There has been an explosion of toys supplied with radio controls such as cars, helicopters, etc. however these technologies are all essentially the same; a single remote control controlling a single device. The technology has essentially stalled at this point mainly due to a lack of simple and inexpensive methods to wirelessly connect multiple systems together. With the current state of the art, it would be a complex process to say, interconnect many devices wirelessly and have them operate together, be controlled separately or as a collective.

Additionally, there is a practical limit on battery management. It is difficult enough for parents to keep track of this process with individual toys. Currently it is often required to change many batteries per device, or plug in the device for recharge. If multiple devices existed in the same system, each requiring individual battery management, the process would become intolerable for all but the most patient of parents. Additionally, introducing conventional wireless technology to a device has significant impact on battery life.

What is needed is a method that is affordable and simple enough for children to operate. With the cost of smartphones decreasing and the ability to build sophisticated remote controls inexpensively, the controller is clearly a reducing barrier. The barrier today is the mechanism and method of establishing a wireless network to include multiple devices and a way to simply establish a wireless network and control infrastructure that is suitable for the toy market.

The invention described discloses apparatus and methods that use ultra-low power wireless networks, methods to associate multiple wired and wireless devices, as well as a superior wireless power transfer and recharging system for improved battery management; based on new and innovative ways to use near field technologies which overcome, minimize the abovementioned problems or provide an alternative.

Adding near field capability to a mobile

With the increasing norm for electronic devices to be connected in some way to mobile phones and operated via an app, there is an increasing market for these "appcessories" to be physically attached to the phone and to operate while connected. The mobile phone and connected device can then operate as a single mobile unit and as such, there is a significant benefit if the attached device can be as small as possible. Eliminating a battery from the attached device or driving the battery capacity down has the significant benefits of physical size reduction and user maintenance benefits with battery charging and exchange.

It would be beneficial if an ultra-low power, battery-less near field data communications device could be added to a mobile device using the standardized audio jack. This would overcome the current state of the art problems of near field communications between mobile to mobile and mobile to battery-less devices.

It would then also be beneficial to be able to use this suitably equipped mobile device to establish communications between multiple devices that are not easily portable.

The invention described herein, covers a variety of technologies that form part of a single, holistic solution that allows an arrangement of multiple mobile and fixed devices to communicate using a combination of near field and long range wired or wireless mechanisms. Multiple problems are solved arising from the limited portability of devices and limited power source availability to devices, that can restrict device positioning, reducing the ability for a user to access these devices needed to effect close proximity near field data transfers.

Brief Summary of the Invention

First aspect: Wand establishes data communication between two or more devices

According to a first aspect of the present invention:
An arrangement for managing communication between a first, second and third devices the arrangement including;
a first device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism;
a second device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism; and
a third device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism, wherein the third and the first devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data and the third and the second devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data; wherein the data transferred between the proximity communication mechanisms of the first device, second device and third device enables communications to be established between the first and second devices using one or more communication mechanisms.

The first device may also be known as a "controller". For clarity a controller is generally, but not limited to a device that commands or invokes actions on another device. A controller may be, but not limited to a device that is not easily portable. For example a personal computer, a light switch, etc. but may also include portable devices such as a mobile phone, keyfob, etc.

The second device may also be known as an "appliance". For clarity an appliance is generally, but not limited to a device whose operational state is determined by another device. An appliance may be, but not limited to a device that is not easily portable. For example a printer, wireless router, light circuit, etc. but may also include portable devices such as a smartcard, toy, etc.

A fixed device is generally referenced to a device that is not easily portable which may be a result of; its size or weight; being wired into position; requiring access to a non-movable power source; has wireless access within a limited area; or may be constrained by environmental factors, etc.

The third device is hereafter known as a "wand" and serves as a portable intermediary device that is used to establish a data communications link between two or more other devices. An example of a wand device is; a purpose designed and built device; handheld controller; keyfob; memory stick; or mobile phone, smartphone, smart remote, tablet, portable media player, running an app.

An example to illustrate the use of a wand would be a user tapping a wand to a wireless printer and then tapping the wand to a computer. Data is exchanged between the computer, printer and wand such that a wireless connection is automatically established between the printer and computer.

More generally the word "device" will refer to any device being a controller or an appliance. An arrangement of devices described within this invention is not limited to a single appliance or controller, but can be any number of devices with any combination of functions or modes. Similarly any number of wand devices can be present in an arrangement.

It is the general principle of this invention that one generally portable device, being the wand, can be positioned at a close distance to other devices, such that the wand can communicate data with a device or identify a device, resulting in two or more other devices establishing a data communication link or network. The data link may or may not include a communication mechanism that includes the wand itself. Thus the wand can act as a one off facilitator to establish communication links or networks between other

devices, of which it is no longer included, or the wand may have a communication mechanism that allows it to continue to be included in the data link or network. This might be beneficial if the wand acts as a controller to devices.

A proximity sensor can be used for detecting the proximity of another device. It should be generally understood that in the embodiment of this invention, proximity means touching or close range such as might be achieved with; mechanical contacts or terminals; electrical contacts; infrared signals; electromechanical mechanisms; magnetic or hall effect sensors; coil coupled circuit; subsonic, audible or supersonic sound waves; fingerprint readers; capacitive sensors; optical recognition systems including barcodes, QR codes; a near field mechanism; a near field communication mechanism; or the like.

A near field proximity sensor is one used for detecting the proximity of another device utilizing a near field mechanism such as might be achieved with; carrier based near field systems, such as the Near Field Communication (NFC) standard; any of the Radio Frequency Identification (RFID) standards; ultra-low power carrier-less Near Field Ping (NFP) systems; wireless signals operating predominantly in the magnetic near field; low power wireless or radio signals.

A proximity communication mechanism refers to a mechanism that allows one device to communicate data to another device when the two devices are brought within a close physical distance such as might be achieved with; data over electrical contacts; infrared signals; capacitively, magnetically or transformer coupled circuits; low power wireless; radio signals; or a near field communication mechanism.

A near field communication mechanism refers to a mechanism that allows one device to communicate data to another device when the two devices are brought within a close physical distance such that data is transferred predominantly using the magnetic near field such as might be achieved with; carrier based near field systems, such as the Near Field Communication (NFC) standard; any of the Radio Frequency Identification (RFID) standards; ultra-low power carrier-less Near Field Ping (NFP) systems; wireless signals operating predominantly in the magnetic near field; low power wireless or radio signals. Typically for NFC systems operating at around 13MHz, the near field communication range is in the order of a few centimeters. It is also a characteristic of these mechanisms that the closeness of the devices and the physical distance of other devices excludes or minimizes any security risk that the data exchanged between the devices will be intercepted, changed or corrupted. Thus the close proximity aspect of the data exchange also ensures identity of respective devices one to the other.

Additionally, devices may be referenced as being equipped with a wireless communication mechanism; however any communication mechanism or any number of communication mechanisms can be utilized.

A communication mechanism refers to a mechanism that allows one device to communicate data to another device. Commonly, the distance over which data is communication would be greater than might be achieved with a near field communication mechanism, such as; wired interfaces including RS485, RS232l, USB, CAN bus, one wire protocols, etc.; or wireless interfaces including any variant of 802.15.4, 802.11, GSM, CDMA, etc. However it is possible to implement a communication mechanism that utilizes a near field communication mechanism without detracting from the general concept, novelty and inventiveness of the invention disclosed herein.

In the first embodiment, the wand, which is typically a portable device, allows two or more other devices, which may or may not be portable, to establish a communication connection where data is transferred over a wired or wireless connection between the two or more other devices.

The wand can consist of data storage sufficient to hold device data from two or more devices in order to establish a data connection between the two or more devices.

It is possible that the wand can be any suitably equipped device, including an NFC equipped smartphone, remote control, keyfob, or the like. If the device is not suitably equipped, it might be possible to add an accessory device to provide the functionality required. For example a near field communication dongle could be added to the audio or USB port of a smartphone not already suitably equipped.

The wand itself can be used as a controller so would benefit from being equipped with switches, keypad, microphone, or motion sensors to act as user inputs for the control of devices. Motion sensors could send commands based on user gestures and a microphone input could be used for voice recognition.

