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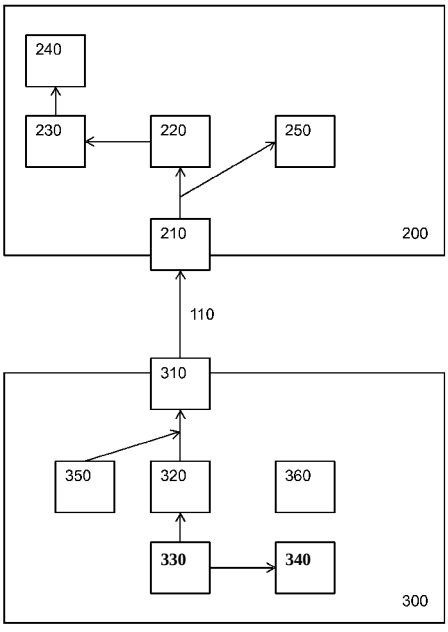

100

Figure 1

(57) Abstract: A wireless network configuration system 100 comprising a receiving device 200 and a sending device 300, the receiving device comprising an audio input device 210 for receiving an audio signal from the sending device, a data extractor 220 configured to extract network configuration data from the received audio signal, and a first wireless network device 240 configured to connect to a wireless network using the extracted network configuration data, and the sending device comprising, a data embedder 320 for embedding the network configuration data in the audio signal, and an audio output device 310 for sending the audio signal to the receiving device.

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Wireless network configuration system and method

FIELD OF THE INVENTION

The invention relates to a wireless network configuration system comprising a receiving device having a wireless network device configured to connect to a wireless network using network configuration data.

The invention also relates to a method for configuring a wireless network system, and to corresponding software.

BACKGROUND OF THE INVENTION

Many household devices currently comprise a wireless network device for connecting the device to a wireless network, and through the wireless network with the Internet. Such a wireless network device is convenient for many different purposes, ranging from updating firmware of the receiving device, receiving content, such as audio and/or video content, on-demand services, and the like.

A problem associated with having a wireless network device is that it needs to be configured locally. During manufacture it is unknown what local wireless network may be available at the place where the device is used. Accordingly, configuration must take place by a user of the device. The procedure of configuring a wireless network is not very user friendly. Especially, if the household device does not have a keyboard and/or a display then configuration may be tedious.

For example, this situation occurs with a wireless network device that is configured for Wi-Fi. In that case the network configuration data comprise a network identifier and optionally a cryptographic key. The wireless network device is uses the network identifier to get hold of the physical address of the network, which is needed to communicate via this network. The cryptographic key is used for authentication and encryption/decryption of sent/received packets.

SUMMARY OF THE INVENTION

One option to get network configuration data to the device would be to send it from a device which already has been configured previously for the wireless network. For

example, a mobile phone, a tablet computer, and the like, which is configured for a wireless network could send its network configuration data to the device which is to be configured. A problem is that there are many types of devices, not all of which have the same type of output ports. Some may have a USB port, some may not. Furthermore, some ports may require a connector license (e.g. Apple connector) and/or require certification programs. If possible, one would like to have the option of avoiding such a port.

The inventor had the insight that almost all mobile communication devices have an audio-out port, for example, to connect headphones to. This audio-out port could be used to transfer network configuration data.

An advantageous wireless network configuration system comprises a receiving device and a sending device. The receiving device comprises an audio input device for receiving an audio signal from the sending device, a data extractor configured to extract network configuration data from the received audio signal, and a first wireless network device configured to connect to a wireless network using the extracted network configuration data. The sending device comprises a data embedder for embedding the network configuration data in the audio signal, and an audio output device for sending the audio signal to the receiving device.

The sending device embeds the network configuration data in an audio signal and plays it over an audio output device, e.g., an audio-out line. The first device is configured to receive this audio signal and to extract the network configuration data. Having the network configuration data the wireless device may be configured by the receiving device and a connection to the network established. Thus network configuration data has been sent to a receiving device using a commonly available port.

Because of the proliferation of different types of ports on mobile devices and the increasingly popular licensed ports it is very advantageous to be able to use a free and commonly available port, e.g. an audio port.

For example, the receiving device may be a television, a Blu-Ray player, a media player, a wireless speaker, a baby monitor, home automation equipment, set-top box, computer, game console, etc. For example, the sending device may be a mobile phone, a smartphone, a tablet computer, a laptop, a computer, a netbook, etc. The first and second wireless network devices may be Wi-Fi adaptors.

The data embedder may use various known data embedding methods which are known per se in the art (modulation techniques) and use them to embed network configuration data in an audio signal. For example, the data embedder may represent the

configuration data as a sequence of bits. Each bit of the sequence may be embedded selectively modifying a frequency and/or amplitude in dependence on a bit of the sequence. The modification could take place on a carrier wave, say of a single frequency. The modification could also take place by modifying an existing sound signal, say by embedding the signal as a watermark. The data may also embedded by encoding bits as the presence or absence of sound, even Morse code could be used.

