

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
12 February 2009 (12.02.2009)

PCT

(10) International Publication Number
WO 2009/021220 A1

(51) International Patent Classification:
H04B 5/00 (2006.01)

(74) Agents: **PERRY, Steve, M.** et al.; Thorpe North & West-
ern, LLP, PO Box 1219, Sandy, UT 84091 (US).

(21) International Application Number:
PCT/US2008/072709

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA,
CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE,
EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID,
IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK,
LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW,
MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT,
RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ,
TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(22) International Filing Date: 8 August 2008 (08.08.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/954,784 8 August 2007 (08.08.2007) US

(71) Applicant (for all designated States except US):
RADEUM, INC. [US/US]; 266 West Center Street,
Orem, UT 84057 (US).

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL,
NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG,
CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **DOBYNS, Douglas,
Howard** [US/US]; 351 West 700 North, Lindon, UT 84042
(US). **DOBYNS, Howard, Bernard** [US/US]; 463 South
Palisades Drive, Orem, UT 84097 (US). **WOODARD,
Jed, Erich** [US/US]; 2515 Oakridge Drive, Spanish Fork,
UT 84660 (US). **SUTERA, Anthony, Joseph** [US/US];
381 North Alphinhof Lane, Midway, UT 84049 (US).

Published:
— with international search report

(54) Title: NEAR FIELD COMMUNICATIONS SYSTEM HAVING ENHANCED SECURITY

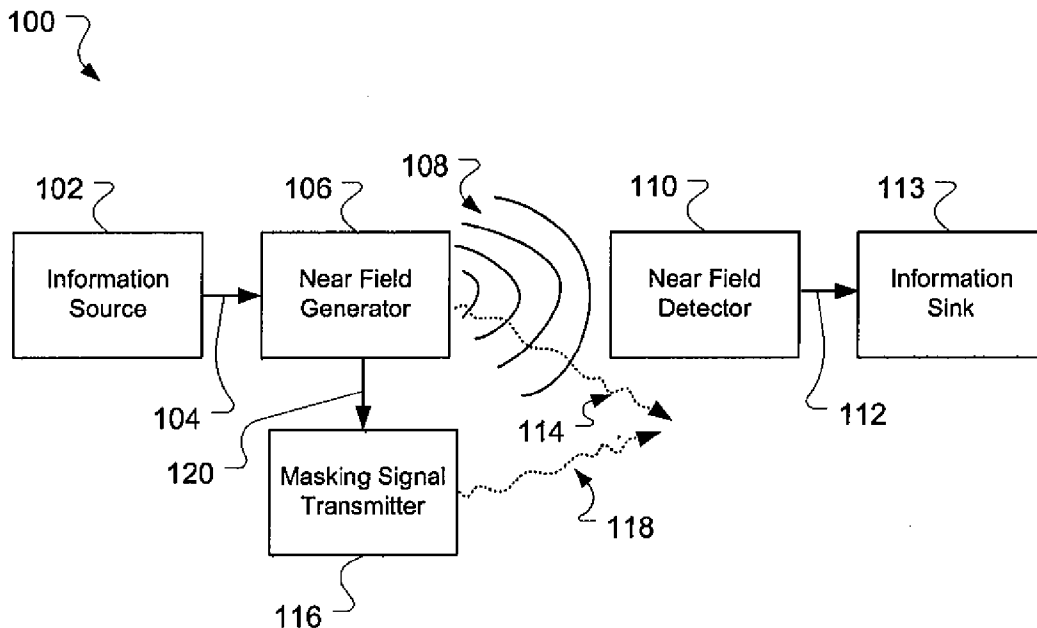


FIG. 1

(57) Abstract: A near field communication system can include a near field generator configured to generate a near field detectable information signal. The near field generator and supporting circuitry also produces incidental electromagnetic radiation. A masking signal transmitter is used with the near field generator and radiates a masking electromagnetic signal. The masking electromagnetic signal may substantially mask the incidental electromagnetic radiation.

WO 2009/021220 A1

NEAR FIELD COMMUNICATIONS SYSTEM HAVING ENHANCED SECURITY

PRIORITY

5 This application claims priority to United States Provisional Patent Application Serial No. 60/954,784 filed on August 8, 2007 which is incorporated herein by reference in its entirety.

BACKGROUND

10 Near field communication systems can prove useful in a variety of analog or digital information exchange applications such as audio transmission, data transmission, video transfer, and message signaling. For example, a near field communication system can be used to provide a wireless link between a headset and a radio, such as, a public service transceiver, military transceiver, cellular telephone, amateur radio transceiver, or
15 the like. The radio may, for example, be worn on a belt while the headset allows for hand-free operation.

 One advantage of such comparatively short range communication systems is increased security due to the reduced radiation emission levels. This security benefit makes short range communication systems valuable for wireless links where secure
20 information is exchanged. However, while near field communication is inherently short range, eavesdropping may be possible. Accordingly, techniques to enhance the security of near field communications systems are desired.

SUMMARY OF THE INVENTION

25 A system and method are provided for a near field communication system. The system can include a near field generator configured to generate a near field detectable information signal. The near field generator and supporting circuitry also produces incidental electromagnetic radiation. A masking signal transmitter is used with the near field generator and radiates a masking electromagnetic signal. The masking
30 electromagnetic signal has characteristics that may be substantially similar to the incidental electromagnetic radiation and substantially uncorrelated to the information.

BRIEF DESCRIPTION OF THE FIGURES

Additional features and advantages of certain exemplary embodiments of the invention will be apparent from the description which follows, taken in conjunction with the accompanying drawings, which together illustrate, by way of example, features of the invention; and, wherein:

5 FIG. 1 is a block diagram illustration of a near field communications system having enhanced security in accordance with an exemplary embodiment of the present invention;

 FIG. 2 is a block diagram illustration of a near field communications system having enhanced security by varying a load on a generated field in accordance with an
10 exemplary embodiment of the present invention; and

 FIG. 3 is a flow chart illustration of a method of enhancing security of a near field communication system in accordance with an exemplary embodiment of the present invention.

