NFC
A World of Opportunities
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Introduction to NFC

ST, a leading provider of NFC technology

Based on the 13.56 MHz wireless communication protocol, Near Field Communication (NFC) uses contactless connectivity to build key enablers that greatly facilitate the adoption of new innovative applications. Currently found in contactless payment, e-government (passports), access control, public transport ticketing systems and e-government (passports), NFC is a convenient, always-on radio link that is driving the growth for simple pairing, diagnostic readout, parameter programming and much more. NFC’s unique features will have a positive impact on many of our activities in areas such as smart living, industrial, and mobile devices.

As a main provider of NFC technology, ST’s complete product portfolio will help you build the most effective and secure solutions for all your applications.

OVERVIEW OF NFC TECHNOLOGY

NFC’s main features make it ideal for everyday use:

- Fast and intuitive, no training required
- Already widely used in mobile, cards and tags
- Short operating distance guarantees privacy and security
- Perfect for secure transactions, such as payments or access control
- Greatly facilitates Bluetooth pairing and Wi-Fi hotspot registration

ST’S NFC OFFER

- **NFC Readers and Tags**
  - NFC / HF RFID Reader ICs for embedded, payment and automotive applications
  - NFC / HF RFID tag ICs for consumer engagement and products
  - Dynamic NFC tag ICs for consumer, industrial and logistics
- **NFC Mobile**
  - NFC controllers for smartphones, tablets, wearables and connected PCs
- **NFC Cards**
  - Payment and ticketing applications
  - Certified solutions
- **NFC combos (NFC controller & eSE)**

ST’s sophisticated technology ensures improved power consumption and an extended communication range.
NFC TECHNOLOGY IN EVERYDAY LIFE

A special communication technology

Complementary to other wireless technologies, NFC is designed to transfer data between two devices in close proximity. Its features make it the ideal fit for a large number of use cases that cannot be achieved by the other technologies, creating a unique opportunity for product and services.

NFC is ubiquitous

Found in all mobile devices based on Android (since v.4.0) and iOS (v.11), NFC is also used to cover Banking transaction between banking card and POS terminals, transportation and eTicketing, digital access, passports, contactless digital identity and multiple other contactless applications.

NFC technology is also becoming widely adopted in industrial equipment, utility meters, gaming platforms, and access control for buildings and vehicles.

NFC UNIQUE FEATURES

What’s so special about NFC?

Triggered by a simple tap; NFC transactions are short, lasting just a fraction of a second, with no need for any preliminary steps. The result is a very intuitive gesture.

In NFC, only one device needs to be powered (except for Peer-to-peer mod). The possibility to have inexpensive, completely passive tags is a true enabler for IoE (Internet of Everything) scenarios.

NFC is a proximity technology based on an intentional action that makes obvious the NFC device is present and identifiable by its owner.

The NFC software stack is fully integrated into Android, iOS and Windows® 10 mobile operating systems that natively provide a number of services, creating the opportunity for many applications to use NFC without the need to install any specific software.

NFC MAIN FEATURES

- Simple adoption
  - Easy-to-use, tap-and-go solutions
  - Zero training required
  - No preliminary setup
- Security
  - Short operating distance
- Communication speeds
  - ISO/IEC 14443: From 106 up to 848 kbps and 6.8 Mbps with VHBR
  - ISO/IEC 15693: 26 / 53 kbps

No energy source needed to operate tags cards

NFC: AREAS OF APPLICATION

- Present in most mobile devices
  - Standard feature in all new smartphones
  - Mobile OS support
    - Android (since 4.0)
    - iOS (since iOS11)
    - From Windows® 7
- Native NFC actions in mobile OSes
  - Sending text, mail
  - Placing calls
  - Launching applications
  - Browse to URLs
  - Wireless pairing (Bluetooth, Wi-Fi)
  - Sharing contacts and appointments
- NFC Secure applications
  - Payment
  - Transport
  - Loyalty
  - Access Control

Smart Things

Contactless payment
Pairing
Anti-counterfeiting
Extended user interface
Gaming
Access control
Consumer engagement

Smart Homes & Cities

Contactless payment
Pairing
Access control
Authentication
Ticketing
Smart posters

Smart Driving

Car access
Personalized driving experience
Engine start
Tethering
Tap & navigate

Smart Industry

Simplified diagnostics & maintenance
Firmware upgrades
Product personalization
Traceability
Advanced logistics
Extended user interface
Authentication
The NFC Forum defines three kinds of NFC devices: universal NFC Forum device, reader device and tag device. These NFC devices can operate in three communication modes that also categorizes the type of use case.

**Rich set of communication possibilities**

- **Peer to Peer**: Connect devices through physical proximity
- **Card Emulation**: Use your device as a Card
- **Tag Reader/Writer**: Connect the world of apps with the physical world
READER/WRITER MODE

In Reader/Writer mode, an NFC reader interrogates a tag to execute a transaction. NFC Forum defines 5 types of tags, which cover a wide range of applications. The reader can be either a dedicated NFC reader, or a mobile device. An NFC reader is capable of sensing the presence of more than one tag.

CARD EMULATION MODE

An NFC controller, typically present in mobile devices, emulates the behavior of a contactless card as defined by ISO/IEC 14443 or FeliCa standards, for use in a contactless infrastructure such as payment, transport...

The NFC controller only handles the low-level communication, while the NFC application resides either in a SIM card, an embedded Secure Element (eSE), an embedded SIM (eSIM) or directly in the main application processor (HCE for Android). The Card emulation based on SWP-SIM, eSE & eSIM brings the benefit of remote provisioning (eSIM) and remote management with a high level of security.

PEER-TO-PEER MODE

This mode is designed for exchanging data such as contact information between two NFC devices like mobile phones.

Each peer takes turn as a reader (transceiver) and tag for a complete exchange between both parties.
The Internet of Things has opened the potential for billions of “Smart Things” to communicate with each other and improve daily life. NFC is the proximity technology that meets the needs of those smart things: it brings connectivity, convenience, security and a cost-effective implementation.

CONTACTLESS PAYMENT
The growth of contactless mobile transactions is driving the adoption of NFC and embedded secure element (eSE) solutions in consumer mobile devices such as smartphones and wearables but also the deployment of contactless interfaces in Point-Of-Sale (POS) terminals. Increasingly popular, payment and transport wallets are being deployed by OEMs and MNOs. It allows consumers to use their favorite payment and transport schemes directly in their mobile devices thanks to the ST21 NFC controller, ST54 NFC secure solution (NFC controller & eSE) or ST53G System-in-Package (NFC booster & eSE).
Thanks to the superior performance of the ST25R readers, POS terminal designers can guarantee a smooth and reliable user experience when tapping, being compliant to the latest EMVCo standard.

