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How can NFC add value to your brand and enhance the user experience ?

Innovative manufacturers continuously endeavor to add value to their portfolio using several means which may include a combination of adding original products and features, enhancing the customer experience, user personalization or brand recognition. They also want to protect their investments and market share by preventing competitors from easily entering the marketplace. To tackle these factors, several technical challenges must be overcome efficiently and cost-effectively.

Multi-purpose products often come with accessories which may have to be configured individually. For example, power tools can often be used with various accessories such as a jigsaw or a sander; each requiring different adjustments in terms of motor rotation speed, torque, etc.

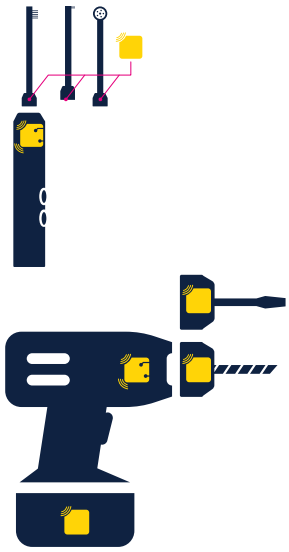
Similarly, products using disposable items can benefit from dynamically applying specific settings in order to provide the optimal experience for the various types of consumables.
A good example is a tea or coffee machine that requires different parameters for brewing the various beverages.

Such products are also prone to counterfeit accessories or consumables. Counterfeit accessories may damage the brand by negatively affecting the user experience, potentially causing harm to the user, and reducing the potential benefits the company might seek otherwise. The impact on business revenues can be significant in some cases.

When solving these challenges, wouldn't it be beneficial to be able to conveniently improve your customer relationship? How can you smoothly deploy innovative products and user enhancements without the need for complex or costly solutions?

Let us walk through the following examples of products that benefit from dynamic configuration or need to identify their accessories unequivocally.

