Reader to Reader technology

By INSIDE Contactless

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In this document, the terms Contactless IC chip, Contactless and RFID refer to the same technology: it consists of an Integrated Circuit (IC) Chip, which uses 13,56 MHz Radio Frequency (also called electromagnetic waves) to transmit information stored into the chip to the Reader via a short range antennae.

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1. Introduction

A mature technology

Major players of the smart card industry, as well as market leaders in fields as various as access control, secure identity or banking, perceive Contactless IC chips as a promising technology which will gradually replace other technologies such as bar codes, magnetic stripe or optical memory, but also the Contact IC chip cards, as well as the 125 KHz RFID systems. This is already widely the case in the access control and mass transit markets, with cashless payment following the way.

Here and now, 10 years after the launch of its first deployment, Contactless IC chips are used on a daily basis by hundred millions of people all around the world. Each year more than 200 millions of contactless chips are produced by IC manufacturers like INSIDE Contactless.

The promises of the technology

Such a consensus is due, for a main part, to the indisputable advantages of the Contactless IC chips over all the other technologies mentioned above.

On the top of which:

- convenience
- speed
- A packaging offer adapted to various needs of form factors.
- An easy integration in readers not limited by mechanical or design problems

Always thriving to stay ahead, and a true pioneer, INSIDE, the only exclusively contactless semiconductor company, has developed R2R™ (Reader-to-Reader) technology that brings the promises of the 13.56 MHz RF technology right into consumer electronics.

2. Contactless technology

Introduction

The contactless RF technology has been available for almost as long as the smart card technology first for Radio frequency identification (RFID) of object and now for smart cards. This was first achieved with RF tags and memory devices. The need for more secure and more versatile products has driven contactless technology from a memory based product through a microprocessor based product which is able to give at the users more value added services.
The Contactless Card is an integrated circuit card that enables energy to flow between the card and the interfacing device without direct physical contact. Instead, induction or high-frequency transmission techniques are used through a radio frequency (RF) interface.

Power Supply

Contactless Cards are generally powered by an RF field. Contactless cards contain an electronic element that is called transponder. A transponder consists of an inductive antenna and a microchip connected to the ends of the antenna. For better protection of the microchip, it is usually packaged in a module and the antenna is then interconnected to the module. The transponder is embedded in the contactless card plastic support as shown in Figure 1.

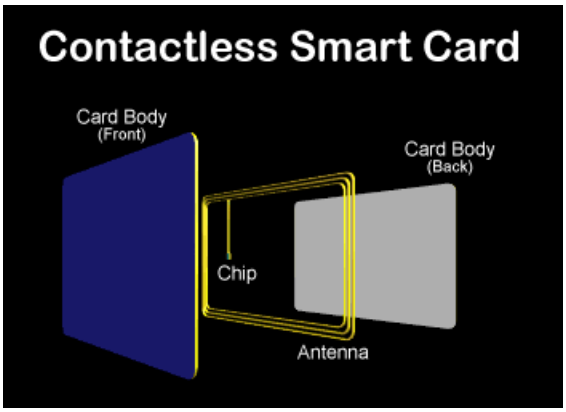


Figure 1 - Contactless card structure

In this case an inductive coupling will transmit both power and data through the air or a non metallic surface from the PCD (Proximity Coupling Device) to the contactless card. The RF energy received by the contactless card antenna embedded in the card is converted in a DC voltage in order to power the card's internal circuits. Power conversion can be done with a bridge rectifier.

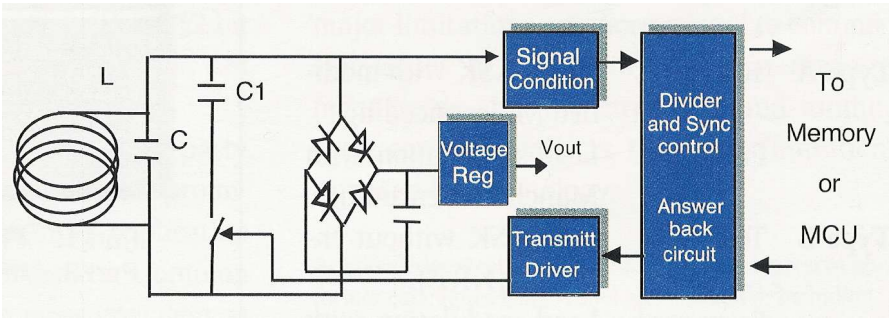


Figure 2 - Typical RF contactless receiver

Another way of looking at the power coupling is to view the card and the card reader antenna coils as component of a RF transformer. The transformer's primary coil is in the card reader, the secondary coil is in the card. The space between the coils is the transformer's air core. The card antenna may be parallel tuned to increase the coupling efficiency.
The diagram (figure 3) illustrates the RF energy coupling between a card and a reader. The card receives the signal, decodes it, and responds back to the reader.

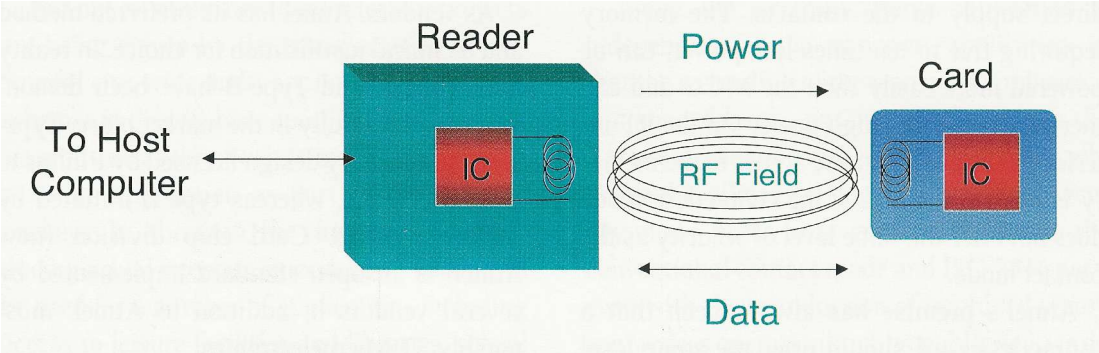


Figure 3 - Contactless card in a RF field

Communication

Contactless cards use an RF interface between the PCD and the card in order to communicate with the IFD using inductive field.