BENEFITS
• Convenient
• Secure
• EMVCo pre-certified readers

PRODUCTS
• ST25R NFC / HF RFID Reader IC
• ST21 NFC controller
• ST54 NFC secure solution (NFC controller & eSE)
• ST53 NFC optimized secure solution (NFC booster & eSE)
GAMING
NFC embedded in a gaming console enables contactless communication and peer-to-peer data exchanges with gaming accessories. It makes it possible to add and customize characters in supported games, as well as deliver bonus content.

Other area of applications can also be transfer of contact information, collect information or promotional coupons for later use.

BENEFITS
• Fast, intuitive, and convenient
• Easy to exchange contact, calendar and other data
• Included in Android OS and RTOS for standard MCUs

PRODUCTS
• ST25TA NFC Forum Type 4 tag
• ST25TV NFC Forum Type 5 tag
• ST21NFC NFC controller
• ST54 NFC secure solution (NFC controller & eSE)
• ST25R NFC / HF RFID Reader IC

CONSUMER ENGAGEMENT
NFC tags are the ideal solution for increasing customer engagement while protecting against counterfeit, grey market or unauthorized distribution. Using smartphone, product authenticity can be checked from manufacturing line to end-user. A unique digital signature from a ST25TA or ST25TV tag acts as an electronic certificate of authenticity. Combined with its non-volatile memory content, the NFC tags also offer tracking, enriched product information and direct access to the end-user, thus enhancing consumer engagement.

BENEFITS
• Product identification with enriched information
• Brand protection
• Verification using digital signature

PRODUCTS
• ST25TA NFC Forum Type 4 tag
• ST25TV NFC Forum Type 5 tag
• ST25R NFC / HF RFID Reader IC
• ST21NFC NFC controller
• ST25DV-I2C NFC Forum Type 5 Dynamic Tag
Challenges for smart homes & cities

With an increasing share of the world population moving to urban areas, cities and homes will need massive innovation to improve energy efficiency, communication and quality of life. A key enabler for the change will be a dense and complex architecture of sensors, actuators, and communication infrastructure, both inside and outside the house. With its reach in digital payments, access control and systems pairing, NFC is a key technology to help streamline some of the key processes of this transformation.

ACCESS CONTROL

Thanks to NFC, the traditional access control for entry gates and transport can now grow into a wider application footprint. Mobile phones with ST21NFC or ST54 NFC secure SiP solution can be used in place of dedicated contactless cards, enabling remote hotels check-in and time-badging as well as room/apartment sharing applications. The truly low-power ST25R reader family makes it possible to implement low power NFC solutions even in locks with metal housing. Thanks to the good performance of our ST25TA and ST25TV NFC tags, developers can also extend the offer in new innovative form factors, such as labels, buttons, as well as traditional plastic cards.

BENEFITS

- Mobile access control apps for remote hotel check-in, room-sharing apps
- New tag form factors for innovative marketing programs

PRODUCTS

- ST25TA NFC Forum Type 4 tag
- ST25TV NFC Forum Type 5 tag
- ST25R NFC / HF RFID Reader IC
- ST21NFC NFC controller
- ST54 NFC secure solution (NFC controller & eSE)
BLUETOOTH / WI-FI PAIRING
NFC lets you easily pair Bluetooth or Wi-Fi devices. A simple tap is enough to join a Wi-Fi network or connect a Bluetooth equipment device without having to enter a complex passcode. This method of pairing only takes a few seconds and is secure thanks to the strict proximity operation of NFC.

SEAMLESS USER INTERFACE
Many Smart Home and Cities systems lack a user-friendly interface for easily adding new components. Thanks to NFC, the mobile phone screen becomes a rich interface, allowing even the most complex system to be easily configured through the NFC link.

A system equipped with an ST25DV-I2C dynamic NFC tag can dialog with a mobile phone, equipped with an ST21NFC controller in order to be configured and put into operation.

BENEFITS
• Simple & fast pairing
• Eliminates complex passcode entry
• Secure
• No need for a separate user interface

PRODUCTS
• ST25TA, ST25TV tag
• ST25DV-I2C dynamic NFC tag
• ST25R NFC / HF Reader IC
• ST21NFC NFC controller

BENEFITS
• Easy configuration of complex systems
• Reduced cost, thanks to mobile devices acting as a user interface

PRODUCTS
• ST25DV-I2C dynamic NFC tag
• ST25R NFC / HF Reader IC
• ST21NFC NFC controller
Making driving more connected

Smart Driving is about focusing on the driver and passengers. The automobile is being transformed by technology; improving security and enhancing the driver experience. As part of this new driving experience, NFC technology is bringing personalized entertainment and a connected experience into the car environment in a safe and easy-to-use manner.

CAR START: MIDDLE CONSOLE

By placing a card or phone on the center console, it is possible to start the car and pair with its infotainment systems.

ST NFC chipsets work seamlessly with Qi charging technology and our unique automatic antenna tuning (AAT) technologies minimizes the impact of coins or other metallic objects placed close to, or even on top of the NFC antenna. Our futureproof ST25R NFC / HF RFID readers allows for contactless EMVCo-certified payments for electric vehicle (EV) charging stations.

The ST33 secure element combined with the ST25R reader make the perfect solution for the digital car key.

**BENEFITS**

- Insensitive to metal objects
- Works seamlessly with Qi charging
- Fast reaction/interaction times
- Secure transactions

**PRODUCTS**

- ST25R3914/15 NFC / HF RFID reader
- ST33G1M2A Secure element
CAR ACCESS: DOOR HANDLES AND B-PILLARS
By waving a Near Field Communication-enabled card or smartphone near the door handle or B (or center) pillar, the driver can lock and unlock the vehicle’s doors. NFC covers the three most important requirements for such an access application: security, usability and costs.

Car keys become as slim as a credit card or are stored in smartphones while expensive traditional lock systems and key fobs are replaced by their cost-efficient NFC counter parts.

**BENEFITS**
- Cost-efficient
- More robust
- Increased safety
- High output power
- Automatic low-power field detection
- AEC-Q100 Grade1

**PRODUCTS**
- ST25R3914/15 NFC / HF RFID reader
- ST54 NFC secure solution (NFC controller & eSE)
- ST33G1M2A Secure element

PERSONALIZED DRIVING EXPERIENCE
NFC is making driving a tailored experience. A simple tap with your smartphone will seamlessly configure your car’s environment. Chair, mirrors, ambient lights or wireless connections are automatically adjusted to your profile.

**BENEFITS**
- Easy to design
- Seamless user experience
- Low power requirements
- Enhanced interoperability

**PRODUCTS**
- ST25TA, ST25TV tags
- ST25DV-I2C dynamic NFC tag
- ST25R3914/15 NFC / HF RFID reader
Smart industry reflects the digitization of manufacturing technologies resulting in improved productivity, cost and safety. This trend is accelerating thanks to a wide range of technologies including NFC which brings connectivity, flexibility, configurability and serviceability.

