Panasonic

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WHITE PAPER VERSION 1.0

SMARTPHONE TECHNOLOGY AND APPLICATIONS DRIVING NEAR FIELD COMMUNICATIONS (NFC)

OCTOBER 2015

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INTRODUCTION

Near Field Communication (NFC) refers to emerging short-range wireless communication technology that typically operates within 10cm between loosely coupled inductive circuits and offers great and multiple promises in services such as consumer electronics, ticketing, voting, and many others.

> NFC emerged around ten years ago and has become instantly a contributor to en vogue technologies

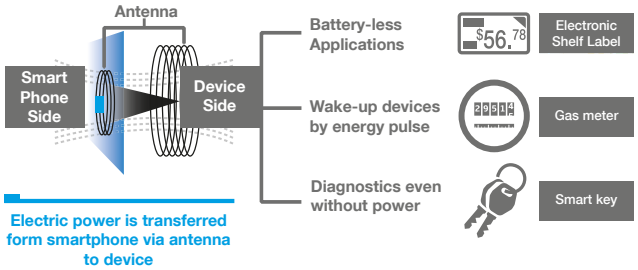
Though it emerged only around ten years ago it has become instantly a significant contributor to en vogue technologies such as Ambient Intelligence (Aml), Cloud Computing (CC), Internet of Things (IoT), Ubiquitous/Pervasive Computing (Ubicomp) and Wireless Sensor Network (WSN). NFC uses the 13.56MHz frequency band and has data rates that typically ranges between 106 to 424kbit/s.

NFC creates additional opportunities for entrepreneurs and its ecosystem creates promising business opportunities. As of today, most smartphones are sold with an integrated NFC hardware module (the latest Android phones and the iPhone 6 support NFC standards), and almost all smartphone/Mobile Operating Systems (MOSs) have NFC support, which are important evidences of its popularity and usefulness through the dissemination of the technology.

HOW NFC WORKS

The technology works by electromagnetic induction between two loop antennas, one in each device which may be active or passive. One device – the initiator – generates an RF field that powers the passive target, or tag. In passive communications mode, the initiator emits a carrier field and the tag responds by modulating the field. In active communications mode, both initiator and target communicate by alternately generating their own fields. One of them will deactivate its RF field while it waits for data. In this mode, both devices normally have their own power supply. They can transmit and receive data at the same time though. More often the mobile phone is used as the source of power, transferring it from the smartphone via the antenna to the device - handy for battery-less applications such as electronic shelf labels or for waking up devices with an energy pulse. Diagnostics too may be performed on a device such as a smart key even if the power is off. Due to the fact that power comes from the reader, also known as an initiator, targets can be quite small, in formats such as tags, key fobs and cards.

FIGURE 1 - HOW NFC WORKS



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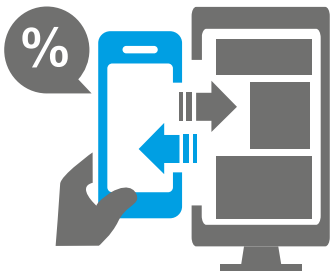
TYPICAL APPLICATIONS

As the technology becomes more and more popular and as international standards have been agreed and published, the market is set for widespread adoption of the technology in a whole range of applications. One area that is likely to be popular is digital signage. The sign could show a promotion or a product and, by touching a smartphone to the sign, more information about the product could be downloaded or even a promotional voucher entitling the owner to money off if they purchase the product in a nearby store or in a web store. This is a lot more convenient than the multi-step QR scanning approach. That's why out-of-home consumers don't need to take diminishing battery life into account when they use their smartphone to access NFC tags. Furthermore, there is no need to download or install any specific applications and NFC doesn't collect personally identifiable information making consumers feel more secure without the risk of privacy concerns. In this example, NFC would also simplify marketing analysis by measuring the number of touches and the number of sales via a downloaded coupon.

FIGURE 2 - DIGITAL SIGNAGE



Another valued application for NFC is the instant seamless connection with *Bluetooth*® devices and Wi-Fi networks, making critical processes faster, easier and more and more intuitive. You can use NFC inlays to enable media sharing among smart devices, connect Wi-Fi networks and *Bluetooth*® devices. By linking *Bluetooth*® devices and Wi-Fi networks, consumers can create a bridge between the physical and virtual worlds.