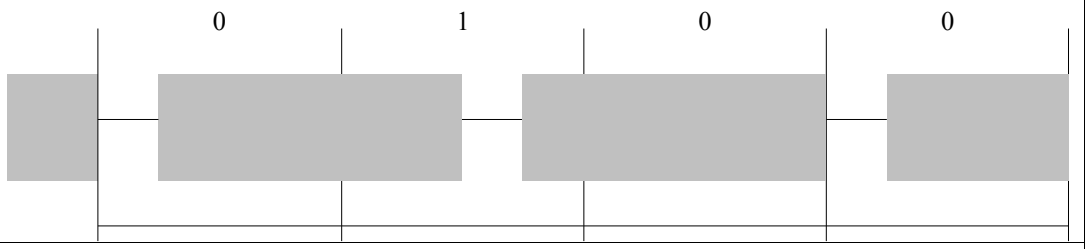
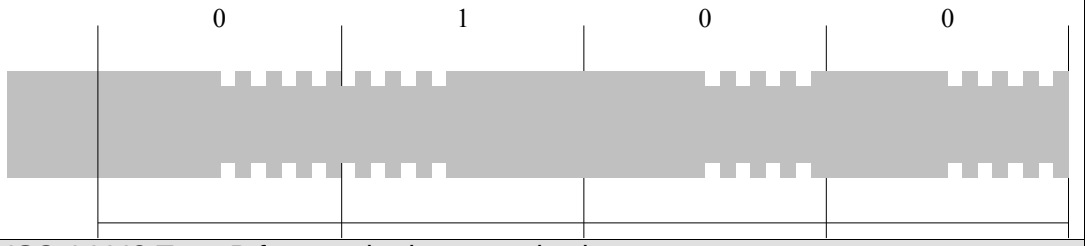
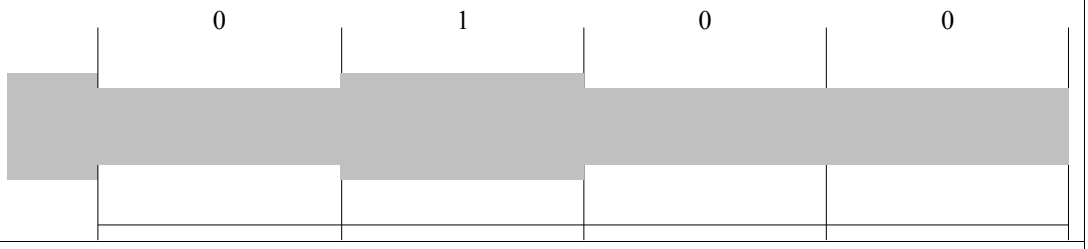
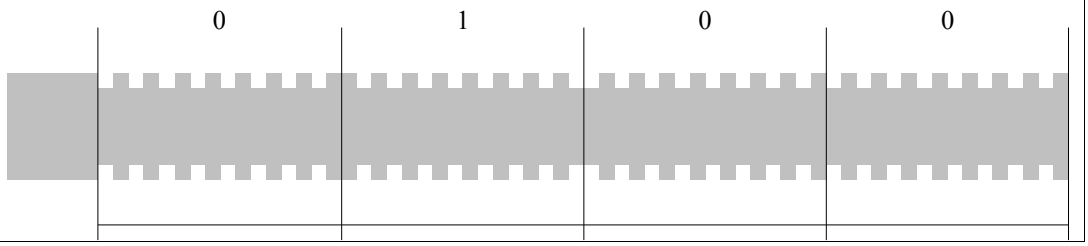
Inductive coupling involves the use of two coils of wire - one acts as a primary coil and one acts as a secondary coil. An alternating current passes through a primary coil that creates an alternating magnetic field, which induces a flow of current in the secondary coil when they are in close proximity. Modulating the current at two different frequencies as it passes through the primary coil allows data to be transmitted to the secondary coil. When the card receives the current, it demodulates the signal and retrieves the data at the same time as it uses the transmitted power to activate its circuitry. Therefore, the advantage of this process is that it is able to transfer both information and power to a smart card.

Inductive coupling contactless cards communicate with the PCD using a technique called load modulation where the card changes its load (for example a resistor), which is sensed by the reader.

Contactless cards which operate at 13.56 MHz use different types of modulation and different types of coding, but take into account only the modulation standardised by ISO/IEC : we speak about the Proximity Integrated Circuit Cards (PICC) and Vicinity Integrated Circuit Card (VICC).

PICC are described by the ISO/IEC 14443 standard series. The standard defines two possible modulations called Type A and Type B. Both Type A and Type B use Amplitude Shift Key (ASK) modulation for communication between the reader, called Proximity Coupling Device (PCD), and the card.

Communication between PCD and PICC are described in the ISO 14443 standard:

	ISO 14443 Type A for standard communication
Reader Modulation **PCD ➔ PICC**	ASK 100% Miller modified 106 kbits/s 
Card modulation **PICC ➔ PCD**	OOK-Manchester Load modulation 847 KHz sub-carrier 106 kbits/s 
	ISO 14443 Type B for standard communication
Reader Modulation **PCD ➔ PICC**	ASK 10% NRZ 106 kbits/s 
Card modulation **PICC ➔ PCD**	BPSK-NRZ Load modulation 847 KHz sub-carrier 106 kbits/s 

PCD → PICC Communication

Type A uses the modulation principle of ASK 100% of the RF operating field to create a "Pause". The bit coding is done with the Modified Miller code.

Type B uses the modulation principle of ASK 10% of the operating field. The bit coding is done with a Non Return to Zero.

PICC → PCD Communication

Both Type A and Type B cards are able to communicate with the PCD via an inductive coupling area where the carrier frequency (13,56 MHz) is loaded to generate a sub-carrier with frequency of ~847 kHz. The sub-carrier is obtained by switching a load in the PICC.

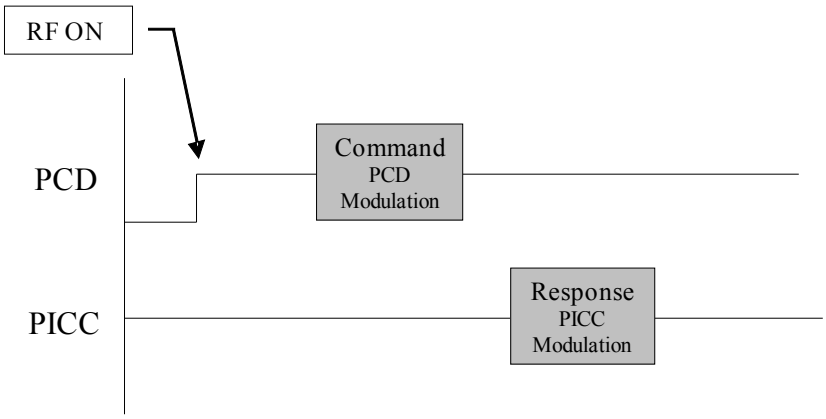
Type A cards modulate the sub-carrier using On-Off Keying (OOK) modulation. The bit coding is done with the Manchester coding

Type B cards modulate the sub-carrier using Binary Phase Shift Keying (BPSK) modulation. The bit coding is done with a Non Return to Zero where the change of logic level is denoted by a phase shift (180°) of the sub-carrier.

Type A and Type B communicate in either direction (PCD to PICC and PICC to PCD) at the rate of 106 Kbytes/s.

Data Exchange

The data exchange between the PCD and the PICC is based on a master-slave exchange with the PCD as the master and the PICC as a slave. PCD send commands and PICC send back responses.



3. NFC Technology

Introduction

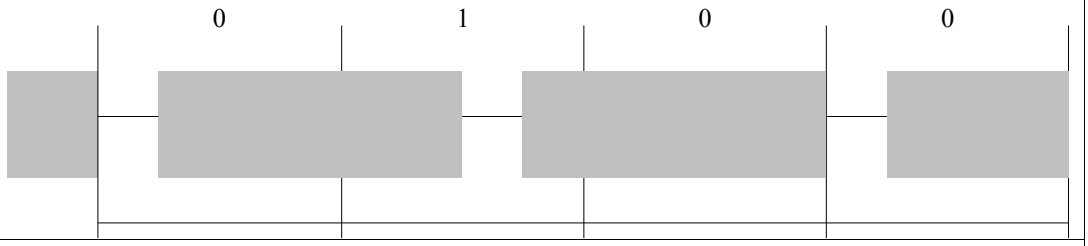
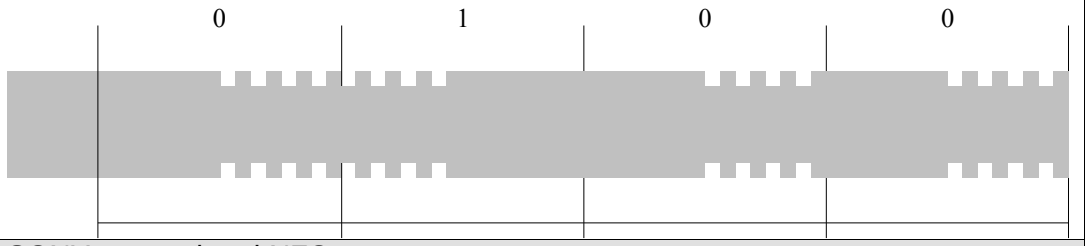
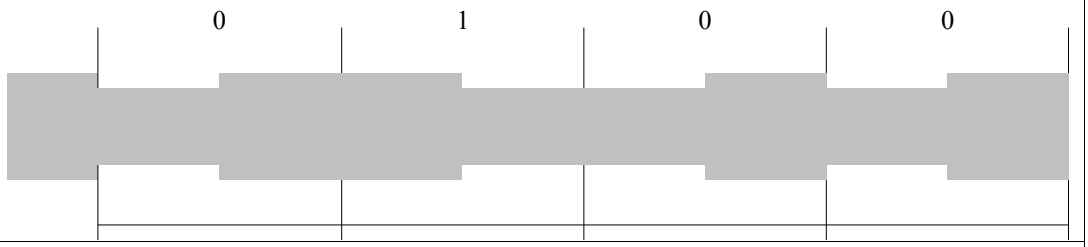
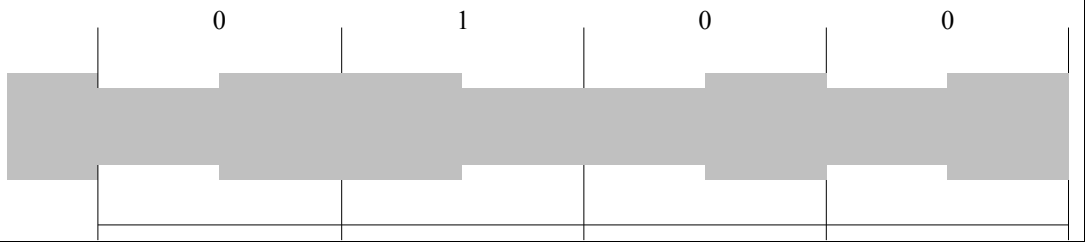
In September 2002, after the refusal by the ISO committee to include SONY in the ISO standard, Philips and Sony made an agreement to propose a new proprietary standard called NFC “Near Field Communication” which allows 2 NFC device to communicate together and dedicated for ISO 14443 type A and Sony protocol. The real need behind that was to get an ISO standard for SONY protocol in order to make it approved in Japan.

