US 20140192849A1

(19) United States
(12) Patent Application Publication
Terry
(10) Pub. No.: US 2014/0192849 A1
(43) Pub. Date: Jul. 10, 2014

(54) **SYSTEM, A DEVICE AND A METHOD FOR ADJUSTING OUTPUT POWER IN A DISTRIBUTED AMPLIFIER SYSTEM**

(71) Applicant: **ZONE ACCESS TECHNOLOGIES, INC.**, Duluth, GA (US)

(72) Inventor: **Scott Terry**, Pleasanton, CA (US)

(73) Assignee: **ZONE ACCESS TECHNOLOGIES, INC.**, Duluth, GA (US)

(21) Appl. No.: **14/149,832**

(22) Filed: **Jan. 8, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/749,922, filed on Jan. 8, 2013.

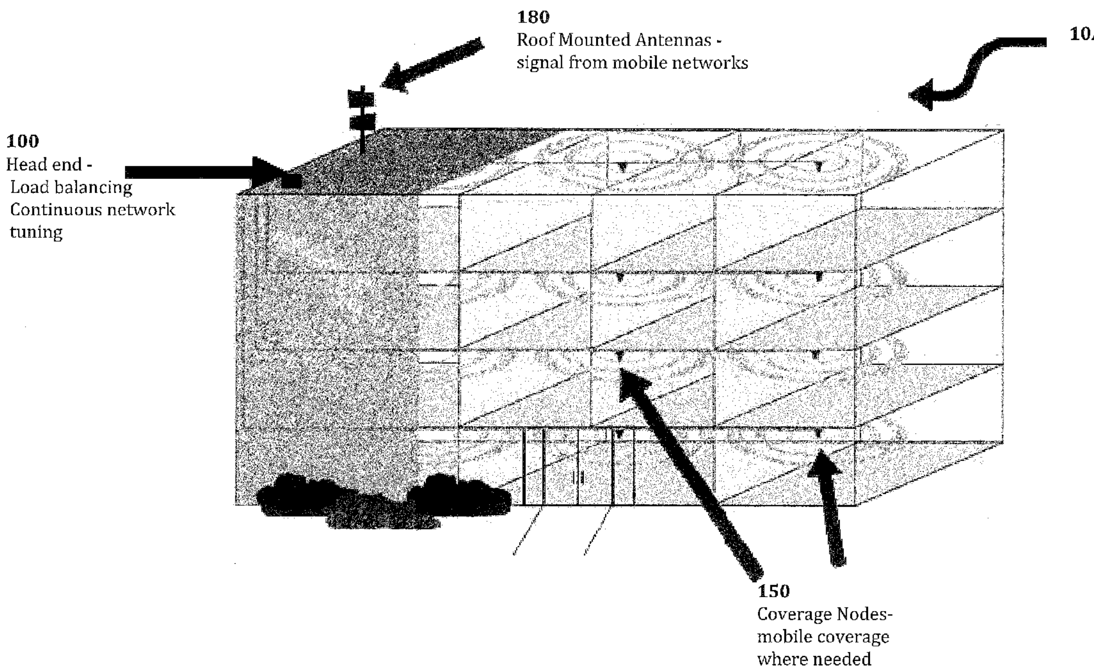
Publication Classification

(51) **Int. Cl.**
H04W 52/24 (2006.01)

(52) **U.S. Cl.**
CPC *H04W 52/245* (2013.01)
USPC **375/219**; 375/259

(57) **ABSTRACT**

A system comprises a first device and a second device. The first device comprises a receiver, a spectrum analyzer, a controller, an amplifier, a filter and a transmitter. The first device receives from at least one antenna a plurality of signals from different sources. The spectrum analyzer is coupled to the receiver and determines whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold. The controller is coupled to the spectrum analyzer and generates a first indication indicating lowering gains of an amplifier on signals from at least one source with downlink signal power larger than the predetermined threshold. The amplifier is coupled to the controller and lowers gains of the amplifier according to the indication from the controller. The transmitter transmits the plurality of signals after adjustment to at least one second device distributed within a site.