CUSTOM SETTINGS FOR A WIDE VARIETY OF DEVICES

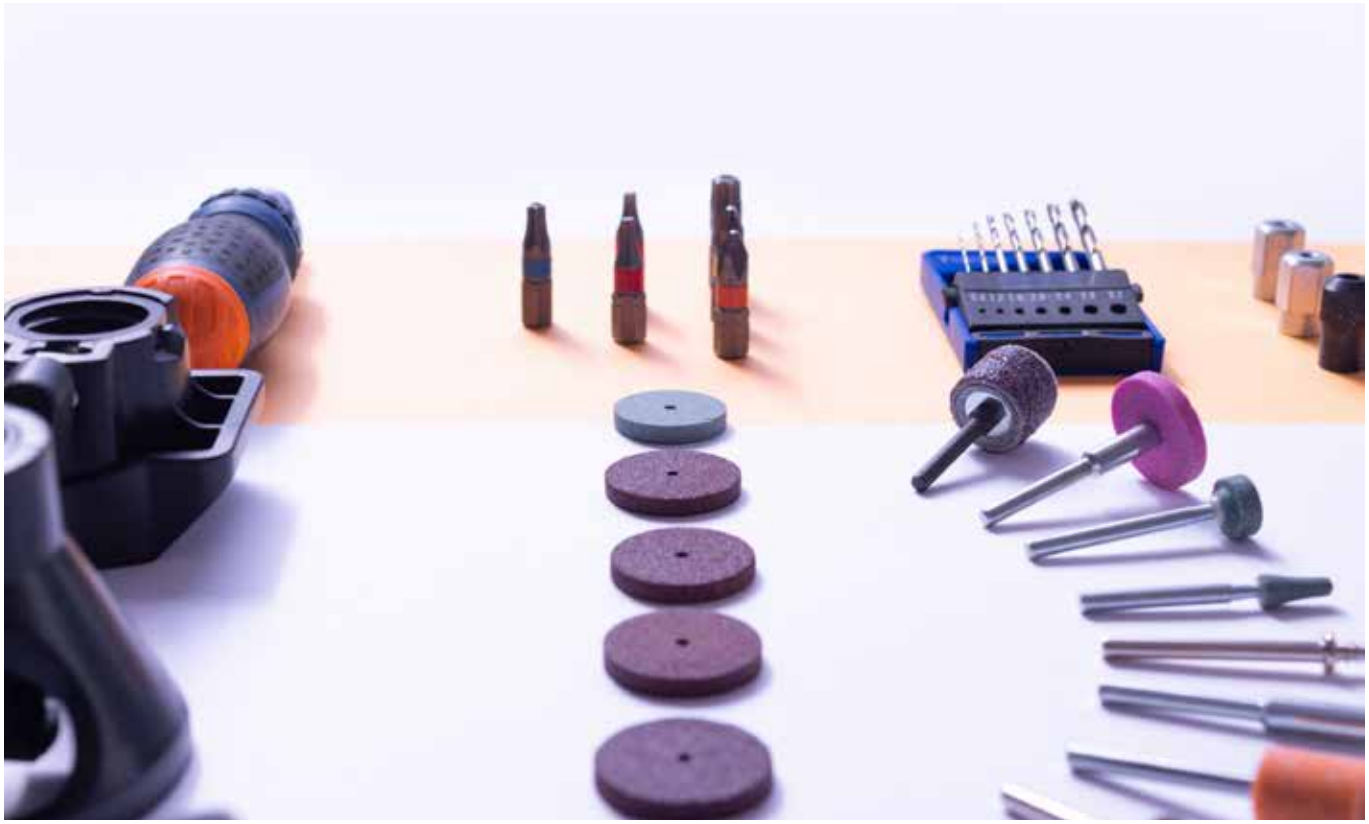


When users can buy a single, reliable device that can be used for multiple functions by adding different, well-suited accessories, they will continue to invest in the brand as it helps them save both money and storage space in an environment-friendly approach.

Multi-purpose tools aim to adapt the main unit parameters to the requirements of the specific accessory (for example, personal care products, such as toothbrushes or glucose meters) in a seamless way. By doing so, the end product is more adaptive, can be further optimized and will provide the end user with improved performance and convenience.

Several products such as power tools and small appliances could benefit from an automatic/dynamic configuration once an accessory or a consumable is plugged into the main unit. A power tool could adjust its settings (e.g. speed, torque, air flow, heat, etc.) for best performance.

Also, multi-purpose devices could become more practical when a user connects their own accessory, the main unit recognizes it automatically and applies the user's preferred settings. Devices that are shared among multiple users such as gym or laboratory equipment could recognize the user and adjust the settings automatically according to the user's preferences.



This type of user-friendly design greatly improves the product's usability and setup times for an enhanced customer experience in complete safety. Once the product is identified, devices could provide tips on using the accessory, enrich the user experience with a particular interface, or link to a webpage with more information and promotional offers, etc.

In addition to the immediate benefits for the consumer, manufacturers can improve product traceability and manufacturing processes including in-factory programming of firmware or custom settings, storage of quality control data, or the building of digital twins.

ENSURE BRAND RECOGNITION AND DEVICE AUTHENTICITY

Brand recognition is, in certain applications, a key element for customers that guarantees quality, reliability, and performance of products and features. Brand recognition, or the ability to easily identify products and accessories, can also involve verifying the device's authenticity. If an accessory is not recognized, the product could warn the user of a non-certified accessory and prevent starting up, guaranteeing that the product only works with approved accessories and ensuring end user's safety. More details related to brand recognition can be found in our **ST25 Security and Privacy application notes.**

There already exist several means to ensure brand authenticity with different levels of complexity and assurance.

Where high-value products may require a sophisticated scheme to ensure an item's origin; in low-end products (e.g., disposable consumables), a simpler and less costly solution can also ensure a sufficient level of confidence.

CONVENIENTLY BOOST CUSTOMER ENGAGEMENT, LOYALTY AND SALES

With the aim of generating more sales and fostering loyalty and brand awareness, a company is always looking to improve its relationship with its customers. Thanks to marketing or awareness campaigns via social networks, websites, etc., companies seek to establish a privileged and unique relationship with their customers and offer them the best possible experience. This consumer engagement remains a key factor in the brand's success. A convenient way to encourage consumer engagement is to rely on devices that users already carry with them at all times, namely mobile, portable or wearable devices. The product to be purchased must also contain information that when accessed with a mobile phone, for instance, will enable consumer engagement.

Several different use cases could be conveniently deployed to boost customer engagement, loyalty and sales such as reordering consumables, displaying additional information about the products or accessories, or activating a product warranty as well as registering for a user account to benefit from additional offers or services.

