

A COMMUNICATION SYSTEM, A COMMUNICATION APPARATUS AND A COMMUNICATION METHOD IN ASSOCIATION THERETO

Field Of Invention

The present disclosure generally relates to a communication system and a communication apparatus. The present disclosure can further relate to a communication method in association with the communication system and/or the communication apparatus.

Background

In the context of voluminous consumer/user usage of communication networks, conventional solutions include providing multiple access points to cater for access by a large number of user devices.

In an exemplary scenario, in a stadium which can have about fifty thousand attendees (i.e., approximately 50,000 potential users), multiple access points (operable in 2.4GHz bands) would conventionally be deployed. In a pure 802.11n based deployment, the approximate number of active users could be limited to up to 300 users whereas in a pure 801.11g based deployment, the approximate number of active users could be limited to up to 54 users at any one point in time.

Therefore, conventional solutions do not facilitate voluminous consumer/user usage of a communication network in an effective manner.

The present disclosure contemplates that there is a need to improve the manner in which, for example, voluminous consumer usage of a communication network can be facilitated.

Summary of the Invention

In accordance with an aspect of the disclosure, there is provided a communication apparatus (also referable to as a communication system).

The communication apparatus/system can include at least one controller module and a plurality of unit modules. The plurality of unit modules can be coupled to the controller module.

Each of the unit module can be capable of being coupled to a plurality of antennas. The plurality of antennas can be coupled to the unit modules to form an antenna array. The antenna array can be capable of being arranged in a manner so as to form an effective multipath.

In accordance with another aspect of the disclosure, there is provided a communication method which can be associated with the communication apparatus/system.

Brief Description of the Drawings

Embodiments of the disclosure are described hereinafter with reference to the following drawings, in which:

Fig. 1 shows a communication system/apparatus which can include one or more unit modules, according to an embodiment of the disclosure;

Fig. 2 shows a unit module of Fig. 1 in further detail, according to an embodiment of the disclosure;

Fig. 3 shows an exemplary implementation in association with the communication system/apparatus of Fig. 1, according to an embodiment of the disclosure; and

Fig. 4 shows a communication method in association with the communication system/apparatus of Fig. 1, according to an embodiment of the disclosure.

Detailed Description

Referring to Fig. 1, a communication system 100 is shown, in accordance with an embodiment of the disclosure. The communication system 100 can, for example, be suitable for use in wireless based communication(s) such as wireless local area

network (WLAN) communication, Wi-Fi based communication and/or, generally, communication in the microwave band.

The communication system 100 can include one or more controller modules 102 and one or more unit modules 104. In one embodiment, the communication system 100 can include a controller module 102 and a plurality of unit modules 104.

The unit module(s) 104 can be coupled to the controller module 102. Specifically, coupling between the controller module 102 and the unit module(s) 104 can be by manner of one or both of wired coupling and wireless coupling. In one embodiment, coupling can be by manner of fiber optic line coupling, ethernet cabling based coupling or direct trace coupling (e.g., on a printed circuit board), or any combination thereof.

The communication system 100 can, for example, be in the form of an electronic apparatus in which the controller module(s) 102 can be coupled to the unit module(s) 104. In this regard, the communication system 100 can, in one embodiment, further include one or more printed circuit boards (not shown) carrying the controller module(s) 102 and the unit module(s) 104. Moreover, it is appreciable that the communication system 100 can also be referred to as a communication apparatus.

In one embodiment, the controller module(s) 102 and the unit module(s) 104 can be carried by a base such as a printed circuit board (PCB).

In another embodiment, the controller module(s) 102 can be carried by a base such as a printed circuit board (PCB) and the unit module(s) 104 can be carried by another base such as another printed circuit board (PCB).

In yet another embodiment, a portion of one or both of the controller module(s) 102 and the unit module(s) 104 can be carried by a base such as a printed circuit board (PCB). Another portion of one or both of the controller module(s) 102 and the unit module(s) 104 can be carried by another base such as another printed circuit board (PCB).