With the explosion of Internet connected devices, more devices and device types are foreseen to have wireless connectivity and many of these are planned to exist in what is known as the "connected home".

A typical connected home may consist of appliances, power outlets and light switches, etc. that are wirelessly or even Internet connected. For the case of a lighting example, it is beneficial if the light switch and / or light controller are fitted with a suitable wireless communication mechanism as to allow the switch to function with mobile devices. Thus a light can be controlled from light switches and mobile

devices, forming a multi way wireless light switch arrangement. Additional mobile devices could become controllers in this arrangement by simply tapping the mobile to the light switch, thus pairing with the switch using near field data communication.

In a further embodiment, it is possible that a wand can be used to establish wireless connections between more than two devices by tapping multiple devices in order for them all to be connected to a common wireless network such as a PAN.

It is also possible that the wand can be used to form groups of devices that can be controlled, monitored or otherwise interacted with, as a collective. An example of grouping might be to touch several lights with the wand that will enable these lights to now be controlled as a group rather than individually.

It is also possible that one of the devices could be a wireless router. Currently devices such as mobile phones, tablets, computers, media players, etc. connect to a wireless router by entering the SSID and password of the network to establish connection. For devices with a Graphical User Interface (GUI) this process, although rather laborious and error prone, is possible. However, if a device is not equipped with a GUI, this type of connection process is not normally possible.

The current invention makes it possible and easy to connect devices without a GUI.

Some examples of devices that would not normally be equipped with a GUI yet might benefit from being connected to a wireless network include light controllers, light switches, power outlets, wireless chargers, keyboards, keyfobs, electronic toys and toy bricks or building blocks, fridges, toaster, electric blankets, sensors, remote control devices of various appliances, etc.

Wireless routers which might normally be used to connect these devices are typically not equipped with a GUI. The wand can be used to touch one or more devices and then touched to the router to establish a wireless network.

A wireless router could come equipped with a removable wand device allowing the user to tap all the devices to be connected. By tapping or docking the wand to the router, automatically established a wireless link between the devices.

PLC extenders are also network devices without a GUI. Considering a situation where multiple PLC extenders are utilized with several separate networks, setup using the current state of the art would be challenging. However, using the wand to simply tap each extender that is to be added to a network becomes a simple and intuitive task. The task is then repeated for multiple networks.

The wand itself may have no user interface, akin to a memory stick, or be equipped with LED indicators, or an LCD type GUI which could communicate data or status to the user. In addition, the wand may connect to a device that has a GUI, such as a mobile phone or smart remote.

Second aspect: Battery-less

In this aspect of the invention, the wand can perform an additional function where the near field communication mechanism can also be used to transfer power between the wand and device.

It can be beneficial if a device is completely wireless, eliminating the need to provide power wires to the device. The device could then be located at a convenient, user accessible location, completely independent of external mains or other wiring. In this case the electronic circuits could be powered by batteries; however it would be even further beneficial if the device was also battery-less.

In the case of the light switch, if it does not require external power then the expense and inconvenience of installing wires down the wall cavity to the switch is eliminated resulting in full flexibility as to the installation position of the switch.

However a completely wireless light switch would need some power source to operate the microprocessor, near field communication and the long range wireless circuits. This could be a battery or solar cell combination, but both of these sources have the potential to run out of charge, rendering the light switch inoperable. Additionally, batteries can be costly and ecologically unfriendly and there is the inconvenience of having to change them periodically.

In a preferred arrangement, the motion or actuation of the switch itself would generate sufficient energy to power the electronic circuits and radio to transmit wireless data to turn the associated light on or off.

This could be achieved in many ways, including the rotary action of a light switch driving a small generator, a wind up or clockwork generator, or an action of the switch or some other device, generating a small energy pulse, etc.

The problem still remains of how to connect, associate, or "pair" the light switch to a light controller or suitably equipped light fitting or light bulb.

In the arrangement described herein the wand connects a light switch to light controller
The preferred embodiment is to use the near field communication mechanism to transfer data between the light controller and the wand; and also the light switch and the wand; as to enable the light switch and light controller to pair and communicate data over a longer range wireless communications network.

However, during the near field pairing process with the light switch, energy is also required and may exceed the amount stored from the energy generation process resulting from normal operation, such as turning the light switch on or off, etc.

It may therefore be necessary to find an additional source of energy for the near field communication pairing process.

Third aspect: Wand power transfer

In this aspect of the invention the wand itself could provide power to a device using a power transmitting mechanism. The device can receive the power using a power receiving mechanism.

This is beneficial in the case where there is none or insufficient power available for a device to perform some function, such as powering a proximity communication mechanism. A wand can then be used to provide power to the device when the wand and device are in close proximity.

It is particularly beneficial for use in battery-less devices or to recharge a built in energy storage mechanism.

An energy storage mechanism which can consist of one or more energy storage elements such as a battery, capacitor or super cap, or a combination of circuits and energy storage elements.

A power transmitting mechanism can transfer power to a device using electrical conductors or a wireless mechanism.

Power transmitting mechanism using electrical conductors

The power can be transferred from the wand to the device using electrical conductors. Charge from a charge storage reservoir in the wand can be transferred to a charge storage reservoir in the device through electrical contacts, when the wand and device are in close proximity. These contacts might be connector pins, spring loaded pins, conductive contacts or the like.

Power transmitting mechanism using a wireless mechanism

More advantageously though, power could be transferred from the wand to the device using a wireless mechanism. In this way, the device is not cosmetically hindered with visible pads, slots or connectors or subject to long term unreliability issues due to contact failure or contamination.

Power receiving mechanism

The device can receive power from a wand by utilizing a power receiving mechanism. In the case where electrical conductors are used to transfer power from the wand, the energy is then stored in an energy storage mechanism.

In the case where the device uses a wireless mechanism, a coil element is used to generate a voltage when in close proximity to a wand power transmitting mechanism. This voltage would typically be rectified, filtered and stored in an energy storage mechanism. The available voltage is then used to power electronic circuits.

The coil element can be a coil made from wire or made using printed conductors on a printed circuit board.

The invention described here involves the wand being held in close proximity to a device, such that an energy field is generated by the wand, sufficient to transfer power from the wand to the device. This can be used to recharge an energy storage mechanism in the device, such that the received power can be used to sustain sufficient power to supply the electronic circuits in the device. These circuits could include a near field communication mechanism to transfer data between the device and the wand.

The power transmitting and receiving mechanisms can be implemented using the same near field communication mechanism described previously. In which case the mechanism can be used to transfer power only; or power and data.

In this example, the energy transfer is sufficient to power the circuits in the light switch to transfer or exchange data between the switch and the wand that will be used for pairing.

Thus the wand is first brought into close proximity to the battery-less light switch where power is transferred from the wand to the switch sufficient to power a near field data transfer. Then the wand is brought into close proximity to one or more lighting controllers or fittings. Wireless pairing is established allowing the light switch to control the lights. In some embodiments the wand will also be able to control the lights, thus enabling a multi way light switch arrangement.

It is of course understood by those skilled in the art that this invention can be applied to many other applications beyond the light switch example and can include any arrangement including controllers and appliances where a wand device can be used to pair and establish communications between the controllers and appliances. It is particularly beneficial where a device is wireless and there is a further preference or need to remove batteries.

Fourth aspect: Wand controller

In this aspect of the invention, the wand can be equipped with communication mechanisms, User Interface (UI) or sensors, allowing it to act as a controller or status display for devices.

An example of this might allow a wand to tap light controllers and then act as a controller for those lights. The lights could then be controlled using gestures, audible inputs, switches or touch screen, etc. Additionally, the status of the lights could be indicated using some form of display or audible device such as a beeper.

When a wand taps a light controller, it can be paired with the controller and at that time a nickname or some other identifier added to the light, for example, "lounge light". Where multiple lights are paired, the process of touching, pairing and identifying can be repeated for each light.

Identifying multiple lights

Sixth aspect: Security wand

In this aspect of the invention, the wand can act as a security device.

