Essentials for Successful NFC Mobile Ecosystems

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Contents

ABSTRACT

NFC mobile services are an important emerging area for NFC technology, with great potential for growth. The NFC Forum's strategy for accelerating the growth of this business area includes recognizing and describing what is needed to realize successful NFC mobile services, such as key technologies, typical use cases, and the structure of the overall ecosystem. In this white paper, the NFC Forum analyzes how to expand the existing contactless card ecosystem to enable NFC mobile services, identifies new functionalities in this ecosystem, and discusses additional functionalities. The paper aims to provide ecosystem players, particularly Mobile Networks Operators (MNOs) and Service Providers (SPs), with a common understanding of such new functionalities. It also provides detailed information that will help them evaluate the opportunities, develop their markets and promote their participation in the ecosystem.

1 Introduction

Within the last few years, contactless card technology has been maturing and has been adopted by major sectors such as transport, payment, and retailing. In parallel, mobile phones with the additional offerings of Internet and multimedia services have successfully entered people's lifestyles. Contactless card technology can now expand its domain of applicability by adding contactless functionality to the mobile phone. The Near Field Communication (NFC) mobile service, which leverages the current contactless infrastructures, has just started to emerge. In some countries, services benefiting from the convergence of contactless card technology and mobile phones have already been introduced commercially, and these converging services are ubiquitous and successful.

The purpose of this white paper is to describe a "big picture" of the NFC mobile world in order to raise awareness of the potential of new technologies, and to accelerate deployment of NFC mobile services among the ecosystem business players. While the NFC Forum has focused on device perspectives and has defined Reader/Writer, Peer-to-Peer and optional Card Emulation modes, this white paper primarily focuses on the aspect of Card Emulation mode that is made available by default on mobile phones that are equipped with NFC capabilities.

The white paper further explains how the mobile phone adds value beyond its contactless card counterpart and presents a vision that includes a range of possibilities for realizing NFC mobile services.

After introducing typical use cases, this white paper provides a comprehensive overview of the NFC mobile ecosystem. It then proposes essential recommendations and a technical framework that will support a variety of business models and business requirements. An introduction to existing systems is provided to facilitate the understanding and positioning of the current state of available technologies.

2 NFC Mobile Phone

This section reviews the additional value produced by adding the functions of a mobile phone to those of a contactless card and defines the "NFC Mobile Phone," a new intelligent device.

When the functions of a contactless card are combined with the wide variety of functions of a mobile phone, the card evolves into a device whose resulting value is greater than just the value of the two devices added together. This newly defined device is an NFC Mobile Phone. It is an intelligent mobile network-enabled device that can connect with other NFC devices in close proximity (hence the term Near Field Communication).

This unique combination of both mobile and NFC technology enables users to enjoy

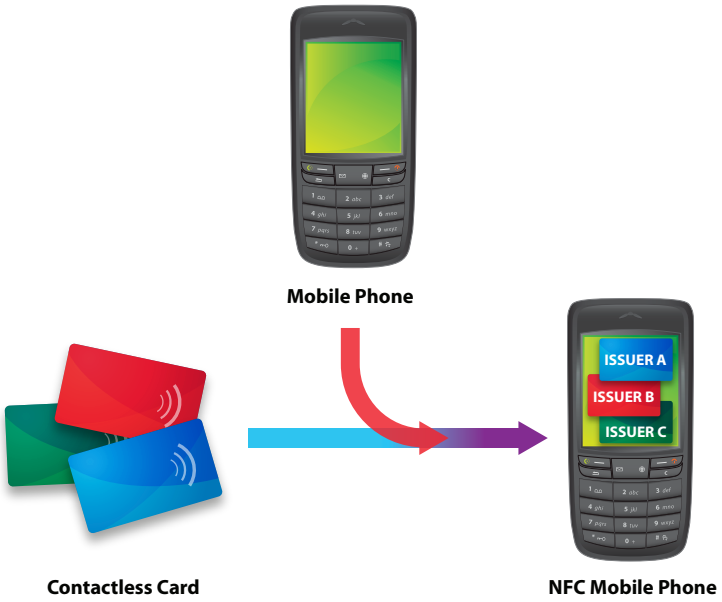

Figure 2.1 Concept of the NFC Mobile Phone

innovative services. Users can access myriad NFC services in their daily lives by having an all-in-one personal device that provides them with a highly personalized and interactive environment.

