and interference experienced on the wireless signal. By way of an example, the parameters associated with the unique wireless technologies may include, but are not limited to transmission power, reception sensitivity, Link Quality Indicator (LQI), default channel, range, radiation type, beam width (angular measurement), repeater/router functionality, antenna type, antenna gain, Received Signal Strength Indicator (RSSI), Signal-to-Noise Ratio (SNR), Received Channel Power Indicator (RCPI), Signal-to-Interference-plus-Noise Ratio (SINR). The one or more performance parameters may be continuously determined, as the sniffer device 100 moves across the predefined area covering different locations in the predefined area.

[067] Based on the predefined location and the one or more performance parameters determined for each of the plurality of unique wireless technologies, the sniffer device 100, at step 304, may generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area. The wireless signal plot may be indicative of the relative performance of each of the plurality of unique wireless technologies in the predefined area. The wireless signal plot has already been explained in detail in conjunction with FIG. 1. The method steps for analyzing a plurality of unique wireless technologies are further explained in detail in conjunction with FIG. 4.

[068] Referring now to FIG. 4, a flowchart of a method 400 for analyzing a plurality of unique wireless technologies within a predefined area is illustrated, in accordance with another embodiment. At step 402, the sniffer device 100 may receive a layout map associated with a predefined area. The layout map may represent a floor plan of the predefined area, such as, an office space area and a residential housing space area, in which a wireless network is to be established. By way of an example, the layout map may include a 2D image, a 3D image of floor plan, construction details like number of floors, concrete structures, pillars, wooden structures, glass structures, metal structures, false ceilings, fiber and polymer structures, power supply cabinet and details about electrical wiring details (for example, lighting or HVAC), ducts, existing radio devices, electricity generator, elevation above ground level, nearby radio towers, water bodies (for example, swimming pool), and outside and Inside temperature. This has already been explained in detail in conjunction with FIG. 1

[069] At step 404, the sniffer device 100 may receive navigation instructions for aiding the navigation of the sniffer device 100 within the predefined area. By way of an example, the navigation instructions may be received by the GPS sensor 122. Based on the layout map and the navigation instructions, the sniffer device 100, at step 406, may be caused to automatically move within the predefined area in order to receive wireless signals from a plurality of access points associated with the plurality of unique wireless technologies. This has been explained in detail in conjunction with FIG. 1. At step 408, the sniffer device 100 may receive wireless signals from the plurality of access points. At step 410, the sniffer device 100 may buffer each of the wireless signals received from the plurality of access points. The wireless signals may be buffered in the memory 110 of the sniffer device 100, by the radio transceiver and the microcontroller module 106. At step 412, the sniffer device 100 may determine one or more frequencies and modulation of the wireless signals. In order to determine the one or more frequencies of the wireless signals,

the sniffer device 100 may employ one or more filtering and matching modules 124. This has been explained in detail in conjunction with FIG. 1.

[070] At step 414, the sniffer device 100 may determine one or more performance parameters associated with each of the plurality of unique wireless technologies. The one or more performance parameters may be determined based on the wireless signals. The performance parameters may be continuously determined as the sniffer device 100 is moved across the predefined area through different locations. This has been explained in detail in conjunction with FIG. 1 an FIG. 2.

[071] Based on the predefined location of the plurality of the access points and the at least one performance parameter determined for each of the plurality of unique wireless technologies, at step 416, a wireless signal plot may be generated for the plurality of unique wireless technologies relative to the predefined area. The wireless signal plot may also include a signal interference plot for the plurality of unique wireless technologies. In order to generate the wireless signal plot, the one or more performance parameters may be correlated with the layout map of the predefined area at step 416a. This has been explained in detail in conjunction with FIG. 1.

[072] At step 418, a report is created based on the wireless signal plot. The report may indicate relative performance of each of the plurality of unique wireless technologies within the predefined area. By way of an example, the report may provide information about the wireless signal strength, area wise signal strength density, frequencies of the signals, channels, interference of signals, signal bandwidth, signal noise, active/inactive status of the devices, wireless product (for example, MAC address, Identification Number, IP address), and position of the devices. The position of the devices may include the existing position and ideal suggested position for the devices.

[073] By way of an example, the report may be in form of a heat map, such that, a variation of colors with respect to the regions in the predefined area indicates variations in the relative strength of the wireless signals receivable from the plurality of access points at that region. For example, a region where the strength of wireless signals receivable is relatively high, is represented in yellow color, while a region where the strength of wireless signals receivable is relatively low high is represented in red color. The report may further be presented to the user in the form of a text output, graphs and charts (for example, bar graph, line graph, dotted graph, 2D surface, 3D surface, pie chart, or bubble), a graphical representation of the plot depicting the floor plan and the devices, and combination the above.

[074] Referring now to FIG. 5, a flowchart of a method 500 for placing a plurality of access points associated with a plurality of unique wireless technologies within a predefined area is illustrated, in accordance with an embodiment. The plurality of access points is to be placed within the predefined area to establish a wireless network. By way of an example, the predefined area may be an office space area or a residential housing space area in which the wireless network is required to be established by using the plurality of access points.

[075] At step 502, a layout map associated with the predefined area is received. The layout map may be received by a computing device (for example, the computing device 108). The layout map may be a graphical representation of the predefined area, and may include a 2D image, a 3D image of floor plan, construction details like number of floors, concrete structures, pillars, wooden structures, glass structures, metal structures, false ceilings, fiber and polymer structures, power supply cabinet and details about electrical wiring details (for example, lighting or,

HVAC), ducts, existing radio devices, electricity generator, elevation above ground level, nearby radio towers, water bodies (for example, swimming pool), and outside and Inside temperature. The layout map may be received in the form of a digital map (for example, in PDF, JPG, or JPEG). Alternatively, the layout map may be received as a physical map on a sheet of paper, which may be scanned by a built-in camera of the computing device, to convert the physical map into a digital layout map.

[076] The layout map may then be uploaded on an interactive GUI of the computing device and each of the plurality of access points may be virtually placed at a predefined location on the layout map, through the interactive GUI. Based on simulated wireless signals received from the plurality of access points placed at virtual locations, at step 504, one or more performance parameter associated with each of the plurality of unique wireless technologies are iteratively simulated. Based on the iterative simulation and the layout map, an optimum location for each of the plurality of access points is determined within the predefined area at step 506. In other words, the optimum virtual location is determined for placing each of the plurality of access points on the layout map. Thereafter, these optimum virtual locations are implemented to place each of the plurality of access points at real locations within the predefined area. This is further explained in detail in conjunction with FIG. 6 and FIG. 7.

[077] Referring now to FIG. 6, a flowchart of a method 600 for iteratively simulating virtual locations of a plurality of access points on a layout map to determine optimum location for the plurality of access points within a predefined area is illustrated, in accordance with an embodiment. The plurality of access points is associated with a plurality of unique wireless technologies within the predefined area and the layout map is associated with the predefined area. The layout map has been explained in detail in conjunction with FIG. 1, FIG. 4, and FIG. 5.

[078] At step 602, the layout map is received through an interactive GUI on a display of a computing device. The interactive GUI may be presented in a 2D or 3D format. The layout map may be stored in a memory of the computing device. Alternatively, the layout map may be received from an external device or through the Internet. Thereafter, the layout map is displayed through the interactive GUI at step 604. At step 606, through the interactive GUI, a user may place each of the plurality of access points at virtual location within the layout map. As the layout map is a virtual representation of the actual layout of the predefined area, a virtual location on the layout map corresponds to an actual location within the predefined area. The user may place an access point at a virtual location by using commands on the interactive GUI, for example, “Insert a new access Point.” The user may also get an option to select various attributes associated with the access point. By way of an example, the user may be able to select a unique wireless technology to be associated with the access point and a type of antenna (omnidirectional, unidirectional, or bidirectional, for example) to be used by the access point. The user may be able to select the make and model of the access point, based on which associated radio parameters may be pulled out from remote servers or a local database in the computing device. The radio parameters may include but are not limited to Unique Identification Number (UIN), Media Access Control (MAC) ID, operating country, default radio frequency, available channels, range at line of sight, or default data rate. The attributes selected by the user may be actual attributes of an access device to be placed at the access point. This is further explained in detail in conjunction with FIG. 7.