In yet a further embodiment, the controller module(s) 102 can be carried by a base such as a printed circuit board (PCB) whereas the unit module(s) 104 is/are not carried by a base such as a printed circuit board. The unit module(s) 104 can correspond to device(s) external to the PCB carrying the controller module(s) 102 and can be coupled to the controller module(s) 102 by manner of one or both of wired coupling and wireless coupling.

In yet another further embodiment, the unit module(s) 104 can be carried by a base such as a printed circuit board (PCB) whereas the controller module(s) 102 is/are not carried by a base such as a printed circuit board. The controller module(s) 102 can be coupled to the unit module(s) 104 (i.e., carried by a PCB) by manner of one or both of wired coupling and wireless coupling.

Generally, the communication system 100 (i.e., also referable to as "communication apparatus 100") can be associated with a plurality of antenna types.

For example, the communication system 100 can be associated with a plurality of individual/distinct antenna types.

In a more specific example, the communication system 100 can include a hundred and twenty-eight individual/distinct antenna types or more (i.e., up to 128 individual antenna types or more).

In a yet more specific example, each unit module 104 can be associated with one or more antenna types, according to an embodiment of the disclosure. Specifically, each unit module 104 can, for example, be coupled to one or more antenna types, according to an embodiment of the disclosure. The unit module(s) 104 will be discussed later in further detail with reference to Fig. 2, according to an embodiment of the disclosure.

Examples of an antenna type can include an Omni type, a sector panel type, a planar type, a log periodic type and/or a Yagi PCB design type. In this regard, the communication system 100 can, for example, include an Omni type antenna, a sector panel type antenna, a planar type antenna, a log periodic type antenna, a

Yagi PCB design type antenna, or any combination thereof, according to an embodiment of the disclosure. Other examples and/or other combinations can also be useful.

The present disclosure contemplates that depending on application(s) (e.g., narrow sector-based application(s) and/or wide sector-based application(s)), the antenna type(s) associated with the communication system 100 can be one or both of a dedicated frequency-based antenna type and a wideband frequency-based antenna type. The selection/use of an antenna type would generally be dependent on matching based on radio(s) being connected/coupled.

In one example, specific quarter wave spacing can be used for individual PCB(s) to create a carpet-like electronic effect with corresponding specific supplementary angles at each PCB and within the antenna design on the PCB to ensure proper polarization. This would also allow for various polarizations to work in unison.

In another example, an Omni type antenna can be considered where wider/broader tolerance and coverage may be required along with variations in potential polarization changes which would improve performance. This performance enhancement would benefit devices such as, mobile handsets, tablet, laptops and others where polarization has as much impact as antenna gain. Moreover, the present disclosure contemplates that an Omni type antenna can benefit more from the specific interconnectivity pattern of the radio(s) to the antenna(s).

The present disclosure contemplates that the aforementioned plurality of antenna types can be arranged to form an antenna array (not shown). The antenna array can be optimized in a manner such that the communication system 100 can, for example, be suitable for use with devices (i.e., corresponding to the aforementioned unit module(s) 104) having three or more radios. For example, the communication system 100 can be connectable to four or more (e.g., up to sixteen) devices (e.g., corresponding to the aforementioned unit modules 104) having Mu-MIMO (Multiuser - Multiple Input Multiple Output) type radios which can include three or more antennas each (i.e., 3, 4 or more antennas per radio).

Preferably, the antenna array can be arranged in a manner such that an effective multipath can be created. The effective multipath, in combination spatial capture capability of the undulating pattern of the PCB, can allow for enhanced signal coverage, beam forming, penetration and an acceptable VSWR (Voltage Standing Wave Ratio) measurement of the antenna itself. Specifically, the antenna array can be arranged in a manner such that an effective multipath receiver and/or transmitter (e.g., a transceiver) group assembly can be created. For example, an effective multipath can be created in association with communication in relation to a group assembly of devices (not shown) capable of receiving and/or transmitting type communications. The devices can, for example, be associated with varying parameters (polarization, gain and/or reception angle etc.). The present disclosure contemplates that such an effective multipath can, for example, enhance communications to all forms of devices (e.g., communication devices in a group assembly of devices) regardless of expected polarization, device operator gain, angle of reception of signal, and can enhance distance performance.

