

# NFC

SMARTPHONE TECHNOLOGY  
AND APPLICATIONS DRIVING  
NEAR FIELD COMMUNICATIONS

# WHITEPAPER 2019

A growing number of devices use NFC standards to improve our daily life. Panasonic Industry Europe offers a variety of components that provide new opportunities for developers and companies. Enhancements in durability and security will ensure that NFC connected devices will accompany us in the future.

## UP CLOSE TO COMMUNICATE

# SMARTPHONE TECHNOLOGY AND APPLICATIONS DRIVING NEAR FIELD COMMUNICATIONS (NFC)

|   |    |
|---|----|
| INTRODUCTION/ HOW NFC WORKS             | 3  |
| TYPICAL APPLICATIONS                    | 4  |
| MEMORY/ SECURITY, STANDARDS AND SUPPORT | 7  |
| PORTFOLIO OF PANASONIC                  | 9  |
| CONCLUSION                              | 11 |

## UP CLOSE TO COMMUNICATE

# SMARTPHONE TECHNOLOGY AND APPLICATIONS DRIVING NEAR FIELD COMMUNICATIONS (NFC)

### INTRODUCTION

Near Field Communication (NFC) refers to emerging shortrange 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.

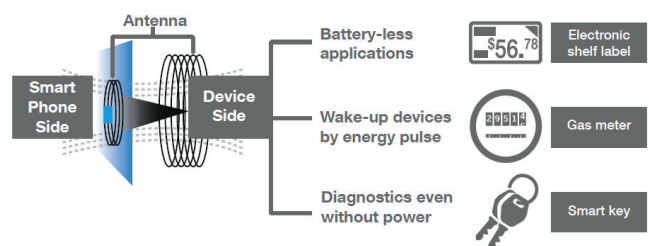
## NFC emerged around 15 years ago and has become instantly a contributor to en vogue technologies

Though it emerged only around 15 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 (almost all available Android phones and iPhones 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



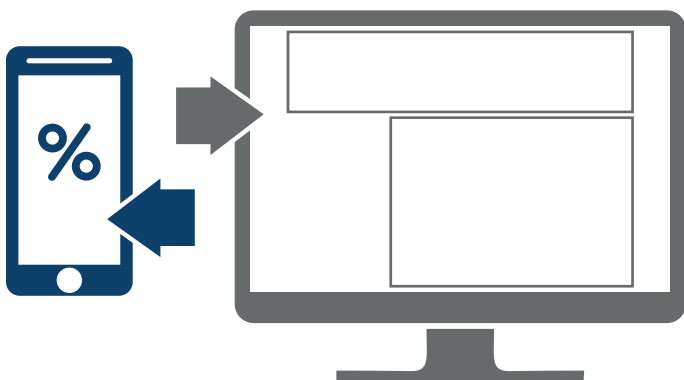
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### TYPICAL APPLICATIONS

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. Another valued application for NFC is the instant seamless connection with Bluetooth® devices and Wi-Fi

FIGURE 2 - DIGITAL SIGNAGE



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 and 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.

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

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

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 typically 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.



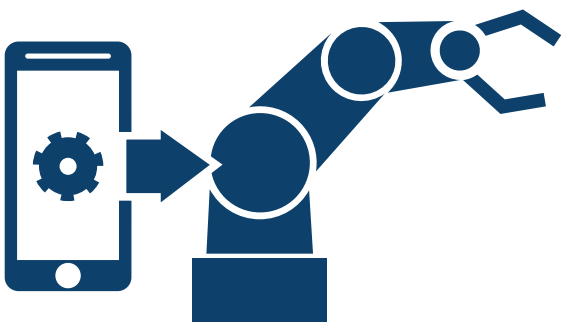
A wristband for monitoring a user's pulse and activity rates can transfer the data directly to a mobile phone where the information can be read on the screen. Likewise, it can provide links to blood pressure, meters and weight scales, which in turn can through the mobile phone connect directly to online 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 20 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 MN63Y1213 and the MN63Y1221 it introduced the industry's first NFC-tag IC with built-in serial interface based on both JISX6319-4 (Felica) and ISO/IEC 14443 TypeA and TypeB 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 1 $\mu$ s versus more than 1000 $\mu$ s 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