[079] Once each the plurality of access points is placed on the associated virtual location on the layout map, the interactive GUI simulates, at step 608, performance parameters for each of the

plurality of access points based on associated virtual location and attributes assigned by the user. The performance parameters for an access point are determined based on simulated wireless signals of the access point received from the virtual location of the access point.

[080] At step 610, a check is performed to determine whether simulated performance parameters for each of the plurality of access points satisfy predefined performance criteria. The predefined performance criteria may include minimum interference experienced by the simulated wireless signals of the plurality of access points. It would be apparent to a person skilled in the art that interference may occur when wireless signals transmitted from two or more access points may overlap due to close proximity of the two or more access points. In an embodiment, to depict interference, a pattern of simulated wireless signals received from two or more access points may be represented on the interactive GUI, such that, interfering wireless signals are depicted as overlapping, while non-interfering wireless signal are depicted as non-overlapping.

[081] Referring back to step 610, when simulated performance parameters for one or more access points from the plurality of access points do not satisfy the predefined performance criteria, a user at step 612, through the interactive GUI, may modify virtual locations of the one or more access points on the layout map. In an embodiment, in order to modify the current virtual location of the access point, the user may select the access point in the current virtual location, via the interactive GUI, and may drag and drop it to a subsequent virtual location on the layout map. In another embodiment, the user may provide new coordinates through the interactive GUI to move the access point from the current virtual location to the subsequent virtual location. In yet another embodiment, the user may rotate the access point within the interactive GUI to change the radiation angle of an antenna. It will be apparent to a person skilled in the art that any other means for modifying the virtual location on the layout map may be incorporated. Thereafter, the control goes back to step 608.

[082] Referring back to step 610, when simulated performance parameters for each of the plurality of access points satisfy the predefined performance criteria, at step 614, the current virtual locations for each of the plurality of access points on the layout map are established as optimum locations. Thereafter, based on associated current virtual locations on the layout map for the plurality of access points, each of the plurality of access points are affixed at real locations within the predefined area. As discussed before, the real locations correspond to current virtual locations of associated access points on the layout map. The interactive GUI depicting simulation of virtual locations for a plurality of access points on a layout map is further explained in conjunction with an exemplary embodiment given in FIG. 7.

[083] The simulation-based placement of the plurality of access points within a predefined area considerably reduces the cost and time required to set up a wireless network that involves multiple unique wireless technologies. The plurality of access points affixed based on the simulation, results in a wireless network that has optimal performance parameters for each unique wireless technology. Moreover, a network planner does not need to iteratively affix multiple access point and then later modify location of the access points for better performance of the wireless network. Repeatedly relocating the access points leads to increased costs and customer dissatisfaction. This problem is address by simulation based placement of the plurality of access points.

[084] Referring now to FIG. 7, an interactive GUI 700 depicting simulation of virtual locations for a plurality of access points 702 on a layout map 704 associated with an office floor is

illustrated, in accordance with an exemplary embodiment. The interactive GUI 700 may display the layout map 704 through a display of a computing device. The computing device, for example, may be a smartphone, a laptop, a desktop, or a tablet. A user may interact with the interactive GUI 700 in order to simulate virtual locations for the plurality of access points. These virtual locations are then used to determine actual locations for the plurality of access points in the office floor. The office floor may include multiple cabins and rooms separated by walls. The walls are depicted using lines in the layout map 702 and enclosures between these lines depict the cabins and rooms of the office floor.

[085] To start with, as depicted in FIG. 7, an access point 702a, an access point 702b, an access point 702c, and an access point 702d, collectively referred to as the plurality of access points 702, are placed at four respective virtual locations on the layout map 704, through the interactive GUI 700. Each of the access points 704a to 704b have omnidirectional transmitters and thus transmit wireless signals in all the directions based on an associated transmitting radius. The wireless signals for each of the access points 702a to 702d are simulated as concentric circles around a respective access point.

[086] To determine whether performance parameters for the plurality of access points 702 satisfy the predefined performance criteria of no or minimum interference, the interactive GUI 700 may depict whether simulated wireless signal associated with each of the plurality of access points 702 overlap with simulated wireless signal associated with one or more other access points from the plurality of access points 702. An overlap of concentric circles associated with two access points may indicate that signals of those access points are interfering. Thus, it will be apparent from the FIG. 7 that simulated wireless signal of the access point 702a and the access point 702c interfere. This interference is depicted by 706. Similarly, the interference between simulated wireless signal associated with the access point 702b and the access point 702d is depicted by 708.

[087] Based on the above depiction on the interactive GUI 700, it will be apparent to a user that one of the access points 702a and 702c needs to be moved farther in order to avoid the interference and provide greater coverage area on the layout map 704. Similarly, one of the access points 702a and 702c may need to be moved farther to avoid interference. The interactive GUI 700 may enable the user to modify a virtual location of an access point by dragging and dropping the access point to a new location on the layout map 704. The interactive GUI 700 may also enable the user to add new access points on the layout map 704 and delete existing access points from the layout map 704.

[088] FIG. 8 is a block diagram of an exemplary computer system for implementing various embodiments. Computer system 802 may include a central processing unit ("CPU" or "processor") 804. Processor 804 may include at least one data processor for executing program components for executing user- or system-generated requests. A user may include a person, a person using a device such as such as those included in this disclosure, or such a device itself. Processor 804 may include specialized processing units such as integrated system (bus) controllers, memory management control units, floating point units, graphics processing units, digital signal processing units, etc. Processor 804 may include a microprocessor, such as AMD® ATHLON® microprocessor, DURON® microprocessor OR OPTERON® microprocessor, ARM's application, embedded or secure processors, IBM® POWERPC®, INTEL'S CORE® processor, ITANIUM® processor, XEON® processor, CELERON® processor or other line of processors, etc. Processor 804 may be implemented using mainframe, distributed processor,

multi-core, parallel, grid, or other architectures. Some embodiments may utilize embedded technologies like application-specific integrated circuits (ASICs), digital signal processors (DSPs), Field Programmable Gate Arrays (FPGAs), etc.

[089] Processor 804 may be disposed in communication with one or more input/output (I/O) devices via an I/O interface 806. I/O interface 806 may employ communication protocols/methods such as, without limitation, audio, analog, digital, monoaural, RCA, stereo, IEEE-1394, serial bus, universal serial bus (USB), infrared, PS/2, BNC, coaxial, component, composite, digital visual interface (DVI), high-definition multimedia interface (HDMI), RF antennas, S-Video, VGA, IEEE 802.n /b/g/n/x, Bluetooth, cellular (e.g., code-division multiple access (CDMA), high-speed packet access (HSPA+), global system for mobile communications (GSM), long-term evolution (LTE), WiMax, or the like), etc.

[090] Using I/O interface 806, computer system 802 may communicate with one or more I/O devices. For example, an input device 808 may be an antenna, keyboard, mouse, joystick, (infrared) remote control, camera, card reader, fax machine, dongle, biometric reader, microphone, touch screen, touchpad, trackball, sensor (e.g., accelerometer, light sensor, GPS, gyroscope, proximity sensor, or the like), stylus, scanner, storage device, transceiver, video device/source, visors, etc. An output device 810 may be a printer, fax machine, video display (e.g., cathode ray tube (CRT), liquid crystal display (LCD), light-emitting diode (LED), plasma, or the like), audio speaker, etc. In some embodiments, a transceiver 812 may be disposed in connection with processor 804. Transceiver 812 may facilitate various types of wireless transmission or reception. For example, transceiver 812 may include an antenna operatively connected to a transceiver chip (e.g., TEXAS® INSTRUMENTS WILINK WL1283® transceiver, BROADCOM® BCM4550IUB8® transceiver, INFINEON TECHNOLOGIES® X-GOLD 618-PMB9800® transceiver, or the like), providing IEEE 802.11a/b/g/n, Bluetooth, FM, global positioning system (GPS), 2G/3G HSDPA/HSUPA communications, etc.