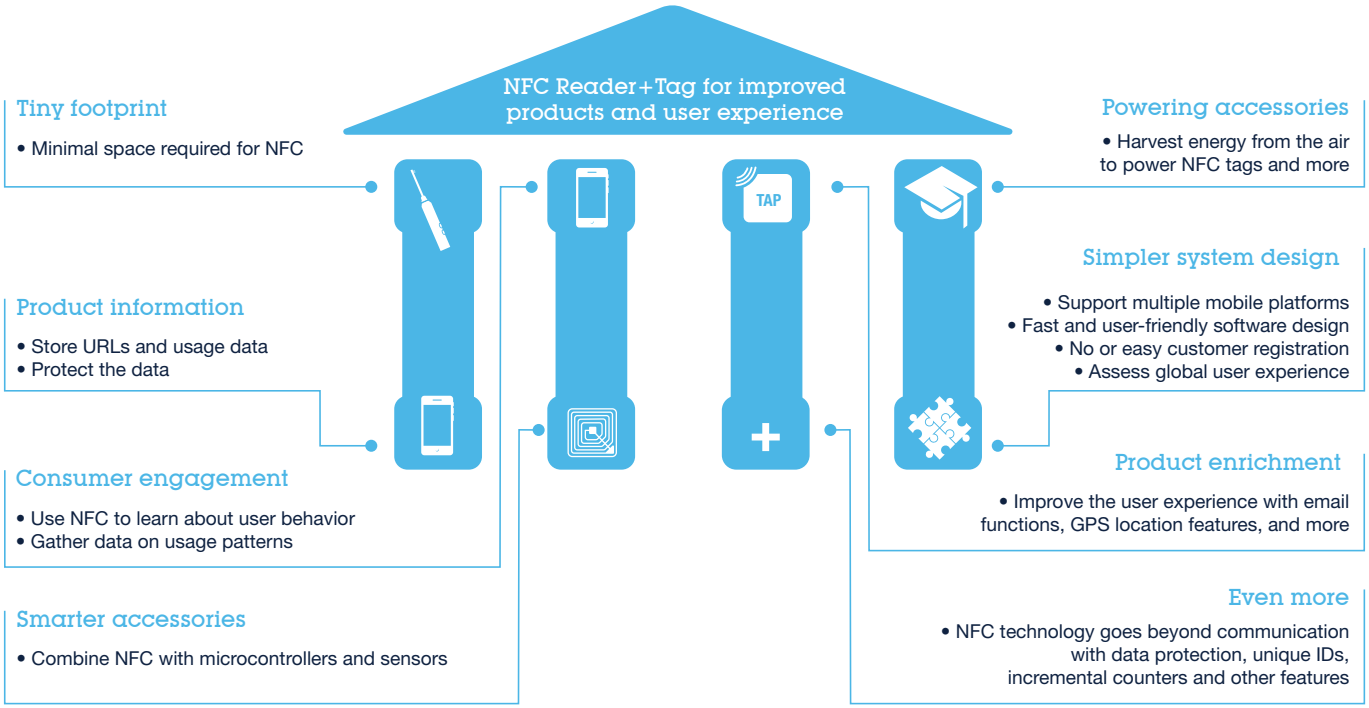
Air purifier and filter (consumables)

USING NFC TECHNOLOGY TO IMPROVE PRODUCTS AND USER EXPERIENCE

Near Field Communication (NFC) technology fully addresses all these needs. Widely available in both consumer and industrial applications, this technology has a short communication range and is well adapted for systems that require a main unit with several other parts that can be plugged in at any given moment of operation. The use of an NFC reader on the main unit combined with NFC tags on accessories/consumables can easily be adapted for such scenarios and resolves a number of technical challenges related to their integration.

NFC technology makes it easy to implement product configuration as well as brand recognition and authentication functions, even for the tiniest devices. By adding value to the product, NFC enriches customer engagement, loyalty and sales.

To further enhance the user experience, the overall system design can be combined with microcontrollers and sensors to create smarter products that offer new functionalities and improve reliability in addition to increasing product utilization and its capabilities.



Using NFC technology to increase your brand's reach

Tiny footprints

The NFC technology can fit into tiny footprints, enabling its implementation in devices such as toothbrushes, rings, and other small personal electronic devices.

NFC technology is already embedded in several products today with only minimal space for electronics.

Storing product information

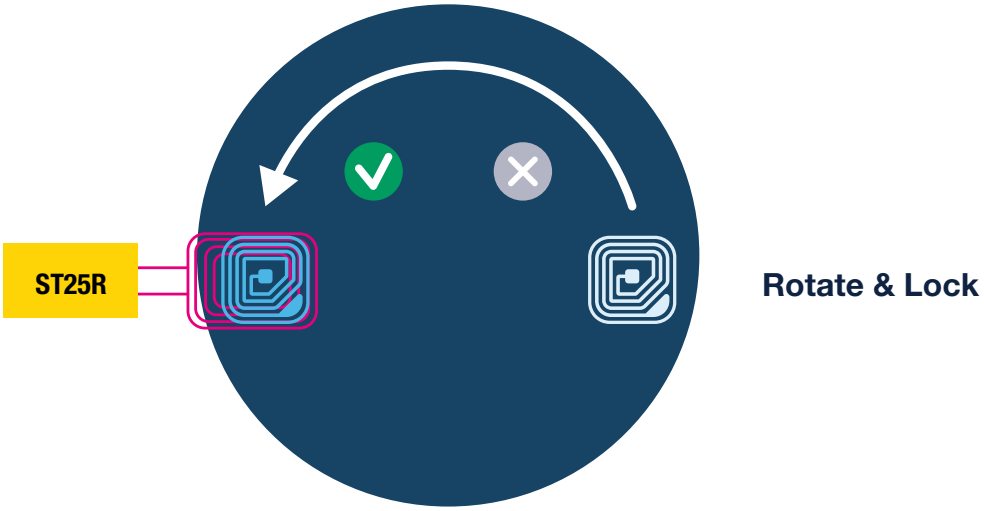
NFC tags include non-volatile memories of various sizes that can store different information including product usage data such as time since last use, days since last purchase, etc. as well as URLs to product pages and e-store websites. Several mechanisms embedded in the NFC tags can be used to protect sensitive information. Proprietary data schemes can be applied, or when formatted in compliance with NFC Forum standards, tags can be read with any smartphone that has NFC capability, nearly 80% of devices being used today.

