Far and Near Field Communication

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In an RFID system, for communication to exist between a reader and a tag, energy and information must be transferred between them. There are two ways to transfer energy and information in passive tags. The first mode is Near Field, which involves coupling the tag inductively to an approximately circular magnetic field around the reader. And the second mode is Far Field, which uses a reflection technique called backscatter.

NFC Far Field Near Field

1. Near Field and Far Field

According to Neiva[1], the concept of Near Field is based on the principle of electromagnetic induction proposed by Faraday, which consists of the circulation of electric current in a conductor wire creating a magnetic field capable of producing, through induction, electric current in another circuit placed under the effect of the created magnetic field. In basic electricity, we can take as an example a transformer from 220 volts to 110 volts, where basically, we have two coils, in which the 220 volt energy received from the input is applied to the first and by induction it generates 110 volts in the second coil, from where the energy for the output is extracted.

Bringing the concept of electromagnetic induction to RFID, we have a reader that has a coil in which an alternating electric current circulates, generating an approximately circular electromagnetic field around it. So the tags also have a small coil, in this case their antenna. When they are close enough to the reader, they end up being within the magnetic field generated by it, so that current is induced in them. As the name suggests, the technique can only be used over small distances due to the nature of electromagnetic induction. The voltage created in the tag is then used to power its internal circuit after being rectified, that is, the alternating current converted into direct current. The energy that circulates in the tag's coil ends up producing its own electromagnetic field that opposes the reader's field, making it able to detect it through the increase in the current produced in its circuit, which is proportional to the charge applied to the tag. tag coil. As the variation in the resistance of this load is controlled by data transmission, it can be transmitted from the tag to the reader. This type of transfer is called Load Modulation. The Near Field technique is normally used in systems that operate at Low Frequency or High Frequency, and is generally used on NFC cards, but is not limited to them.

In Far Field, the tag receives the electromagnetic waves produced by the reader, producing a voltage in the antenna coil. It is rectified and stored in a capacitor to power the internal circuit. Unlike Near Field, the reader is out of range. Thus, the energy required to transmit data from the tag to the reader comes from the latter, being reused through the backscatter technique, reflecting the electromagnetic wave received. In this way, part of the energy

captured by the tag is used to power the internal circuit and part of the energy is also reflected back to the reader, after introducing some changes in its shape properties and sending at the same time the information contained in the tag. . To this end, some tags change properties using binary language to encode the information to be transmitted, where a load resistance is switched on and off in the antenna circuit in order to modulate the signal that must return to the reader. Thus, the reflected signal is detected by the reader not through variations in the electromagnetic field, but through sensitive radio receivers, as the signal is much lower than what was originally emitted. The Far Field technique is normally used in systems that operate at Ultra High Frequency, or in Microwaves[1].

2. Near Field Communication

For many years, pervasive computing research has explored the benefits of creating connections between the virtual world and the physical world where we live. Near Field Communication Technology, commonly known as Near Field Communication or simply NFC, is a standard for wireless communication that is enabling this ubiquitous vision to become a reality. The NFC Concept is generally close and linked to the Internet of Things concept, as by connecting the physical and the virtual, any object, person or place can be automatically associated with some document or online content[2].

According to Alves et al[3], NFC is a technology that allows interactive communication between smart devices. The interaction occurs through a communication protocol compatible with wireless technology, based on the ISO/IEC 14443 standard[4]. The great advantage of the technology is the fact that instead of other approaches in which it is necessary to insert codes or data to carry out an interaction, in NFC just bringing the devices together is enough to carry out an interaction between them. Based on these advantages, several sectors and industries use the technology, such as Sony, Samsung, Google, Microsoft and IBM, and also in banking entities such as Visa, Mastercard, Citibank and the like. Table 1 summarize the characteristics of the ISO/IED 14443 Standard used for NFC.

Table 1. Summary of Technical Characteristics and Security Mechanisms of the RFID/NFC Standard.

Technical Characteristics	ISO/IEC 14443
Band	HF
Distance	between 7 and 15 cm
Traffic Analysis	Analysis of traffic between tags and readers

Data	Type A: 32-, 56-, or 80-bit identifier Type B: 32-bit identifier

NFC technology also allows for tag reading capability. NFC Proximity Tags or Cards are small labels that have a passive NFC chip that store information. Passive communication occurs in exactly the same way as in RFID, so when an NFC card approaches the reader, it is powered by a magnetic field and is thus capable of returning the information contained in it. Thus, the Reader is the one who initiates the communication and the card must interact in response to the reader's commands[2]. With the advancement of technology, smart devices are capable of acting as NFC proximity cards and, at other times, acting as card readers. In this way, two smart devices with NFC can communicate with each other, one acting as a reader and the other acting as an NFC card. Therefore, the adoption of this technology in mobile devices, such as Smartphones, has become advantageous due to the ease of transporting the NFC chip from cards to devices and the ability to add the possibility of acting as readers[2]. According to Nassar and Viera[5], unlike RFID, NFC is a technology that allows data transfer in wireless communication.

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