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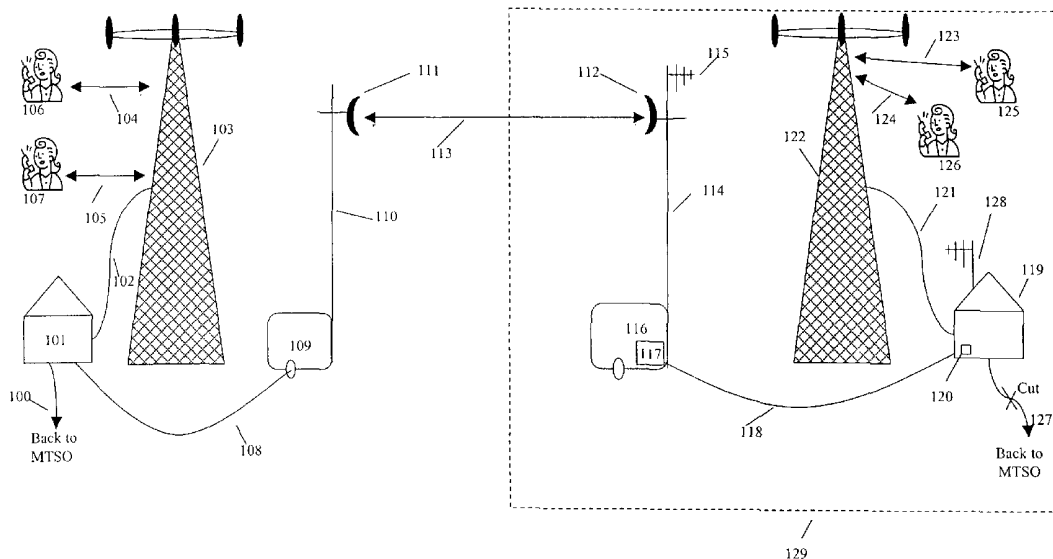
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(54) Title: WIRELESS COMMUNICATIONS METHODS AND SYSTEMS USING A REMOTE, SELF-CONTAINED COMMUNICATIONS ANTENNA UNIT



(57) Abstract: This invention provides wireless communications using a remote, self-contained communications antenna unit that transceives signals from a disconnected cell site and communicates these signals with a communications network. In an exemplary embodiment, the remote, self-contained communications antenna unit includes a transportation vehicle that carries a generator for power, backup batteries, transmitter and receiver equipment, a digital signal processor (DSX), a network interface unit, an air conditioner, and an extendible mast.



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

WIRELESS COMMUNICATIONS METHODS AND SYSTEMS USING
A REMOTE, SELF-CONTAINED COMMUNICATIONS ANTENNA UNIT

PRIORITY APPLICATION

5 This application claims priority to co-pending US Provisional Application No. 60/228,244 filed August 25, 2000, entitled "Wireless Communications Methods and Systems Using Remote, Self-Contained Communications Devices," which is fully incorporated herein by reference.

CROSS REFERENCE TO RELATED APPLICATIONS

10 This application relates to applicant's co-pending Attorney Docket Number 36968-206524 application filed simultaneously herewith, entitled "Wireless Communications Methods And Systems Using A Remote, Self-Contained Cell Site" which is fully incorporated herein by reference.

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20 **BACKGROUND OF THE INVENTION**

1. Field of the Invention

 This invention relates generally to the field of wireless communications. More particularly, this invention relates to wireless communications methods and systems for wireless personal communication devices and for interconnecting these wireless personal

communication devices over a linking frequency using a remote, self-contained communications antenna unit.

2. Background

Wireless communication networks comprise one or more cell sites that assign
5 radio channels for connecting a wireless personal communication device, such as, for
example, a cellular telephone, to another telephone (wireless or wired) through a cellular
switch connected to a terrestrial telephone network. Wireless communication networks
typically include a plurality of interconnected (wireless or wired) cell sites that are
coupled with a centrally located cellular switch, called a Mobile Telephone Switching
10 Office (MTSO), and that connect to a communications network. Cell sites are essentially
buildings that house equipment for transmitting, receiving, and processing wireless
communications to the communications network. There are typically fifty to one hundred
cell sites in large cities, fifteen to fifty cell sites in smaller cities, and very few cell sites or
none in rural areas. Depending on capacity constraints, cell sites may be located one-half
15 to twenty miles from each other. Further, each cell site generally comprises one or more
stationary antennas mounted on a triangular platform that is placed on a tower or atop a
tall building preferably sixty to three hundred feet above the surrounding terrain.