Simplifying system design

A low-cost solution for contactless communication, NFC tags are perfectly suitable for deployment on most accessories and consumables. Under certain circumstances, NFC technology has several advantages over a wired/contact connection, especially if the distance between the reader and tag is only a few centimeters as there is no need to meet stringent physical characteristics such as a controlled placement and can offer some design flexibility.

However if necessary, the reading distance can be also tailored to enforce a more controlled placement. One possible use case would be the improvement of mechanical safety. For example, the mechanical mounting mechanism of a blender could

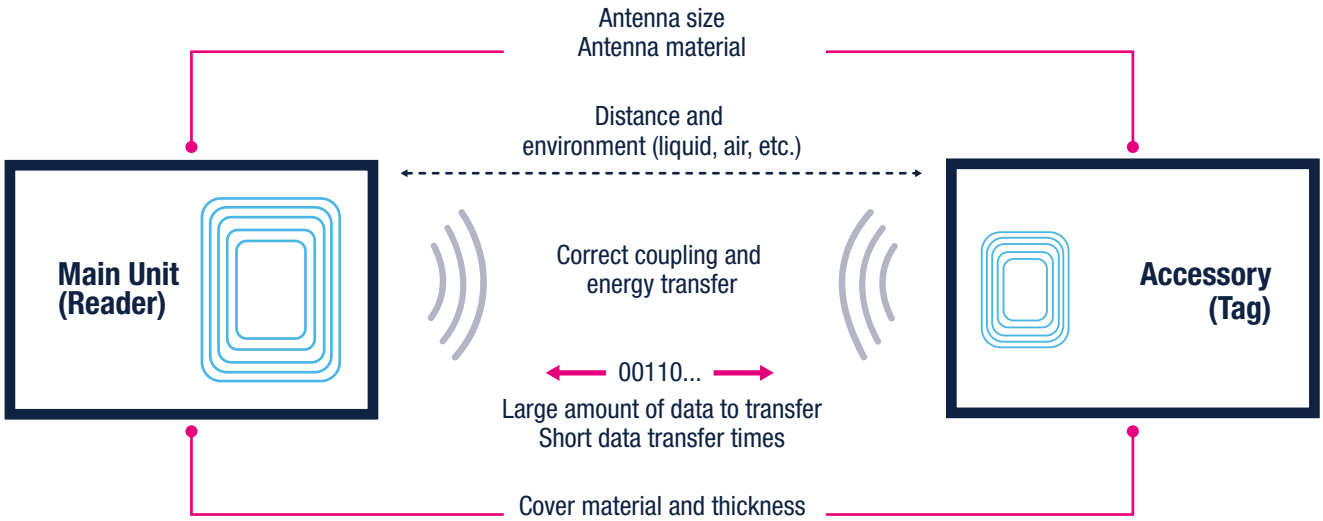
be improved by adding an NFC enabled rotate & lock feature, which would verify its correct position by checking the alignment of a reader in the main unit and a tag in the accessory.



An NFC-enabled mechanism designed to ensure the safe positioning of accessory on main unit

As NFC is a wireless interface, both the reader in the main unit and the tag in the accessory can be protected by a plastic cover, and still be read correctly when placed in contact or separated by up to a few centimeters. Furthermore, NFC alleviates design constraints in regard to waterproof system requirements when compared to wired connections.

However, a few constraints need to be considered when designing the system such as RF power, antenna tuning, and other characteristics for wireless communication and energy harvesting.



Considerations for system design

A wide variety of choices are possible to meet most system design needs. More extensive recommendations on how to make an NFC implementation successful are available in our **NFC design considerations for an improved User Experience whitepaper.**

Bringing power to the accessory

NFC tags can be powered through the RF energy transmitted by the reader. This technique is called energy harvesting.