The present disclosure contemplates that the antenna array can, in one embodiment, be considered to correspond to a type of true array which is made up of a plurality of antennas (e.g., small antennas) with each antenna being associable with a unique polarization, angle, type and/or frequency band.

In this regard, it is appreciable that the communication system 100 can facilitate enhanced performance in association with, for example, connected/coupled devices (e.g., which can correspond to the aforementioned unit module(s) 104) such as SDR (Software Defined Radio) type chipset device(s), Mu-MIMO type chipset device(s) and/or MIMO type chipset device(s). In this regard, examples of the unit module(s) 104 can include SDR type chipset device(s), Mu-MIMO type chipset device(s) and/or MIMO type chipset device(s).

The present disclosure contemplates that the communication system 100 can be suitable for use for managing and enhancing performance of, for example, a distributed array of mobile and/or fixed base wireless units (e.g., the aforementioned SDR type chipset device(s), Mu-MIMO type chipset device(s) and/or MIMO type chipset device(s)). The present disclosure further contemplates that at least a

portion of the distributed array of mobile and/or fixed base wireless units (i.e., one or more of the aforementioned, for example, SDR type chipset device(s), Mu-MIMO type chipset device(s) and/or MIMO type chipset device(s)) can be configured to function as relay(s), controller(s), as hardware/software defined radio interface(s), central node(s) and/or satellite(s). For example, at least a portion of communication can be can be relayed via one or more units simultaneously so as to enhance performance and expand coverage of embedded low power transceivers (either singularly or through multiple transceivers simultaneously). In another example, a central node or multiple central nodes can, in interchangeable manner (i.e., a central node can, functionally, be replaced by another central node), communicate with a distributed array of mobile and/or fixed base units.

According to an embodiment of the disclosure, the communication system/apparatus 100 can include a plurality of unit modules 104. Moreover, the unit modules 104 can be connected to at least one controller module 102 which can, for example, correspond to a Central Processing Unit (CPU) which can, for example, include a plurality of CPU cores to make up a central node. Processing of the CPU cores can, for example, be by manner of parallel processing.

Each unit module 104 can, for example, be associated with one or more communication routes and can, for example, operate as a relay unit with respect to another unit module 104. In one embodiment, communication routes associable with one unit module 104 can be stored in another unit module 104 (e.g., a relay unit). In one embodiment, information concerning the communication route(s) of a unit module 104 can be relayed (e.g., by a relay unit) to, for example, another unit module 104.

In one embodiment, each unit module 104 can include one or more transceivers. In another embodiment, each unit module 104 can include one or more transceiver chipsets/modules. In yet another embodiment, each unit module 104 can include one or more communication cards operating based on one or both of a dedicated communication standard or multiple communication standards (e.g., any one of, or any combination of, 802.11 based communication protocol, Code-Division Multiple Access/Time-Division Multiple Access, Global System for Mobile communications,

Long Term Evolution, Ultra-wideband and Bluetooth etc.). In yet a further embodiment, each unit module 104 can include any one of at least one transceiver, at least one transceiver chipset/module, at least one communication card, or any combination thereof.

A transceiver can, for example, be operated (switching in communication mode etc.) based on a frequency band/range of between 70MHz and 60GHz. Therefore, it is appreciable that the unit module(s) 104 can be operable (switching in communication mode etc.) based on a frequency band/range of between 70MHz and 60GHz.

Earlier mentioned, each unit module 104 can be associated with one or more antenna types, according to an embodiment of the disclosure. This will be discussed in further detail with reference to Fig. 2 hereinafter.

Referring to Fig. 2, a unit module 104 is shown in further detail, according to an embodiment of the disclosure.

