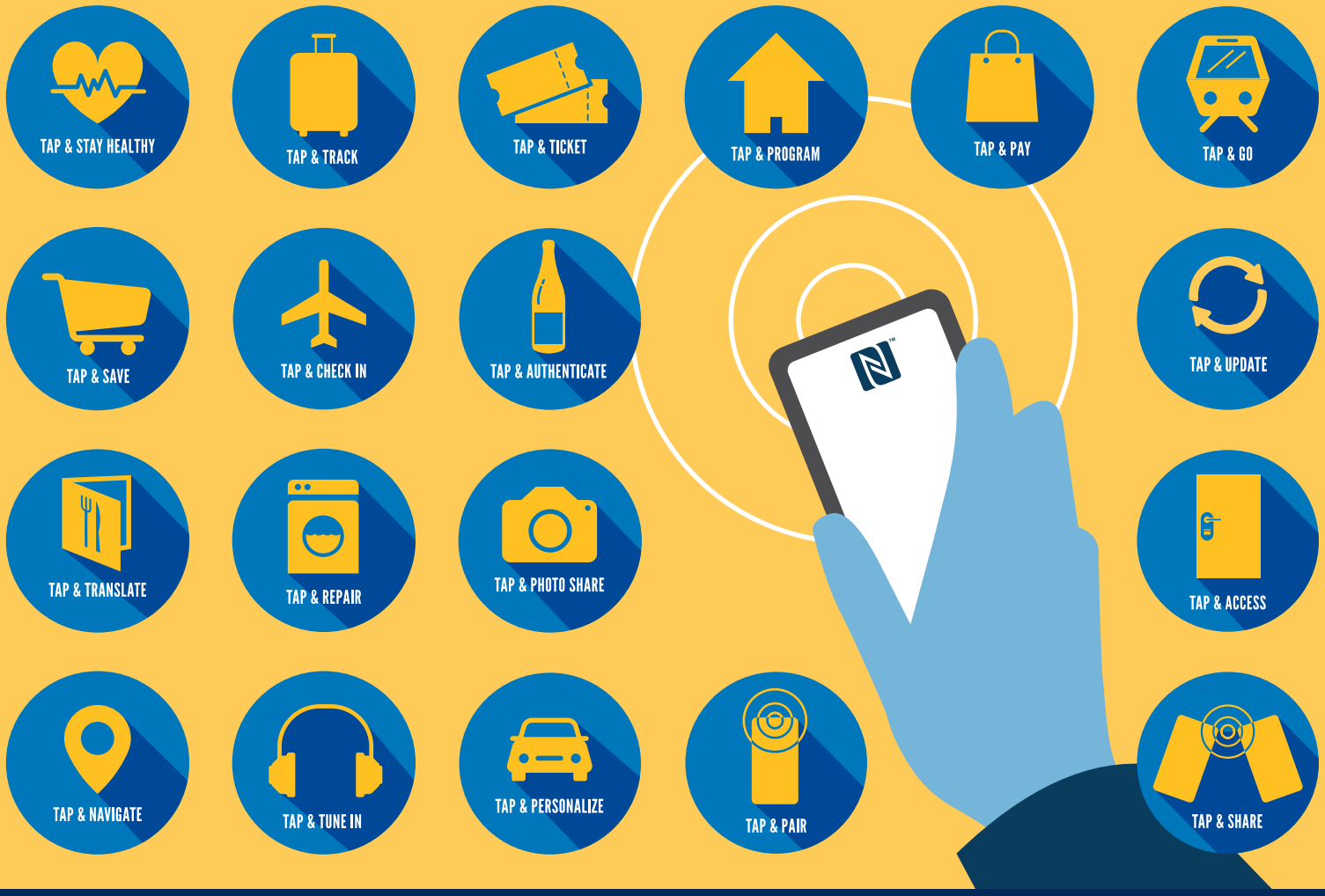

NFC Forum 15-Year Position Paper

Accomplishments and the Future

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NFC FORUM

Contents

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Introduction: 15 Years of NFC Technology Advancement

Since 2004, the NFC Forum has led the effort to expand the adoption of Near Field Communication (NFC) technology around the world.