[091] In some embodiments, processor 804 may be disposed in communication with a communication network 814 via a network interface 816. Network interface 816 may communicate with communication network 814. Network interface 816 may employ connection protocols including, without limitation, direct connect, Ethernet (e.g., twisted pair 50/500/5000 Base T), transmission control protocol/internet protocol (TCP/IP), token ring, IEEE 802.11a/b/g/n/x, etc. Communication network 814 may include, without limitation, a direct interconnection, local area network (LAN), wide area network (WAN), wireless network (e.g., using Wireless Application Protocol), the Internet, etc. Using network interface 816 and communication network 814, computer system 802 may communicate with devices 818, 820, and 822. These devices may include, without limitation, personal computer(s), server(s), fax machines, printers, scanners, various mobile devices such as cellular telephones, smartphones (e.g., APPLE® IPHONE® smartphone, BLACKBERRY® smartphone, ANDROID® based phones, etc.), tablet computers, eBook readers (AMAZON® KINDLE® ereader, NOOK® tablet computer, etc.), laptop computers, notebooks, gaming consoles (MICROSOFT® XBOX® gaming console, NINTENDO® DS® gaming console, SONY® PLAYSTATION® gaming console, etc.), or the like. In some embodiments, computer system 802 may itself embody one or more of these devices.

[092] In some embodiments, processor 804 may be disposed in communication with one or more memory devices (e.g., RAM 826, ROM 828, etc.) via a storage interface 824. Storage interface 824 may connect to memory 830 including, without limitation, memory drives,

removable disc drives, etc., employing connection protocols such as serial advanced technology attachment (SATA), integrated drive electronics (IDE), IEEE-1394, universal serial bus (USB), fiber channel, small computer systems interface (SCSI), etc. The memory drives may further include a drum, magnetic disc drive, magneto-optical drive, optical drive, redundant array of independent discs (RAID), solid-state memory devices, solid-state drives, etc.

[093] Memory 830 may store a collection of program or database components, including, without limitation, an operating system 832, user interface application 834, web browser 836, mail server 838, mail client 840, user/application data 842 (e.g., any data variables or data records discussed in this disclosure), etc. Operating system 832 may facilitate resource management and operation of computer system 802. Examples of operating systems 832 include, without limitation, APPLE® MACINTOSH® OS X platform, UNIX platform, Unix-like system distributions (e.g., Berkeley Software Distribution (BSD), FreeBSD, NetBSD, OpenBSD, etc.), LINUX distributions (e.g., RED HAT®, UBUNTU®, KUBUNTU®, etc.), IBM® OS/2 platform, MICROSOFT® WINDOWS® platform (XP, Vista/7/8, etc.), APPLE® IOS® platform, GOOGLE® ANDROID® platform, BLACKBERRY® OS platform, or the like. User interface 834 may facilitate display, execution, interaction, manipulation, or operation of program components through textual or graphical facilities. For example, user interfaces may provide computer interaction interface elements on a display system operatively connected to computer system 802, such as cursors, icons, check boxes, menus, scrollers, windows, widgets, etc. Graphical user interfaces (GUIs) may be employed, including, without limitation, APPLE® Macintosh® operating systems' AQUA® platform, IBM® OS/2® platform, MICROSOFT® WINDOWS® platform (e.g., AERO® platform, METRO® platform, etc.), UNIX X-WINDOWS, web interface libraries (e.g., ACTIVEX® platform, JAVA® programming language, JAVASCRIPT® programming language, AJAX® programming language, HTML, ADOBE® FLASH® platform, etc.), or the like.

[094] In some embodiments, computer system 802 may implement a web browser 836 stored program component. Web browser 836 may be a hypertext viewing application, such as MICROSOFT® INTERNET EXPLORER® web browser, GOOGLE® CHROME® web browser, MOZILLA® FIREFOX® web browser, APPLE® SAFARI® web browser, etc. Secure web browsing may be provided using HTTPS (secure hypertext transport protocol), secure sockets layer (SSL), Transport Layer Security (TLS), etc. Web browsers may utilize facilities such as AJAX, DHTML, ADOBE® FLASH® platform, JAVASCRIPT® programming language, JAVA® programming language, application programming interfaces (APis), etc. In some embodiments, computer system 802 may implement a mail server 838 stored program component. Mail server 838 may be an Internet mail server such as MICROSOFT® EXCHANGE® mail server, or the like. Mail server 838 may utilize facilities such as ASP, ActiveX, ANSI C++/C#, MICROSOFT .NET® programming language, CGI scripts, JAVA® programming language, JAVASCRIPT® programming language, PERL® programming language, PHP® programming language, PYTHON® programming language, WebObjects, etc. Mail server 838 may utilize communication protocols such as internet message access protocol (IMAP), messaging application programming interface (MAPI), Microsoft Exchange, post office protocol (POP), simple mail transfer protocol (SMTP), or the like. In some embodiments, computer system 802 may implement a mail client 840 stored program component. Mail client 840 may be a mail viewing application, such as APPLE MAIL® mail client, MICROSOFT ENTOURAGE® mail client, MICROSOFT OUTLOOK® mail client, MOZILLA THUNDERBIRD® mail client, etc.

[095] In some embodiments, computer system 802 may store user/application data 842, such as the data, variables, records, etc. as described in this disclosure. Such databases may be implemented as fault-tolerant, relational, scalable, secure databases such as ORACLE® database OR SYBASE® database. Alternatively, such databases may be implemented using standardized data structures, such as an array, hash, linked list, struct, structured text file (e.g., XML), table, or as object-oriented databases (e.g., using OBJECTSTORE® object database, POET® object database, ZOPE® object database, etc.). Such databases may be consolidated or distributed, sometimes among the various computer systems discussed above in this disclosure. It is to be understood that the structure and operation of the any computer or database component may be combined, consolidated, or distributed in any working combination.

[096] It will be appreciated that, for clarity purposes, the above description has described embodiments of the invention with reference to different functional units and processors. However, it will be apparent that any suitable distribution of functionality between different functional units, processors or domains may be used without detracting from the invention. For example, functionality illustrated to be performed by separate processors or controllers may be performed by the same processor or controller. Hence, references to specific functional units are only to be seen as references to suitable means for providing the described functionality, rather than indicative of a strict logical or physical structure or organization.

[097] Various embodiments of the invention provide method and device for analyzing multiple unique wireless technologies in an area. The plurality of unique wireless technologies are analyzed for placing a plurality of access points associated with the unique wireless technologies within the area. A sniffer device, as per one of the embodiments, provides a compact and low cost solution for analyzing a plurality of unique wireless technologies within a predefined area. As a single sniffer device is capable of analyzing multiple unique wireless technologies, therefore, need for using multiple devices each compatible with one type of wireless technology is eliminated. As a result, cost and time for analyzing multiple unique wireless technologies is reduced. Further, the sniffer device allows for performing iterative simulation of at least one performance parameter associated with each of the plurality of unique wireless technologies to thereby determine an optimum location for each of the plurality of access points within the predefined area. As a result, distribution of a plurality of wireless access points can be better planned, such that, interference between two or more wireless signals is eliminated or reduced to minimum. Hence, efficient wireless network environment may be achieved.

[098] The specification has described method and device for analyzing multiple unique wireless technologies in an area. The illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

[099] Furthermore, one or more computer-readable storage media may be utilized in implementing embodiments consistent with the present disclosure. A computer-readable storage

medium refers to any type of physical memory on which information or data readable by a processor may be stored. Thus, a computer-readable storage medium may store instructions for execution by one or more processors, including instructions for causing the processor(s) to perform steps or stages consistent with the embodiments described herein. The term "computer-readable medium" should be understood to include tangible items and exclude carrier waves and transient signals, i.e., be non-transitory. Examples include random access memory (RAM), read-only memory (ROM), volatile memory, nonvolatile memory, hard drives, CD ROMs, DVDs, flash drives, disks, and any other known physical storage media.

[0100] The illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

[0101] It is intended that the disclosure and examples be considered as exemplary only, with a true scope and spirit of disclosed embodiments being indicated by the following claims.

We claim:

1. A method (300) for analyzing a plurality of unique wireless technologies within a predefined area, the method comprising:

determining (302), by a sniffer device (100), at least one performance parameter associated with each of the plurality of unique wireless technologies, based on wireless signals received from a plurality of access points associated with the plurality of unique wireless technologies, wherein each of the plurality of access points has a predefined location within the predefined area; and

generating (302) a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area, based on the predefined location and the at least one performance parameter determined for each of the plurality of unique wireless technologies.

