



NOKIA

White Paper Near Field Communication

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About Near Field Communication

Near Field Communication (NFC) offers tremendous potential, not only because it can be rolled out for mass adoption, but because of the number of different ways in which it can be used to make life easier.

This document provides background on NFC including an explanation of what the technology can achieve, how it works and where it could be used.

It also highlights Nokia's role in NFC and the company's support for its mass adoption as well as outlining how a number of companies, including Nokia, are working together to create the right environment to allow NFC to become a commercial success.

What is Near Field Communication (NFC)?

NFC is a short range wireless technology that allows communications to take place between devices that either touch or are momentarily held close together.

The technology works via magnetic field induction and operates on an unlicensed radio frequency band. "Tags" are embedded within devices (these could be mobile devices such as mobile phones or PDAs, or NFC stations such as ticket barriers or cash registers). NFC enables devices that are held together to share information either in one direction or both.

NFC is based on Radio Frequency Identification (RFID) technology, which is compatible with most of the contactless transportation and ticketing solutions that are commonly used around the world to enable quick and smooth flow of people within public transportation systems or ticketed environments. NFC is an open platform technology and was approved as an ISO/IEC global standard in December 2003.

Why is NFC important?

NFC is an important technology for a number of reasons:

1. Reach and availability: NFC has the potential over time to be integrated into every mobile handset in the world. This would give the technology a potential reach as global as the mobile phone itself. By integrating NFC technology into a mobile handset, users could gain access to a number of new services via their phone.

2. Variety of use: NFC can be used for a number of tasks, from payment for goods to ticketing and from pairing devices to sharing information or discovering new services. Examples of these applications are outlined in this document.

3. Ease of use: Because NFC only requires that two devices touch in order to communicate, NFC can simplify many tasks, from opening a web browser on a mobile phone to pairing two Bluetooth devices automatically to accessing wireless hotspots simply and easily.

4. Security: NFC requires a user to actively wave or hold their mobile device against another device or NFC station to activate a service or to share information. In so doing, the technology requires the user to make a positive action to confirm the transaction or exchange. In addition it is possible to build multiple levels of security into an NFC enabled device.

5. Value added services: NFC enables users to access value added services that would otherwise be unavailable with a traditional ticket or payment card. Just as users of prepay mobile services are able to access their current credit balance through the phone's menu system, so users of an NFC enabled phone will be able to access similar information through their device. Furthermore, NFC enabled devices could access the mobile network to add credit to the device when it runs out or is low, or alternatively on a set date each week or month.

6. Infrastructure: NFC is compatible with the current contactless infrastructure used as a platform for ticketing, transportation, and increasingly payment, across the world. NFC mobile devices could easily be made compatible with the major transport systems world-wide that use contactless access to services, for example those based on the MIFARE system. It is also compatible with the increasingly popular "wave to pay" credit and debit cards that are being rolled out in many countries. The roll out of NFC to existing contactless environments is straight forward. Users know how the system works and much of the infrastructure is in place already. The roll out of NFC is an extension to services that already exist, but enhanced with the additional element of a mobile phone's user interface and a connection to the internet.

Nokia's role in NFC

Nokia recognises that its investment in research and development is one of its key success factors. The company is committed to the development of new and compelling technologies that allow the transformation and growth of the converging internet and communications industries.

As the world's largest manufacturer of mobile phones, Nokia's DNA is intrinsically connected to the simple usability of its devices. Nokia has a key interest in NFC as a technology that can add functionality and value, through the mobile handset, to people's lives.

The company also recognises that in order to succeed, NFC will require the partnership of a number of different players to create an infrastructure within which NFC can flourish. Key partnerships will need to include payment bodies, banks, mobile operators, SIM card manufacturers, system integrators, the developer community etc. All of these parties have a role to play in making NFC a commercial success. All these key stakeholders will need to collaborate closely. Nokia has been helping to create these partnerships, leveraging existing relationships and building new ones to support the right environment for NFC to succeed.

