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NFC APPLICATIONS IN THE TRACKING SYSTEMS

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Abstract: Radio Frequency Identification (RFID) and a Near Field Communication (NFC) is an automatic identification method, relying on storing and remotely retrieving data using devices different devices. An RFID tag and NFC devices is a small object that contains an antenna that enables it to receive and respond to radio-frequency. Basic requirements that these devices have to work in any conditions. In the working environment (closed or open air) there are always objects which can interact with radio frequency. This technical problem is to be considered when it comes to implementation of RFID or NFC devices knowing that materials can reflect, absorb or detune radio waves. In our paper we describe a system where NFC is applied. Numerous economic and technological questions arise by the implementation and usage.
Keywords: RFID, NFC, logistics, tracking.

1. Introduction

It is without doubt that introduction of RFID gives advantage to companies by helping them the integration in supply chains. However RFID –although widely used – need to be improved be-cause of one way communication. This is why Sony and Philips created the two way communication standard, the NFC in 2003. The requirement for NFC is similar to the RFID but be-cause of the possibilities of a two way communication it can be used in situations previously impossible.

2. Possibilities and problems

2.1. RFID technology. RFID technology is a technology for storing data appropriate for identification and describing attributes on an RFID tag that allows retrieving these data from far places via an RFID device attached to an antenna. The tag chip can be attached to products, unit load devices, animals etc. It is connected to an antenna which allows receiving and reflecting questions by radio frequency. Production of these devices is a very complex task. Low energy consumption is needed and the antenna has to meet various requirements (frequency, performance etc.). Communication between the reader and the tag is based on the theory of spreading radio waves. When the tag enters the electronic (or magnetic) field generated by the reader, it for-wards its unique identification or any other stored information. RFID tags are classified de-pending on their power source, among active (with own power source) and passive (with no own power source, so they are triggered by the field of the reader's antenna). The reader can be attached to a computer, thus identification becomes integrated in the company system [11].

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2.2. NFC technology. The NFC standard creates a possibility for fast direct and simple communication within few centimeters distance for passive and active devices, cards, and smart phones. The communication requires an active chip on at least one side that can support energy to the passive chip through its antenna, awakening it. The passive chip emits the stored data which can be read by the active chip.

The capacity depends from the size of the data storage layer. The smallest tags can store 64 bytes but the currently available tags are able to store one kilobyte. The row chip needs preparation and treatment to function. The chips can be banded but not heavy duty [10]. The base chips can be placed in layered paper but special treatment is needed to function on placed it on metal. The interference caused by the metal can disturb the communication. More expensive chips can have UV protection needed for outdoor use.

2.3. Radio frequency communication range. Any device using radio frequency communication has a definite frequency for reliable message transmission. If the distance between sender and receiver increases exceeding a definite value, transmission fails. This is why it is a good idea to operate the radio communication system with a margin that does not coincide with the maximum range. It is required to do to achieve reliable performance, since the range changes from moment to moment. The exact range is affected by various factors, thus in simple terms there are four:

- the power in the RF wave transmitted,
- the sensitivity of the receiving equipment
- the environment in which the waves travel
- the presence of interference.

These are more or less obvious, but the relationship between the power and range is of high importance. Radio waves disperse in any direction after leaving the transmitting antenna (in case of non-directed antennas). Also the effect of environment on radio communication influences the frequency transmission. Electromagnetic radiation passing through the material may be reflected, detuned or absorbed to a certain extent, depending on the properties of the material and the type of radiation.

The operation frequency of NFC systems effects the operating range. According to the analysis of the physics of NFC communication the optimum frequency is 13,56 MHz this frequency determined on the basis of RFID “ISO/IEC 14443 A&B and JIS-X 6319-4” standard [9].

This kind of analysis cannot be regarded as general since there are plenty of factors to be taken into account which result in different effects depending on application. Factors affected by choice of frequency include for instance: size of antenna, problems of power delivery to the tag, problems of communication of the tag back to the reader [11].