In turn, tags with an energy harvesting feature can provide a certain amount of power from the NFC reader to the accessory which might not have any power source otherwise. This amount of power is sufficient to control for example an LED that would indicate the access is recognized.

Smarter accessories

While the simplest NFC tags will always be able to provide static information, when adding an NFC tag as an interface to a microcontroller, the accessory becomes smarter. NFC tags able to exchange data with a microcontroller are known as dynamic tags.
When coupled with a microcontroller and its firmware, dynamic tags could be used to enable self-diagnostics on the accessory and send the result back to the NFC reader for proper handling.

Sensors integrated with the accessory could indicate whether its temperature is within acceptable limits or if the accessory is correctly positioned, replacing more costly mechanical switches.

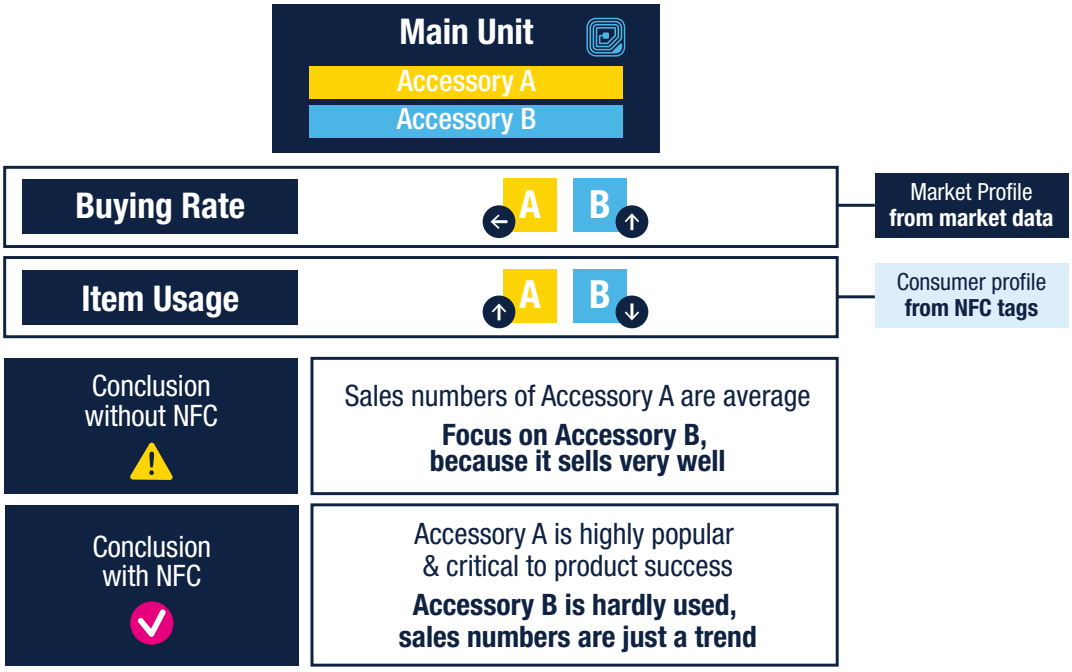
For example, an angle grinder could monitor the temperature of its disk and shut down the tool if the temperature could damage the material being grinded or the grinder itself. An LED could also indicate if the device is safe for operation or possibly cause damage.

An enriched user experience for improved customer engagement

On top of the technical advantages, NFC solutions already comprise several extended features that enrich your product to better fit into your customers' lives and change them for the better.

An additional benefit when products embed product configuration or brand authentication features is that customer engagement comes at little expense. Customer engagement is enriched with NFC as the tags embedded in the accessory or the main unit typically can code an URL that when read by a smartphone will directly browse to the brand's website. Standardized actions are also available such as sending an email requesting more information or for registering the product in addition to displaying the location of the nearest repair facility or authorized store via an online mapping app. There are an endless number of innovative possibilities.

A dedicated mobile app could also be downloaded from a digital application distribution service to gain insight into users' behavior so as to increase value to the customer and to the brand. This is a major benefit for manufacturers who now have much more comprehensive and accurate data about user behavior and preferences than simple market data like sales numbers or trends. Using this data prevents drawing false conclusions based on inaccurate data and enables management to make strategic decisions. All these capabilities as a standalone solution or in some combination can further improve how the customer perceives the brand, with an enhanced user experience.



