Latest Standardization Activities of NFC Forum

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Abstract

This article focuses on near field communication (NFC) technology, which is applicable to a wide range of areas: from connecting a device to intelligent home appliances to retrieving information stored in an NFC tag. In particular, the application of NFC technology to mobile phones is currently receiving worldwide attention. The key to success is to ensure interoperability between NFC devices to maximize the attractiveness of services, and this requires standardization of NFC technology. In this area, the main international standards organization is the NFC Forum. Recent activities of the NFC Forum are introduced in this article.

1. Introduction

Near field communication (NFC) is a wireless communication technology that operates within the globally available and unlicensed ISM (industrial, scientific, and medical) band of 13.56 MHz with data transfer rates of up to 424 kbit/s. It provides bidirectional communication over a short distance of about ten centimeters. There are two kinds of communication methods: (1) passive communication between a reader/writer and an unpowered contactless IC (integrated circuit) card or NFC tag and (2) active communication between two powered devices working alternately as the initiator and target.

NFC is applicable to a wide range of areas: from connecting a device to intelligent home appliances to retrieving information stored in an NFC tag, and several NFC technologies have been introduced around the world. In particular, the application of NFC technology to mobile phones is currently receiving worldwide attention. In Japan, Osaifu-Keitai*, a mobile phone integrated with a contactless interface, is becoming widely used in daily life. One of its advantages is its simple and intuitive interface. Users can use its services simply by waving a device over a reader/writer. The key technology making this interface possible is NFC.

The key to successful introduction of NFC technology is to ensure interoperability between NFC devices to maximize the attractiveness of services, and this requires standardization of NFC technology. Standardization has been carried out on the basis of existing technologies popular in Japan and Europe. In 2003, the standard specification was formulated as ISO/IEC 18092 NFCIP-1 (Near Field Communication Interface and Protocol-1).

There are several related standard specifications. ISO/IEC 14443 defines proximity communication for contactless IC cards consisting of two methods: Types A and B. Furthermore, ISO/IEC 15693 specifies vicinity communication, which covers slightly longer distances than proximity communication. To integrate these communication methods, ISO/IEC 21481 NFCIP-2 specifies a mechanism that supports the coexistence of these three wireless data communication methods (ISO/IEC 18092, 14443, and 15693) and selection of the method to use.

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* Osaifu-Keitai, which literally means wallet mobile, is a trademark of NTT DOCOMO
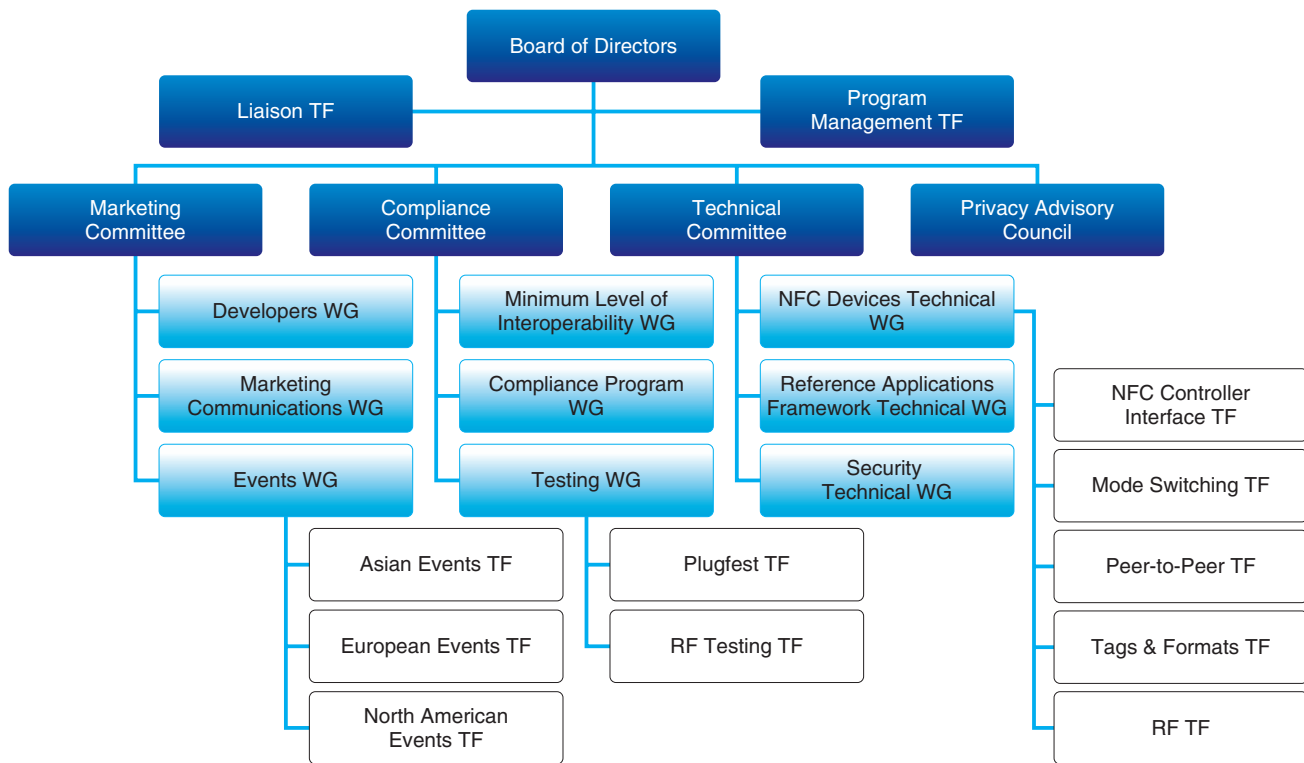
Fig. 1.   Organization of NFC Forum.