It all started in March of that year, when Nokia, Philips Semiconductors (now NXP), and Sony first joined together to harmonize and build upon RFID standards for Near Field Communication as the NFC Forum. Within months, companies from around the globe – today's sponsor level members include: Apple, DNP, Google, Infineon, Mastercard, NXP Semiconductors, Qualcomm, Samsung, Sony, STMicroelectronics, Thinfilm and Visa, which includes a seat on the Forum's Board of Directors.

Over the next 15 years, as our membership grew and the board expanded, the Forum focused on three areas of development: Technical Specifications, Compliance and Certification Programs, and Market Adoption Initiatives.

Highlights of our accomplishments include:

- June 2005: The launch of the first four Technical Working Groups
- June 2006: NFC Forum announces its NFC technology architecture and first five specifications
- December 2006: Membership tops 100 member organizations
- July 2007: NFC Forum issues four tag type specifications
- September 2007: NFC Forum announces its 130th member
- January 2008: BBC names NFC as one of the "Five Top Technologies of 2008"
- March 2009: NFC Forum and ETSI sign agreement to promote global interoperability
- June 2009: Target N-Mark is introduced
- August 2009: NFC Forum and Mobey Forum sign partnership agreement
- February 2010: NFC Forum forms liaisons with EMVCo and Smart Card Alliance
- December 2010: NFC Forum launches Certification Program
- December 2010: 15th NFC specification published
- July 2011: Partnerships formed with APSCA, ARTS, and Open Mobile Alliance
- October 2011: NFC Forum forms partnership with Continua Health Alliance
- December 2011: NFC Forum and Bluetooth SIG publish developers' guide
- June 2012: NFC Forum signs MOU with GS1
- October 2012: NFC Analog technical specification published
- November 2012: NFC Forum publishes NFC Controller Interface (NCI) specification
- January 2013: NFC Forum signs collaboration agreements with Global Certification Forum, IATA and Wi-Fi Alliance
- January 2013: First NFC Forum Special Interest Groups (SIG) launched
- July 2013: Health Care Technical Specification published
- February 2014: NFC Forum signs collaboration agreement with SD Association

- October 2014: NFC Forum launches NFC Developers Program
- October 2015: Type 5 Tag Technical Specification published
- February 2016: NFC Forum signs collaboration agreement with APTA
- May 2016: NFC Forum signs collaboration agreement with Global Certification Forum (GCF)
- June 2016: First VISIONFC event held
- June 2016: NFC in IoT white paper published
- September 2016: NFC Forum forms partnerships with Car Connectivity Consortium (CCC), Fast Identity Online (FIDO) Alliance, and Smart Ticketing Alliance
- November 2016: NFC Forum unveils tag certification initiative
- March 2017: 100 entries compete in the NFC Forum Innovation Awards
- April 2017: NFC Forum, European Committee for Standardization TC278 WG3 and GSMA collaborate to enable public transport interoperability
- August 2017: NFC Forum signs liaison with the Active & Intelligent Packaging Industry Association (AIPIA) and the Wireless Power Consortium (WPC)
- September 2018: NFC Forum signs liaison with the German Association of the Automotive Industry
- September 2018: NFC signs liaison with the Thread Group
- January 2019: NFC Forum announces specification for wireless charging of IoT devices
- January 2019: NFC Forum signs liaison with AIM
- March 2019: NFC Forum signs liaison with LoRa Alliance
- August 2019: NFC Forum receives ASAE 2019 Power of A Silver Award for innovation and positive contributions to society

Success Across Many Markets

The NFC Forum's Special Interest Group (SIG) initiative fosters broad adoption of NFC technology by sharing expertise across key vertical market sectors. The member-driven SIG Committee and its Working Groups create opportunities across Forum membership to accelerate the delivery of exciting new NFC solutions for businesses and consumers.