Conventional installation of a new cell site requires placement of one or more
antennas and construction of a cable transmission path for a wired connection (e.g., use of
20 a T1) of the cell site to a switching system. The cost associated with installing a new cell
site is very substantial and ranges on the average from several hundred thousand to half a
million dollars. Additionally, actual siting may not be available for a variety of reasons,
such as unavailability of the sector for the physical plant that contains the cell site, terrain
restraints, regulatory restraints, and the like.

25 When the wired connection is lost to a conventional cell site, the cell site is
disconnected and goes "off the air." Wireless personal communication devices serviced
by the disconnected cell site cannot transmit or receive signals (i.e., a customer cannot
place or receive a telephone call). Depending on the nature of the trouble, the cell site
could be off the air for an extended period of time. Loss of revenue to the cellular
30 provider and customer inconvenience result until the wired connection is repaired and

restored. While there are techniques known in the art that provide emergency means in case of a line fault, they: (1) are bulky and difficult to readily implement; (2) are expensive; and (3) have a limit in the number of applicable connections and in the applicable status of a connection.

5 Thus, replacement methods and systems are needed to provide easy, affordable, and flexible remote wireless communications with wireless personal communication devices communicating with a disconnected cell site and to connect these devices with a communications network.

SUMMARY OF THE INVENTION

10 This invention provides wireless communications using a remote, self-contained communications antenna unit coupled to a disconnected cell site to communicate with a cellular system connected to a communications network. As used herein, a “disconnected” cell site includes remote cell sites, such as, for example, a cell on wheels (COW) and also includes conventional cell sites (i.e., buildings with cellular transceiving equipment) that have lost connection with a cellular switch (e.g., the T1 is cut or there is
15 another line fault) and are “off the air.” As used herein, the term “transceive” includes transmitting, receiving, and processing communication signals. Further, as used herein, a “communications network” includes terrestrial communications networks, such as, for example, the public switch telephone network, as well as celestial communications
20 networks. When the remote, self-contained communications antenna unit is coupled (e.g., wired or wireless connection) to a disconnected cell site, it has the appearance of a operational cell site to the communications network. This invention provides a rapid, inexpensive, and efficient method and system to transceive wireless communication signals (e.g., the Industrial, Scientific, and Medical (ISM) Band frequencies, such as, 2.4-
25 2.5GHz, cellular telephone frequencies, such as, 806-960 MHz, 1710-1855 MHz, and 2500-2690 MHz, paging frequencies, digital processing frequencies, and any other frequency in the electromagnetic spectrum) from wireless personal communication devices communicating with a disconnected cell site and to connect these wireless personal communication devices with the communications network. Further, this

invention is easily positioned at a variety of locations because of the highly mobile platforms that carry the remote, self-contained communications antenna unit.

The remote, self-contained communications antenna unit is coupled with a disconnected cell site to provide remote communications with wireless personal devices. The wireless personal devices transceive radio frequencies to the disconnected cell site, and these signals are communicated to the remote, self-contained communications antenna unit. The remote, self-contained communications unit transceives these signals to the communications network. In one embodiment, the remote, self-contained communications antenna unit may be hard-wired using a T-1 connection to a local service provider's crossbox junction point that connects to a cellular switch, such as, for example, a MTSO. In a second embodiment, the remote, self-contained communications antenna unit transceives these signals using a microwave frequency link to an operational cell site. The operational cell site connects these signals to the MTSO and the communications network. In a third embodiment, the remote, self-contained communications antenna unit transceives these signals to a second remote, self-contained communications antenna unit that is connected to an operational cell site. The second remote, self-contained communications antenna unit may be used as an alternative to a direct connection with an operational cell site when there are obstacles (e.g., terrain obstruction) between the remote, self-contained communications antenna unit coupled with the disconnected cell site and the operational cell site.

The remote, self-contained communications antenna unit includes a power source, backup power source, transceiving equipment, a signal processor, network communications equipment, antenna, and an antenna mast for transmitting and receiving wireless communications at various heights. Further, the remote, self-contained communications antenna unit may be mounted upon a transportation vehicle.

In a preferred embodiment, the remote, self-contained communications antenna unit is a trailer that transports and carries a generator for power, backup batteries, transceiving equipment, a digital signal processor (DSX), a network interface unit (NIU), an air conditioner, an antenna, and an extendible mast that supports the antenna. The remote, self-contained communications antenna unit also includes a power charging unit, such as a battery charger.