2. The method (300) as claimed in claim 1, wherein the plurality of wireless technologies comprise Wireless Fidelity (Wi-Fi), Worldwide Interoperability for Microwave Access (WiMAX), Long-Term Evolution (LTE), 5G, Wireless Personal Area Network (WPAN), Zigbee, Bluetooth, Near Field Communication (NFC), Industrial, Scientific and Medical (ISM) radio bands, Wireless Local Area network (WLAN), Wireless Highway Addressable Remote Transducer Protocol (wiHART), Global Positioning System (GPS), Long range, low power wireless platform (LoRa®), Ultra-WideBand, radio frequency identification (RFID), Enocean, Wireless Regional Area Network (WRAN), Digital Enhanced Cordless Telecommunication (DECT), TransferJet, Wireless Home Digital Interface (WHDI), Wireless Meter Bus (WMBus) and IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN).

3. The method (300) as claimed in claim 1, wherein the at least one parameter associated with a unique wireless technology from the plurality of unique wireless technologies comprises at least one of power of a wireless signal received from an associated access point, strength of the wireless signal, bandwidth associated with the wireless signal, noise in the wireless signal, and interference experienced on the wireless signal.

4. The method (300) as claimed in claim 1, further comprising demodulating and buffering each of the wireless signals received from the plurality of access points before determining the at least one performance parameter.

5. The method (300) as claimed in claim 1, further comprising creating a report based on the wireless signal plot, wherein the report indicates relative performance of each of the plurality of unique wireless technologies in the predefined area.

6. The method (300) as claimed in claim 1, further comprising receiving a layout map associated with the predefined area.

7. The method (300) as claimed in claim 6, wherein generating the wireless signal and interference plot comprises correlating the at least one performance parameter determined for each of the plurality of unique wireless technologies with the layout map of the predefined area.

8. The method (300) as claimed in claim 6, further comprising:

receiving navigation instructions from a GPS sensor (122); and

based on the navigation instructions, causing the sniffer device (100) to automatically move within the predefined area based on the layout map, to receive the wireless signals from the plurality of access points.

9. The method (300) as claimed in claim 1, further comprising receiving the wireless signals from the plurality of access points associated with the plurality of unique technologies.

10. A sniffer device (100) for analyzing a plurality of unique wireless technologies within a predefined area, the sniffer device (100) comprising:

a plurality of antennas (102) configured to receive wireless signals from a plurality of access points associated with the plurality of unique wireless technologies, wherein each of the plurality of access points has a predefined location within the predefined area, and wherein each of the plurality of antennas (102) corresponds to one of the plurality of unique wireless technologies; and

at least one radio transceiver and microcontroller module (106) communicatively coupled to the plurality of antennas (102), wherein the at least one radio transceiver and microcontroller module (106) is configured to:

determine at least one performance parameter associated with each of the plurality of unique wireless technologies, based on the wireless signals received from the plurality of access points; and

generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area, based on at least one performance parameter determined for each of the plurality of unique wireless technologies.

11. The sniffer device (100) as claimed in claim 10, wherein the at least one parameter associated with a unique wireless technology from the plurality of unique wireless technologies comprises at least one of power of a wireless signal received from an associated access point, strength of the wireless signal, bandwidth associated with the wireless signal, noise in the wireless signal, Link Quality Indicator (LQI), and interference experienced on the wireless signal.

12. The sniffer device (100) as claimed in claim 10, further comprising a memory (110) communicatively coupled to the at least one radio transceiver and microcontroller module (106), wherein the memory (110) is configured to buffer each of the wireless signals received by the plurality of antennas (102) through the at least one radio transceiver and microcontroller module

(106), wherein the at least one radio transceiver and microcontroller module (106) uses the buffered wireless signals to determine the at least one performance parameter.

13. The sniffer device (100) as claimed in claim 10, wherein the at least one radio transceiver and microcontroller module (106) is further configured to create a report based on the wireless signal plot, wherein the report indicates relative performance of each of the plurality of unique wireless technologies in the predefined area.

14. The sniffer device (100) as claimed in claim 13, further comprising a graphical representation module (118) configured to render the report to a user.

15. The sniffer device (100) as claimed in claim 10, further comprising at least one indication module (112) configured to indicate a performance parameter associated with a unique wireless technology from the plurality of unique wireless technologies, wherein the at least one indication module (112) further comprises at least one of a light source (114) and a buzzer (116).

16. The sniffer device (100) as claimed in claim 10, further comprising at least one button (132) configured to control at least one operation of the sniffer device (100), wherein the at least one operation of the sniffer device (100) comprises at least one of switching on and off power of the sniffer device (100), signal scanning rate of the sniffer device (100), and controlling signal reception sensitivity for at least one of the plurality of unique wireless technologies.

17. The sniffer device (100) as claimed in claim 10, further comprising a mobility module (120) configured to automatically move the sniffer device within the predefined area.

18. The sniffer device (100) as claimed in claim 17, further comprising a GPS sensor (122) configured to navigate the mobility module (120) for automatic movement of the sniffer device (100) within the predefined area.

19. A transceiver module (200) for analyzing a plurality of unique wireless technologies within a predefined area, the transceiver comprising:

a plurality of antennas (202) configured to receive wireless signals from a plurality of access points associated with the plurality of unique wireless technologies, wherein each of the plurality of access points has a predefined location within the predefined area, and wherein each of the plurality of antennas (202) corresponds to one of the plurality of unique wireless technologies; and

at least one radio transceiver and microcontroller module (208) communicatively coupled to the plurality of antennas, wherein the at least one radio transceiver and microcontroller module (208) is configured to determine at least one performance parameter associated with each of the plurality of unique wireless technologies, based on the wireless signals received from the plurality of access points, and wherein at least one performance parameter is used to generate a wireless signal plot for the plurality of unique wireless technologies relative to the predefined area.

20. A non-transitory computer-readable storage medium having stored thereon, a set of computer-executable instructions causing a computer comprising one or more processors to perform steps comprising:

receiving a layout map associated with the predefined area;

iteratively simulating at least one performance parameter associated with each of the plurality of unique wireless technologies, based on simulated wireless signals received from the plurality of access points, wherein each of the plurality of access points is virtually placed at a predefined location within the predefined area based on the layout map; and

determining an optimum location for each of the plurality of access points within the predefined area based on the iterative simulations and the layout map.