Working Groups enable members to take an active role in fostering the adoption of NFC technology among stakeholders within targeted industry sectors. Initial objectives for activities undertaken by each individual SIG include:

- Encouraging broad adoption of NFC deployment by defining and promoting NFC solution use cases
- Gathering new business and technology requirements to drive future new and modified technical work
- Establishing collaborative relationships with liaison organizations to further joint efforts
- Creating educational tools and guidelines for each industry (e.g., white papers, demos, best practices, how-to guides, etc.)

In recent years, the work of the SIGs has been focused on key vertical markets, and great progress has been made in accelerating adoption of NFC technology in these markets. In recent years, the SIGs have published use cases, case studies, white papers, webinars and other educational materials for the benefit of the industry.

Mobility, Identity and Transport

More and more, consumers rely on their mobile devices to get things done every day—from reading the news to navigation to banking. That trend will only accelerate as personalized mobility services play a greater role in our future.

People want to choose how they access mobility services. They want to be able to seamlessly switch between different mobility options. Examples include: private and public services, such as metro and bus networks; park-and-ride schemes; car and ridesharing services; bike rental systems; and pop-up services with on-demand cars or buses. Service providers need to develop solutions that can integrate different types of transport services into a single, personalized mobility application tailored to the needs of each traveler and available on any form factor – from cards and tickets, to wearables and smartphones.

This requires mobility platforms based on NFC technology. Form factor independent technologies such as NFC and protocols are key enablers in this evolution. Already today, by allowing a mobile phone to act as a contactless transport card (or as a card reader), NFC enables millions of NFC-enabled devices in the marketplace to work seamlessly with the millions of contactless readers that Public Transport Operators have deployed globally.

The widespread adoption of NFC in Public Transport requires the assurance that NFC-enabled devices will interoperate with existing Public Transport systems throughout the world. Working with industry organizations, standards bodies, and Public Transport Operators, the NFC Forum has succeeded in providing this assurance by harmonizing the

specifications of the mobile device NFC interface with those of Public Transport readers and cards. Test specifications have been amended accordingly.

These actions have provided Public Transport Operators, Mobile Network Operators, and handset manufacturers with a roadmap for accelerating the implementation of NFC-enabled mobile ticketing. The pieces are in place to enable Radio Frequency interoperability for Public Transport systems – without changing Public Transport infrastructures.

Mobility, Identity and Transport Use Case: an NFC-enabled seamless transport experience

Wizway Solutions provides a comprehensive, secure NFC mobile ticketing solution that simplifies the deployment of mobile contactless transport solutions across all modes of transportation for a seamless user experience. Launched in France in 2017, the service will soon be offered across Europe and will be available for other uses, including city services, such as access to swimming pools and libraries.

Mobility, Identity and Transport Use Case: NFC-based mobile transport ticketing

ScotRail, the national railway of Scotland, recently launched an NFC-based mobile ticketing service that allows customers to buy, store and use tickets directly from their smartphones. The solution enables customers to buy and download digital tickets from a single app, anytime, anywhere. Users then tap through ticket gates using their phones, skipping the queue at ticket vending machines and reducing the need for paper tickets or plastic cards.

Automotive

NFC offers a wealth of benefits at the intersection of mobility and connectivity. Many automobile models already use NFC for fast and intuitive Bluetooth/Wi-Fi pairing, enabling hands-free telephony for a more convenient and safer drive. But that's just the beginning.

Beyond connectivity, NFC is playing an essential role in new, innovative car access systems that enable smartphone-centric solutions and support new business models for rental, sharing and fleet management. NFC supports digital key management systems, reducing the cost and complexity of physical key handling. Unlike other technologies, NFC works in digital key management systems even when the user's mobile phone battery is drained, always enabling them to open and start their vehicles. NFC also allows ad-hoc sharing of private cars with family and friends, and even "automotive AirBnB" solutions.