15 DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

 Reference will now be made to exemplary embodiments of the invention, and specific language will be used herein to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended.

 Alterations and further modifications of the inventive features illustrated herein, and
20 additional applications of the principles of the inventions as illustrated herein, which would occur to one skilled in the relevant art and having possession of this disclosure, are to be considered within the scope of the invention as defined by the appended claims and their equivalents.

 It is to be understood that the singular forms “a,” “an,” and “the” include plural
25 referents unless the context clearly dictates otherwise. Thus, for example, reference to “a component surface” includes reference to one or more of such surfaces.

 As used herein, the term “about” means that dimensions, sizes, formulations, parameters, shapes and other quantities and characteristics are not and need not be exact, but may be approximated and/or larger or smaller, as desired, reflecting tolerances,
30 conversion factors, rounding off, measurement error and the like and other factors known to those of skill in the art.

 By the term “substantially” is meant that the recited characteristic, parameter, or value need not be achieved exactly, but that deviations or variations, including for

example, tolerances, measurement error, measurement accuracy limitations and other factors known to skill in the art, may occur in amounts that do not preclude the effect the characteristic was intended to provide.

Exemplary embodiments of the present invention relate to near field
5 communications. More particularly, exemplary embodiments of the present invention relate to enhanced security in a near field communications system.

FIG. 1 illustrates a near field communication system in accordance with a first exemplary embodiment of the present system. The near field communication system, shown generally at 100, includes an information source 102 that produces information
10 104. The information may be in an analog or digital format. For example, the information may be a continuous analog audio signal, a digitized audio signal, a video signal, a data sequence, a simple on/off signal, or the like. As a particular example, the information source may include a microphone for converting an acoustic signal into an electric signal, a digitizer, other electronic equipment, or combinations thereof.

The system includes a means for generating a near field detectable information
15 signal, such as a near field generator 106. The near field generator generates a near field signal 108 having the information encoded therein. For example, the near field generator may generate a magnetic or electric field. The near field generator may include a coil (for magnetic induction) or capacitance plate (for electrostatic induction) for generating the
20 near field.

A near field detector 110 can sense or measure the near field signal 108. For example, the near field detector can magnetically or electrostatically couple to the near field and decode the information encoded in the near field. The decoded information 112
25 may be output to an information sink 113. For example, the information sink may include: a speaker that converts an electronic signal into an acoustic signal, digital to analog conversion, other electronics equipment, or combinations thereof.

Near field communication using magnetic or electrostatic coupling can also be used in data communication applications. For example, near field magnetic
30 communication can be used to connect a personal computer or laptop to one or more peripheral devices such as a mouse, keyboard, speakers, audio headsets, microphones, or other data oriented peripherals in a system. Wireless programming of devices can also take place using near field communication, and configuration data can be sent to a device to change the device's setup. Signaling or switching applications can use near field

communications to turn a device on/off or set a device to a simple state (e.g., ready to receive).

An advantage of using near field communications is that the strength of the near field 108 typically decays rapidly with increased distance from the near field generator 5 106. This helps to reduce interference between near field communication systems by using small amounts of spatial separation. Another advantage of the rapid decay of field strength is a certain amount of security, since it can be difficult to detect the near field a large distance away. More particularly, electric and magnetic field power densities typically drop by about 60 decibels (dB) per decade of distance.

10 Unfortunately, the near field generator 106 may produce incidental electromagnetic radiation 114. For example, unwanted and spurious electromagnetic emissions can be generated by the near field generator and associated circuitry. At least some of this electromagnetic information may be correlated to the information 104, and thus may be detectable and decodable by outside systems.

15 For example, the incidental electromagnetic radiation 114 may be induced by time variation in the generated near field. A time varying magnetic field generates an electric field, and vice versa, as described by Maxwell's equations, and can radiate in the form of a propagating electromagnetic wave. Propagating electromagnetic waves drop off in amplitude much more slowly with distance than the electric or magnetic field strength 20 used for near field communication. For example, propagating electromagnetic waves tend to drop off by about 20 dB per decade of distance, as compared to drop off by about 60 dB per decade of distance for magnetic or electrostatic coupling. Accordingly, the incidental electromagnetic radiation can adversely affect the security of the near field communication system 100, if an eavesdropper detects the incidental electromagnetic 25 radiation and extracts information from it.

Filtering and shielding can be included to help reduce the level of incidental electromagnetic radiation. Furthermore, the near field generator may be designed to provide high efficiency near field generation while providing low efficiency electromagnetic radiation.

30 For example, a loop antenna may be used to generate a magnetic field. The efficiency of the propagated electromagnetic radiation is reduced as the transmitting loop's antenna diameter is decreased as compared to the transmitted frequency modulated through the

loop antenna. Unfortunately, incidental electromagnetic radiation can be difficult to avoid, and undesirable levels of radiation may be present.

The near field system 100 can therefore include a means for radiating a masking signal, such as a masking signal transmitter 116 to radiate a masking electromagnetic signal 118. The masking electromagnetic signal may substantially reduce a detectability of at least one of the incidental electromagnetic radiation and the information. Further, the masking electromagnetic signal may substantially reduce the detectability, decodability or extractability of the information from the incidental electromagnetic radiation. In one exemplary implementation, the masking electromagnetic signal may be generated with characteristics substantially similar to the incidental electromagnetic radiation, so that the masking electromagnetic signal is difficult to distinguish or separate from the incidental electromagnetic radiation. For example, the masking electromagnetic signal may be an artificial noise floor or jamming signal, such as random noise, random pulses, stepped tones, warbler, randomly keyed carrier wave, pulses, recorded sounds, and the like. Preferably, the masking electromagnetic signal is uncorrelated with the information. Accordingly, the masking electromagnetic signal helps to enhance the security of the near field communication system by making it difficult for an eavesdropper to detect the information, decode or extract the information, and/or detect the incidental electromagnetic radiation.

