(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 696 503 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.08.2006 Bulletin 2006/35

(21) Application number: **05251173.0**

(22) Date of filing: **28.02.2005**

(51) Int Cl.:
H01Q 1/24 *(2006.01)* ***H01Q 3/24*** *(2006.01)*
H01Q 21/28 *(2006.01)* ***H04B 7/08*** *(2006.01)*
H04B 1/38 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR LV MK YU

(71) Applicant: **Research In Motion Limited**
Waterloo, Ontario N2L 3W8 (CA)

(72) Inventors:
- **Kezys, Vitas**
  Ancaster
  Ontario, N2T 2H3 (CA)
- **Qi, Yihong**
  Waterloo
  Ontario, N2T 2H3 (CA)

(74) Representative: **Roberts, Gwilym Vaughan et al**
Kilburn & Strode
20 Red Lion Street
London WC1R 4PJ (GB)

(54) Mobile wireless communication device with human interface diversity antenna and related methods

(57) A mobile wireless communications device may include a portable handheld housing, and a wireless transceiver carried by the housing. A pair of an antennas are positioned in side-by-side relation preferably in the upper portion of the portable handheld housing. A human interface diversity controller is connected to the wireless transceiver to preferentially operate with the plurality of antennas based upon a relative position of the portable handheld housing with respect to a hand of a human user. The device can select or weight the antennas based upon the position of the device when being held by a user.

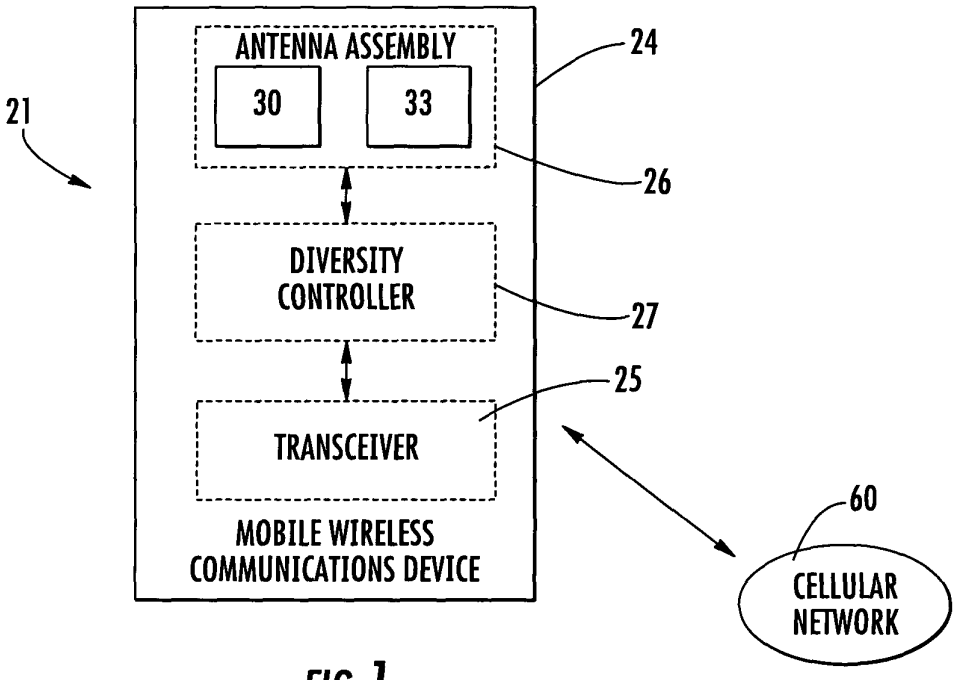

FIG. 1

EP 1 696 503 A1

(Cont. next page)

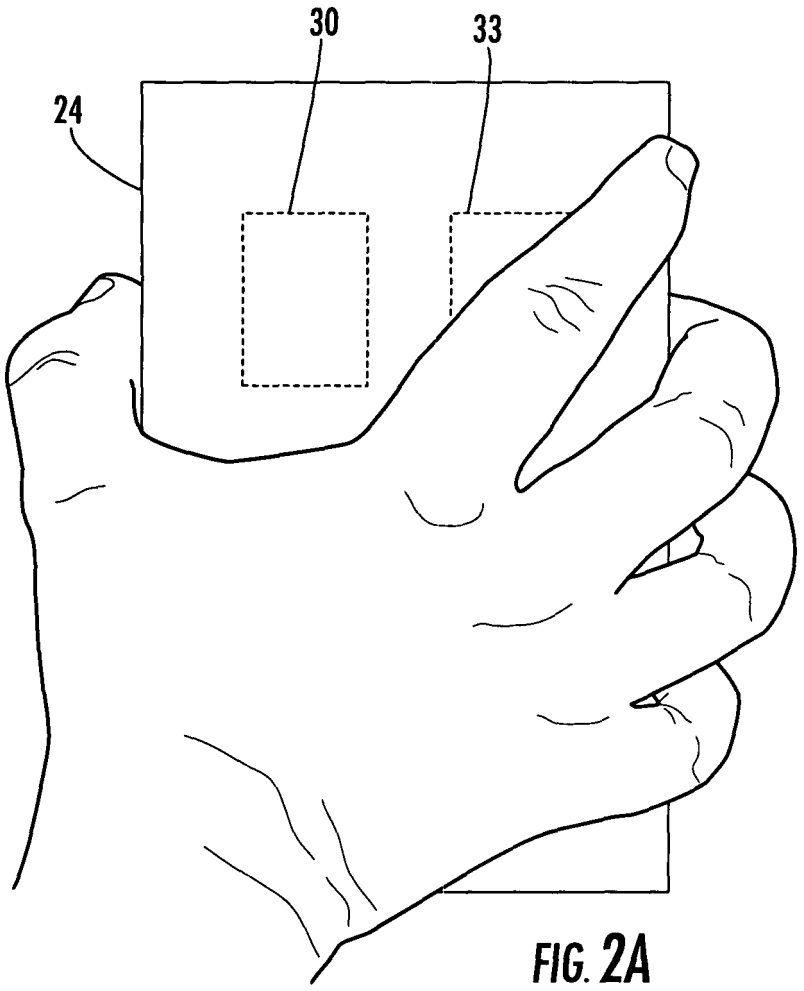

FIG. 2A

Description

Field of the Invention

[0001] The present invention relates to the field of communications systems, and, more particularly, to wireless communications systems and related methods.