Automotive Use Case: One-tap Bluetooth pairing

Before the NFC Forum published its Connection Handover specification, pairing a smartphone with a car's Bluetooth system was a cumbersome, multi-step process requiring users to enter numerical codes correctly. Now all it takes is to activate the vehicle's Bluetooth and tap an NFC-enabled device to a touchpoint. In an instant, drivers can be streaming their favorite music or following GPS navigation instructions through their cars' audio system.

Automotive Use Case: NFC-enabled digital keys

In 2018, the Car Connectivity Consortium (CCC), an organization focused on enabling seamless mobile device-to-vehicle connectivity, published its Digital Key Release 1.0 specification – the first standardized solution that enables drivers to download a digital key onto their smart devices and use it for any vehicle. With digital keys, drivers can lock, unlock, start the engine, and share access to their car – all from their smart devices. Ongoing specification work is being conducted by CCC members, including Apple, Audi, BMW, General Motors, HYUNDAI, LG Electronics, Panasonic, Samsung, STMicroelectronics, Volkswagen, ALPS ELECTRIC, Continental Automotive GmbH, DENSO, Gemalto, NXP Semiconductors, and Qualcomm.

Retail and Payment

To be successful today, brands and retailers need to compete more effectively in a mobile-first, omnichannel world. NFC technology offers a multitude of ways for brands and retailers to develop and strengthen their connection with the consumer at every step throughout their journey – pre-purchase, in-store, and post-purchase. NFC helps consumers by connecting them to useful information when and where it's needed, offering a channel to interact with brands, delivering offers and rewards, providing the simplicity of one-tap payment, and more.

When NFC tags are attached to products or their packaging, they can enhance branded product experiences by:

- Targeting marketing messages at consumers based on their location where products are purchased or used
- Delivering product information to support the consumer purchase decision
- Engaging consumers to forge deeper, more lasting relationships by supporting after-sales services, loyalty programs, social communities, e-commerce, etc.
- Supporting on-item data analytics to help deliver new behavioral insights (e.g., product usage)

NFC tags can also protect experiences by:

- Providing advanced anti-counterfeiting and brand protection by verifying the authenticity of products
- Offering anti-tampering and product integrity protection to ensure a product has not been opened anywhere in the supply chain prior to sale
- Supporting supply chain control – as products can be allocated to different distributors, unauthorized channels can be identified and corrective actions taken

For retailers and brands, NFC can lead to revenue growth, better customer experiences, new insights via customer analytics, and deeper, long-lasting relationships with the people who buy and use their products.

Retail Use Case: Mobile payments via mobile phones

More and more mobile payment and digital wallet services are being offered that enable users to make payments in person, within apps, or on the web. These mobile or contactless payment services are supported, not only by mobile phones, but also by wearable devices and contactless cards that can operate on NFC-compatible protocols. Tokenization services are available that digitize payment credit and debit cards – thereby replacing them – and perform ultra-quick payment transactions (below 300ms) in a very convenient and secure way at a contactless-capable point-of-sale terminal. This service can work with the millions of contactless payment terminals already installed globally with full security standards and approval processes in place. These face-to-face NFC transactions can work with any merchant that accepts contactless payments. NFC payments can also be combined with two-factor authentication via Touch ID, Face ID, PIN, or passcode to make the payment experience even more secure and convenient. Devices can become secure and interoperable by implementing an NFC antenna and a dedicated chip (called the Secure Element) that stores encrypted payment information.

Retail Use Case: NFC tags to increase customer loyalty and enhance the shopping experience

Inexpensive NFC tags enable users with NFC-enabled devices to read information stored in embedded labels, smart posters, or other small items, such as key fobs or wristbands. We see more and more retailers making use of these convenient, low-cost devices to share additional information with their customers on the products they are interested in. In addition, customer loyalty points can be earned and stored by presenting NFC tags that can fit in an ultra-small and thin package without occupying another valuable card slot in the customer's wallet. All of these uses help strengthen retailers' bonds with their customers while better competing in an omnichannel world.