As shown, the unit module 104 can include one or both of at least one radio module 202 and at least one central processing unit (CPU) 204. In one embodiment, the unit module 104 can include a plurality of radio modules 202 and a CPU 204. The radio modules 202 can be coupled to the CPU 204.

A radio module 202 can include one or more antenna ports 206. For example, an antenna associated with an antenna type can be coupled to an antenna port 206. In one embodiment, each radio module 202 can include eight individual antenna ports 206, each to which an antenna associated with an antenna type can be coupled. Specifically, an antenna associated with an antenna type can be coupled to the radio module 202 via an antenna port 206. A radio module 202 can, for example, correspond to a SDR type chipset radio module (e.g., ADRV9009 chips or other similar or forth coming SDR core designs which can include at least one Field-Programmable Gate Array), a Mu-MIMO type chipset radio module or a MIMO type chipset radio module. In this regard, a radio module 202 can, for example, correspond to the aforementioned SDR type chipset device, the Mu-MIMO type chipset device or the MIMO type chipset device.

In one embodiment, a unit module 104 can be associated with a single type chipset device. For example, the unit module 104 can include a plurality of radio modules 202 all of which are based on SDR type chip devices, Mu-MIMO type chipset devices or MIMO type chipset devices.

In another embodiment, a unit module 104 can be associated with multiple type chipset devices. For example, the unit module 104 can include a plurality of radio modules 202 which can be based on any combination of SDR type chip device(s), Mu-MIMO type chipset device(s) or MIMO type chipset device(s).

Moreover, a radio module 202 can further include one or more other periphery devices, according to an embodiment of the disclosure. For example, a radio module 202 can further include one or more of Random Access Memory (RAM) type device(s), Erasable Programmable Read-Only Memory (EPROM) type device(s), Ethernet/Fiber connection port(s), Input/ Output (I/O) port(s), Universal Serial Bus (USB) port(s), bus connector(s) (e.g., Mini Peripheral Component Interconnect type bus slot(s) and/or Peripheral Component Interconnect Express type bus slot(s)), or any combination thereof.

The present disclosure contemplates that in one embodiment, the radio module 202 can include a base (not shown) such as a Printed Circuit Board (PCB) carrying one or both of the radio module(s) 202 and the CPU(s) 204. One or more of the periphery device(s) can, for example, be either carried by the base or externally coupled to the base (e.g., the RAM type device(s) and/or the EPROM type device(s) can be carried by another, for example, PCB and coupled to the radio module 202 via one or more bus connector(s)).

The radio module(s) 202 will be discussed in further detail based on an exemplary implementation with reference to Fig. 3 hereinafter.

Referring to Fig. 3, an exemplary implementation 300 in relation to the communication system/apparatus 100 is shown, according to an embodiment of the disclosure.

In the exemplary implementation 300, a unit module 104 can include a first radio module 302, a second radio module 304, a third radio module 306 and a fourth radio module 308.

The first radio module 302 can be associated with a first antenna type 310, the second radio module 304 can be associated with a second antenna type 312, the third radio module 306 can be associated with a third antenna type 314 and the fourth radio module 308 can be associated with a fourth antenna type 316.

The first antenna type 310 can include one or more first type antennas 310a. The second antenna type 312 can include one or more second type antennas 312a. The third antenna type 314 can include one or more third type antennas 314a. The fourth antenna type 316 can include one or more fourth type antennas 316a.

The first type antenna(s) 310a can be coupled to the first radio module 302. The second type antenna(s) 312a can be coupled to the second radio module 304. The third type antenna(s) 314a can be coupled to the third radio module 306. The fourth type antenna(s) 316a can be coupled to the fourth radio module 308.

The first radio module 302 can, for example, correspond to a 802.11n 2.4GHz built-in radio and the first type antenna(s) 310a can, for example, correspond to OMNI circular polarized or clover leaf type antennas(s).

The second radio module 304 can, for example, correspond to a 802.11n 2.4GHz built-in radio and the second type antenna(s) 312a can, for example, correspond to antenna(s) suitable for 2.4GHz communication (e.g., narrow band antennas(s) with 2.4GHz as center frequency).