> The market is set for widespread adoption of NFC in a whole range of applications

The technology can be used e.g. in the context of *Bluetooth*® for linking a mobile phone - or other music players or speakers – by simply tapping NFC and *Bluetooth*® enabled devices together to connect them. There is no manual setup or authentication necessary and there is no interference from other nearby NFC enabled devices.

FIGURE 3 - *BLUETOOTH*® PAIRING WITH NFC

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The connection is almost instantaneous, and NFC tags can quickly turn over their signal to *Bluetooth®* devices to enable longer connection distances.

What this example demonstrates: *Bluetooth®* and Wi-Fi are not really competitors to NFC but more complementary.

> *Bluetooth®* and Wi-Fi are not really competitors to NFC but more complementary

As NFC is characterized by the convenience of data exchange, high security, and lower power consumption, it can help exchange parameters to establish a connection for *Bluetooth®* and Wi-Fi transmission. By combining NFC with *Bluetooth®* and Wi-Fi, users not only can avoid all kinds of attacks to the PIN code for pairing the *Bluetooth®* or Wi-Fi transmission but also reduce time consumption of connection before data transmission and the overall power consumption of the system. Range and speed are the two areas in which *Bluetooth®* and Wi-Fi are clearly superior. This can be seen by the specifications, where NFC has a maximum range of 10cm compared with about 10m for *Bluetooth®* and about 100m for Wi-Fi. Transfer speed is significantly different: the maximum for NFC is typ. 0.424Mbit/s whereas for *Bluetooth®* and Wi-Fi the data rate depends on the output power of the chosen version – for example for *Bluetooth®* Classic it is 2Mbit/s and for IEEE802.11b Wi-Fi it is 11Mbit/s.

Another advantage of NFC technology is that it can be a much cheaper alternative when adding a display or interface to a product, as it can use the existing interface on a smartphone. A typical application might be wearable devices in the health and fitness market.

FIGURE 4 - EXAMPLES OF NFC APPLICATIONS IN THE CONSUMER MARKET

A wristband for monitoring a user's pulse and activity rates can transfer the data directly to a mobile phone where the information can be read on the screen. Likewise, it can provide links to blood pressure, meters and weight scales, which in turn can through the mobile phone connect directly to online fitness and weight reduction programmes.

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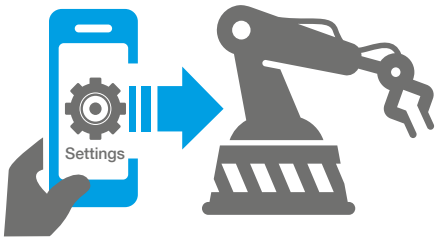
As well as reducing costs by eliminating the need for displays, buttons and switches, this technology is very reliable because there are no mechanical contacts that can deteriorate, and it can be used in sealed and waterproof devices, often seen as a must for some wearables. This would also be beneficial in industrial markets where NFC technology could be used in conjunction with smartphones to realize product setup and diagnostics simply and securely.

FIGURE 5 - EXAMPLES OF NFC APPLICATIONS IN THE INDUSTRIAL MARKET



The full range of applications is vast. They can be used on audio-visual equipment such as digital cameras, headphones and speakers, on home appliances from washing machines to microwave ovens and, as mentioned, for health and fitness devices. Furthermore, tags can be used as a form of authentication method for protecting products and data. This can be handy for plagiarism detection and even for blocking malware from getting into certain devices.

They can also be used on office equipment, such as printers, photocopying machines, routers and projectors, and in an industrial environment for machine tools, power tools, HVAC meters and smoke detectors. Smart keys for cars are a popular use as is digital signage based marketing.

Panasonic has invested for more than 15 years intellectual power and time in order to bring strategic innovations to customers' product development process and provides the technology and engineering resources to enable manufacturers to plan and build world-class NFC solutions to meet their customer needs.

> NFC reduces costs by eliminating the need for displays, buttons and switches and is very reliable

With the introduction of the MN63Y1208 and the MN63Y1210A it introduced the industry's first NFC-tag IC with built-in serial interface based on both JISX6319-4 (Felica) and ISO/IEC 14443 Type B standards with many benefits, including: stable communication with endurance rated at 100,000,000 times; high-security with access restriction by encrypted communication path and authentication; support of tunnel communication mode, enabling fast high-capacity data communication; and automatic NFC communication standard switching to meet worldwide market demand.

