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

(11) EP 2 302 561 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
29.08.2018 Bulletin 2018/35

(21) Application number: **10176444.7**

(22) Date of filing: **13.09.2010**

(51) Int Cl.:
H04B 1/40 (2015.01) ***H04B 1/401*** (2015.01)
H04W 80/06 (2009.01) ***H04W 88/06*** (2009.01)
H04L 29/08 (2006.01) ***G06K 7/01*** (2006.01)
G06K 7/10 (2006.01)

(54) **Encoded information reading terminal with user-configurable multi-protocol wireless communication interface**

Endgerät zum Lesen codierter Informationen mit benutzerkonfigurierbarer drahtloser Mehrfachprotokoll-Kommunikationsschnittstelle

Terminal de lecture d'informations codées avec interface de communication sans fil multi-protocole configurable par l'utilisateur

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **25.09.2009 US 567158**

(43) Date of publication of application:
30.03.2011 Bulletin 2011/13

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(56) References cited:
WO-A1-98/14023 **US-A1- 2009 148 074**

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Description

FIELD OF THE INVENTION

[0001] The invention is generally related to encoded information reading (EIR) terminals and is specifically related to an EIR terminal comprising a multi-protocol wireless communication interface.

BACKGROUND OF THE INVENTION

[0002] Encoded information reading (EIR) terminals equipped with wireless communication interfaces are widely used in retail stores, shipping facilities, etc. While wireless communication of EIR terminals offers many advantages as compared to wired communications, traditional wireless communication interfaces have noticeable shortcomings, *e.g.*, by failing to support more than one communication protocol and/or standard.

[0003] Accordingly, there is a need for further advances in EIR terminals and systems which would support multiple communication protocols and standards.

[0004] US patent application, publication number US2009148074A1 discloses a method for automatically performing a plurality of image processing functions on an electronic device.

[0005] PCT patent application, publication number WO9814023A1 discloses a configurable multiprocessor communications architecture which performs digital communications functions and which is configurable for different digital communications standards, such as various digital cellular standards.

SUMMARY OF THE INVENTION

[0006] In accordance with the present invention, there is provided an encoded information reading (EIR) terminal according to any of the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] For the purpose of illustrating the invention, the drawings show aspects of one or more embodiments of the invention. However, it should be understood that the present invention is not limited to the precise arrangements and instrumentalities shown in the drawings, wherein:

Fig. 1 depicts a network level layout of a data collection system employing EIR terminal according to the invention;

Fig. 2 depicts a functional layout of a wireless communication interface;

Fig. 3 depicts a component level layout of an EIR terminal according to the invention;

Fig. 4 illustrates the functions of the base-band encoder software program according to the invention;

Fig. 5 illustrates the functions of the base-band encoder software program according to the invention;

Figs. 6a and 6b illustrate an exemplary hand held EIR terminal housing;

Figs. 7a-7c illustrate an exemplary portable and remountable EIR terminal housing;

Fig. 8a illustrates a first exemplary deployment of an EIR terminal according to the invention within a retail store;

Fig. 8b illustrates a second exemplary deployment of an EIR terminal according to the invention within a retail store;

Figs. 8c and 8d illustrate PIN and signature data entry operational modes of an EIR terminal according to the invention.

[0008] The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the drawings, like numerals are used to indicate like parts throughout the various views.

DETAILED DESCRIPTION OF THE INVENTION

[0009] There is provided an encoded information reading (EIR) terminal for incorporation in a data collection system. The data collection system, schematically shown in Fig. 1, can include a plurality of EIR terminals 100a-100z in communication with a plurality of interconnected networks 110a-110z. In one aspect, the plurality of networks 110a-110z can include at least one IEEE 802.11 conformant wireless network. In another aspect, an EIR terminal 100a can be in communication with at least one wireless device over Bluetooth™ wireless communication protocol. In a further aspect, the plurality of networks 110a-110z can include at least one GSM wireless network. In a further aspect, the plurality of networks 110a-110z can include at least one CDMA wireless network. Still further, the plurality of networks 110a-110z can include at least one 3G wireless network, *e.g.*, UMTS, HSUPA/HSDPA, or CDMA2000EvDO. In another aspect, the plurality of networks 110a-110z can include at least one 4G wireless network, *e.g.*, LTE, UWB, or 802.16m (WiMax). A skilled artisan would appreciate the fact that wireless networks implementing other wireless communication protocols are within the scope of the invention.

[0010] In one aspect, an EIR terminal can comprise a wireless communication interface. The EIR terminal 100c can establish a communication session with the host computer 171. In one embodiment, network frames can be exchanged by the EIR terminal 100c and the host computer 171 via one or more routers, base stations, and other infrastructure elements. In another embodiment, the host computer 171 can be reachable by the EIR terminal 100c via a local area network (LAN). In a yet another embodiment, the host computer 171 can be reachable by the EIR terminal 100c via a wide area network (WAN). A skilled artisan would appreciate the fact that other methods of providing interconnectivity between the EIR terminal 100c and the host computer 171 relying upon LANs, WANs, virtual private networks (VPNs), and/or other types of network are within the scope of the invention.

[0011] In a further aspect, the wireless communication interface can be configured to support at least two wireless communication protocols. In one embodiment, the wireless communication interface can be configured to support HSPA/GSM/GPRS/EDGE protocol family and CDMA/EV-DO protocol family. A skilled artisan would appreciate the fact that wireless communication interfaces supporting other communication protocols are within the scope of the invention.

[0012] In one embodiment, the communications between the EIR terminal 100c and the host computer 171 can comprise a series of HTTP requests and responses transmitted over one or more TCP connections, although a person skilled in the art would appreciate the fact that using other transport and application level protocols is within the scope the invention.

[0013] In one aspect, at least one of the messages transmitted by the EIR terminal can include decoded message data corresponding to, *e.g.*, a bar code label or an RFID label attached to a product or to a shipment item. For example, an EIR terminal can transmit a request to the host computer to retrieve product information corresponding to a product identifier encoded by a bar code label attached to the product, or to transmit an item tracking record for an item identified by a bar code label attached to the product.

[0014] A wireless communication interface 210 best viewed in Fig. 2, can comprise a transmitter circuit 220 electrically coupled to a data source 221. The transmitter circuit 220 can be implemented by one or more specialized microchips, and can perform the following functions: source encoding 223, encryption 226, channel encoding 229, multiplexing 232, modulation 235, and frequency spreading 238.

[0015] The wireless communication interface 210 of Fig. 2 can further comprise a receiver circuit 250 electrically coupled to the data sink 271. The receiver circuit 250 can be implemented by one or more specialized microchips, and can perform the following functions: frequency de-spreading 253, demodulation 256, de-multiplexing 259, channel decoding 262, decryption 265, and source decoding 268.

[0016] Each of the transmitter circuit 220 and receiver circuit 250 can be electrically coupled to a radio frequency (RF) front end 299. The RF front end 299 can be used to convert high frequency RF signals to/from base-band or intermediate frequency signals. A skilled artisan would appreciate the fact that RF front ends of different data rates, sensitivities, output powers, operating frequencies, and measurement resolutions are within the scope of the invention.

[0017] On the receiving side, the RF front-end 299 can include all filters, low-noise amplifiers (LNAs), and down-conversion mixer(s) needed to process modulated RF signals received by the antenna into based-band signals. In one embodiment, the receiving part of the RF front end 299 can comprise one or more of the following components:

- a first matching circuit to transfer to the next stage the energy received by the antenna;
- a band-pass filter (BPF) to knock down out-of-band jammers;
- a second matching circuit at the input of a low-noise amplifier (LNA);
- the LNA, the primary responsibility of which is to set the sensitivity of the receiver, by providing a high gain;
- a third matching circuit between the LNA output and the receive (RX) mixer (down-converter);
- the down-conversion RX mixer.

[0018] On the transmitting side, the RF frond-end area can be described as a "mirrored" version of a receiver. The front end of a transmitter up converts an outgoing base-band signal and then feeds the signal to a high power amplifier. A skilled artisan would appreciate the fact that other ways of implementing the RF front end are within the scope of the invention.

[0019] According to one embodiment of the invention, the wireless communication interface supporting at least two wireless communication protocols can be implemented using a single dual-protocol (or multi-protocol) chipset. The chipset can include integrated circuits (ICs), application specific integrated circuits (ASICs), and/or other components providing the necessary functionality.

[0020] In another embodiment, the wireless communication interface supporting at least two wireless communication protocols can be implemented using two or more chipsets. Each of the chipsets can include integrated circuits (ICs), application specific integrated circuits (ASICs), and/or other components providing the necessary functionality.

