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Controlling Home Appliances Using Near Field Communication and J2ME

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Abstract— Near Field Communication, is a short range wireless RFID technology that makes use of interacting electromagnetic radio fields instead of the typical direct radio transmissions used by technologies such as Bluetooth. It is meant for applications where a physical touch, or close to it, is required in order to maintain security. NFC is planned for use in mobile phones for, among other things, payment, in conjunction with an electronic wallet, and for setting up connections between Bluetooth devices (rendering the current manual Bluetooth pairing process obsolete).

Another use of NFC would be controlling your home Appliances with your smartphone. This would mean a universal access device to all of your home appliances right from entry to exit.

Index Terms— electromagnetic radio fields, RFID, short range, universal access device..

1. INTRODUCTION

Near field communication, abbreviated NFC, is a form of contactless communication between devices like smartphones or tablets. Contactless communication allows a user to wave the smartphone over a NFC compatible device to send information without needing to touch the devices together or go through multiple steps setting up a connection. Fast and convenient, NFC technology is popular in parts of Europe and Asia, and is quickly spreading throughout the United States.

This technology can be used to easily pair with devices as all it needs is a simple tap over the other NFC enabled device. This would result in pairing with the device it has been tapped on. A smartphone could be used for remotely operating the home appliances. Only a tap on the appliance would be needed connect with that appliance and then the appliance could be remotely controlled by Bluetooth technology.

2. HOW NFC WORKS

As the name Near Field Communications implies, it's a wireless technology that only works over a very 'near'/short distance, usually a centimetre or two. And, typically, this involves touching ('tapping') your device to the tag or chip (since you have to allow for the bulk of the tag container and phone body). NFC operates at 13.56 MHz and at data rates ranging up to 424 kbps - technical readers will spot that this isn't very fast, but then the amount of information transferred by NFC is typically very small - less than a kilobyte - any larger transfers are handed off to another wireless technology, e.g. Bluetooth (see the use examples below).

Just as with other proximity card technologies, NFC works using magnetic induction between two loop antennas located within each other's 'near field', effectively forming an 'air-core transformer'. In other words, power can be transferred ('induced') in an otherwise passive, unpowered chip (usually referred to as the 'target'), after which basic RF data transfer can occur. So NFC targets can be simple tags, stickers or cards that do not require batteries and can be extremely small and thin.

Such targets are effectively read-only, with information programmed in at the time of manufacture, or at least at the time they ship. Typical information in a NFC target would be an Internet URL (e.g. a Facebook page or web site), but almost any data is possible, depending on how widely compatible with real world devices the target is intended to be.

In addition, the target can of course be powered too, so-called 'peer to peer' communication. For example, two smartphones, or a smartphone and a headset or other accessory. In this 'active' mode, both the initiator and the target device communicate by alternately generating their own 'near' radio frequency modulations. I.e. they take turns sending information - each device deactivates its RF field while it is waiting for data so that it can pick up modulations from its NFC partner.

Interestingly, because of the 'near' bit, i.e. the two devices have to be touching, there's no need for 'pairing' as we're used to in the Bluetooth world. In other words, there's no need to confirm that you've got the right devices, tag or accessory, since it's pretty obvious. NFC is also more suitable for letting devices communicate in a crowded environment like a tech event - a situation where Bluetooth can fall down flat because of the sheer number of pair able devices within 'range'.

3. NFC FOR HOUSE HOLD APPLIANCES

Using a NFC enabled universal remote, one can control all the devices one uses in his daily life, and without the fear of losing that universal remote as the remote is going to be a smartphone.

Let us have a look at how NFC would help us forget the use of keys for getting in our homes:

The Flowchart in the diagram depicts the steps in which the user is authenticated and then can enter his home. This would mean that there is no need of keys that are used to open the lock of the door.

Let’s take a look at the procedure where we can pair with the television and control it. The television should be NFC enabled and should also be Bluetooth enabled.

Step 1: Tap the Smart phone near your NFC enabled television.

Step 2: The Smartphone is authenticated. If authorized, go to step 4.

Step 3: Connection rejected.

Step 4: The devices are paired and transmission is handed over to Bluetooth

4. NFC SPECIFICATIONS

When developing near field communication devices and new technology, NFC standards must be met. Standards exist to ensure all forms of near field communication technology can interact with other NFC compatible devices and will work with newer devices in the future. Two major specifications exist for NFC technology: ISO/IEC 14443 and ISO/IEC 18000-3. The first defines the ID cards used to store information, such as that found in NFC tags. The latter specifies the RFID communication used by NFC devices.

ISO/IEC 18000-3 is an international standard for all devices communicating wirelessly at the 13.56MHz frequency using Type A or Type B cards, as near field communication does. The devices must be within 4cm of each other before they can transmit information. The standards explain how a device and the NFC tag it is reading should communicate with one another. The device is known as the interrogating device while the NFC tag is simply referred to as the tag.

To function, the interrogator sends out a signal to the tag. If the devices are close enough to each other, the tag becomes powered by the interrogator's signal. This signal powers the tag, allowing the tag to be small in size and function without any battery or power source of its own.