**PRODUCT PERSONALIZATION: “IN THE BOX” PROGRAMMING**

NFC technology makes it possible to interact with products at any stage of the manufacturing chain, even after packaging. The ST25DV-I2C dynamic NFC tag’s memory can store information such as languages, settings, and warranty registration information that is then retrieved at power up. This flexibility in software personalization brings great benefit for product manufacturing and simplifies logistics.

**BENEFITS**
- In-the-box product personalization
- Increased production flexibility
- Simplified logistics
- No power supply required

**PRODUCTS**
- ST25DV-I2C dynamic RFID / NFC tag
- ST25DV-PWM Dynamic RFID / NFC Tag
- ST25R NFC / HF RFID Reader IC
- ST21NFC NFC controller
**SIMPLIFIED DIAGNOSTICS & MAINTENANCE**

Embedded in almost all smartphones, NFC lets these ubiquitous devices become an advanced user interface for accessing diagnostics and maintenance information. Both end-users and maintenance teams can use mobile devices to monitor, troubleshoot or adjust equipment parameters thanks to the embedded NFC controller & Secure Element. Even if the equipment is not powered or operational, diagnostics can be performed thanks to tag’s energy harvesting capabilities.

An ST25DV-I2C dynamic NFC tag embedded in electronic equipment can store in its non-volatile memory useful diagnostic information including model number, product configuration parameters, firmware and BOM versions, error codes, or use patterns. An ST25DV-PWM, included in your LED driver, or power unit, or even a motor, will bring convenience for its configuration by providing a flexible and easy way to set duty cycle and frequency.

**BENEFITS**
- Flexibility
- Convenient maintenance
- Security with short operating distance
- On-site actions

**PRODUCTS**
- ST25DV-I2C dynamic RFID / NFC tag
- ST25DV-PWM dynamic RFID / NFC tag
- ST25R NFC / HF RFID Reader IC
- ST21NFC NFC controller
- ST54 NFC secure solution (NFC controller & eSE)

**FIRMWARE UPGRADES**

Dual interface tags such as ST25DV-I2C, having contactless and I2C interfaces, can act as a bridge to connect a smartphone to an electronic device to do firmware upgrade of the embedded micro-controller. All the process is achievable without having to do any physical action on the unit.

**BENEFITS**
- Fast and easy connection
- Cost-effective
- Built-in advanced user interface

**PRODUCTS**
- ST25DV-I2C dynamic RFID / NFC tag
- ST25R NFC / HF RFID Reader IC
- ST21NFC NFC controller
- ST54 NFC secure solution (NFC controller & eSE)
ST is a leader in NFC technology and ecosystem

One of the early pioneers of RFID and NFC technologies, ST offers a comprehensive range of products and solutions covering all NFC application needs as well as rich development ecosystem. Discover our extensive portfolio of NFC / RFID tags, Dynamic NFC tags, NFC /HF RFID readers, NFC controllers and Secure NFC solutions including NFC controller or NFC booster and embedded secure element.

COMPREHENSIVE PORTFOLIO

ST25 NFC / RFID Tag
ST25 Dynamic NFC Tag
ST25 NFC / RFID Reader
ST21 NFC Controller
ST33 / ST54 Secure NFC

ST is an active Sponsor Member of the NFC forum.

ST25 NFC Tags and Dynamic Tags are NFC Forum certified

BENEFITS
• Comprehensive portfolio to cover all NFC applications
• Best-in-class RF performance
• Rich ecosystem
• Long-proven expertise in adding security to NFC
NFC / RFID TAGS, DYNAMIC TAGS & READERS

ST offers a comprehensive portfolio of NFC/RFID products, which operate at 13.56 MHz and are based on NFC and ISO standards:

- NFC/RFID tags, ideal for wireless pairing (Bluetooth or Wi-Fi) and product identification, feature counters, data protection (password) and able to wake-up the Host chip thanks to a general-purpose output
- Dynamic RFID / NFC tags, featuring a reliable EEPROM memory with data protection (password), an I2C interface to connect to a MCU and a RFID/NFC tag interface, enabling multiple use-cases for Consumer, Industrial and IoT applications
- NFC / HF RFID readers, which support multiple NFC protocols in Reader or Peer-to-Peer modes, accessed via SPI interface and able to cope with the most challenging environments thanks to their high RF performance and advanced features

ST also offers a large range of Discovery kits, Nucleo expansion boards, reference software and documentation in order to ease the design process.

NFC CONTROLLER, NFC BOOSTER AND SECURE ELEMENT

Near field communication (NFC) technology is at the heart of an expanding spectrum of easy-to-use, intuitive, contactless applications. Mobile devices such as smartphones, tablets, wearables and connected PCs are increasingly integrating NFC technology to enable contactless payment as well as transport and access control features.

ST provides an exhaustive offer of NFC products and solutions to address secure mobile transaction applications:

- ST21NFC state-of-the-art NFC Controller
- Embedded secure elements ST31/ST33
- ST53/ST54 NFC & eSE, integrating the widely deployed ST31/ST33 Secure Element combined with STS3922 booster / ST21NFC controller

KEY FEATURES

- Best-in-class RF performance
- 13.56 MHz frequency
- Highly reliable EEPROM with data protection
- I2C/SPI serial interface PWM output / GPO
- Energy harvesting capabilities
- Tamper detection feature
- Automatic Antenna Tuning
- High and Dynamic Power Output
- EMVCo compliant
- AEC-Q100 grade 1

ST53G

ST54F/H

ST54J
ST25 NFC/RFID Tag ICs

NFC / RFID Tag ICs with NFC Forum Type 4 or Type 5 RF interface

ST25TA and ST25TV tag ICs provide certified NFC Forum Type 4 or Type 5 RF interfaces with memory density which spans from 512 bits to 64 Kbits. These tag ICs cover a broad range of applications including consumer engagement, brand protection based on cloud management, access control, asset tracking and gaming.

SPECIAL FEATURES

The ST25TA and ST25TV series deliver state-of-the-art RF performance and include TruST25® Digital Signatures for operation with cloud management and a tamper-detect feature for open/short detection.

Its user-programmable digital output can be used to wake up a host MCU (microcontroller).