Background of the Invention

[0002] One of the challenges of wireless communications is designing suitable antennas that can provide desired performance characteristics, yet are relatively small in size to fit within mobile devices. For example, with wireless devices such as mobile telephones, it is desirable to keep the overall size of the telephone as small as possible. Furthermore, internal antennas are generally preferred over external antennas, as externally mounted antennas take up more space and may be damaged while traveling, etc.

[0003] The use of an internal antenna in a handheld device, particularly those that can be held in various positions, such as by either, both or no hands, leads to the antenna environment being modified in different ways depending on how the user holds/positions the device. Accordingly, antenna designs have to be optimized for only a single position, e.g. one handheld scenario, or the antenna has to be designed to compromise between mulitple scenarios.

[0004] One example of an antenna that is implemented on a PCMCIA card to be inserted in a PCMCIA slot of a laptop computer is disclosed in U.S. Patent No. 6,031,503 to Preiss, II et al. The antenna assembly includes two folded, U-shaped antennas, which may be dipoles or slot radiators, that are disposed orthogonally to one another to provide polarization diversity. Polarization diversity means that signals are transmitted and received on two different polarizations to increase the likelihood that the signal is received. Signals are carried to and from the antenna by microstrip feed lines. The microstrip lines are placed off center along each antenna slot to establish an acceptable impedance match for the antenna, and the feed lines are coupled to the communications card by coaxial cables.

[0005] Accordingly, with even more restrictive space constraints for such handheld devices, there is a need for antennas which are appropriately sized for such applications yet still provide desired performance characteristics.

Summary of the Invention

[0006] In view of the foregoing background, it is therefore an object of the present invention to provide a mobile wireless communications device with an antenna and transceiver providing human interface diversity as well as other desired signal characteristics and related methods.

[0007] This and other objects, features, and advantages in accordance with the present invention are provided by a mobile wireless communication device including a portable handheld housing which may have an upper portion and a lower portion, and a wireless transceiver carried by the portable handheld housing. A plurality of antennas, preferably a pair of an antennas, are positioned in side-by-side relation preferably in the upper portion of the portable handheld housing. A human interface diversity controller is connected to the wireless transceiver to preferentially operate with the plurality of antennas based upon a relative position of the portable handheld housing with respect to a hand of a human user.

[0008] The human interface diversity controller preferentially weights transmit signals, and/or switches at least one antenna on and at least one antenna off, for example, based upon received signal strength. The plurality of antennas may be operable on a same frequency, have different polarizations, have different conductive patterns and/or have different frequencies for transmit and receive.

[0009] The portable handheld housing preferably has opposing parallel front and back surfaces and the plurality of antennas are arranged in side-by-side relation extending in a plane parallel to the front and back surfaces. A display, user input device and an input/output transducer are carried by the portable handheld housing and connected to the transceiver. Furthermore, the transceiver and the plurality of antennas are operable in a LAN wireless network and/or a cellular wireless network.

[0010] A method aspect of the invention is directed to operating a mobile wireless communications device to account for different human interface, the mobile wireless communications device having a portable handheld housing and a wireless transceiver therein, and a pair of antennas side-by-side in an upper portion of the portable handheld housing and connected to the wireless transceiver. The method includes controlling the wireless transceiver to preferentially operate with the pair of antennas based upon a relative position of the portable handheld housing with respect to a hand of a human user.

[0011] Controlling the wireless transceiver may include preferentially weighting transmit signals, and/or preferentially switching one antenna on and one antenna off for transmit signals. Again, the pair of antennas may be operated on a same frequency, and each antenna of the pair of antennas may have a different conductive pattern. Preferably, the

portable handheld housing has opposing parallel front and back surfaces and the pair of antennas are arranged in side-by-side relation extending in a plane parallel to the front and back surfaces.

Brief Description of the Drawings

[0012] FIG. 1 is schematic diagram of a mobile wireless communications device in accordance with the present invention.

[0013] FIGs. 2A and 2B are schematic diagrams of the mobile wireless communications device of FIG. 1 illustrating the device being held by a user in respectively different positions.

[0014] FIG. 3 is an enlarged rear elevational view of a portion of the mobile wireless communications device of FIG. 1 with the housing removed illustrating the pair of antennas thereof in greater detail.

[0015] FIG. 4 is a schematic block diagram of an exemplary mobile wireless communications device for use with the present invention.

Detailed Description of the Preferred Embodiments

[0016] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0017] Referring initially to FIG. 1, a mobile wireless communications device **21** in accordance with the present invention is first described. The mobile wireless communications device **21** illustratively includes a portable, handheld housing **24,** and a wireless transceiver **25** carried by the portable, handheld housing. The device **21** also illustratively includes an antenna assembly **26** for cooperating with the wireless transceiver **25** to communicate over the wireless network, as will be discussed further below. More particularly, the device **21** may be a PDA-type device in which the wireless transceiver and antenna assembly **26** cooperate to communicate various types of data, such as voice data, video data, text (e.g., email) data, Internet data, etc. over the wireless network. More specifically, the antenna assembly **26** may be used for placing telephone calls, in which case the device **21** may generally take the form or shape of a typical cellular telephone or a cellular-enabled PDA device, for example.