In an embodiment, the audio input device is configured to receive an audio cable and the audio output device is configured to receive the audio cable, the sending device being configured to send the audio signal to the receiving device over the audio cable and the receiving device being configured to receive the audio signal from the sending device over the audio cable.

The preferred way to transfer the audio signal is as an analog audio signal, preferably over an audio cable. Alternatively, the audio signal could be played over a speaker. In that case the sending device comprises a speaker for playing the audio signal and the receiving device comprises a microphone for receiving the audio signal.

An analog audio port is available on virtually all mobile communication devices. This means that it could be used as a general configuration mechanism. Current, cumbersome configuration methods could be avoided which is both cost efficient and user friendly.

In an embodiment, the data embedder comprises a processor, e.g. a digital signal processor, for embedding the network configuration data into a digital file representing the audio signal, and wherein the sending device is configured to play the digital file over the audio output device.

Using digital audio processing to embed the configuration data into the audio signal has the advantage of lower costs. In fact the digital signal processor may be implemented in software. This means that no hardware modifications are needed at the side of the sending device. A software update, say an 'app', after being installed and executed on the sending device may, digitally embed the configuration data into the a digital audio file, say a 'wav' file, and then play the file. A text displayed by the software on the screen could instruct the user to connect the sending device to the receiving device. After the connection is made, for example after an indication of the user, or by repeating the signal for some time, the digital audio file is played using the regular play API. In this manner the configuration data is send over the audio cable.

In an embodiment, the audio input device is functionally connected to an audio speaker of the receiving device.

The receiving device could have a regular audio-in connection which is connected both to an audio speaker and to the data extractor. The connection between audio input device and audio speaker may go through an intermediate device, say an amplifier. Alternatively, the audio input device may not be functionally connected to an audio speaker of the receiving device. The audio input device may be solely present in the receiving device for the purpose of receiving configuration data. In fact, in an embodiment, the audio input device is not connected to an audio speaker; in fact the receiving device does not necessarily comprise an audio speaker.

In an embodiment, the data embedder further embeds a notification signal indicating that network configuration data will be embedded in the audio signal, the data extractor is configured to detect the notification signal and to suppress playing of the received audio signal with embedded network configuration data on the audio speaker.

The receiving device may be configured to play incoming audio signals, say on a speaker, or to forward them to a speaker. However, if the audio signal with embedded configuration data is distorted or otherwise unpleasant to listen to, audio playing may be suppressed. For example, the notification signal may be a signal of predetermined duration and frequency. For example, the notification signal may be a non-data carrying watermark embedded in the audio signal to signal that configuration data is about to be played.

The audio signal may only be an audio presentation of the configuration data. The audio signal may also be an existing audio signal having information content for a human.

For example, the configuration data could be embedded in the form of a data-carrying watermark together with regular audio. For example, the audio could be music or a message to the user. For example, the audio could instruct the user to connect the audio cable.

In an embodiment, the audio output device is a head-pone jack configured to connect to a headphone cable and to send audio signals to the head phone. In an embodiment, the audio-input device could be a female jack connector, and the audio output device could be a headphone jack.

In an embodiment, the data extractor comprises a demodulator and the data embedder comprises a modulator. One advantageous way to embed the configuration data in the audio signal is to modulate a carrier wave. The demodulator extracts the configuration

data from the modulated carrier wave. For example, the modulator and demodulator could be two parts of a modem. The data embedder may modulate an analog carrier signal to encode digital configuration data. The carrier signal has a frequency in a range supported by the audio input, output and cable.

In an embodiment, the sending device comprises a second wireless network device configured to connect to the wireless network using the network configuration data.

After the receiving device has been configured to connect to the wireless network, it may be advantageous to establish a network connection between the sending and receiving device.

For example, in an embodiment, the sending device is configured to stream digital audio and/or video content to the receiving device over the wireless network, and the receiving device is configured to receive the digital audio and/or video content stream from the receiving device over the wireless network, and to play the digital audio and/or video content stream. For example, a user of the sending device may use the sending device to consume a content item, say watch a video and/or listen to audio. By connecting the sending device to the receiving device, the receiving device is enabled to connect to the wireless network. Thereupon, the content is sent to the receiving device in digital format over the wireless network. For example, the user could continue to watch the same movie on the receiving device as on the sending device, but e.g. on a larger screen and/or in higher resolution.

There exist several ways in which such a connection could be established.

In an embodiment, the sending device is configured to execute a discovery network protocol on the wireless network to obtain a network address of the receiving device, the sending device is configured to send a digital network packet over the wireless network to the receiving device addressed to the network address of the receiving device. For example, the discovery network protocol may be the SSDP protocol, say the SSDP protocol used in uPnP and DLNA.

In an embodiment, the sending device is configured to send a multicast network packet configured to be received by multiple devices connected to the wireless network as part of the discovery network protocol, the receiving device is configured to reply to the sending device in response to receiving the multicast network packet. The reply may comprise a timestamp indicating the time at which the audio signal was sent or the time at which the audio cable was inserted or indicate a specific state of the receiving device (e.g. not paired yet).

