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An Emerging Era of Wireless Technology : NFC

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Abstract — Near Field Communication (NFC) is a new, short-range wireless connectivity technology that evolved from a combination of existing contactless identification and interconnection technologies. It was jointly developed by Sony and NXP Semiconductors (formerly Philips).NFC is designed to enable the exchange of various types of information, such as telephone numbers, pictures, MP3 files or digital authorizations between two NFC enabled devices like mobile phones, or between an NFC enabled mobile phone and a compatible RFID chip card or reader that are held close to each other. NFC is intended to be used as an access key to contents and for services such as cashless payment, ticketing and access control.

Keywords-component; Information security, Privacy, NFC, Devices, Tags, Intelligent Environments, Mobile Phones, NFC, RFID, Ubiquitous Computing.

I. INTRODUCTION

NFC operates in a frequency range centered on 13.56 MHz and offers a data transmission rate of up to 424 kbit/s within a distance of approximately 10 centimeters. In contrast to the conventional contactless technology in this frequency range (only active-passive communications), communications between NFC-capable devices can be active-active (peer-to-peer) as well as active-passive, NFC therefore represents a link to the RFID world. NFC is backwards compatible with the widely used Smart Card infrastructure based on ISO/IEC 14443 A (e. g. NXP's MIFARE technology) and ISO/IEC 14443 B as well as with the Sony FeliCa card (JIS X 6319-4). For the exchange of information between two NFC devices, a new protocol was developed which is defined in the standards ECMA-340 and ISO/IEC 18092. The NFC Forum was founded in the year 2004 by NXP, Sony and Nokia to harmonize the NFC technique and to stimulate its deployment. The NFC forum develops specifications which ensure interoperability of NFC units and services. All of the above mentioned standards (ISO/IEC 14443 A, B, ISO/IEC 18092 und JIS X 6319-4/FeliCa) are included. The NFC Forum certifies NFC units compatible to its specifications from December 2010 onwards.

To ensure interoperability between mobile phones and RFID chip cards of different manufacturers, digital protocol tests and RF measurements are required on NFC devices. The RF measurements essentially include timing measurements, the measurement of signal strength in polling mode, carrier frequency measurement, reception sensitivity in polling mode, and the measurement of load modulation (signal strength of the listener signal).

The use of NFC Smart Posters in the development and creation of intelligent environments establishes a new user interaction paradigm requiring new tools and infrastructure to create them. In this paper we describe an open and generic tool providing a platform for creating of NFC Smart Posters containing tags with standards based data (such as NFC NDEF message, URIs or MIME) enabling users to access to information and services with NFC enabled devices in an easy and intuitive way at anywhere and anytime. Besides, in this paper we describe some of the smart posters applications, already installed in the University of Córdoba. These scenarios have been developed thanks to the tool described in this paper and with the aim to create intelligent environments in the university ambient.

Near Field Communication (NFC) technology is supported by the leading mobile device, infrastructure and technology manufacturers, and by all major payment providers. The NFC- Forum [1] is a non-profit organization and whose mission is to advance the use of NFC technology by developing standard specifications, ensuring interoperability among devices and services, and educating the market about NFC technology. NFC Forum organization is responsible for providing the NFC standards [2] that make it possible for successful communication between devices and tags, and enable any company to create NFC-Forum compliant solutions that will be interoperable with other

company's devices and solutions.

NFC-Forum has defined four initial tag formats based on ISO 14443 [3]. These specifications are: NFC Data Exchange Format (NDEF), NFC Record Type Definition (RTD), NFC Uniform Resource Identifier (URI) Service Record Type Description, NFC Text Record Type Description and NFC Smart Poster Record Type Description.

The NFC Forum Tag is a contactless tag that can operate according to one of the four NFC forum tag platforms called NFC Forum type 1-4 Tag Platforms. The application data stored inside an NFC Forum Tag is encapsulated firstly into an NDEF message and secondly into a data structure specified by the NFC Forum Type Tag Platform. The NDEF message and the NFC Forum Type Tag Platform encapsulation are used to provide a simple way to access a remote service by using the touch paradigm [4].

The vCard use case consists of an NFC Forum Tag embedded into a business card that contains an electronic vCard (vCARD21, RFC 2425, RFC 2426) with the person details. Reading the tag using an NFC Forum device like a mobile phone or a notebook, the user can retrieve and save the vCard information into his address book. Once the information is correctly stored and saved, the user can use it as desired. This saves the user from manually typing the person details of the business card. If the memory space of the NFC Forum Tag is big enough even a Jpeg image can be stored in the electronic vCard. Thus, Smart Posters is one of the key use cases for NFC technology [5].

From the technical point of view, NFC is blend of contactless smart card technology and cell phone. NFC equipped devices normally operate in three different modes. Card emulation mode, peer-to-peer mode, and reader-writer mode. In card emulation mode NFC device behaves like a reader e.g. NFC tag. This tag has the capacity to store data securely and the applications of this mode are electronic ticketing and payments. In peer to-peer mode two devices equipped with NFC can exchange data directly by touching each other. Applications of P2P mode are transferring data between laptop and cell phone. Printing of data by touching laptop with printer. In reader-writer mode NFC device can read or write the tags in similar fashion like RFID tags [6].

1.1 NFC Modes of Communication

Three modes of communication are defined by NFC forum.

- Read/Write mode
- Tag emulation mode
- Peer-to-peer mode

In read/write mode NFC phone can read or write to the tag.

Contactless communication supports this mode [7]. While in tag emulation mode NFC phone acts like smart card. For example, mobile as electronic wallet. Third mode is peer to-peer mode in which link level communication is established between two NFC phones.

For example exchanging business cards.