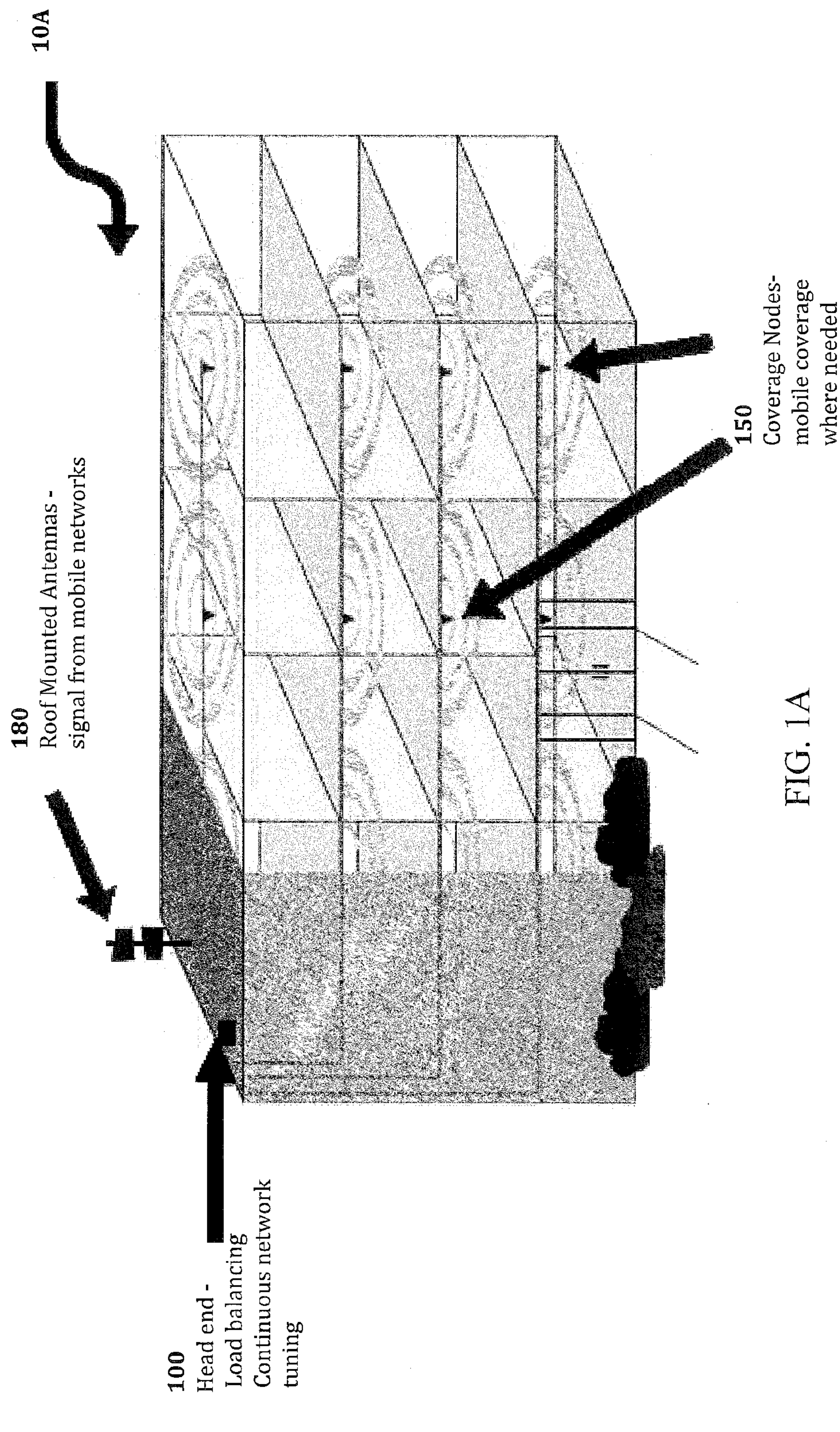

10A
180
Roof Mounted Antennas -
signal from mobile networks
150
Coverage Nodes-
mobile coverage
where needed
100
Head end -
Load balancing
Continuous network
tuning

FIG. 1A

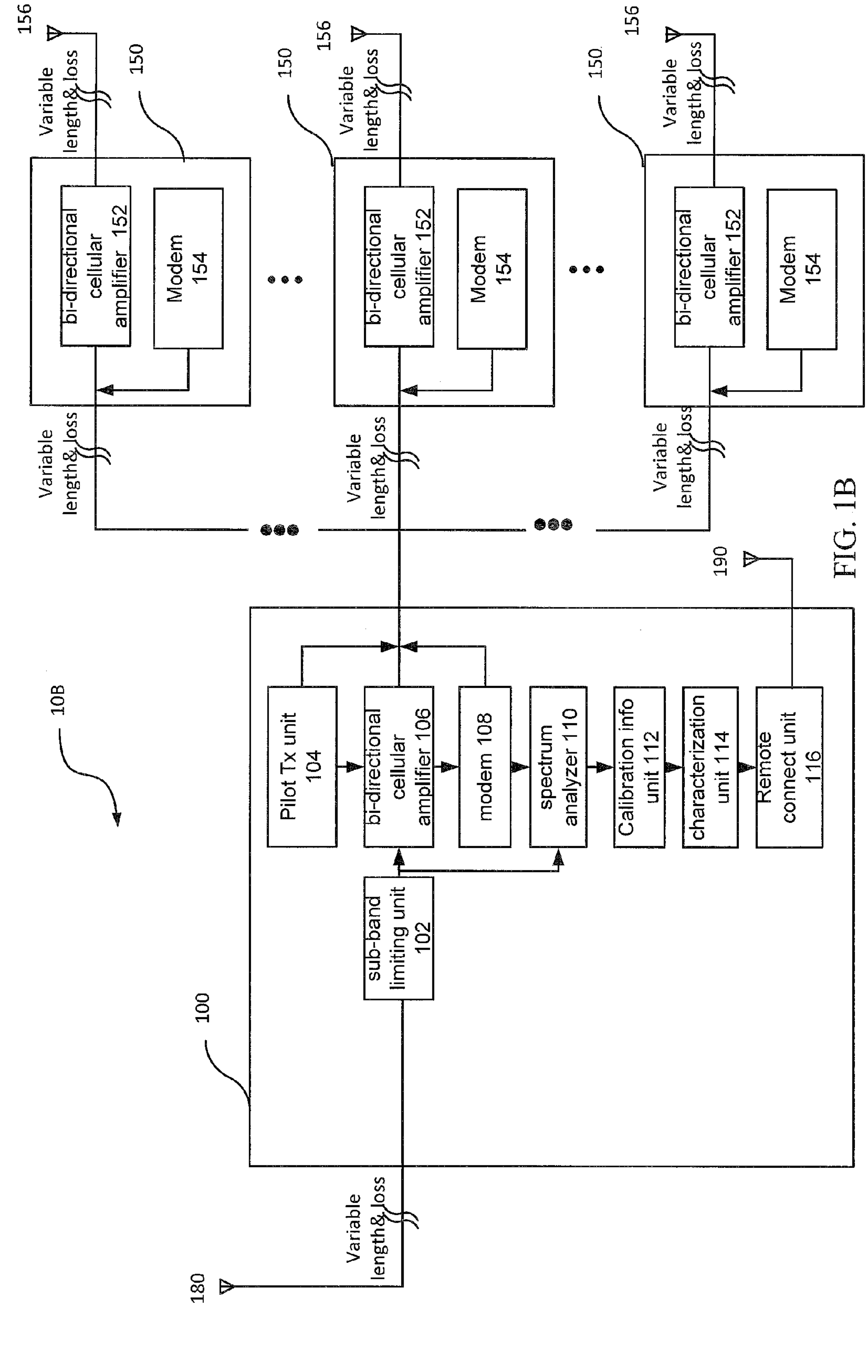

10B
100
180
Variable length& loss
sub-band limiting unit 102
Pilot Tx unit 104
bi-directional cellular amplifier 106
modem 108
spectrum analyzer 110
Calibration info unit 112
characterization unit 114
Remote connect unit 116
190
150
156
bi-directional cellular amplifier 152
Modem 154