Retail Use Case: NFC tags for product authentication

According to Forbes, sales of counterfeit and pirated goods add up to $1.7 billion per year. NFC tags attached to products can combat this global problem while enhancing brand recognition. At each step of the supply chain, officials can use NFC to check product shipments and verify their authenticity before reaching retailers and consumers. At point-of-sale, consumers can tap products with their NFC-enabled smartphones to confirm their legitimacy. As a bonus, the same NFC tags can be used by brands to engage purchasers and build relationships after the sale.

IoT

The Internet of Things (IoT) promises a world in which physical objects of all kinds — from household systems to health monitors — are able to collect and exchange data. It's an attractive prospect, enabling remarkable efficiency and productivity, less data re-entry, easier control, and the many benefits of data analytics.

But there are challenges in implementing the Internet of Things. For example, how can you ensure a network connection for an object? How do connected objects know a user's intent? What about security? And how do you connect unpowered objects that lack nearby Internet access?

NFC answers all of these questions by delivering:

- **Easy network access and data sharing** — NFC makes the process of connecting devices easy and intuitive. There's no lengthy handshaking or data entry requirements. Just tap and go.
- **User control with expressed intent** — NFC offers a simple, intuitive means of indicating the user's intent to initiate action. A quick tap makes it clear.
- **Data security at multiple levels** — Wide-open networks allow opportunities for hackers. NFC counters with built-in features that limit opportunities for eavesdropping, and easy-to-deploy options for additional protections to match each use case.
- **The ability to connect the unconnected** — NFC solves the problem of unpowered objects that lack network access. By embedding NFC tags in unpowered, unconnected objects, you can add intelligence anywhere. With a tap of an NFC-enabled device, it can open a URL and provide access to online information.

According to DBS Group Research, by 2030 there will be 125 billion IoT devices installed and connected to the Internet, up from 11 billion in 2018. With this growth, and as new industrial applications, smart home products, smart campus solutions, and smart office technologies come to market, NFC will play an increasingly key role in making IoT a working reality.

IoT Use Case: Data acquisition from an NFC-enabled circuit breaker

A global leader in electrical equipment manufacturing recently introduced a smart circuit breaker that includes onboard Ethernet communications and active power metering. It is able to self-diagnose problems and send instructions to facilities managers to maximize uptime. While Bluetooth is the primary wireless communication means, the circuit breaker also includes NFC so that facilities managers can monitor the device's condition even in a power outage.

IoT Use Case: Addressing an appliance malfunction

When an appliance malfunctions, it often produces an error code that can be used to diagnose the problem. Some appliances display the error code, while others require a repair technician's diagnostic tool to access the code. In the past, the consumer would have had to read the error code off the appliance display (if available), look up the code on the Internet, or call the appliance support center to share the error code and get the proper diagnosis and begin the process of fixing the malfunction. With NFC, this process is streamlined considerably by using an NFC-enabled phone and cloud assistance to diagnose the problem. The consumer taps the NFC phone to the appliance to retrieve the error code and the code is sent directly to the cloud server for analysis. The problem can either be solved directly with a firmware download transferred to the appliance via NFC, or the consumer may be automatically redirected to another resource to find the solution.

New Markets and Areas of Opportunity

Blockchain

Blockchain technology is rapidly being adopted for digital transactions because it helps prevent fraud and abuse while supporting decentralization, immutability, security, and transparency. Blockchain technology allows for verification without having to depend on third parties. NFC offers similar benefits for physical objects, confirming authenticity and providing greater security. Now developers are bringing the digital and physical worlds together – offering solutions that leverage both blockchain and NFC.