To this end, Nokia was one of the co-founders of the NFC Forum in 2004. The Forum is a non-profit making industry association that promotes NFC technology. Today the Forum has more than 140 members. More information about the NFC Forum can be found at www.nfc-forum.org

Applications of NFC

NFC can be used in a number of ways. Some of the most compelling applications are outlined below.

Ticketing and Payment



Many major cities around the world use contactless payment systems within the transport infrastructure. These systems rely on Radio Frequency Identification (RFID) smart cards to provide access to transport services and tenable quick and convenient payment.

Typically, a user purchases a plastic card with a certain monetary value embedded on a chip within the card. As the user accesses the public transport system, the cost of the ticket is taken from the card, leaving a new card balance. Once the card has no value, the user can either discard it or "top up" the balance by adding more money to the card to enable further journeys.

This approach has great benefits in terms of ease of use and speed of access to transport systems. There is no need for users to purchase a card every day. Access to online top ups and monthly access fees also ensure less queuing at ticketing booths and the need for less staff. Ticket machines do not need to be emptied and single use tickets are not discarded.

Whilst the service works well, the "smart" cards used within the system are not actually that smart. This is where NFC can add value to this existing application.

By replacing a smart card with a NFC enabled mobile device, users can access all of the services they have with a smart card, with the added functionality of a user interface providing additional

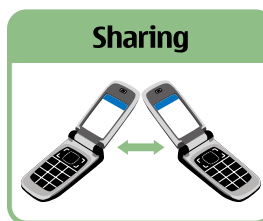
information (for example their current balance or the number of journeys left), as well as access via the mobile network to online top up facilities at the touch of a button. The phone could also use current mobile network technology to access the latest traffic information (such as when trains are delayed or cancelled) or mapping information.

Users of an NFC enabled mobile device are not necessarily limited to topping up a card. It is possible to add a credit card element to an NFC device, enabling the user to "wave to pay" at any compatible station or retail outlet.

It is also possible to add multiple separate credit or debit cards to an NFC mobile device. In this scenario, the mobile device becomes a "virtual wallet", carrying a number of different cards, some credit, some debit, some loyalty, within the device. Ultimately, the NFC mobile device could replace the need for a user to carry a wallet at all – providing a central facility for former cash transactions, debit card purchases and credit card facilities – all from one mobile device.

Because of the ubiquity of the mobile phone – no one leaves home without it – the user does not have to remember another card, or a wallet or a loyalty card. All of this information could be contained within the mobile device.

Touch to pair/Touch to share



A further application of NFC takes advantage of the data sharing capability to enable the simple and seamless transfer of data from one device to another, simply by touching the devices together.

A number of activities associated with the transfer of data between devices require some degree of user interaction to set up. For example, many Bluetooth devices require a "pairing" process to take place before the devices can be used together. Whilst this is relatively straight forward, the functionality may not be immediately accessible within the menu system and the pairing process can be an inhibitor to using the technology.

The most up to date core specification for the Bluetooth standard includes the capability to pair devices via NFC. Simply put, the whole process of activating Bluetooth on both sides, searching, waiting, pairing and authorisation on both sides can be replaced by touching the two devices together. This provides the user with a simple and engaging way to link Bluetooth enabled devices.

In a similar manner, users of NFC could "touch to access" a wireless LAN hotspot. Instead of the lengthy process of searching for a hotspot, accessing it and paying for use, a user could simply touch an NFC compatible wireless LAN point and the whole process could be automated, including the payment of any cost from the "virtual wallet" on the device.

As the mobile device increasingly becomes the home for digital content, so the ability to easily share this content will become more compelling.

NFC can enable an environment where people can touch devices to share business cards, touch to download their photographs to a printer, or touch to share their music with a friend.