From Philips and Sony sources, the goal of this standard is to allow communication between two NFC enabled devices in order to exchange multimedia data like Bluetooth or Infrared is already doing.
From a press release, “NFC would allow, for example, consumers to download an electronic transit ticket from their PC onto their mobile phone, then wave the phone in front of a subway gate to pay a fare. Or, consumers could hold a contactless card next to a video game console to identify themselves for play. The technology could pass video between laptops and cell phones or even download new applications to contactless chip cards.”

Communication

The NFC communication is described in ECMA-340 which just becomes ISO 18092. The following explanation is based on this standard paper and the additional ECMA-352, but not on potential improvements of this technology.

This standard defines two possible modulations called Type A and SONY which are defined as following:

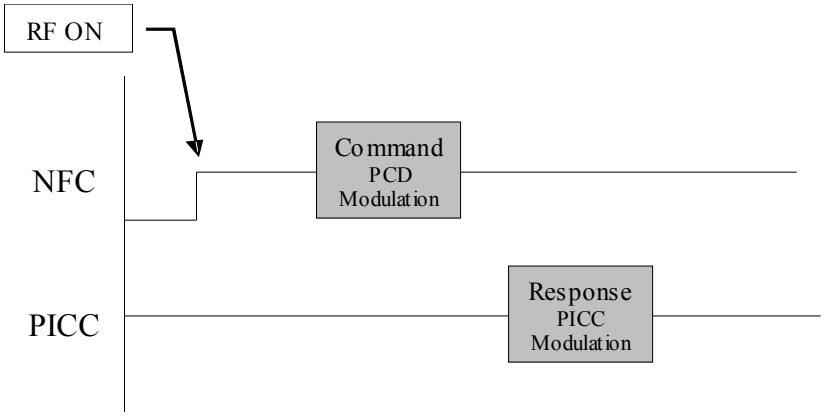
	ISO 14443 Type A for standard communication and NFC
Reader Modulation **NFC ➔ PICC or NFC**	ASK 100% Miller modified 106 kbits/s 
Card modulation **PICC or NFC passive ➔ NFC**	OOK-Manchester Load modulation 847 KHz sub-carrier 106 kbits/s 
	SONY protocol and NFC
Reader Modulation **NFC ➔ PICC or NFC**	ASK 10% Manchester 212 kbits/s 
Card modulation **PICC➔ NFC**	OOK-Manchester Load modulation No sub-carrier 212 kbits/s 

Data Exchange

This NFC communication is also using inductive coupling between the 2 readers coils. The main difference with the contactless communication is that NFC device work as 2 different modes which are passive or active.

NFC in passive mode :

The device is powered by the PCD which generates the field and act as a standard ISO card, but only use ISO 14443-Type A or SONY protocols.
It is stated in NFC papers that a NFC device can operate as a chip but it is also stated that a standard ISO 14443 type A card or a SONY card can be also called a NFC device while being a simple PICC device. So this mode seems to be supported only by PICC but not by readers to propose a reader to reader communication in this mode.

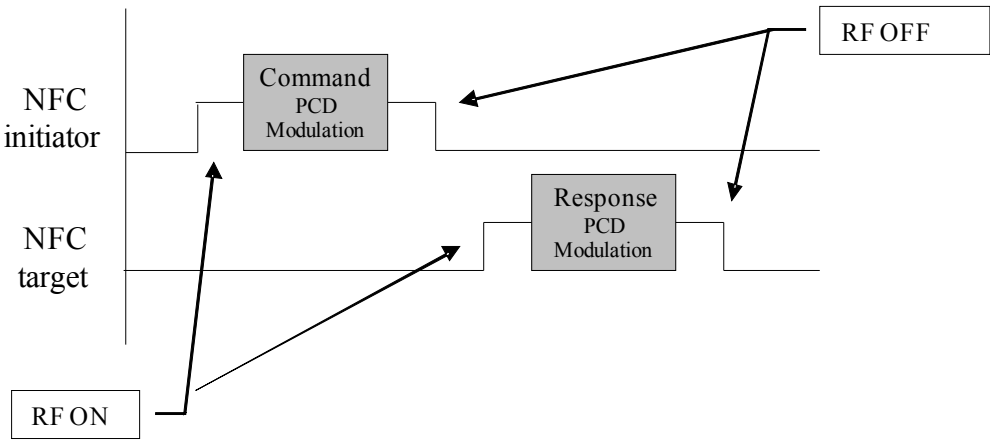


NFC acting as a reader has recently been improved in the ECMA-352 specification to support communication as a PCD (reader) with ISO 14443 and ISO 15693 but still not as chip emulation.

NFC in active mode :

The device is powered with batteries. A PCD (initiator) can send some request command to another NFC device to ask him to switch to active mode as well. In this case both devices are only sending PCD to PICC modulations.
A NFC device enter active mode only if no RF field is detected. This is called RF collision avoidance.

Before sending a command the NFC device checks if there is RF field or not. If there is no RF field then it activate it and send a command like a PCD to the target NFC device which decodes it. Then initiator cut its RF field to allow the target NFC to send back the response like a PICC but using a PCD modulation.



NFC Limitations

NFC technology is today limited in several way:

- Only 2 protocols can be used for this technology which limit the expansion of this technology and make the system closed for all application which are looking for and open solutions.
- Standard PCD which are already deployed in application cannot communicate with existing NFC device in active mode
- A NFC system is not compliant with already installed ISO 14443-B reader base which is widely used in many payment and transport applications all other the world.
- The NFC system is not compliant with already installed ISO 15693 reader base which is the reference for all access control and RFID applications
- Is NFC really an open standard ? Are there patents on NFC or a license to pay to use it ? These questions are really important for real deployment of this technology

4. Reader to Reader technology : R2R

Introduction

This technology has been developed by INSIDE in year 2000. It was to respond to a real market need which was to setup some reader parameters and download all the transactions done during a day on a vending machine to a mass storage. The idea was then to use a contactless reader (PCD) inserted in a PDA as a PICC emulator. Thanks to this, the reader embedded in the vending machine was able to upload all its information to this PDA using a standard PICC communication protocol.