After transmitting the configuration parameters to the device, the sending device, say mobile phone/tablet, may attempt to discover the device on the network. The response sent from the receiving device to the sending device can contain an identifier, for example a custom timestamp: how long ago was the audio cable inserted, to help identifying said device on the network. This is particularly useful if multiple devices are connected to the local network and may show up during the discovery process.

In an embodiment, the reply comprises a string identifying the receiving device, say its make and/or model; this allows the user to select the device out of all replies that were received from devices in response to the discovery protocol. In an embodiment, the reply comprises a string identifying the receiving device, the software may be configured to recognize the string, in order to select the response from the multiple received responses that originated from the receiving device.

In an alternative embodiment, a discovery protocol is not used, instead the network address is also embedded in the audio signal. For example, in an embodiment, the data embedder is configured to further embed a network address of the sending device in the audio signal, the data extractor is configured to extract the network address of the sending device in the audio signal, and the receiving device is configured to send a network packet comprising a network address of the receiving device to the sending device.

In an embodiment, the network configuration data comprise a network identifier, e.g. the network name, the receiving device using the network identifier to obtain a physical address of the network, and/or the network configuration data comprise a cryptographic key, the first and second wireless network devices being configured to encrypt a network packet using the cryptographic key before sending the packet over the wireless network. The cryptographic key may also be used for authentication and decryption received packets.

The sending and receiving devices are preferably electronic devices.

A further aspect of the invention concerns a receiving device comprising an audio input device for receiving an audio signal from a sending device, a data extractor configured to extract network configuration data from the received audio signal, and a first wireless network device configured to connect to a wireless network using the extracted network configuration data. The receiving device may advantageously have any of the advantageous features described for a receiving device herein.

A further aspect of the invention is a sending device comprising, a data embedder for embedding the network configuration data in the audio signal, an audio output

device for sending the audio signal to the receiving device. The sending device may advantageously have any of the advantageous features described for a sending device herein.

A further aspect of the invention is a method for configuring a wireless network system, comprising embedding network configuration data in an audio signal at a sending device, sending the audio signal from the sending device to a receiving device, receiving the audio signal from the sending device at the receiving device, extracting the network configuration data from the received audio signal, and connect to a wireless network using the extracted network configuration data.

A further aspect of the invention is a method for a sending device to configure a wireless network system, comprising embedding network configuration data in an audio signal at a sending device, sending the audio signal from the sending device to a receiving device. Embodiment of the method for a sending device to configure a wireless network system may comprise steps of the sending device as described herein.

A further aspect of the invention is a computer program comprising computer program code means adapted to perform the steps of embedding network configuration data in an audio signal at a sending device, sending the audio signal from the sending device to a receiving device, when the computer program is run on a computer. In an embodiment of the computer program comprises computer program code means adapted to perform a step of a method for the sending device.

A further aspect of the invention is a method for a receiving device to configure a wireless network system, comprising receiving an audio signal from a sending device at the receiving device, extracting network configuration data from the received audio signal, and connect to a wireless network using the extracted network configuration data.

Any method according to the invention may be implemented on a computer as a computer implemented method, or in dedicated hardware, or in a combination of both. Executable code for a method according to the invention may be stored on a computer program product. Examples of computer program products include memory devices, optical storage devices, integrated circuits, servers, online software, etc. Preferably, the computer program product comprises non-transitory program code means stored on a computer readable medium for performing a method according to the invention when said program product is executed on a computer

In a preferred embodiment, the computer program comprises computer program code means adapted to perform all the steps of a method according to the invention

when the computer program is run on a computer. Preferably, the computer program is embodied on a computer readable medium.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained in further detail by way of example and with reference to the accompanying drawings, wherein:

Fig. 1 is a block diagram illustrating a wireless network configuration system,

Fig. 2 is a flow chart illustrating a method for configuring a wireless network.

Fig. 3 is an schematic drawing of a possible embodiment of the a wireless network configuration system.

Throughout the Figures, similar or corresponding features are indicated by same reference numerals.

List of Reference Numerals:

100	a wireless network configuration system
110	an audio cable
200	a receiving device
210	an audio input connector
220	a data extractor
230	a network configuration data store
240	a wireless network device
250	an audio processing device
300	a sending device
310	an audio output connector
320	a data embedder
330	a network configuration data store
340	a wireless network device
350	an audio processing device
360	a controller
500	a wireless network configuration system
510	a smart phone or tablet
520	a Blu-ray player
530	an audio cable

DETAILED EMBODIMENTS

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail one or more specific embodiments, with the understanding that the present disclosure is to be considered as exemplary of the principles of the invention and not intended to limit the invention to the specific embodiments shown and described.

Figure 1 illustrates a wireless network configuration system 100.

Configuration system 100 comprises a receiving device 200. The receiving device may be e.g. a television. Configuration system 100 comprises an audio input connector 210 for receiving analog audio signals. For example, audio input device 210 may be a female jack in connector for receiving an audio cable. Receiving device 200 comprises a data extractor 220 to extract network configuration data from the received audio signal. For example, data extractor 220 may be a demodulator to retrieve information from a modulated carrier signal. For example, data extractor 220 may be watermark detector for extracting a data-carrying watermark from the audio signal. Figure 1, shows an audio cable 110.