BENEFITS

- Wide memory density options
- High-reliability EEPROM
- Built-in NDEF format support
- Strong password protection scheme
- TruST25® Digital Signature
- Read or write operation counter
- Tamper Detect
- Flexible user-programmable GPO
- NFC Type 5 combining long range HF RFID and NFC compliance
### AREA OF APPLICATIONS
- Smart things
- Consumer engagement
- Authentication
- Smart city
- Services
- Library
- Access control
- Smart industry
- Identification
- Asset tracking

### HARDWARE DEVELOPMENT BOARDS

**CLOUD-ST25TA02KB**
ST25TA-based NFC tag evaluation board

**ST25TV-eSEAL**
ST25TV-based NFC tag evaluation board

### PRODUCT PORTFOLIO

<table>
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<tr>
<th>Part number</th>
<th>RF Interface</th>
<th>NFC Forum certification</th>
<th>Memory size</th>
<th>Data protection</th>
<th>Counter</th>
<th>Special features</th>
<th>Package</th>
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<td>ST25TV512</td>
<td>ISO15693 / NFC Forum Type 5</td>
<td>YES</td>
<td>512 bit</td>
<td>32-bit / 64-bit encrypted password</td>
<td>16-bit</td>
<td>TruST25® Digital signature</td>
<td>UFDFPN5, SBN075 and SBN12 (*)</td>
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<td>ST25TV02K</td>
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<td>YES</td>
<td>2 Kbit</td>
<td>32-bit / 64-bit encrypted password</td>
<td>16-bit</td>
<td>TruST25® Digital signature</td>
<td>UFDFPN5, SBN075 and SBN12 (*)</td>
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<td>ST25V02K-AD</td>
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<td>YES</td>
<td>2 Kbit</td>
<td>32-bit / 64-bit encrypted password</td>
<td>16-bit</td>
<td>Tamper detect pin/TruST25® Digital signature</td>
<td>UFDFPN5, SBN075 and SBN12 (*)</td>
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<td>ST25V16K</td>
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<td>16 Kbit</td>
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<td>64 Kbit</td>
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<td>ST25TA512B</td>
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<td>512 bit</td>
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<td>SBN12 (*)</td>
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<td>2 Kbit</td>
<td>128-bit password</td>
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<td>TruST25® Digital signature</td>
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<td>Yes (CMOS positive GPO)</td>
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<td>2 Kbit</td>
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<td>TruST25® Digital signature</td>
<td>UFDFPN5</td>
<td>YES (Open Drain GPO)</td>
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<td>16 Kbit</td>
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<td>64 Kbit</td>
<td>128-bit password</td>
<td>NO</td>
<td>NO</td>
<td>SBN12 (*)</td>
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(*) SBN075: Sawn and bumped wafer (die form), 75 µm thickness;
SBN12: Sawn and bumped wafer (die form), 120 µm thickness
Dynamic ISO/IEC 15693 NFC Forum Type 5 Tag ICs with either I2C Interface, Fast transfer mode and Energy Harvesting or PWM outputs

ST’s Dynamic NFC / RFID tag ICs feature an RF ISO/IEC 15693 and NFC Forum Type 5 certified contactless interface operating at 13.56 MHz. The ST25DV-I2C series feature from 4 Kbits to 64 Kbits of EEPROM which can be accessed through the RF contactless interface or by means of a low power I2C interface, while the innovative ST25DV-PWM series feature 2 Kbits of EEPROM and up to 2 PWM output as second interface. In addition, the ST25DV-I2C offer a broad range of features including energy harvesting and a 256-byte Fast Transfer Mode that ensures faster data transfer between the RF interface and the host microcontroller connected through the I2C. Both the ST25DV-I2C and ST25DV-PWM series offer multiple 32/64 bit passwrds to ensure flexible data protection mechanism.

**MAIN APPLICATIONS**

By combining its Fast Transfer mode over ISO/IEC 15693 distances with NFC Forum Type 5 support as well as Energy Harvesting capabilities, the ST25DV-I2C series offers a unique set of features for a broad range of Internet of Things (IoT) and Industrial (Industry 4.0) applications.

Perfectly suited to get instant read-outs of device status, usage and diagnostics, ST25DV-I2C tags give battery-free or power-conscious devices the ability to communicate, even if they are completely sealed.

A common trademark is their ability to support multiple use-cases all along a product’s lifetime: from product tracking and factory customization to black box tool at product end-of-life as well as providing a convenient interface for end-user or maintenance support in the field.

By combining ST’s proven NFC technology with PWM logic for the first time, the ST25DV-PWM dynamic tag ICs generate control signals using an embedded pulse-width/period mechanism based on settings received via the RF interface and stored in on-chip EEPROM. The ST25DV-PWM is suited for all applications featuring PWM (Pulse Width Modulation)-based controllers, such as lighting products, power supply units, motorized appliances, fans, and thermostats. The ST25DV-PWM introduces an innovative contactless way to program presets for products on the production line or in-situ, and simplify setup or fine-tuning at the point of use.

Both the ST25DV-I2C and the ST25DV-PWM are NFC forum certified. They are therefore able to fit more consumer-oriented application for home, fitness, or healthcare.

**KEY FEATURES**

- **ST25DV-I2C**
  - Up to 64-Kbit EEPROM
  - I2C interface (1MHz)
  - Configurable output signal (GPO)
  - 256-byte buffer (Fast Transfer mode)
  - Energy harvesting

- **ST25DV-PWM**
  - 2-Kbit EEPROM
  - Up to 2 PWM outputs (up to 15-bit resolution)
  - TruST25® digital signature

- **Common features**
  - NFC Forum Type 5
  - High Reliability EEPROM
  - Power supply: 1.8 to 5.5V
  - 32/64-bit password protection
  - Industrial temperature range
### AREA OF APPLICATIONS
- Smart industry
- Factory automation
- Industrial lighting
- Motor Control
- Smart home
- Home automation
- Security systems
- Smart city
- Metering
- Street lighting
- Smart things
- Healthcare
- Wellness