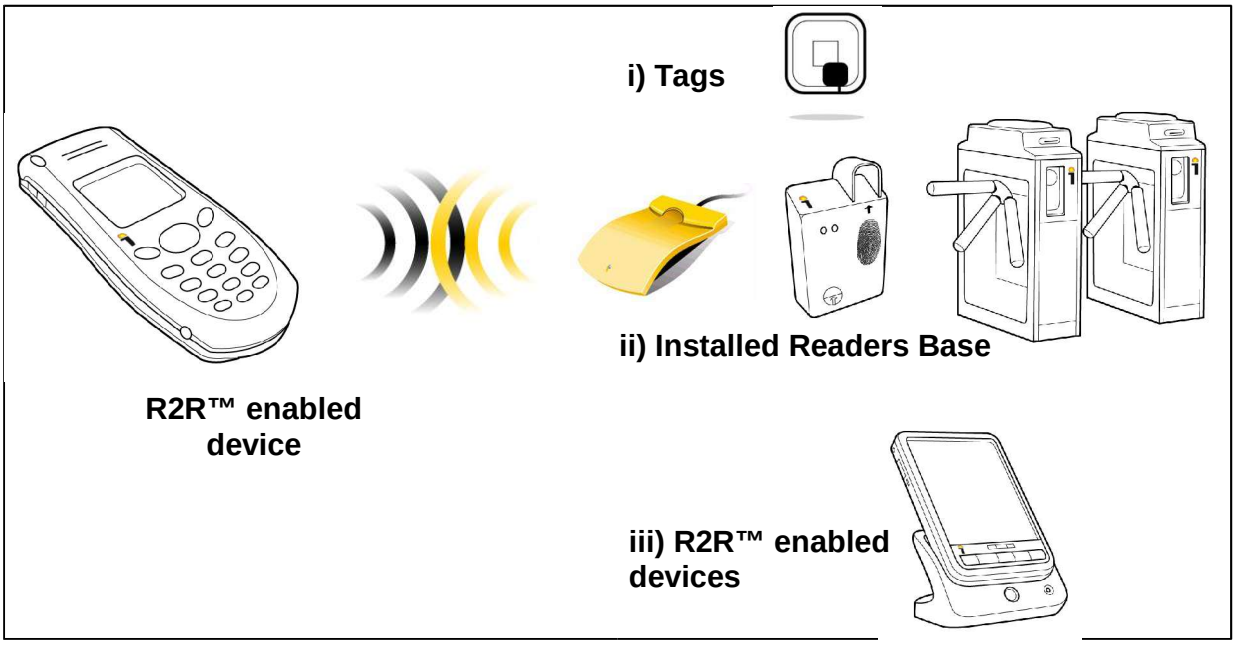
The R2R communication allow a PCD to become a PICC emulator which means to receive command from a standard PCD and send back response like a PICC will do. Thanks to this, it allows a reader to communicate with millions or readers already in place everywhere in the world to exchange data or perform standard smart card transactions.

Moreover, R2R is also capable of communicating with all NFC devices and support ISO 14443 Type A & B, SONY and ISO 15693 protocols which position it as a superset of NFC and a very open platform for all new developments

Functional description

A consumer electronic device (mobile phones or PDA) equipped with INSIDE R2R™ technology becomes both a RF reader and a tag, all in one.

R2R allows data transfer from and to any peer R2R enabled device.



We will use, as an example a mobile phone equipped with R2R™ technology: R2R empowers the end-user with the 3 following functions:

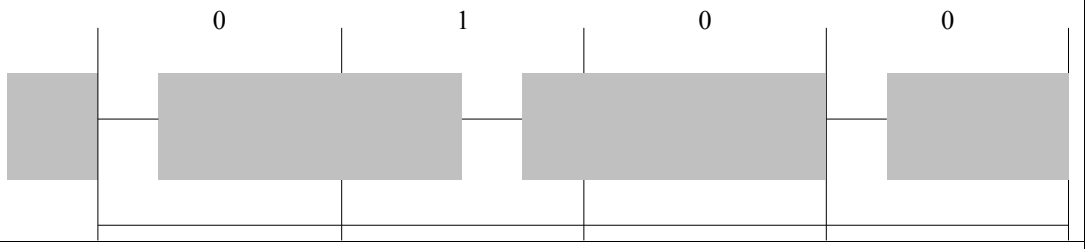
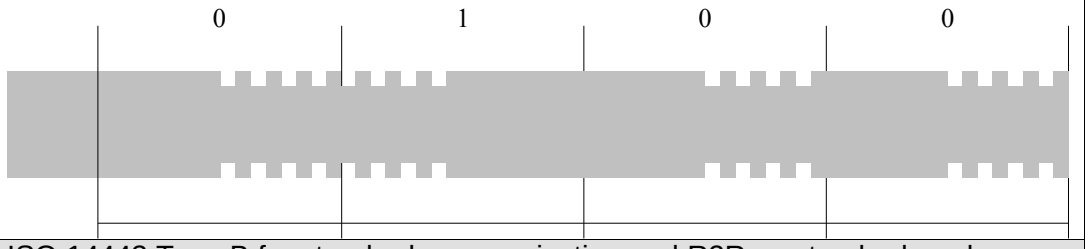
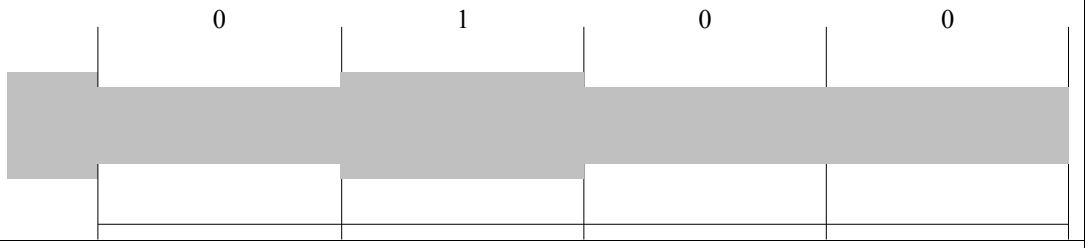
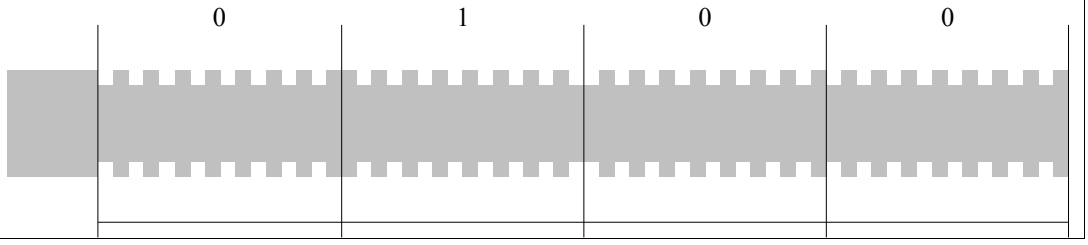
i) R2R enabled mobile phone is a 13,56 MHz universal reader: the end-user can use his mobile phone to read & write any ISO 14443 A/B, Felica™ or ISO 15693 tags.