[0018] The antenna assembly **26** includes a plurality of antennas, preferably a pair of an antennas **30, 33** as illustrated. The pair of antennas **30, 33** are positioned in side-by-side relation preferably in the upper portion of the portable handheld housing **24.** A human interface diversity controller **27** is connected to the wireless transceiver **25** to preferentially operate with the pair of antennas **30, 33** based upon a relative position of the portable handheld housing **24** with respect to a hand of a human user.

[0019] As discussed above, the use of an internal antenna in a handheld device, particularly those that can be held in various positions, such as by either, both or no hands, leads to the antenna environment being modified in different ways depending on how the user holds/positions the device. Accordingly, conventional antenna designs are optimized for only a single position, e.g. one handheld scenario, or the antenna is designed to compromise between mulitple scenarios.

[0020] Turning additionally to FIGS. 2A and 2B, an embodiment of the pair of antennas **30, 33** and associated human interface diversity controller **27** will be described. Firstly, by using mulitple antennas in a human diversity arrangement, the mobile wireless communications device **21** can select the best antenna, or weighted combination, based upon how the user is holding the device. The antennas **30, 33** are designed to provide an overall high antenna system efficiency for the common user holding positions. The figures respectively illustrate a user holding the device **21** in a right hand and a left hand. As can be seen, the user's hand may be directly adjacent one of antennas **30, 33** thereby affecting the performance of the antennas. Accordingly, the associated human interface diversity controller **27** will preferentially operate the pair of antennas **30, 33** to provide the better or stronger signal tranmsission/reception.

[0021] The human interface diversity controller **27** preferentially weights transmit signals, and/or switches at least one antenna on and at least one antenna off, for example, based upon received signal strength. The plurality of antennas **30, 33** may be operable on a same frequency, have different polarizations, have different conductive patterns and/or have different frequencies for transmit and receive.

[0022] The portable handheld housing **24** preferably has opposing parallel front and back surfaces and the plurality of antennas **30, 33** are arranged in side-by-side relation extending in a plane parallel to the front and back surfaces. A display, user input device and an input/output transducer are carried by the portable handheld housing **24** and connected to the transceiver **25** as discussed below. Furthermore, the transceiver **25** and the plurality of antennas are operable in a cellular wireless network **60** and/or a LAN wireless network. The wireless LAN may operate in accordance with various wireless LAN standards, such as IEEE 802.11/802.11b or Bluetooth, for example, as will also be appreciated by those

skilled in the art.

[0023] Turning additionally to FIG. 3, further details of an embodiment of the antenna assembly **26** will be described and illustratively include the first antenna **30** coupled to the transceiver **25** at a feed point **31** and having a first shape. The antenna assembly **26** also illustratively includes the second antenna **33** coupled to the wireless transceiver **25** at a feed point **34.** The second antenna **33** has a second shape different from the first shape of the first antenna **30.**

[0024] The polarizations of the first and second antennas **30, 33** may be orthogonal to one another to provide maximum polarization diversity, as will be appreciated by those skilled in the art. Of course, other arrangements may be possible in other embodiments.

[0025] The first and second antennas **30, 33** may advantageously be implemented as planar, printed conductive elements on a circuit board **36.** The circuit board may be mounted on the back side of the device **21** (i.e., the side pointing away from the user when holding the device to place a telephone call) at the top of the device (i.e., adjacent the end of the device with the ear speaker). The first and second antennas **30, 33** are shown with hatching to provide greater clarity of illustration.

[0026] The first antenna **30** illustratively includes a feed branch **37** including the first feed point **31,** a second feed point **38** which is connected to ground, and a feed section **39** connected between the first and second feed points. The first antenna **30** further illustratively includes a loop branch **45** having a first end **46** coupled to the feed section **39** adjacent the first feed point **31.** A second end **47** of the loop branch **45** is spaced apart from the feed section **39** by a gap **48,** and the second end is adjacent the second feed point **38.** A loop-back section **49** extends between the first and second ends **46, 47.** More specifically, the loop-back section **49** generally loops in a clockwise direction from the first end **46** to the second end **47,** as shown. The first antenna **30** thus generally defines a dual feed point, open loop configuration. This configuration advantageously provides increased space savings (i.e., reduced antenna footprint), as will be appreciated by those skilled in the art.

[0027] The second antenna **33** also illustratively includes a feed branch defined by the feed point **34** and a feed section **50.** Further, a loop branch having a first end **51** coupled to the feed section **50,** a second end **52** adjacent the feed branch and separated therefrom by a gap **53,** and a loop-back **54** section extending between the first and second ends. The loop-back section **54** illustratively includes an arcuate portion **55.** The second antenna **33** thus defines a single feed point, open loop element configuration. Again, this provides space savings, and, thus, reduced antenna footprint.

[0028] As will be appreciated by those skilled in the art, various design parameters (e.g., widths, lengths, loop shapes, notches, etc.) may be altered in the first and second antennas **30, 33** to provide different signal characteristics. By way of example, the overall dimensions of the first and second antennas **30, 33** may be 2 to 3 cm high by 2 to 3 cm wide for each element, although other dimensions may also be used. The antennas **30, 33** preferably operate over a wireless frequency range of about 2.4 to 2.5 GHz, for example, although other frequencies are also possible. Moreover, the coupling between the first and second antennas **30, 33** may also be adjusted to provide desired performance characteristics. By way of example, a preferred coupling distance or gap between the first and second antennas **30, 33** may be in a range of about 3 to 7 mm, although other gap distances may also be used as appropriate for different embodiments.