The distance of communication is limited to few centimeters and so is the bandwidth of data transfer which is limited 424kbit/sec. However the stored data can be emitted within a second. Even though it is slow compared the other standard it using minimum energy and there is no need for pairing the devices.

2.4. Environmental challenges. NFC devices have to work in any conditions. In the working environment (closed or open air) there are always objects which can interact with radio frequency. This technical problem is to be considered when it comes to

implementation of NFC devices knowing that materials can reflect, absorb or detune radio waves.

Electromagnetic waves can be reflected off any conductive or non-conductive surface, such as metal, water or concrete. Reflection can result in an opposite effect, namely waves can be reflected in the environment of objects which would normally barrier radio waves or the waves result in an enhanced signal after reaching the same phase. The opposite can also occur, that is the waves cancel themselves which results in a no-read situation. The side effects can be reduced by using multiple antennas. Note that nulls are of more frequent occurrence than enhancements.

Attenuation of radio signals (due to absorption) depends on the properties of the material through which the electromagnetic waves travel. Absorption of energy is caused by the energy dissipating in the material that leads to resistance against the waves and is converted to heat [11].

3. NFC in the corporate logistics

NFC and next to RFID systems provide solutions for corporate logistics problems.

Potential users of the new system indicated understand the core of business values of NFC implementations but they cannot clearly see how to proceed. They also recognized potential benefits of NFC systems which are provided for customers in improved productivity, asset management and accuracy.

They do not really understand how hardware and software components come together with NFC application, what changes are required to be introduced for enjoying benefits from the new technology and what changes are necessary to take on their own existing system. Another concern is who are the experts with expertise and previous project success that are suitable for providing enough help and advice to make the projects successful [11].

The NFC system can be widely used similar to RFID technology, for example:

- Receiving:
  - better productivity,
  - reduced labor costs,
  - faster throughput at the receiving,
  - no need of physical check og packaging slip,
  - needs indicated for Cross-Docking system.
- Storage:
  - put away accuracy and efficiency,
  - less bar codes required,
  - better storage place utilization (random location system).
- Pick and Pack:
  - Picking accuracy (items),
  - Productivity measurement,
  - Time measurement,
  - No need of manual scales.
- Shipping:
  - more accurate shipping process,
  - automatic verification at the portal of outbound dock door,
  - accounting all items leaving the premises.

Our papers describe a new possible field of used namely human resource monitoring. In many causes it is difficult to follow the movement of employers within parts of company. A few solutions already exist for this problem but the costs related the implementation and operation are high or it cannot be used in closed places.

Our proposed solution to this problem will use the aforementioned NFC technology.

4. The possibility implementation of NFC to tracking practice

In our paper we investigated the system of a security company.

Our aim is to locate the employer of the security company before arriving at the place of work. If the employer is not going to arrive to start the work on time the substitution can be arranged proactively.