[0021] In a yet another embodiment, at least some of the functions of the transmitter circuit and the receiver circuit can be advantageously performed by one or more software programs executed by a microprocessor. In one embodiment the EIR terminal 100 can comprise at least one microprocessor 310 and a memory 320, both coupled to the system bus 370, as best viewed in Fig. 3.

[0022] The microprocessor 310 can be provided by a general purpose microprocessor or by a specialized microprocessor (e.g., an ASIC). In one embodiment, the EIR terminal 100 can comprise a single microprocessor which can be referred to as a central processing unit (CPU) and which can perform at least some of the functions of the transmitter circuit and the receiver circuit. In another embodiment, the EIR terminal 100 can comprise two or more microprocessors; for example, a CPU providing some or most of the EIR functionality and a specialized microprocessor performing some of the functions of the transmitter circuit and the receiver circuit. A skilled artisan would appreciate the fact that different schemes of processing tasks distribution among the two or more microprocessors are within the scope of the invention.

[0023] The EIR terminal 100 can further comprise one or more encoded information reading (EIR) devices 330, including a bar code reading device, an RFID reading device, and a card reading device, also coupled to the system bus 370. In one embodiment, an EIR reading device can be capable of outputting decoded message data corresponding to an encoded message. In another embodiment, the EIR reading device can output raw message data containing an encoded message, *e.g.*, raw image data or raw RFID data.

[0024] Of course, devices that read bar codes, read RFID, or read cards bearing encoded information may read more than one of these categories while remaining within the scope of the invention. For example, a device that reads bar codes may include a card reader, and/or RFID reader; a device that reads RFID may also be able to read bar codes and/or cards; and a device that reads cards may be able to also read bar codes and/or RFID. For further clarity, it is not necessary that a device's primary function involve any of these functions in order to be considered such a device; for example, a cellular telephone, smartphone, or PDA that is capable of reading bar codes is a device that reads bar codes for purposes of the present invention

[0025] The EIR terminal 100 can further comprise a keyboard interface 354 and a display adapter 355, both also coupled to the system bus 370. The EIR terminal 100 can further comprise a battery 356.

[0026] In a further aspect, the EIR terminal 100 can further comprise an RF front end 340. In a further aspect, the EIR terminal 100 can further comprise an analog-to-digital (ADC) converter 350, the input of which can be electrically coupled to the RF front end 340. The choice of ADC can be determined by the receiver architecture, and can depend upon the selectivity of the filters, the dynamic range afforded by the front-end amplifiers, and the bandwidth and type of modulation to be processed. For example, the level or dynamic range of signals expected to be presented to the ADC will dictate the bit resolution needed for the converter. An ADC can also be specified in terms of its spurious-free dynamic range (SFDR). The ADC's sensitivity can be influenced by wideband noise, including spurious noise, and can be improved through the use of an anti-aliasing filter at the input of the ADC to eliminate sampling of noise and high-frequency spurious products. To avoid aliasing when converting analog signals to the digital domain, the ADC sampling frequency must be at least twice the maximum frequency of the input analog signal. This minimum sampling condition derived from Nyquist's theorem, must be met in order to capture enough information about the input analog waveform to reconstruct it accurately. In addition to selecting an ADC for IF or baseband sampling, the choice of buffer amplifier to feed the input of the converter can affect the performance possible with a given sampling scheme. The buffer amplifier should provide the rise/fall time and transient response to preserve the modulation information of the IF or base-band signals, while also providing the good amplitude accuracy and flatness needed to provide signal amplitudes at an optimum input level to the ADC for sampling.

[0027] In another embodiment, the EIR terminal 100 can further comprise a digital-to-analog (DAC) converter 360, the output of which can be electrically coupled to the RF front end 340. In a further aspect, a DAC can be viewed as a component providing a function reversed to that of an ADC.

[0028] In a further aspect, the output of the ADC 350, and the input of the DAC 360 can be electrically coupled to a system bus 370. A skilled artisan would appreciate the fact that other microprocessors, memory, and/or peripheral devices can be electrically coupled to the system bus 370 without departing from the scope of the invention.

[0029] In another aspect, the microprocessor 310 can execute a base-band encoder software program which can encode a bit stream which needs to be transmitted over a wireless medium. The encoded bit stream outputted by the base-band encoder software program can be fed to the input of the DAC 360. The analog signal representative of the encoded bit stream can be outputted by the DAC 360 to the RF front end 340 in order to be transmitted over a wireless medium.

[0030] In one embodiment, the base-band encoder software program 400 can perform at least one of the following functions schematically shown in Fig. 4: source encoding 410 of a bit stream 405, encryption 420, channel encoding 430, multiplexing 440, modulation 450, frequency spreading 460, and media access control 470. In one embodiment, the remaining functions (*i.e.*, those not implemented by the base-band encoder software program) can be implemented by one or more dedicated hardware components.

[0031] In one aspect, the source encoding function 410 can be provided by a process of encoding information using a different number of bits (or other information bearing units) than an un-encoded representation would use, through use of specific encoding schemes.

[0032] In another aspect, the encryption function 420 can be implemented by using an algorithm (cipher) suitable to transform an unencrypted ("plain text") information stream to an encrypted information stream.

[0033] In a further aspect, the channel encoding function 430 can be provided by a process suitable to encode the transmitted information stream into a form, which would allow guaranteed reliable information transmission at a rate close to the maximum channel capacity. According to the Shannon theorem, for a given bandwidth and signal-to-noisy ratio, the theoretical maximum channel capacity (reliable information transfer rate) for a particular noise level is defined by the following equation:

$$C = B\log_2(1+\tfrac{S}{N}).$$

[0034] For any information transmission rate R < C, there exists an encoding scheme that would allow the probability of errors at the receiver to be made less than a pre-defined value ε. The channel encoding function 430 can select and/or implement an encoding scheme for a pre-defined value of ε.

[0035] In a further aspect, the multiplexing function 440 can be employed to combine multiple signals or data streams into one signal transmitted over a shared physical transmission medium (wireless channel). The multiplexing function 440 can implement one or more of the multiplexing technologies including TDMA (Time division multiple access), FDMA (Frequency division multiple access), CDMA (Code division multiple access), CSMA (Carrier sense multiple access), etc.

[0036] In a further aspect, the frequency spreading function 460 can implement one or more of the following technologies: DSSS (Direct Sequence Spread Spectrum), FHSS (Frequency Hopping Spread Spectrum), and OFDM (Orthogonal Frequency Division Multiplexing).

[0037] In a further aspect, the media access control function 470 can provide addressing and channel access control mechanisms.

[0038] In another aspect, the RF front end 340 can output to the ADC 350 an analog signal representative of a signal received over the wireless medium. The ADC 350 can output a digital signal representative of the analog signal outputted by the RF front end 340. The microprocessor 310 can execute a base-band decoder software program which can input the digital signal outputted by the ADC 350 and can decode the digital signal into a form suitable for further processing by other software programs.

[0039] In a further aspect, the base-band decoder software program 500 can perform at least at least one of the following functions schematically shown in Fig. 5: media access control 510, frequency de-spreading 520, demodulation 530, de-multiplexing 540 the analog signal, channel decoding 560, decryption 570, and source decoding 580. In one embodiment, the remaining functions (*i.e.*, those not implemented by the base-band decoder software program) can be implemented by one or more dedicated hardware components.

[0040] In one aspect, each of the frequency de-spreading 520, de-modulation 530, de-multiplexing 540, channel decoding 560, decryption 570, and source decoding 580 functions can be implemented as a reverse function of the frequency spreading 460, modulation 450, multiplexing 440, channel encoding 430, encryption 420, source encoding 410 functions, respectively.

[0041] In another aspect, the base-band encoder software program can be implemented as two or more software programs. In another aspect, the base-band decoder software program can be implemented as two or more software programs. In a further aspect, the base-band encoder software program and the base-band decoder software program can be implemented as a single software program.

[0042] In another aspect, due to advantageously performing at least some of the source bit stream encoding functions by a software program, the EIR terminal 100 can be devoid of dedicated hardware components configured to implement at least one of the following functions: source encoding of said first bit stream, encryption, channel encoding, multiplexing, modulation, frequency spreading, and media access control.

[0043] In another aspect, due to advantageously performing at least some of the analog signal decoding functions by a software program, the EIR terminal 100 can be devoid of dedicated hardware components configured to implement at least one of the following functions: media access control, frequency de-spreading, de-modulation, de-multiplexing, channel decoding, decryption, and source decoding.

[0044] In a further aspect, the EIR terminal 100 can be configured to dynamically select a wireless communication network, a wireless communication protocol, or one or more parameters of the wireless communication protocol (*e.g.*, frequency or transmission power) to be used by the RF front end 340.