[0029] Because the first and second antennas **30, 33** have different shapes, they will also have different gain patterns, and thus advantageously provide pattern diversity, as will be appreciated by those skilled in the art. Moreover, the first and second antennas **30, 33** are preferably tuned to have substantially equal main lobe gain for enhanced performance. Of course, it will be appreciated that other antenna element shapes or types may be used in addition to those noted above. Electromagnetic shielding may be placed over one or both sides of the circuit board **36** as necessary in certain applications, as will also be appreciated by those skilled in the art.

[0030] A method aspect of the invention may include controlling the wireless transceiver **25** to preferentially operate with the pair of antennas **30, 33** based upon a relative position of the portable handheld housing **24** with respect to a hand of a human user. Again, controlling the wireless transceiver **25** may include preferentially weighting transmit signals, and/or preferentially switching one antenna on and one antenna off for transmit signals. Additional method aspects will be appreciated by those skilled in the art from the foregoing description.

[0031] Another example of a handheld mobile wireless communications device **1000** that may be used in accordance the present invention is further described with reference to FIG. 4. The device **1000** includes a housing **1200,** a keyboard **1400** and an output device **1600.** The output device shown is a display **1600,** which is preferably a full graphic LCD. Other types of output devices may alternatively be utilized. A processing device **1800** is contained within the housing **1200** and is coupled between the keyboard **1400** and the display **1600.** The processing device **1800** controls the operation of the display **1600,** as well as the overall operation of the mobile device **1000,** in response to actuation of keys on the keyboard **1400** by the user.

[0032] The housing **1200** may be elongated vertically, or may take on other sizes and shapes (including clamshell housing structures). The keyboard may include a mode selection key, or other hardware or software for switching between text entry and telephony entry.

[0033] In addition to the processing device **1800,** other parts of the mobile device **1000** are shown schematically in FIG. 4. These include a communications subsystem **1001;** a short-range communications subsystem **1020;** the keyboard

1400 and the display **1600,** along with other input/output devices **1060, 1080, 1100** and **1120;** as well as memory devices **1160, 1180** and various other device subsystems **1201.** The mobile device **1000** is preferably a two-way RF communications device having voice and data communications capabilities. In addition, the mobile device **1000** preferably has the capability to communicate with other computer systems via the Internet.

[0034] Operating system software executed by the processing device **1800** is preferably stored in a persistent store, such as the flash memory **1160,** but may be stored in other types of memory devices, such as a read only memory (ROM) or similar storage element. In addition, system software, specific device applications, or parts thereof, may be temporarily loaded into a volatile store, such as the random access memory (RAM) **1180.** Communications signals received by the mobile device may also be stored in the RAM **1180.**

[0035] The processing device **1800,** in addition to its operating system functions, enables execution of software applications **1300A-1300N** on the device **1000.** A predetermined set of applications that control basic device operations, such as data and voice communications **1300A** and **1300B,** may be installed on the device **1000** during manufacture. In addition, a personal information manager (PIM) application may be installed during manufacture. The PIM is preferably capable of organizing and managing data items, such as e-mail, calendar events, voice mails, appointments, and task items. The PIM application is also preferably capable of sending and receiving data items via a wireless network **1401.** Preferably, the PIM data items are seamlessly integrated, synchronized and updated via the wireless network **1401** with the device user's corresponding data items stored or associated with a host computer system.

[0036] Communication functions, including data and voice communications, are performed through the communications subsystem **1001,** and possibly through the short-range communications subsystem. The communications subsystem **1001** includes a receiver **1500,** a transmitter **1520,** and one or more antennas **1540** and **1560.** The antenna system can be designed so that when one antenna is covered by a hand, performance of one or more other antennas, including antenna gain and match, may not be degraded. In addition, the communications subsystem **1001** also includes a processing module, such as a digital signal processor (DSP) **1580,** and local oscillators (LOs) **1601.** The specific design and implementation of the communications subsystem **1001** is dependent upon the communications network in which the mobile device **1000** is intended to operate. For example, a mobile device **1000** may include a communications subsystem **1001** designed to operate with the Mobitex™, Data TAC™ or General Packet Radio Service (GPRS) mobile data communications networks, and also designed to operate with any of a variety of voice communications networks, such as AMPS, TDMA, CDMA, PCS, GSM, etc. Other types of data and voice networks, both separate and integrated, may also be utilized with the mobile device **1000.**

[0037] Network access requirements vary depending upon the type of communication system. For example, in the Mobitex and DataTAC networks, mobile devices are registered on the network using a unique personal identification number or PIN associated with each device. In GPRS networks, however, network access is associated with a subscriber or user of a device. A GPRS device therefore requires a subscriber identity module, commonly referred to as a SIM card, in order to operate on a GPRS network.

[0038] When required network registration or activation procedures have been completed, the mobile device **1000** may send and receive communications signals over the communication network **1401.** Signals received from the communications network **1401** by the antenna **1540** are routed to the receiver **1500,** which provides for signal amplification, frequency down conversion, filtering, channel selection, etc., and may also provide analog to digital conversion. Analog-to-digital conversion of the received signal allows the DSP **1580** to perform more complex communications functions, such as demodulation and decoding. In a similar manner, signals to be transmitted to the network **1401** are processed (e.g. modulated and encoded) by the DSP **1580** and are then provided to the transmitter **1520** for digital to analog conversion, frequency up conversion, filtering, amplification and transmission to the communication network **1401** (or networks) via the antenna **1560.**

[0039] In addition to processing communications signals, the DSP **1580** provides for control of the receiver **1500** and the transmitter **1520.** For example, gains applied to communications signals in the receiver **1500** and transmitter **1520** may be adaptively controlled through automatic gain control algorithms implemented in the DSP **1580.**

[0040] In a data communications mode, a received signal, such as a text message or web page download, is processed by the communications subsystem **1001** and is input to the processing device **1800.** The received signal is then further processed by the processing device **1800** for an output to the display **1600,** or alternatively to some other auxiliary I/O device **1060.** A device user may also compose data items, such as e-mail messages, using the keyboard **1400** and/or some other auxiliary I/O device **1060,** such as a touchpad, a rocker switch, a thumb-wheel, or some other type of input device. The composed data items may then be transmitted over the communications network **1401** via the communications subsystem **1001.**

[0041] In a voice communications mode, overall operation of the device is substantially similar to the data communications mode, except that received signals are output to a speaker **1100,** and signals for transmission are generated by a microphone **1120.** Alternative voice or audio I/O subsystems, such as a voice message recording subsystem, may also be implemented on the device **1000.** In addition, the display **1600** may also be utilized in voice communications mode, for example to display the identity of a calling party, the duration of a voice call, or other voice call related information.