Three unique advantages of the NFC Mobile Phone will widen the opportunities for NFC services.

- **Interactivity:** The user interface functions of mobile phones – displays, keyboards, touch screens, sounds and vibrations – enable NFC services to be interactive. For example, applications can be provided that display purchase records on the screen. In addition, the card emulation mode is used interactively. For example, a user can check available applications and activate or deactivate an application dynamically through the user interface of a mobile phone.
- **Remote Multi-Application Management:** Multi-application use is supported by the NFC Mobile Phones. While this may be supported by contactless cards as well, the addition of a mobile network enables application management functions, such as dynamic provision to a trusted execution environment, assignment of trusted areas, application download, personalization and locking/unlocking. Management functions can be executed remotely in real time, so that a user can start a new service immediately following subscription, bringing new meaning to the term “anytime-anywhere.” Additionally, a user can ask the service provider to stop NFC applications when a device is lost or stolen. Users and service providers are thereby provided with certain controls for managing security and risks associated with their NFC services.
- **Remote User Management:** User management functions are enabled for users and service providers by leveraging the “always on” communication of mobile networks. For example, service providers, with users’ consent, can retrieve NFC service usage records and send users customized information during transactions or on other occasions. In another example, users can access their personal data in real time and can be more proactive about the information they would like to receive.

Compared to a contactless card issued by a single service provider, an NFC Mobile Phone is a medium where multiple service providers are able to have their own services resident within a mobile phone. This is the evolution from the “issuer-centric” model to the “user-centric” model.

It should be noted that the NFC Mobile Phone alone is not enough for NFC services to be realized. The server systems that communicate with the NFC Mobile Phone via the mobile network are essential to enable remote provisioning of applications for multiple NFC services. The combination of an NFC Mobile Phone, the mobile network and these server systems makes up an NFC Mobile System.

3 Use Cases

This section describes some use cases for NFC mobile services, which take advantage of mobile phone functions that complement and enhance the current services enabled by contactless cards. Later sections analyze the use cases and identify the new ecosystem players, the new functions required of an NFC Mobile Phone, and the supporting back-end systems that will add to and enhance the current contactless systems to create the continuously expanding NFC ecosystem.

The following typical day in the life of an NFC Mobile Phone user shows how the device will be integrated into everyday life in the near future.