This invention is useful for restoring cell site functionality, for providing emergency service, for increasing cellular capacity, and for adding a remote, self-contained communications antenna unit coupled with a disconnected cell site. For instance, this invention provides cellular service where a line fault has disconnected the conventional cell site and caused it to go “off the air” (e.g., the T1 connection to the terrestrial telephone network has been cut). It provides service to a location out of range of cell sites, such as service to a rural location. This invention is also useful for temporarily increasing cellular capacity, such as, for example, providing cellular coverage to customers attending large events like the SuperBowl and the Olympics. Further, this invention is useful for adding a permanent cell site when laying a transmission path to a switching system is difficult or impossible or when adding a permanent cell site is too costly.

These uses may be accomplished singularly, or in combination, in one or more of the embodiments of the this invention.

Additional uses, objects, advantages, and novel features of the invention are set forth in the detailed description that follows and will become more apparent to those skilled in the art upon examination of the following or by practice of the invention.

BRIEF DESCRIPTION OF THE FIGURES

Other uses, objects, advantages, and novel features of this invention are more clearly understood by reference to the following and the accompanying figures, in which:

Figure 1 illustrates the communications paths using a first remote, self-contained communication antenna unit of this invention coupled with a disconnected cell site to communicate signals to a second remote, self-contained communications antenna unit of this invention coupled with an operational cell site.

Figure 2 is a more detailed schematic diagram of the remote, self-contained communications antenna unit of this invention shown in Figure 1.

DETAILED DESCRIPTION

The following is presented by way of example and should not be construed as limiting the inventive concept to any particular configuration.

In conventional wireless communications networks, a plurality of interconnected switching systems are coupled with a plurality of cell sites that transmit and receive signals to wireless personal communication devices. This invention allows wireless communication service providers to rapidly, inexpensively, and efficiently provide wireless communication coverage to restore functionality to a disconnected cell site.

Figure 1 depicts the communications paths using remote, self-contained communications antenna unit **116** coupled with disconnected cell site **119** and using another remote, self-contained communication antenna unit **109** connected to the communications network through cell site **101**. Cell site **101** is said to be “on the air” when it is connected to a switching system of the communications network, such as the MTSO, over a wired medium **100**. Disconnected cell site **119** is said to be “off the air” or “disconnected” when it is not connected to a switching system of the communications network, such as when a conventional cell site’s T1 cable to the MTSO is cut **127**.

Cell site **101** connects wireless personal devices **106, 107** with the communications network. Cell site **101** is coupled to an antenna **103** using a wired medium **102**. Cell site **101** is capable of transceiving signals **104, 105** with a plurality of wireless personal communication devices **106, 107** and is capable of communicating signals **104, 105** over the communications network. Cell site **101** is connected to a remote, self-contained communications antenna unit **109** using a wired medium **108**, such as a T1 cable. Alternatively, wireless communications could be used to establish a connection between cell site **101** and remote, self-contained communications antenna unit **109**.

Remote, self-contained communications antenna unit **109** includes a mast **110** that supports a microwave antenna **111**. Microwave antenna **111** transceives signals with microwave antenna **112** of remote, self-contained communications antenna unit **116** on a linking frequency signal **113**. Mast **114** supports microwave antenna **112** and radio frequency antenna **115**. Remote, self-contained communications antenna unit **116** may use a wired medium **118**, such as a T1 cable, to connect Network Interface Unit (NIU) **117** to Customer Service Unit (CSU) **120**. Alternatively, remote, self-contained communications antenna unit **116** may use wireless communications to communicate with disconnected cell site **119**. For example, radio frequency antenna **115** may

transceive signals with radio frequency antenna **128**. Disconnected cell site **119** is coupled to antenna **122** using a wired medium **121**. Disconnected cell site **119** is capable of transceiving signals **123, 124** with a plurality of wireless personal communication devices **125, 126** and is capable of communicating signals **123, 124**.

5 Figure 2 illustrates an exemplary remote, self-contained communications antenna unit **116** that includes a generator **201**, backup batteries **202**, transceiving equipment **203**, a digital signal processor (DSX) **204**, a network interface unit (NIU) **117**, an air conditioner **205**, and an extendible mast **114** that supports microwave antenna **112** and radio frequency antenna **115**. The remote, self-contained communications antenna unit
10 **116** is easily assembled, housed, and transported on a light trailer. Additionally, components **117, 201-204** are configured in a flexible manner such as by mounting them in racks that allows each component to be easily removed and replaced with minimal time and labor resources.