Furthermore, the NFC enabled mobile device could be used to receive information or a promotion from an advertisement. By embedding an NFC chip within a billboard advertisement or beside a product on the shelf of a retail store, users could touch to receive additional information. For example, an advertisement for a new record could allow users to touch to receive the track listings, download a free ringtone, or access the artist's mobile internet site. The NFC technology has the potential to significantly impact the marketing and promotions industry, since by touching to receive information the user is proactively taking an interest in a product or service. By sharing information both ways, the marketer can offer users an incentive in exchange for information or interest in a product or service.

Identity Management/Business Processes

Almost every office or factory based worker is required to carry an identity tag to access working premises. As businesses become more complex and global in nature, many workers require access to multiple premises.

Managing this process can be complicated, even more so in environments where there are different levels of security for different workers.

NFC can allow identity management to be added to a mobile device, providing one single integrated solution for identity

management. The mobile device can be used to provide access to certain premises and, of course, deny access to others. Importantly, access can be upgraded over the mobile or wireless network, meaning workers are not required to physically visit a site to change their user profile.

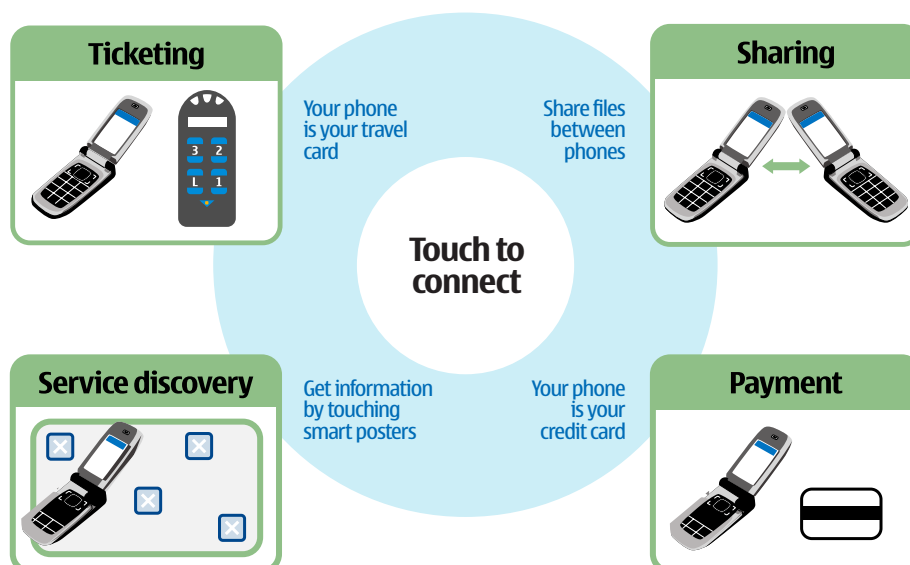
A further related application would be relevant anywhere that people are required to perform multiple tasks within a busy organisation. For example, a care worker that makes a number of home visits during a working day may "touch to inform" that a particular visit has been completed. The worker can then be assigned a new task based on what is most urgent or where the professional is located at that time.

A security guard could touch on entering and exiting a room, providing a digital footprint of his movements during a patrol. A courier could touch on delivery of a parcel to receive local traffic information and directions to the next collection point.

Further Applications

Many applications of NFC are clearly extensions to current solutions. Contactless payment and ticketing solutions are widely available across the world and, crucially, are compatible with NFC. Extending these applications to a suitably equipped mobile device will be the first steps on the road to NFC.

However, to limit the technology to current scenarios is both unrealistic and unimaginative. More likely is that a number of applications will develop as the technology is rolled out. As more people use NFC and it becomes more ubiquitous, so further applications will be generated. To achieve this, an environment needs to be created within which NFC can succeed.



What is required for NFC to succeed?

Key Factors for the success of NFC

The success of NFC depends upon the creation of a complex yet interoperable environment, supported by a number of different parties.