For example, the masking electromagnetic signal may be configured to occupy substantially the same bandwidth as the incidental electromagnetic radiation. In one exemplary embodiment, a near field communication system may have a carrier frequency of 13.56 MHz and modulate the near field transmission at 250 kHz above and 250 kHz below the 13.56 MHz carrier frequency. Accordingly, the masking electromagnetic signal may be configured to occupy a bandwidth from 13.3 MHz to 13.82 MHz. Small differences in bandwidth between the masking electromagnetic signal and the incidental electromagnetic radiation may occur without adversely impacting the security, and thus the bandwidths need not be precisely the same.

In another exemplary embodiment, the masking signal may occupy a wide bandwidth. For example, the near field communication system may have a carrier frequency of 100 MHz with a bandwidth of 1 MHz, where the modulated near field is between 99.5 MHz and 100.5 MHz. Accordingly, the masking signal may provide masking between 50 MHz and 500 MHz frequencies, thus masking the incidental

electromagnetic radiation without revealing the precise modulation frequency of the near field system. This may make detection of the electromagnetic radiation more difficult because a larger bandwidth needs to be searched in order to analyze and decode the incidental electromagnetic radiation.

5 Alternatively, a wideband signal can be used to mask a spectrum containing multiple carrier frequencies that may be used by a carrier frequency applying frequency hopping. For example, the near field system may use multiple carrier frequencies to allow multiple devices to function within a short range of each other or to function despite interfering signals generated by environmental sources. In this type of short range
10 system, the possible carrier frequencies may be 1 MHz, 5 MHz, 10 MHz, 15 MHz, and 20 MHz. Thus, the wideband masking electromagnetic signal may be from 500 KHz to 21 MHz to mask incidental electromagnetic radiation at all possible frequencies.

 Harmonic incidental radiation can also be a concern when trying to maintain an electromagnetic profile that is difficult for potential eavesdroppers to detect. In one
15 exemplary embodiment, a wideband masking signal may be used to mask harmonically generated frequencies as needed. In addition, the harmonics of the masking signal may be used to mask the harmonics of the carrier frequency. In another exemplary embodiment, multiple narrow-band masking signals at defined frequencies can be used to mask detectable harmonic frequencies. For example, certain primary or secondary
20 harmonics may be more detectable to an eavesdropper, and therefore these harmonics may be masked by using multiple narrow-band masking signals generated to hide harmonics of concern.

 In one exemplary embodiment, the masking electromagnetic signal can be radiated with a field strength similar to the incidental electromagnetic radiation. If the
25 masking electromagnetic signal is too weak, relative to the incidental electromagnetic radiation, it may not adequately mask the incidental electromagnetic radiation. In contrast, while radiating a high power masking electromagnetic signal can provide better masking, this may result in undesirable effects such as (1) electromagnetic interference to other equipment (2) increased power consumption, and (3) reduced covertness for the
30 near field communication system.

 In particular, one advantage of the near field communication system 100 is the relatively low probability of detection of the near field generator at a distance. Low probability of detection is helpful when covertness is desired, such as in a warfare

situation. As noted above, the near field falls off at about 60 dB per decade of distance. Detection of the near field communication system at a distance using near field coupling is difficult, requiring an adversary to be very close or to use a large detector array or antenna. At sufficient distances, detection of the near field can become a practical
5 impossibility due to noise caused by other stray fields and noise sources with the adversary's equipment. Accordingly, an adversary may attempt to detect incidental electromagnetic radiation from the near field communication system from a distance beyond which the near field is detectable.

While the incidental electromagnetic radiation 114 is generally at a much lower
10 level (relative to the near field strength) in areas proximate to the near field generator 106, the incidental electromagnetic radiation can propagate with about 20 dB per decade of distance loss. At a distance that is dependant upon the characteristics of the near field generator, the incidental electromagnetic radiation may have a field strength that is higher than the field strength of the near field. Accordingly, an adversary may attempt to detect
15 the incidental electromagnetic radiation. To address the detectability of the incidental electromagnetic radiation a masking electromagnetic signal may be implemented. However, energy radiated in the masking electromagnetic signal, while helpful to block eavesdropping, can increase the detectability of the near field generator.

To maximize masking, a larger signal level for the masking electromagnetic signal
20 is desired, but to minimize detectability, a smaller signal level for the masking electromagnetic signal is desired. Accordingly, providing the electromagnetic signal with substantially the same field strength as the incidental electromagnetic radiation may provide a good compromise between these opposing effects. For example, the masking electromagnetic signal field strength may equal the incidental electromagnetic radiation
25 field strength within a few decibels. The masking electromagnetic signal and the incidental electromagnetic radiation signal levels may vary with time due to tolerances, initial calibration, temperature, etc. during normal equipment operation.

Directional differences between the radiation of the masking electromagnetic signal and the incidental electromagnetic signal can result in variations in the relative
30 field strengths at certain positions relative to the near field generator 106. Areas in which the relative field strength of the electromagnetic signal is higher may make it easier for an eavesdropper to detect the information at those positions. Of course, depending on the application, such a situation may be acceptable. For example, in ground-based

communications, the directions of most concern are in the horizontal direction and radiation in an upward direction (which requires aerial platforms for detection or interception) may be of less concern.