The wand can provide the mechanisms required to facilitate the creation of pairing links between devices that are trusted and highly secure. As the wand communicates with each device over a proximity communication mechanism, the resulting conversations cannot be heard by another party without the intervention being obvious (the eavesdropping party would have to be in close physical proximity as well). In effect, the proximity communication link between the wand and a device is a private channel. This being the case, the wand is in a good position to generate session keys that will later be used to establish a secure communication link between the first and second devices. For example if the wand generated a random 128-bit AES key and passed it on to the first and second devices via a proximity communications links, this would enable the first and second devices to use the key to encrypt the ensuing communications over a longer range communications link established between then to complete the pairing. Once the secure pairing link was established, the devices could both store the key from the wand, or they could generate a new secret key that only they know and use this for all further communications. The new secret key could quite safely be sent over the pairing link as it is already secured by the wand key.

The above mechanism is also applicable to wired communication channels.

A system could be designed where pairing may not be possible without the wand being used as the intermediary device. This can be beneficial to ensure devices cannot be paired or unpaired without the presence of the wand, adding additional security to a system.

In a home environment this may be an advantage as the parents could hide the wand ensuring unauthorized network alterations being made by children or guests, even if they are equipped with suitably enabled mobile devices.

Additionally security authorization mechanisms can be added such as finger print scanners, cameras, voice recognition, etc. to further expand the security and authentication possibilities.

DC level determined switch state

It is also possible to determine the switch state by adding a series resistance to the switch, applying a voltage source to the switch wires and comparing the voltage across the wires which will change depending on whether the switch is open or closed.

It is also possible to apply a voltage source to the switch wires and monitoring the current in the wires which will change depending on whether the switch is open or closed. A diode can be used to isolate the coil during this test.

To those skilled in the art, it will be clear that it is possible to use any number of ways to determine the state of the switch. The point being made here is that it is advantageous and possible to locate a near field coil remotely from the device and implement a coil and switch combination in order allow both near field data transfer and device switching in the same embodiment.

It is also possible for the light switch controller to have wired inputs from one or more light switches, or devices with a switching mechanism; and use wireless communication data from paired controllers, such as a mobile phone or keyfob, each with the ability to control and / or monitor the state of the light.

Eighth aspect: Mobile dongle device.

A first multi-function device attachable to a second multi-function device one function of which is to supply to an attached device an audio signal, the first attachable multi-function device including:

an impedance matching circuit for substantially matching the source impedance of the audio signal received from the second multi-function device to a load impedance of the first multi-function device;

an audio signal voltage multiplier having the load impedance, the multiplier for voltage multiplying the impedance matched audio signal; and

an audio signal converter for converting the alternating current of the impedance matched and multiplied audio signal to a direct current to supply the operation of one or more of the multiple functions of the first multi-function device.

In this aspect of the invention a wand device includes a dongle device added to a mobile device. A dongle device is a device that has electronic circuits and functionality that when added to a mobile device running

software, such as an app or device drivers using the operating system of the mobile device, provides the functionality of a wand.

This can be achieved using an expansion port on a mobile phone, such as a USB port or audio port. In this way additional functionality can be added to a wand, such as a user interface, power supply, wireless communication mechanism, etc. Similarly the dongle device can add functionality not normally available on the mobile device, such as a proximity communication mechanism, a power transmitting mechanism, etc.

Specifically discussed in this embodiment is adding near field data communication capabilities to a mobile phone by plugging a dongle device into the audio port. Those skilled in the art will recognize that the principles described will apply generally to any device that is required to draw power from an audio port.

By running an app on the mobile phone, it is possible to use the voltage signals present on an audio port for data communication and to generate a power supply sufficient to supply electronic circuits.

Impedance transformation

However, one of the implementation problems is that the source voltage of a mobile phone's audio port is too low in magnitude to be used directly and thus the audio port's impedance must be transformed to higher impedance resulting in a higher magnitude voltage which may then be rectified to power a microelectronic circuit. Typical voltages useful for operating microelectronic circuits are above 1V.

Prior attempts to match the audio port's output impedance to the desired load impedance have utilized untuned transformers resulting in non-optimum and ultimately lossy power transfer.

Impedance matching

The impedance matching of the current invention uses a series capacitor, shunt inductor network which transforms the audio port's low impedance to higher impedance so that the available source power may be utilized at a voltage magnitude suitable for powering microelectronic circuits. The inductor used is physically smaller and typically less expensive than a transformer.

Matching the impedance of the audio output of the mobile phone to the device circuits ensures greater efficiency of power transfer, resulting in more power being available for use by the device. This aspect of

the invention herein discloses techniques that achieve impedance matching and voltage multiplication without the use of a transformer.

Dual channel power and data transfer

One channel of a stereo audio port may be used to generate power for the circuits. The second channel may be used for both power generation and data signaling from phone to device. Data signaling using frequency modulation allows additional power to be generated while data is being sent from phone to device. The matching network of the dual-use channel may be optimized for a mid-band frequency of the frequency modulation so that maximum power may be generated during modulation for full-duplex data retransmission, or the network may be optimized at a band edge for half-duplex data retransmission where maximum power is generated once the frequency modulation has completed and the channel returns to a constant frequency.

This invention utilizes both the left and right audio channels of the phone to maximize the power available for the load, while simultaneously being able to transfer data across one or more of the audio channels. The benefit is that the power available from the audio socket is maximized.

Power delivery regulation

In a further aspect of the invention it is disclosed how the device can provide feedback to the phone to control the power delivery. Thus at times where the load is operating in a low power mode, the phone can reduce the amount of power delivered, saving battery life of the phone.

Energy storage capacity and recharge

Using these techniques a wider range of devices can be powered from the audio jack since more power is available. In the cases where a load is too great to be powered from the audio jack alone, an energy storage mechanism, including battery, capacitor, super cap or the like, can be implemented in the device. In this case the invention described here reduces the capacity requirements of the energy storage mechanism and allows recharging to be achieved in a shorter time.

Wireless charging

When recharge is required it can be achieved from either surplus power from the phone or the device can incorporate a wireless charging coil which can receive power from a wireless charging device.

Part of the described invention solves many implementation problems when building an electronic device that communicates through the audio connector of a mobile phone. Including reducing or eliminating the need for a battery in the device which decreases the size and cost of the device and allowing a device to utilize both audio channels and microphone line for digital and analog data communication, including half or full duplex operation, while still sourcing power from both audio lines if required.

Adding a near field communication device

Maximum power transfer to the device from the phone is essential in a system that utilizes near field communication data as the transmit power is high compared to that available through an audio port of a mobile device. Therefore the techniques described herein are particularly advantageous for the addition of a near field device to the mobile.

This aspect of the invention is described in more detail below.

The invention consists of an impedance matching network to match the impedance of the output amplifier driving the audio channel and the load of the device.

The signal from the audio channel is then fed into a voltage multiplier circuit. The voltage multiplier is typically in the form of a doubler or trippler.

The impedance matching network and voltage multiplier is applied to both the left and right audio channels. The resulting amplified left and right signals are then summed prior to a regulator circuit. The regulator provides a supply suitable to run a microprocessor or logic circuits.

Using both audio channels delivers greater power to drive larger load devices than would be possible with a single channel only.

However, it is often still necessary to transmit data across the audio channels to be decoded by the microprocessor or other logic in the device.

Setting the audio volume on the audio player to maximum will produce the maximum signal amplitude and therefore the maximum generated power possible for the load. As a result, it is not beneficial to use Amplitude Modulation (AM) or Amplitude Shift Keying (ASK) to modulate the signal as a lower average power will be generated.

voltage circuits 1834 are then enabled using the HV enable signal 1837 from the processing circuits 1820 when required. It is advantageous to disable these high voltage circuits and regulator B to minimizes the current drain for these circuits, extending the battery life of the mobile phone.

If the device is equipped with a battery or some form of energy storage circuit 1842, the supply out DC A 1836 can be used to charge the battery using battery charging circuits 1840. Additionally the battery can be charged using solar charge circuits 1847. Furthermore the battery can be charged using wireless charging circuits 1846 when wireless charging coil 1845 receives energy from an external wireless charging device.

The device dongle can communicate wirelessly to paired devices within wireless communication range by transmitting wireless data 1827 using the wireless communication circuit 1826 and antenna 1825.