[0045] Due to its ability to dynamically select a wireless communication network and a wireless communication protocol, the EIR terminal 100 according to the present invention can be advantageously used, *e.g.*, by a company operating in several geographies with different wireless communication standards. Using the EIR terminal 100 according to the present invention would allow such a company to deploy the same EIR terminal 100 model in all the geographies.

[0046] In one embodiment, selection of a wireless communication network, a wireless communication protocol, or one or more parameters of a wireless communication protocol can be performed manually by the user of the EIR terminal 100. In one embodiment, the selection can be performed by scanning a pre-defined bar code. In another embodiment, the selection can be performed by the user interacting with the user interface (*e.g.*, via a graphical user interface (GUI), or via a hardware-implemented control). A skilled artisan would appreciate the fact that other methods of manually selecting a wireless communication network, a wireless communication protocol, or one or more parameters of the wireless communication protocol are within the scope of the invention.

[0047] In another embodiment, selection of a wireless communication network, a wireless communication protocol, or one or more parameters of the wireless communication protocol can be performed by a wireless communication protocol selector software program executed by the EIR terminal 100. The wireless communication protocol selector software program can optimize a value of a user-defined criterion.

[0048] In one embodiment, the value of the user-defined criterion can be calculated based on one or more of the following parameters: frequency range, network status, signal strength, service cost, communication channel throughput, and user preferences. The user preferences can be represented, *e.g.*, by network preference, service preference, protocol preference, or frequency preference. A skilled artisan would appreciate the fact that other types of user preferences are within the scope of the invention.

[0049] In one embodiment, the value of the user-defined criterion can be calculated as a weighted sum of components each of which is represented by either a parameter itself (*e.g.*, the signal strength) or a difference between the value of a parameter and the desired value of the parameter (*e.g.*, communication channel throughput). In another embodiment, the value of the user-defined criterion can be calculated as a square root of a weighted sum of squares of components each of which is represented by either a parameter itself (*e.g.*, the signal strength) or a difference between the value of a parameter and the desired value of the parameter (*e.g.*, communication channel throughput). A skilled artisan would appreciate the fact that other methods of calculating the user-defined criterion value are within the scope of the invention.

[0050] For example, if a user is more concerned about the cost than about other communication parameters, the user would want the user-defined criterion to yield the cheapest covered service provider (while the bandwidth, frequency range, and/or network protocol can possibly be secondary factors affecting the service provider and/or network selection). In another example, if a user is more concerned about the signal quality than about other communication parameters, the user would want the user-defined criterion to yield the network with best quality (while the cost can be a secondary factor affecting the service provider and/or network selection). In a yet another example, if a user is more concerned about maintaining uninterrupted communication session than about other communication parameters, the user would want the user-defined criterion to yield the network with best connection reliability (while the bandwidth, frequency range, and/or network protocol can possibly be secondary factors affecting the service provider and/or network selection). A skilled artisan would appreciate the fact that other methods of defining the user-defined criterion are within the scope of the invention.

[0051] In one embodiment, the EIR terminal 100 can be configured to search beacon signals over a pre-defined frequency range (*e.g.*, between 800MHz and 5GHz), and then select a wireless communication network and/or frequency channel which would produce the optimal value of the user-defined criterion.

[0052] In one embodiment, the value of the user-defined criterion can be calculated immediately before the EIR terminal 100 attempts to initiate a communication session, so that a wireless communication network and/or a wireless communication protocol can be chosen which would optimize the user-defined criterion.

[0053] In another embodiment, the value of the user-defined criterion can be calculated periodically at established time intervals so that the EIR terminal 100 can change the wireless communication network and/or the wireless communication protocol between communication sessions or during a communication session if a wireless communication network and/or a wireless communication protocol is detected yielding a value of the user-defined criterion which is closer to the optimum than that of the current network or protocol. In yet another embodiment, the value of a user-defined criterion can be calculated responsive to a pre-defined event (*e.g.*, the signal quality falling below a pre-defined level, or the signal quality exceeding a pre-defined threshold), so that the EIR terminal 100 can automatically (*i.e.*, without user intervention) change the wireless communication network and/or the wireless communication protocol between communication sessions or during a communication session. Thus, the EIR terminal 100 can always maintain a network connection irrespectively of changing external conditions (*e.g.*, when the terminal is physically moved).

[0054] Form factors and housings for the EIR terminal 100 according to the invention are now being described. The components of EIR terminal 100 can be incorporated into a variety of different housings. As indicated by the embodiment of Figs. 6a and 6b, the components of Fig. 5 can be incorporated into a hand held housing 101. EIR terminal 100 of Figs. 6a and 6b is in the form factor of a hand held portable data terminal. EIR terminal 100 as shown in Figs. 6a and 6b includes a keyboard 1090, a display 504 having an associated touch screen overlay, a card reader 1348, and an imaging module 360 which includes the components of imaging assembly as described herein; namely, image sensor array incorporated on an image sensor IC chip. Imaging module 360 has an associated imaging axis, α_i. As indicated by the side view of Fig. 6b, the components of the block diagram of Fig. 5 may be supported within housing 101 on a plurality of circuit boards 1077. Imaging module 360 may include an image sensor array having color sensitive pixels as described in U. S. Provisional Patent Application Nos. 60/687,606, filed June 3, 2005, 60/690,268, filed June

14, 2005, 60/692,890, filed June 22, 2005, and 60/694,371, filed June 27, 2005, all of which are entitled Digital Picture Taking Optical Reader Having Hybrid Monochrome And Color Image Sensor, and all of which are incorporated herein by reference.

[0055] In the embodiment of Figs. 7a-7c, the EIR terminal 100 is in the form of a transaction terminal which may be configured as a retail purchase transaction terminal or as a price verifier. Housing 102 of the transaction terminal shown in Figs. 7a-7c is configured to be portable so that it can be moved from location to location and is further configured to be replaceably mounted on a fixed structure such as a fixed structure of a cashier station or a fixed structure of the retail store floor (*e.g.*, a shelf, a column 264 best viewed in Fig. 8b). Referring to bottom view of Fig. 7c, the housing 102 of the EIR terminal 100 has formations 268 facilitating the replaceable mounting of EIR terminal 100 on a fixed structure. Referring now to Fig. 7b, EIR terminal 100 includes a display 504 having an associated touch screen 504T, a card reader 1348, an imaging module 360, and a luminous shroud 362. When light from the illumination block (not shown in Fig. 8) strikes luminous shroud 362, the shroud glows to attract attention to the location of imaging assembly. In certain operating modes as indicated in Fig. 8c, the EIR terminal 100 in accordance with any of Figs. 7a-7c, displays on display 504 a PIN entry screen prompting a customer to enter PIN information into touch screen 504T. In other operating modes, as indicated in Fig. 8d, the EIR terminal 100 displays on display 504 a signature prompt screen prompting a customer to enter signature information into the device with use of a stylus 505.

[0056] Referring to Figs. 8a and 8b, various installation configurations for the EIR terminal of Figs. 7a-7c are shown. In the view of Fig. 8a, the EIR terminal 100 is installed as a retail purchase transaction terminal at a point of sale cashier station. In the setup of Fig. 8a, the EIR terminal 100 is configured as a retail purchase transaction terminal and is utilized to aid and facilitate retail transactions at a point of sale. A customer may enter a credit card or a debit card into card reader 1348 and retail purchase transaction terminal may transmit the credit card information to credit/debit authorization network.

[0057] In the view of Fig. 8b, the EIR terminal 100 is configured as a price verifier to aid customers in checking prices of products located on a store floor. EIR terminal 100 may be mounted on a shelf (not shown in Fig. 8b) or on a column 254 or other fixed structure of the retail store. EIR terminal 100 may decode bar code data from bar codes on store products and transmit decoded out bar code messages to a store server for lookup of price information which is sent back from the store server to terminal 100 for display on display 504.

[0058] While the present invention has been particularly shown and described with reference to certain exemplary embodiments, it will be understood by one skilled in the art that various changes in detail may be affected therein without departing from the scope of the invention as defined by claims that can be supported by the written description and drawings. Further, where exemplary embodiments are described with reference to a certain number of elements it will be understood that the exemplary embodiments can be practiced utilizing less than the certain number of elements.