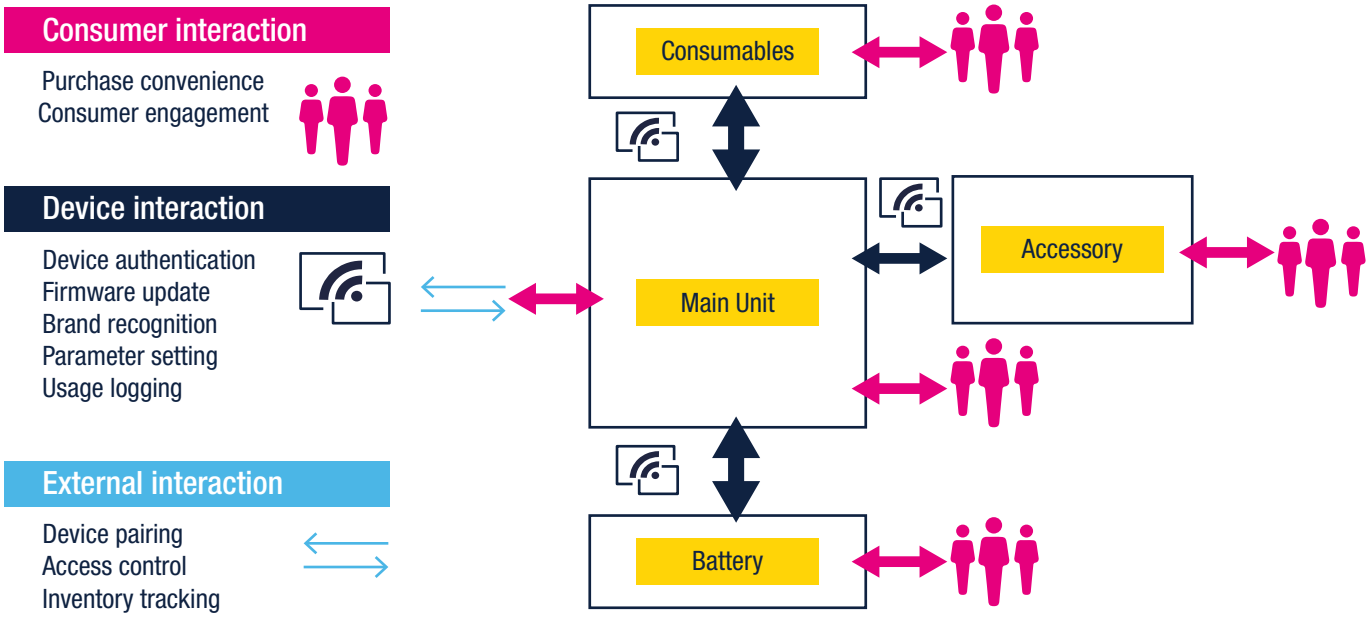
Using NFC as a supplement to gather market data

In the above example, a product is comprised of one main unit and two types of accessories. The information gained through market data suggests that Accessory B is selling far better than Accessory A. Therefore, management could make the decision to ramp down Accessory A and strictly focus on Accessory B.

Using the data from user behavior tracking via NFC, management gets an additional perspective showing, that although good in sales, Accessory B is hardly used. As Accessory A is very popular according to the user logs, it is critical to the product's success and Accessory B might be a non-sustainable trend.

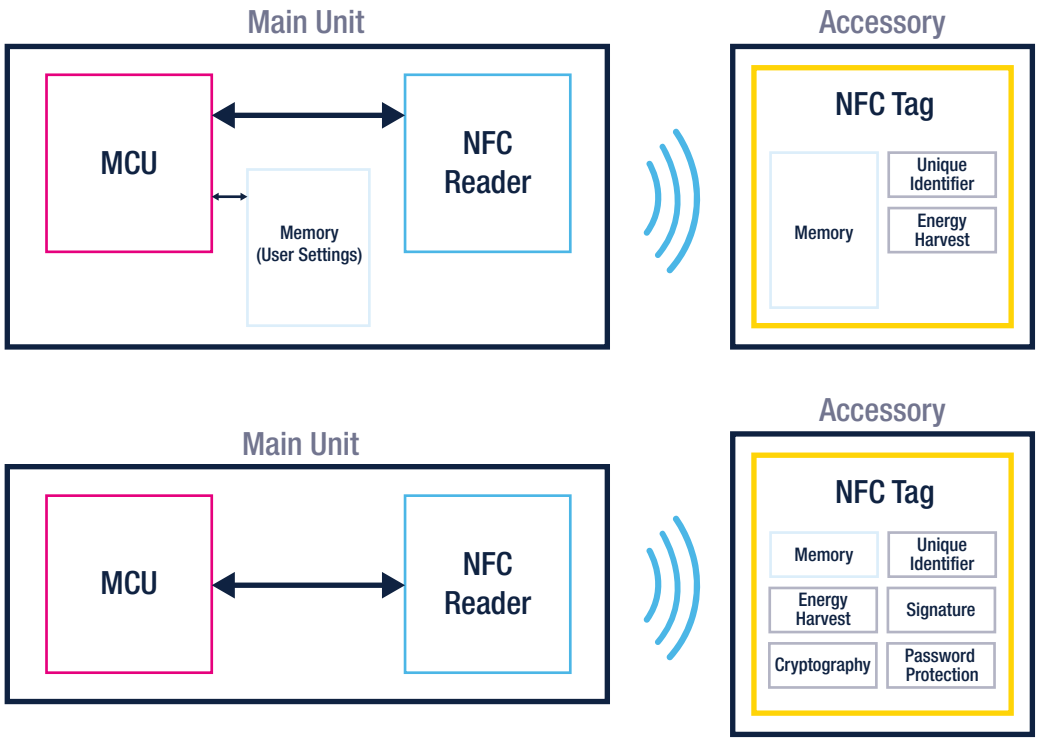
How does it all fit together?