The third radio module 306 can, for example, correspond to a 802.11acW2 5 GHz external radio and the third type antenna(s) 314a can correspond to specific band type antenna(s) (e.g., 5.0GHz to 6.0GHz).

The fourth radio module 308 can, for example, correspond to a 802.11acWz 5 GHz external radio and the fourth type antenna(s) 316a can be analogous to the aforementioned third type antenna(s) 316a.

In this regard, in one embodiment, the first to fourth antenna types 310a/312a/314a/316a can correspond to four different antenna types. In another embodiment, the first to fourth antenna types 310a/312a/314a/316a can be of the same antenna type. In yet another embodiment, some of the first to fourth antenna types (e.g., the third and fourth antenna types 314a/316a) can be the same whereas the remaining antenna types (e.g., the first and second antenna types 310a/312a) can be different antenna types (e.g., two different antenna types from that of the third and fourth antenna types 314a/316a).

Moreover, the present disclosure contemplates that one or more of the first to fourth type antennas 310a/312a/314a/316a, or any combination thereof, can be flexibly positioned (e.g., for the purpose of enhancing signal communication coverage and/or, in general, enhancing performance). In one example, the second type antenna(s) 312a can be positioned so as to have a -45 degrees twist with 7 degrees down tilt from the top. (Comment: please clarify where is "from the top" with respect to the unit module (i.e., XCVR unit))

Earlier mentioned, a unit module 104 can be carried by a base such as a PCB, according to an embodiment of the disclosure.

The present disclosure contemplates that, in one embodiment, the PCB carrying a unit module 104 can include a plurality of sub panels (e.g., small PCB panels) using a variety of available high gain designs using very specific tolerances on the dielectric makeup of the PCB material on which the trace elements are laid out. In this manner, upgradeability can be facilitated (i.e., capability to be flexibly upgraded).

In view of the forgoing, it is appreciable that the communication system/apparatus 100 can be associated with an antenna array which can possibly include a plurality of antennas having variance in terms of, for example, unique polarization, angle and/or frequency band. This can potentially overcome return loss and/or VSWR

issues which can cause inefficiencies (e.g., inefficient external coupling) in conventional systems. Moreover, antenna capability can, for example, range from 450MHz to 60GHz.

Moreover, in view of the forgoing, the present disclosure contemplates that, in one embodiment, the communication system/apparatus 100 can correspond to a SDR multi-standard radio data platform which can handle voluminous connections with a multi-frequency wide-band antenna array and multiple individual addressable radios with security. The present disclosure contemplates that SDR can facilitate capability for variations in standards.

The present disclosure contemplates that the communication system/apparatus 100 can be capable of providing enhanced coverage in a voluminous manner (i.e., to a large number of users each of whom can be affected by various RF issues/nuances) within a broad area. Therefore, the communication system/apparatus 100 (e.g., in view of the aforementioned antenna array) can have versality and capability to communicate with a large number of devices.

For example, in the context of the earlier discussed exemplary scenario of a stadium having approximately fifty thousand attendees, the present disclosure contemplates that with the communication system/apparatus 100, potentially over two-thousand non-active links per basic node can be provided with six-hundred eighty eight active users (at 1 Mbps per user), and over eight hundred and ninety users with over two thousand six hundred non-active (at 768Kbps per user). Additionally, larger radio node counts can be capable of providing about one thousand three hundred and seventy-six or more users per node. In this regard, the present disclosure contemplates that, potentially, approximately twelve thousand three hundred and eighty-four active users (with approximately thirty-seven thousand one hundred and fifty-two nonactive users) can be covered/catered for using the communication system/apparatus 100.

Referring to Fig. 4, a communication method 400 is shown in accordance with an embodiment of the disclosure. The communication method 400 can be associated with the communication system/apparatus 100.

The communication method 400 can include one or both of a controller providing step 402 and a unit module providing step 404, according to an embodiment of the disclosure. In one embodiment, the communication method 400 can further include a coupling step 406.