For example, products in a supply chain can be better tracked and managed by combining NFC and blockchain, thereby improving efficiency while ensuring security. An NFC tag attached to the product packaging can confirm its contents, location, and status in the supply chain, and in turn updating the blockchain via data networks. The combination of NFC and blockchain is advantageous because blockchain makes a data set (such as that used in a supply chain) secure while also enabling it to be accessed by or contributed to by multiple parties with diverse interests, including competitors.

Because NFC tags are inexpensive, small, and can store keys, they offer a way to complement blockchain by ensuring security and privacy for applications involving physical objects in money and payment, charity, and product warranties and inventory management.

Artificial Intelligence

Artificial Intelligence (AI) technology enables machines to mimic human cognitive capabilities, such as learning and problem-solving, to do everything from speech recognition to predictive behavior modeling. It is already disrupting applications such as customer service, autonomous vehicle operation, and industrial robotics. AI is fueled by massive quantities of data.

NFC can play a significant role in AI applications in several ways. First, it can provide a needed means to acquire the data that AI needs – data that may not be available via any other means. For example, NFC can deliver data from home health monitoring solutions for conditions such as diabetes and high blood pressure. That data can then be used by AI medical applications to guide treatment recommendations. NFC can also provide an interface between humans and AI. Finally, NFC can act as a key enabling technology in delivering AI-powered applications, such as personalized marketing, that boost sales and improve customer satisfaction.

Augmented Reality

Augmented Reality (AR) technology enhances a broad range of user experiences by superimposing contextual images and other useful information on top of real-world objects via smart glasses or other portable AR devices. This can enable, for example, a non-expert service technician to repair a machine by following step-by-step instructions and related imagery displayed in context on his or her smart glasses. AR will deliver enhanced experiences to improve everything from manufacturing

assembly to surgical procedures. The AR software market is forecast to grow annually by a compounded growth rate of 58.2%, reaching $338.2 billion by 2026[1].

Because many AR applications rely on wireless devices, such as smart glasses and tablets, NFC will be needed to fulfill a growing need for credentials, authentication, and communication handoffs, helping to streamline operations and better protect systems and people for more security-conscious use cases.

5G

5G cellular network technology delivers a major leap forward in all measures of mobile network performance: reduced latency, faster information transfer rate, wider geographic coverage, and greater bandwidth. As such, 5G will greatly expand the opportunities for new and enhanced IoT applications. Many of these IoT applications will require NFC-enabled devices for easier implementation and efficiency. NFC tags will play an inevitable role in future smart devices for the automation of tasks in integrated functions, smart transportation, aviation, shipping, manufacturing, and more. Integrating NFC technology with modern data communications and transaction processes ensures greater convenience, time savings, energy efficiency, and improved security. As 5G networks reduce latency, response time to NFC tags will be significantly faster.

Healthcare / Medical Devices

NFC technology is already well established in the healthcare industry, primarily as a means to collect and transfer data from home health monitoring devices. However, there are many additional avenues for growth in the future. These include:

- **Secure physical access:** NFC can help ensure that only authorized personnel can gain access to medical facilities, medications, and medical equipment. Employee badges, smartphones, and other devices can be equipped with NFC for access privileges, and NFC tags can track and log every entrance and exit.
- **Secure logical access:** Healthcare providers need to maintain the confidentiality of patient information while also enabling caregivers to gain quick, convenient access to databases and files. Using NFC to control access to computers, tablets, and other devices is a convenient, secure way to protect data while making it faster and more efficient to perform routine tasks, such as updating files and checking records.
- **Real-time updates on patient care:** NFC lets healthcare institutions track people's locations and caregivers' actions. Medical staff can know where a patient is, when the nurse last visited, or what treatment a doctor just administered. Data is captured and stored in access-controlled databases, and viewable in different formats, to help streamline logistics, simplify recordkeeping, and prevent errors. NFC tags and NFC-enabled wristbands for patients can be updated with real-time information, such as when a medication was last given, or which treatment needs to be administered.