[0042] [0031] The short-range communications subsystem enables communication between the mobile device **1000** and other proximate systems or devices, which need not necessarily be similar devices. For example, the short-range communications subsystem may include an infrared device and associated circuits and components, or a Bluetooth communications module to provide for communication with similarly-enabled systems and devices.

[0043] [0032] Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is understood that the invention is not to be limited to the specific embodiments disclosed, and that modifications and embodiments are intended to be included within the scope of the appended claims.

Claims

1. A mobile wireless communication device comprising:

a portable handheld housing;
a wireless transceiver carried by said portable handheld housing;
a plurality of antennas positioned in side-by-side relation in said portable handheld housing; and
a human interface diversity controller connected to said wireless transceiver to preferentially operate with the plurality of antennas based upon a relative position of said portable handheld housing with respect to a hand of a human user.

2. The mobile wireless communications device of Claim 1 wherein said human interface diversity controller preferentially weights transmit signals.

3. The mobile wireless communications device of Claim 1 wherein said human interface diversity controller preferentially weights transmit signals based upon received signal strength.

4. The mobile wireless communications device of Claim 1 wherein said human interface diversity controller preferentially switches at least one antenna on and at least one antenna off for transmit signals.

5. The mobile wireless communications device of Claim 1 wherein said human interface diversity controller preferentially switches at least one antenna on and at least one antenna off for transmit signals based upon received signal strength.

6. The mobile wireless communications device of Claim 1 wherein the plurality of antennas are operable on a same frequency.

7. The mobile wireless communications device of Claim 1 wherein the plurality of antennas have different polarizations.

8. The mobile wireless communications device of Claim 1 wherein the plurality of antennas have different conductive patterns.

9. The mobile wireless communications device of Claim 1 wherein the plurality of antennas have different frequencies for transmit and receive.

10. The mobile wireless communications device of Claim 1 wherein the plurality of antennas comprises a pair of first and second antennas.

11. The mobile wireless communications device of Claim 1 wherein the portable handheld housing has opposing parallel front and back surfaces and wherein said plurality antennas are arranged in side-by-side relation in an upper portion of the portable handheld housing and extending in a plane parallel to the front and back surfaces.

12. The mobile wireless communications device of Claim 1 further comprising a display carried by said portable handheld housing and connected to said transceiver.

13. The mobile wireless communications device of Claim 1 further comprising at least one user input device carried by said portable handheld housing and connected to said transceiver.

14. The mobile wireless communications device of Claim 1 further comprising at least one input/output transducer

carried by said portable handheld housing and connected to said transceiver.

15. The mobile wireless communications device of Claim 1 wherein said transceiver and said plurality of antennas are operable in at least one of a LAN wireless network and a cellular wireless network.

16. A method of operating a mobile wireless communications device to account for different human interface, the mobile wireless communications device having a portable handheld housing and a wireless transceiver therein, and a pair of antennas side-by-side in an upper portion of the portable handheld housing and connected to the wireless transceiver, the method comprising controlling the wireless transceiver to preferentially operate with the pair of antennas based upon a relative position of the portable handheld housing with respect to a hand of a human user.

17. The method of Claim 16 wherein controlling the wireless transceiver comprises preferentially weighting transmit signals.

18. The method of Claim 16 wherein controlling the wireless transceiver comprises preferentially switching one antenna on and one antenna off for transmit signals.

19. The method of Claim 16 wherein each antenna of the pair of antennas has a different conductive pattern.

20. The method of Claim 16 wherein the portable handheld housing has opposing parallel front and back surfaces and wherein the pair of antennas are arranged in side-by-side relation extending in a plane parallel to the front and back surfaces.

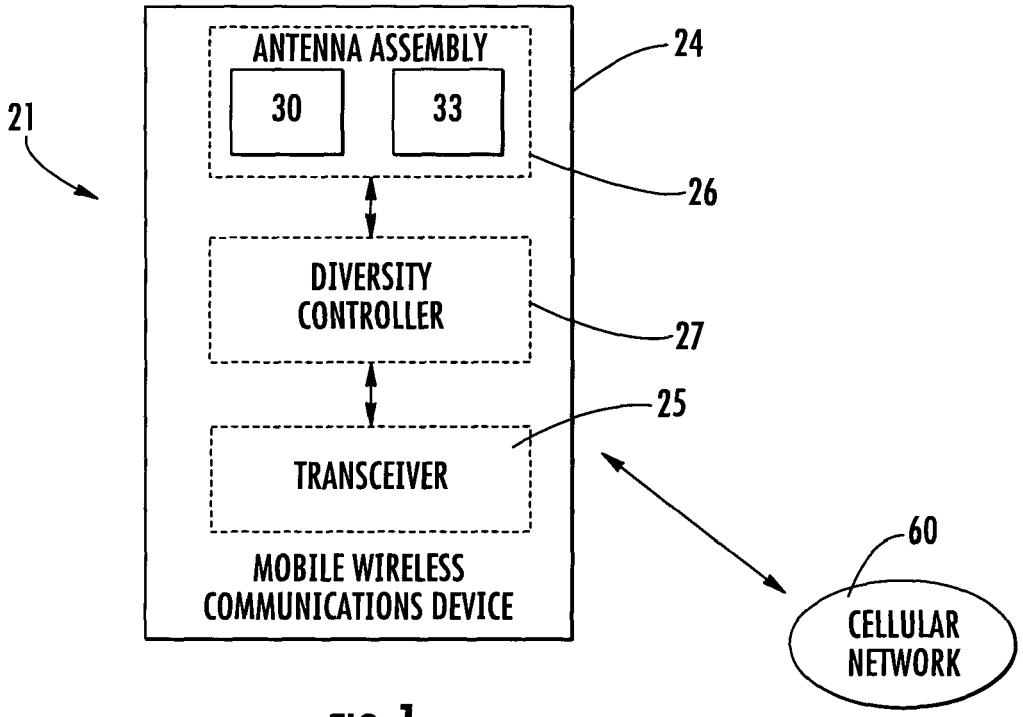
ANTENNA ASSEMBLY
30
33
24
21
26
DIVERSITY CONTROLLER
27
25
TRANSCEIVER
MOBILE WIRELESS COMMUNICATIONS DEVICE
60
CELLULAR NETWORK