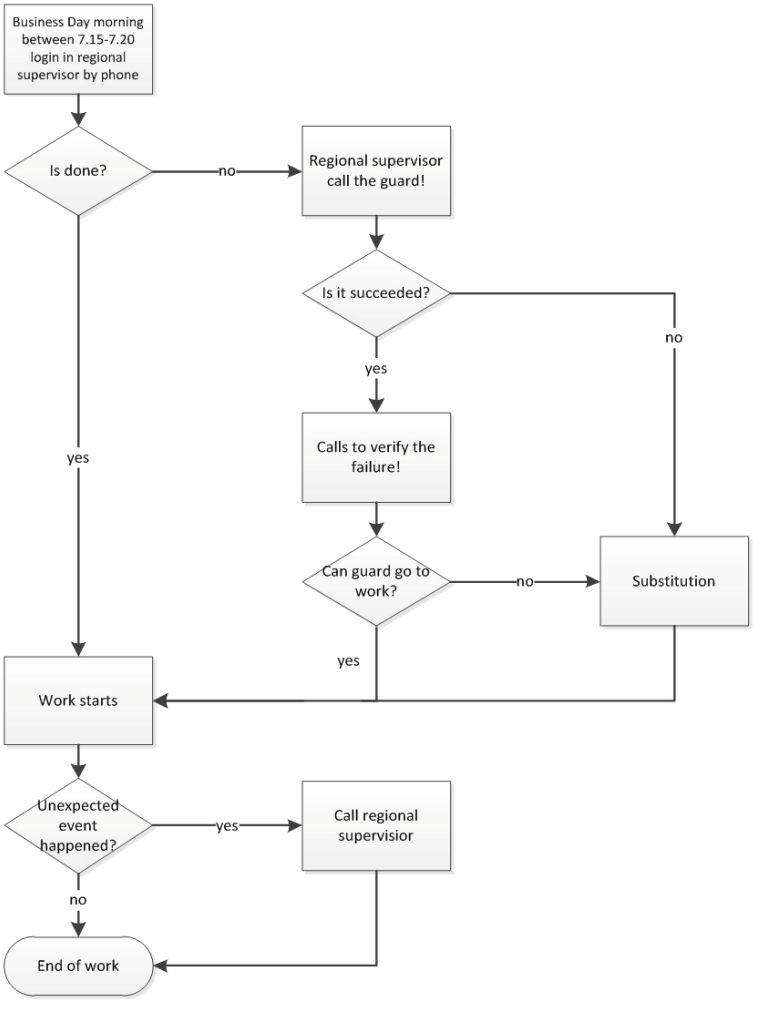

Figure 1. Daily report for duty

4.1. Background Guard Service activities. The presence of the security guard at the facility is very important and without the facility cannot operate.

If the guard is late or cannot start the work at all the security company faces a high level of costs to be paid to the facility.

4.2. Current tracking practice. Current procedure of controlling the presence of guard can be done in two ways:

1. Directly: after showing up at the facility the guard calls the security company.
2. Indirectly: security system of the facility stores the data about the presence of the guard. This way the security company receives the data at the end of each month.

This procedure (Figure 1.) is only able to recognize the presence of the guard thus making proactive measures impossible.

4.3. On-line tracking options. Because the aforementioned procedures it can be seen that the most important issue for the security company is to ensure the presence of the guard.

We propose online tracking of the guard. This way the security company receives information from the movement of the guard before he arrives at the workplace. This way they can react proactively to any problems.

4.4. IT architecture. The main components of our hypothetical system model are as follows:

- Databases
  - Partner Data
  - Data Model Task
  - Data Guardian
  - Contact details
- Applications
  - Strategic applications
  - Planning applications
  - Operational applications
- Members
  - Guards
  - Replacement Guards
  - Area Supervisors
- Mobile Applications
  - NFC
  - GPRS

To the above listed connection system is shown in Figure 2.

The recommended applications developed using:

- At the strategic level: a proactive approach to labor supply, training and equipment.
- At the tactical level: managing of made plans, health and other criteria.
- At the operational level: the implementation of the activity undertaken threatening can be detected in time.