The device dongle can also communicate to other devices using near field proximity by transmitting near field data 1824 using near field communication circuit 1822 and near field coil 1823.

The preceding text has covered in detail the mechanism of how a device connected to a phone's audio socket, can maximize the scavenged power through the audio lines and adjust the power required to supply different circuit needs while minimizing the power consumption of the battery within the phone.

The following sections now discuss how a device and phone can communicate while the device simultaneously scavenges power as described.

When a phone operates as a music player, source music content is processed by the phones music player which consists of software to decode and stream the music to the phone audio circuits. The user may listen to that music using connected headphones. The headphone supports stereo content via left and right audio channels. Additionally, a headset can be connected into the audio socket of a suitably equipped phone and a microphone-in line allows a user's voice input to be processed by the internal circuits and software.

In this invention the phone uses a software application, or "app", to processes data that is to be sent to the dongle device. The app uses the data to modulate the audio signals that the phone outputs on its audio channels. These modulated signals are demodulated by the attached device recovering the data, thus allowing data to be transmitted from the phone to the attached device. The functionality of the device will

CLAIMS

1. An arrangement for managing communication between a first, second and third devices the arrangement including;

a first device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism;

a second device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism; and

a third device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism, wherein the third and the first devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data and the third and the second devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data; wherein the data transferred between the proximity communication mechanisms of the first device, second device and third device enables communications to be established between the first and second devices using one or more communication mechanisms.

2. The arrangement of claim 1 where the proximity sensor is a near field proximity sensor.

3. The arrangement of claim 1where the proximity communication mechanism is a near field communication mechanism.

4. The arrangement of claim 1 where the communications mechanism includes one of the group including; 802.15.4, 802.11, USB, PLC

5. The arrangement according to claim 1wherein

a first device further includes a power receiving mechanism,

a third device further includes a power transmitting mechanism, such that when the devices are brought together the third device transfers power to the first device.

6. The arrangement of claim 5 wherein the power transmitting mechanism is near field communication.

7. The arrangement according to claim 1 where the data exchanged includes security keys.

8. The arrangement according to claim 1, wherein the third device includes a mobile device executing a software application.

9. The arrangement according to claim 1, wherein the third device includes a dongle device connected to a mobile device executing a software application to control the functionality of the dongle device.

10. The arrangement according to claim 9 wherein the dongle exchanges data with the mobile device using audio signals using the audio port of the mobile device.

11. The arrangement according to claim1, wherein the third device is also a controller, an appliance or both.

12. The arrangement according to claim 1, wherein the third device further includes sensors for detecting user inputs.

13. The arrangement according to claim 12 wherein the sensors are one or more of the group: accelerometer, microphone, gyroscopic, touch screen, keypad or button.

14. The arrangement according to claim 1 wherein any device is a controller of an appliance associated with a light, or an appliance associated with light.

15. The arrangement according to claim 14 further including a near field coil coupled to a controller associated with a light switching device.

16. The arrangement according to claim 15 further including

one or more further devices wherein the third device connects with one or more further devices to enable communications to be established between a controller device and said one or more further devices.

17. The arrangement according to claim 11 further including

one or more further devices wherein the third device connects with one or more further controller devices to enable communications to be established between a device and said one or more further controller devices.

18. The arrangement according to claim 1 wherein a device is an appliance being a light and a controller being a light switch controlling a light appliance.

19. The arrangement according to claim 1 wherein a device is an appliance being a wireless router.

20. The arrangement according to claim 1 wherein a device is an appliance includes a PLC as a communication mechanism.

21. An arrangement according to claim 1 wherein the device includes a mechanical power generation device to provide power for use by a respective device.

22. An arrangement for managing communication between a first, second and third devices the arrangement including;

a first device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism;

one or more further devices having one or more communication mechanisms;

a second device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism, and has communication with one or more further devices;

a third device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism, wherein the third and the second devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data to permit the establishment of communication between said further devices and the first device as well communication between the first device and the second device using one or more communication mechanisms; and the third and the first devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data that enables communications to be established between the first and further devices and/or the first and second devices using one or more communication mechanisms.

23. An arrangement according to claim 22 wherein a communication mechanism used by the second device and further devices is PLC.

24. An arrangement according to claim 22 wherein the third device further includes a mechanism for selecting or determining the one or more further devices.

25. An arrangement according to claim 22 wherein the first device or second device includes a portion of a near field communication mechanism located remotely from the device housing.

26. An arrangement according to claim 25 wherein the portion is a near field coil.

27. An arrangement according to claim 26 wherein the portion is remotely located and connected with wires.

28. An arrangement according to claim 27 wherein the wires are exposed to mains voltages.

29. An arrangement according to claim 26 wherein the near field coil is coupled to wires where the coupling is capacitive or coupled using a transformer.

30. An arrangement according to claim 29 wherein near field data is transmitted over the wires.

31. An arrangement according to claim 27 wherein the state of the switching device can be determined through impedance measurement, voltage or current measurement.

32 An arrangement according to claim 22 wherein the switching device includes a mechanical power generation device to provide power for use by a respective device.

33. A first multi-function device attachable to a second multi-function device one function of which is to supply to an attached device an audio signal, the first attachable multi-function device including:

an impedance matching circuit for substantially matching the source impedance of the audio signal received from the second multi-function device to a load impedance of the first multi-function device;

an audio signal voltage multiplier having the load impedance, the multiplier for voltage multiplying the impedance matched audio signal; and

an audio signal converter for converting the alternating current of the impedance matched and multiplied audio signal to a direct current to supply the operation of one or more of the multiple functions of the first multi-function device.

34. A first multi-function device according to claim 33 wherein the impedance matching circuit changes the load impedance dynamically.

35. A first multi-function device according to claim 33 wherein the impedance matching circuit is conductively connected to the received audio signal.

36. A first multi-function device according to claim 33 wherein the second multi-function device provides two or more audio signals and the impedance matching circuit is adapted to receive two or more audio signals.

37. A first multi-function device according to claim 33 wherein the first multi-function device has more than one state and that state is made available to the second multi-function device.

38. A first multi-function device according to claim 37 wherein at least one state of the first multi-function device is the state of the power held by the first multi-function device.

39. A first multi-function device according to claim 33 wherein the first multi-function device further includes a solar energy collection and conversion arrangement to provide power to the first multi-function device.

40. A first multi-function device according to claim 33 wherein the first multi-function device further includes a proximity communication mechanism usable by a connected second multi-function device to communicate to other devices having a near field communication mechanism.

41. A first multi-function device according to claim 40 wherein the proximity communication mechanism is a near field communications mechanism.

42. A first multi-function device according to claim 33 wherein the first multi-function device further includes an automatic gain control circuits usable by a connected second multi-function device.

43. A first multi-function device according to claim 33 further including,

a data receiving circuit for receiving data modulated on the audio signal received from the second multi-function device.

44. A first multi-function device according to claim 33 wherein the voltage multiplier at least doubles the voltage and is controllable to triple the voltage.

45. A first multi-function device according to claim 33 where in the audio signal converter has one or more regulator circuits for providing one or more different regulated direct current voltage outputs.

46. A first multi-function device according to any preceding claim 33 to 45 further including.

a processor and memory for performing programmed steps in accordance with code stored in the memory for controlling of the adjustable impedance matching circuit and/or the multiple voltage output of the voltage multiplier circuit and/or the audio signal converter voltage output.

47. A first multi-function device according to any preceding claim 33 to 46 wherein the second multi-function device has an audio signal input function, the first multi-function device further including,

a data signaling function for providing data signaling to the audio signal input function of the second multi-function device.

4.8 A first multi-function device according to claim 47 wherein the second multi-function device audio signal input function is accessed by a microphone input connector and the first multi-function device further includes,

a data signaling format imposed on FSK or FM forms of modulation.

49. A first multi-function device according to any preceding claim 33 to 48 the first multi-function device further including,

a wireless communication circuit usable to transmit and receive data from and to the first multi-function device.

50. A first multi-function device according to any preceding claim 33 wherein the communication between the first multi-function device and second multi-function device is full duplex.