2.   Organization of NFC Forum

The NFC Forum [1] was established in 2004 with the objectives of educating the world about NFC technologies and promoting products compliant with the standard specifications. It has developed technical specifications based on the ISO/IEC standard specifications to enable interoperability among devices and has encouraged the development of products based on these specifications. Since its launch with 23 companies, many companies have continued to join, such as semiconductor vendors, mobile phone vendors, consumer electronics vendors, mobile network operators, service providers, system integrators, and various companies from a wide range of industries. The number of Forum members has expanded to 142 (as of January 2009).

The organization structure of the NFC Forum is shown in **Fig. 1**. The Board of Directors is responsible for all decision making in the Forum, and the current chairman is from Sony Corporation. The Board of Directors consists of 13 companies. Five of these are from Japan: NEC Corporation, NTT DOCOMO Inc., Panasonic Corporation, Renesas Technology Corp.,

and Sony Corporation. Under the Board of Directors, there are three committees. These include working groups (WGs), which investigate issues in given areas, and task forces (TFs), which take charge of specific issues. There are two TFs directly under the Board of Directors: the Liaison TF builds co-operational structures with other organizations, and the Program Management TF formulates detailed rules and procedures for the Forum.

2.1   Technical Committee

The Technical Committee defines the technical specifications of protocols, data structures, etc. This committee has three WGs under it.

(1) The NFC Devices Technical WG defines the technical specifications for common functions for building NFC devices. There are five TFs under the Devices WG.

   – The NFC Controller Interface TF defines the technical specifications regarding the interface between the device host controlling the overall NFC device and the NFC controller that carries out the wireless communication.

   – The Mode Switching TF defines the technical

Card emulation mode   Peer-to-peer mode   Reader/writer mode

Application

Card emulation

Smart card capability for mobile devices

NFC Forum protocol bindings, IP, OBEX, ...

LLCP

RTD & NDEF

Tag types 1, 2, 3, 4

Mode switch

RF layer ISO18092 + ISO14443 Type A, Type B + FeliCa

IP: Internet protocol
OBEX: object exchange
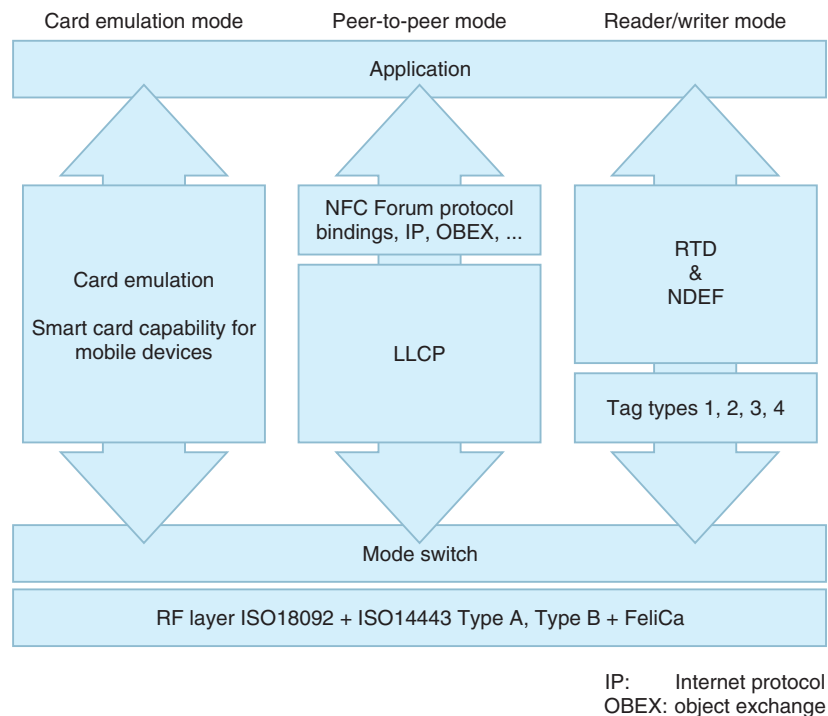
Fig. 2.   Technical architecture.