The two devices create a high frequency magnetic field between the loosely coupled coils in both the interrogating device and the NFC tag. Once this field is established, a connection is formed and information can be passed between the interrogator and the tag. The interrogator sends the first message to the tag to find out what type of communication the tag uses, such as Type A or Type B. When the tag responds, the interrogator sends its first commands in the appropriate specification.

The tag receives the instruction and checks if it is valid. If not, nothing occurs. If it is a valid request, the tag then responds with the requested information. For sensitive transactions such as credit card payments, a secure communication channel is first established and all information sent is encrypted.

NFC tags function at half duplex while the interrogator functions at full duplex. Half duplex refers to a device that can only send or receive, but not both at once. Full duplex can do both simultaneously. A NFC tag can only receive or send a signal, while the interrogating device can receive a signal at the same time it sends a command. Commands are transmitted from the interrogator using PJM (phase jitter modulation) to modify the surrounding field and send out a signal. The tag answers using inductive coupling by sending a charge through the coils in it. Meeting theses specifications ensures all NFC devices and tags can communicate effectively with one another.

5. NFC CONNECTION HANDOVER SPECIFICATION

Defines the structure and sequence of interactions that enable two NFC-enabled devices to establish a connection using other wireless communication technologies. Connection Handover combines the simple, one-touch set-up of NFC with high-speed communication technologies, such as WiFi or Bluetooth. The specification enables developers to choose the carrier for the information to be exchanged. If matching wireless capabilities are revealed during the negotiation process between two NFC-enabled devices, the connection can switch to the selected carrier. With this specification, other communication standards bodies can define information required for the connection setup to be carried in NFC Data Exchange Format (NDEF) messages. The specification also covers static handover, in which the connection handover information is stored on a simple NFC Forum Tag that can be read by NFC-enabled devices. Static mode is used in applications in which the negotiation mechanism or on-demand carrier activation is not required.

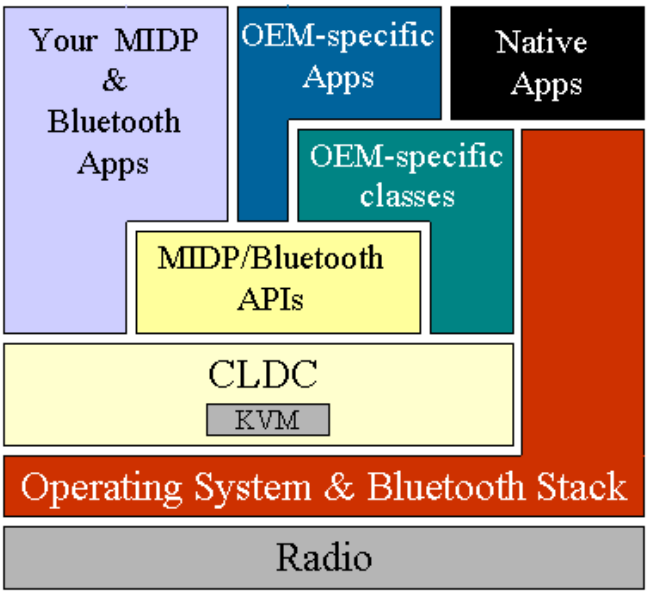
6. APP FOR COMMUNICATION USING J2ME

A application needs to be developed which will communicate using the bluetooth API of j2me.

The application would contain all the commands to communicate with the various appliances. For example, if we are communicating with washing machine, then we will have options for the level of water, the spin speed, etc.

The Java Bluetooth APIs contain the classes LocalDevice and RemoteDevice, which provide the device-management capabilities defined in the Generic Access Profile. LocalDevice depends on the javax.bluetooth.DeviceClass class to retrieve the device's type and the kinds of services it offers. The RemoteDevice class represents a remote device (a device within a range of reach) and provides methods to retrieve information about the device, including its Bluetooth address and name.

The J2ME architecture is shown below:



6. BENEFITS OF USING NFC

NFC provides a range of benefits to consumers and businesses, such as:

- Intuitive: NFC interactions require no more than a simple touch
- Versatile: NFC is ideally suited to the broadest range of industries, environments, and uses
- Open and standards-based: The underlying layers of NFC technology follow universally implemented ISO, ECMA, and ETSI standards
- Technology-enabling: NFC facilitates fast and simple setup of wireless technologies, such as Bluetooth, Wi-Fi, etc.)
- Inherently secure: NFC transmissions are short range (from a touch to a few centimeters)
- Interoperable: NFC works with existing contactless card technologies
- Security-ready: NFC has built-in capabilities to support secure applications

7. CONCLUSION

It's a technology that just makes sense when you use it. It's intuitive - you want information from something, or to give information to it - you want to pair your phone with another gadget - you want to transfer money to something - in each case you literally just 'tap' your phone in the right place and it's done. Then the bluetooth can handle the rest of the communication.

Thus one will be able to use his smartphone for all of his daily appliances.

REFERENCES

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