Receiving device 200 comprises a wireless network device 240, say a wireless network adapter, say, a Wi-Fi adapter, possibly configured for WPA. To be able to connect to a wireless network, wireless network device 240 needs configuration data, i.e., configuration parameters. For example wireless network device 240 may need a network name and/or a cryptographic network key (possibly in the form of a passphrase, or in the form of a sequence of data values), etc. Note that the invention is suitable to transport other configuration data than network configuration from a sending device to a receiving device. If the configuration data is not wireless network configuration data, the wireless network devices are not needed.

Receiving device 200 comprises a network configuration data store 230. Wireless network device 240 is connected to configuration data store 230. In operation, wireless network device 240 obtains network configuration data from configuration data store 230 and uses it to connect to the wireless network. Receiving device 200 comprises an audio input connector 210 for receiving the audio signal. Receiving device 200 may also comprise an audio processing device 250. For example, during normal operation audio processing device 250 may play audio received at audio input device 210. For example, audio processing device 250 comprises an amplifier and a speaker. Another possibility is for audio processing device 250 to comprise an A/D converter and an encoder for encoding the received audio signal in a digital audio format, say mp3. Such an A/D converter may also be used to extract configuration data from the audio signal. Audio processing device 250 is not

needed for receiving the configuration data, but may be needed for other uses of audio connector 210.

Configuration system 100 further comprises a sending device 300. Sending device 300 comprises data embedder 320 for embedding the network configuration data in the audio signal. For example, data embedder 320 may be a modulator. Sending device 300 further comprises an audio output device 310 for sending the audio signal to the receiving device. For example, audio output device 310 may be a head phone connection. Sending device 300 comprises a network configuration data store 330, for storing network configuration data needed to connect to the wireless network. Sending device 300 also comprises a data embedder 320 for embedding the network configuration data in the audio signal. For example, data embedder 320 may be a modulator for modulating a carrier wave in dependency on the network configuration data. If desired, sending device 300 may be connected to the wireless network itself, if so, sending device 300 comprises wireless network device 340. Network device 340 is connected to configuration data store 330 to retrieve the configuration data when needed to connect to the network. Sending device 300 may comprise an audio processing device 350 for playing audio. Audio processing device 350 may be connected to audio output device 310 so that, when an audio cable is inserted audio is played over audio output device 310 instead of over a speaker. Sending device 300 may also comprise a controller 360 for executing control software, controlling the configuration.

The sending device may not have a wireless network adapter of different type than the receiving device; say the sending device may have a 3G adapter and the receiving device a wi-fi adapter, these still will be able to establish a communication channel over the internet.

Configuration data stores 230 and 330 may comprise a non-volatile memory, or a hard disk, etc. Wireless network devices 240 and 340 may communicate with a Wi-Fi access point, router, and the like (not shown.)

The data embedder may be configured to embed a notification signal in the audio signal prior to embedding the configuration data. The notification signal indicates that network configuration data will be embedded next in the audio signal. In that case the data extractor is configured to detect the notification signal and to suppress playing of the received audio signal with embedded network configuration data on the audio speaker. For example, the notification signal be a specific sound, or a 'beep' or predetermined duration an frequency, or a watermark. Suppressing playing of the audio signal is especially

advantageous if the audio signal with embedded configuration data is unpleasant to listen to, as may be the case when a modulator/demodulator is used.

During operation, one particular way in which configuration system 100 may be used is as follows.

A user of configuration system 100 download a software program (not shown), say an 'app', and installs it on sending device 300. Possibly, the software may be downloaded through network device 340. The software may be offered by the manufacturer from receiving device 200. Controller 360 executes the software. The software instructs the user to insert an audio cable in 310 and in audio input device 210. The software may also instruct the user to turn on receiving device 200. The software obtains the network configuration data from configuration data store 330 or prompts the user for it. Next, the software constructs a digital audio file in which the network configuration data is embedded. For example, the software modulates, in digital form, a carrier wave and computes the resulting sound patterns. The resulting audio file represents an audio signal in which the network configuration data is embedded. Embedding may also use an analog device, say an analog modulator. Next the software plays the audio file. Typically, the software will instruct a regular API to play the software, which normally would result in the audio file to be heard over a speaker of sending device 300. However, due to the fact that the cable has been inserted the audio is played, typically in analog form, over audio output device 310. Upon receiving the signal in receiving device 200, the data extractor 220 will extract the network configuration; for example, by demodulating the audio signal. Next the extracted network configuration is stored by data extractor 220 in configuration data store 230 and wireless network device 240 is configured.

Now receiving device 200 may send and receive network packets over wireless network device 240. Wireless network device 240 may include the network name in a network packet during a so-called active scan to determine the MAC address that corresponds to the SSID (network name). For most packets MAC addresses will be used.

Receiving device 200 may be connected to the internet through the wireless network. To that purpose the wireless network may comprise a gateway. Receiving device 200 may receive a firmware update over wireless network device 240.