FIG. 1B

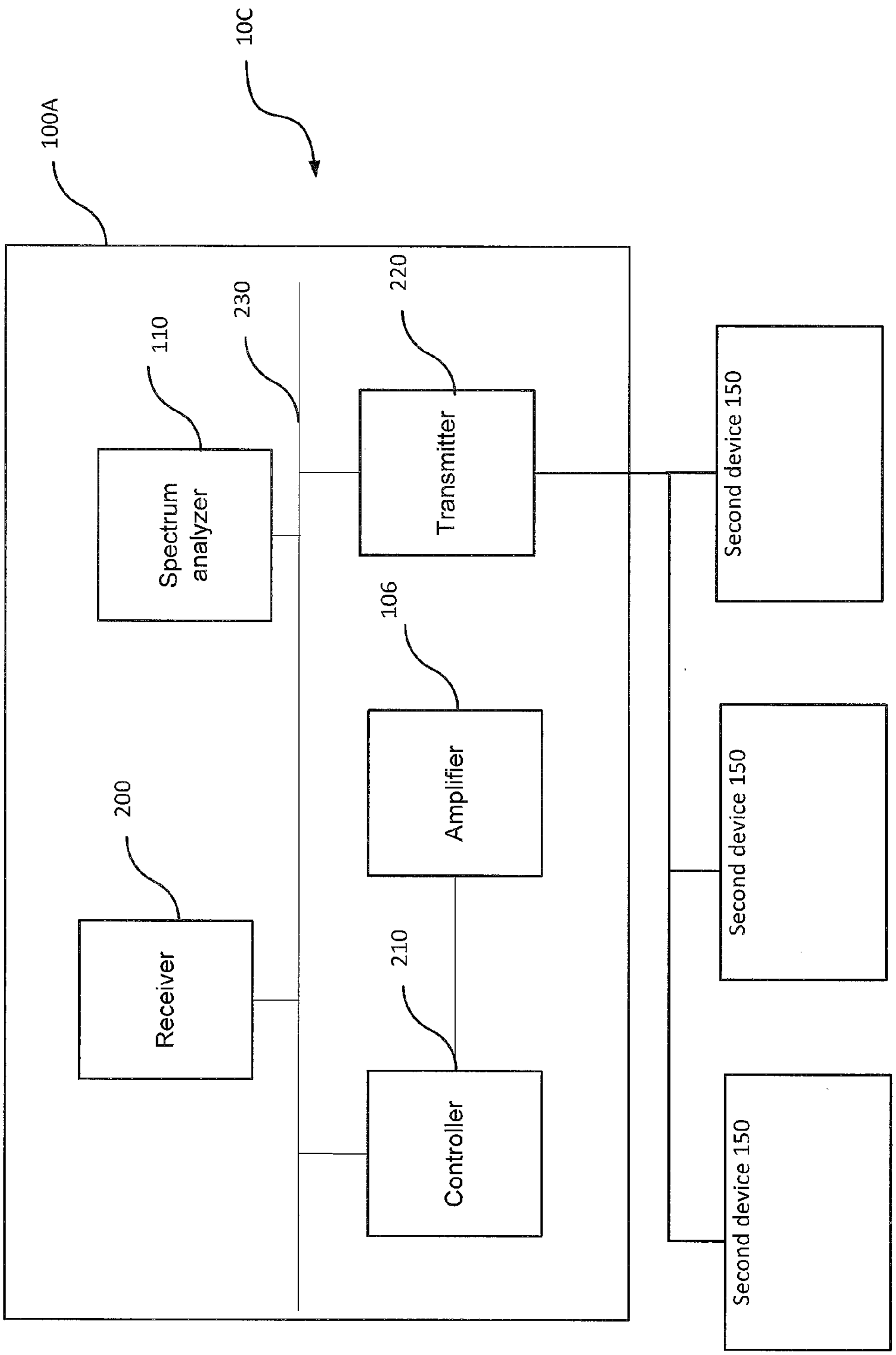

10C
100A
110
Spectrum analyzer
230
220
Transmitter
106
Amplifier
200
Receiver
210
Controller
Second device 150
Second device 150
Second device 150

FIG. 2

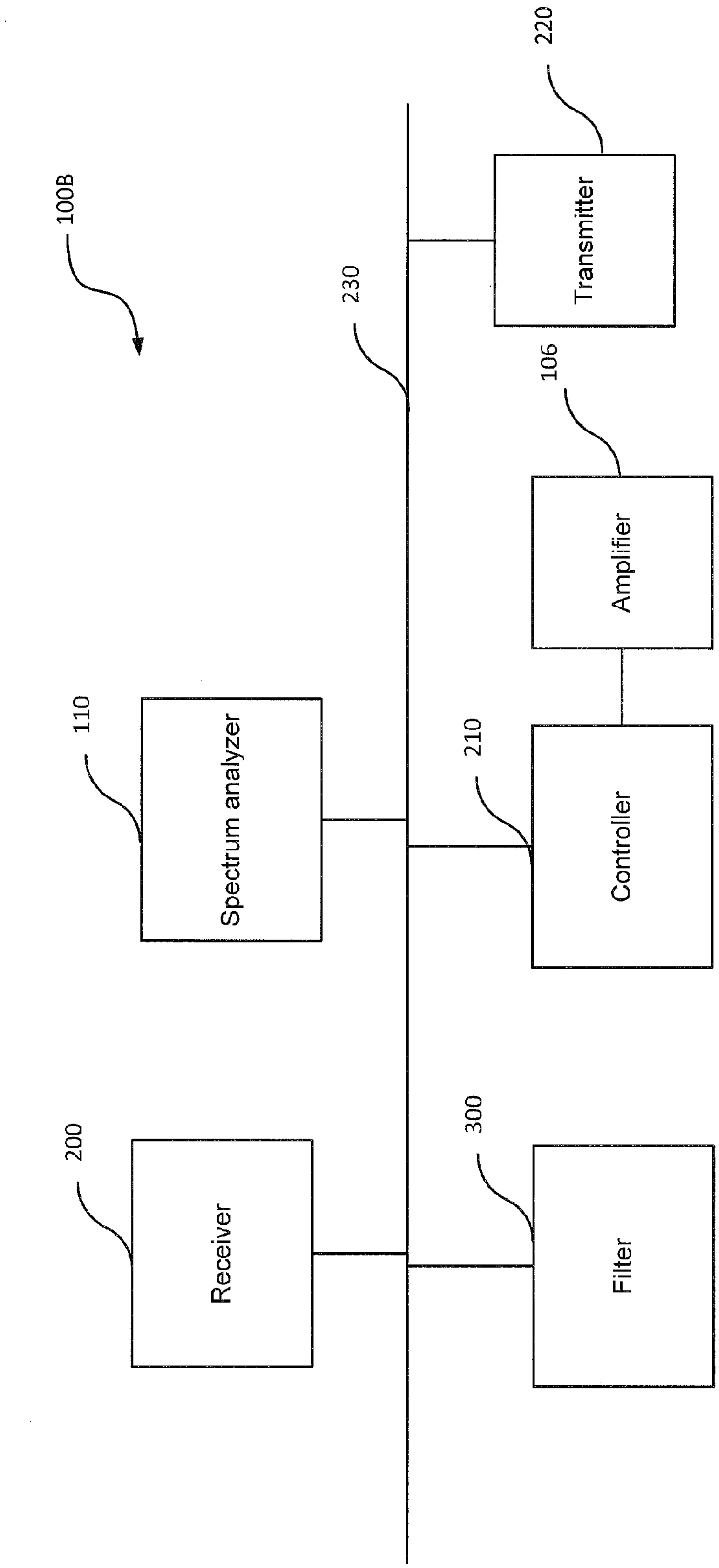

100B
220
Transmitter
230
106
Amplifier
110
Spectrum analyzer
210
Controller
200
Receiver
300
Filter