### HARDWARE DEVELOPMENT BOARDS

- X-NUCLEO-NFC04A1
  ST25DV-I2C based NFC tag Nucleo expansion board

- ST25DV-DISCOVERY
  ST25DV-I2C based NFC Tag Discovery Board

- ST25DV-PWM-eSET
  ST25DV-PWM based NFC TAG discovery board

### PRODUCT PORTFOLIO

<table>
<thead>
<tr>
<th>Part number</th>
<th>RF Interface</th>
<th>NFC Forum Certification</th>
<th>Memory size</th>
<th>Clock frequency</th>
<th>Data protection</th>
<th>Supply (V)</th>
<th>Package</th>
<th>Temperature Range</th>
<th>Energy Harvesting output</th>
<th>RF status output (GPO/PWM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST25DV02K-W1</td>
<td>ISO15693 / NFC Forum Type 5</td>
<td>YES</td>
<td>2 Kbit</td>
<td>NA</td>
<td>64/32-bit password</td>
<td>1.8 to 5.5</td>
<td>S08, TSSOP8</td>
<td>-40°C to +105°C (PWM)</td>
<td>NO</td>
<td>1 PWM</td>
</tr>
<tr>
<td>ST25DV02K-W2</td>
<td>ISO15693 / NFC Forum Type 5</td>
<td>YES</td>
<td>2 Kbit</td>
<td>NA</td>
<td>64/32-bit password</td>
<td>1.8 to 5.5</td>
<td>S08, TSSOP8</td>
<td>-40°C to +105°C (PWM)</td>
<td>NO</td>
<td>2 PWM</td>
</tr>
<tr>
<td>ST25DV04K</td>
<td>ISO15693 / NFC Forum Type 5</td>
<td>YES</td>
<td>4 Kbit</td>
<td>1 MHz</td>
<td>64-bit password</td>
<td>1.8 to 5.5</td>
<td>S08, TSSOP8, FPN8, FPN12, WLCSP</td>
<td>RF: 40°C to +85°C or +105°C or +125°C</td>
<td>YES</td>
<td>configurable GPO</td>
</tr>
<tr>
<td>ST25DV16K</td>
<td>ISO15693 / NFC Forum Type 5</td>
<td>YES</td>
<td>16 Kbit</td>
<td>1 MHz</td>
<td>64-bit password</td>
<td>1.8 to 5.5</td>
<td>S08, TSSOP8, FPN12,</td>
<td>RF: 40°C to +85°C or +105°C or +125°C</td>
<td>YES</td>
<td>configurable GPO</td>
</tr>
<tr>
<td>ST25DV64K</td>
<td>ISO15693 / NFC Forum Type 5</td>
<td>YES</td>
<td>64 Kbit</td>
<td>1 MHz</td>
<td>64-bit password</td>
<td>1.8 to 5.5</td>
<td>S08, TSSOP8, FPN12,</td>
<td>RF: 40°C to +85°C or +105°C or +125°C</td>
<td>YES</td>
<td>configurable GPO</td>
</tr>
</tbody>
</table>

Note: ST25DV-I2C temperature range depends on package and product version.
ST25 NFC / RFID HF Readers

High-performance HF Reader / NFC Initiators with 1.6W supporting VHBR and AAT for contactless applications

The ST25R reader series are a market leading range of high performance NFC/RFID HF reader solutions offering unique features like automatic antenna tuning or active wave shaping and noise suppression functionality designed for noisy environments like antennas around LCD displays. They provide multi-protocol support for 13.56 MHz NFC / RFID HF communications like ISO14443 type A or B, ISO15693, ISO18092, FeliCa following NFC Forum standards.

MAIN APPLICATIONS

The ST25R series covers a wide span of RF power requirements and its combination of unique features makes it suited for a broad range of applications. In addition to a high output power, up to 1.6W, ST25R offer a low-power capacitive sensor that can be used for ultra low-power wake-up functions without having to switch on the reader field to detect a card presence. Combined with the inductive wake-up function the ST25R family is a perfect fit for applications like access control, door lock or gaming.

The top range of the ST25R family allow for EMVCo and PBOC certification, including EMVCo software code and hardware platforms following the newest standards, providing a convenient reference design for contactless payment solution / point-of-sale (POS) terminals.

ST25R3914/15 readers are AEC-Q100 Grade 1 (automotive) qualified making them ideal for digital key and immobilizer applications in cars.

Features like Very High Bit Rate (VHBR) technology allow for quick exchange of large amounts of data required for passport applications. Automatic Antenna Tuning (AAT) is especially useful in ensuring a high read range in challenging and/or metal environments.

KEY FEATURES

- Reader/Writer, P2P, Card Emulation
- Output power up to 1.6W
- Automatic Antenna Tuning (AAT)
- Capacitive and inductive wake up
- Dynamic Power Output
- Active Wave Shaping
- Noise suppression receiver
- VHBR up to 6.8 Mbps
- Two single antennas or one differential antenna
PRODUCT PORTFOLIO

<table>
<thead>
<tr>
<th>Part number</th>
<th>Mode</th>
<th>RF interface</th>
<th>RF speed</th>
<th>Serial interface</th>
<th>Advanced features</th>
<th>Output power</th>
<th>Temperature range</th>
<th>Package</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST25R95</td>
<td>Reader / Writer, Card Emulation</td>
<td>ISO14443A,B / ISO15693</td>
<td>424kbps</td>
<td>SPI</td>
<td>-</td>
<td>0.23W</td>
<td>-25°C to +85°C</td>
<td>32-pin QFN (5x5mm)</td>
<td>Access Control, Gaming, Metering</td>
</tr>
<tr>
<td>ST25R3911B</td>
<td>Reader/Writer, P2P</td>
<td>ISO14443A,B / ISO15693 / Felica</td>
<td>6.8Mbit/s</td>
<td>SPI</td>
<td>AAT, DPO, CIWU</td>
<td>1.4W</td>
<td>-40°C to +125°C</td>
<td>32-pin QFN (5x5mm)</td>
<td>Points of Sale (EMVCo), Passport, Industrial</td>
</tr>
<tr>
<td>ST25R3912</td>
<td>Reader/Writer, P2P</td>
<td>ISO14443A,B / ISO15693 / Felica</td>
<td>848Kbit/s</td>
<td>SPI</td>
<td>DPO, IWU</td>
<td>1.0W</td>
<td>-40°C to +125°C</td>
<td>32-pin QFN (5x5mm), WLCSP</td>
<td>Points of Sale (EMVCo), Access Control</td>
</tr>
<tr>
<td>ST25R3913</td>
<td>Reader/Writer, P2P</td>
<td>ISO14443A,B / ISO15693 / Felica</td>
<td>848Kbit/s</td>
<td>SPI</td>
<td>AAT, DPO, CIWU</td>
<td>1.0W</td>
<td>-40°C to +125°C</td>
<td>32-pin QFN (5x5mm)</td>
<td>Gaming, Access Control</td>
</tr>
<tr>
<td>ST25R3914</td>
<td>Reader/Writer, P2P</td>
<td>ISO14443A,B / ISO15693 / Felica</td>
<td>848Kbit/s</td>
<td>SPI</td>
<td>AAT, DPO, CIWU</td>
<td>1.0W</td>
<td>-40°C to +125°C</td>
<td>32-pin QFN (5x5mm)</td>
<td>Automotive (AEC-Q100 Grade 1)</td>
</tr>
<tr>
<td>ST25R3915</td>
<td>Reader/Writer, P2P</td>
<td>ISO14443A,B / ISO15693 / Felica</td>
<td>848Kbit/s</td>
<td>SPI</td>
<td>DPO, CIWU</td>
<td>1.0W</td>
<td>-40°C to +125°C</td>
<td>32-pin QFN (5x5mm)</td>
<td>Automotive (AEC-Q100 Grade 1)</td>
</tr>
<tr>
<td>ST25R3916</td>
<td>Reader / Writer, P2P, Card Emulation</td>
<td>ISO14443A,B / ISO15693 / Felica</td>
<td>848Kbit/s</td>
<td>SPI &amp; I2C</td>
<td>AAT, DPO, CIWU, AWS, NSR</td>
<td>1.6W</td>
<td>-40°C to +125°C</td>
<td>32-pin QFN (5x5mm), WLCSP</td>
<td>Points of Sale (EMVCo), Industrial, Consumer, Access Control</td>
</tr>
</tbody>
</table>

Note:
VHBR: Very High Bit Rate
AAT: Automatic Antenna Tuning
DPO: Dynamic Power Output
NSR: noise suppression receiver
AWS: Active Wave Shaping
CIWU: Capacitive & Inductive Wakeup
IWU: Inductive Wakeup
Secure Element for contactless & NFC applications

STMicroelectronics provides a global offer of products and solutions for NFC enablement. This includes best-in-class secure 32-bit Flash-based microcontrollers to address, embedded secure elements (SE) with or without software, SWP-SIM, and eSIM applications. Secure solutions are delivered as discrete ICs or systems-in-package for optimized solutions.