3.1 A Day in the Life of an NFC Mobile Phone User

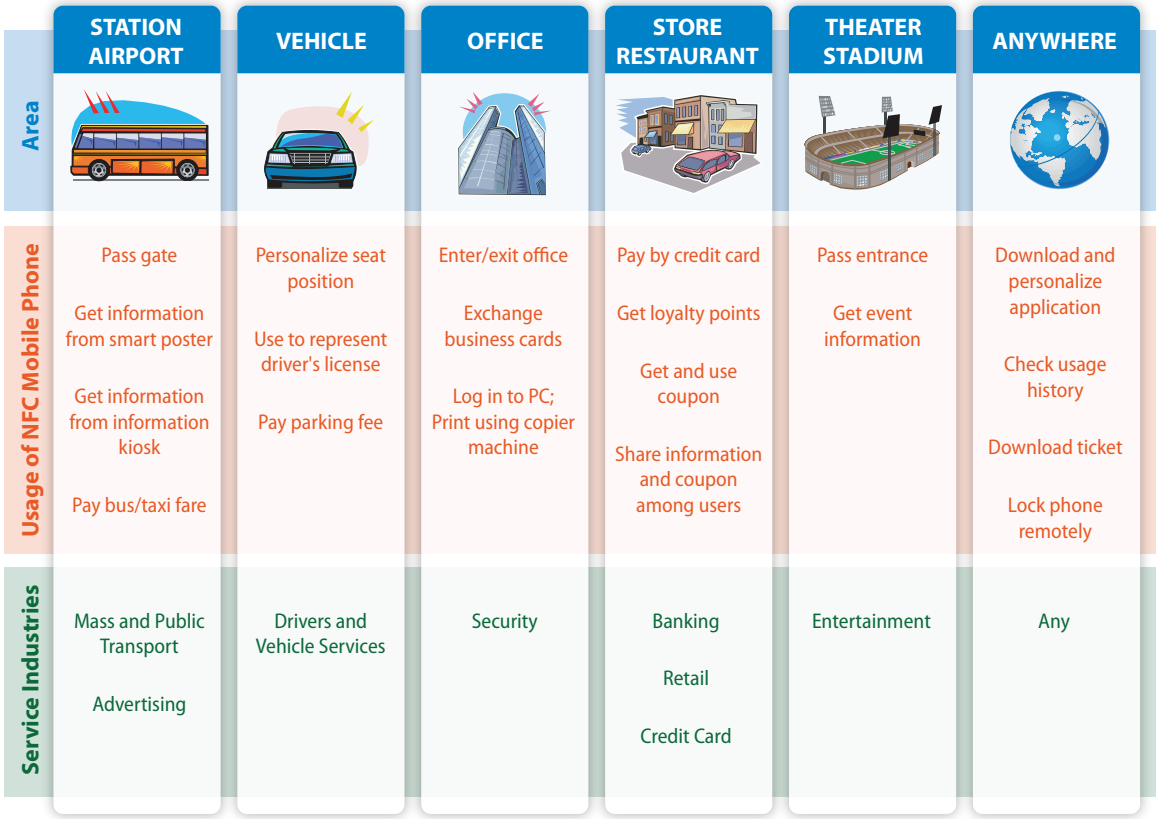

Figure 3.1 Life Made Easier with NFC Mobile Services

- Eric gets on a train to go to his office. (The details are described in Section 3.2.1 Transport.)
- He sees a poster announcing a free concert this evening. He touches his NFC Mobile Phone to the NFC mark on the poster and transfers the detailed information onto his phone. He reserves seats for the concert with his mobile phone, using mobile communications (e.g., SMS, internet, packet-based connections), and the complimentary tickets are sent to his mobile phone. He sends a text message to his wife to invite her to the concert and dinner.
- When he arrives at his office, he touches his NFC Mobile Phone to the office gate and opens the door.
- At lunch time, he pays for his meal using one of the credit cards stored in his phone. (The details are described in Section 3.2.2 Retail: Restaurant.)
- After lunch, he visits the office of his new business partner for a meeting. Those attending the meeting exchange their business cards stored in their NFC Mobile Phones by touching their phones together.
- He meets his wife at 6 PM, and they go to the concert venue. He touches his NFC Mobile Phone to a turnstile at the entrance to the concert, their reservations are confirmed, and they are admitted.
- They visit a shopping center after the concert, where they go shopping and have dinner. (The details are described in Section 3.2.3 Retail: Shopping Center.)

- When they arrive at their house, he realizes that he has left his NFC Mobile Phone on the train. He immediately calls the mobile network operator and makes a request to disable all active NFC services in the phone. If his NFC Mobile Phone is later found, he will be able to reactivate these services.

3.2 Detailed Use Case Description

This section describes details of the use cases in the typical vertical segments that were identified in the "day in the life" example in the previous section.

3.2.1 Transport

1. Assumption

   It is assumed that a gated system at the station has been equipped with NFC readers/writers, allowing entry only to passengers with legitimate tickets read from contactless cards or devices. Eric has bought a train ticket that is stored in his contactless card or his NFC Mobile Phone.