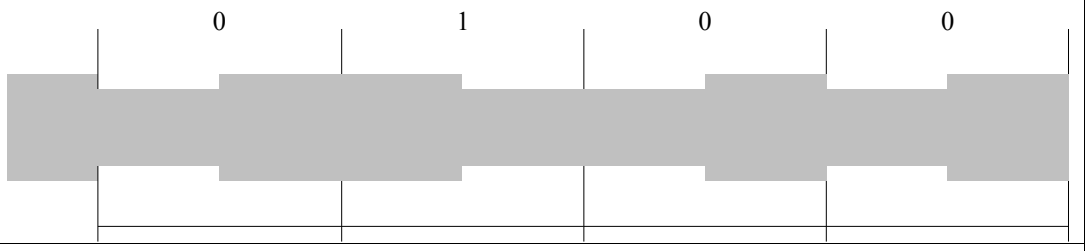
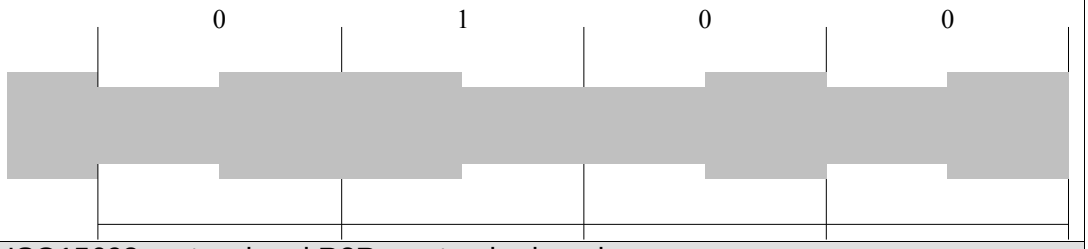
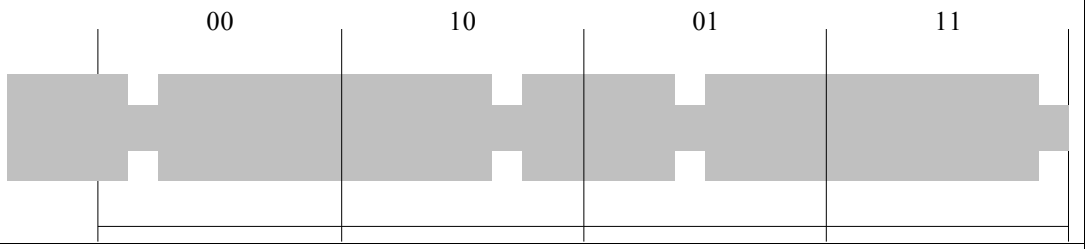
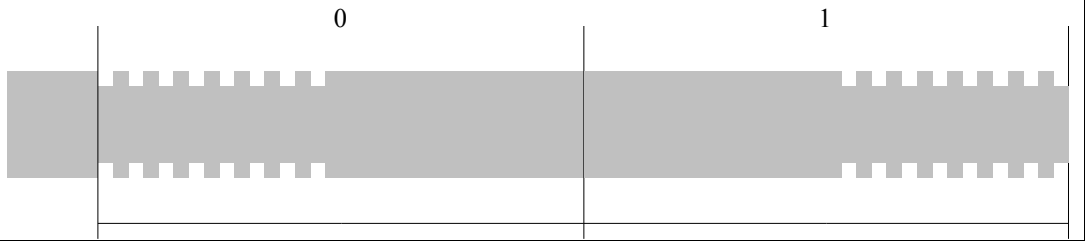
ii) R2R enabled mobile phone behaves exactly as a 13,56 Mhz tag (it can be read & written by any ISO 14443 A/B, Felica™ or ISO 15693 installed reader): as an example, the end-user can use his mobile phone to pass the gate, or pay (cashless payment), etc

iii) R2R enabled mobile device can exchange data with an other R2R enabled device: the end-user can use his mobile phone to exchange very quickly his contact information etc…

Communication

The R2R communication is described in ISO 14443 type A, ISO 14443 type B, ISO 15693 and NFC for the SONY protocol. Moreover, as NFC is compliant to R2R, the NFC specification can be used as a reference for all NFC communication with R2R devices.

	ISO 14443 Type A for standard communication and R2R as standard mode
Reader Modulation **R2R ➔ PICC or NFC**	ASK 100% Miller modified 106 kbits/s 
Card modulation **R2R ➔ PCD or NFC**	OOK-Manchester Load modulation 847 KHz sub-carrier 106 kbits/s 
	ISO 14443 Type B for standard communication and R2R as standard mode
Reader Modulation **R2R ➔ PICC or NFC**	ASK 10% NRZ 106 kbits/s 
Card modulation **R2R ➔ PCD or NFC**	BPSK-NRZ Load modulation 847 KHz sub-carrier 106 kbits/s 

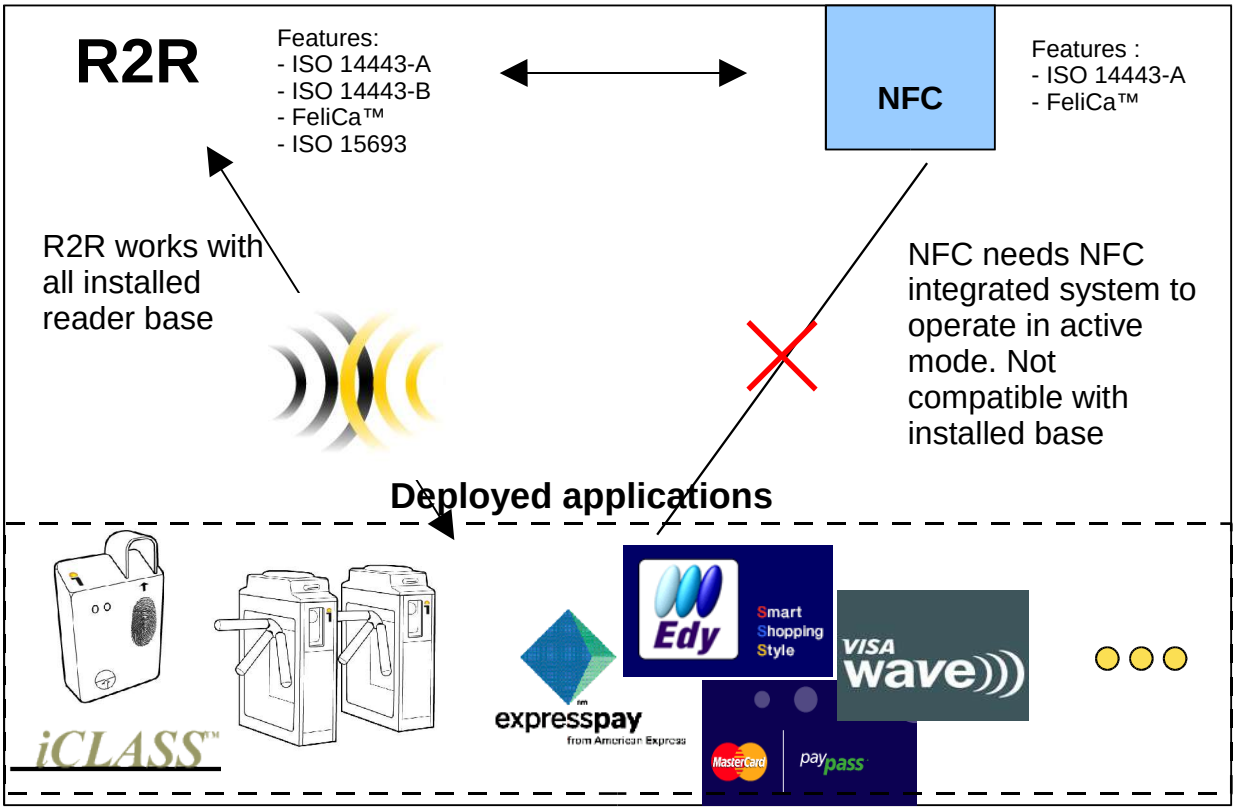
	SONY protocol and R2R as standard mode
Reader Modulation **R2R ➔ PICC or NFC**	ASK 10% Manchester 212 kbits/s 
Card modulation **R2R ➔ PCD or NFC**	OOK-Manchester Load modulation No sub-carrier 212 kbits/s 
	ISO15693 protocol and R2R as standard mode
Reader Modulation **R2R ➔ PICC or NFC**	ASK 10-30% or 100% 1 out of 4 coding 26 kbits/s 
Card modulation **R2R ➔ PCD or NFC**	OOK-Manchester Load modulation 424 KHz sub-carrier 26 kbits/s 

Moreover, R2R as a special mode (boost mode) which allow getting higher distances when necessary. For example when R2R is used in harsh environment such as metallic environment, this special mode can be very useful. This mode is also compatible with standard PCD or NFC devices.

R2R benefits

Over NFC, R2R as many advantages such as:

- Management of all protocols including ISO 14443 type A&B, SONY and ISO 15693 with management of higher baud rates up to 847Kbits/s
- Communication with all existing installed based reader in all applications such as payment and access control
- Complete PICC emulation to avoid new development on the already installed reader base
- Long range management if the user decide to use it with ISO 15693.
- Booster mode to double the communication distance for metallic environment or simply extend the communication range
- Fully open solution



Patents

Inside's patent on R2R technology defines how a PCD can emulate a PICC allowing it to communicate with standard contactless PCD.