specifications for digital protocols as well as those for establishing communication among NFC devices and NFC tags.
– The Peer-to-Peer TF defines the technical specifications for the logical link control protocol.
– The Tags & Formats TF defines the technical specifications for the operations of NFC tags during reader/writer (R/W) mode operation and the data formats within NFC tags.
– The RF TF defines the technical specifications for the analog characteristics of the radio frequency (RF) interface of NFC devices.
(2) The Reference Applications Framework Technical WG defines the application framework, specifies the data format for applications, and specifies technical specifications and recommendations for interaction with other technologies such as Bluetooth.
(3) The Security Technical WG handles all issues related to security and data protection for NFC technology.
The technical architecture defined by the Technical Committee is shown in **Fig. 2**. Here, three operating modes are defined: card emulation (CE), peer-to-peer (P2P) and R/W. These modes are defined as follows.

(1) In CE mode, an NFC device will act in the same manner as a contactless IC card or an NFC tag. This mode provides compatibility with the communication between a contactless IC card and reader/writers already on the market.
(2) P2P mode provides peer-to-peer communication among NFC devices.
(3) In R/W mode, data is read from and written to NFC tags and contactless IC cards.
To date (as of January 2009), the following technical specifications, which are based on the NFC Forum technical architecture, have been released.
(1) Document specifying the common data format of NFC tags
– NFC Data Exchange Format (NDEF) Technical Specification
(2) Documents specifying the record type used in messages sent among NFC devices and from NFC devices to NFC tags and vice versa.
– NFC Record Type Definition (RTD) Technical Specification
– NFC Text RTD Technical Specification
– NFC URI RTD Technical Specification
– NFC Smart Poster RTD Technical Specification
– NFC Generic Control RTD Technical Specifica-

tion

(3) Technical specification for the reader/writer to read and write NDEF data in NFC tags.

– NFC Forum Types 1–4 Tag Operation Specifications

(4) Technical specification for switching the means of communication from NFC technologies to other technologies (Bluetooth, wireless local area network, etc.).

– NFC Forum Connection Handover Technical Specification

The following technical specifications are still under development and are scheduled to be released soon.

(5) Technical specifications for digital signals based upon ISO/IEC18092 and ISO/IEC14443.

– NFC Digital Protocol Specification
– NFC Activity Specification

(6) Technical specifications for the logical link control protocol for P2P mode, which is the adjacent layer above the NFC Digital Protocol.

– Logical Link Control Protocol (LLCP) Specification

These technical specifications form the basic functional building blocks of NFC devices.

2.2 Compliance Committee

The Compliance Committee defines a product certification program to guarantee the interoperability of an NFC device. Compliance is indicated by the approval of an NFC device as being compliant with the technical specifications. Under the Compliance Committee, there are three WGs:

(1) The Minimum Level of Interoperability WG defines the list of minimum functions that a device should support to guarantee its interoperability with other NFC devices.

(2) The Compliance Program WG defines the policies and operation rules for the product certification program.

(3) The Testing WG defines the test methods and test specifications for the NFC device certification program.

The Compliance Committee is putting together "High Level Conformance Requirements" to help in the selection of technical specifications applicable to the certification program. It starts to prepare test specifications before the Technical Committee finishes formulating technical specifications and this parallel work accelerates the certification program. The Committee is also preparing to launch a product certification program and intends to start running it as

soon as possible.

2.3 Marketing Committee

The Marketing Committee educates the marketplace about NFC technology and the NFC Forum's work with the aim of activating the industry. It produces press releases, participates in exhibitions, prepares websites, and recruits participating companies. It also prepares and provides logos and trademarks. There are three WGs under the Marketing Committee.

(1) The Developers WG provides information and support for developers of NFC products and services. It periodically presents awards for impressive work to encourage developers.

(2) The Marketing Communications WG creates and maintains a variety of communications tools and materials. It is working to raise awareness of the certification program and to prepare a certification mark for NFC devices. Furthermore, it has prepared and released white papers giving a general explanation of NFC technology and the service ecosystem. In addition, Webcast, a two-way communication Web channel, has newly been provided for this purpose.

(3) The Events WG identifies and promotes suitable events at which to increase the presence of the NFC Forum. It also provides the NFC Zone at major exhibitions.