Since there may be multiple devices on the wireless network, there may be a desire for the sending device to find out which one of them is the receiving device. After sending the audio signal, the sending device, e.g. under control of the software may start a discovery protocol, say SSDP, by sending, using wireless device 340, a multicast network

packet configured to be received by multiple devices connected to the wireless network. Receiving device 200 receives the multicast network packet and responds to it. In the response, receiving device 200 may include identifying data to identify itself to the sending device 300. For example, receiving device 200 may include a timestamp indicating the time the audio signal was received; or the time the audio cable was inserted; A time may be indicated with amount of time that has elapsed. Receiving device 200 may include a string in the identifying data, for example containing make and model, or a magic number or indicate a specific state of the device (e.g. configuration mode). Note sending device 300 may also receive replies from different devices than receiving device 200. Upon receiving the replies of receiving device 200 and possibly of other devices on the same wireless network, sending device 300 may select which reply was from receiving device 200. For example, sending device 300 may verify that the received timestamp corresponds with a time the sending device recorded for the event (sending audio signal/inserting cable) or at least within an accuracy range. Sending device 300 may verify that the magic number or string is as expected. Sending device 300 may show the string to the user and ask for confirmation that it corresponds to receiving device 200.

Instead of using a discovery protocol, sending device 300 may embed a network address, e.g. an IP address or a URL, in the audio signal to enable the receiving device to reply to the audio signal.

Sending device 300 and receiving device 200 may establish a communication channel between them over the wireless network. Sending device 300 may stream content, e.g. audio and/or video content to receiving device 200 (or vice versa from receiving device to sending device). Sending device 300 may be used to remotely control receiving device 200, e.g. by sending remote control commands. Remote control commands may control the playing of content. Remote control commands may include, e.g., play, pause, fast-forward etc.

For example, the receiving device may receive digital audio and/or video content (say as a stream) from the receiving device over the wireless network, and play the digital audio and/or video content. For example, the receiving device could play audio over a speaker comprised in, or connected to, the receiving device. For example, the receiving device could play video on a display comprised in, or connected to, the receiving device.

If desired, a bi-directional channel between receiving device 200 and sending device 300 may be made by connecting an audio-in at sending device 300 with an audio-out at receiving device 200 and using the invention with the roles of sending and receiving

device reversed. For example, the channel from receiving device 200 to sending device 300 may be used for a response, confirming the correct receipt of the configuration data.

Figure 3 illustrates a possible embodiment of the configuration system 500. A smart phone 510 (or tablet) functions as sending device. A blu-ray player 520 functions as receiving device. In this embodiment as shown, the analog audio-out headphone connector of the smart-phone or table 510 is connected through analog headphone cable, to an audio-in connector of player 520.

In an embodiment, the sending device is a phone or tablet. In order for the phone or tablet and the receiving device to communicate with each other (for example for streaming audio from the phone to the device) via Wi-Fi, both need to be connected to the same wireless network. The wireless network is typically secured (for example using a WPA password). Said receiving device often does not have a display or full keyboard, so there is no way of typing in a password or selecting which Wi-Fi network to connect to.

The mobile phone or tablet may already be connected to a Wi-Fi access point or router, so it can transfer these configuration parameters to the device via the audio cable. The user can be guided through the setup process by an app on the mobile phone/tablet. Except for the low cost audio cable, no other additional hardware or expensive connectors are needed on the sending device. Connector licenses and certification programs can also be avoided.

For example, the network configuration data to connect to the local network may be the SSID (name of the wireless network) and security credentials. If it can obtain these parameters programmatically, the software (app) on the mobile phone or tablet can transmit the SSID and security credentials of the local network directly to the device. If not, it can first prompt the user for these parameters.

After transmitting the configuration parameters to the device, the mobile phone/tablet may attempt to discover the device on the network. The discovery packets/response sent from the device to the mobile phone/tablet can contain an identifier (for example a custom timestamp: how long ago was the audio cable inserted?) to help identifying said device on the network. This is particularly useful if

- Multiple devices are connected to the local network and may show up during the discovery process
- A standardized discovery protocol is used (for example SSDP protocol used in uPnP and DLNA)

Note that the so-called "audio input" on the receiving device may be dedicated to receiving configuration data, and need not necessarily be used for receiving regular audio. Audio input device 210 would function as a "Network configuration port", with no analog to digital convertor behind it, but a simple low-cost circuit designed to demodulate/decode whatever protocol is used for the audio signal generated by the sending device.

On a smartphone or tablets, one may use the microphone pin on the mini-jack connector as audio input.

Figure 2 illustrates in a flowchart a method for configuring a wireless network. Step 410 comprises embedding network configuration data in an audio signal at a sending device. Step 420 comprises sending the audio signal from the sending device to a receiving device. Step 430 comprises receiving the audio signal from the sending device at the receiving device. Step 440 comprises extracting the network configuration data from the received audio signal. Step 450 comprises connecting to a wireless network using the extracted network configuration data.

Many different ways of executing the method are possible, as will be apparent to a person skilled in the art. For example, the order of the steps can be varied or some steps may be executed in parallel. Moreover, in between steps other method steps may be inserted. The inserted steps may represent refinements of the method such as described herein, or may be unrelated to the method. For example, steps 420 and 430 may be executed, at least partially, in parallel. Moreover, a given step may not have finished completely before a next step is started.