Convergence of R2R and NFC ?

As seen before, R2R remove the limitation of NFC and extend its capabilities thanks to new functions. This makes R2R the new open reference in this market.

As a strong believer in this market, Inside is willing to participate in the NFC forum and will be glad to have R2R added in complement to NFC.
However, if not possible, both technologies will continue to exist and we strongly believe that R2R will become the reference anyway as it already includes NFC and all ISO communication protocols.

As R2R communication is compliant with NFC this give us a step ahead our product line.

5. INSIDE Product offer

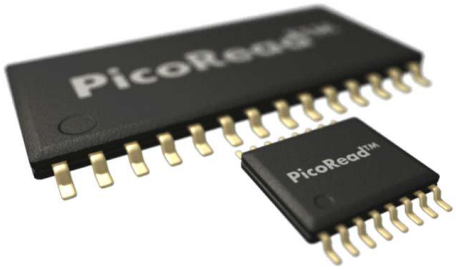
PicoRead Chipset is INSIDE answer to the fast growing demand for RF 13,56Mhz interface in large scale applications such as Transport, Access Control, Secure Identity or Electronic Payment. PicoRead was specifically designed to address the needs of OEMs in consumer electronics and equipments

Product development behind this technology as been targeted to focus on 3 main points:

> Very low power consumption below 20mA with RF field activated and management of standby modes to save battery energy.
> Very small footprint for integration in consumer devices such as mobiles phones or games
> Versatility thanks to management of all protocols management including smart card, R2R & NFC + different host and antenna connections for a very optimized product

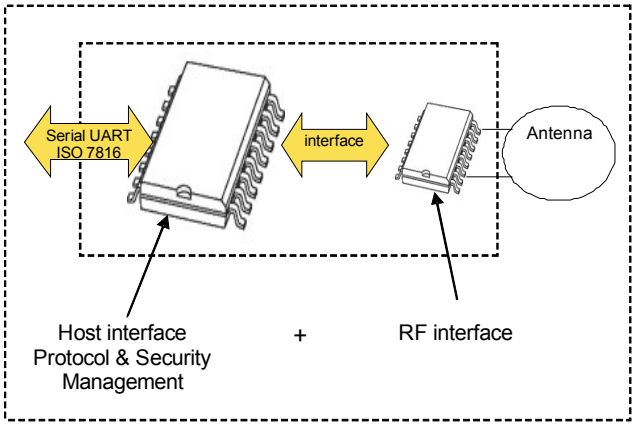
From these points is PicoRead chipset has been designed:

PicoRead Chipset:



This chipset is composed of 2 chips :

> Host interface
> RF interface



Host interface :

- Serial UART/ISO7816 interface with host with T=0 protocol
- High level function interface for easy integration
- Manage contactless protocols (T=CL, Proprietary)
- Anticollision management
- Cryptographic management
- Code download capabilities to upload applications or fast transactions
- QFN28 or TSSOP14 package

RF interface :

- Operating range up to 10cm
- Compliant with ISO 14443 Type A&B, SONY and ISO 15693
- R2R support with NFC compliance
- Support for higher baud rates 212K..847Kbits/s to allow very fast transactions
- Manage frame format including SOF, EOF, CRC, Parity
- 3.3V and 5V power supply operation
- Single or differential antenna connection for low/high RF power
- Power saving modes for ultra low power
- TSSOP16 package

Product Comparison with other reader chips

As NFC doesn't exist yet as a chipset or a single component, this comparison has only been done with existing chips on the market.

	INSIDE PicoRead	**PHILIPS RC531**	**TI RI-R6C**	**INFINEON SL9000**	**PicoRead advantage**
Voltage	3.3V or 5V	5V	3-5V	5V	Comply with low or higher power
Consumption	20mA min 100mA max	> 200 mA	140mA	5mA without RF	Low power consumption => longer battery live
Stand-by mode	10uA	6mA	50uA	No	Allow to save batteries in stand-by mode
External components	8	11	14	>50	Smaller space used on reader PCB
Interface	Serial UART	Parallel/SPI	SPI	Parallel	Easier to integrate
Package	TSSOP16 + QFN28	SO32	SSOP20	PLCC44	Smallest solution => Smaller readers
Baud Rates	106k – 847k	106k – 424k	26k & 106k	106k	Higher baud rates available for all protocols
Protocols	ISO 14443 A&B, SONY, ISO 15693	ISO 14443 A & B	ISO 15693	ISO 14443 B	Multi-Standard protocols
R2R™	Yes	No	No	No	Allow R2R communication
NFC	Yes	No	No	No	Compliant with future NFC
Card detection	Yes	No	No	No	Lower power comsumption

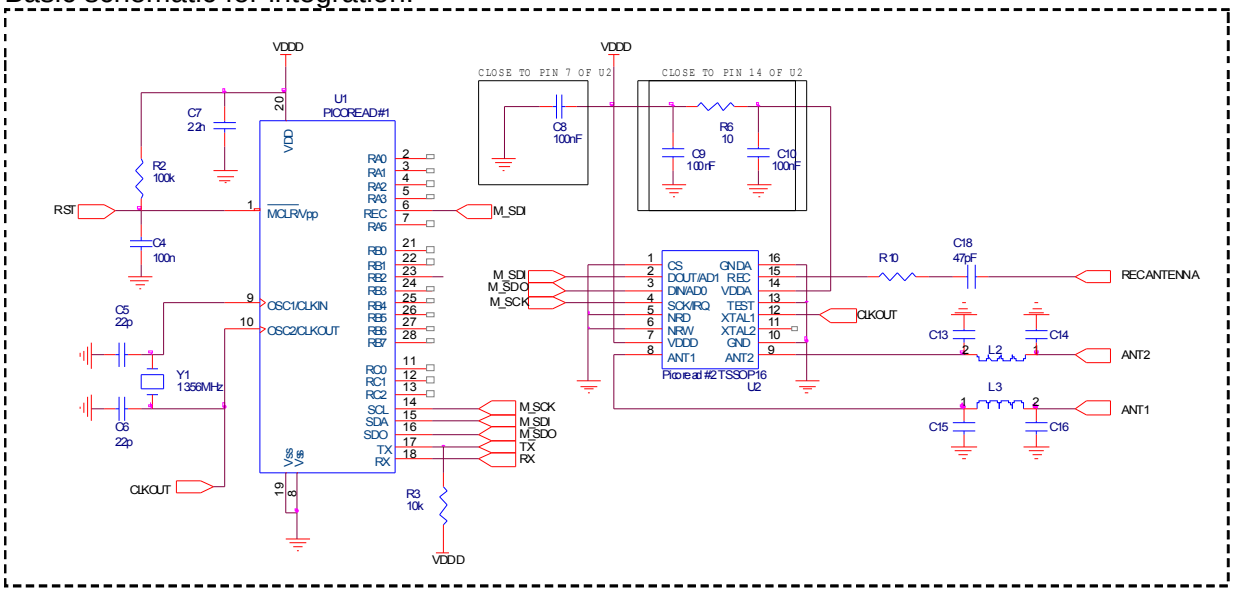
MicroRead™: Available later in 2005, MicroRead will offer in a single chip all the benefits of PicoRead.