5 It may be desirable for the masking electromagnetic signal to be radiated with similar directivity as the incidental electromagnetic radiation to avoid areas in which the masking electromagnetic signal varied in signal strength from the incidental electromagnetic radiation. For example, if the incidental electromagnetic signal is radiated generally in one direction relative to the near field generator, the masking electromagnetic signal can be radiated generally in the same direction. Of course, the radiating mechanism for the incidental electromagnetic radiation may be different than the masking electromagnetic signal. As a particular example, in a magnetic induction system, the near field can be generated using a coil. The coil is a relatively low efficiency radiator for the electromagnetic radiation, and produces electromagnetic radiation propagating mostly in directions aligned with the plane of the loop. In contrast, the masking electromagnetic signal may be radiated using a small dipole or bowtie antenna. Accordingly, it may be helpful to align the antenna used to radiate the masking electromagnetic signal appropriately to match the electromagnetic radiation from whatever structures are used to generate the near field.

10 In light of the above considerations, maintaining similar signal strengths between the incidental electromagnetic radiation 114 from near field generator 106 and the masking electromagnetic signal 118 from masking signal transmitter 116 can be enhanced by positioning the antenna or other radiating structure of the masking signal transmitter near the near field generator. For example, the antenna can be integrated into the housing of the near field generator or the antenna can be located on or adjacent to the near field generator.

25 The signal level of the masking electromagnetic signal may be selected so that, in combination with the incidental electromagnetic radiation, the total propagated energy is less than a defined level at a preset distance from the near field generator. For example, a typical noise floor level for eavesdroppers or adversaries may be determined, and the system can be designed to achieve low probability of detection at a preset distance from the adversary.

30 As noted above, it is beneficial for the signal characteristics of the masking electromagnetic signal to substantially match one or more of the characteristics of the

incidental electromagnetic radiation. In addition to matching signal bandwidth, carrier frequency (if any), and signal strength, other characteristics can also be matched. For example, if the near field is modulated to encode information, a similar modulation may appear in the incidental electromagnetic radiation. Accordingly, the masking
5 electromagnetic signal can use the same modulation scheme as is applied to the near field. It should be appreciated that the masking electromagnetic signal can be modulated with masking information that is uncorrelated to the (useful) information.

There may be instances where the characteristics of the masking electromagnetic signal are not similar to all of the characteristics of the incidental electromagnetic
10 radiation. For example, the masking signal may reduce the achievable link distance of the near field system somewhat, when compared to near field systems without the presence of the masking signal. There may also be situations where the additional link distance is a higher priority than the security benefits of the masking signal. In these situations, the masking signal may use a lower power level or be shut off completely to provide a greater
15 link distance regardless of the characteristics or detectability of the incidental electromagnetic signal. Therefore, it may be possible to turn on the masking signal, turn off the masking signal, and increase or decrease the power level of the masking signal independently from the incidental electromagnetic signal.

Furthermore, there may be instances where the characteristics of the masking
20 electromagnetic signal are not similar to any of the characteristics of the incidental electromagnetic radiation and yet the collective characteristics of the masking electromagnetic signal are sufficient to mask the incidental electromagnetic radiation and thereby reduce the detectability of the incidental electromagnetic radiation. Still further, the masking electromagnetic signal may be generated to allow detection of the incidental
25 electromagnetic radiation and yet substantially reduce the detectability, decodability and/or extractability of information from the incidental electromagnetic radiation.

In addition, there may be instances where the timing of the masking signal is independent of the incidental electromagnetic signal. For example, a CDMA (Code Division Multiple Access) or TDD (Time Division Duplex) system which enables
30 multiple systems to co-exist through time division or time slice management may be identified by an eavesdropper through observing the timing of the presence or absence of the incidental electromagnetic signal. If the masking electromagnetic signal has timing that is similar to the incidental electromagnetic signal timing, it may be possible for the

eavesdropper to determine the type of modulation scheme used by the near field system. By generating the masking electromagnetic signal using a timing scheme that is independent from the near field system or incidental electromagnetic signal's timing, the modulation of the near field system can be made more difficult to identify.

5 When the masking electromagnetic signal is cycled on and off corresponding to transmission by the near field system, the masking electromagnetic signal may be cycled on by at least a first defined period of time before a transmission by the near field system and may be cycled off a second defined period of time after the near field system ceases transmission. By making the duration of a transmission of the masking electromagnetic
10 signal longer than the duration of a transmission by the near field system, the resulting incidental electromagnetic can be better masked. Further, as described above, the first and second defined periods of time may vary based on each cycle, a period of time, or the like. In addition, the masking electromagnetic signal may be constantly transmitted.

 By applying masking information to the electromagnetic masking signal that is
15 uncorrelated to the useful information, the security of the useful information is enhanced. This is because it is difficult for an eavesdropper to differentiate between the electromagnetic masking signal and the incidental electromagnetic information. For example, simply delaying the useful information to obtain the masking information produces a correlated masking signal. Direct detection of the information is difficult, due
20 to interference between the masking signal and the incidental signal; however, techniques such as rake receivers may be used by an eavesdropper to detect the useful information. Such vulnerabilities may be avoided by appropriate selection of the masking information.

 For example, the masking information may be randomized. In general, cryptographic techniques may be applied in obtaining the masking information. For
25 example, the masking information may be selected to provide statistically similar properties as the useful information, while remaining substantially uncorrelated. For example, for digital data, the useful information may be passed through a cryptographic algorithm to obtain the masking information. The masking information may also be directly generated using a random data generator.