The following diagram demonstrates in which areas NFC provides a convenient solution within a larger system.



NFC use cases

A typical system would, for example, consist of an NFC reader and a main unit with a microcontroller whose memory stores a database of user or accessory settings. The accessory would integrate an NFC tag that consists of a memory and several other features such as a Unique Identifier, incremental counters and an energy harvesting function.



Typical setups of an NFC-equipped product

Giving life to your brand

Bringing digital life to everyday consumer goods becomes possible when approaching an NFC-enabled smartphone to an NFC tag located on the product, and then opens a great world of possibilities including a website, phone number, social media, loyalty, warranty, coupon delivery, deals, contest registration, and product identification for many applications including consumer engagement, brand protection, anti-theft, asset tracking, and more.

How brand authentication and product configuration features work

Solutions for brand authentication	
Unique Identifier (UID)	The IC manufacturer assigns an UID to the tag, which is typically used to verify the identity of an accessory. The UID can also prevent cloning attacks when a password is included in the tag. When the tag's data is copied onto another tag, the data cannot be decrypted or accessed by the password because the UID will be different.
Digital Signature	The IC manufacturer assigns a digital signature to the tag, based on cryptography. The digital signature is computed in a secure environment and using the Manufacturer's secret and unique encryption key. During the assembly, new information and digital signatures can be added to the product's tag to further protect each step of the manufacturing process. By checking this signature, the reader guarantees the tag's origin and that the accessory is not counterfeit.
Data Protection by password	A tag's user data can be read and/or write protected using passwords. Only the main unit with the proper password will be able to access the data in the accessory, thus ensuring the accessory will not work with a non-authorized device. Similarly, password-protected commands will not be executed unless they are accompanied by the correct password.
Tamper protection	Tamper protection lets you know if an accessory has been modified or not. For example, it detects if the device has been opened. Tags with the tamper protection feature can be interrogated by the reader in the main unit to determine the tamper status of the accessory and then proceed accordingly.
Received Signal Strength Indicator (RSSI)	The RSSI and other diagnostics can be used to detect any changes in certain well-known system characteristics (based on factory values) which may be due to a potential malicious attack.
Collision detection	NFC solutions are fitted with mechanisms that can detect when two or more tags are present in the reader's field (known as a collision) which can be used to identify unexpected operating conditions due to several reasons which may include a potential malicious attack.
Protocol/Framing	NFC readers and dynamic NFC tags have a great flexibility on the data exchanged via RF allowing for custom solutions based on proprietary commands. This gives systems additional flexibility to use non-standard mechanisms and the ability evolve over time, even after the products have reached the end customer.
Automatic Antenna Tuning	This feature helps optimize a reader's field range and signal strength so that it functions correctly in harsh environments that have moving metallic parts, temperature drifts, and other challenging conditions for wireless communication.
Solutions for product configuration	
Non volatile memory (EEPROM)	The data stored in the tag's memory contain parameter settings needed by the accessory to work properly with the main unit (reader) as well as other data required for the application.
Energy harvesting	Energy harvesting allows the tag to recover energy from the reader's RF field for use in the accessory. For example, the energy can be used to power an LED in different colors to show whether the accessory is recognized by the main unit, whether it is working properly, etc.
Dynamic NFC tags	Dynamic NFC tags have a wired interface in addition to the wireless interface. The wired interface can be connected to an MCU that is either powered by a battery or by energy harvesting. If the accessory has a dynamic NFC tag, it can be used for specific diagnostics when sensors are integrated with the accessory and controlled by an MCU. Diagnostic results can be returned to the main unit for further processing and/or storage or stored in the accessory tag's memory to keep track of its history.
Incremental counters	Tags typically contain counters that are incremented on certain actions such as writing to the tag. This feature enables readers to keep track of the number of times an accessory has been used for example and to warn the end customer when maintenance is required.