6. Integration of R2R technology

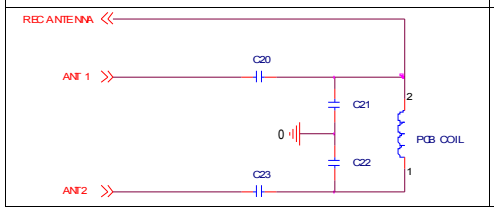
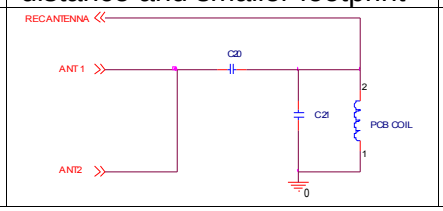
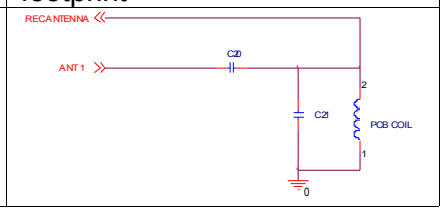
Ease of integration:

One of the main focus was to ease the integration of contactless technology in order simplify the customer action even if he doesn't have any knowledge about contactless technology. This basic idea is in the line with INSIDE Contactless policy for all our products.

Basic schematic for integration:



With some very simple antenna connection depending on targeted communication distance and available power supply :

Differential antenna for better distance but higher power	Double single ended antenna for good communication distance and smaller footprint	Single ended antenna for smaller power and smaller footprint
		

Integration within a mobile phone

R2R provides the possibility of a natural convergence between a billion + mobile phones, and an already large, and fast growing RF 13,56MHZ infrastructure (Transit, Payment – Sony Edy™, Mastercard PayPass™, Visa Wave™, AMEX ExpressPay™, Dexit™ , HID IClass™ as a few examples)

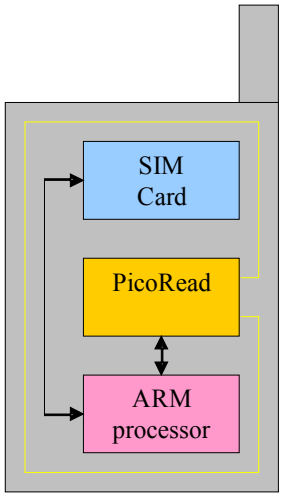
The mobile phone is the best platform for integration of R2R technology with PicoRead or MicroRead because it already got :

- Communication channels for a direct link to secured servers
- A powerful processor which can handle communications with contactless devices
- A SIM module to handle security
- A powerful Graphical User interface including a display and a keyboard

There are 3 different way of integrating contactless technology in mobile phones depending on customer strategy and who want to control this new market. The 3 options below are done for the case of payment application using a mobile phone.

Option 1 : PicoRead integration

This option is mainly done to add the contactless function to the mobile phone in order to manage the contactless interface using the existing main processor (ARM) already embedded in the mobile phone. The SIM card is used to manage the security for the payment application



Roles of players

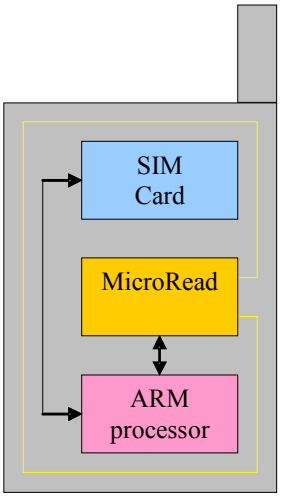
Mobile operator	Partner with banks to get the payment application available beside the SIM card phone functions. Does banks will deal with operators knowing that operator can become the bank itself ?
Mobile manufacturer	Integrate PicoRead and the antenna in the mobile phone and give access to it through application which is in the ARM processor
Smart card manufacturer	Provide the SIM card having the payment security integrated in it

The communication with a contactless reader or with a card is fully managed by the mobile phone processor which can communicate with the SIM module for security calculations. This option is the easiest and fastest to integrate but some problems need to be solved:

- SIM card are slow today
- Banks and operator need to find agreement which is not easy

Option 2 : MicroRead integration

This option allows separating the contactless applications with the SIM functions to avoid the un-resolved multi-application management in the SIM card. MicroRead is then a second independent contactless interface and security manager for contactless applications.



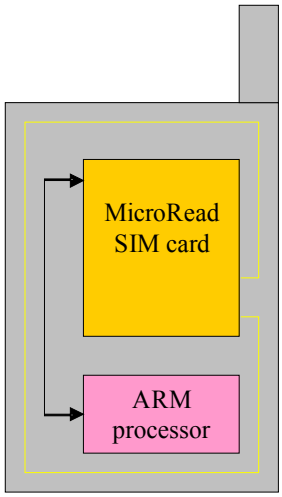
Roles of players

Mobile operator	Still use the SIM card for phone operation but can also use MicroRead to handle contactless applications.
Mobile manufacturer	Integrate MicroRead and the antenna in the mobile phone and give access to it through application which is in the ARM processor
Smart card manufacturer	Provide the SIM card having the payment security integrated in it or work with operator or Mobile manufacturer to load applications in MicroRead

In this case, MicroRead can be used by 3 parties depending on their business model and relations with other parties to manage contactless applications independently from SIM card.

Option 3 : Replacement of the SIM card with MicroRead SIM

If multi-application is possible between banks and phone operators, the SIM card can be replaced by MicroRead SIM having a contact interface for standard SIM functions and to receive contactless command + a contactless interface for reader (R2R) or card (PICC) communication.



Roles of players

Mobile operator	Use **MicroRead SIM** to handle SIM phone functions and contactless applications.
Mobile manufacturer	Only integrate an **antenna** in the mobile phone connected to the C4 and C8 contact of the SIM slot
Smart card manufacturer	Provide the **MicroRead SIM** with all applications in it

Again, the main problem of this solution is to allow management of multi-application in the same device, so does banks and operators will partner together ?