A method according to the invention may be executed using software, which comprises instructions for causing a processor system to perform method 400. Software may only include those steps taken by a particular sub-entity of the system. The software may be stored in a suitable storage medium, such as a hard disk, a floppy, a memory etc. The software may be sent as a signal along a wire, or wireless, or using a data network, e.g., the Internet. The software may be made available for download and/or for remote usage on a server.

It will be appreciated that the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of source code, object code, a code intermediate source and object code such as partially compiled form, or in any other form suitable for use in the implementation of the method according to the invention. It will also be appreciated that such a program may have many different architectural designs. For example, a program

code implementing the functionality of the method or system according to the invention may be subdivided into one or more subroutines. Many different ways to distribute the functionality among these subroutines will be apparent to the skilled person. The subroutines may be stored together in one executable file to form a self-contained program. Such an executable file may comprise computer executable instructions, for example, processor instructions and/or interpreter instructions (e.g. Java interpreter instructions). Alternatively, one or more or all of the subroutines may be stored in at least one external library file and linked with a main program either statically or dynamically, e.g. at run-time. The main program contains at least one call to at least one of the subroutines. Also, the subroutines may comprise function calls to each other. An embodiment relating to a computer program product comprises computer executable instructions corresponding to each of the processing steps of at least one of the methods set forth. These instructions may be subdivided into subroutines and/or be stored in one or more files that may be linked statically or dynamically. Another embodiment relating to a computer program product comprises computer executable instructions corresponding to each of the means of at least one of the systems and/or products set forth. These instructions may be subdivided into subroutines and/or be stored in one or more files that may be linked statically or dynamically.

The carrier of a computer program may be any entity or device capable of carrying the program. For example, the carrier may include a storage medium, such as a ROM, for example a CD ROM or a semiconductor ROM, or a magnetic recording medium, for example a floppy disc or hard disk. Furthermore, the carrier may be a transmissible carrier such as an electrical or optical signal, which may be conveyed via electrical or optical cable or by radio or other means. When the program is embodied in such a signal, the carrier may be constituted by such cable or other device or means. Alternatively, the carrier may be an integrated circuit in which the program is embedded, the integrated circuit being adapted for performing, or for use in the performance of, the relevant method.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention may be implemented by means of hardware comprising several distinct elements, and by means of a suitably

programmed computer. In the device claim enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1. A wireless network configuration system (100) comprising a receiving device (200) and a sending device (300),
the receiving device comprising
- an audio input device (210) for receiving an audio signal from the sending device,
- a data extractor (220) configured to extract network configuration data from the received audio signal, and
- a first wireless network device (240) configured to connect to a wireless network using the extracted network configuration data, and
the sending device comprising,
- a data embedder (320) configured to embed the network configuration data in the audio signal, and
- an audio output device (310) for sending the audio signal to the receiving device.

2. Wireless network configuration system as in Claim 1, wherein the audio input device is configured to receive an audio cable (110) and the audio output device is configured to receive the audio cable, the sending device being configured to send the audio signal to the receiving device over the audio cable and the receiving device being configured to receive the audio signal from the sending device over the audio cable.

3. Wireless network configuration system as in Claim 1, wherein the data embedder comprises a processor configured to embed the network configuration data into a digital audio file representing the audio signal, and wherein the sending device is configured to play the digital audio file in analog form over the audio output device.

4. Wireless network configuration system as in Claim 1, wherein the audio input device is functionally connected to an audio speaker (250) of the receiving device.

5. Wireless network configuration system as in Claim 4, wherein

- the data embedder further embeds a notification signal indicating that network configuration data will be embedded in the audio signal,
- the data extractor is configured to detect the notification signal and to suppress playing of the received audio signal with embedded network configuration data on the audio speaker.

6. Wireless network configuration system as in Claim 1, wherein

- the audio output device is a head-pone jack configured to connect to a headphone cable and to send audio signals to the head phone.

7. Wireless network configuration system as in Claim 1, wherein the data embedder comprises a modulator and the data extractor comprises a demodulator.

8. Wireless network configuration system as in Claim 1, wherein

- the sending device comprises a second wireless network device (340) configured to connect to the wireless network using the network configuration data,
- the sending device is configured to stream digital audio and/or video content to the receiving device over the wireless network, and
- the receiving device is configured to receive the digital audio and/or video content stream from the sending device over the wireless network, and to play the digital audio and/or video content stream.

9. Wireless network configuration system as in claim 1 or 8, wherein

- the sending device comprises a second wireless network device configured to connect to the wireless network using the network configuration data,

and wherein

- the sending device is configured to execute a discovery network protocol on the wireless network to obtain a network address of the receiving device,
- the sending device is configured to send a digital network packet over the wireless network to the receiving device addressed to the network address of the receiving device.

10. Wireless network configuration system as in Claim 1, 8 or 9 wherein

- the sending device comprises a second wireless network device (340) configured to connect to the wireless network using the network configuration data,
- the sending device is configured to remotely control the receiving device over the wireless network by sending remote control commands, and
- the receiving device is configured to receive the remote control commands from the sending device over the wireless network, and to execute the remote control commands.