First, there needs to be mobile devices that support the system. This relies on mobile handset manufacturers producing NFC-compatible devices. These will also need to come from different vendors, offering the market choice and differentiation. The first NFC compatible mobile devices are now available on the market.

Mobile network operators will also need to support NFC. Access to additional data services, and the potential revenues that these could bring through the mobile network, is a critical value add of NFC and the support of the mobile operator community is required to facilitate this.

Banks and credit card companies, along with transport operators will also need to engage with NFC. Delivering a required high level of perceived and real security will be essential to the success of NFC and the banks and credit companies have a critical role to play, ensuring the roll out of payment services to NFC devices.

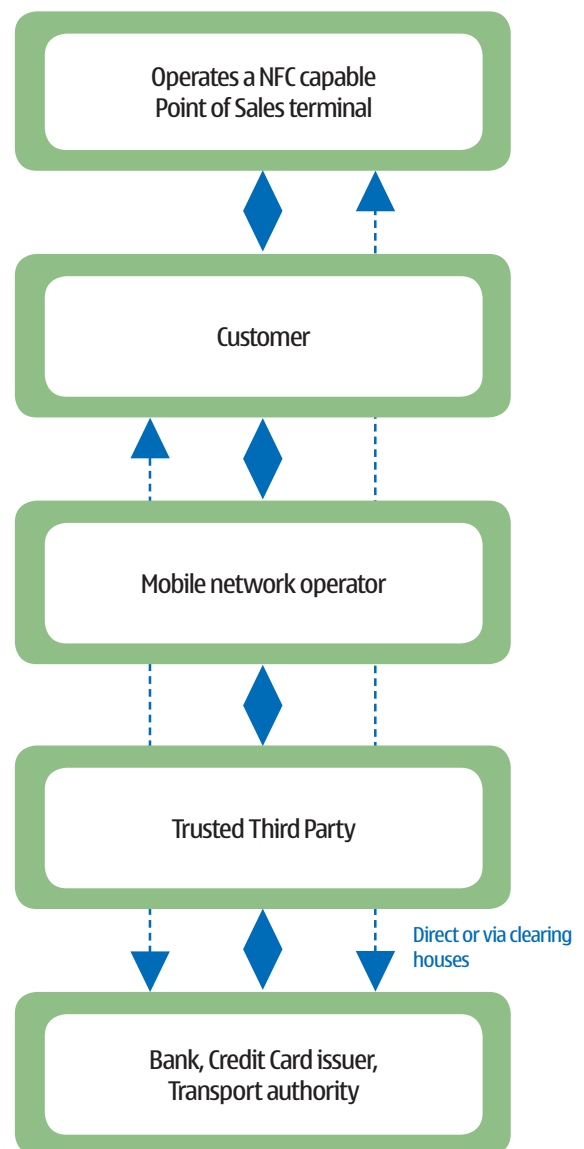
Retailers, from shops to restaurants, and from newsagents to coffee shops will need to support and enhance their current offerings with an NFC element.

In much the same way as the development of chip and PIN solutions led to the roll out of new hardware in retail, so the development of NFC will facilitate new retail hardware. Retailers will require "touch pads" to facilitate "wave to pay/touch to pay" solutions.

Whilst this may seem like a significant investment for retailers, many are already rolling out NFC compatible technology to support payment through transportation cards or the new generation of "wave to pay" credit and debit cards. NFC is an extension of this technology, compatible with the current standards and offering customers further choices as to how to pay.

Of course, the roll out of NFC technology within retail is likely to take place over time. Retailers near public transport stations may be early adopters of the technology to provide a service to their customers that are already using contactless solutions for transport. As mass adoption takes place, with increasing numbers of devices commercially available, the roll out of NFC to retail outlets will become ubiquitous.

Finally, the developer community is also critically important to the development of NFC. An active developer community



Adapted from GSMA 2007

with the right tools in place to quickly and effectively bring new solutions to market can add impetus to the technology and offer easily accessible NFC applications to end users.