FIG. 3

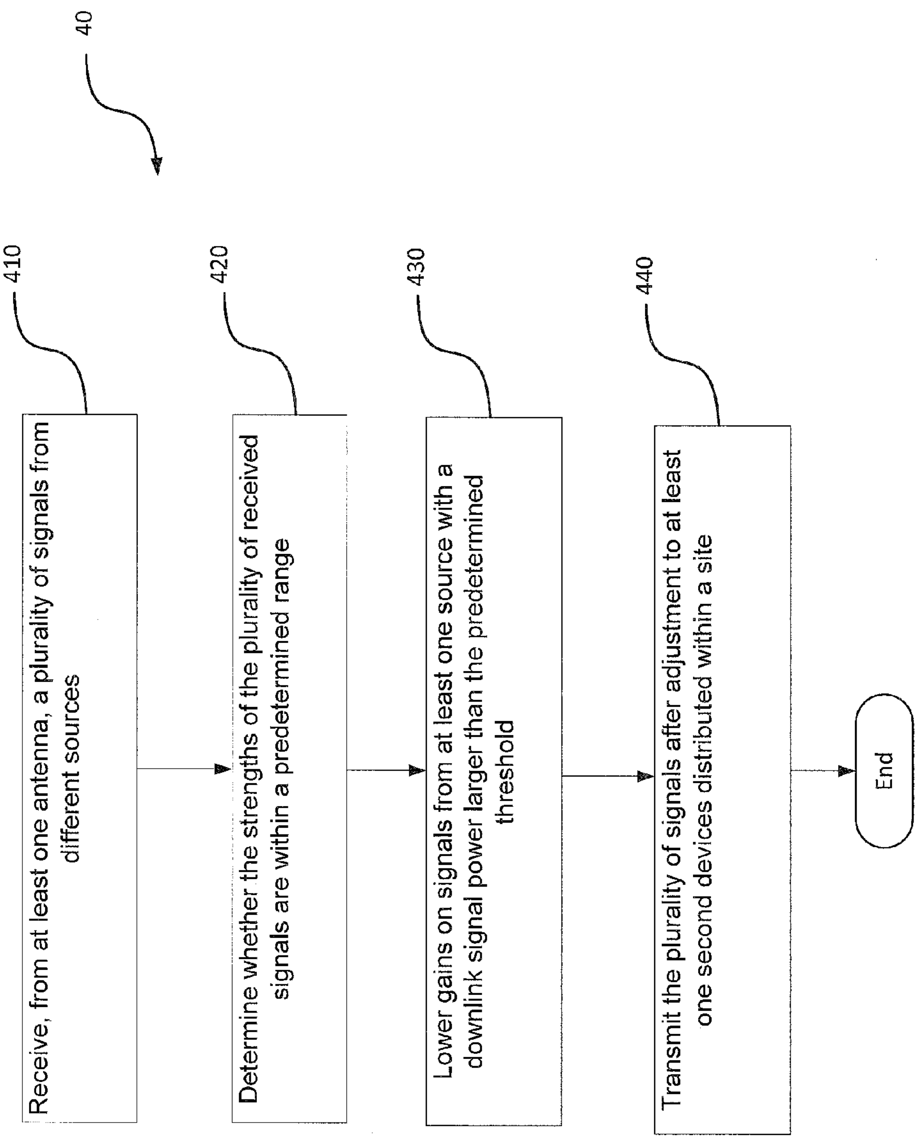

40
410
Receive, from at least one antenna, a plurality of signals from different sources
420
Determine whether the strengths of the plurality of received signals are within a predetermined range
430
Lower gains on signals from at least one source with a downlink signal power larger than the predetermined threshold
440
Transmit the plurality of signals after adjustment to at least one second devices distributed within a site
End