ST31 AND ST33 SECURE MICROCONTROLLERS

The ST31 secure microcontroller is intended for highly-secure applications including banking, identification, pay TV, and transport. ST31 dual-interface secure microcontrollers are designed to enable secure and fast contactless transactions. Additionally, it can be delivered with or without the STPay banking application, a fully certified SW solution for payment applications. Combined with the STS3922 NFC booster IC, it meets all the requirements to support wearable payment/transport applications with very small antennas...

ST33 secure microcontrollers are designed to meet advanced security and performance requirements for secure mobile applications including NFC embedded secure element and advanced SIM with a large user Flash memory capability. Combined with the ST21NFC NFC controller, it meets all the requirements for integrating payment, transport or multi-application solutions in smartphones, tablets, wearables or connected PCs.

KEY FEATURES

- 32-bit ARM® SC000 CPU / SC300 CPU
- Multi-protocol (ISO/IEC 7816, ISO/IEC 14443A/B/F and VHBR)
- EMVCo and Common Criteria certified
- Multi-application support
**ST31 / ST33 FEATURES**

With the ARM® SecurCore® SC000 processor and an architecture optimized for contactless performances, the ST31 platform offers multiple hardware interfaces and a wide range of libraries, including MIFARE Plus® and MIFARE®, DESFire® and certified cryptographic functions. The platform addresses the best-in-class security standards including Common Criteria up to EAL5+, EMVCo, and CUP.

With the latest ARM® SecurCore® SC300 32-bit RISC processor and an architecture optimized for high performance, the ST33 platform offers large memory capacity, multiple communication interfaces and certified cryptographic libraries in different form factors including wafers, SIM modules, DFN, and WLCSP packages. The ST33 platform addresses the highest security standards including Common Criteria up to EAL5+, EMVCo and CUP. To support MIFARE® technology on secure element applications, optional MIFARE® libraries (MIFARE® Classic and MIFARE® DESFire® EV1 libraries) are available on ST33 secure microcontrollers and are certified up to Common Criteria EAL5+.

**TYPICAL APPLICATION BLOCK DIAGRAM**

**PRODUCT PORTFOLIO**

<table>
<thead>
<tr>
<th>Part number</th>
<th>Secure device</th>
<th>NFC mode</th>
<th>RF protocol</th>
<th>Interface</th>
<th>Key features</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST31G480</td>
<td>eSE 480-Kbytes Flash memory</td>
<td>Card Emulation</td>
<td>ISO/IEC 14443 A, B, ISO/IEC 18092, VHBR, ISO/IEC 7816, ISO/IEC14443</td>
<td>32-bit ARM® SecurCore® SC000 CPU eSE for payment, transport, access control MIFARE® Classic &amp; DESFire® Available with or without STPay Payment application ideal for contactless payment integration in battery-less wearables</td>
<td>DFN Modules Wafers</td>
<td></td>
</tr>
<tr>
<td>ST33G1M2</td>
<td>eSE 1.2-Mbytes Flash memory</td>
<td>Card emulation / reader / P2P combined with NFC controllers</td>
<td>Managed by NFC controller</td>
<td>ISO/IEC 7816, SPI, SWP</td>
<td>32-bit ARM® SecurCore® SC300 CPU eSE for payment, transport, access control MIFARE® Classic &amp; DESFire®</td>
<td>WLCSP DFN Wafers</td>
</tr>
<tr>
<td>ST33J2M0</td>
<td>eSE 2-Mbytes Flash memory</td>
<td>Card emulation / reader / P2P combined with NFC controllers</td>
<td>Managed by NFC controller</td>
<td>ISO/IEC 7816, SPI, PC, SWP</td>
<td>32-bit ARM® SecurCore® SC300 CPU MIFARE® Classic &amp; DESFire®, combining eSE and eSIM</td>
<td>WLCSP QFN20 Wafers</td>
</tr>
</tbody>
</table>
ST21NFC Controller

NFC booster

Implementing Active Load Modulation technology, ST’s NFC boosters (STS3921/22) and NFC controller (ST21NFCD) solutions guarantee NFC transactions on mobile devices and wearables even in challenging metallic environments or with a very small antenna.

Key benefits include:

- Simplifies the hardware integration: Reference designs, expansion boards, design guidelines are available
- Simplifies the software integration: Compatible with most operating systems on the market (Linux, Android, RTOS, etc.). ST lowers the cost for developers by providing multi-application support with optimized solutions including intuitive SDK platforms for integrating contactless services around any microcontroller architecture for wearables
- Simplifies the deployment: Integration into the most popular TSMs and pre-certification services help reduce time to market as well as development costs

**KEY FEATURES**

- Enhanced user experience (reading distance)
- Allows ultra-small antenna
- Minimizes footprint
- Facilitates integration
- Increases interoperability
- Helps ensure low power consumption
**PRODUCT PORTFOLIO**

<table>
<thead>
<tr>
<th>Part number</th>
<th>Type</th>
<th>NFC modes</th>
<th>RF protocol</th>
<th>Interface</th>
<th>Key features</th>
<th>Package</th>
</tr>
</thead>
</table>
| STS3921     | NFC Booster | Card emulation                | ISO/IEC 14443A         | Contactless bridge to secure microcontroller SPI to Host | Active Load Modulation  
Q factor adjustment  
Automatic Power Control  
Automatic Gain Control  
Low-power field detection | WLCSP    |
| STS3922     | NFC Booster | Card emulation                | ISO/IEC 14443A         | Contactless bridge to secure microcontroller SPI to Host | Active Load Modulation  
Automatic Antenna Tuning  
Q factor adjustment  
Automatic Power Control  
Automatic Gain Control  
Low-power field detection | Wafer    |
| ST21NFCD    | NFC Controller | Card emulation, Reader, P2P  | ISO/IEC 14443A/B  
ISO/IEC 18092  
ISO/IEC 15693 | SWP, SPI, PC, UART           | Active Load modulation  
Optimized power consumption modes  
NCI 2.0 compliant  
Secure Firmware Update mechanism | BGA 4*4  |
Integrated secure solutions

From ST31 and ST33 secure MCU platforms, STPay software to a complete portfolio of NFC products based on ST53 and ST54 families, ST offers a complete range of turnkey solutions pre-certified for most payment and transit schemes including EMVCo, PBOC, VISA, MC, AMEX, Discover, and MIFARE®. STPay, ST secure payment solution is now available with an over-the-air (OTA) personalization with third party partner.