Security

Security is a critical requirement for NFC payment and ticketing and as such, it is important to understand the security within an NFC enabled environment.

Mobile phones tend to come equipped with pass code that can be activated by the user. Whilst many users activate these to secure their phone, an NFC enabled mobile device, especially one that could incorporate a number of credit and debit cards, needs to have a higher level of security to reassure the user against misuse.

Inherently, NFC technology is built with a high level of security. Users can activate several options in order to store their data in a secure environment.

A user can set a financial limit beyond which a pass code is required to authorise payment, or a user can also arrange for the mobile wallet element of the phone to be switched on for only, say two minutes at a time. This allows the user to make a purchase and then be sure the device is deactivated shortly afterwards. By transferring cash from one element of the device to another (ie from a credit card application to a "cash in wallet" type application), a user would also be able to limit the amount of risk associated with losing a phone to a relatively small amount. Further credit card and/or debit card applications could be activated only with a user pass code.

Beyond user created and user defined security measures, there is an extremely high level of security built into an NFC wallet or payment application.

An NFC enabled credit/debit card or ticketing application is held within a secure element of the mobile device. Using the same technology as chip and PIN cards, this secure element is certified and supported by the payment industry, providing as high a level of assurance to the end user as a traditional credit card.

The secure element can either be held on a chip within the mobile phone, or on the SIM card or a memory card device. Potentially, there could even be a secure element on both the SIM card and the phone. This would ensure that the right phone and SIM card were used for any transaction, adding a further level of security.

Finally, unlike a lost wallet, a mobile phone regularly communicates with the mobile network to enable it to function. At any given point, the mobile network will know where a phone is with a degree of accuracy. What is more, a phone can be disabled over the air within moments, moving the whole credit card to a new device.

Added together, these measures provide a far more comprehensive level of security than is available with most credit or debit cards (including the current generation of contactless payment and transport cards) that might sit in a wallet or home. The measure of confidence provided by these security elements is evident by the interest and involvement of industry standards like VISA and Mastercard in NFC.

Nokia's role in NFC

Nokia has a key role to play in the development of NFC for a number of reasons.

- 1.** Nokia is the world's largest mobile handset manufacturer. As such, it has a critical role to play in the development of NFC. For the technology to become mainstream, the number of devices supporting NFC will need to be measured in the hundreds of millions. Because of Nokia's position in the global mobile handset market, it is uniquely positioned to play a significant part in enabling this.
- 2.** Many of the key players in creating an NFC environment are companies that Nokia has a relationship with through its current businesses. For example, Nokia has a close relationship with mobile network operators across the world and this partnership will be critical to ensure the success of NFC. Furthermore, Nokia regularly partners with SIM card providers, chip manufacturers, applications developers and industry bodies such as the GSM Association, all of whom have an important role to play in the development of NFC.
- 3.** Where Nokia believes that additional support and resource is required to enable NFC, it has been prepared to launch new partnerships and investments. In June 2006, Nokia partnered with Giesecke and Devrient to establish Venyon. This new company operates a secure and versatile service platform to deliver consumer applications such as credit and debit cards or transport tickets over the air. Recognising the need to provide this solution, Nokia moved quickly to launch Venyon with another key partner in the NFC Forum.
- 4.** Nokia has a strong and active developer community via its Forum Nokia. This community is provided with key software tools with which to develop new and compelling applications for Nokia devices. Having launched the Nokia 6131 NFC phone in 2007, Nokia has provided the developer community with a Software Development Kit to enable the rapid creation of new NFC applications or to extend existing applications to benefit from NFC. Furthermore, value-added services are available within the community including NFC discussion forums and wiki sites.
- 5.** In 2004, Nokia was one of the founding members of the NFC Forum, an industry association that support the use of NFC wireless solutions. The NFC Forum now has more than 140 members world wide.