With regard to the controller providing step 402, one or more of the aforementioned controller modules 102 can be provided.

With regard to the unit module providing step 404, one or more of the aforementioned unit modules 104 can be provided.

With regard to the coupling step 406, the controller module(s) 102 and the unit module(s) 104 can be coupled. Coupling can be by manner of one or both of wired coupling and wireless coupling.

It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments.

In one example, the communication system/apparatus 100 can be coupled to a computer (e.g., desktop computer, laptop, a mobile/handheld device with computing capabilities such as a Smartphone or an electronic tablet) loaded (i.e., installed) with software/software application which can facilitate flexible operability (e.g., operability based on multiple communication standards and/or frequencies, operability by manner of specifying parameters to be used).

In another example, a unit module 104 can be updated by one or both of the controller module(s) 102 and another unit module 104 (e.g., which can correspond to a relay unit) via multiple frequencies, communication standards and/or installed software applications/operating systems (e.g., on a computer which can be coupled to the communication system/apparatus 100). For example, a unit module 104 can be associated with firmware and the firmware can be updated.

In yet another example, the communication system/apparatus 100 can be mobile based (e.g., a mobile type apparatus/system) or can be fixed location based (e.g., a non-mobile type apparatus/system). Moreover, the communication system/apparatus 100 can be positioned indoors or outdoors. For example, the communication system/apparatus 100 can be positioned underground, on surface or in space. Furthermore, the communication system/apparatus 100 can be suitable for communication in association with (e.g., across, between and/or within) the position(s) (e.g., underground, on surface and/or in space) earlier mentioned.

In yet a further example, the communication system/apparatus 100 can include and/or can be coupled to one or more, or any combination of the following:

- Environmental sensor(s) (sensory, audio etc.);
- Visual sensor(s);
- Tactile sensor(s);
- Virtual Reality Interface(s);
- Positional sensor(s); and
- Biometric based sensor(s) (brain machine interface(s), human interaction(s) etc.),

which can be helpful for interaction with, distribution of information (e.g., within their applicable location(s)) and/or obtaining data (e.g., data associated with the environment). The present disclosure contemplates the possibility of obtaining data associated with the environment to, for example, determine dimensions to facilitate three-dimensional (3D) mapping of location.

In another further example, the communication system/apparatus 100 can be configured to maintain location-based services information (e.g., based on the aforementioned communication route(s)) and/or time/date stamps concerning update(s)/loading of software to the unit module(s) 104. The present application contemplates that this could be useful for the purpose of, for example, enhancement(s) in communication(s).

In yet another further example, the communication system/apparatus 100 can be configured to capture, maintain and update security authentication parameters based

on key authentication, hardware address authentication, graphic or video feature authentication, biometric authentication, tactile and non-tactile gesture authentication, or any combination thereof.

In yet a further additional example, a unit module 104 can be configured to operate based on one or both of a plurality of software defined radios (e.g., sixteen software defined radios) and fixed standard type radios.

In yet a further additional example, in one or more various embodiments of the disclosure, the communication system/apparatus 100 or a portion thereof (e.g., a unit module 104) and/or any of the aforementioned device(s)/apparatus(es) can be associated with and/or correspond to dedicated device(s), appliance(s), television(s), Virtual Reality (VR) type device(s), digital slot machine(s), digital video casino game console(s), interactive real-time video casino game type console(s), kiosk(s), ATM(s) (automatic teller machine(s)), virtual casino interaction type device(s), digital sports wagering type device(s) and/or any other software/hardware defined device(s), appliance(s)/unit communicating via established type communication network(s)/standard(s) (in any distributed and/or local environment etc.).

In the foregoing manner, various embodiments of the disclosure are described for addressing at least one of the foregoing disadvantages. Such embodiments are intended to be encompassed by the following claims, and are not to be limited to specific forms or arrangements of parts so described and it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modification can be made, which are also intended to be encompassed by the following claims.