**KEY FEATURES**
- Enhanced user experience (reading distance)
- Allows ultra-small antenna
- Minimizes footprint
- Facilitates integration
- Increases interoperability
- Helps ensure low power consumption
COMPLETE DEVELOPMENT ECOSYSTEM FOR SECURE SOLUTIONS

Available for ST54 (SCT-DB11G-54xx / SCT-NUCLEO-ST54E1) and ST53 (SCT-NUCLEO-ST53A) platforms, these reference starter kits provide all the necessary software and hardware reference design to help original equipment manufacturers (OEMs) easily integrate secure payment, NFC or multi-application services in their devices as well as evaluate and test the full NFC functionality.

- The hardware reference design for ST54 and ST53 provides the schematics, layout and reference antenna matching.
- The ST21NFC / ST54 Software package includes:
  - NFC explorer allowing Firmware update, Device configuration and the validation, demonstration of capabilities through the usage of basic scenario. Running on PC under Windows 7.
  - Software modules to ease the integration on Android, Windows10 and STM32
- The ST53 Tools package includes:
  - RF parameters adjustment
  - Application development
  - STPay banking application availability

For more information please contact your sales interface.

<table>
<thead>
<tr>
<th>Part number</th>
<th>SE integrated</th>
<th>Contactless Front End</th>
<th>Targeted devices</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST53G</td>
<td>ST31G480</td>
<td>STS922</td>
<td>Ideal for single/dual contactless applications Available with or without STPay ST secure payment application (STPay-Boost)</td>
<td>BGA (4* x 4)</td>
</tr>
<tr>
<td>ST54F</td>
<td>ST33G1M2</td>
<td>ST21NFCD</td>
<td>Supports multiple secure applications</td>
<td>BGA (4* x 4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ideal for middle- and high-end wearables</td>
<td></td>
</tr>
<tr>
<td>ST54H</td>
<td>ST33J2M0</td>
<td>ST21NFCD</td>
<td>Supports multiple secure applications and eSIM Ideal to enable convergence of applications such as eSIM</td>
<td>BGA (4* x 4)</td>
</tr>
<tr>
<td>ST54J</td>
<td>Single die with ST33 2MB &amp; NFC controller</td>
<td>Support multiple secure applications and eSIM. Ideal to enable convergence of application such as eSIM.</td>
<td>WLCSP</td>
<td></td>
</tr>
</tbody>
</table>

PRODUCT PORTFOLIO

ST53G expansion board

SCT-DB11G-54xx
A nucleo adapter is available (SCT-DB11-2-NUCL)
Design support

Make it easy and make it fast

ST has a wide product portfolio for NFC applications and provides solution to ease and solve the most complex design challenge:

• Single Product Evaluation Boards
• Fast prototyping and Development Boards
• Solution Evaluation Boards
• Software Development Tools

HARDWARE ECOSYSTEM

Product Evaluation boards

ST proposes a wide range of evaluation boards that may be used to perform a comprehensive evaluation of ST’s products reducing your development time. These evaluation boards help you evaluate the features and performance of selected products, all of them have published online fully tested schematics, BOMs and Gerber files to facilitate your hardware design. Many, where appropriate, also have demonstration software packages, including example code, available as well.

Antenna e-design tool

To help develop antennas for your NFC solution, ST provides an antenna design tool to compute rectangular antennas for 13.56-MHz signals.

After entering the parameters related to the PCB material and antenna dimensions, the tool estimates the antenna equivalent inductance by calculating the self-inductance and estimating the stray capacitance of the antenna to ensure the best fit for your design.

http://www.st.com/edesignsuite
STM32 Open Development Environment

The STM32 Open Development Environment is a fast and affordable way to prototype and develop innovative applications with state-of-art ST components based on the STM32 32-bit microcontroller family and a comprehensive set of functions for sensing, connectivity, power, audio, motor control and more. The combination of a broad range of expandable hardware based on leading-edge commercial products and modular software, from driver to application level, enables fast prototyping of ideas that can be smoothly transformed into final designs.

The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK-ARM, ARM® mbed™ and GCC-based environments.

http://www.st.com/stm32ode

SOFTWARE DEVELOPMENT TOOLS

STM32Cube software ecosystem

With STM32Cube, ST provides a comprehensive software tool, significantly reducing development efforts, time and cost. Libraries, snippets, middleware, codecs and protocol stacks, sample applications are provided in Firmware packages to assist in the development process. It permits software development with a certain level of abstraction from the register level of the hardware.


Software development kit

The ST25SDK is software library to be used in Java applications. It can be run by any platform supporting JVM (Windows, Android, and Linux) and some components can be re-used for iOS.

It allows to support several readers with the same application and it offers an easy-to-use model of RF tags, including ST’s specific features.

http://www.st.com/st25sdk

Smartphone Apps and SDKs

Several Apps are available to evaluate quickly ST Solutions, multi-platform Software Development Kit for Android and iOS. Easy development thanks to the source code availability and application examples available for quick startup.

COMMUNITY

Connect with our community of ST users from around the world and:

- Ask questions, find answers, get advices;
- Help the community by answering community members’ questions, write helpful content, and vote on polls;
- Share your projects, your events, your videos on ST products;
- Contribute your knowledge by writing tutorials, tips & tricks, and courses.

http://community.st.com
NFC: proximity contactless technology

CONTACTLESS COMMUNICATION: PHYSICAL LAYER

NFC communication is based on contactless standards that use a 13.56MHz carrier, a worldwide license-free frequency. An initiator energizes an antenna with a 13.56MHz signal to create an electromagnetic field. The near field is used to transfer energy to target. The initiator sends data to the target by modulating the field intensity. The target sends back data to the initiator by load-modulating the field.

In passive mode of operation, only the NFC initiator generates RF field. This mode is typically used for reading tags or smart cards. In active mode of operation, both NFC devices take turns to generate RF electromagnetic field. Typically, this mode might be used by two mobile devices during peer-to-peer communication.
**TECHNOLOGIES AND TAG TYPES**

The NFC Forum defines technologies and tag types based on existing proximity and vicinity contactless standards.