FIG. 4

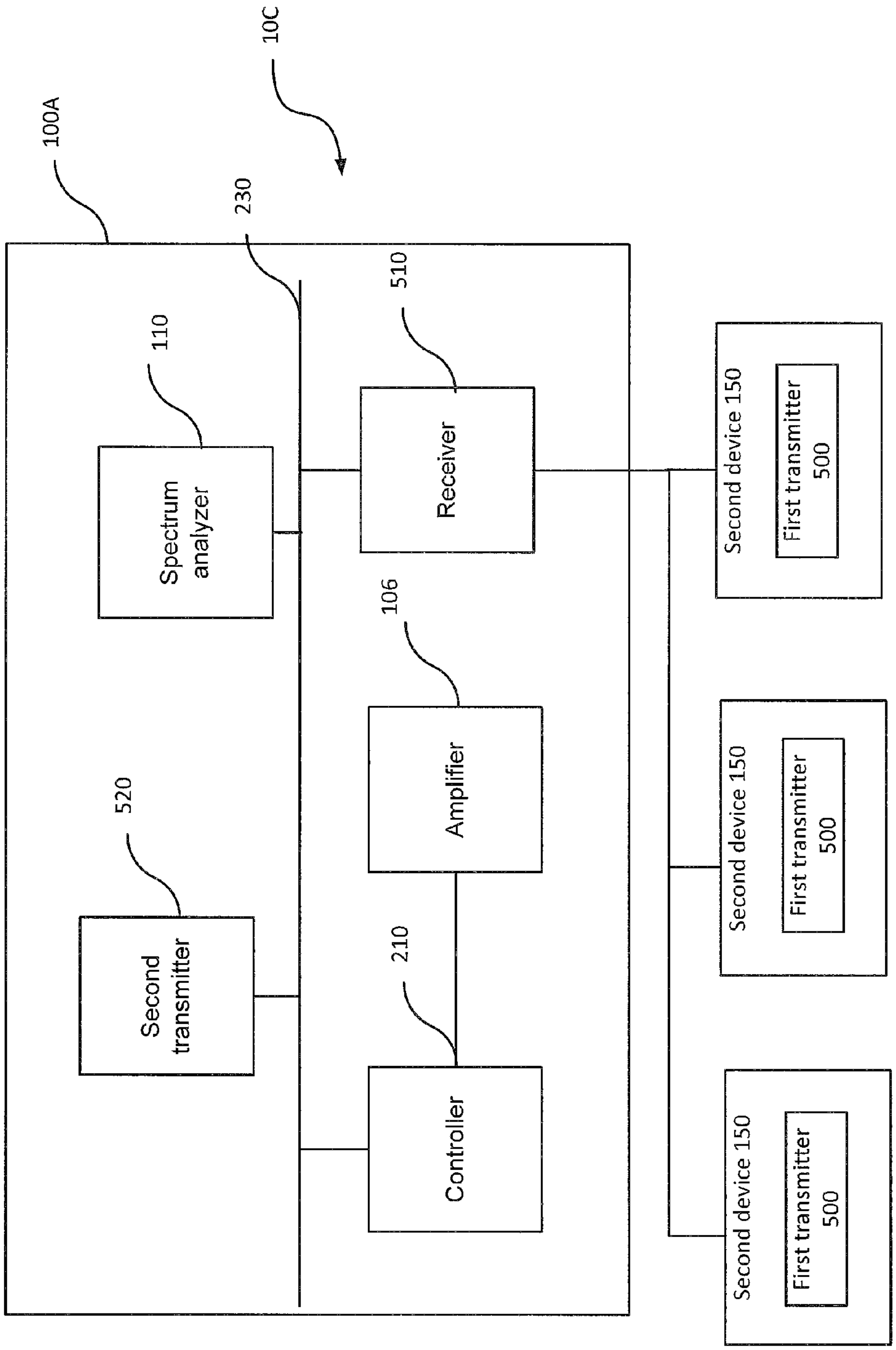

10C
100A
230
510
110
Spectrum analyzer
Receiver
106
Amplifier
520
Second transmitter
210
Controller
Second device 150
First transmitter 500
Second device 150
First transmitter 500
Second device 150
First transmitter 500

FIG. 5

SYSTEM, A DEVICE AND A METHOD FOR ADJUSTING OUTPUT POWER IN A DISTRIBUTED AMPLIFIER SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] The present application claims the benefit of and incorporates by reference U.S. provisional application No. 61/749,922, entitled "Intelligent Distributed Amplifier System," which was filed on Jan. 8, 2013.

TECHNICAL FIELD

[0002] The present disclosure relates to a telecommunication system, and more particularly, but not exclusively to a system, a device and a method for adjusting signal output power in a distributed amplifier system.

BACKGROUND

[0003] In a distributed amplifier system (DAS), when the DAS system is located very close to the communications network source signal such as a cellular tower, a power of a communication device can be so low that it may result in degraded performance or a dropped call.

[0004] In order to protect the communications network, the DAS will lower the output power to where the noise is below the noise floor of the communications system. Unfortunately, lowering the output power of the DAS amplifier will lower the output power for communication signals that are going to different communication systems from different network providers, therefore reducing the effectiveness of the DAS for the wireless devices using a variety of communication networks. Therefore, a system and method for improving adjusting of signal output power across sub-bands may be needed.

SUMMARY OF THE INVENTION

[0005] According to an embodiment of the invention, a system comprises a first device and a second device. The first device comprises a receiver, a spectrum analyzer, a controller, an amplifier, a filter, and a transmitter. The first device receives, from at least one antenna, a plurality of signals from different sources.

[0006] The spectrum analyzer is communicatively coupled to the receiver and determines whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold. The controller is communicatively coupled to the spectrum analyzer and generates a first indication indicating lowering gains of an amplifier on signals from at least one source with downlink signal power larger than the predetermined threshold. The amplifier is communicatively coupled to the controller and lowers gains of the amplifier according to the indication from the controller. The transmitter transmits the plurality of signals after adjustment to at least one second device distributed within a site. The at least one second devices transmits the plurality of received signals after adjustment within the site.

[0007] In another embodiment, a first device comprises a receiver, a spectrum analyzer, a controller and a transmitter. The receiver receives, from at least one antenna, a plurality of signals from different sources. The spectrum analyzer is communicatively coupled to the receiver and determines whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold. The controller is communicatively coupled to the spectrum analyzer and generates an indication indicating lowering gains on signals from at least one source with a downlink signal power larger than a predetermined threshold. The amplifier is communicatively coupled to the controller and lowers gains of the amplifier according to the indication from the controller. The transmitter transmits the plurality of signals after adjustment to at least one second device distributed within a site.

[0008] In another embodiment, a method comprises receiving, from at least one antenna, a plurality of signals from different sources; determining whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold; lowering gains on signals from at least one source with a downlink signal power larger than the predetermined threshold; transmitting the plurality of signals after adjustment to a plurality of second devices distributed within a site.

[0009] In another embodiment, a system comprises a plurality of first devices and a second device. The first devices are distributed in a site each comprising a first transmitter configured to transmit at least one signal to a second device. The second device comprises a receiver, a spectrum analyzer, a controller, an amplifier and a transmitter. The receiver receives a plurality of signals from the plurality of first devices. The spectrum analyzer determines whether a downlink signal power from a source to the system exceeds a predetermined threshold. The controller is communicatively coupled to the spectrum analyzer and generates an indication indicating lowering gains on signals from the first device to the second device when a downlink signal power from the source to the system exceeds a predetermined threshold. The amplifier is communicatively coupled to the controller and lowers gains of the amplifier according to the indication from the controller. The transmitter configured to transmit the plurality of signals after adjustment to the source.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The present invention is illustrated in an exemplary manner by the accompanying drawings. The drawings should be understood as exemplary rather than limiting, as the scope of the invention is defined by the claims. In the drawings, like references indicate similar elements.

[0011] FIG. **1**A is a diagram illustrating a deployment of distributed amplifier system.

[0012] FIG. **1**B is a block diagram illustrating a detailed embodiment of the distributed amplifier system.

[0013] FIG. **2** is a diagram illustrating a block diagram of a different embodiment of the distributed amplifier system.

[0014] FIG. **3** is a block diagram illustrating a different embodiment of a first device of FIGS. **1**A and **1**B.

[0015] FIG. **4** is a flow chart illustrating an embodiment of a method.

[0016] FIG. **5** is a block diagram illustrating another embodiment of a first device operating in uplink transmission.