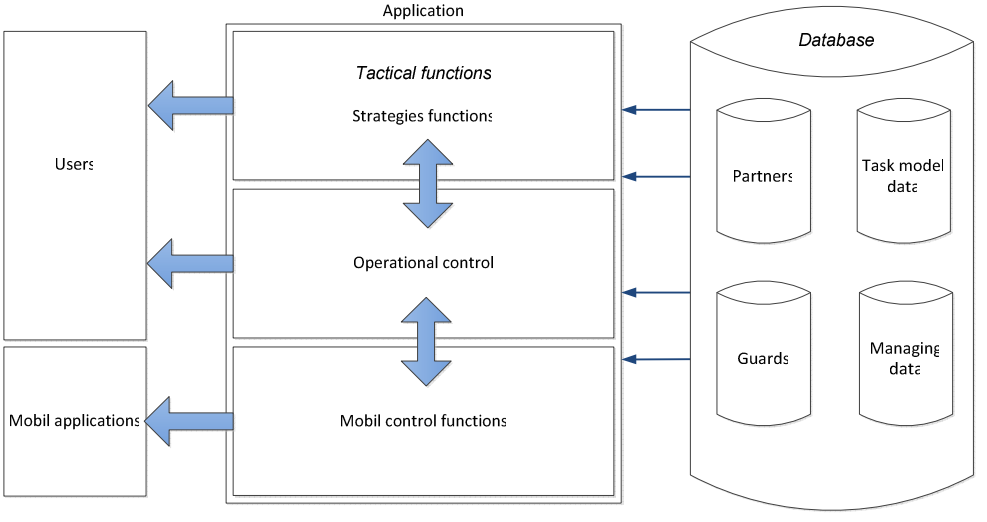

Figure 2. IT architecture

5. Possible tracking solution

The guard receives a NFC device with GSM capability. After reaching designated places he is able to send a signal to the center.

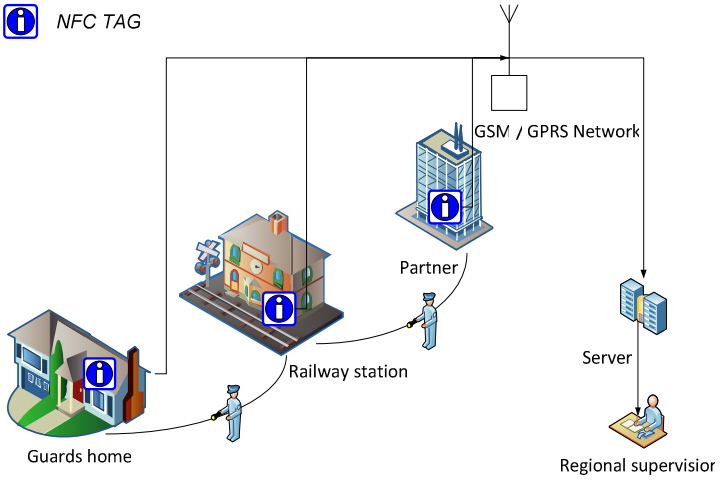

Figure 3. General tracking practices

The developed system components:

- Smartphone
- Reading program,
- NFC tags with location coordinates data
- GPRS network

In our model in NFC tags store the location coordinates. This way by using the NFC devices the guards send location data to the center.

We placed NFC tags a long route of the guard for example at home, bus stations, and the facility.

The path of the guards can be followed by this way automatically. The center can follow of the movement of the guards, and so predicting the estimated time of arrival to work.

5.1. Pilot project. The guards and the substitutional guards are in online connection with the center (Figure 4). In the pilot project we used a smart phone which is NFC capable (Figure 5). The data was sent via GPRS network and decoded at the center (Figure 6).

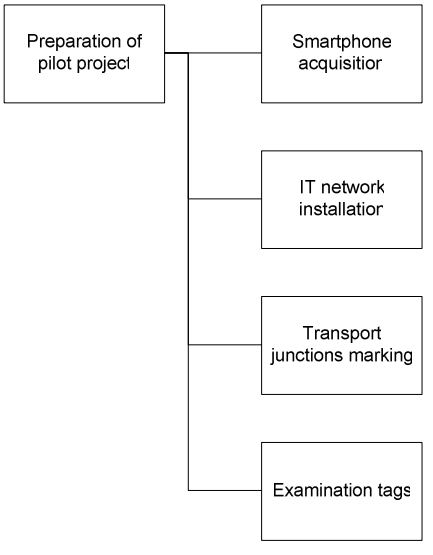

Figure 4. Structure of pilot project

Figure 5. Example of NFC tags to accommodate

Figure 6. Example of reading NFC tags

Reading was accomplished by the application NFC TagInfo available on the Android market the received data was sent manually via GPRS network to the central server at the university where it was decode.

If the company likes this idea, we need to code an android based application where data can be send automatically from the NFC device.

6. Conclusion

We can state that the widespread NFC technology penetrates various sectors of economy as well as commerce and tracking. Due to current investment and maintenance costs NFC application in tracking is not confined.

Our idea can be easily implemented at factories also where the tracking of the movement of the employees between the buildings is necessary.

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