<table>
<thead>
<tr>
<th>Tag types</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Type 4</th>
<th>Type 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFC technology</td>
<td>NFC-A</td>
<td>NFC-A</td>
<td>NFC-F</td>
<td>NFC-A or B</td>
<td>NFC-V</td>
</tr>
<tr>
<td>Memory size</td>
<td>96-bytes ÷ 2K-bytes</td>
<td>48-bytes ÷ 2K-bytes</td>
<td>2K-bytes</td>
<td>32K-bytes</td>
<td>64K-bytes</td>
</tr>
<tr>
<td>Data rate (kbit/s)</td>
<td>106</td>
<td>106</td>
<td>212 / 424</td>
<td>106</td>
<td>26.5</td>
</tr>
<tr>
<td>Anti-collision</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Capability</td>
<td>Read</td>
<td>Re-write</td>
<td>Read</td>
<td>Re-write</td>
<td>Read</td>
</tr>
<tr>
<td></td>
<td>Re-write</td>
<td>Read-only</td>
<td>Re-write</td>
<td>Read-only</td>
<td>Re-write</td>
</tr>
<tr>
<td></td>
<td>Read-only</td>
<td></td>
<td>Re-write</td>
<td>Factory-configured</td>
<td>Read-only</td>
</tr>
<tr>
<td>Notes</td>
<td>Simple, cost effective</td>
<td>Simple, cost effective</td>
<td>Complex applications, targeting Japanese market</td>
<td>Complex applications</td>
<td>Vicinity area</td>
</tr>
</tbody>
</table>

**NFC COMMUNICATION PRINCIPLE**

The simplicity of the NFC technology relies on fast and simple communication steps. There are always an initiator, typically a NFC reader or a mobile one, and a target, typically a tag or mobile phone in card emulation mode.

**A - TECHNOLOGY DETECTION**

Initiator scans for targets and detects them by their technology (NFC-A, B, F, V).

**B - COLLISION RESOLUTION**

Initiator uses anti-collision to handle presence of multiple tags with same technology.

**C - TARGET DEVICE ACTIVATION**

The initiator activates one device among the targets identified in previous steps.

**D - DATA EXCHANGE**

Initiator starts to read/write data to the target.
DATA ORGANIZATION AND EXCHANGE

NDEF

The data in an NFC device are organized in records according to a structured format, known as the NFC Data Exchange Format (NDEF). The records contain information that is encoded according to the Record Type Definition (RTD) specification:

- “Device information”, like firmware version
- “Text” strings
- “Universal Resource Identifiers”, like web URL
- “Connection Handovers”, used for pairing
- “Signature”, used for authentication
- “Smart poster”, text like SMS message

NDEF also defines how to encapsulate records into a message in order to transmit them to the other device. NDEF is supported by all NFC compliant devices regardless of their types.

For mobile, the NDEF message is interpreted by the built-in SW and it will trigger the appropriate action by the device itself like:

- Send an e-mail or SMS
- Open a web page
- Place a call
- Launch a specific application

The complete list of actions and RTD is defined and maintained by the NFC Forum.

SNEP

In peer-to-peer mode, more complex and larger amount of data are exchanged. The data exchange is done according to Simple NDEF Exchange Protocol (SNEP) to ensure an efficient, robust and fast transaction.

SNEP uses a reliable transport layer: Logical Link Control Protocol (LLCP).

NFC CERTIFICATION

The NFC Forum Certification Program confirms that your device, tag or reader is compliant with NFC Forum specifications. Conformance to the specifications provides consistency of behavior across NFC implementations and sets the foundation for interoperability.

Users — both commercial and consumer — will benefit through access to features such as program and firmware updates, inventory management and control, and access to information and pricing that improve convenience and productivity.

https://nfc-forum.org/certification-program-overview/
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AAT</td>
<td>Automatic Antenna Tuning.</td>
</tr>
<tr>
<td>Card Emulation mode</td>
<td>NFC mobile device emulating a contactless card.</td>
</tr>
<tr>
<td>EMV</td>
<td>Sets of specification issued by EMVCo to cover all different payment modes such as contactless card, mobile payment…</td>
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<tr>
<td>EMVCo</td>
<td>Association of leading company in payment industry.</td>
</tr>
<tr>
<td>FeliCa</td>
<td>Contactless IC card technology developed by Sony Corporation</td>
</tr>
<tr>
<td>ISO/IEC 14443</td>
<td>ISO specification defining behavior and protocols for proximity contactless cards and readers</td>
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<tr>
<td>ISO/IEC 15693</td>
<td>ISO specification defining behavior and protocols for vicinity contactless cards and readers</td>
</tr>
<tr>
<td>ISO/IEC 18000-3M3</td>
<td>ISO specification defining communication mode for near field communication</td>
</tr>
<tr>
<td>ISO/IEC 18092</td>
<td>ISO specification defining communication mode for near field communication</td>
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<tr>
<td>ISO/IEC 18000-3M3</td>
<td>ISO specification defining RFID 13.56Mhz air interface standards for the item identification world</td>
</tr>
<tr>
<td>Inlay</td>
<td>Thin laminate containing antenna and NFC tag IC</td>
</tr>
<tr>
<td>NDEF</td>
<td>NFC Data Exchange Format. Specification defined by NFC Forum</td>
</tr>
<tr>
<td>SNEP</td>
<td>Simple NDEF exchange Protocol. Specification defined by NFC Forum</td>
</tr>
<tr>
<td>NFC Forum</td>
<td>Association of industry actors, that is specifying, certifying and promoting NFC technology. <a href="http://www.nfc-forum.com">www.nfc-forum.com</a></td>
</tr>
<tr>
<td>P2P</td>
<td>Peer-to-Peer mode. Communication mode defined by NFC Forum, used to establish a link between two symmetric NFC devices.</td>
</tr>
<tr>
<td>POS</td>
<td>Point of Sale. All recent models include a NFC reader device</td>
</tr>
<tr>
<td>SWP</td>
<td>Single Wire Protocol. Used to connect SIM or eSE to the NFC controller in a mobile device. Specification defined by ETSI</td>
</tr>
<tr>
<td>Initiator</td>
<td>NFC Forum device that starts a NFC Communication</td>
</tr>
<tr>
<td>Target</td>
<td>NFC Forum device that is reached by the initiator</td>
</tr>
<tr>
<td>Universal device</td>
<td>NFC Forum device that is reader/writer, supports P2P and optionally card emulation mode</td>
</tr>
<tr>
<td>Tag device</td>
<td>NFC Forum device with which a Reader /writer can communicate and contain an NDEF</td>
</tr>
<tr>
<td>Reader device</td>
<td>NFC Forum device which can communicate with tag devices</td>
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<tr>
<td>LLCP</td>
<td>Logical Link Control Protocol. Specification defined by NFC Forum</td>
</tr>
<tr>
<td>RTD</td>
<td>Record type Definition. Specification defined by NFC Forum</td>
</tr>
<tr>
<td>VHBR</td>
<td>Very High Bit Rate</td>
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<tr>
<td>AEC-Q100</td>
<td>Specification established by the AEC Component Technical Committee to define common electrical component qualification requirements for automotive industry</td>
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