Claims

1. An encoded information reading, EIR terminal (100) comprising:

a microprocessor (310) electrically coupled to a system bus (370);
a memory (320) communicatively coupled to said microprocessor;
an encoded information reading, EIR device (330) selected from the group consisting of a bar code reading device, an RFID reading device, and a card reading device, said EIR device configured to perform at least one of outputting raw message data containing an encoded message and outputting decoded message data corresponding to an encoded message; and
a wireless communication interface (210) comprising a radio frequency front end (340) configured to perform at least one of receiving a first radio signal and transmitting a second radio signal, said radio frequency front end electrically coupled to at least one of an analog-to-digital converter, ADC (350) electrically coupled to said system bus and a digital-to-analog converter, DAC (360) electrically coupled to said system bus;
wherein said microprocessor is configured to execute at least one of a base-band encoder software program (400) and a base-band decoder software program (500);
wherein said base-band encoder software program is configured to produce a first encoded bit stream by performing at least one of the following functions: source encoding (410) of a first bit stream (405), encryption (420), channel encoding (430), multiplexing (440), modulation (450), frequency spreading (460), and media access control (470);
wherein said DAC is configured to output to said radio frequency front end an analog signal corresponding to said first encoded bit stream;
wherein said ADC is configured to output a second encoded bit stream corresponding to an analog signal produced by said radio frequency front end;
wherein said base-band decoder software program is configured to produce a second bit stream corresponding to said second encoded bit stream by performing at least one of the fol-

lowing functions: media access control (510), frequency de-spreading (520), de-modulation (530), de-multiplexing (540), channel decoding (560), decryption (570), and source decoding (580);

wherein the EIR terminal further comprises a wireless communication protocol selector software program, said wireless communication protocol software program configured to optimize a value of a user-defined criterion in order to dynamically select at least one of a wireless communication network (110a, 110b), a wireless communication protocol, and a parameter of a wireless communication protocol; and

wherein said EIR terminal (100) is further **characterized by** at least one of a), b), and c) hereinbelow;

a) said value of said user-defined criterion is calculated based on at least one of network status, communication quality, signal strength, service cost, bandwidth, a user preference, and communication channel throughput;

b) said EIR terminal (100) is configured to search beacon signals over a pre-defined frequency range, and then select at least one of a wireless communication network and frequency channel which optimizes said user-defined criterion;

c) said EIR terminal (100) is configured to switch at least one of said wireless communication network (110a, 110b) and said wireless communication protocol responsive to evaluating said user-defined criterion.

2. The EIR terminal (100) of claim 1, wherein said EIR terminal is devoid of dedicated hardware components configured to implement at least one of the following functions: source encoding (410) of said first bit stream, encryption (420), channel encoding (430), multiplexing (440), modulation (450), frequency spreading (460), media access control (470), frequency de-spreading (520), de-modulation (530), de-multiplexing (540), channel decoding (550), decryption (570), and source decoding (580).

3. The EIR terminal (100) of claim 1 further comprising a wireless communication protocol selector software program, said wireless communication protocol software program configured to optimize a value of a user-defined criterion in order to dynamically select at least one of a wireless communication network (110a, 110b), a wireless communication protocol, and a parameter of a wireless communication protocol.

4. The EIR terminal (100) of claim 1, wherein said baseband encoder software program (400) is executed by at least one of a general purpose microprocessor, a specialized microprocessor.

5. The EIR terminal (100) of claim 1, wherein said baseband decoder software program (500) is executed by at least one of a general purpose microprocessor, a specialized microprocessor.

6. The EIR terminal (100) of claim 1, wherein said wireless communication interface (210) is implemented using a single multi-protocol chipset.

7. The EIR terminal (100) of claim 1, wherein said wireless communication interface (210) is implemented using two or more chipsets.

8. The EIR terminal (100) of claim 1, wherein a sampling frequency of said ADC (350) is at least twice a maximum frequency of said analog signal produced by said radio frequency front end (340).

9. The EIR terminal (100) of claim 1, further comprising a buffer amplifier configured to amplify said analog signal produced by said radio frequency front end.

Patentansprüche

1. Endgerät zum Lesen codierter Informationen, EIR, (100), umfassend:

einen Mikroprozessor (310), der mit einem Systembus (370) elektrisch gekoppelt ist;

einen Speicher (320), der mit dem Mikroprozessor kommunikativ gekoppelt ist;

eine Vorrichtung zum Lesen codierter Informationen, EIR, (330), die aus der Gruppe bestehend aus einer Strichcode-Lesevorrichtung, einer RFID-Lesevorrichtung und einer Kartenlesevorrichtung ausgewählt ist, wobei die EIR-Vorrichtung so konfiguriert ist, dass sie mindestens eines von Ausgeben von Rohnachrichtendaten, die eine codierte Nachricht enthalten, und Ausgeben von decodierten Nachrichtendaten, die einer codierten Nachricht entsprechen, durchführt; und

eine drahtlose Kommunikationsschnittstelle (210), die ein Hochfrequenz-Frontend (340) umfasst, das so konfiguriert ist, dass es mindestens eines von Empfangen eines ersten Funksignals und Senden eines zweiten Funksignals durchführt, wobei das Hochfrequenz-Frontend elektrisch gekoppelt ist mit mindestens einem von einem Analog-Digital-Wandler, ADC, (350), der mit dem Systembus elektrisch gekoppelt ist, und einem Digital-Analog-Wandler, DAC, (360), der

mit dem Systembus elektrisch gekoppelt ist;
wobei der Mikroprozessor so konfiguriert ist, dass er mindestens eines von einem Basisband-Encoder-Softwareprogramm (400) und einem Basisband-Decoder-Softwareprogramm (500) ausführt;
wobei das Basisband-Encoder-Softwareprogramm so konfiguriert ist, dass es durch Ausführen mindestens einer der folgenden Funktionen einen ersten codierten Bitstrom erzeugt: Quellencodierung (410) eines ersten Bitstroms (405), Verschlüsselung (420), Kanalcodierung (430), Multiplexen (440), Modulation (450), Frequenzspreizung (460) und Medienzugriffssteuerung (470) ;
wobei der DAC so konfiguriert ist, dass er ein Analogsignal, das dem ersten codierten Bitstrom entspricht, an das Hochfrequenz-Frontend ausgibt;
wobei der ADC so konfiguriert ist, dass er einen zweiten codierten Bitstrom ausgibt, der einem Analogsignal entspricht, das durch das Hochfrequenz-Frontend erzeugt wird;
wobei die Basisband-Decoder-Softwareprogramm so konfiguriert ist, dass es durch Ausführen mindestens einer der folgenden Funktionen einen zweiten Bitstrom erzeugt, der dem zweiten codierten Bitstrom entspricht: Medienzugriffssteuerung (510), Frequenzentspreizung (520), Demodulation (530), Demultiplexen (540), Kanaldecodierung (560), Entschlüsselung (570) und Quellendecodierung (580);
wobei das EIR-Endgerät ferner ein Drahtloskommunikationsprotokollauswahl-Softwareprogramm umfasst, wobei das Drahtloskommunikationsprotokoll-Softwareprogramm so konfiguriert ist, dass es einen Wert eines benutzerdefinierten Kriteriums optimiert, um mindestens eines von einem drahtlosen Kommunikationsnetzwerk (110a, 110b), einem Drahtloskommunikationsprotokoll und einem Parameter eines Drahtloskommunikationsprotokolls dynamisch auszuwählen;
wobei das EIR-Endgerät (100) ferner durch mindestens eines von a), b) und c) gekennzeichnet ist, wie folgt:

a) der Wert des benutzerdefinierten Kriteriums wird basierend auf mindestens einem von einem Netzwerkstatus, einer Kommunikationsqualität, einer Signalstärke, Dienstkosten, einer Bandbreite, einer Benutzerpräferenz und einem Kommunikationskanaldurchsatz berechnet;
b) das EIR-Endgerät (100) ist so konfiguriert, dass es Bakensignale über einen vordefinierten Frequenzbereich sucht und dann mindestens eines von einem drahtlosen Kommunikationsnetzwerk und einem Frequenzkanal auswählt, das/der das benutzerdefinierte Kriterium optimiert;
c) das EIR-Endgerät (100) so konfiguriert ist, dass es mindestens eines von dem drahtlosen Kommunikationsnetzwerk (110a, 110b) und dem Drahtloskommunikationsprotokoll in Reaktion auf ein Auswerten des benutzerdefinierten Kriteriums wechselt.

2. EIR-Endgerät (100) nach Anspruch 1, wobei das EIR-Endgerät keine dedizierte Hardwarekomponenten aufweist, die zum Implementieren mindestens einer der folgenden Funktionen konfiguriert sind: Quellencodierung (410) des ersten Bitstroms, Verschlüsselung (420), Kanalcodierung (430), Multiplexen (440), Modulation (450), Frequenzspreizung (460), Medienzugriffssteuerung (470), Frequenzentspreizung (520), Demodulation (530), Demultiplexen (540), Kanaldecodierung (550), Entschlüsselung (570) und Quellendecodierung (580).

3. EIR-Endgerät (100) nach Anspruch 1, ferner umfassend ein Drahtloskommunikationsprotokollauswahl-Softwareprogramm, wobei das Drahtloskommunikationsprotokoll-Softwareprogramm so konfiguriert ist dass es einen Wert eines benutzerdefinierten Kriteriums optimiert, um mindestens eines von einem drahtlosen Kommunikationsnetzwerk (110a, 110b), einem Drahtloskommunikationsprotokoll und einem Parameter eines Drahtloskommunikationsprotokolls dynamisch auszuwählen.