DETAILED DESCRIPTION

[0017] FIG. **1**A is a diagram illustrating a deployment of a distributed amplifier system **10**A. The cellular signals from outdoor cellular towers may not provide clear and consistent coverage inside buildings, so wireless operators and building owners use distributed antenna systems **10**A to broadcast cellular signals throughout their sites. Note that the cellular signals are for illustration, and it may also include Wi-Fi signals, satellite signals, and other communication signals. The communications signals are distributed throughout building interiors, campus environments, and outdoor areas using an active Distributed Amplifier System (DAS). The DAS is active because it uses signal amplifiers to add gain to communications radio frequency (RF) signals. This gain also facilitates penetration of the signals throughout a building, campus environment, or outdoor areas despite physical obstructions such as walls, interior structures, poles, and trees without loss of signal integrity.

[0018] The distributed amplifier system **10**A comprises a head end **100**, a plurality of coverage nodes **150** and roof mounted antenna(s) **180**. The distributed amplifier systems **10**A work by distributing wireless signals throughout an interior space: the signal is typically brought to the building using roof-mounted antennas **180** or with a base station (BTS) installed in a telecommunications equipment room. The antennas **180** or BTS is then connected to the DAS using coaxial cabling or other wired or wireless connection mechanism. The DAS network of coverage nodes **150** is placed strategically throughout the building using cable or other connection mechanism. The DAS works with multiple coverage nodes **150** strategically placed within the building to provide reliable text messaging, data, and voice communications. All coverage nodes **150** in the system may be networked together to deliver a balanced and reliable signal throughout the site. The head end unit **100** manages all of the coverage nodes **150** in the DAS system along with local and remote access for monitoring and status checking. Alternatively, management may be distributed across the network.

[0019] Alternatively, the DAS system can be installed in any site, which may include tunnels, fields, sports stadiums, subway or railway stations, buses, airports, or subways, etc. in additional to the building shown in FIG. **1**A.

[0020] FIG. **1**B is a block diagram illustrating a detailed embodiment **10**B of the distributed amplifier system **10**A shown in FIG. **1**A. A distributed amplifier system **10**B shown in FIG. **1**B comprises a head end **100** and a plurality of coverage nodes **150**. The head end **100** comprises a sub-band limiting unit **102**, a Pilot Tx (Transmit) unit **104**, a bi-directional cellular amplifier **106**, a modem **108**, a spectrum analyzer **110**, a calibration info unit **112**, a characterization unit **114**, and a remote connect unit **116**.

[0021] The sub-band limiting unit **102** is communicatively coupled to the antenna **180** and limits strength of sub-band signals. The bi-directional cellular amplifier **106** is communicatively coupled to the sub-band limiting unit **102** and amplifies the sub-band signals. The bi-directional cellular amplifier **106** is also communicatively coupled to the pilot Tx unit **104**, so that the bi-directional cellular amplifier **106** can obtain information regarding how close the coverage antennas **156** are to each other from the pilot Tx unit **104**. The bi-directional cellular amplifier **106** is further communicatively coupled to the modem **108**, so that the amplified signals are delivered to the modem **108**. The modem **108** is part of an internal network for access and control of the DAS. To be more specific, the modem **108** is a communication device that talks to all of the remote nodes including but not limited to modems **154**. The spectrum analyzer **110** is communicatively coupled to the sub-band limiting unit **102** and analyzes spectrum of the signals outputted by the sub-band limiting unit **102**. The calibration information unit **112** is communicatively coupled to the spectrum analyzer **110** and collects calibration information from the spectrum analyzer **110**. The calibration info unit **112** is the place where all of the calibration information for all nodes and the head end are stored. This calibration information is used by the characterization unit **114** to determine if the environment has changed. The characterization unit **114** is communicatively connected to the calibration information unit **112** and observes the way the unit is calibrated and then monitors the entire DAS system to determine if the environment is change that needs re-calibration. The characterization unit **114** can be used to trigger trouble shooting in the system. The remote connect unit **116** is communicatively connected to the characterization unit **114** and transmits remote connect information through the antenna **190** or via other wired or wireless connection mechanism. The Pilot Tx unit **104** is a Pilot transmitter, and is used to measure how close the coverage antennas are to each other. The term "communicatively couple" includes any kinds of coupling, such as wired or wireless connection.

[0022] While only one amplifier **106** is shown in the first device **100**, in an embodiment of the invention, there are multiple amplifiers to amplify different frequencies. Further, while the amplifier **106** is referred to as a cellular amplifier, it can also amplify other signals, such as WiFi, WiMax, public emergency signals etc. Similarly, while only one amplifier **152** is shown in the second device **150**, in an embodiment of the invention, there are multiple amplifiers to amplify different frequencies. Further, while the amplifier **152** is referred to as a cellular amplifier, it can also amplify other signals, such as WiFi, WiMax, public emergency signals etc. Further, the amplifier may also be a single direction amplifier, such as uplink or downlink.

[0023] While only one sub-band limiting unit **102** is shown in the first device **100**, in an embodiment of the invention, there are multiple sub-band limiting units **102** to filter signals in different sub-bands.

[0024] Each of the coverage node **150** comprises a bi-directional cellular amplifier **152** and a modem **154**. The bi-directional cellular amplifier **152** is communicatively coupled to the modem **154**. The uplink and downlink signals are amplified by the bi-directional cellular amplifier **152**. Each of the cellular amplifier is also communicatively coupled to an antenna **156** to transmit downlink signals to user equipment attached to or covered by the coverage nodes **150**, or receive uplink signals from the user equipment attached to or covered by the coverage nodes **150**. The head end **100** and each of the coverage nodes **150** are connected by coaxial cable or other wired or wireless connection mechanism.

[0025] Each of the various modules shown in FIG. **1**B (e.g., Calibration info unit **112**) can be implemented in pure hardware (e.g., specially-designed dedicated circuitry such as one or more application-specific integrated circuits (ASICs)), or in programmable circuitry appropriately programmed with software and/or firmware, or in a combination of pure hardware and programmable circuitry.