7. Applications with R2R technology

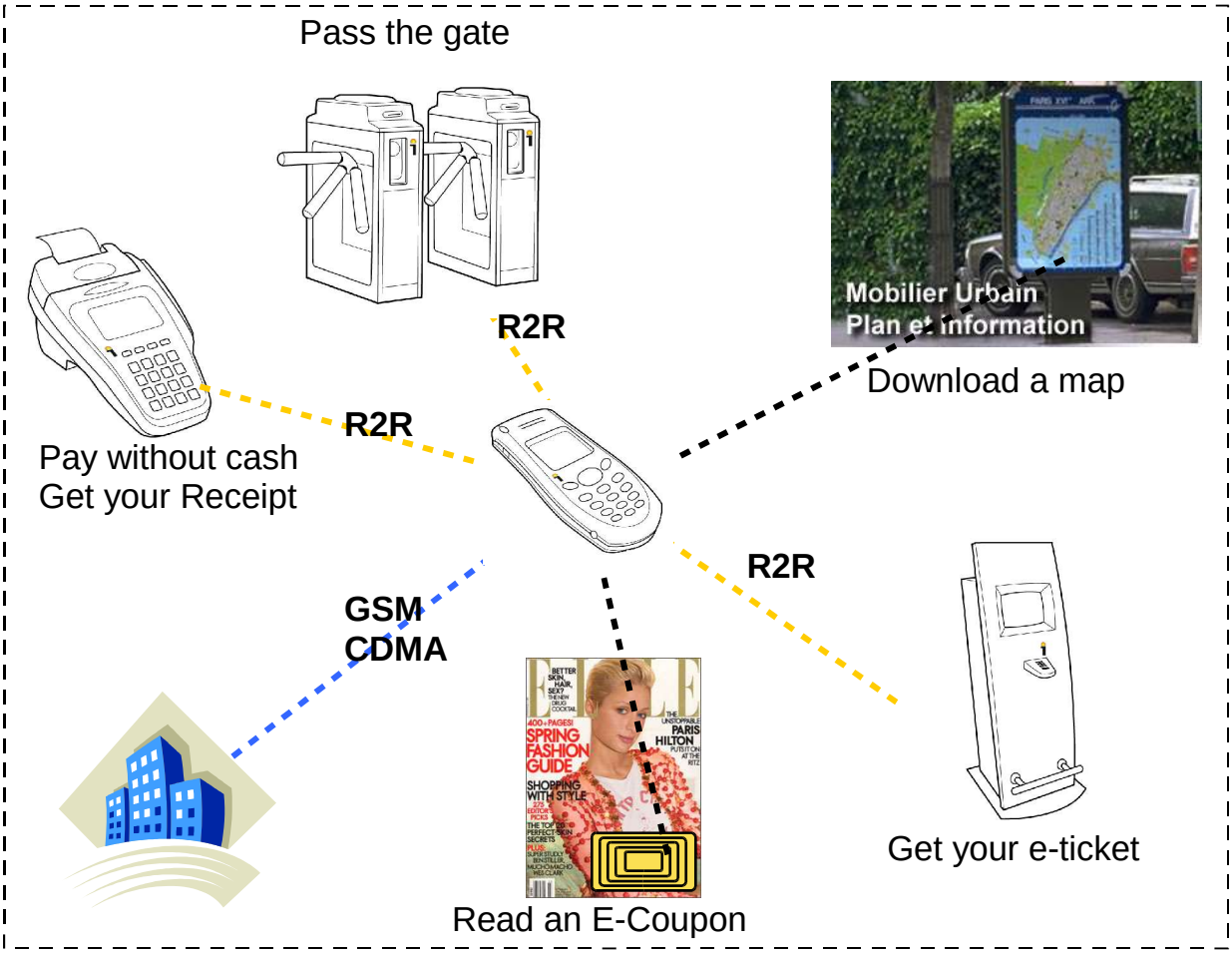
Applications Convergence

A major success factor of the Contactless IC chip technology is the convenience for the user, while offering the same level of security which has made the success of the Contact IC chips.

On the other hand, consumer electronic devices, such as handsets and PDAs, offer to end-users the most convenient and most powerful “media” for carrying credentials.

Built in a PDA or in a mobile phone, R2R allows the end-user to hand carry both a Contactless tag/card and a Contactless reader, with the comfort offered by an integrated keyboard, screen and all other features available on such consumer electronic devices.

Thanks to this technology some can think about linking applications with dynamic loading of applications in a mobile phone:



In this multi-application view, the process can be :

Travelling :

- Check a map and load it into the phone thanks to a tag included in the town map which can be found on a street
- Choose your destination, enter the subway and get a e-ticket
- Use your phone as a card to pass the gate in a subway

Shopping :

- Load the payment application from a server through standard mobile phone communication and SMS
- Read a e-coupon (contactless tag) on a magazine to get some discount
- Go shopping and use the mobile phone to pay using e-purse application. Cash status can be displayed on the mobile phone

This new technology will push the all in one concept even further...

Contactless Maintenance Device

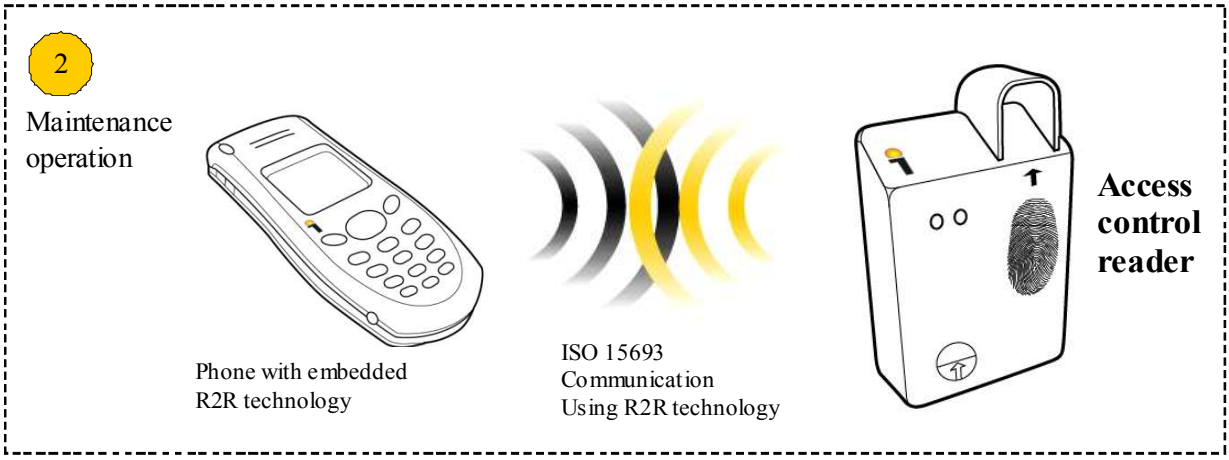
The R2R function can be very useful also for the transfer of a large amount of data which cannot fit in a “traditional” contactless card.

As an example, let’s use the case of access control or alarm systems which are massively migrating to 13.56MHz RF technology (HID iClass™ as an example). Control panel of such systems are not physically accessible for obvious security reasons and configuration parameters or black list download need to be done thanks to a cable.
In replacement of contactless cards which today, limit enormously the flexibility of maintenance operations, a maintenance technician could use the R2R function of his portable equipment, to communicate remotely with the control panel, for upgrading the blacklists, changing the reader behavior or retrieving the events log file from the system.

This application is already in place today with readers from ADEMCO (Honeywell) using a PDA with built in R2R technology to configure the access control reader such as LED behavior, Buzzer update or application download through the 13.56Mhz communication. Security between the 2 devices can be programmed to use a 3DES or only a simple PIN code.

Standard access control reader using ISO 15693 communication with a smart card:

Maintenance process where the mobile device is used to send new parameters to the access control reader:



How it is working ?

The Access control contactless reader is designed to recognize a R2R reader thanks to a special serial number, and according to the correct detection of this number to enter in a communication with the mobile device. Once both readers identified together, the mobile device can ask the reader to setup new parameters or download all the access done during the week. Thanks to this, no physical connection is required which is safer and more reliable for the reader supplier and more convenient for the administrator.

Same concept has been used in year 2000 with vending machines to allow the maintenance operator to download all the transaction done during the week and to set-up new pricing. This technology allowed the operator to avoid an expensive connection to a central database and thanks to the contactless communication through the vending machine housing to avoid vandalism which was done before on the connector to make the same maintenance operation.

8. Who are the beneficiaries of R2R™?

End-users:

R2R technology empowers end-users consumer devices (Handsets and PDA) with RF 13.56 MHz applications, already deployed or still to come.

- Transit ticket.
- Cashless payment
- Residential access control

etc..

They benefit from the best of two worlds:

- A single, multi-functional, networked, user friendly device (their handset)
- Convenience and speed of the 13.56 MHz RF technology

Application Providers: Financial institutions, Mass Transit Operators:

- Consumer devices such as handsets, open new field of opportunities to the application providers for issuing their application credential. In replacement of the traditional and expensive Card Fulfilment and Card Issuance methods, they can benefit from the complete applet download platforms offered by Mobile Telecom Operators infrastructure, and Handsets operating systems

- R2R™ answers to the multi–applications card barrier: smart card industry was never able to deliver the promise of a single multi-purpose card, which would have lighten consumer's wallet. The recurrent problems of the ownership of the card, and the cost sharing of the card between application providers have always been a barrier.
  Thanks to R2R™ technology, this is the end-user who provides his own "media" (his handset) for carrying the applications he wants.

- Applications can be download dynamically in the mobile phone to assure service on demand

Consumer devices (Hand sets and PDAs) manufacturers:

Always thriving for differentiations, added value, and new-functions, R2R provide manufacturers with the access to a fast growing market:

R2R being compatible with the existing 13.56 RF installed readers, handset manufacturers can now and here offer to their customers the benefits of the existing 13.56 RF installed readers base applications (Mass transit, Cashless, etc)

Thanks to R2R, manufacturer can avoid having a new SIM module to allow new applications with their phone which can make them think about new business models.

9. References

Writing of this document is based on existing standard documents either ordered from ISO standard or taken on internet when it was freely available. So they are :

- ISO 14443 standard Part 2,3,4
- ISO 15693 standard
- ECMA-340.pdf found on ECMA web site :
  http://www.ecma-international.org/publications/standards/Ecma-340.htm
- ECMA-352.pdf found on ECMA web site (December 2003).
- Datasheets and flyers of competitor products when available
- Eurosmart TB6 whitepapers explaining contactless technology where INSIDE Contactless participated in 2002
- DoCoMo information :
  http://www.nttdocomo.com/