4. EIR-Endgerät (100) nach Anspruch 1, wobei das Basisband-Encoder-Softwareprogramm (400) durch mindestens einen von einem Universal-Mikroprozessor, einem Spezial-Mikroprozessor ausgeführt wird.

5. EIR-Endgerät (100) nach Anspruch 1, wobei das Basisband-Decoder-Softwareprogramm (500) durch mindestens einen von einem Universal-Mikroprozessor, einem Spezial-Mikroprozessor ausgeführt wird.

6. EIR-Endgerät (100) nach Anspruch 1, wobei die drahtlose Kommunikationsschnittstelle (210) unter Verwendung eines einzigen Mehrfachprotokoll-Chipsatzes implementiert ist.

7. EIR-Endgerät (100) nach Anspruch 1, wobei die drahtlose Kommunikationsschnittstelle (210) unter Verwendung von zwei oder mehr Chipsätzen implementiert ist.

8. EIR-Endgerät (100) nach Anspruch 1, wobei die Abtastfrequenz des ADCs (350) mindestens zweimal

eine maximale Frequenz des Analogsignals ist, das durch das Hochfrequenz-Frontend (340) erzeugt wird.

9. EIR-Endgerät (100) nach Anspruch 1, ferner umfassend einen Pufferverstärker, der so konfiguriert ist, dass er das Analogsignal verstärkt, das durch das Hochfrequenz-Frontend erzeugt wird.

Revendications

1. Terminal de lecture d'informations codées, EIR, (100) comprenant :

un microprocesseur (310) couplé électriquement à un bus système (370) ;
une mémoire (320) couplée de manière communicative audit microprocesseur ;
un dispositif de lecture d'informations codées, EIR, (330) sélectionné dans le groupe consistant en un dispositif de lecture de code à barres, un dispositif de lecture RFID et un dispositif de lecture de carte, ledit dispositif EIR étant configuré pour exécuter au moins une des opérations suivantes : délivrer en sortie des données de message brutes contenant un message codé et délivrer en sortie des données de message décodées correspondant à un message codé ; et
une interface de communication sans fil (210) comprenant une extrémité avant radiofréquence (340) configurée pour exécuter au moins une des opérations parmi la réception d'un premier signal radio et la transmission d'un second signal radio, ladite extrémité avant radiofréquence étant couplée électriquement à au moins un convertisseur parmi un convertisseur analogique-numérique, ADC, (350) couplé électriquement audit bus système et un convertisseur numérique-analogique, DAC, (360) couplé électriquement audit bus système ;
où ledit microprocesseur est configuré pour exécuter au moins un programme parmi un programme logiciel de codeur en bande de base (400) et un programme logiciel de décodeur en bande de base (500) ;
où ledit programme logiciel de codeur en bande de base est configuré pour produire un premier train de bits codé en exécutant au moins l'une des fonctions suivantes : un codage de source (410) d'un premier train de bits (405), un cryptage (420), un codage de canal (430), un multiplexage (440), une modulation (450), un étalement de fréquence (460), et un contrôle d'accès au support (470) ;
où ledit DAC est configuré pour délivrer en sortie à ladite extrémité avant radiofréquence un signal analogique correspondant audit premier train de bits codé ;
où ledit ADC est configuré pour délivrer en sortie un second train de bits codé correspondant à un signal analogique produit par ladite extrémité avant radiofréquence ;
où ledit programme logiciel de décodeur en bande de base est configuré pour produire un second train de bits correspondant audit second train de bits codé en exécutant au moins l'une des fonctions suivantes : un contrôle d'accès au support (510), un désétalement de fréquence (520), une démodulation (530), un démultiplexage (540), un décodage de canal (560), un décryptage (570) et un décodage de source (580) ;
où le terminal EIR comprend en outre un programme logiciel de sélection de protocole de communication sans fil, ledit programme logiciel de protocole de communication sans fil étant configuré pour optimiser une valeur d'un critère défini par l'utilisateur afin de sélectionner dynamiquement au moins un élément parmi un réseau de communication sans fil (110a, 110b), un protocole de communication sans fil et un paramètre d'un protocole de communication sans fil ; et
où ledit terminal EIR (100) est en outre **caractérisé par** au moins un des points a), b) et c) cidessous :

a) ladite valeur dudit critère défini par l'utilisateur est calculée sur la base d'au moins un des éléments suivants : l'état du réseau, la qualité de la communication, l'intensité du signal, le coût du service, la largeur de bande, une préférence de l'utilisateur et le débit du canal de communication ;
b) ledit terminal EIR (100) est configuré pour rechercher des signaux de balise sur une plage de fréquences prédéfinie, puis sélectionner au moins un élément parmi un réseau de communication sans fil et un canal de fréquence qui optimise ledit critère défini par l'utilisateur ;
c) ledit terminal EIR (100) est configuré pour commuter au moins un élément parmi ledit réseau de communication sans fil (110a, 110b) et ledit protocole de communication sans fil en réponse à l'évaluation dudit critère défini par l'utilisateur.

2. Terminal EIR (100) selon la revendication 1, dans lequel ledit terminal EIR est dépourvu de composants matériels dédiés configurés pour mettre en oeuvre au moins l'une des fonctions suivantes : le codage de source (410) dudit premier train de bits, le cryptage (420), le codage de canal (430), le multiplexage (440), la modulation (450), l'étalement de fréquence (460), le contrôle d'accès au support

(470), le désétalement de fréquence (520), la démodulation (530), le démultiplexage (540), le décodage de canal (550), le décryptage (570) et le décodage de source (580).

3. Terminal EIR (100) selon la revendication 1, comprenant en outre un programme logiciel de sélection de protocole de communication sans fil, ledit programme logiciel de protocole communication sans fil étant configuré pour optimiser une valeur d'un critère défini par l'utilisateur afin de sélectionner dynamiquement au moins un élément parmi un réseau de communication sans fil (110a, 110b), un protocole de communication sans fil et un paramètre d'un protocole de communication sans fil.

4. Terminal EIR (100) selon la revendication 1, dans lequel ledit programme logiciel de codeur en bande de base (400) est exécuté par au moins un microprocesseur parmi un microprocesseur d'usage général et un microprocesseur spécialisé.

5. Terminal EIR (100) selon la revendication 1, dans lequel ledit programme logiciel de décodeur en bande de base (500) est exécuté par au moins un microprocesseur parmi un microprocesseur d'usage général et un microprocesseur spécialisé.

6. Terminal EIR (100) selon la revendication 1, dans lequel ladite interface de communication sans fil (210) est mise en oeuvre en utilisant un seul jeu de puces à protocoles multiples.

7. Terminal EIR (100) selon la revendication 1, dans lequel ladite interface de communication sans fil (210) est mise en oeuvre en utilisant deux jeux de puces, ou davantage.

8. Terminal EIR (100) selon la revendication 1, dans lequel une fréquence d'échantillonnage dudit ADC (350) est au moins le double d'une fréquence maximale dudit signal analogique produit par ladite extrémité avant radiofréquence (340).

9. Terminal EIR (100) selon la revendication 1, comprenant en outre un amplificateur tampon configuré pour amplifier ledit signal analogique produit par ladite extrémité avant radiofréquence.