FIG. 1

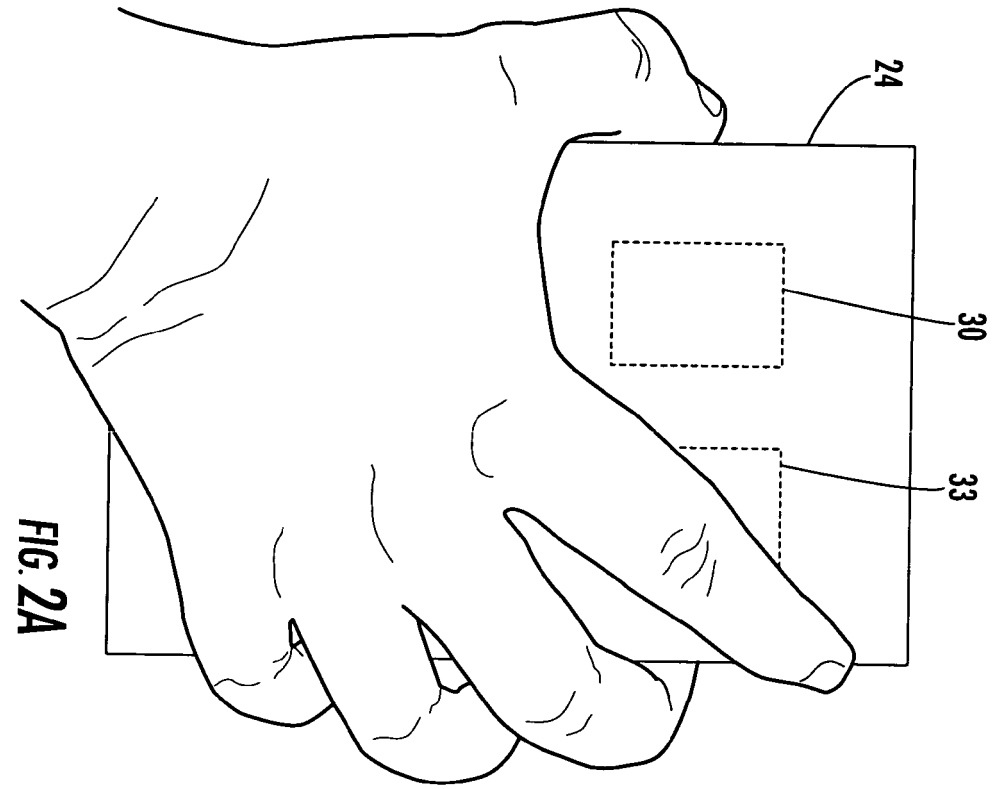

FIG. 2A

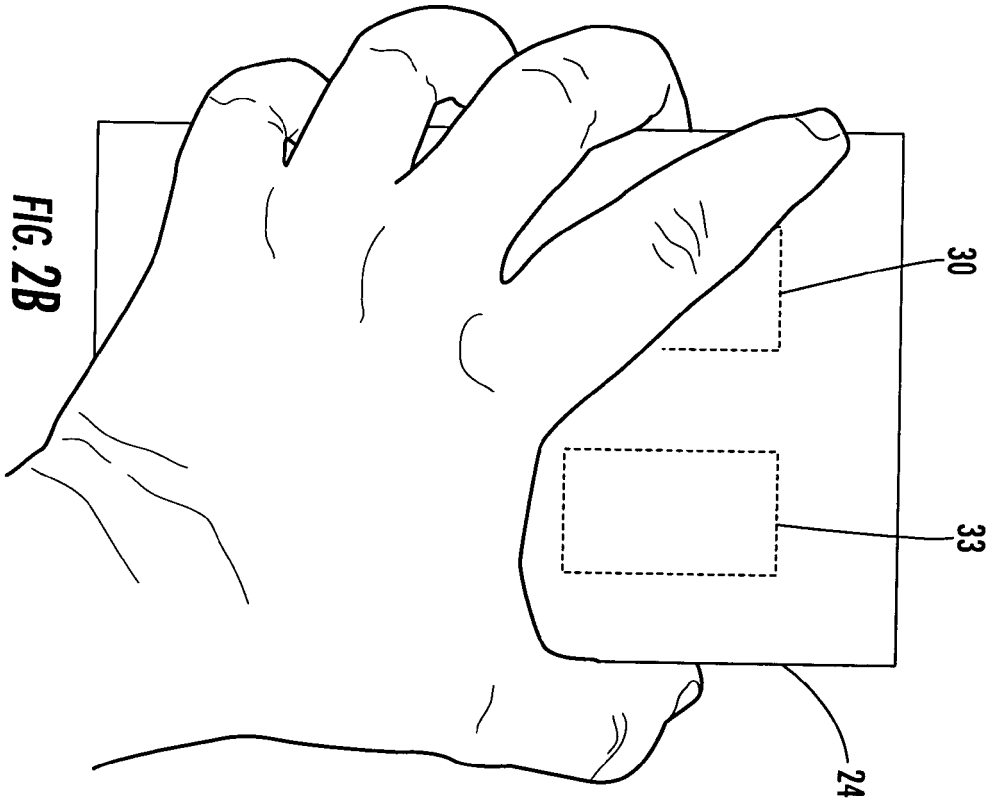

FIG. 2B

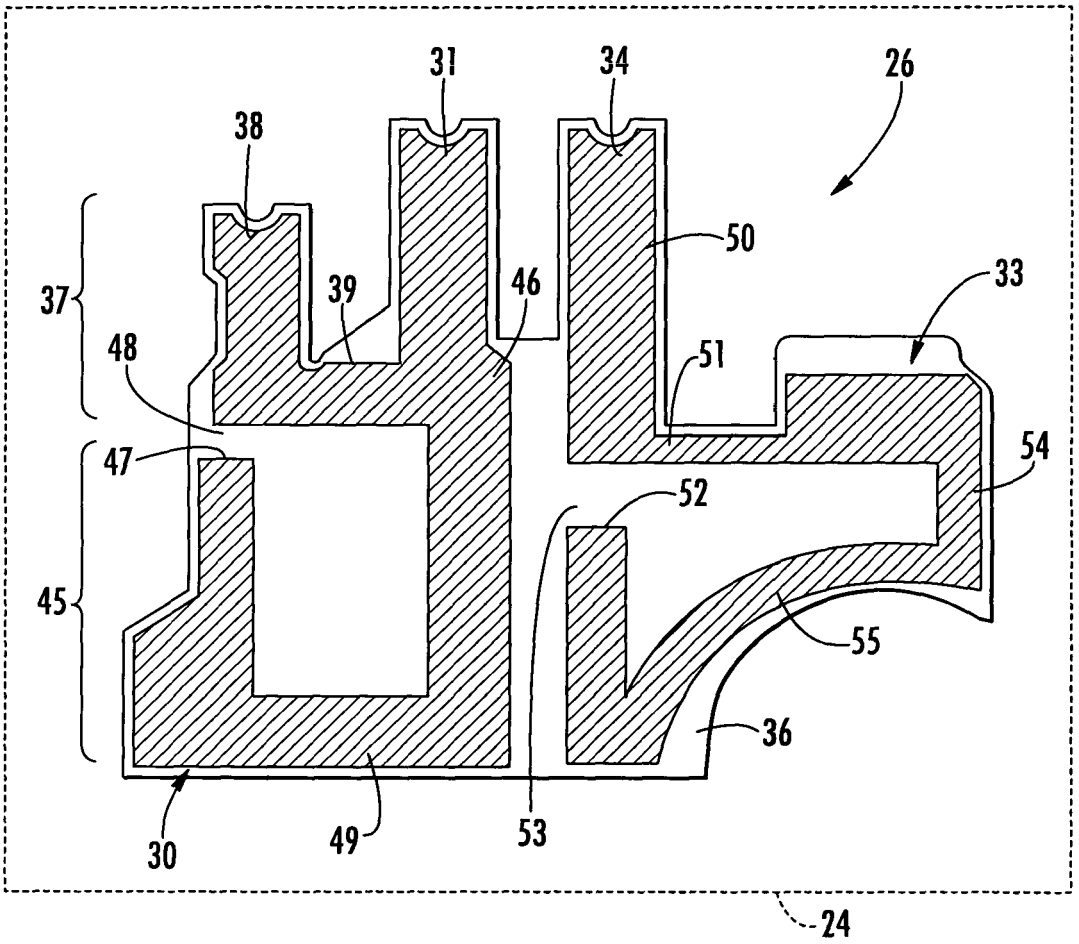

FIG. 3

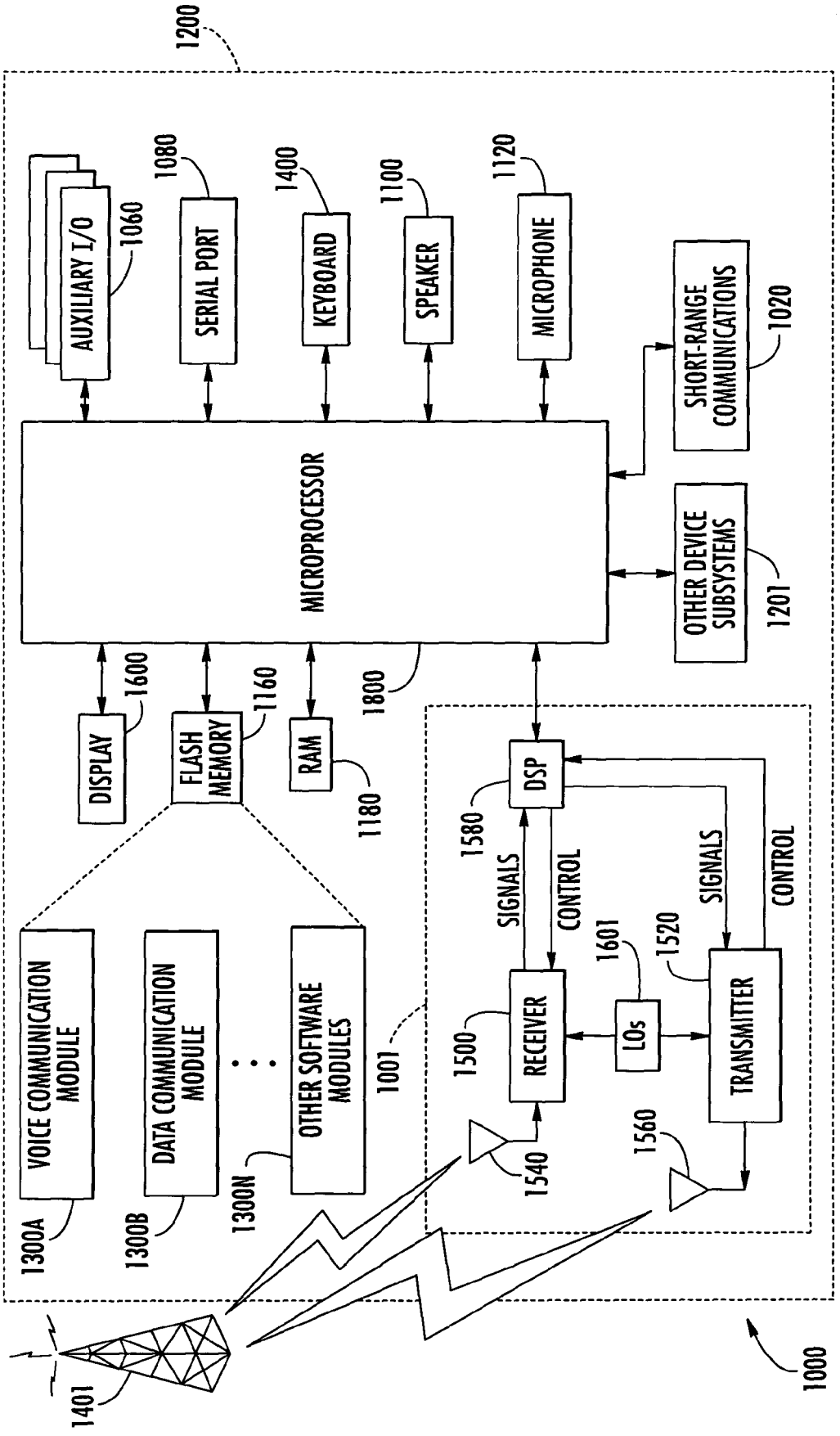
1200
AUXILIARY I/O
1060
SERIAL PORT
1080
KEYBOARD
1400
SPEAKER
1100
MICROPHONE
1120
SHORT-RANGE COMMUNICATIONS
1020
MICROPROCESSOR
OTHER DEVICE SUBSYSTEMS
1201
1800
DISPLAY
1600
FLASH MEMORY
1160
RAM
1180
DSP
1580
SIGNALS
CONTROL
SIGNALS
CONTROL
1601
1520
VOICE COMMUNICATION MODULE
DATA COMMUNICATION MODULE
OTHER SOFTWARE MODULES
1001
1500
RECEIVER
LOs
TRANSMITTER
1300A
1300B
1300N
1540
1560
1401
1000

FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 25 1173

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2004/053582 A1 (NAKANISHI KIYOSHI ET AL) 18 March 2004 (2004-03-18) * paragraph [0016] - paragraph [0056]; figures 1,5-9,12-17B *	1-20	H01Q1/24 H01Q3/24 H01Q21/28 H04B7/08 H04B1/38