 The remote, self-contained communications antenna unit coupled with a
15 disconnected cell site **129** has the appearance of an “on the air” cell site and provides the means to establish wireless communications between the communications network and wireless personal communication devices **125, 126**. In an illustrative embodiment, the remote, self-contained communications antenna unit **116** functions as follows. When cell site **119** is disconnected and goes “off the air” (e.g., the T1 connection is cut), a remote,
20 self-contained communications antenna unit **116** is mobilized. The remote, self-contained communications antenna unit **116** is positioned near or at the disconnected cell site **119** to re-establish communications with the communications network. The trailer that transports the remote, self-contained communications antenna unit **116** is small enough to be placed near the disconnected cell site **119** and the extendible mast **114** supporting
25 microwave antenna **112** and radio frequency antenna **115** is raised. A wired medium **118** is used to connect the CSU **120** to the NIU **117**.

 NIU **117** is connected to microwave radio **203**, and a signal is transmitted up mast **114** to the microwave antenna **112**. The microwave antenna **112** transmits the signal to a nearby cellular system, such as another remote, self-contained communications antenna
30 unit **109** coupled to a “on the air” cell site **101**. Alternatively, remote, self-contained communications antenna unit **109** could be coupled using a wired medium to a local

service provider's crossbox junction point. Mast 110 is raised along with a matching microwave antenna 111. The two microwave antennas 111, 112 are aligned using extendible masts 110, 114 and signals 123, 124 from wireless personal communication devices 125, 126 are immediately and conveniently communicated to the communications network.

Further details on these embodiments, other possible embodiments, and additional methods and systems of the this invention are set forth below.

The wired mediums discussed above may be a fiber, cable, or other carrier medium.

In alternate embodiments, this invention can be mounted on a variety of conventional and non-conventional transportation vehicles, such as, for example, motorized vehicles (e.g., a car, a boat, an airplane, or a helicopter) and non-motorized vehicles (e.g., a utility trailer or a hot-air balloon).

The equipment and communication methods of the remote, self-contained communications antenna unit are usable with all wireless communication products, methods, and frequencies. They are usable with cellular/PCS phones, wireless computers and modems, wireless personal data assistants, global positioning devices, and any other wireless data, voice, or video communications devices. They are usable with satellite phones and satellite communications technology. They are usable with code-division multiple access (CDMA) technologies, time-division multiple access (TDMA) technologies, the global system for mobile communications (GSM) technology, and other technologies. Further, they are usable with all frequencies in the electromagnetic spectrum and are compatible with the June 2000 World Radiocommunication Conference agreement on third-generation cellular telephony.

Additionally, range of operation of the remote, self-contained communications antenna unit is partially a function of transmitter power, and is, therefore, a matter of choice. Antenna selection and siting is also a matter of choice. For example, omnidirectional or directional antennas can be used. Additionally, the remote, self-contained communications antenna unit may include diversity reception of mobile signals in various embodiments of the this invention. Further, linking frequency signal 113 may be in the microwave or other communications band and is the medium over which the

remote, self-contained communications antenna unit site communicates with
communicates with a cellular system connected to the communications network.

In other various embodiments, the remote, self-contained communications antenna
unit includes other useful components. For example, the trailer used to transport the
5 remote, self-contained communications antenna unit includes stabilizing equipment, such
as a scissors jack to provide improved trailer stability. Another example is that the mast
of the remote, self-contained communications antenna unit may be a telescopic mast that
quickly and easily allows the mast to be extended and collapsed.

10 Various embodiments of the invention have been described in fulfillment of the
various objects of the invention. It should be recognized that these embodiments are
merely illustrative of the principles of this invention. Numerous modifications and
adaptations thereof will be readily apparent to those skilled in the art without departing
from the spirit and scope of this invention.

What is claimed is:

1. A remote, self-contained communications antenna apparatus for establishing wireless communications, comprising:
 - (a) a vehicle; and
 - 5 (b) attached to said vehicle, equipment for
 - (i) tranceiving wireless communication signals between said equipment and a disconnected cell site, and
 - (ii) transceiving wireless communication signals between said equipment and a communications network.
- 10 2. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said disconnected cell site are tranceived at 806-960 MHz.
3. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said disconnected cell site are tranceived at 1710-1855 MHz.
4. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said disconnected cell site are tranceived at 2500-2690 MHz.
- 15 5. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said disconnected cell site are tranceived at 2.4-2.5 GHz.
6. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said disconnected cell site are for wireless paging devices.
- 20 7. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said disconnected cell site are for digital processing devices.
8. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said disconnected cell site comprise any frequency signal in the electromagnetic spectrum.
- 25 9. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said communications network unit are tranceived at 806-960 MHz.
10. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said communications network unit are tranceived at 1710-1855 MHz.
- 30 11. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said communications network unit are tranceived at 2500-2690 MHz.

12. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said communications network unit are transceived at 2.4-2.5 GHz.
13. The apparatus of claim 1, wherein said wireless communication signals between said equipment and said communications network unit comprise any frequency signal in the electromagnetic spectrum.
14. The apparatus of claim 1, wherein said communications network comprises a celestial communications network.
15. The apparatus of claim 1, wherein said communications network comprises a terrestrial communications network.
16. The apparatus of claim 1, wherein said disconnected cell site transceives wireless communication signals with a wireless device.
17. The apparatus of claim 16, wherein said wireless device comprises at least one of the following:
- (a) a phone;
 - (b) a computer;
 - (c) a modem;
 - (d) a pager;
 - (e) a personal data assistant;
 - (f) a global positioning system receiver; and
 - (g) an interactive television.
18. The apparatus of claim 1, wherein said equipment comprises one or more of the following:
- (a) a power source for providing power to said remote, self-contained communications antenna apparatus;
 - (b) a backup power source for providing backup power to said remote, self-contained communications antenna apparatus;
 - (c) a charging source for
 - (1) charging said power source, and
 - (2) charging said backup power source;
 - (d) transceiving equipment for

- (i) transmitting and receiving said wireless communication signals between said equipment and said disconnected cell site, and
- (ii) transmitting and receiving said wireless communication signals between said equipment and said communications network;
- 5 (e) network interface equipment for
- (i) processing said wireless communication signals between said equipment and said disconnected cell site, and
- (ii) processing said wireless communication signals between said equipment and said communications network;
- 10 (f) a control unit for
- (i) managing said wireless communication signals between said equipment and said disconnected cell site, and
- (ii) managing said wireless communication signals between said equipment and said communications network;
- 15 (g) a data storage unit for storing data associated with
- (i) said wireless communication signals between said equipment and said disconnected cell site, and
- (ii) said wireless communication signals between said equipment and said communications network;
- 20 (h) a mast for extending and collapsing an antenna of said transceiving equipment;
- (i) environmental control equipment for controlling temperature; and
- (j) stabilizing equipment to secure and balance the attachment of said equipment to said vehicle.
- 25 19. The apparatus of claim 18, wherein said control unit comprises a personal computer.
20. The apparatus of claim 18, wherein said vehicle comprises a non-motorized vehicle.
21. The apparatus of claim 20, wherein said motorized vehicle comprises a trailer.
22. The apparatus of claim 18, wherein said vehicle comprises a motorized vehicle.
23. The apparatus of claim 22, wherein said charging source further charges said
- 30 motorized vehicle.
24. The apparatus of claim 18, wherein said mast comprises an extendible mast.