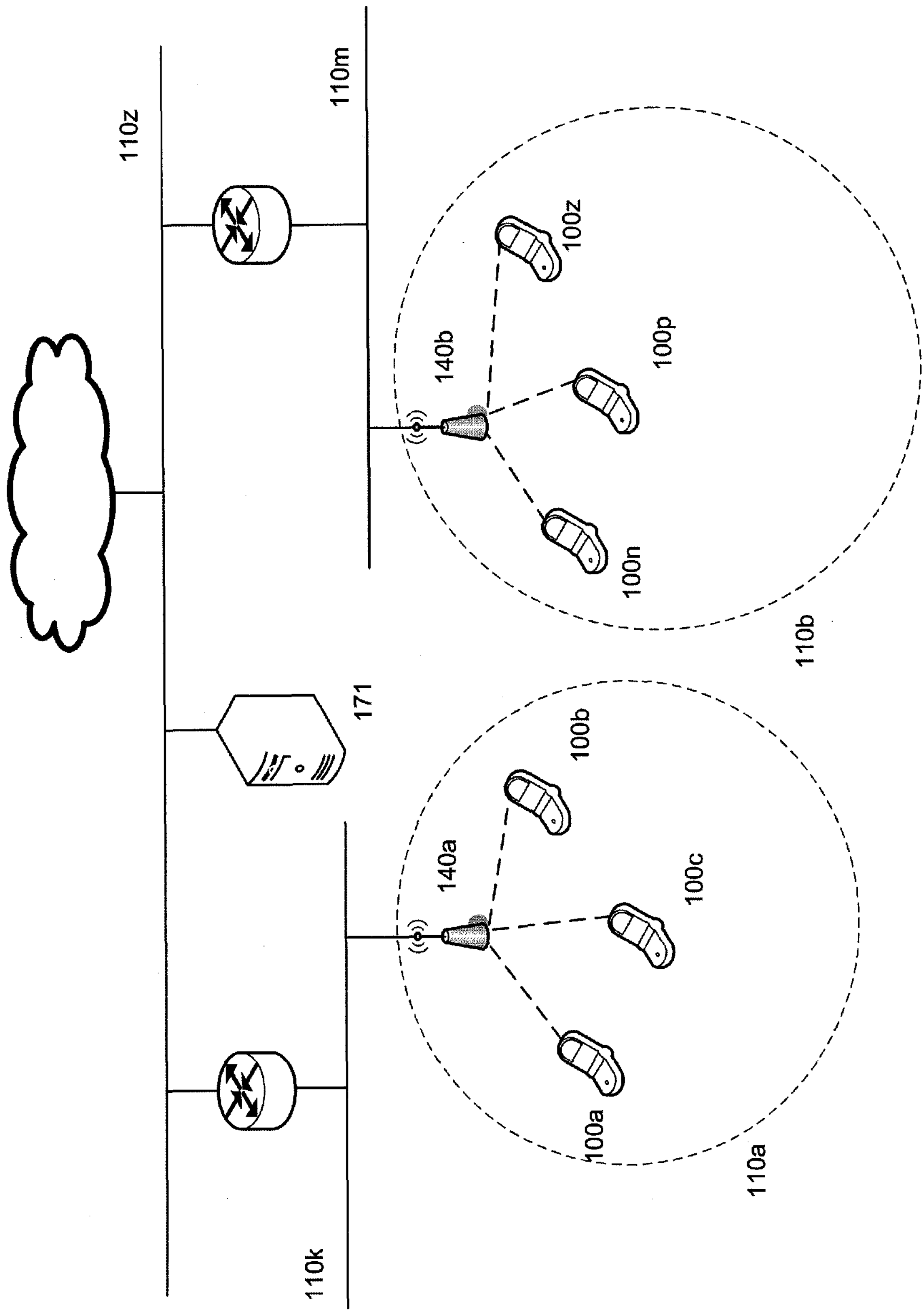
110z
110m
140b
100z
100p
100n
110b
171
100b
140a
100c
100a
110a
110k

Fig. 1

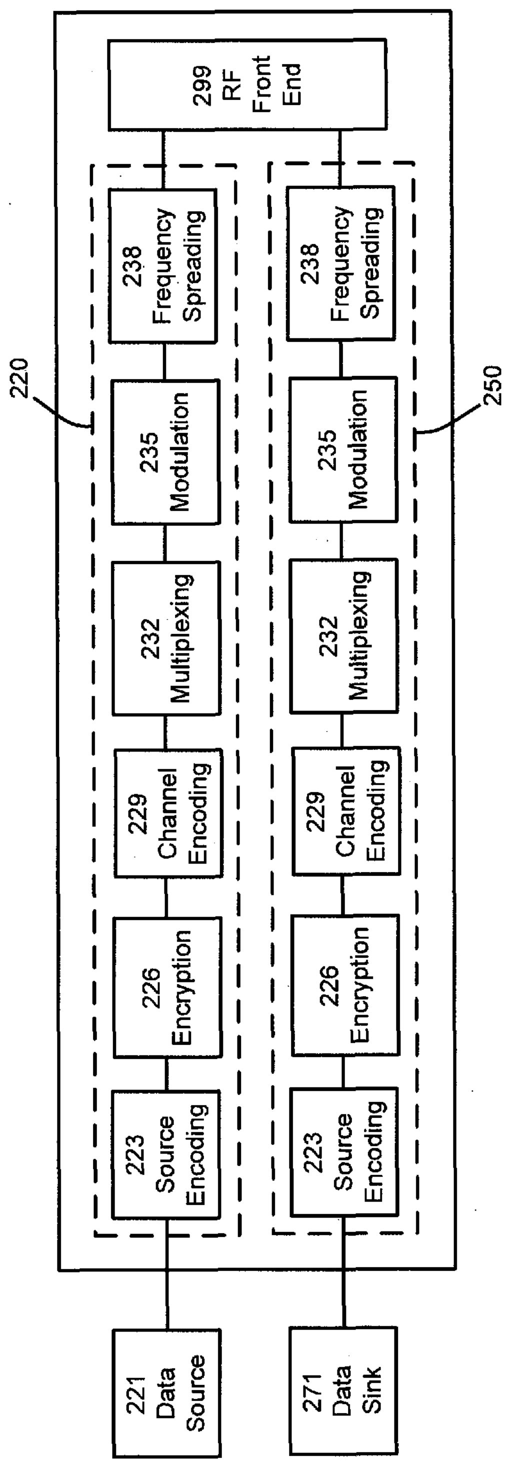
220
250
299 RF Front End
238 Frequency Spreading
235 Modulation
232 Multiplexing
229 Channel Encoding
226 Encryption
223 Source Encoding
238 Frequency Spreading
235 Modulation
232 Multiplexing
229 Channel Encoding
226 Encryption
223 Source Encoding
221 Data Source
271 Data Sink

Fig. 2

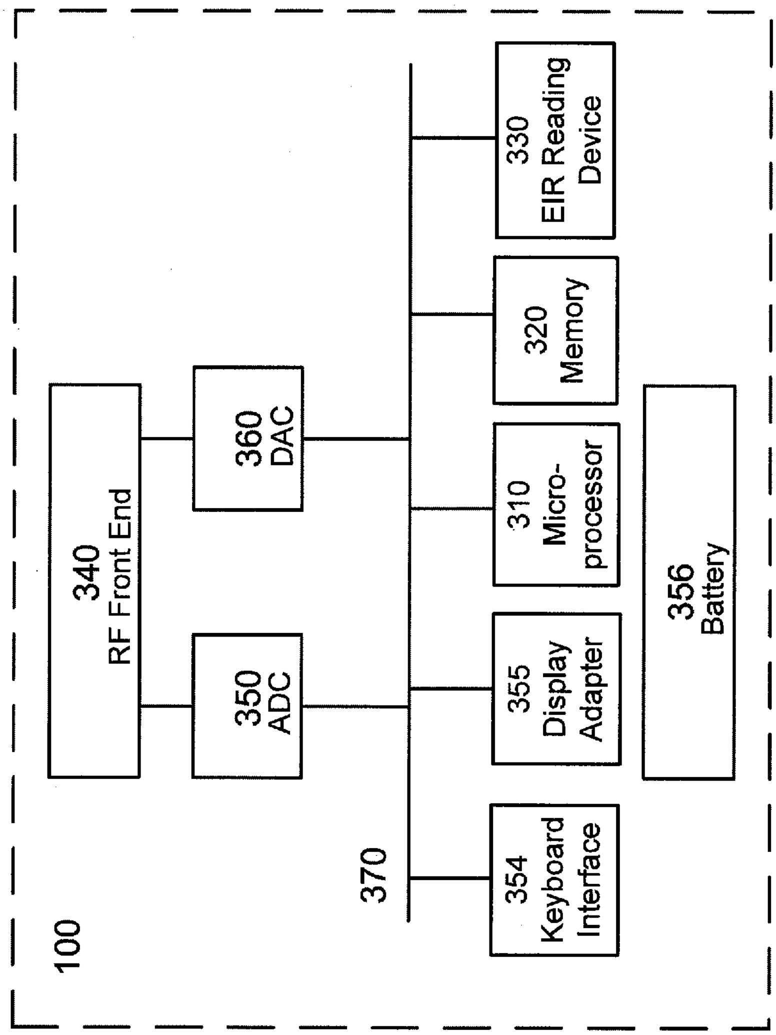
100
340
RF Front End
350
ADC
360
DAC
370
354
Keyboard
Interface
355
Display
Adapter
310
Micro-
processor
320
Memory
330
EIR Reading
Device
356
Battery