[1] https://www.ccsentinel.com/business/global-augmented-reality-software-market-2/

- **Intelligent ID bracelets:** Patient ID bracelets with embedded NFC tags can replace traditional "Medic-Alert" bracelets, providing more detailed information for first responders treating people with serious health conditions, such as diabetes, asthma, or allergies to food or medications.
- **Medication safety:** NFC tags can be added to a medication's packaging or labeling. This enables patients to simply tap the tag with an NFC-enabled device to verify the medication's authenticity, view details about dosages, or read about side effects and drug interactions. The tag can also provide access to web links to get more information, request a refill, or contact a medical professional.

Industry 4.0

The Fourth Industrial Revolution, or Industry 4.0, builds upon the adoption of computers and automation in manufacturing by incorporating smart and autonomous systems fueled by data and machine learning. The result will be "smart factories" powered by the Industrial Internet of Things (IIoT) where machines, devices, and sensors provide continuous streams of data for real-time feedback, analytics, and decision-making.

NFC is a key enabling technology to facilitate automation and data exchange in the Industry 4.0 world. Here are four use cases:

Ensuring network communication efficiency. NFC can help ensure the recovery of data that might otherwise be lost in longer-range transmissions due, for example, to network topology issues. A simple tap of an NFC-enabled device recovers the data.

Enabling efficient firmware updating. Smart factories demand smooth product management to improve efficiency. Many electronic products require firmware updates as they move through production or along the supply chain. Workers with NFC-enabled devices can perform this operation conveniently, swiftly, and securely, increasing production and warehouse management flexibility and reducing error.

Troubleshooting on the manufacturing floor and in the field. NFC gives manufacturers the ability to add contactless access to any electronic product. This can simplify troubleshooting by enabling service people to gain real-time access to embedded electronics.

Data acquisition from legacy machines. NFC enables manufacturers to acquire data from older industrial machines that lack connectivity. With the addition of an NFC-enabled connectivity module connected directly to the debug port of the machine's microcontroller, organizations can tap a smartphone, collect machine data, and if desired, upload it to the cloud. This protects the existing capital investment in industrial machines while saving energy and reducing data collection errors.

The Future of NFC

Looking ahead, the NFC Forum is focused on driving greater adoption and use by making it easier for consumers and implementers to be successful with NFC technology. This will entail extending and enhancing the touch paradigm to deliver increased capabilities to the end user and supporting industry efforts to deliver higher data rates and maintain a secure touch paradigm.

The NFC Forum welcomes companies across the ecosystem to engage with us to submit new contributions via our standard specification development process. In order to make these contributions, a company must be a member of the NFC Forum at a membership level that allows one to propose initiatives and contribute to the development of Forum deliverables.

Other key future themes for the NFC Forum include:

- Allowing a parallel and seamless use of different form factors and standards
- Ensuring backward compatibility with current Forum specifications
- Enhancing interoperability by fully relying on standardized technologies
- Supporting scalable security based on the application or a fixed level defined by the NFC Forum

What's Ahead for the NFC Forum

The future will see an increasingly interconnected world in which the demand for connectivity solutions and convenient and intuitive user control will only grow. NFC will fill a vital role in this world – enabling connections beyond the reach of wired networks, strengthening security for critical applications, empowering users to exercise control, providing user interfaces where none exist, extending online access into areas without electrical power, bringing intelligence to physical objects, and much more. In doing so, NFC will inspire and enable new innovation, overcome obstacles, and bring greater ease and convenience to businesses and consumers throughout the world.

The NFC Forum will help usher in this future by continuing its work to empower organizations to deliver secure, tap-based interactions with an intuitive, reliable user experience. By continuously monitoring technology and industry developments and emerging needs, providing needed resources and education to enterprises and developers, and creating specifications and test mechanisms that ensure consistent, reliable NFC transactions, the NFC Forum will surely add many new chapters to its 15-year legacy of achievement.