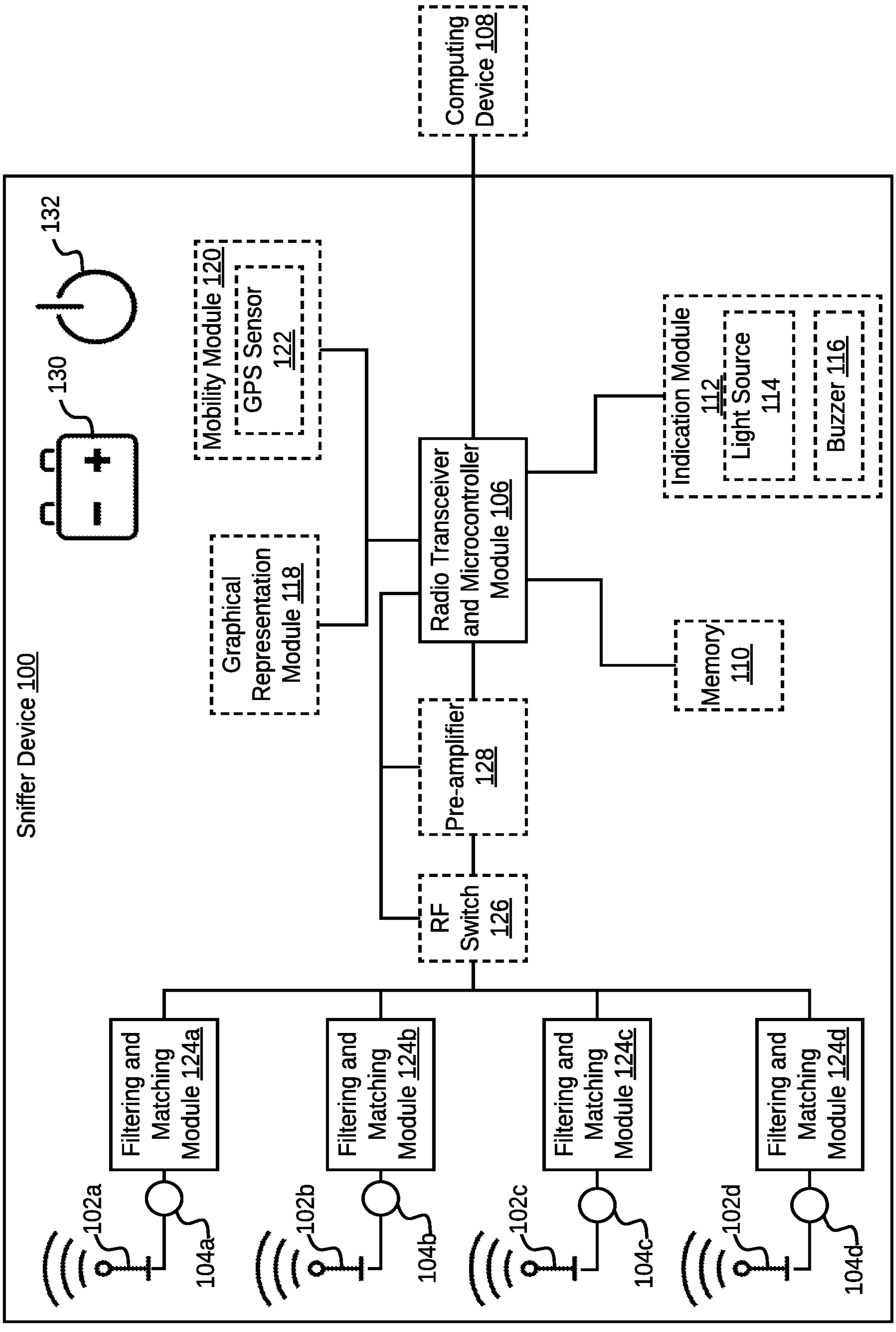
Computing Device 108
Sniffer Device 100
132
130
Mobility Module 120
GPS Sensor 122
Graphical Representation Module 118
Radio Transceiver and Microcontroller Module 106
Indication Module 112
Light Source 114
Buzzer 116
Memory 110
Pre-amplifier 128
RF Switch 126
Filtering and Matching Module 124a
Filtering and Matching Module 124b
Filtering and Matching Module 124c
Filtering and Matching Module 124d
102a
102b
102c
102d
104a
104b
104c
104d

FIG. 1

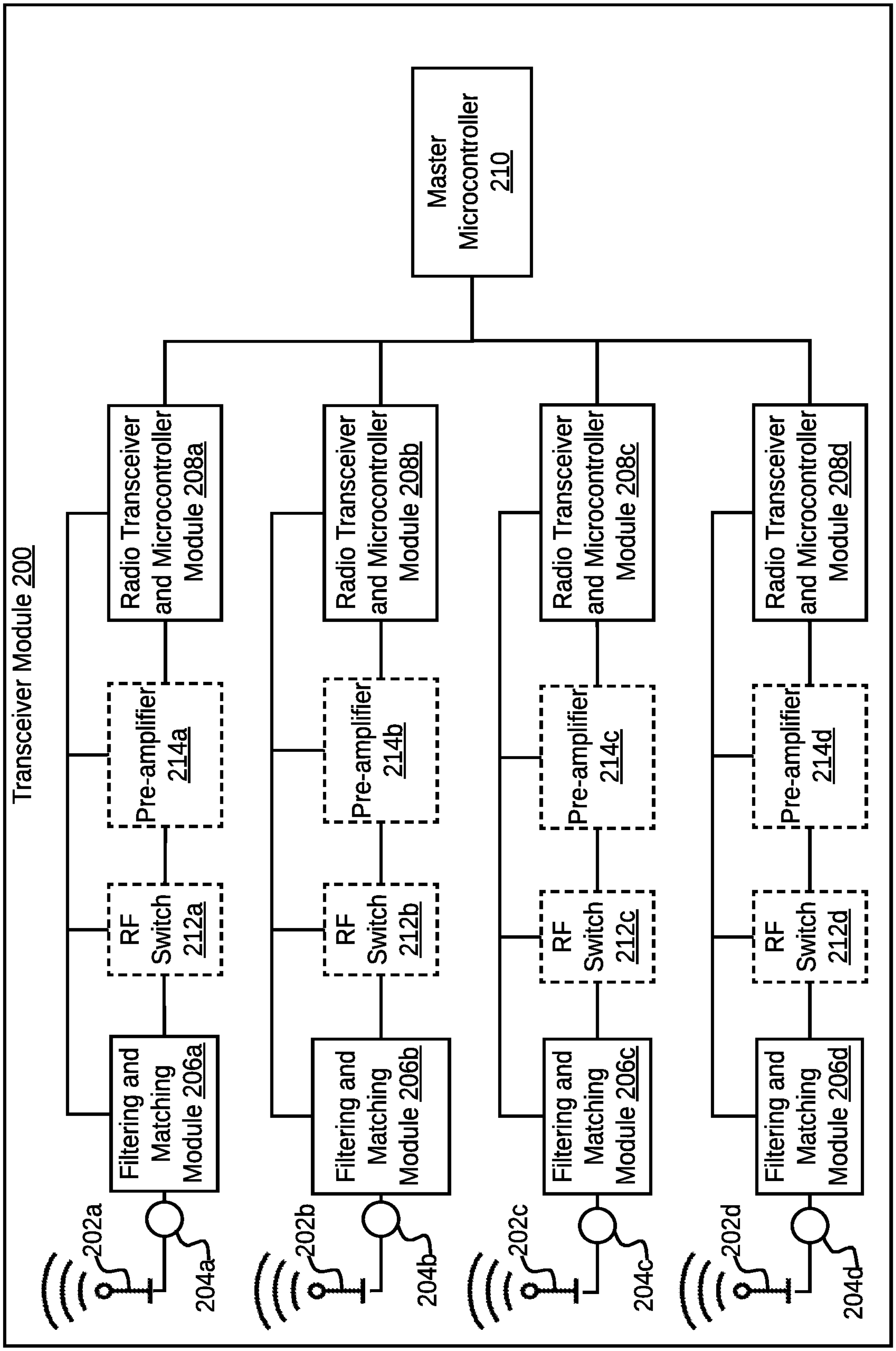
Transceiver Module 200
Master Microcontroller 210
Radio Transceiver and Microcontroller Module 208a
Radio Transceiver and Microcontroller Module 208b
Radio Transceiver and Microcontroller Module 208c
Radio Transceiver and Microcontroller Module 208d
Pre-amplifier 214a
Pre-amplifier 214b
Pre-amplifier 214c
Pre-amplifier 214d
RF Switch 212a
RF Switch 212b
RF Switch 212c
RF Switch 212d
Filtering and Matching Module 206a
Filtering and Matching Module 206b
Filtering and Matching Module 206c
Filtering and Matching Module 206d
202a
202b
202c
202d
204a
204b
204c
204d