11. Wireless network configuration system as in Claim 1, wherein the sending device is a mobile communication device.

12. A receiving device comprising

- an audio input device for receiving an audio signal from a sending device,
- a data extractor configured to extract network configuration data from the received audio signal,
- a first wireless network device configured to connect to a wireless network using the extracted network configuration data.

13. A sending device comprising,

- a data embedder configured to embed the network configuration data in the audio signal,
- an audio output device for sending the audio signal to the receiving device.

14. A method for configuring a wireless network system, comprising

- embedding network configuration data in an audio signal at a sending device,
- sending the audio signal from the sending device to a receiving device,
- receiving the audio signal from the sending device at the receiving device,
- extracting the network configuration data from the received audio signal,
- connecting to a wireless network using the extracted network configuration data

15. A computer program comprising computer program code means adapted to perform the steps of

- embedding network configuration data in an audio signal at a sending device,
- sending the audio signal from the sending device to a receiving device,

when the computer program is run on a computer.

16. A computer program as claimed in claim 15 embodied on a computer readable medium.

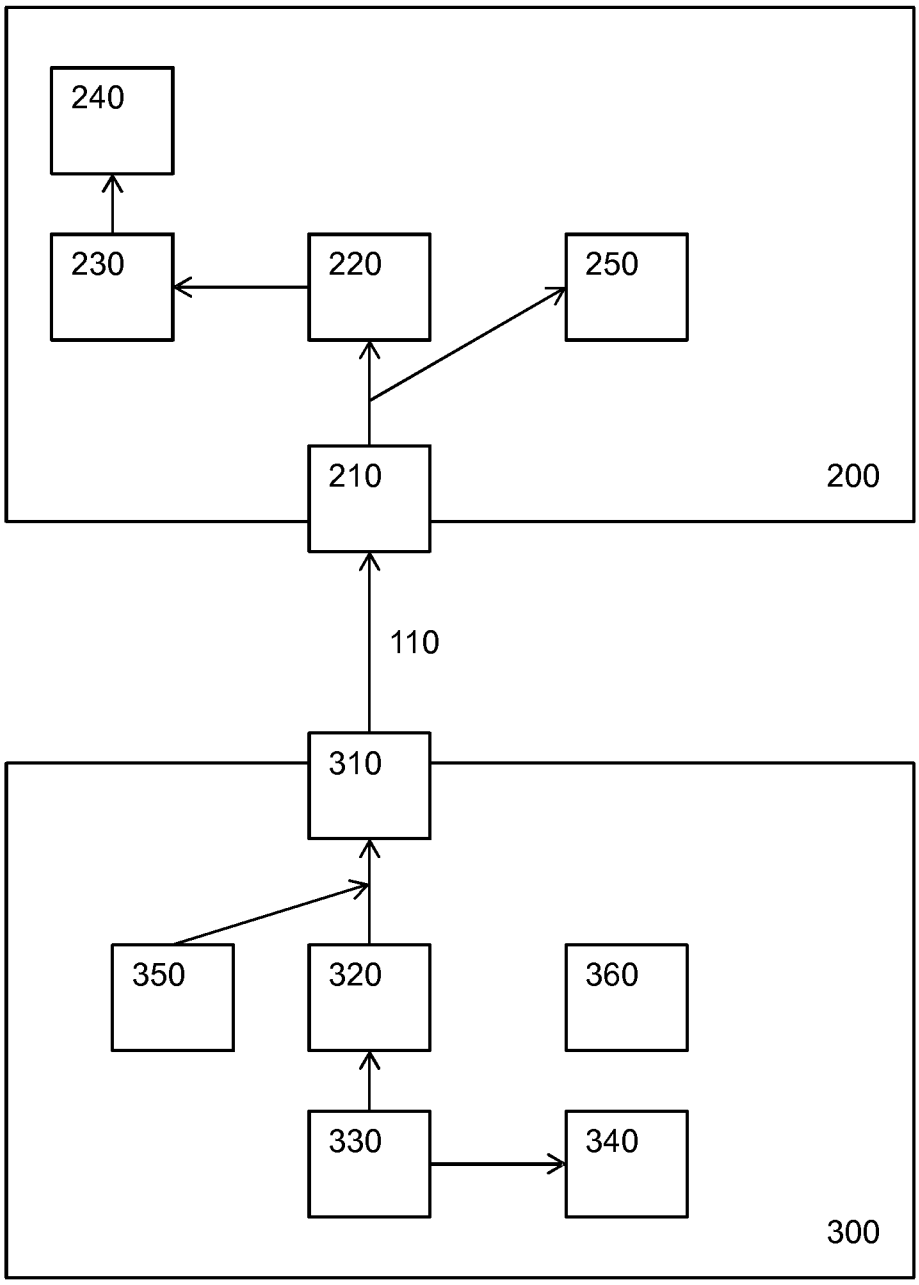
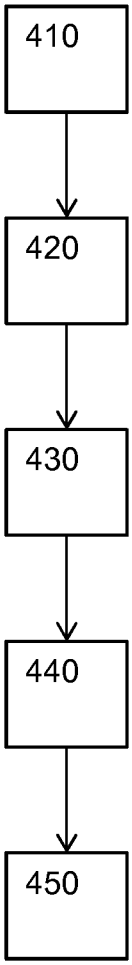