51. A method for effecting communications between a first device and a second device, using a third device, the method including the following steps:

positioning the third device at a close proximity to a first device, wherein the close proximity is suitable for data transfer using the near field communication mechanism;

positioning the third device at a close proximity to a second device, wherein the close proximity is suitable for data transfer using the near field communication mechanism; wherein

the data transferred between the near field communication mechanisms of the first device, second device and third device enables communications to be established between the first and second devices.

52. The method of claim 51 where the method includes the further step:

transfer by the third device of power to a first device.

53. The method of claim 52 wherein the power is transferred using one or more of the following wireless mechanisms: near field communication, low frequency electromagnetic transfer.

54. The method of claim 51 wherein the power is transferred using a time multiplexed carrier and data.

55. The method of claim 51 wherein the power is transferred using a sustained carrier.

There has been an explosion of toys supplied with radio controls such as cars, helicopters, etc. however these technologies are all essentially the same; a single remote control controlling a single device. The technology has essentially stalled at this point mainly due to a lack of simple and inexpensive methods to wirelessly connect multiple systems together. With the current state of the art, it would be a complex process to say, interconnect many devices wirelessly and have them operate together, be controlled separately or as a collective.

Additionally, there is a practical limit on battery management. It is difficult enough for parents to keep track of this process with individual toys. Currently it is often required to change many batteries per device, or plug in the device for recharge. If multiple devices existed in the same system, each requiring individual battery management, the process would become intolerable for all but the most patient of parents. Additionally, introducing conventional wireless technology to a device has significant impact on battery life.

What is needed is a method that is affordable and simple enough for children to operate. With the cost of smartphones decreasing and the ability to build sophisticated remote controls inexpensively, the controller is clearly a reducing barrier. The barrier today is the mechanism and method of establishing a wireless network to include multiple devices and a way to simply establish a wireless network and control infrastructure that is suitable for the toy market.

The techniques described herein relate to apparatus and methods that use ultra-low power wireless networks, methods to associate multiple wired and wireless devices, as well as a superior wireless power transfer and recharging system for improved battery management; based on new and innovative ways to use near field technologies which overcome, minimize the abovementioned problems or provide an alternative.

Adding near field capability to a mobile

With the increasing norm for electronic devices to be connected in some way to mobile phones and operated via an app, there is an increasing market for these “appcessories” to be physically attached to the phone and to operate while connected. The mobile phone and connected device can then operate as a single mobile unit and as such, there is a significant benefit if the attached device can be as small as possible. Eliminating a battery from the attached device or driving the battery capacity down has the significant benefits of physical size reduction and user maintenance benefits with battery charging and exchange.

It would be beneficial if an ultra-low power, battery-less near field data communications device could be added to a mobile device using the standardized audio jack. This would overcome the current state of the art problems of near field communications between mobile to mobile and mobile to battery-less devices.

It would then also be beneficial to be able to use this suitably equipped mobile device to establish communications between multiple devices that are not easily portable.

The techniques described herein, cover a variety of technologies that form part of a single, holistic solution that allows an arrangement of multiple mobile and fixed devices to communicate using a combination of near field and long range wired or wireless mechanisms. Multiple problems are solved arising from the limited portability of devices and limited power source availability to devices, that can restrict device positioning, reducing the ability for a user to access these devices needed to effect close proximity near field data transfers.

Brief Summary of the Invention

The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims.

First aspect: Wand establishes data communication between two or more devices

According to a first exemplary aspect:

An arrangement for managing communication between a first, second and third devices the arrangement including;

a first device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism;

a second device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism; and

a third device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism, wherein the third and the first devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data and the third and the second devices are brought together such that at least one of the respective proximity sensors confirms the proximity of the other device after which the respective devices communicate to exchange data; wherein the data transferred between the proximity communication

mechanisms of the first device, second device and third device enables communications to be established between the first and second devices using one or more communication mechanisms.

The first device may also be known as a “controller”. For clarity a controller is generally, but not limited to a device that commands or invokes actions on another device. A controller may be, but not limited to a device that is not easily portable. For example a personal computer, a light switch, etc. but may also include portable devices such as a mobile phone, keyfob, etc.

The second device may also be known as an “appliance”. For clarity an appliance is generally, but not limited to a device whose operational state is determined by another device. An appliance may be, but not limited to a device that is not easily portable. For example a printer, wireless router, light circuit, etc. but may also include portable devices such as a smartcard, toy, etc.

A fixed device is generally referenced to a device that is not easily portable which may be a result of; its size or weight; being wired into position; requiring access to a non-movable power source; has wireless access within a limited area; or may be constrained by environmental factors, etc.

The third device is hereafter known as a “wand” and serves as a portable intermediary device that is used to establish a data communications link between two or more other devices. An example of a wand device is; a purpose designed and built device; handheld controller; keyfob; memory stick; or mobile phone, smartphone, smart remote, tablet, portable media player, running an app.

An example to illustrate the use of a wand would be a user tapping a wand to a wireless printer and then tapping the wand to a computer. Data is exchanged between the computer, printer and wand such that a wireless connection is automatically established between the printer and computer.

More generally the word “device” will refer to any device being a controller or an appliance. An arrangement of devices described within this application is not limited to a single appliance or controller, but can be any number of devices with any combination of functions or modes. Similarly any number of wand devices can be present in an arrangement.

It is the general principle is applicable herein that one generally portable device, being the wand, can be positioned at a close distance to other devices, such that the wand can communicate data with a device or identify a device, resulting in two or more other devices establishing a data

communication link or network. The data link may or may not include a communication mechanism that includes the wand itself. Thus the wand can act as a one off facilitator to establish communication links or networks between other devices, of which it is no longer included, or the wand may have a communication mechanism that allows it to continue to be included in the data link or network. This might be beneficial if the wand acts as a controller to devices.

A proximity sensor can be used for detecting the proximity of another device. It should be generally understood that as described herein, proximity means touching or close range such as might be achieved with; mechanical contacts or terminals; electrical contacts; infrared signals; electromechanical mechanisms; magnetic or hall effect sensors; coil coupled circuit; subsonic, audible or supersonic sound waves; fingerprint readers; capacitive sensors; optical recognition systems including barcodes, QR codes; a near field mechanism; a near field communication mechanism; or the like.

A near field proximity sensor is one used for detecting the proximity of another device utilizing a near field mechanism such as might be achieved with; carrier based near field systems, such as the Near Field Communication (NFC) standard; any of the Radio Frequency Identification (RFID) standards; ultra-low power carrier-less Near Field Ping (NFP) systems; wireless signals operating predominantly in the magnetic near field; low power wireless or radio signals.

A proximity communication mechanism refers to a mechanism that allows one device to communicate data to another device when the two devices are brought within a close physical distance such as might be achieved with; data over electrical contacts; infrared signals; capacitively, magnetically or transformer coupled circuits; low power wireless; radio signals; or a near field communication mechanism.

A near field communication mechanism refers to a mechanism that allows one device to communicate data to another device when the two devices are brought within a close physical distance such that data is transferred predominantly using the magnetic near field such as might be achieved with; carrier based near field systems, such as the Near Field Communication (NFC) standard; any of the Radio Frequency Identification (RFID) standards; ultra-low power carrier-less Near Field Ping (NFP) systems; wireless signals operating predominantly in the magnetic near field; low power wireless or radio signals. Typically for NFC systems operating at around 13MHz, the near field communication range is in the order of a few centimeters. It is also a characteristic of these mechanisms that the closeness of the devices and the physical distance of other devices excludes or minimizes any security risk that the data exchanged

between the devices will be intercepted, changed or corrupted. Thus the close proximity aspect of the data exchange also ensures identity of respective devices one to the other.

Additionally, devices may be referenced as being equipped with a wireless communication mechanism; however any communication mechanism or any number of communication mechanisms can be utilized.

A communication mechanism refers to a mechanism that allows one device to communicate data to another device. Commonly, the distance over which data is communication would be greater than might be achieved with a near field communication mechanism, such as; wired interfaces including RS485, RS232l, USB, CAN bus, one wire protocols, etc.; or wireless interfaces including any variant of 802.15.4, 802.11, GSM, CDMA, etc. However it is possible to implement a communication mechanism that utilizes a near field communication mechanism without detracting from the general concept, novelty and inventiveness of the techniques disclosed herein.