2. NFC Common Service Flow

   When Eric arrives at the train station, he enters the gate by touching his contactless card or his NFC Mobile Phone to the reader/writer and is granted access. The same action occurs at the destination station in order for him to exit.

3. NFC Mobile Phone Service Flow

   The NFC Mobile Phone brings services in addition to those enabled by a contactless card.

   - Eric can download and purchase a new ticket using his NFC Mobile Phone without the need to go to a physical ticket booth.
   - While waiting for a train, he can touch his NFC Mobile Phone to a nearby information kiosk to obtain the latest updated train information and local information such as maps and the weather forecast, transferred directly to his phone.
   - At the same time, additional on-line real-time local traffic information is available to him by linking to a mobile Internet site and/or by reading "pushed" information.

4. Alternative Service Flow

   As some transport systems rely on an honor system and don't have gated systems, Eric can touch his NFC Mobile Phone to a ticket confirmation machine, thereby activating the ticket and recording the activation time. During his travel, a train conductor may confirm his ticket activation using a portable NFC reader/writer device.

3.2.2 Retail: Restaurant

1. Assumption

   It is assumed that restaurants in Eric's office building accept payments at Point-of-Sale terminals equipped with NFC reader/writers, and that contactless cards are widely used there. Eric has enabled one or more of his credit/debit card applications in his NFC Mobile Phone.

2. NFC Common Service Flow

   Eric pays for his lunch at the restaurant by touching his contactless card or his NFC Mobile Phone to the Point-of-Sale terminal.

3. NFC Mobile Phone Service Flow

   The NFC Mobile Phone brings services in addition to those enabled by a contactless card.

   - Using his NFC Mobile Phone, Eric chooses which credit/debit card application to pay with, depending on whether his lunch is a business or personal expense.
   - He can link to a mobile banking site to check the balance of a credit/debit card prior to making a payment or view his usage/purchase history.
   - He can receive messages indicating that the balance of a credit/debit card is low or indicating that a payment to a credit card is due.
   - Depending on the transaction amount, Eric may be prompted by the NFC Mobile Phone to authorize the payment. For example, authorizations might range from simple and quick confirmations in the case of lower amounts all the way to special authentication mechanisms such as biometrics for large amounts.

4. Alternative Service Flow

   At some point in the future, it may be possible for Eric, as an informal merchant in his spare time, to use his NFC Mobile Phone as a Point-of-Sale terminal to accept contactless payments from his customers' NFC Mobile Phones or contactless cards.

3.2.3 Retail: Shopping Center

1. Assumption

   It is assumed that the growing popularity of NFC Mobile Phones will provide an incentive to retailers to enhance the functionality of their current Point-of-Sale terminals equipped with NFC readers/writers so that they can read coupons from NFC Mobile Phones. It is also assumed that retailers and consumer goods manufacturers will offer a variety of mechanisms to obtain coupons, such as a "push" or "pull" to NFC Mobile Phones, or reading them from conveniently placed smart posters. With this ubiquity of NFC coupons and opportunities to redeem coupons, it is assumed that Eric has downloaded and personalized the required applications on his NFC Mobile Phone.

2. NFC Common Service Flow

   Entering a shopping center, Eric makes a purchase in a shop and pays by touching his contactless card or NFC Mobile Phone to a payment terminal.

3. NFC Mobile Phone Service Flow

   The NFC Mobile Phone brings more new services to the retail environment.

   - Upon entering the shopping center, Eric touches his NFC Mobile Phone to a conveniently located kiosk and
     - Receives shopping center loyalty points for returning to the center
     - Receives information linking the current coupons on his NFC Mobile Phone to stores within the center offering those consumer goods and possibly additional discounts
     - Receives special offers customized to his profile directly to his NFC Mobile Phone
   - Walking through the center, Eric notices a smart poster offering him a discount on a product that he has been considering purchasing. Eric touches his NFC Mobile Phone to the poster to retrieve the coupon.