30 When useful information is encoded into the near field using a digital modulation technique (e.g., phase shift keying, amplitude shift keying, frequency shift keying, or combinations thereof) the near field varies according to modulation symbol timing. It may be helpful to couple the masking signal transmitter 116 to the near field generator

106 to enable synchronizing the modulation of the masking electromagnetic signal 118 to the symbol timing of the near field generator 106. This coupling can be done in various ways to provide symbol timing information 120 to the masking signal transmitter. For example, the near field generator can provide a timing signal to the masking signal transmitter. As another example, the masking signal transmitter may extract a timing signal from the modulated near field.

One exemplary embodiment may include a masking signal that is decoupled from the near field generator. For example, an independent random noise generator can be used that has no knowledge of the data output or characteristics of the incidental electromagnetic radiation. The random noise generator can be a wide bandwidth noise generator or the random noise generator can be tuned to specific electromagnetic spectrums.

Another exemplary embodiment may include a masking signal generator that is not coupled to and is independent from the near field generator, but the masking signal generator has the capability to detect and respond to the presence of and/or modulation type of near field communications. For example, the masking signal generator may turn on the masking signal when near field communications are detected and turn off the masking signal when the near field communications are not active. In addition, the masking signal generator may select an optimized masking pattern and bandwidth based on the near field communication type that is detected.

In one exemplary embodiment, the masking signal can be uncorrelated to the information encoded in the near field signal when viewed in various dimensions of signal space. In other words, as is known in the art, signals can be viewed in time domain, frequency domain, code domain (for spread spectrum encoded signal), or viewed in vector spaces using defined sets of basis functions. Accordingly, it is helpful for the masking electromagnetic signal and the incidental electromagnetic radiation to be substantially similar regardless of what signal space the signals are viewed in. One way to accomplish this is to generate the masking signal using the same basic processes as the near field signal (e.g. modulation scheme, data format, data timing, etc) while randomizing the masking signal in at least one dimensions relative to the near field signal to provide low or zero cross-correlation between the signals when measured in the at least one dimension. For example, randomizing data used to drive modulation of the signal can accomplish this randomization.

FIG. 2 illustrates another exemplary embodiment of a near field communication system 200. In this configuration, the near field system may exchange information using a near field detector 210 which acts as a near field generator to generate a magnetic or electric field 208. An information source 202 can then vary a load 206 on the generated
5 field which correlates to the information to be exchanged. The near field generator can include modules to detect modulation changes and decode the information encoded in the magnetic or electric field in order to provide an information output to an information sink 213.

The time variation of the near field due to variation of the load on the near field
10 may produce unwanted and spurious incidental electromagnetic radiation 214. This incidental electromagnetic radiation may enable an eavesdropper to more easily detect communication patterns, and so it is valuable to obfuscate the incidental electromagnetic radiation. In a similar manner as discussed previously, a masking signal generator 216 can be provided to generate a masking signal 218. The masking signal generator 216 can
15 be linked to near field generator to provide correlated masking. Alternatively, the masking signal generator 220 can generate the masking signal in an independent fashion as discussed previously.

The present system for using the masking signal transmitter has been described as masking one other device, but the masking signal transmitter can be used to mask two or
20 more devices that are within near field communication range of one another. For example, a masking transmitter may mask: a wireless speaker microphone and a headset to which it is coupled, a wireless remote PTT switch, a wireless remote control module for volume or channel selection, a wireless data interface to a laptop or other data device, and mask the masking transmitter itself.

25 Finally, a method for enhancing security of near field communications system is described in conjunction with a flow chart shown in FIG. 3. The method, shown generally at 300, can include forming 302 an energy field for transmission of information via near field communications techniques. For example, the energy field may be a magnetic field or an electric field. Characteristics of the energy field may be varied to
30 encode information thereon. For example, the energy field may be varied in field strength, orientation, etc. The energy field may be varied according to a carrier signal, with characteristics of the carrier signal (e.g. frequency, phase, amplitude, and combinations thereof) varied to encode the information. For example, a carrier signal can

have a frequency of 100 kHz, 13.56 MHz, or other frequencies. In general, higher carrier signal frequency provides generally a shorter near field range.

The method includes radiating 304 incidental electromagnetic radiation correlated to the information. For example, as described above, incidental electromagnetic radiation can be produced by a varying magnetic or electric field. The level of incidental
5 electromagnetic radiation may be quite small, having been reduced by filtering, shielding, or other techniques, yet a measurable amount may remain.

The method can also include generating 306 a masking electromagnetic signal. As described above, the masking electromagnetic signal has characteristics substantially
10 similar to the incidental electromagnetic radiation and substantially uncorrelated to the information. The method can include radiating 308 the masking electromagnetic signal. Accordingly, the masking signal can interfere with the incidental electromagnetic radiation, making it difficult for an eavesdropper to decode the information. The masking signal may be similar in signal level to the incidental electromagnetic radiation, helping to
15 hide the information without unacceptable increases in the ability for an adversary to detect the combined radiated signals.

The use of a near field communication system in this disclosure has been described as a short range system but this is relative term that compares near field systems to existing longer range radio frequency (RF) systems. More specifically, the use
20 of the term short range refers to the near field region of the electromagnetic radiation which is generally equal to or less than $\frac{\lambda}{2\pi}$ (the wavelength over 2pi). For example, there are communication applications such as mining and short range systems where the near field communications can be extended to hundreds of meters by reducing the carrier frequency and increasing the wavelength. For example, a carrier frequency of 100 kHz
25 may be used to generate near fields with a range of over 400 meters.

To summarize, exemplary embodiments of the present invention may be useful in short range communications applications where security and/or low probability of detection are desired. By masking propagating electromagnetic emissions from the near field communications equipment, detection and interception of the near field system can
30 be minimized. Such exemplary embodiments may be particularly useful for hands-free headsets in military, law enforcement, security, public service, and other applications. Other applications can include the transfer of data between computing and

communication devices over a short distance or the communication of signals such as stopping and starting other devices or providing a single signal to set a defined state.