Figure 1 : Examples of NFC Communication Modes

1.2 NFC Modes of Operation

RF signal transmission between transmitter and receiver creates the main distinction between NFC and other RF wireless communication modes. NFC depends upon straight magnetic/electrostatic coupling between devices instead of freely broadcasting of radio waves, such as in Wi-Fi. NFC devices can operate on low electric or magnetic field strengths due to its short range communication property [8].

Field Strength of NFC [8]

NFC system can operate either in active or passive mode depending upon requirements.
ECMA-340 is the standard which defines the modes of operation.

1.2.1 Active Mode

In this mode both devices generate RF (radio frequency) field to transfer data. In this situation any of the devices can be the initiator and other will be the target. While in passive mode, only one device generates the RF field and other uses load modulation to transfer data. In this situation initiator of the communication will generate field and target will use load modulation. During the communication, the initiator starts the communication in a particular mode at a specific speed. Target finds out the current speed and replies back to the initiator. Termination of the communication takes place either when two devices move out of the range or application gives command to terminate it [1].During communication either initiator or target generates RF field of level H min that does not go beyond the field level of H max[9].

1.2.2 Passive Mode

This mode has a key benefit for battery powered devices. For battery powered devices low consumption of battery is the basic priority. Thus NFC allows battery powered devices such as cell phones to operate in passive mode. In this mode RF field is generated on the other side. Thus battery power is saved that was needed to be used for generating RF field. In passive mode target operates continuously between H min and H max magnetic field strength [9]. NFC protocol is also compatible with connectionless smart card protocols like Felicia and Mifare. NFC device can work with both smart card and smart card reader. Another benefit of he NFC device is that it can be used as smart card, as well as smart card reader [1].
Devices cannot change mode of communication (Active/Passive) during single transaction unless target is removed or deactivated. Even transfer speed of target to initiator and vice versa may not effect the change in mode [9].

1.3 NFC Stickers

These stickers are the alternative solution to NFC devices and contactless cards. They are self adhesive and smaller in size, can fit on any device, like a cell phone. They are simple to use and have potential of gaining significant business benefits. For production and personalization standard they are following A1 credit card format standard. Although NFC stickers can save start up cost, their production cost is more than simple contactless cards. Only the increase in volume of such stickers can reduce its cost. According to a survey volume of NFC sticker is increased in 2009 and during 2010 and in 2011 it is expected that there will be significant increase in their volume, reducing its price [10].

Figure 2: NFC Stickers

1.4 How NFC works

There are four ways how NFC works.
1. Phone to phone
2. Phone to device

3. Phone to tag
4. Phone to reader

1.4.1 Phone to Phone

In this category two cell phones equipped with NFC communicate with each other. They can transfer music files or pictures by just touching each other.

Figure 3: Phone to Phone NFC Transaction

1.4.2 Phone to Device

Here NFC equipped cell phone can communicate with any device. For example, by just touching phone with NFC equipped printer can print the pictures stored in cell phone. Or by touching payment device can perform payment transaction.

Figure 4: Phone to Device Transaction

1.4.3 Phone to Tag

Tag contains data. Normally tags are embedded on posters for marketing purpose. Cell phone is touched with tag and data from tag is transferred to cell phone. For example there is a tag on bus terminal which by touching cell phones transfers bus timings and other details.

Figure 5: Phone to Tag Transaction

1.4.4 Phone to Reader

We can purchase and store electronic tickets on our cell phones. Cell phone can communicate with external reader by just touching it with reader. So one can purchase ticket easily instead of standing and waiting in a long queue.

Figure 6 : Phone to Reader Transaction

Figure 8: Peer-to-Peer data transfer

Figure 9: Presenting e-ticket to machine

Figure 10: NFC Access control

Figure 13: Copying picture from NFC Frame

II. Conclusions

We are in this report and a brief description of the security and privacy threats to the devices NFC. The same technology and security threats the same wireless technology. Compared with other wireless technologies some of the threats have an impact on the low NFC, such as eavesdropping, which is difficult to achieve through the transaction due to the distance in less communication between devices and the denial of the attack, which will only affect the normal operation for some time. The data modification, data corruption, and the attack of the sequential devices NFC. Because when we look at the use cases with regard to smart posters, where addresses are used malicious websites to direct users to malicious websites or services.

Can be used to download malicious software on the mobile phone. Can then be used malicious software to eavesdrop on the data entered on the keyboard or attempt to access sensitive data, which threatens the security of other applications. Encryption gives us better way to secure communications. But the question is which encryption method to use here, either symmetric or asymmetric. Symmetric encryption has its own issues, like key distribution and trust, etc. Asymmetric encryption technique increases transaction time and more utilization of battery power. Which is not suitable in terms of low powered devices. Advanced encryption techniques like ECC (Elliptic Curve Cryptography) can be used to solve such issues. Using appropriate encryption technique depends on the use case. In sensitive environments, where more security is required, asymmetric cryptography should be used despite of its increased transaction time property.

Using NFC devices will affect personal privacy by tractability. Possibly someone could read UID of a NFC tag from a distance and see that the same phone passes at a later time.

Having GPS in the cell phone will help attacker to pin point your location. Cell phone affected by malware can collect all of the information stored in the cell phone or the information typed by the keyboard and can send it back to the attacker.

No doubt NFC technology will ease our life. Its touch and go facility will be fun for the people. But, this

technology is not mature yet and has lots of security and privacy issues.
Using NFC devices for entertainment will be fun. But for business use we think that this technology is not yet ready. and privacy threats faced by NFC, discussion and critical analysis of these issues by looking from different aspects? Impact of privacy issues on daily life will also be addressed.

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