In the first embodiment, the wand, which is typically a portable device, allows two or more other devices, which may or may not be portable, to establish a communication connection where data is transferred over a wired or wireless connection between the two or more other devices.

The wand can consist of data storage sufficient to hold device data from two or more devices in order to establish a data connection between the two or more devices.

It is possible that the wand can be any suitably equipped device, including an NFC equipped smartphone, remote control, keyfob, or the like. If the device is not suitably equipped, it might be possible to add an accessory device to provide the functionality required. For example a near field communication dongle could be added to the audio or USB port of a smartphone not already suitably equipped.

The wand itself can be used as a controller so would benefit from being equipped with switches, keypad, microphone, or motion sensors to act as user inputs for the control of devices. Motion sensors could send commands based on user gestures and a microphone input could be used for voice recognition.

With the explosion of Internet connected devices, more devices and device types are foreseen to have wireless connectivity and many of these are planned to exist in what is known as the “connected home”.

A typical connected home may consist of appliances, power outlets and light switches, etc. that are wirelessly or even Internet connected. For the case of a lighting example, it is beneficial if the light switch and / or light controller are fitted with a suitable wireless communication mechanism as to allow the switch to function with mobile devices. Thus a light can be controlled from light switches and mobile devices, forming a multi way wireless light switch arrangement. Additional mobile devices could become controllers in this arrangement by simply tapping the mobile to the light switch, thus pairing with the switch using near field data communication.

In a further embodiment, it is possible that a wand can be used to establish wireless connections between more than two devices by tapping multiple devices in order for them all to be connected to a common wireless network such as a PAN.

It is also possible that the wand can be used to form groups of devices that can be controlled, monitored or otherwise interacted with, as a collective. An example of grouping might be to touch several lights with the wand that will enable these lights to now be controlled as a group rather than individually.

It is also possible that one of the devices could be a wireless router. Currently devices such as mobile phones, tablets, computers, media players, etc. connect to a wireless router by entering the SSID and password of the network to establish connection. For devices with a Graphical User Interface (GUI) this process, although rather laborious and error prone, is possible. However, if a device is not equipped with a GUI, this type of connection process is not normally possible.

The current techniques make it possible and easy to connect devices without a GUI.

Some examples of devices that would not normally be equipped with a GUI yet might benefit from being connected to a wireless network include light controllers, light switches, power outlets, wireless chargers, keyboards, keyfobs, electronic toys and toy bricks or building blocks, fridges, toaster, electric blankets, sensors, remote control devices of various appliances, etc.

Wireless routers which might normally be used to connect these devices are typically not equipped with a GUI. The wand can be used to touch one or more devices and then touched to the router to establish a wireless network.

A wireless router could come equipped with a removable wand device allowing the user to tap all the devices to be connected. By tapping or docking the wand to the router, automatically established a wireless link between the devices.

PLC extenders are also network devices without a GUI. Considering a situation where multiple PLC extenders are utilized with several separate networks, setup using the current state of the art would be challenging. However, using the wand to simply tap each extender that is to be added to a network becomes a simple and intuitive task. The task is then repeated for multiple networks.

The wand itself may have no user interface, akin to a memory stick, or be equipped with LED indicators, or an LCD type GUI which could communicate data or status to the user. In addition, the wand may connect to a device that has a GUI, such as a mobile phone or smart remote.

Second aspect: Battery-less

In this exemplary aspect, the wand can perform an additional function where the near field communication mechanism can also be used to transfer power between the wand and device.

It can be beneficial if a device is completely wireless, eliminating the need to provide power wires to the device. The device could then be located at a convenient, user accessible location, completely independent of external mains or other wiring. In this case the electronic circuits could be powered by batteries; however it would be even further beneficial if the device was also battery-less.

In the case of the light switch, if it does not require external power then the expense and inconvenience of installing wires down the wall cavity to the switch is eliminated resulting in full flexibility as to the installation position of the switch.

However a completely wireless light switch would need some power source to operate the microprocessor, near field communication and the long range wireless circuits. This could be a battery or solar cell combination, but both of these sources have the potential to run out of charge, rendering the light switch inoperable. Additionally, batteries can be costly and ecologically unfriendly and there is the inconvenience of having to change them periodically.

In a preferred arrangement, the motion or actuation of the switch itself would generate sufficient energy to power the electronic circuits and radio to transmit wireless data to turn the associated light on or off.

This could be achieved in many ways, including the rotary action of a light switch driving a small generator, a wind up or clockwork generator, or an action of the switch or some other device, generating a small energy pulse, etc.

The problem still remains of how to connect, associate, or "pair" the light switch to a light controller or suitably equipped light fitting or light bulb.

In the arrangement described herein the wand connects a light switch to light controller
The preferred embodiment is to use the near field communication mechanism to transfer data between the light controller and the wand; and also the light switch and the wand; as to enable the light switch and light controller to pair and communicate data over a longer range wireless communications network.

However, during the near field pairing process with the light switch, energy is also required and may exceed the amount stored from the energy generation process resulting from normal operation, such as turning the light switch on or off, etc.

It may therefore be necessary to find an additional source of energy for the near field communication pairing process.

Third aspect: Wand power transfer

In this exemplary aspect the wand itself could provide power to a device using a power transmitting mechanism. The device can receive the power using a power receiving mechanism.

This is beneficial in the case where there is none or insufficient power available for a device to perform some function, such as powering a proximity communication mechanism. A wand can then be used to provide power to the device when the wand and device are in close proximity.

It is particularly beneficial for use in battery-less devices or to recharge a built in energy storage mechanism.

An energy storage mechanism which can consist of one or more energy storage elements such as a battery, capacitor or super cap, or a combination of circuits and energy storage elements.

A power transmitting mechanism can transfer power to a device using electrical conductors or a wireless mechanism.

Power transmitting mechanism using electrical conductors

The power can be transferred from the wand to the device using electrical conductors. Charge from a charge storage reservoir in the wand can be transferred to a charge storage reservoir in the device through electrical contacts, when the wand and device are in close proximity. These contacts might be connector pins, spring loaded pins, conductive contacts or the like.

Power transmitting mechanism using a wireless mechanism

More advantageously though, power could be transferred from the wand to the device using a wireless mechanism. In this way, the device is not cosmetically hindered with visible pads, slots or connectors or subject to long term unreliability issues due to contact failure or contamination.

Power receiving mechanism

The device can receive power from a wand by utilizing a power receiving mechanism. In the case where electrical conductors are used to transfer power from the wand, the energy is then stored in an energy storage mechanism.

In the case where the device uses a wireless mechanism, a coil element is used to generate a voltage when in close proximity to a wand power transmitting mechanism. This voltage would typically be rectified, filtered and stored in an energy storage mechanism. The available voltage is then used to power electronic circuits.

The coil element can be a coil made from wire or made using printed conductors on a printed circuit board.

The technique described here involves the wand being held in close proximity to a device, such that an energy field is generated by the wand, sufficient to transfer power from the wand to the device. This can be used to recharge an energy storage mechanism in the device, such that the received power can be used to sustain sufficient power to supply the electronic circuits in the device. These circuits could include a near field communication mechanism to transfer data between the device and the wand.

The power transmitting and receiving mechanisms can be implemented using the same near field communication mechanism described previously. In which case the mechanism can be used to transfer power only; or power and data.

In this example, the energy transfer is sufficient to power the circuits in the light switch to transfer or exchange data between the switch and the wand that will be used for pairing.

Thus the wand is first brought into close proximity to the battery-less light switch where power is transferred from the wand to the switch sufficient to power a near field data transfer. Then the wand is brought into close proximity to one or more lighting controllers or fittings. Wireless pairing is established allowing the light switch to control the lights. In some embodiments the wand will also be able to control the lights, thus enabling a multi way light switch arrangement.

It is of course understood by those skilled in the art that the techniques disclosed herein can be applied to many other applications beyond the light switch example and can include any arrangement including controllers and appliances where a wand device can be used to pair and establish communications between the controllers and appliances. It is particularly beneficial where a device is wireless and there is a further preference or need to remove batteries.