Figure 1



400

Figure 2

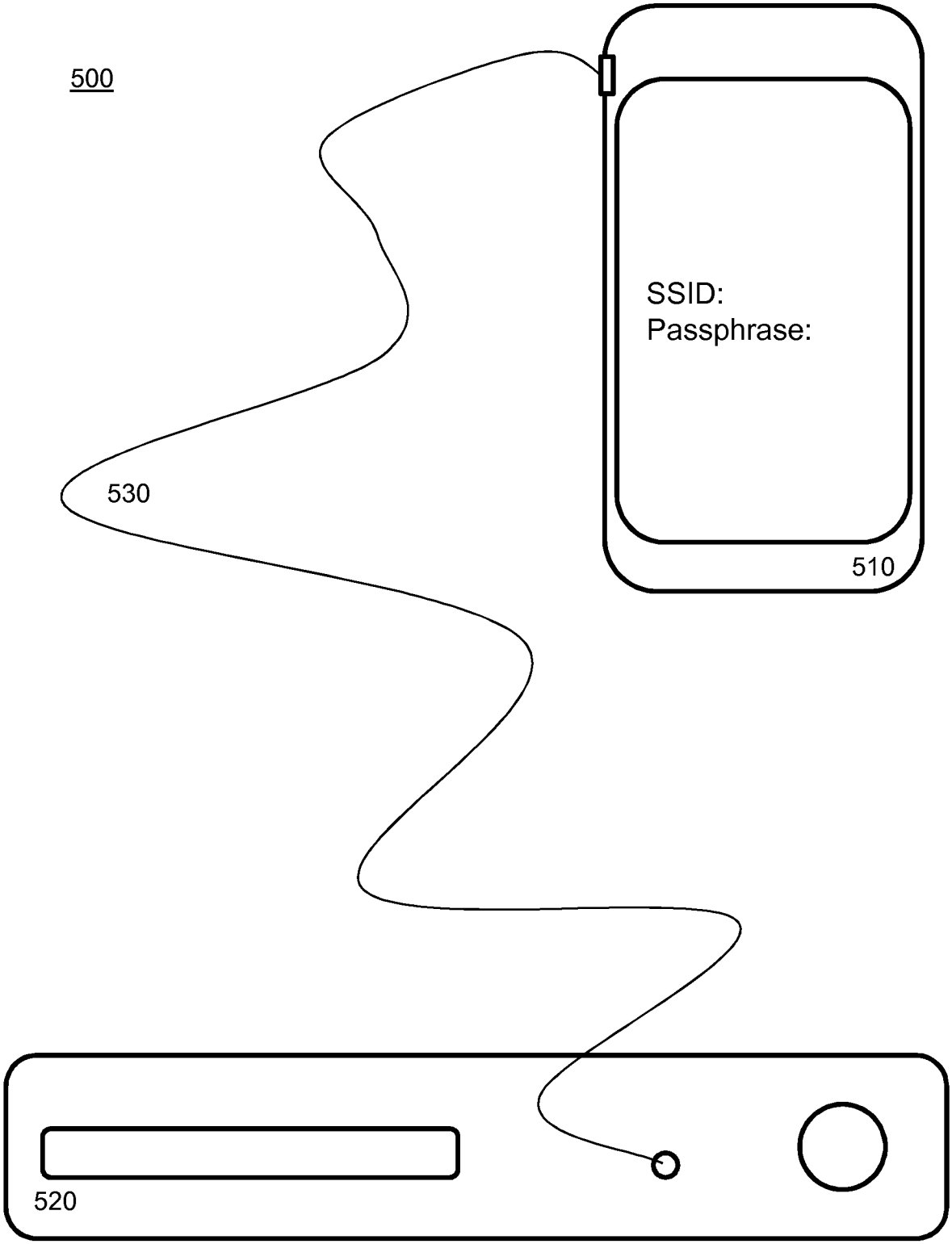


Figure 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/057510

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/28 H04L29/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/143455 Al (GITZINGER THOMAS E [US]) 29 June 2006 (2006-06-29)	1-3 ,6, 8-10, 12-16
Y	paragraph [0013] paragraph [0015] paragraph [0017] paragraph [0020] - paragraph [0021] paragraph [0025] - paragraph [0026] paragraph [0028] - paragraph [0030] paragraph [0033]	4,5 , 7, 11

X	US 2011/179182 Al (VADLA RAVNAES OLE ANDRE [NO]) 21 July 2011 (2011-07-21)	1,3,4, 6-9 , 11-16
A	paragraph [0014] - paragraph [0018] paragraph [0021] - paragraph [0022] paragraph [0034]	2,5, 10

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" documentwhich may throw doubts on priority claim(s) orwhich is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 Apri l 2013	29/04/2013

Name and mailing address of the ISA/	Authorized officer
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Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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International application No
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