X	US 4 584 709 A (KNEISEL ET AL) 22 April 1986 (1986-04-22) * column 3, line 23 - column 4, line 28 * * column 10, line 42 - column 11, line 4; figures 1-5 *	1-20	
A	US 2004/198473 A1 (TRAN ALLEN) 7 October 2004 (2004-10-07) * paragraph [0013]; figures 1-8 * * paragraph [0017] - paragraph [0020] * * paragraph [0033] * * paragraph [0040] *	1-20	
A	EP 0 752 735 A (DETEMOBIL DEUTSCHE TELEKOM MOBILNET GMBH) 8 January 1997 (1997-01-08) * abstract; figures 1-3 *	1-20	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	WO 02/078123 A (TELEFONAKTIEBOLAGET L M ERICSSON ; BOLIN, THOMAS; YING, ZHINONG; ANDER) 3 October 2002 (2002-10-03) * figures 1,9-12 *		H01Q H04B
A	US 6 476 769 B1 (LEHTOLA ANTERO) 5 November 2002 (2002-11-05) * abstract; figures 1,2 *		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 May 2005	Angrabeit, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 25 1173

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-05-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004053582 A1	18-03-2004	JP 2002185372 A	28-06-2002
		EP 1343256 A1	10-09-2003
		WO 0249238 A1	20-06-2002
US 4584709 A	22-04-1986	AU 3151684 A	07-02-1985
		CA 1220546 A1	14-04-1987
		EP 0148920 A1	24-07-1985
		IL 72379 A	31-01-1988
		IT 1179389 B	16-09-1987
		MX 155466 A	16-03-1988
		WO 8500480 A1	31-01-1985
US 2004198473 A1	07-10-2004	WO 2004091115 A1	21-10-2004
EP 0752735 A	08-01-1997	DE 19524288 C1	06-03-1997
		AT 198012 T	15-12-2000
		DE 59606178 D1	11-01-2001
		EP 0752735 A1	08-01-1997
		ES 2154364 T3	01-04-2001
WO 02078123 A	03-10-2002	SE 518988 C2	17-12-2002
		EP 1378021 A1	07-01-2004
		SE 0102183 A	24-09-2002
		WO 02078123 A1	03-10-2002
		US 2004137950 A1	15-07-2004
US 6476769 B1	05-11-2002	CN 1409437 A	09-04-2003
		DE 60200508 D1	24-06-2004
		EP 1296410 A1	26-03-2003
		JP 2003124730 A	25-04-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82