F*ourth aspect: Wand controller*

In this exemplary aspect, the wand can be equipped with communication mechanisms, User Interface (UI) or sensors, allowing it to act as a controller or status display for devices.

An example of this might allow a wand to tap light controllers and then act as a controller for those lights. The lights could then be controlled using gestures, audible inputs, switches or touch screen, etc. Additionally, the status of the lights could be indicated using some form of display or audible device such as a beeper.

When a wand taps a light controller, it can be paired with the controller and at that time a nickname or some other identifier added to the light, for example, “lounge light”. Where multiple lights are paired, the process of touching, pairing and identifying can be repeated for each light.

Identifying multiple lights

Sixth aspect: Security wand

In this exemplary aspect, the wand can act as a security device.

The wand can provide the mechanisms required to facilitate the creation of pairing links between devices that are trusted and highly secure. As the wand communicates with each device over a proximity communication mechanism, the resulting conversations cannot be heard by another party without the intervention being obvious (the eavesdropping party would have to be in close physical proximity as well). In effect, the proximity communication link between the wand and a device is a private channel. This being the case, the wand is in a good position to generate session keys that will later be used to establish a secure communication link between the first and second devices. For example if the wand generated a random 128-bit AES key and passed it on to the first and second devices via a proximity communications links, this would enable the first and second devices to use the key to encrypt the ensuing communications over a longer range communications link established between then to complete the pairing. Once the secure pairing link was established, the devices could both store the key from the wand, or they could generate a new secret key that only they know and use this for all further communications. The new secret key could quite safely be sent over the pairing link as it is already secured by the wand key.

The above mechanism is also applicable to wired communication channels.

A system could be designed where pairing may not be possible without the wand being used as the intermediary device. This can be beneficial to ensure devices cannot be paired or unpaired without the presence of the wand, adding additional security to a system.

In a home environment this may be an advantage as the parents could hide the wand ensuring unauthorized network alterations being made by children or guests, even if they are equipped with suitably enabled mobile devices.

Additionally security authorization mechanisms can be added such as finger print scanners, cameras, voice recognition, etc. to further expand the security and authentication possibilities.

DC level determined switch state

It is also possible to determine the switch state by adding a series resistance to the switch, applying a voltage source to the switch wires and comparing the voltage across the wires which will change depending on whether the switch is open or closed.

It is also possible to apply a voltage source to the switch wires and monitoring the current in the wires which will change depending on whether the switch is open or closed. A diode can be used to isolate the coil during this test.

To those skilled in the art, it will be clear that it is possible to use any number of ways to determine the state of the switch. The point being made here is that it is advantageous and possible to locate a near field coil remotely from the device and implement a coil and switch combination in order allow both near field data transfer and device switching in the same embodiment.

It is also possible for the light switch controller to have wired inputs from one or more light switches, or devices with a switching mechanism; and use wireless communication data from paired controllers, such as a mobile phone or keyfob, each with the ability to control and / or monitor the state of the light.

Eighth aspect: Mobile dongle device.

A first multi-function device attachable to a second multi-function device one function of which is to supply to an attached device an audio signal, the first attachable multi-function device including:

an impedance matching circuit for substantially matching the source impedance of the audio signal received from the second multi-function device to a load impedance of the first multi-function device;

an audio signal voltage multiplier having the load impedance, the multiplier for voltage multiplying the impedance matched audio signal; and

an audio signal converter for converting the alternating current of the impedance matched and multiplied audio signal to a direct current to supply the operation of one or more of the multiple functions of the first multi-function device.

In this exemplary aspect a wand device includes a dongle device added to a mobile device. A dongle device is a device that has electronic circuits and functionality that when added to a

mobile device running software, such as an app or device drivers using the operating system of the mobile device, provides the functionality of a wand.

This can be achieved using an expansion port on a mobile phone, such as a USB port or audio port. In this way additional functionality can be added to a wand, such as a user interface, power supply, wireless communication mechanism, etc. Similarly the dongle device can add functionality not normally available on the mobile device, such as a proximity communication mechanism, a power transmitting mechanism, etc.

Specifically discussed in this embodiment is adding near field data communication capabilities to a mobile phone by plugging a dongle device into the audio port. Those skilled in the art will recognize that the principles described will apply generally to any device that is required to draw power from an audio port.

By running an app on the mobile phone, it is possible to use the voltage signals present on an audio port for data communication and to generate a power supply sufficient to supply electronic circuits.

Impedance transformation

However, one of the implementation problems is that the source voltage of a mobile phone's audio port is too low in magnitude to be used directly and thus the audio port's impedance must be transformed to higher impedance resulting in a higher magnitude voltage which may then be rectified to power a microelectronic circuit. Typical voltages useful for operating microelectronic circuits are above 1V.

Prior attempts to match the audio port's output impedance to the desired load impedance have utilized untuned transformers resulting in non-optimum and ultimately lossy power transfer.

Impedance matching

The impedance matching may use a series capacitor, shunt inductor network which transforms the audio port's low impedance to higher impedance so that the available source power may be utilized at a voltage magnitude suitable for powering microelectronic circuits. The inductor used is physically smaller and typically less expensive than a transformer.

Matching the impedance of the audio output of the mobile phone to the device circuits ensures greater efficiency of power transfer, resulting in more power being available for use by the device. This

exemplary aspect herein discloses techniques that achieve impedance matching and voltage multiplication without the use of a transformer.

Dual channel power and data transfer

One channel of a stereo audio port may be used to generate power for the circuits. The second channel may be used for both power generation and data signaling from phone to device. Data signaling using frequency modulation allows additional power to be generated while data is being sent from phone to device. The matching network of the dual-use channel may be optimized for a mid-band frequency of the frequency modulation so that maximum power may be generated during modulation for full-duplex data retransmission, or the network may be optimized at a band edge for half-duplex data retransmission where maximum power is generated once the frequency modulation has completed and the channel returns to a constant frequency.

It is possible to utilize both the left and right audio channels of the phone to maximize the power available for the load, while simultaneously being able to transfer data across one or more of the audio channels. The benefit is that the power available from the audio socket is maximized.

Power delivery regulation

In a further exemplary aspect it is disclosed how the device can provide feedback to the phone to control the power delivery. Thus at times where the load is operating in a low power mode, the phone can reduce the amount of power delivered, saving battery life of the phone.

Energy storage capacity and recharge

Using these techniques a wider range of devices can be powered from the audio jack since more power is available. In the cases where a load is too great to be powered from the audio jack alone, an energy storage mechanism, including battery, capacitor, super cap or the like, can be implemented in the device. In this case it is possible to reduce the capacity requirements of the energy storage mechanism and allowing recharging to be achieved in a shorter time.

Wireless charging

When recharge is required it can be achieved from either surplus power from the phone or the device can incorporate a wireless charging coil which can receive power from a wireless charging device.

Part of the described techniques may solve many implementation problems when building an electronic device that communicates through the audio connector of a mobile phone. Including reducing or eliminating the need for a battery in the device which decreases the size and cost of the device and allowing a device to utilize both audio channels and microphone line for digital and analog data communication, including half or full duplex operation, while still sourcing power from both audio lines if required.

Adding a near field communication device

Maximum power transfer to the device from the phone is essential in a system that utilizes near field communication data as the transmit power is high compared to that available through an audio port of a mobile device. Therefore the techniques described herein are particularly advantageous for the addition of a near field device to the mobile.

This exemplary aspect is described in more detail below.

It is possible to use an impedance matching network to match the impedance of the output amplifier driving the audio channel and the load of the device.

The signal from the audio channel is then fed into a voltage multiplier circuit. The voltage multiplier is typically in the form of a doubler or trippler.

The impedance matching network and voltage multiplier is applied to both the left and right audio channels. The resulting amplified left and right signals are then summed prior to a regulator circuit. The regulator provides a supply suitable to run a microprocessor or logic circuits.

Using both audio channels delivers greater power to drive larger load devices than would be possible with a single channel only.

However, it is often still necessary to transmit data across the audio channels to be decoded by the microprocessor or other logic in the device.