Fig. 3

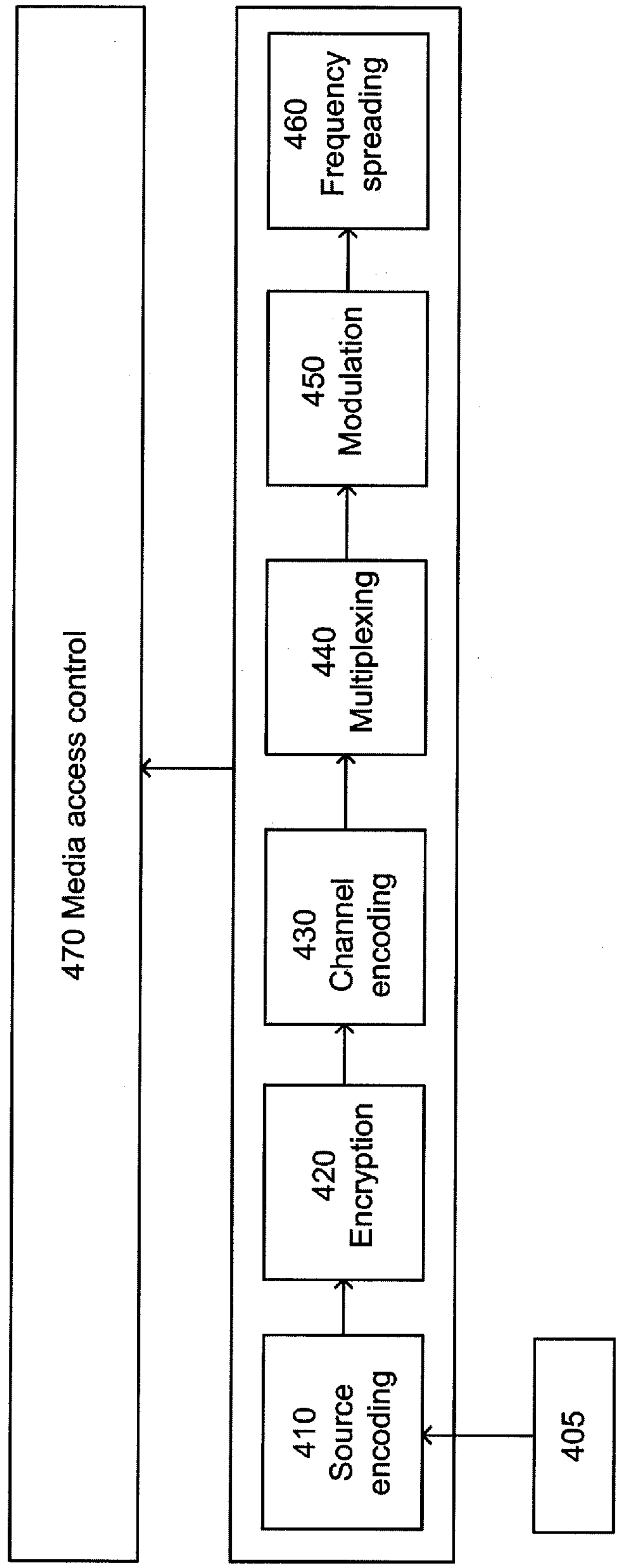
470 Media access control
460 Frequency spreading
450 Modulation
440 Multiplexing
430 Channel encoding
420 Encryption
410 Source encoding
405

Fig. 4

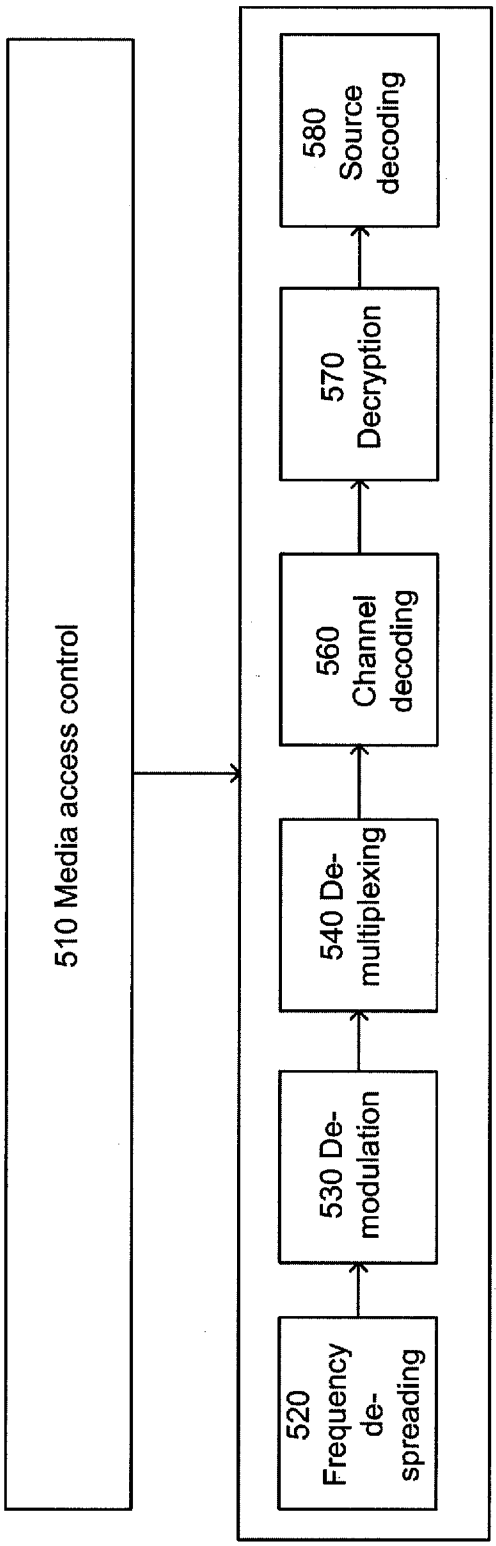
510 Media access control
520 Frequency de-spreading
530 De-modulation
540 De-multiplexing
560 Channel decoding
570 Decryption
580 Source decoding

Fig. 5

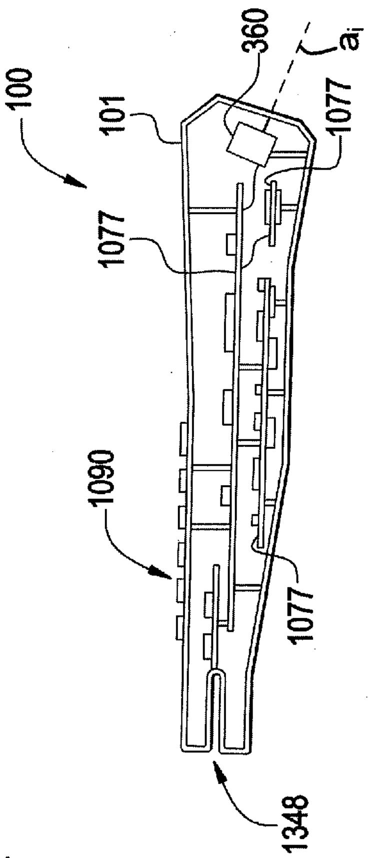
100
101
360
a_i
1077
1077
1090
1077
1348

FIG. 6b

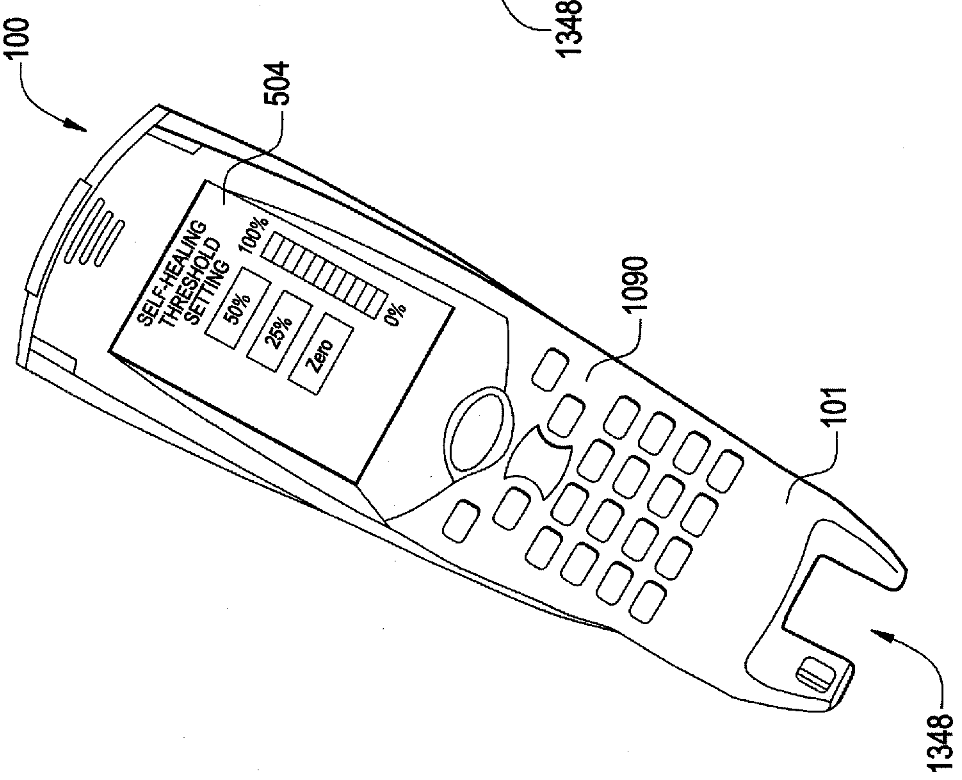
100
504
SELF-HEALING
THRESHOLD
SETTING
100%
0%
50%
25%
Zero
1090
101
1348