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

### 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. 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. 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

The screenshot shows the Panasonic NFC Design Navigator web design tool interface. The interface is divided into several sections:

- Tag antenna design:** Includes sliders and input fields for Lx (Length X), Ly (Length Y), w (Width), g (Gap), t (Thickness), and N (Turns). It also has a checkbox for "No update while a slider is moving" and a "Cr (Resonance capacity)" section with "Auto" and "Set" options.
- R/W Setting:** Includes a radio button for "Original RW" and a "Nexus S" option.
- Function and result:** Shows the "Model Number: MN63Y1213" and a "Selection of LSI" table.
- Selection of LSI:** A table showing communication distance and magnetic field for selected devices.
- Resonance capacity table:** A table with columns for Resonance capacity\* (Cr), input capacity\*\*(Ct), L, Lx, Ly, w, g, t, and N.
- Diagram:** A schematic diagram of the tag antenna design showing the LSI, Cr, Lx, Ly, w, g, t, and N parameters.
- For first visited user:** A note about selecting a function on the "Mag. Field" tab.
- Video of operation for NFC Design Navigator:** A link to a video showing the tool's operation.

| Model Number                                 | NFC spec.            | Host IF      | IF voltage   | Onboard FeRAM | Encrypted communication |
|--|----------------------|--------------|--------------|---------------|-------------------------|
| <input checked="" type="radio"/> MN63Y1213   | TypeB FelCa (Note)   | RC (100Kbps) | 3V system    | 432Byte       | AES128                  |
| <input type="radio"/> MN63Y1210A             | TypeB FelCa          | RC (100Kbps) | 3V/5V system | 432Byte       | -                       |
| <input type="radio"/> MN63Y1214<br>MN63Y1221 | TypeA<br>TypeB FelCa | RC (400Kbps) | 3V system    | 960Byte       | (Password)              |

| Resonance capacity* | input capacity**(Ct) | Tag antenna design parameter |    |    |      |      |      |   |
|---------------------|----------------------|------------------------------|----|----|------|------|------|---|
| Cr                  | Ct                   | L                            | Lx | Ly | w    | g    | t    | N |
| pF                  | pF                   | μH                           | mm | mm | mm   | μm   | turn |   |
| 158.0               | 15.5                 | 0.872                        | 30 | 40 | 0.50 | 0.30 | 60   | 3 |

\*An external resonance capacity may subtract the input capacity\*\*(Ct) of the LSI from the displayed Cr.



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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

| Parts No   |           | MN63Y<br>1210AF                                     | MN63Y<br>1212-E1      | MN63Y<br>1213-E1              | MN63Y<br>1221-E1   |
|--|-----------|---|-----------------------|-------------------------------|--|
| Operation Voltage                                    |           | 1.8V to 3.6V<br>or<br>4.5V to 5.5V                  | -                     | 1.7V to 3.6V                  |  |
| Operating Temperature                                |           | -20 to 85°C   |                       |                               |  |
| Storage Temperature                                  |           | -40 to 85°C   |                       |                               |  |
| Non-volatile Memory                                  |           | Total Storage: 512 Byte<br>User Data Area: 432 Byte |                       |                               | Total Storage: 1024<br>Byte<br>User Data Area:<br>960 Byte |
|  |           | Endurance : 100 000 000 times                       |                       |                               |  |
| RF Interface *1<br>(Automatic protocol<br>detection) | Type-A *2 |   |                       |                               | ✓  |
|  | Type-B *3 | ✓   | ✓                     | ✓                             | ✓  |
|  | Type-F *4 | ✓   | ✓                     | ✓                             | ✓  |
| NFC Forum Tag  |           | Type3   | Type4B, Type3         |                               | Type4A, Type4B, Type3                                      |
| Security Function                                    |           | N/A   | AES128 Encryption     |                               | Password Protection  |
| Serial Interface                                     |           | UART (38.4kbps)<br>Sync serial (1Mbps)              | N/A<br>( only IRQ )   | I <sup>2</sup> C<br>(100kbps) | I <sup>2</sup> C<br>(400kbps)                              |
| Package Size   |           | SSOP 16pin<br>5.0x6.4x1.3mm                         | SON 8pin<br>2x2x0.5mm |                               |  |