FIG. 2

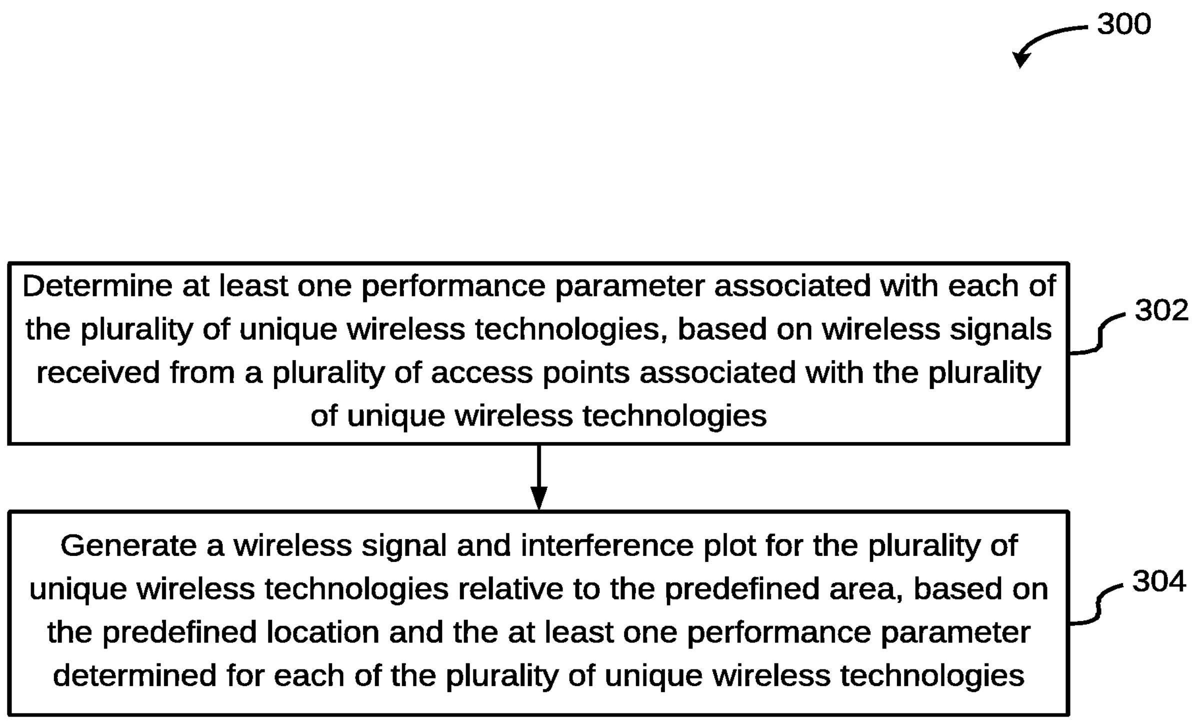
300
Determine at least one performance parameter associated with each of the plurality of unique wireless technologies, based on wireless signals received from a plurality of access points associated with the plurality of unique wireless technologies
302
Generate a wireless signal and interference plot for the plurality of unique wireless technologies relative to the predefined area, based on the predefined location and the at least one performance parameter determined for each of the plurality of unique wireless technologies
304

FIG. 3

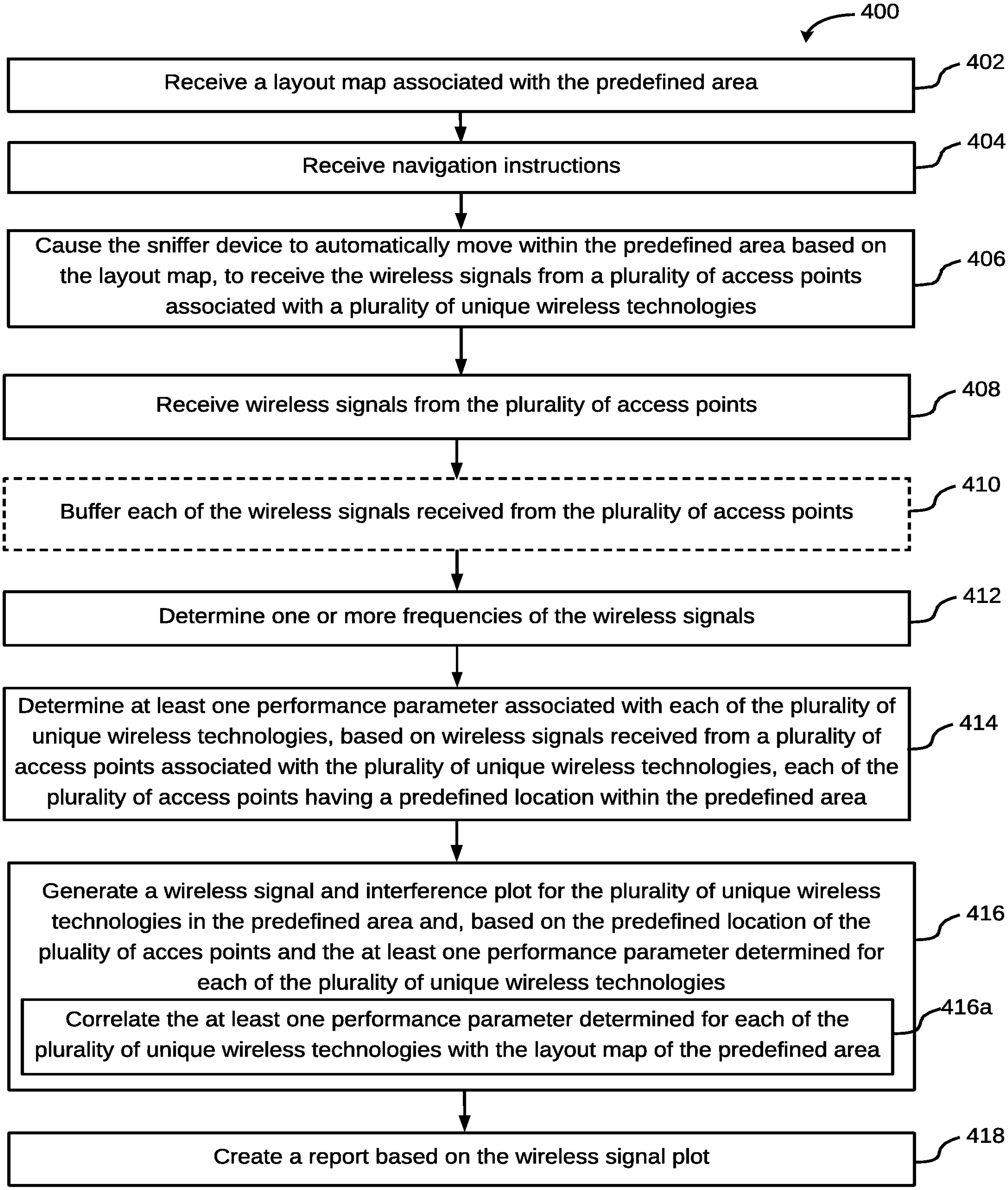
400
Receive a layout map associated with the predefined area
402
Receive navigation instructions
404
Cause the sniffer device to automatically move within the predefined area based on the layout map, to receive the wireless signals from a plurality of access points associated with a plurality of unique wireless technologies
406
Receive wireless signals from the plurality of access points
408
Buffer each of the wireless signals received from the plurality of access points
410
Determine one or more frequencies of the wireless signals
412
Determine at least one performance parameter associated with each of the plurality of unique wireless technologies, based on wireless signals received from a plurality of access points associated with the plurality of unique wireless technologies, each of the plurality of access points having a predefined location within the predefined area
414
Generate a wireless signal and interference plot for the plurality of unique wireless technologies in the predefined area and, based on the predefined location of the pluality of acces points and the at least one performance parameter determined for each of the plurality of unique wireless technologies
416
Correlate the at least one performance parameter determined for each of the plurality of unique wireless technologies with the layout map of the predefined area
416a
Create a report based on the wireless signal plot
418