[0026] FIG. **2** is a diagram illustrating a detailed embodiment **10**C of the distributed amplifier system **10**A shown in FIG. **1**A. The distributed amplifier system **10**C shows units or modules pertinent to the embodiment. The system **10**C comprises a first device **100**A and at least one second devices **150**. The first device **100**A comprises a receiver **200**, a spectrum analyzer **110**, a controller **210**, an amplifier **106** and a transmitter **220**. The first device **100**A may be implemented by the head end **100** shown in FIGS. **1**A and **1**B. The second devices **150** shown in FIG. **2** are substantially the same as the second devices **150** shown in FIGS. **1**A and **1**B. An interconnect **230** shown in FIG. **2** is an abstraction that represents any one or more separate physical buses, point-to-point connections, wired or wireless connections. The interconnect **230**, therefore, may include, for example, a system bus, a form of Peripheral Component Interconnect (PCI) bus, a HyperTransport or industry standard architecture (ISA) bus, a small computer system interface (SCSI) bus, a universal serial bus (USB), IIC (I2C) bus, a CAN-bus (Controller Area Network), or an Institute of Electrical and Electronics Engineers (IEEE) standard 1394 bus, also called "Firewire", and/or any other suitable form of physical or virtual connection, either wired or wireless.

[0027] The receiver **200** receives, from at least one antenna, a plurality of signals from different sources. The source includes but is not limited to a telecommunication tower such as a cellular tower, an access point such as a Wi-Fi hot spot, or a satellite signal transmitter, etc. The spectrum analyzer **110** is communicatively coupled to the receiver **200** and determines whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold. The predetermined threshold may be a value between −60 dBm to −40 dBm. The downlink signal power or strength is an indicator of a distance between the source (not shown in FIG. **2**) and a DAS system **10**C. Examples of source include a cellular tower, a WIFI hotspot. The closer the DAS system **10**C to the source, the larger the downlink signal power between the source and the DAS system. By contrast, the farther the DAS system **10**C to the source, the smaller the downlink signal power between the source and the DAS system. The controller **210** is communicatively coupled to both the spectrum analyzer **110** and an amplifier **106** and configured to generate a first indication indicating lowering gains of the amplifier **106** on signals from at least one source with downlink signal power larger than the predetermined threshold. The amplifier **106** adjusts gains according to the first indication from the controller **210**. In other words, the gains of signals on the sub-band from the source nearer to the DAS system are lowered compared to the other signals on other sub-band across the band. The filters are configured so that each of the different radio frequency (RF) sub-band may be handled independently.

[0028] When the distributed amplifier system is closer to the tower, not as much signal gain is required as what is needed for a tower farther away. Since the distributed amplifier system is closer to that tower, it doesn't need a strong signal. The communication quality for a signal with a lower signal strength will not deteriorate when the DAS system is closer to the source.

[0029] Further, noise refers to the noise emitted into the cellular network from an amplifier system. Noise is emitted because amplifier system amplifies the wanted cellular signal together with the noise contained in the air at the input antenna. The more gain an amplifier system has, the more noise it emits. The noise may include "white noise", and is spread out across all frequencies. In order not to have a negative effect on the cellular network, gains are reduced when the signal is from nearer cellular towers. Therefore, lowering the output power on an amplifier for signal from a nearer source will not affect the output power for communication signals that are going to different communication systems from different network providers. The gain on the sub-bands used by the nearby towers are lowered thus lowering the noise on this sub-band, while still providing high gain on the sub-bands used by far away towers. As a result, the effectiveness of the DAS system for the wireless devices using a variety of communication networks can be improved.

[0030] In another embodiment, the first indication further comprises lowering output power of the signals from at least one source with downlink signal power larger than the predetermined threshold such that noises of the plurality of signals after adjustment are below a predetermined noise floor. The predetermined noise floor may be −100 dBm.

[0031] The transmitter **220** transmits the plurality of signals after adjustment to at least one of the second devices **150** distributed within a site.

[0032] Alternatively, the controller **210** may further generate a second indication indicating increasing gains on signals from at least one source with downlink signal power smaller than or equal to the predetermined threshold. In other words, the output power of an amplifier for signal from a farther source will be increased.

[0033] FIG. **3** is a block diagram illustrating a different embodiment **1008** of the first device **100**A shown in FIG. **2**. Details are omitted for elements already described with respect to FIG. **2**. Compared to FIG. **2**, the first device **1008** further comprises a filter **300**. The filter **300** is also communicatively coupled to the controller **210**. The filter **300** also adjusts output power of the signals on specific sub-bands indicated by the controller **210**. For example, the filter **310** lowers the output power of the signal on the sub-band from a source with a larger downlink signal power.

[0034] The filter **300** may include a radio frequency (RF) filter configured to lower output power of the signals from the at least one source with downlink signal power larger than the predetermined threshold. Alternatively, the filter **300** may include a synthesizer configured to lower output power of the signals from the at least one source with downlink signal power larger than the predetermined threshold. Alternatively, the filter **300** may comprise a digital signal processing (DSP) unit configured to lower output power of the signals from the at least one source with downlink signal power larger than the predetermined threshold. The interconnect **230** shown in FIG. **4** is substantially the same as the interconnect **230** shown in FIG. **2**, which represents the interconnection among the receiver **200**, the spectrum analyzer **114**, the filter **400**, the controller **410** and the transmitter **220**.

[0035] In another embodiment, the receiver **200**, the controller **210**, the filter **300**, the amplifier **106** and the spectrum analyzer **110**, and the transmitter **220** are connected in serial. The filter **400** may change the signal to make it more flat, and the output of this filter **400** may feed into the transmitter **220** and the spectrum analyzer **110**. In other words, the filter **300** will alter what the spectrum analyzer **110**, the amplifier **106** and the transmitter **220** will get.

[0036] FIG. **4** is a flow chart illustrating an embodiment of a method **40**. The method **40** comprises receiving (in block **410**), from at least one antenna, a plurality of signals from different sources, determining (in block **420**) whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold; lowering (in block **430**) gains on signals from at least one source with a downlink signal power larger than the predetermined threshold; transmitting (in block **440**) the plurality of signals after adjustment to at least one second devices distributed within a site.

[0037] The above embodiment illustrates a downlink transmission scenario. In uplink transmission, however, directions of all the arrows are reversed in respect to the direction shown in FIG. 1B. In other words, the arrows are upstream for the uplink scenario. FIG. 5 is a diagram illustrating another embodiment **100** of the distributed system **10**A operating for uplink transmission. The distributed amplifier system **100** comprises a plurality of second devices **150** and a first device **100**A. The plurality of second devices **150** are distributed in a site. Each second device **150** comprises a first transmitter **500** that transmits at least one signal to the first device **100**A. The first device **100**A comprises a receiver **510**, a spectrum analyzer **110**, a controller **210**, an amplifier **106**, and a second transmitter **520**. The receiver **510** receives a plurality of signals from the plurality of second devices **150**. The spectrum analyzer **110** is communicatively coupled to the receiver **510** and determines whether a downlink signal power from a source to the system exceeds a predetermined threshold. The controller **210** is communicatively coupled to the spectrum analyzer **110** and generates an indication indicating lowering gains on output power of signals from the second device **500** to the first device **100**A when a downlink signal power from the source to the system exceeds a predetermined threshold. The amplifier then lowers the output power of the received signals according to the indication from the controller **210**. The second transmitter **520** transmits the plurality of signals after adjustment to the source. Therefore, lowering the output power of an amplifier for signal to a nearer source will not affect the output power for communication signals that are going to different communication systems from different coverage nodes, therefore the effectiveness of the DAS for the wireless devices using a variety of communication networks can be improved. Note that the downlink signal which is used by the spectrum analyzer **110** are different from the uplink signals received by the receiver **510** from the second device **150**, adjusted by the amplifier and then transmitted by the second transmitter **520**.