\*1 RF communication can be stopped (MN63Y1221-E1)

\*2: ISO/IEC14443 TypeA [106kbps]

\*3: ISO/IEC14443 TypeB [106kbps, 212kbps, 424kbps (MN63Y1221-E1)]

\*4: JIS X 6319-4 FeliCa [212kbps, 424kbps]

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### Panasonic NFC Tag Modules

| Parts No   | MN63Y<br>3212N1 *1                               | MN63Y<br>3212N4 *1        | MN63Y<br>3212N5 *1            | MN63Y<br>3213N1 *1            | MN63Y<br>3214N1 *1                                      |
|--|--|---------------------------|-------------------------------|-------------------------------|---|
| Operation Voltage                                  | -<br>Connect VSS when<br>using IRQ               | -                         | -                             | 1.7V to 3.6V                  |   |
| Operating Temperature                              | -20 to 75°C                                      | -20 to 55°C               |                               | -20 to 75°C                   |   |
| Storage Temperature                                | -40 to 85°C                                      | -25 to 80°C               |                               | -40 to 85°C                   |   |
| Non-volatile Memory                                | Total Storage: 512 Byte User Data Area: 432 Byte |                           |                               |                               | Total Storage: 1024<br>Byte User Data<br>Area: 960 Byte |
|  | Endurance : 100 000 000 times                    |                           |                               |                               |   |
| RF Interface<br>(Automatic protocol-<br>detection) | Type-A *2  |                           |                               |                               | ✓   |
|  | Type-B *3  | ✓                         | ✓                             | ✓                             | ✓   |
|  | Type-F *4  | ✓                         | ✓                             | ✓                             | ✓   |
| NFC Forum Tag                                      | Type4B, Type3                                    |                           |                               |                               | Type4A, Type4B,<br>Type3                                |
| Security Function                                  | AES128 Encryption                                |                           |                               |                               | Password<br>Protection                                  |
| Serial Interface                                   | N/A<br>( only IRQ )                              | N/A                       |                               | I <sup>2</sup> C<br>(100kbps) | I2C (400kbps)   |
| Package Size                                       | 25x11.5x0.85mm                                   | Ø30x3mm<br>IP68 PC molded | 30x15x2.4mm<br>IP68 PC molded | 30x9x1.4mm                    | 40x30x1.35mm  |

\*1: The specifications are subject to change without notice since it is under development

\*2: ISO/IEC14443 TypeA [106kbps]

\*3: ISO/IEC14443 TypeB [106kbps, 212kbps, 424kbps (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.



## About Panasonic Industry Europe

**Panasonic**  
INDUSTRY

Panasonic Industry Europe GmbH is part of the global Panasonic Group and provides automotive and industrial products and services in Europe. As a partner for the industrial sector, Panasonic researches, develops, manufactures and supplies technologies that support the slogan "A Better Life, A Better World". The company's portfolio covers key electronic components, devices and modules up to complete solutions and production equipment for manufacturing lines across a broad range of industries. Panasonic Industry Europe is part of the global company Panasonic Industrial Solutions. More about Panasonic Industry Europe: [industry.panasonic.eu](https://industry.panasonic.eu)