3. NFC mobile service

NFC mobile service is one of the most attractive fields for applying NFC technologies. While most of the basic technical specifications are ready, the NFC Forum continues to search for the next strategically important field. As a part of this activity, the Mobile TF chaired by NTT DOCOMO was formed. This TF started a study at the end of 2007 on the NFC mobile ecosystem and its architecture and technical requirements. The results of this study has been summarized in a white paper, "Essentials for Successful NFC Mobile Ecosystems" released in October 2008 [2]. An overview of the white paper is given below.

Combining the functions of a conventional contactless IC card with the wide variety of functions in a mobile phone produces three unique advantages for NFC services. The first is interactivity. A conventional IC card requires a physical connection with an external device to enable access to service data, e.g., to check the prepaid balance or change the password. However, interactive usage is now possible by using the user interface of a mobile phone such as the key-
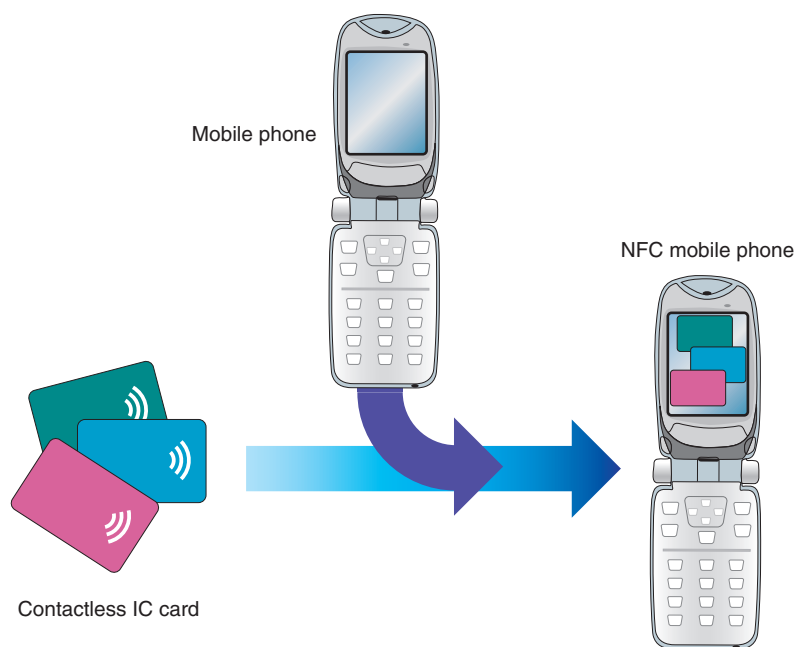
Fig. 3.   Concept of NFC mobile phone.

pad and screen. The second is the ability to add and delete card applications by using the mobile phone's communication function. This allows the installation of new services without the need to issue a new card. The third is direct communication between service providers and users via the communication function. For example, the service provider can send advertisements customized for each user.

The white paper proposed that devices with these advantages should be called "NFC mobile phones" (**Fig. 3**). To obtain these three advantages, an NFC mobile system must have Trusted Service Manager (TSM) functions. TSM plays the role of a *hub* connecting numerous service providers, mobile network operators, and NFC mobile phones. The white paper proposes an NFC mobile framework by defining all the functions that should be supported by the NFC mobile phone, TSM, and service providers. Furthermore, it explains existing technologies and standardization activities related to NFC mobile phones. Although secure card applications are outside the scope of the NFC forum, they are most important in the NFC mobile area. In this area, de facto standard technologies have taken the lead, and it will be some time before standardization activities catch up. The white paper explains de facto standard technologies such as FeliCa® and MIFARE®. It also introduces

the case of the Japanese market where these services are widespread and points out the key to service popularization. GSMA (GSM Association), the association of mobile communication operators, is also very enthusiastic about popularizing NFC mobile services, and GSMA activities are introduced in the white paper (GSM: global system for mobile communications).

The NFC mobile service is positioned in the borderland where members from different industries with different values and histories (contactless cards and mobile communication) meet. Because of these differences, a considerable amount of time was spent even on deciding terms during the preparation of the white paper. Nevertheless, new services often emerge from borderlands. We hope that this white paper becomes the first step in exploiting a new field.

4.   Future vision

A mobile phone is something that we constantly carry around these days, and it accumulates information necessary for our daily lives. If we can link the mobile phone with other personal devices around us, and if that information can be shared among these devices, then it will be easy to utilize that information more effectively in a simple way. NFC technology

provides an effective method for intuitively, easily, and safely transferring information. To achieve these types of linkage among devices, it is becoming more important to promote international technical standardization and ensure interoperability across devices.

References

[1]　http://www.nfc-forum.org/
[2]　http://www.nfc-forum.org/resources/white_papers/NFC_Forum_ Mobile_NFC_Ecosystem_White_Paper.pdf