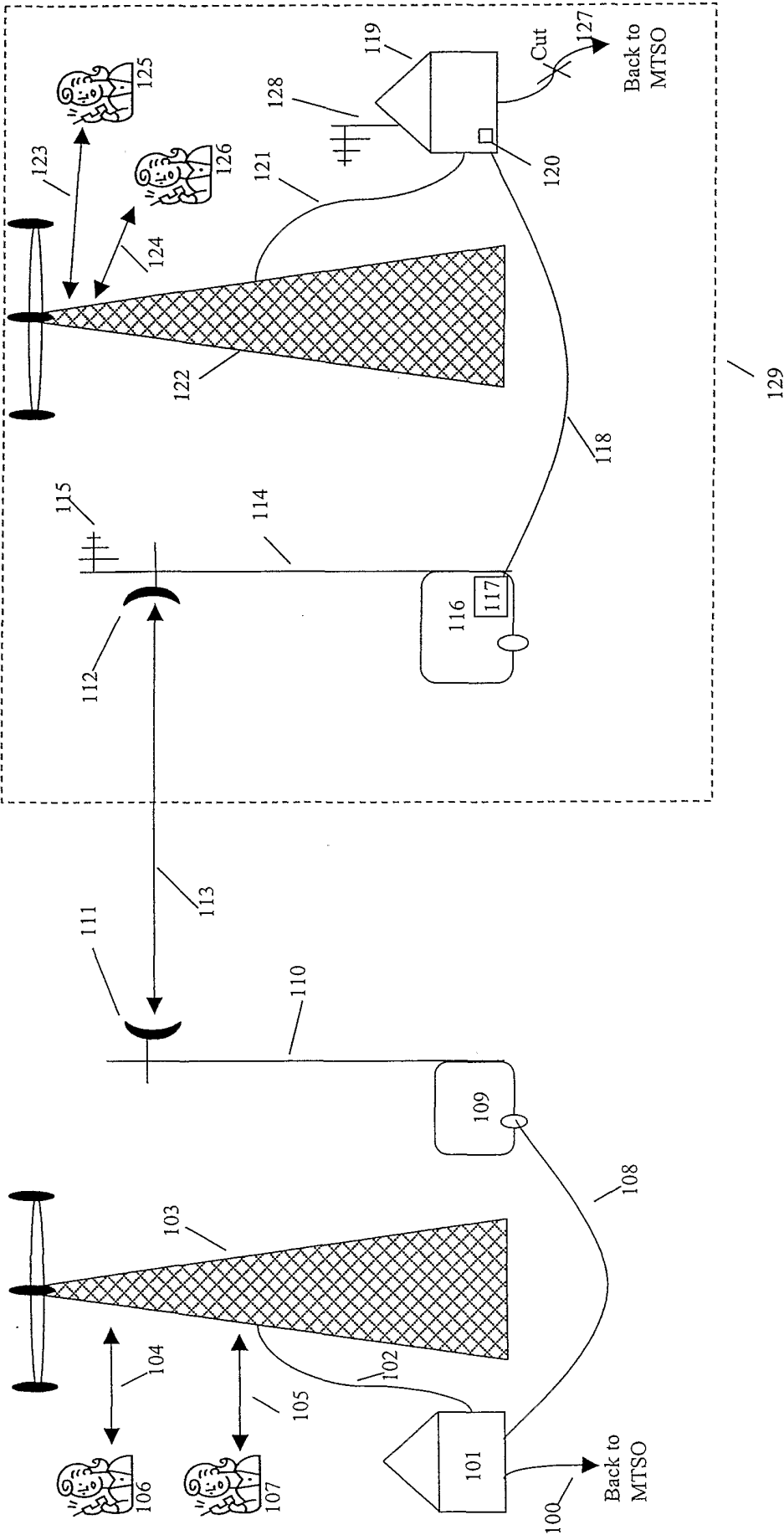
25. The apparatus of claim 18, wherein said signal processor comprises a digital signal processor.
26. The apparatus of claim 18, wherein said signal processor comprises an analog signal processor.
- 5 27. The apparatus of claim 18, wherein said power source comprises at least one of the following:
- (a) a gasoline-powered generator;
 - (b) a solar-powered generator; and
 - (c) an electrical-powered generator.
- 10 28. The apparatus of claim 18, wherein said network interface unit communicates with a customer service unit of said disconnected cell site using wireless communications.
29. The apparatus of claim 18, wherein said network interface unit communicates with a customer service unit of said disconnected cell site using a wired medium.
30. A remote, self-contained communications antenna apparatus for establishing wireless communications, comprising:
- 15 (a) a vehicle; and
- (b) attached to said vehicle, equipment for
- (i) transceiving wireless communication signals between said equipment and a cellular system, and
 - 20 (ii) transceiving wireless communication signals between said cellular system and a communications network.
31. The apparatus of claim 30, wherein said cellular system comprises a cellular switch.
32. The apparatus of claim 30, wherein said cellular system comprises a remote cell site.
33. The apparatus of claim 30, wherein said cellular system comprises a cell site.
- 25 34. The apparatus of claim 30, wherein said cellular system comprises a disconnected cell site.
35. A method for establishing wireless communications, comprising:
- (a) transceiving wireless communication signals between a wireless device and a disconnected cell site; and
 - 30 (b) transceiving wireless communication signals between said disconnected cell site and a remote, self-contained communications antenna apparatus; and

(c) transceiving wireless communication signals between said remote, self-contained communications antenna apparatus and a communications network.

36. A method for establishing wireless communication, comprising:

5 (a) transceiving wireless communication signals between a remote, self-contained communications antenna apparatus and a cellular system; and

(b) transceiving wireless communication signals between said cellular system and a communications network.



1/2
FIG 1