- Eric chooses some products to buy in a store, and during the checkout process he touches his NFC Mobile Phone to the Point-of-Sale terminal to:
  - Automatically redeem coupons matched to the items he is purchasing
  - Make the purchase
  - Receive new special offers for future purchases customized to his profile
- Eric can check the history of purchases and remaining loyalty points on his NFC Mobile Phone whenever he wants.
- Users can share information and coupons, where permitted by the coupon issuer, by touching their NFC Mobile Phones together.

4 NFC Mobile Ecosystem

This section describes the NFC Mobile Ecosystem.

4.1 Ecosystem Overview

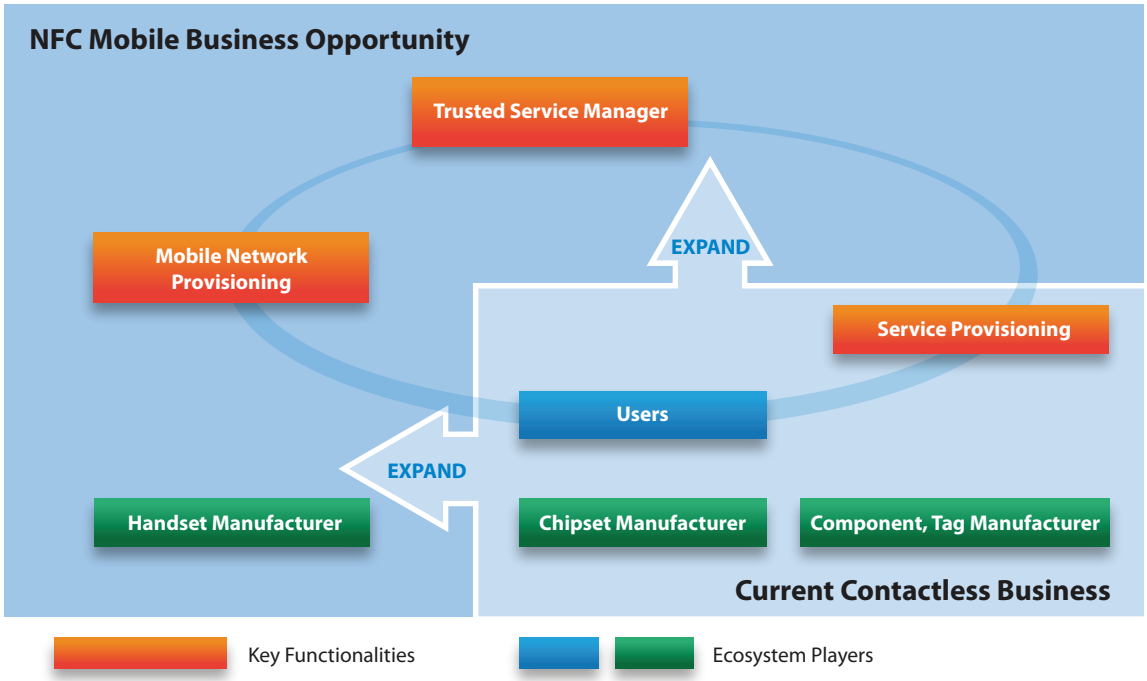

Figure 4.1 The NFC Mobile Ecosystem

As shown by the arrows in the diagram, the current contactless business domain is expanding into domains including NFC mobile business opportunities. In some mass market businesses such as transport or payment, a contactless infrastructure already exists in a growing number of schemes, and users have some experience with those contactless services. The NFC Mobile Phone will enhance these existing services and provide

opportunities for new revenue sources. The NFC Mobile Ecosystem can be built as a new marketplace, and its success depends on the win-win relationships among all the stakeholders.

The NFC Mobile Ecosystem extends the current contactless ecosystem model with additional functionality. There are multiple possibilities for ecosystem players to provide these mobile system functionalities, which are identified in the following description of key functionalities.