About Nokia

Nokia is the world leader in mobility, driving the transformation and growth of the converging Internet and communications industries. Nokia makes a wide range of mobile devices and provides people with experiences in music, navigation, video, television, imaging, games and business mobility through these devices. Nokia also provides equipment, solutions and services for communications networks.

NFC Devices

Nokia has led the global development of NFC devices. In May 2005, Nokia started marketing an NFC shell for mobile phones. When users added this NFC shell to the Nokia 3220, they were able to access a host of services on their mobile phone simply by touching the shell to an NFC tag. This would create a shortcut access to browser based or text messaging services. Instead of having to compose a text message or browse to a particular site, the tag provided direct access to a particular service.

In 2007, Nokia went one step further and launched the Nokia 6131 NFC. This is the first mobile phone with fully integrated NFC technology embedded in it, allowing users to make purchases, use travel tickets and access services easily via NFC technology. The device is widely available and has been used in numerous NFC projects and deployments around the world. Notably in Austria and in China, commercial deployments started as early as Q3 2007. The device is supported by a software development kit (SDK) that enables developers to create Java™ MIDlet applications using NFC features. This SDK is available via [Forum Nokia](#).

The roll out of NFC around the world:

NFC technology has been widely trialled across Europe, Asia and North America, using a number of ticketing and purchasing applications. 2007 has marked the launch of a number of trials and commercial roll outs of NFC using mobile phones.

NFC Trials

- During July, a final pre-launch project in Germany was launched involving the RMV transport network, Nokia and T-Systems. In November 2007 this was converted in commercial service. The project, which is taking place in Frankfurt, Germany, allows users at more than 7000 touch points all over the city to touch to buy transport tickets, receive information on timetables and other services. Previously, users needed to open a payment application and go through many steps in order to buy a ticket through their mobile phone. The addition of NFC technology allows this to take place without the user needing to launch the application, making it quicker and easier to purchase a ticket.

- Meanwhile in Taiwan, Nokia has partnered with Chunghwa Telecom, Visa International and the Chinatrust Commercial Bank to pioneer NFC technology on the mobile phone. Mobile users will be able to use existing Visa PayWave contactless card readers to pay for small value products. At the same time, the trial will allow users to access information through smart posters with NFC technology embedded to obtain special offers and additional information.

- In November 2007, the O2 Wallet trial was announced with O2, Transport for London, Transys, Barclaycard, Visa Europe, AEG and Nokia for the first true pilot of NFC to test consumer demand and behaviour in the UK. The trial of the O2 Wallet paves the way for the mass market use of mobile phones to pay for purchases, access events or even be used as Oyster cards for travel around London, simply by touching the phone to a reader.

Vodafone Germany, RMV, Germany – transport ticketing, loyalty

NFC mobile ticketing described as practical, easy-to-use, comfortable, fast and trouble-free

KPN, JCB, Netherlands – ticketing, payment (Mobile J/Speedy™)

100 users/Nokia 3220 with NFC shell. Users very satisfied with the solution

Cingular, Visa, Chase Bank, Philips Arena, US – payment, service initiation

“You should be able to use it anywhere for anything”
“Why did I wait so long to get a phone like this?”

AT&T (Cingular) Citibank, MasterCard, NYC Subway, US – transport ticketing, payment

88% Would continue using the trial phone if commercially available

Xiamen transportation, China Mobile, China – ticketing

92% Liked NFC Ticketing Concept
100% Would Want to See other Payment Cards in Mobile Phone

NFC Commercial Roll outs

- During July 2007, Nokia announced the commercial launch of NFC payment with its Nokia 6131 NFC phone in selected cities in China. These include Guangzhou, Xiamen, and Beijing where users are able to access the current paywave infrastructure with their mobile phone to purchase shopping in supermarkets, travel tickets and to pay for meals in restaurants. The commercial deployment followed a successful one year trial in 2006 in the city of Xiamen.