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MEMORY

Panasonic has embedded FeRAM within the NFC tag LSI and carries following advantages in comparison to other forms of non-volatile memory. Its most outstanding feature is its greater number of write-erase cycles that guarantees 100 million write cycles, which is up to 1000 times or more than a typical EEPROM. Another advantage of Panasonic FeRAM technology is the lower power consumption – a crucial factor for battery-powered devices; NFC operating voltages are several times lower than EEPROM. Rewrite speed is also much quicker – about 1µs versus more than 1000µs for EEPROM which is especially important for ticketing and access control. Beyond all this, FeRAM is radiation resistant, making it suitable for some medical applications.

Some tags, such as those from Panasonic, allow direct access from the NFC terminal to the microcontroller using virtual memory mapping. This means data rewriting can be carried out without going via the memory, which saves time and thus power consumption for the process

SECURITY, STANDARDS AND SUPPORT

Panasonic offers NFC tags with 128bit password protection as well as AES security with 128bit key length for data protection, detection of counterfeit products and so on. Configurable access rights can be protected or non-protected. Protected communication is a required necessity for any application where authentication is required for diagnostic and firmware updates to make sure they were carried out by authorised service personnel. The authentication can also be used for tracking and tracing the devices or for the user to personalise them. Unprotected communication is typically used for user applications such as checking the device status or looking for online support and downloading a user manual via the internet.

> Protected communication is a required necessity to make sure they were carried out by authorised personnel while unprotected communication is used for user applications

The tags support not only NFC-A and NFC-B based on ISO14443 but also NFC-F based on Felica JIS X6319-4, meaning they have worldwide coverage and the terminals only have to support one standard.

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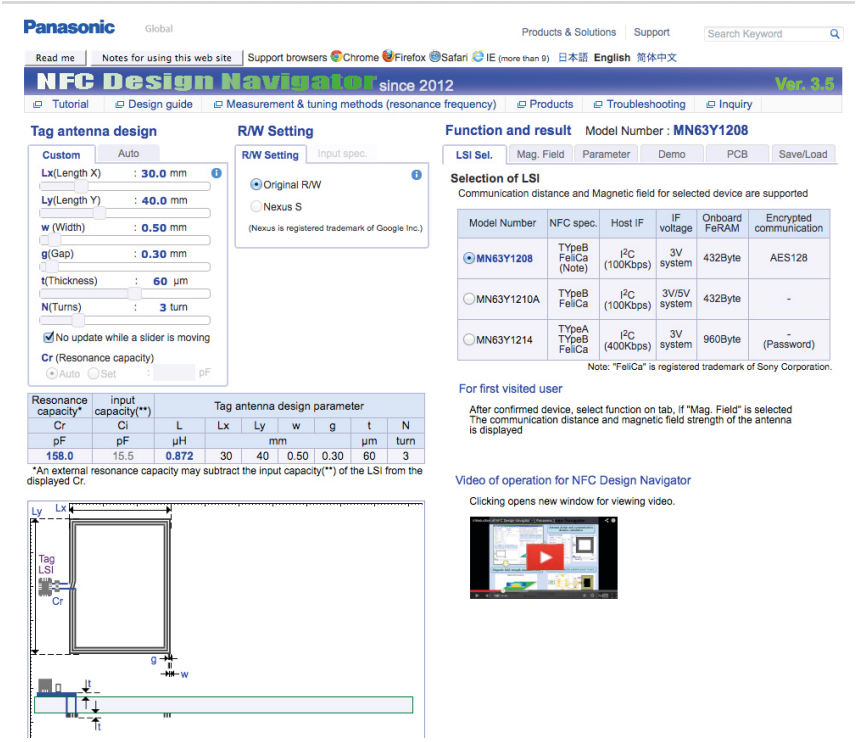
Documentation support for the Panasonic tags includes datasheets, application notes, package standards, administrator's manual, evaluation board circuit diagram and manual, and a software development kit manual. The company's NFC support centre provides design services, interoperability tests, and compliance and certification tests.

Two types of evaluation boards are available, one for the antenna and one for the microcontroller. There is a software development kit for Panasonic microcontrollers and Android, application software for evaluation for Android and a tag dump tool for Windows.

On top of that is a web design tool that lets anyone easily design an NFC antenna, test and simulate antenna mechanical parameters and magnetic field strength.

PANASONIC NFC WEB DESIGN TOOL



http://www.semicon.panasonic.co.jp/en/tool/nfcdesignnavigator/

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PORTFOLIO OF PANASONIC

Panasonic has a range of NFC Tag ICs and NFC Tag modules available with a variety of specifications as shown by the following specification overview.