4.2 Key Functionalities

4.2.1 Service Provisioning

Service Provisioning is a function of the current contactless business enabling users to subscribe to and receive their personalized contactless cards, and this capability will expand for NFC mobile services. The functions to which a user subscribes and the functions of the Service Provisioning preparing the personalization data will ride upon the existing infrastructure. New functionalities such as remote user management and authentication will then emerge due to the availability of a connected network.

This key functionality is usually performed by the service providers.

4.2.2 Mobile Network Provisioning

Mobile Network Provisioning, while existing in the mobile domain, adds new functionality to the contactless domain to realize the NFC Mobile Ecosystem. It includes functionalities to maintain the network infrastructure, to provide data connectivity service to users, to offer user authentication for ensuring that only contracted users can connect to the mobile network, and to offer user care for the data connectivity service.

This key functionality is usually performed by the MNOs (Mobile Network Operators) or MVNOs (Mobile Virtual Network Operators).

4.2.3 Trusted Service Manager[1]

The Trusted Service Manager (TSM) provides a contact point between service providers and NFC Mobile Phones. SPs can provide NFC Mobile Phones with remote multi-application management functionality through the TSM. See Section 4.4.1, 4.4.2, and 6.2 for more discussion on the TSM.

This new functionality includes the following:

- Issuing and managing a trusted execution environment
- Assigning trusted areas within a trusted execution environment to a specific service
- Managing keys for a trusted execution environment
- Securely downloading applications to NFC Mobile Phones
- Personalizing applications
- Locking, unlocking and deleting applications according to requests from a user or a service provider

These functionalities can be performed by mobile network operators, service providers or third parties, and all or part can be delegated by one party to another.

1 The terminology TSM (Trusted Service Manager) can be used to mean either an ecosystem player or a functionality [6][7][8][10][11][12]. In this paper, TSM is used strictly to mean a functionality that is independent of ecosystem players.

4.3 Ecosystem Players

4.3.1 Users

An NFC mobile service user is required to have an agreement with the service provider of an NFC mobile service prior to its first use. In addition, the user is required to subscribe to the mobile network provisioning service and have an NFC Mobile Phone in order to make use of NFC mobile services.

In the era of the plastic card, users typically need to have a different contactless card for each service, but when the NFC Mobile Phone becomes available, they can put all their services on one mobile device.

4.3.2 Chipset Manufacturers

Chipset manufacturers provide the integrated circuit components (ICs) needed for all NFC devices, in line with the relevant technical standards (ISO/IEC, Ecma, ETSI, and NFC Forum). Chipset development is carried out in close cooperation with handset manufacturers and service providers in order to fulfill application requirements.

These chipsets include:

- ICs for the NFC Controller, including device drivers and middleware, as used in handsets and reader/writer terminals
- ICs for the trusted execution environments (UICC, embedded, removable for phones, and SAMs for terminals), including in many cases the pre-personalization of such devices
- ICs for smart tags (as used in smart posters, etc.)

Chipset manufacturers contribute to standardization efforts in relevant organizations, based on their experience in NFC and related areas such as RFID and contactless smart cards.

4.3.3 NFC Handset Manufacturers

Handset manufacturers design and produce NFC Mobile Phones according to industry standards. They provide capabilities for service providers to develop applications that provide an intuitive experience to users. Handset manufacturers compete by providing attractive combinations of design, price and feature sets, where NFC capabilities make applications and service offerings easier to use, and also by enabling new usage scenarios for phones.

The integration of cutting-edge technologies and services in mobile phones will contribute to a flow of innovations and acceptance that encourages users to adopt NFC services and also to upgrade their current mobile devices to NFC Mobile Phones offering these services.

4.3.4 NFC Component and Tag Manufacturers

NFC component and tag manufacturers design and produce devices according to requirements from service providers and industry standards. They also deliver the following values to the ecosystem in order to reduce the implementation efforts of service providers:

- Secure methods of fulfilling customer requirements
  - Tamper resistance
  - Encryption of communication channel and/or contents
  - Encryption key management by service providers

- Software (e.g., drivers, middleware, and software development kits (SDKs))
- Interoperability management and quality management

NFC component and tag manufacturers cooperate with mobile network operators, NFC handset manufacturers, and service providers to make the devices capable of communicating with new form factors and to support new communication logic, such as is offered by peer-to-peer (P2P) mode.