FIG. 6a

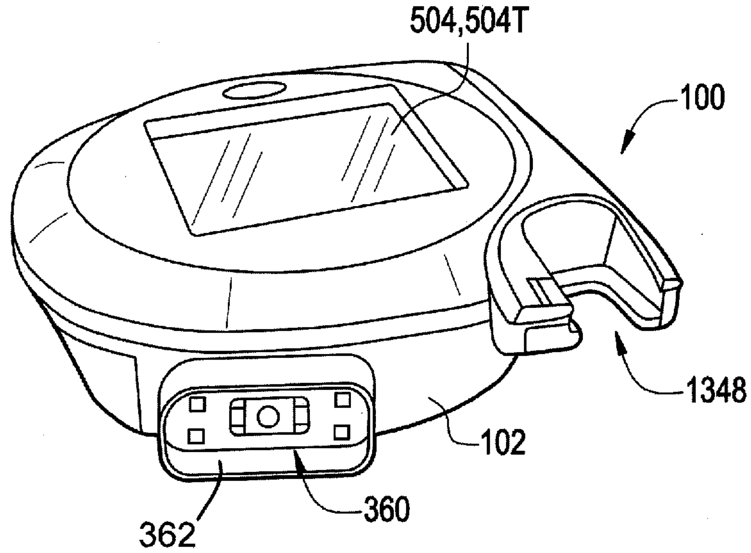

FIG. 7b

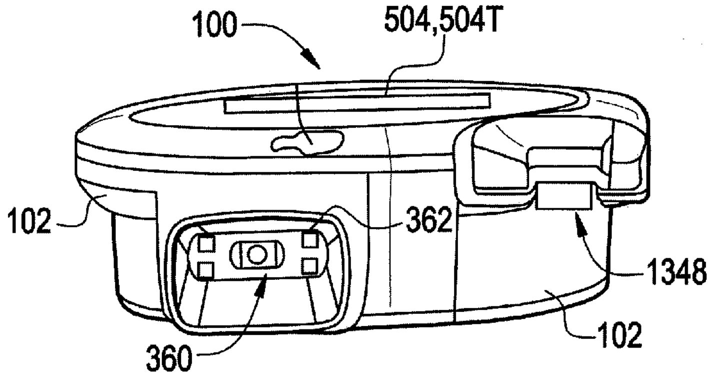

FIG. 7a

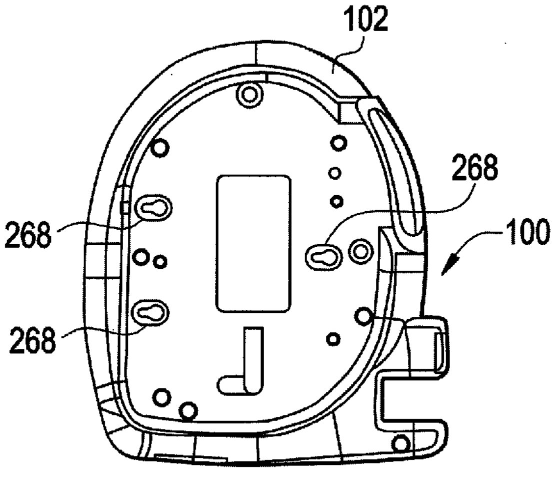

FIG. 7c

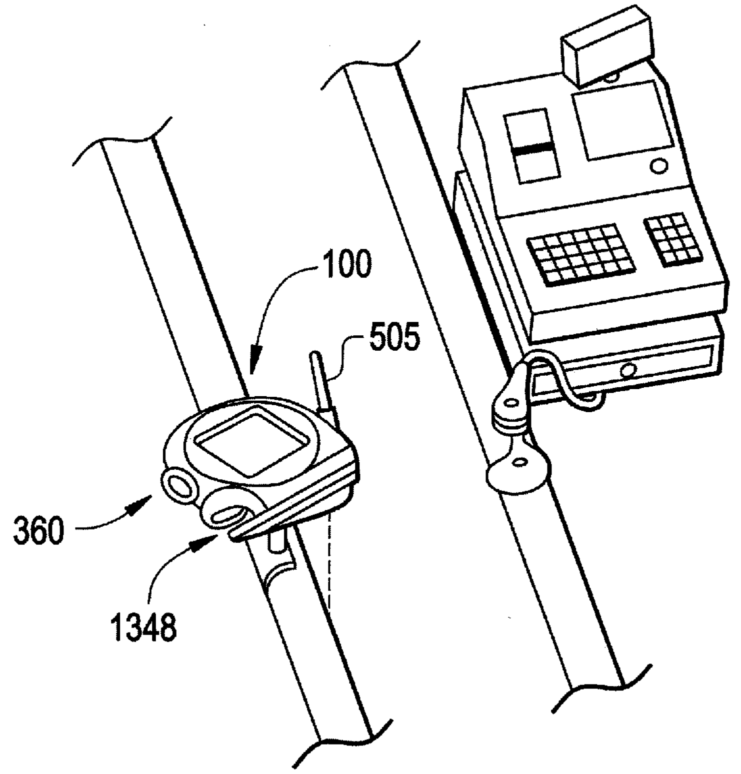

FIG. 8a

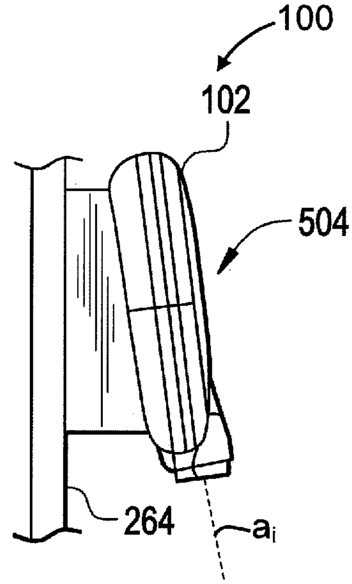

FIG. 8b

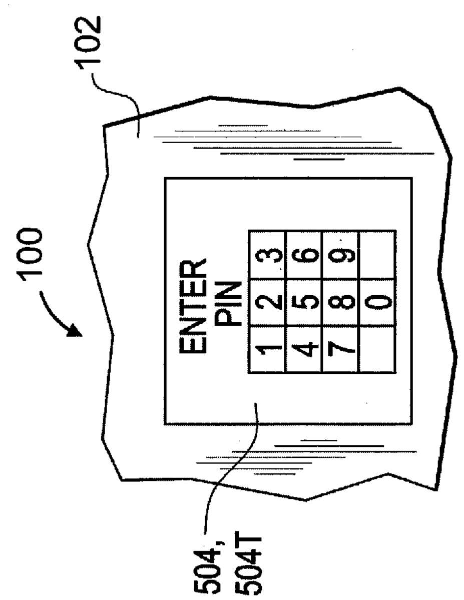
100
102
ENTER
PIN
1
2
3
4
5
6
7
8
9
0
504,
504T

FIG. 8c

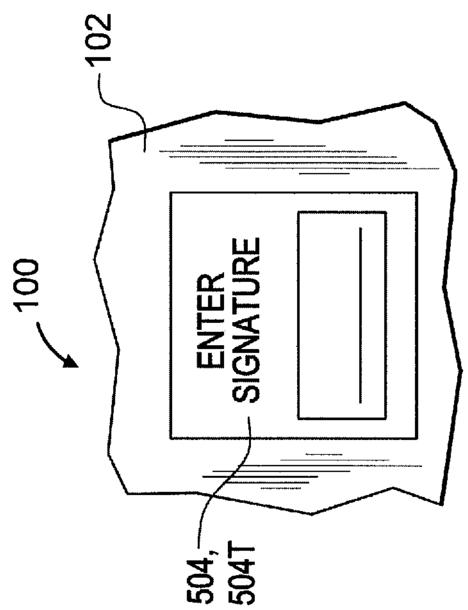
100
102
ENTER
SIGNATURE
504,
504T

FIG. 8d

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2009148074 A1 **[0004]**
- WO 9814023A1 A1 **[0005]**
- US 68760605 P **[0054]**
- US 60690268 B **[0054]**
- US 60692890 B **[0054]**
- US 60694371 B **[0054]**