Panasonic NFC Tag ICs

Type		NFC Tag ICs					
Parts No		MN63Y 1210A	MN63Y 1208	MN63Y 1212	MN63Y 1213	MN63Y 1214	MN63Y 1217
Operation Voltage		1.8V to 3.6V or 4.5V to 5.5V	1.7V to 3.6V	–	1.7V to 3.6V		
Operating temperature		-20 to 85°C					
Storage Temperature		-40 to 85°C					
Non-volatile Memory		Total Storage: 4K bit, User Data Area (432 Byte)				Total Storage: 8K bit, User Data Area (960 Byte)	
		Endurance: 100 000 000 times, Data Retention: 10 years					
RF Interface (Automatic protocol detection)	**Type-A** *1					✔	✔
	Type-B *2	✔	✔	✔	✔	✔	✔
	Type-F *3	✔	✔	✔	✔	✔	
NFC Forum Tag		Type3	Type4B, Type3			Type4A Type4B, Type3	Type4A Type4B
Power by field		Available					
Security Function		N/A	AES128 Encryption			Password Protection	
Serial Interface		UART (38.4kbps), Sync serial (1Mbps)	I²C (to 100kbps)	N/A (only IRQ)	I²C (to 100kbps)	I²C (to 400kbps)	
Operating Current		to 500uA		–	to 500uA		
Package Size		SSOP 16pin 5.0x6.4x1.3mm	QFN 16pin 3.2x4.2x0.77mm	SON (8pin) 2x2x0.45 mm			

*1: ISO/IEC14443 Type4 [106kbps]
*2: ISO/IEC14443 TypeB [106kbps, 212kbps, 424kbps (MN63Y1214/1217, MN63Y3214N1)]
*3: JIS X 6319-4 FeliCa [212kbps, 424kbps]

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Panasonic NFC Tag Modules

Type		NFC Tag Modules				
Parts No		MN63Y 3212N1 *1	MN63Y 3212N4 *1	MN63Y 3212N5 *1	MN63Y 3213N1 *1	MN63Y 3214N1 *1
Operation Voltage		– +ON using IRQ, connect VSS	–	–	1.7V to 3.6V	1.7V to 3.6V
Operating Temperature		-20 to 85°C	-20 to 80°C		-20 to 85°C	
Storage Temperature		-40 to 85°C	-25 to 80°C		-40 to 85°C	
Non-volatile Memory		Total Storage: 4K bit, User Data Area (432 Byte)				Total Storage: 8K bit, User Data Area (960 Byte)
		Endurance: 100 000 000 times, Data Retention: 10 years				
RF Interface (Automatic protocol detection)	**Type-A** *2					✔
	Type-B *3	✔	✔	✔	✔	✔
	Type-F *4	✔	✔	✔	✔	✔
NFC Forum Tag		Type4B, Type3				Type4A Type4B, Type3
Power by field		Available				
Security Function		AES128 Encryption		Password Protection		
Serial Interface		N/A (only IRQ)	N/A	I²C (to 100kbps)	I²C (to 400kbps)	
Power consumption on RF Communication		–		to 1mW		
Operating Current		–		to 500uA		
Package Size		25(L) x 11,5(W) x 0.85(H) mm	30(ø) x 3(H) mm IP68 PC molded	30(L) x 15(W) x 2.7(H) mm IP68 PC molded	9 x 30 mm	40 x 30 mm

*1: The specifications are subject to change without notice since it is under development.
*2: ISO/EC14443 TypeA [106kbps]
*3: ISO/EC14443 TypeB [106kbps, 212kbps, 424kbps (MN63Y1214/1217, MN63Y3214N1)]
*4: JIS X 6319-4 FeliCa [212kbps, 424kbps]

Furthermore, Panasonic offers also NFC bare dies, for example the MN63Y1216-D or MN63Y1218-D.

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CONCLUSION

The use of NFC is growing well beyond the transport ticketing systems that was one of the major early drivers. Improvements in durability and security have led to more applications from coffee machines to power tools, and from card payments to home appliances. Reliability and usability of NFC applications are the most important keys to its ongoing success. Starting with the very first successful partnerships and collaborations between stakeholders, more applications with good user experiences are being realised (or will be realised or will be created or will be deployed). The existence of such applications further motivates and incentivises handset manufactures to continue to expand the production of NFC enabled smartphones. Having accomplished this, it is very likely that the NFC technology will play a major role in future everyday life.

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