It is to be understood that the arrangements described herein are only illustrative of the application for the principles of the present invention. Numerous modifications
5 and alternative arrangements can be devised without departing from the spirit and scope of the present invention as defined by the appended claims and their equivalents. While the present invention has been shown in the drawings and fully described above with particularity and detail with reference to certain exemplary embodiments thereof, it will
10 be apparent to those of ordinary skill in the art that numerous modifications can be made without departing from the principles and concepts of the invention as set forth herein.

CLAIMS

1. A near field communication system having enhanced security, comprising:
 - a near field generator configured to generate a near field detectable signal having information encoded therein, wherein incidental electromagnetic radiation correlated to the information is produced when the near field detectable signal is generated; and
 - a masking signal transmitter configured to radiate a masking electromagnetic signal and to mask the incidental electromagnetic radiation.
2. The system of claim 1, wherein the masking electromagnetic signal reduces at least one of detectability, decodability and extractability of the information from the incidental electromagnetic radiation.
3. The system of claim 1, wherein the radiated masking electromagnetic signal reduces the detectability of the incidental electromagnetic radiation.
4. The system of claim 1, wherein the masking electromagnetic signal comprises at least one characteristic substantially similar to at least one characteristic of the incidental electromagnetic radiation.
5. The system of claim 1, wherein the radiated masking electromagnetic signal is substantially uncorrelated to the information.
6. The system of claim 1, wherein the masking signal transmitter is coupled to the near field generator and the masking electromagnetic signal is generated using the information.
7. The system of claim 1, wherein the masking signal transmitter is decoupled from the near field generator and the masking electromagnetic signal is generated without using the information.
8. The system of claim 1, wherein the masking signal transmitter is independent from the from the near field generator.

9. The system of claim 1, wherein a timing associated with the near field generator is different than a timing associated with the masking signal transmitter.
- 5 10. The system of claim 1, wherein the masking signal transmitter is configured to radiate a plurality of masking electromagnetic signals.
11. The system of claim 1, wherein the masking signal transmitter is configured to radiate at least one masking electromagnetic signal configured to mask the incidental
10 electromagnetic radiation produced by the near field generator and incidental electromagnetic radiation produced by at least one other near field generator.
12. The system of claim 1, wherein the masking electromagnetic signal comprises substantially the same field strength as the incidental electromagnetic radiation.
15
13. The system of claim 1, wherein the masking electromagnetic signal is radiated in a direction similar to the incidental electromagnetic radiation.
14. The system of claim 1, wherein the masking electromagnetic signal is designed to
20 spectrally match the incidental electromagnetic radiation.
15. The system of claim 1, wherein the masking electromagnetic signal is configured to occupy substantially the same bandwidth as the incidental electromagnetic radiation.
- 25 16. The system of claim 1, wherein the masking electromagnetic signal is configured to occupy a wider bandwidth than the incidental electromagnetic radiation.
17. The system of claim 1, wherein the near field detectable signal is propagated by way of magnetic induction.
30
18. The system of claim 1, wherein the near field detectable signal is propagated by way of capacitive coupling.

19. The system of claim 1, wherein the masking electromagnetic signal is generated using a random data generator.
20. The system of claim 1, wherein the masking electromagnetic signal comprises a similar modulation as the near field detectable signal that is modulated with encoded information.
21. The system of claim 1, wherein the masking electromagnetic signal and the incidental electromagnetic radiation have a combined noise level less than a defined noise level at a preset distance from the system.
22. The system of claim 1, wherein the masking electromagnetic signal is radiated using an antenna.
23. The system of claim 22, wherein the antenna is contained in the same housing as the near field generator.
24. The system of claim 1, wherein a timing signal is provided from the near field generator to the masking signal transmitter.
25. The system of claim 1, wherein the masking signal transmitter extracts a timing signal from the near field detectable signal.
26. A near field communication system having enhanced security, comprising:
means for generating a near field detectable signal having information encoded therein, wherein incidental electromagnetic radiation correlated to the information is produced when the near field detectable signal is generated; and
means for radiating a masking signal for masking the incidental electromagnetic radiation.
27. The system of claim 26, wherein the radiated masking electromagnetic signal reduces at least one of detectability, decodability and extractability of the information from the incidental electromagnetic radiation.

28. The system of claim 26, wherein the radiated masking electromagnetic signal reduces the detectability of the incidental electromagnetic radiation.
- 5 29. The system of claim 26, wherein the masking electromagnetic signal comprises at least one characteristic substantially similar to at least one characteristic of the incidental electromagnetic radiation.
- 10 30. The system of claim 26, wherein the radiated masking electromagnetic signal is substantially uncorrelated to the information.
31. A method for enhancing security of near field communications system, comprising:
- forming an energy field for transmission of information via near field
 - 15 communications techniques;
 - radiating incidental electromagnetic radiation correlated to the information;
 - generating a masking electromagnetic signal for masking the incidental electromagnetic radiation; and
 - radiating the masking electromagnetic signal.
- 20 32. The method of claim 31, wherein the radiating of the incidental electromagnetic radiation comprises varying a load in the energy field.
33. The method of claim 31, wherein the radiated masking electromagnetic signal
- 25 reduces at least one of detectability, decodability and extractability of the information from the incidental electromagnetic radiation.
34. The method of claim 31, wherein the radiated masking electromagnetic signal reduces the detectability of the incidental electromagnetic radiation.
- 30 35. The method of claim 31, wherein the masking electromagnetic signal comprises at least one characteristic substantially similar to at least one characteristic of the incidental electromagnetic radiation.

36. The method of claim 31, wherein the radiated masking electromagnetic signal is substantially uncorrelated to the information.