Setting the audio volume on the audio player to maximum will produce the maximum signal amplitude and therefore the maximum generated power possible for the load. As a result, it is not beneficial to use Amplitude Modulation (AM) or Amplitude Shift Keying (ASK) to modulate the signal as a lower average power will be generated.

voltage circuits 1834 are then enabled using the HV enable signal 1837 from the processing circuits 1820 when required. It is advantageous to disable these high voltage circuits and regulator B to minimizes the current drain for these circuits, extending the battery life of the mobile phone.

If the device is equipped with a battery or some form of energy storage circuit 1842, the supply out DC A 1836 can be used to charge the battery using battery charging circuits 1840. Additionally the battery can be charged using solar charge circuits 1847. Furthermore the battery can be charged using wireless charging circuits 1846 when wireless charging coil 1845 receives energy from an external wireless charging device.

The device dongle can communicate wirelessly to paired devices within wireless communication range by transmitting wireless data 1827 using the wireless communication circuit 1826 and antenna 1825.

The device dongle can also communicate to other devices using near field proximity by transmitting near field data 1824 using near field communication circuit 1822 and near field coil 1823.

The preceding text has covered in detail the mechanism of how a device connected to a phone's audio socket, can maximize the scavenged power through the audio lines and adjust the power required to supply different circuit needs while minimizing the power consumption of the battery within the phone.

The following sections now discuss how a device and phone can communicate while the device simultaneously scavenges power as described.

When a phone operates as a music player, source music content is processed by the phones music player which consists of software to decode and stream the music to the phone audio circuits. The user may listen to that music using connected headphones. The headphone supports stereo content via left and right audio channels. Additionally, a headset can be connected into the audio socket of a suitably equipped phone and a microphone-in line allows a user's voice input to be processed by the internal circuits and software.

The phone may use a software application, or "app", to processes data that is to be sent to the dongle device. The app uses the data to modulate the audio signals that the phone outputs on its audio channels. These modulated signals are demodulated by the attached device recovering the data, thus allowing data to be transmitted from the phone to the attached device. The functionality of the device will

Claims

1. An arrangement for managing communication between a first, second and third devices the arrangement including;

a first device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism;

a second device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism; and

a third device having a proximity sensor for detecting the proximity of another device, a proximity communication mechanism and a memory for storing received data and making stored data available,

wherein the respective devices are configured for, when the third and the first devices are brought together, at least one of the respective proximity sensors to confirm the proximity of the other device and, thereafter, for the respective devices to communicate to exchange data using the proximity communication mechanism without pairing and configured for, when the third and the second devices are brought together, at least one of the respective proximity sensors to confirm the proximity of the other device and, thereafter, for the respective third and second devices to communicate to exchange data using the proximity communication mechanism; wherein the arrangement is such that the data to be transferred using the proximity communication mechanisms of the first device, second device and third device includes data for enabling communications to be established and pairing between the first and second devices using one or more communication mechanisms.

2. The arrangement of claim 1 where the proximity sensor is a near field proximity sensor.

3. The arrangement of claim 1 where the proximity communication mechanism is a near field communication mechanism.

4. The arrangement of claim 1 where the communications mechanism includes one of the group including; 802.15.4, 802.11, USB, PLC

5. The arrangement according to claim 1wherein

a first device further includes a power receiving mechanism,

a third device further includes a power transmitting mechanism, such that when the devices are brought together the third device transfers power to the first device.

6. The arrangement of claim 5 wherein the power transmitting mechanism is near field communication.

7. The arrangement according to claim 1 configured for the data to be exchanged to include security keys.

8. The arrangement according to claim 1, wherein the third device includes a mobile device configured to execute a software application.

9. The arrangement according to claim 1, wherein the third device includes a dongle device for connection to a mobile device configured to execute a software application to control the functionality of the dongle device.

10. The arrangement according to claim 9 configured for the dongle to exchange data with the mobile device using audio signals using the audio port of the mobile device.

11. The arrangement according to claim1, wherein the third device is also a controller, an appliance or both.

12. The arrangement according to claim 1, wherein the third device further includes sensors for detecting user inputs.

13. The arrangement according to claim 12 wherein the sensors are one or more of the group: accelerometer, microphone, gyroscopic, touch screen, keypad or button.

14. The arrangement according to claim 1 wherein any device is a controller of an appliance associated with a light, or an appliance associated with light.

15. The arrangement according to claim 14 further including a near field coil coupled to a controller associated with a light switching device.

16. The arrangement according to claim 15 further including
one or more further devices wherein the third device is configured to connect with one or more further devices to enable communications to be established between a controller device and said one or more further devices.

17. The arrangement according to claim 11 further including
one or more further controller devices wherein the third device is configured to connect with one or more further controller devices to enable communications to be established between a device and said one or more further controller devices.

18. The arrangement according to claim 1 wherein a device is an appliance being a light or a controller being a light switch controlling a light appliance.

19. The arrangement according to claim 1 wherein a device is an appliance being a wireless router.

20. The arrangement according to claim 1 wherein a device is an appliance includes a PLC as a communication mechanism.

21. An arrangement according to claim 1 wherein the device includes a mechanical power generation device to provide power for use by a respective device.

22. An arrangement for managing communication between a first, second and third devices the arrangement including;

a first device having a proximity sensor for detecting the proximity of another device, and a proximity communication mechanism and memory for storing received data and making stored data available;

one or more further devices having one or more communication mechanisms;

a second device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism, and has communication with one or more further devices;

a third device having a proximity sensor for detecting the proximity of another device, one or more communication mechanisms, one of which is a proximity communication mechanism, wherein the respective devices are configured for, when the third and the second devices are brought together, at least one of the respective proximity sensors to confirm the proximity of the other device and, thereafter, for the respective devices to communicate using the proximity communication mechanism to exchange data to permit the establishment of communication between said further devices and the first device as well communication between the first device and the second device using one or more communication mechanisms; and configured for, when the third and the first devices are brought together, at least one of the respective proximity sensors to confirm the proximity of the other device and, thereafter, for the respective devices to communicate using the proximity communication mechanism without pairing to exchange data for enabling communications to be established between the first and further devices and/or the first and second devices using one or more communication mechanisms and to pair between respective devices.

23. An arrangement according to claim 22 wherein a communication mechanism for use by the second device and further devices is PLC.

24. An arrangement according to claim 22 wherein the third device further includes a mechanism for selecting or determining the one or more further devices.

25. An arrangement according to claim 22 wherein the first device or second device includes a portion of a near field communication mechanism for locating remotely from the device housing.

26. An arrangement according to claim 25 wherein the portion is a near field coil.

27. An arrangement according to claim 26 configured for the portion to be remotely located and connected with wires.

28. An arrangement according to claim 27 configured for the wires to be exposed to mains voltages.

29. An arrangement according to claim 26 configured for the near field coil to be coupled to wires where the coupling is capacitive or coupled using a transformer.

30. An arrangement according to claim 29 configured for the near field data to be transmitted over the wires.

31. An arrangement according to claim 27 further comprising a switching device, wherein the state of the switching device can be determined through impedance measurement, voltage or current measurement.

32 An arrangement according to claim 22 further comprising a switching device, wherein the switching device includes a mechanical power generation device to provide power for use by a respective device.

33. A method for effecting communications between a first device and a second device, using a third device having a near field communication mechanism, the method including the following steps:

positioning the third device at a close proximity to a first device, wherein the close proximity is suitable for data transfer using the near field communication mechanism without pairing;

positioning the third device at a close proximity to a second device, wherein the close proximity is suitable for data transfer using the near field communication mechanism; wherein

the data transferred between the near field communication mechanisms of the first device, second device and third device enables communications to be established between the first and second devices using other than the near field communication mechanism to pair the first device to the second device.

34. The method of claim 33 where the method includes the further step:

transfer by the third device of power to a first device.

35. The method of claim 34 wherein the power is transferred using one or more of the following wireless mechanisms: near field communication, low frequency electromagnetic transfer.

36. The method of claim 33 wherein the power is transferred using a time multiplexed carrier and data.

37. The method of claim 33 wherein the power is transferred using a sustained carrier.