[0038] Further, noise refers to the noise emitted into the cellular network from an amplifier system. Noise is emitted because any amplifier system amplifies the wanted cellular signal together with the noise contained in the air at the input antenna. The more gain an amplifier system has, the more noise it emits. In order not to have a negative effect on the cellular network, gains are reduced for uplink signal to nearer the cellular towers. Therefore, lowering the output power on an amplifier for signal to a nearer source will not affect the output power for communication signals that are going to different communication systems from different network providers. The gain on the sub-bands used by the nearby towers are lowered thus lowering the noise on this sub-band, while still providing high gain on the sub-bands used by far away towers. As a result, the effectiveness of the DAS system for the wireless devices using a variety of communication networks can be improved.

[0039] Note that any and all of the embodiments described above can be combined with each other, except to the extent that it may be stated otherwise above or to the extent that any such embodiments might be mutually exclusive in function and/or structure.

[0040] Although the present invention has been described with reference to specific exemplary embodiments, it will be recognized that the invention is not limited to the embodiments described, but can be practiced with modification and alteration within the spirit and scope of the appended claims. Accordingly, the specification and drawings are to be regarded in an illustrative sense rather than a restrictive sense.

[0041] From the foregoing, it will be appreciated that specific embodiments of the invention have been described herein for purposes of illustration, but that various modifications may be made without deviating from the scope of the invention. Accordingly, the invention is not limited except as by the appended claims.

[0042] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. Even if certain features are recited in different dependent claims, the present invention also relates to an embodiment comprising these features in common. Any reference signs in the claims should not be construed as limiting the scope.

[0043] Features and aspects of various embodiments may be integrated into other embodiments, and embodiments illustrated in this document may be implemented without all of the features or aspects illustrated or described. One skilled in the art will appreciate that although specific examples and embodiments of the system and methods have been described for purposes of illustration, various modifications can be made without deviating from the spirit and scope of the present invention. Moreover, features of one embodiment may be incorporated into other embodiments, even where those features are not described together in a single embodiment within the present document. Accordingly, the invention is described by the appended claims.

I/We claim:

1. A system comprising:

a first device comprising

a receiver configured to receive, from at least one antenna, a plurality of signals from different sources;

a spectrum analyzer communicatively coupled to the receiver and configured to determine whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold;

a controller communicatively coupled to the spectrum analyzer and configured to generate a first indication indicating lowering gains of an amplifier on signals from at least one source with downlink signal power larger than the predetermined threshold;

the amplifier communicatively coupled to the controller and configured to lower gains of the amplifier according to the indication from the controller;

a transmitter configured to transmit the plurality of signals after adjustment to at least one of the second device distributed within a site; and

the at least one second devices configured to transmit the plurality of received signals after adjustment within the site.

2. The system of claim **1**,

wherein the controller is also configured generate a second indication indicating increasing gains on signals from at least one source with downlink signal power smaller than or equal to the predetermined threshold.

3. The system of claim **1**,

wherein the first indication further comprises lowering output power of the signals from at least one source with downlink signal power larger than the predetermined threshold such that noises of the plurality of signals after adjustment are below a predetermined noise floor.

4. The system of claim **1**, further comprising a filter communicatively coupled to the controller, wherein the filter includes a radio frequency (RF) filter configured to lower output power of the signals from the at least one source with downlink signal power larger than the predetermined threshold.

5. A system of claim **1**, further comprising a filter communicatively coupled to the controller, wherein the filter includes a synthesizer configured to lower output power of the signals from the at least one source with downlink signal power larger than the predetermined threshold.

6. A system of claim **1**, further comprising a filter communicatively coupled to the controller, wherein the filter further comprises a digital signal processing (DSP) unit configured to lower output power of the signals from the at least one source with downlink signal power larger than the predetermined threshold.

7. The system of claim **1**,

wherein the first device comprises a head end, and the second device comprises a coverage node.

8. A first device comprising

a receiver configured to receive, from at least one antenna, a plurality of signals from different sources;

a spectrum analyzer communicatively coupled to the receiver and configured to determine whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold;

a controller communicatively coupled to the spectrum analyzer and configured to generate an indication indicating lowering gains on signals from at least one source with a downlink signal power larger than a predetermined threshold;

an amplifier communicatively coupled to the controller and configured to lower gains of the amplifier according to the indication from the controller; and

a transmitter configured to transmit the plurality of signals after adjustment to at least one second device distributed within a site.

9. A method comprising:

receiving, from at least one antenna, a plurality of signals from different sources;

determining whether a downlink signal power from each of the sources to the system exceeds a predetermined threshold;

lowering gains on signals from at least one source with a downlink signal power larger than the predetermined threshold;

transmitting the plurality of signals after adjustment to a plurality of second devices distributed within a site.

10. A system comprising:

A plurality of first devices distributed in a site each comprising

a first transmitter configured to transmit at least one signal to a second device; and

the second device comprising

a receiver configured to receive a plurality of signals from the plurality of first devices;

a spectrum analyzer configured to determine whether a downlink signal power from a source to the system exceeds a predetermined threshold; and

a controller communicatively coupled to the spectrum analyzer and configured to generate an indication indicating lowering gains on signals from the first device to the second device when a downlink signal power from the source to the system exceeds a predetermined threshold;

an amplifier communicatively coupled to the controller and configured to lower gains of the amplifier according to the indication from the controller;

a transmitter configured to transmit the plurality of signals after adjustment to the source.

11. The system of claim **10**,

wherein the controller is also configured to increase gains on signals when a downlink signal power from the destination to the system is smaller or equal to a predetermined threshold.

12. The system of claim **10**,

wherein the first device comprises a head end, the second device comprises coverage nodes, and the source comprises a telecommunication tower or access point.

* * * * *