5 37. The method of claim 31, wherein the generating of the masking electromagnetic signal comprises generating a plurality of masking electromagnetic signals, further wherein the radiating of the masking electromagnetic signal comprises radiating the plurality of masking electromagnetic signals.

10 38. The method of claim 31, wherein the masking electromagnetic signal comprises substantially the same field strength as the incidental electromagnetic radiation.

39. The method of claim 31, wherein the masking electromagnetic signal spectrally matches the incidental electromagnetic radiation.

15

40. The method of claim 31, wherein the masking electromagnetic signal occupies substantially the same bandwidth as the incidental electromagnetic radiation.

20 41. The method of claim 31, wherein the masking electromagnetic signal occupies a wider bandwidth than the incidental electromagnetic radiation.

42. The method of claim 31, wherein the masking electromagnetic signal is generated using a random data generator.

25 43. The method of claim 31, wherein the masking electromagnetic signal and the incidental electromagnetic radiation have a combined noise level less than a defined noise level.

30 44. The method of claim 31, further comprising encoding information in the near field using a digital modulation technique.

45. The method of claim 31, further comprising directing the masking signal in the same direction as the incidental electromagnetic radiation.

46. The method of claim 31, further comprising shielding an energy field generator that is creating the energy field to reduce the level of incidental electromagnetic radiation.
- 5 47. The method of claim 31, further comprising providing a timing signal to the masking signal transmitter.
48. The method of claim 31, further comprising extracting a timing signal from the near field detectable signal for use with the masking signal transmitter.
- 10 49. A near field communication system having enhanced security for a near field generator, the system comprising:
a masking signal transmitter configured to radiate a masking electromagnetic signal for masking incidental electromagnetic radiation produced when a near field detectable signal having information encoded therein is generated by a near field
15 generator.
50. The system of claim 49, wherein the radiated masking electromagnetic signal reduces at least one of detectability, decodability and extractability of the information from the incidental electromagnetic radiation.
- 20 51. The system of claim 49, wherein the radiated masking electromagnetic signal reduces the detectability of the incidental electromagnetic radiation.
52. The system of claim 49, wherein the masking electromagnetic signal comprises at
25 least one characteristic substantially similar to at least one characteristic of the incidental electromagnetic radiation.
53. The system of claim 49, wherein the radiated masking electromagnetic signal is substantially uncorrelated to the information.