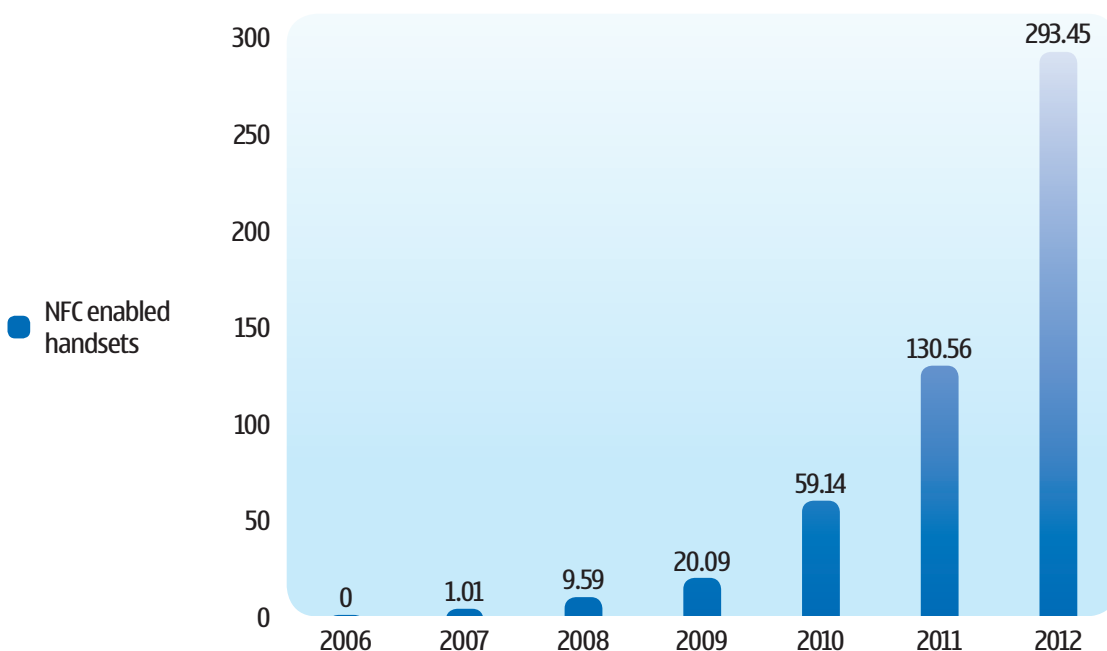
- In September 2007, Mobilkom Austria, as the 1st mobile GSM operator globally, launched the largest and most comprehensive commercial deployment of NFC so far. Partnering with Austria’s federal railway ÖBB and Wiener Linien (Vienna’s public transport provider), Selecta (no1 vending machine provider in Austria) and Nokia the NFC services allows users to purchase transportation tickets, buy convenience goods, pay for their car parking over the air, play lotto, download ring tones and other services via their mobile phones.

Conclusion

Nokia believes that NFC has the potential to be a disruptive technology, changing the way that lives are lived, transforming everyday tasks, making things easier, more intuitive and more effective. NFC wireless communications can be applied in many different ways, some of which are outlined in this document. However, perhaps most exciting of all is the creation of an environment with all the key components for NFC to become a mass adoption technology. From here, any number of applications can be created to sit within the environment.

Nokia will continue to look for ways in which to develop NFC and help to create and sustain the environment necessary for its success. By implementing the technology within its handset portfolio, playing an active role in the NFC Forum, creating new initiatives such as Venyon and using its existing partnerships to promote and support NFC, Nokia plans to be a key partner in NFC’s future success.

ABI research 2007*: NFC-Enabled Handset Shipments (millions)



If you wish to find out more about Nokia and NFC, please visit www.nokia.com/nfc

*Near Field Communication (NFC) Leveraging Contactless for Mobile Payments, Content, and Access, ABI research 2007