FIG. 4

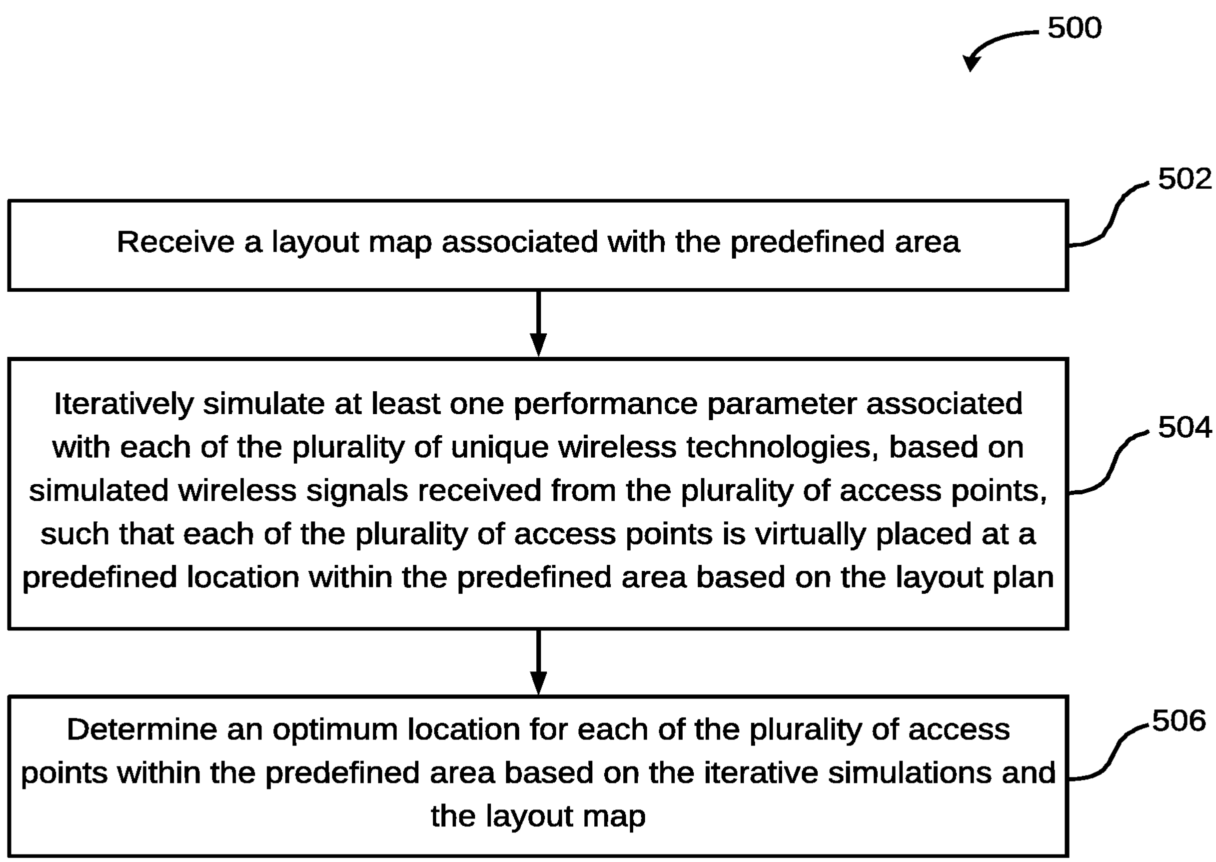
500
502
Receive a layout map associated with the predefined area
504
Iteratively simulate at least one performance parameter associated with each of the plurality of unique wireless technologies, based on simulated wireless signals received from the plurality of access points, such that each of the plurality of access points is virtually placed at a predefined location within the predefined area based on the layout plan
506
Determine an optimum location for each of the plurality of access points within the predefined area based on the iterative simulations and the layout map

FIG. 5

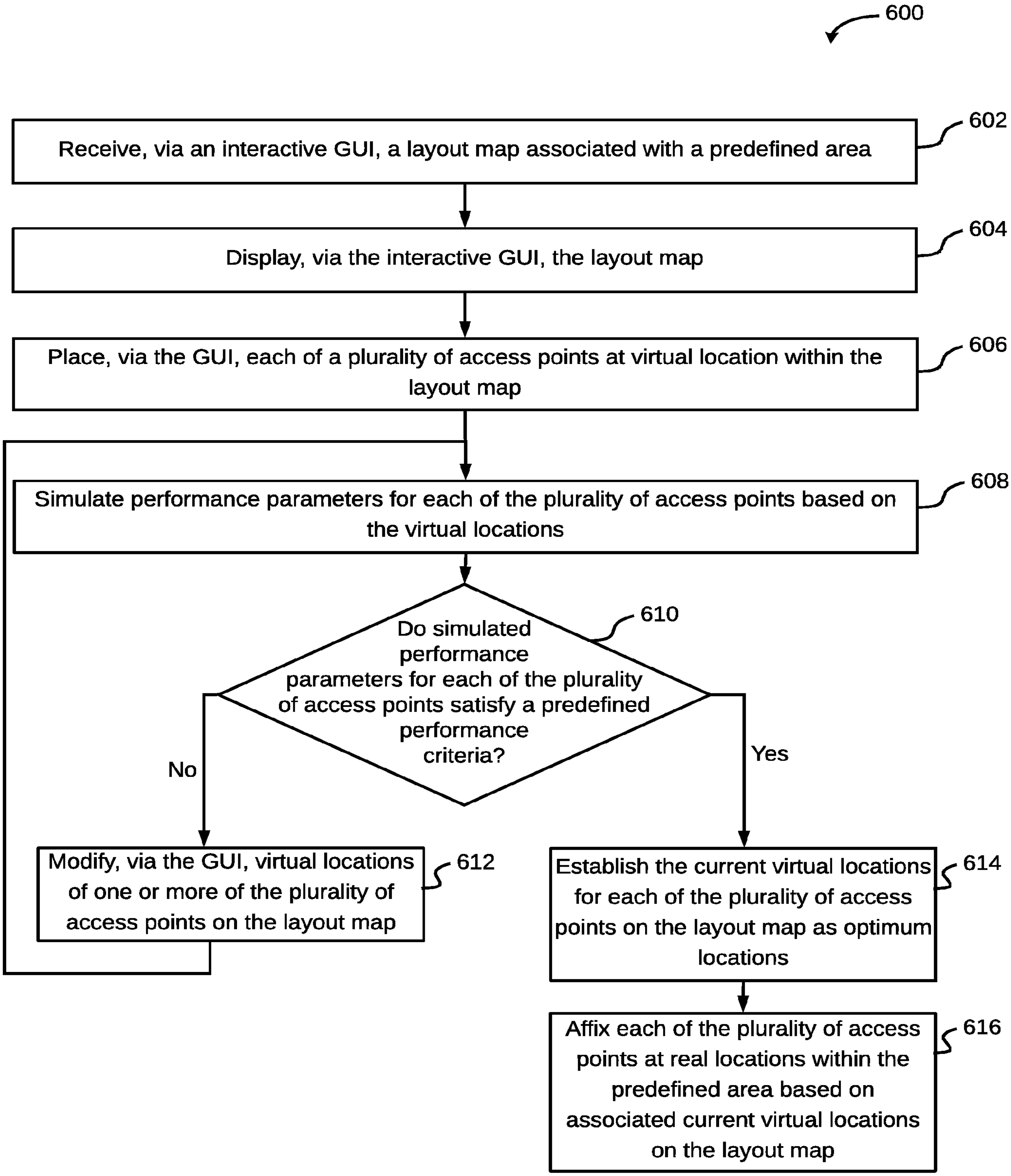
600
Receive, via an interactive GUI, a layout map associated with a predefined area
602
Display, via the interactive GUI, the layout map
604
Place, via the GUI, each of a plurality of access points at virtual location within the layout map
606
Simulate performance parameters for each of the plurality of access points based on the virtual locations
608
Do simulated performance parameters for each of the plurality of access points satisfy a predefined performance criteria?
610
No
Yes
Modify, via the GUI, virtual locations of one or more of the plurality of access points on the layout map
612
Establish the current virtual locations for each of the plurality of access points on the layout map as optimum locations
614
Affix each of the plurality of access points at real locations within the predefined area based on associated current virtual locations on the layout map
616