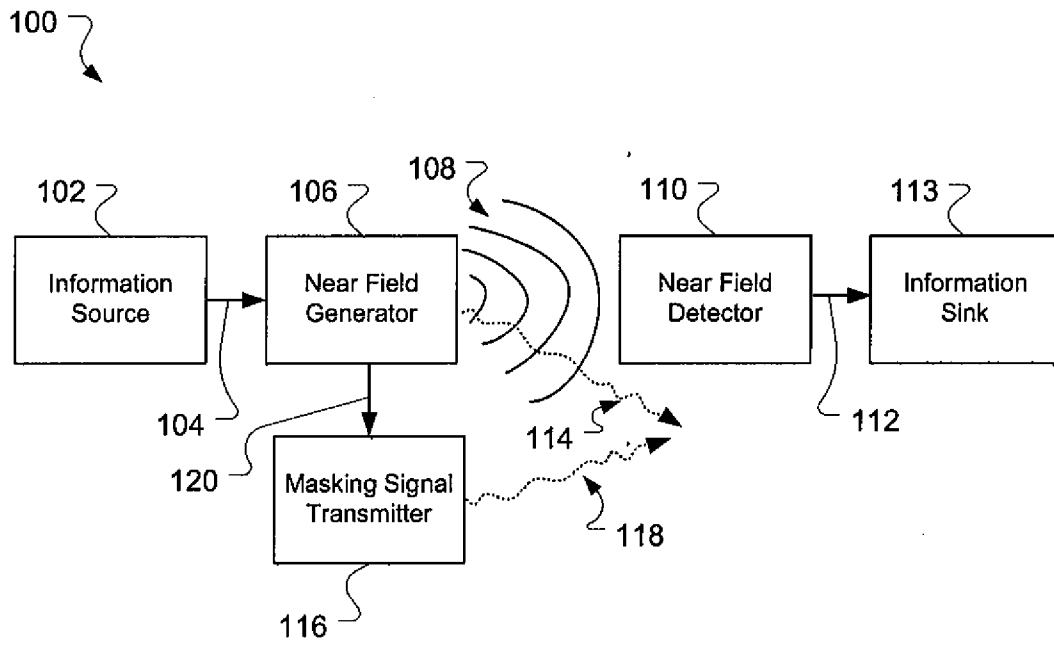


FIG. 1

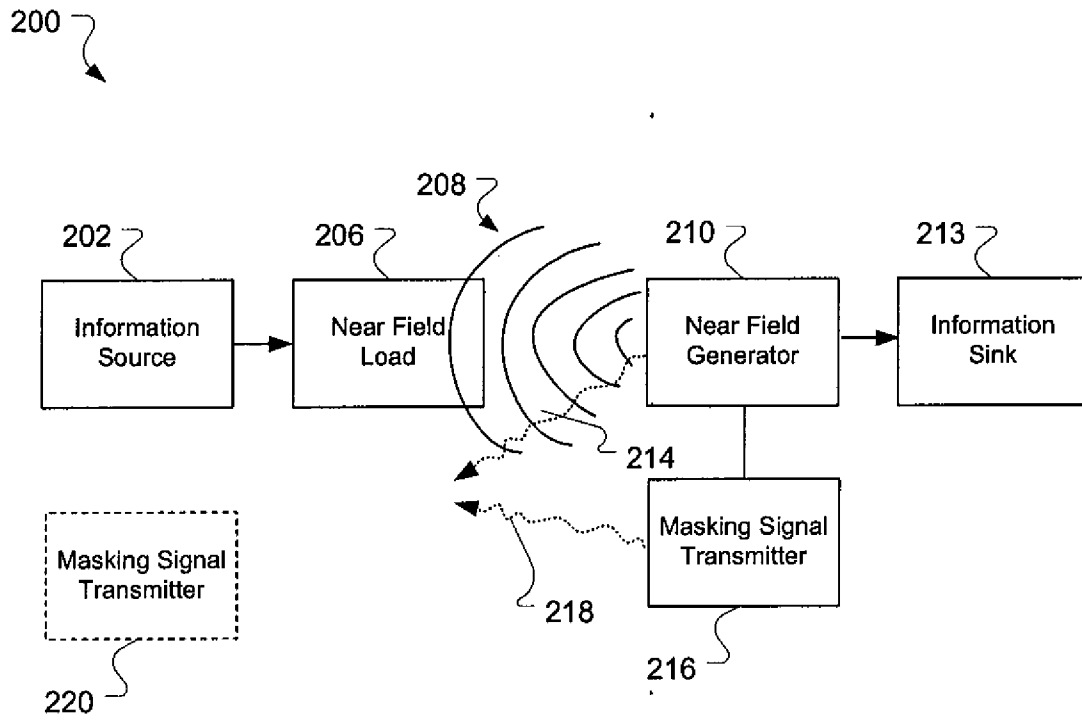
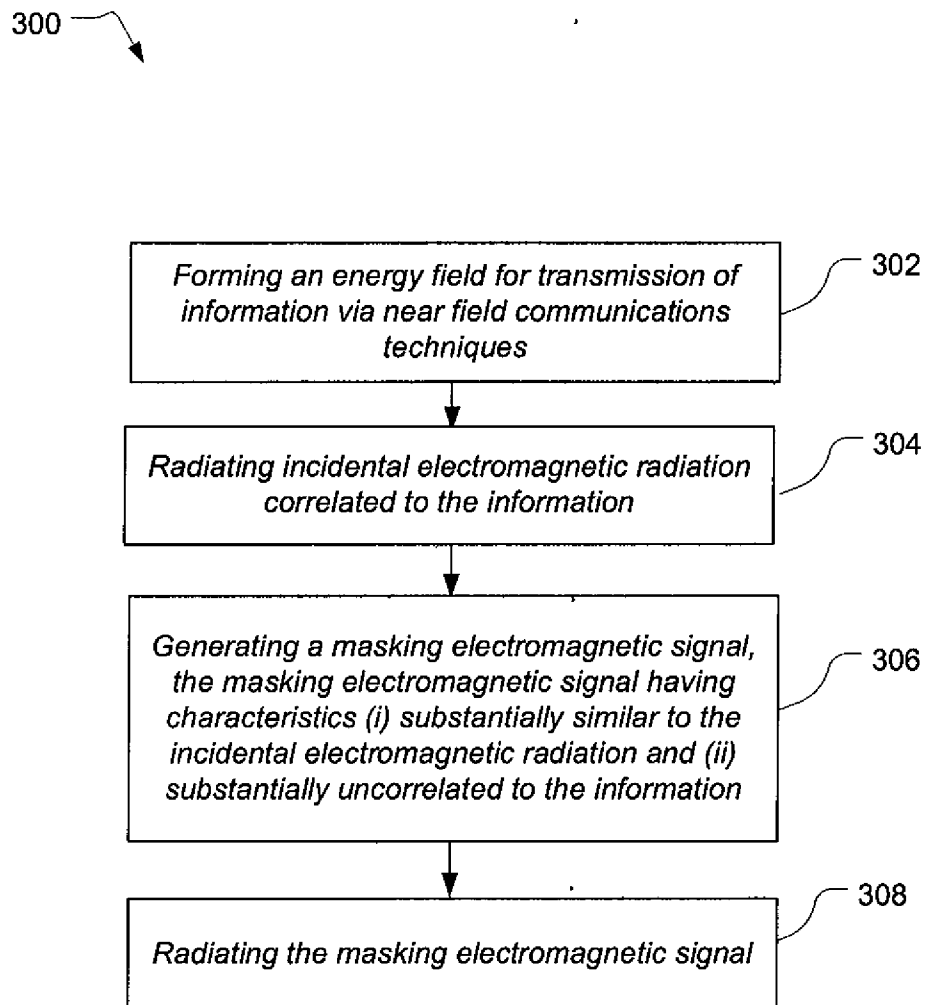




FIG. 2

3 / 3

**FIG. 3**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/072709

A. CLASSIFICATION OF SUBJECT MATTER		
<i>H04B 5/00(2006.01)i</i>		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC 8 G08B, H04B, H04K, H04Q		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean Utility models and applications for Utility Models since 1975 Japanese Utility models and applications for Utility Models since 1975		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKIPASS(KIPO internal) "masking, signal, tag"		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006-0226969 A1 (BANDY) 12 October 2006 See the abstract and claims 1-7.	1-6, 8, 10, 12-20, 22-23, 26-36, 38-42, 44-46, and 49-53
X	US 2007-0046439 A1 (TAKAKU et al.) 1 March 2007 See the abstract and claims 1-6.	1, 26, 31, 49
A	US 2006-0109983 A1 (YOUNG et al.) 25 May 2006 See the abstract and figure 5.	1-59
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 14 NOVEMBER 2008 (14.11.2008)		Date of mailing of the international search report 18 NOVEMBER 2008 (18.11.2008)
Name and mailing address of the ISA/KR  Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140		Authorized officer SON, Hyun Wung Telephone No. 82-42-481-5973 

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2008/072709

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0226969 A1	12.10.2006	US 7283044 B2	16.10.2007
US 2007-0046439 A1	01.03.2007	None	
US 2006-0109983 A1	25.05.2006	None	