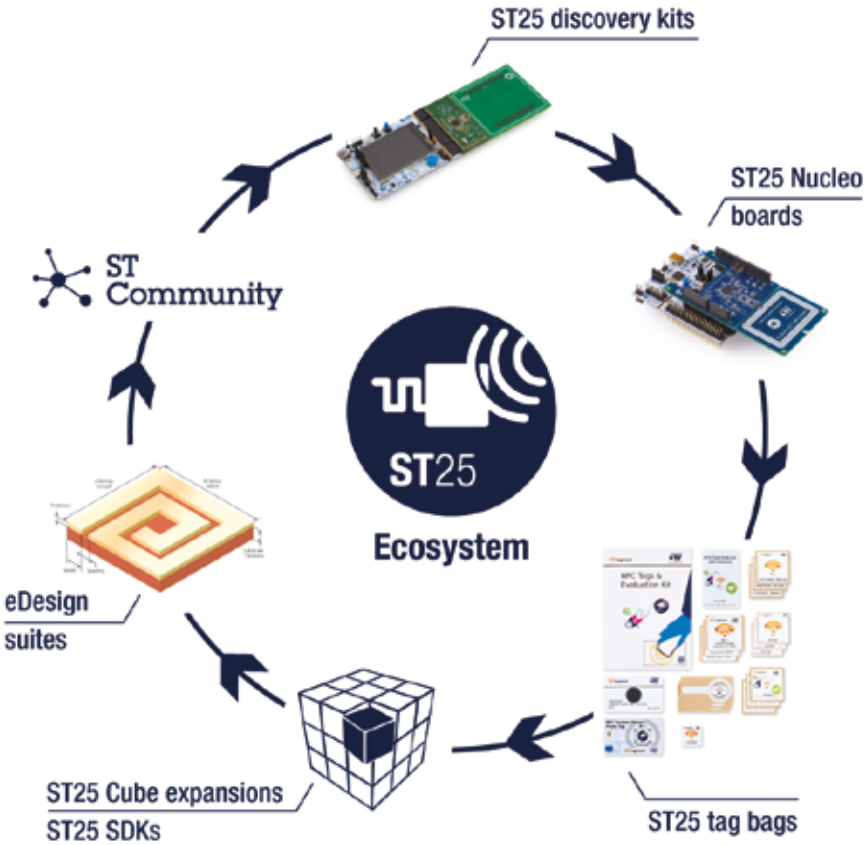
HOW CAN ST HELP YOU GET TO MARKET QUICKER?

To best meet all your requirements, ST offers a full range of static (ST25T) and dynamic NFC tags (ST25D) with various memory sizes and reading distances as well as a comprehensive feature set for brand authentication, production configuration, and more.

ST's ST25R series of NFC reader ICs include entry-level as well as high-performance devices for a perfect fit for all specific needs and applications. Integrated into size-optimized footprints, ST25 readers offer a variety of features such as automatic antenna tuning, dynamic power output, and power-saving wake-up modes to ensure reliable and efficient operation in all environments. NFC Forum certified, interoperability with other certified products on the market is guaranteed while granting a high flexibility for each application at the same time.

STMicroelectronics is continuously expanding its portfolio of NFC solutions and works closely together with customers to meet their needs. This approach fits perfectly with ST's core value of providing excellent products as well as a comprehensive development ecosystem. Starting from the first proof-of-concept, for which various evaluation boards are available, up to prototype development, where design tools, software development kits (SDK), and reference designs pave the way - ST supports every step of the development towards a successful product. Underlining this open-source mentality, also the set of application notes, demos, videos, and other collateral is being released on a regular basis.

Being the perfect companion for ST25 products, the widespread STM32 MCUs come with a large variety of feature sets to leverage the deployment of NFC solutions.



ST25 discovery kits

CONCLUSION

NFC technology is perfectly suitable for addressing solutions requiring product/feature differentiation, dynamic product configuration, customer experience enrichment, user personalization and brand recognition.

Its ubiquity, cost-effectiveness, energy harvesting, and contactless communication capabilities grant several possibilities for manufacturers to add value to their product lines as well as to better serve their customers.

Thanks to the combination of an NFC reader in the main unit and a static or dynamic NFC tag in the accessory, the whole product performs better, safer, and lets you provide a unique solution with a whole new range of capabilities to better improve the user experience and bring life to your brand.

Explore our ST25 NFC Reader+Tag ecosystem page and discover helpful information about integrating related components, real-life use cases, featured products, evaluation tools and developer resources.

www.st.com/reader-plus-tag

ADDITIONAL RESOURCES

ST25 Reader+Tag ecosystem
[www.st.com/reader-plus-tag]

Near Field Communication (NFC) technology
[www.st.com/nfc]

ST25 Evaluation tools
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List of NFC Forum certified products
[https://nfc-forum.org/our-work/compliance/certification-program/certification-register/]

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