FIG. 6

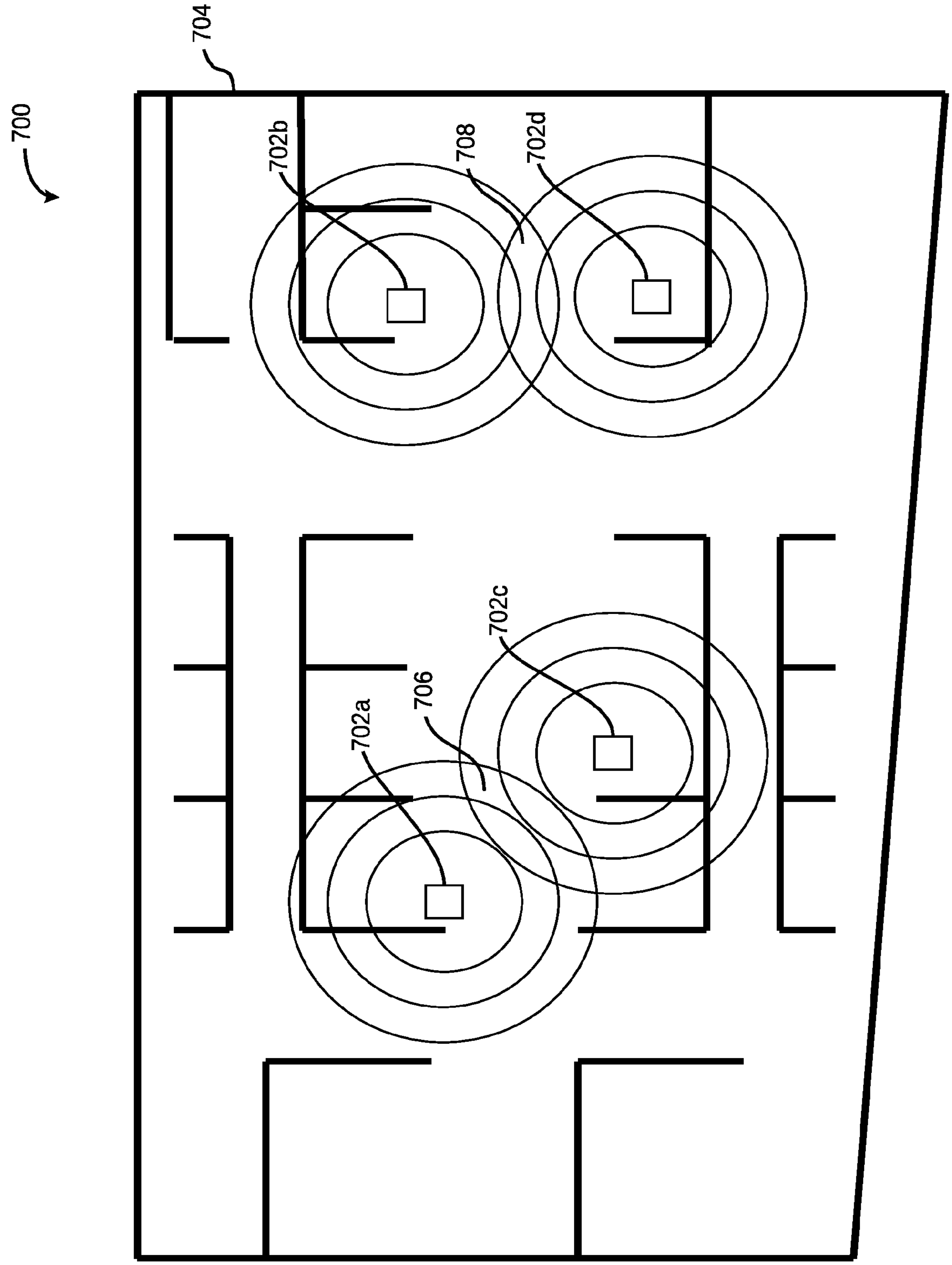

FIG. 7

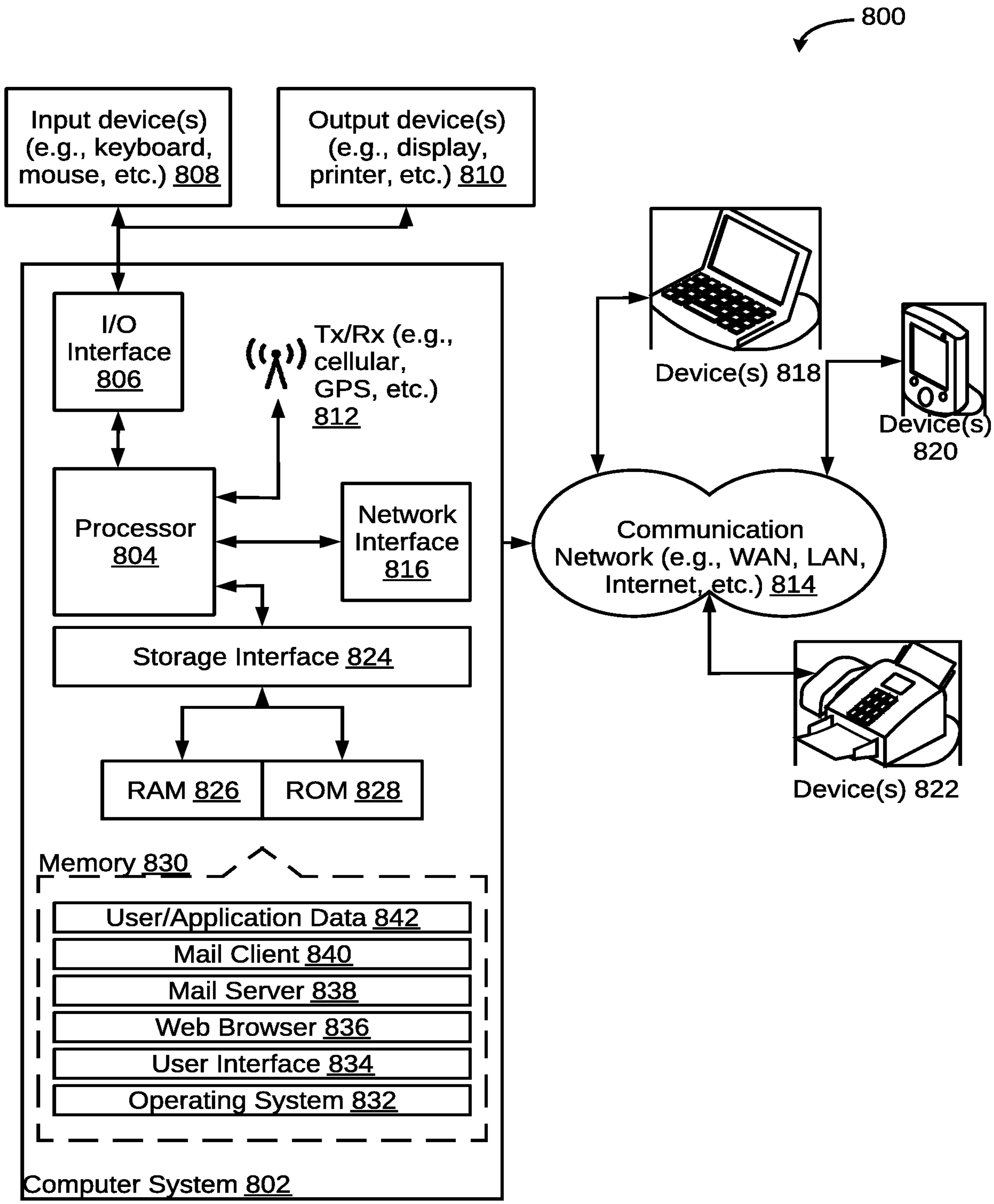
800
Input device(s) (e.g., keyboard, mouse, etc.) 808
Output device(s) (e.g., display, printer, etc.) 810
I/O Interface 806
Tx/Rx (e.g., cellular, GPS, etc.) 812
Processor 804
Network Interface 816
Storage Interface 824
RAM 826
ROM 828
Memory 830
User/Application Data 842
Mail Client 840
Mail Server 838
Web Browser 836
User Interface 834
Operating System 832
Computer System 802
Device(s) 818
Device(s) 820
Communication Network (e.g., WAN, LAN, Internet, etc.) 814
Device(s) 822

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2018/052120

A. CLASSIFICATION OF SUBJECT MATTER
H04W24/00 Version=2018.01

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)

H04W

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 practicable, search terms used)

DATABASES:- IPO INTERNAL, TOTAL PATENT ONE
KEYWORDS:- PLURAL, MULTIPLE, PARAMETER, ATTRIBUTE, LOCATION, PLOT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US8050707 B2 (DELL PRODUCTS L.P.[US]) 01 November 2011 (01-11-2011) ABSTRACT; LINES 51-52 of COLUMN 2, LINES 34-42 of COLUMN 3, LINES 41-46 of COLUMN 4; FIGURE 2	1-20
Y	US20150341226 A1 (ROOT WIRELESS INC[US]) 26 November 2015 (26-11-2015) PARAGRAPHS [0007], [0049], [0303], [0306]; FIGURES 3, 5D	1-20

☐ Further documents are listed in the continuation of Box C. ☒ 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 application or patent 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
19-07-2018	19-07-2018
Name and mailing address of the ISA/ Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Authorized officer Saurabh Dwivedi Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2018/052120

Citation	Pub.Date	Family	Pub.Date
US 8050707 B2	01-11-2011	US 20080188206 A1	07-08-2008