4.4 Key Factors in Building a Successful NFC Mobile Ecosystem

The NFC Mobile Ecosystem is an expansion of the current contactless ecosystem, mainly targeting contactless card businesses. To be attractive and successful, it must create value, and to achieve that goal, it requires the addition of new functionality on top of the current card business. On the other hand, depending on the marketplace, the NFC Mobile Ecosystem must be open enough to support the variety of existing and future models. To be successful it must support a win-win relationship among all the ecosystem players. This section considers the key factors for building a successful NFC Mobile Ecosystem from the viewpoint of the potential players, especially targeted to the new functionalities.

4.4.1 Mobile Network Operators

The evolution of a mobile phone into an NFC Mobile Phone will provide mobile network operators with opportunities to develop new business areas. NFC mobile services will increase the opportunity for mobile usage in many new situations, as explained in the use cases. To achieve this, it is not sufficient to offer the contactless card functionalities separately from those of a mobile phone. It is vital to create and offer new value by combining the functionalities of both mobile phones and contactless cards.

When an NFC Mobile Phone supports the multi-application capability, it will not only boost convenience for users by allowing them to use many applications in one device, but will also stimulate the NFC market by increasing the number of users of NFC mobile services. Smooth introduction of the multiple-application capability is one of the key success factors. A second essential factor is to guarantee to users and service providers a trusted end-to-end system for their applications and data. This will be achieved via the TSM functionality.

The TSM is the contact point that links mobile network operators, service providers and NFC Mobile Phones, and it provides the functionality of remote multi-application management. While there will be many possible models showing who might provide the functionalities that make up the TSM, potential candidates include mobile network operators and service providers. It should be noted that, whatever model may be selected, it is vital to clearly specify the responsibilities of each ecosystem player within the specific model. How the functionalities of the TSM are divided and provided by the ecosystem players is another of the key factors for success.

4.4.2 Service Providers

From the service providers' point of view, a key success factor is improving their existing contactless services. Users will adopt NFC mobile services only if they feel that they are receiving new functionality and/or advantages. On top of the existing contactless card services, it now becomes possible for service providers to offer personalized advertisements or messages to the same device that is hosting the contactless card. With the contactless card, the methods of providing such information are either asynchronous, with the card being touched on the Reader/Writer, or delivered through a completely separate channel (e.g., email). Compared to this model, an NFC Mobile Phone is always connected to a mobile network, and service providers can send

messages to the phone anytime and anywhere. An interactive real-time and fine-grained one-to-one user management scenario becomes possible and makes NFC mobile services more attractive to users.

Service providers will benefit from the increased number of NFC services and a higher frequency of usage by supporting the multi-application capability of an NFC Mobile Phone.

The TSM also provides an important functionality for service providers. The trustworthiness of the TSM guarantees that they can put multiple applications in one device safely, which is ensured by the TSM's management of the trusted area. Service providers also expect that freedom of their service management is guaranteed.

5 Recommendations

This section describes recommendations[2] for making NFC mobile services a reality. These recommendations are derived from an analysis of the basic service flows of the use cases. NFC mobile services give added value to existing contactless services, and functions of current contactless systems should be available in the NFC Mobile System. Recommendations are provided for NFC Mobile Phones, for Trusted Service Manager and for Service Provisioning.

1. Recommendations for the NFC Mobile Phone
   - The NFC Mobile Phone should support NFC Card Emulation mode and provide some trusted execution environments, such as those in a smart card.
   - The NFC Mobile Phone should support NFC Peer-to-Peer mode and be able to exchange data with existing contactless devices and other NFC Mobile Phones.
   - The NFC Mobile Phone should support NFC Reader/Writer mode and be able to read and write to NFC Tags.
   - The NFC Mobile Phone should utilize the user interface functionality of the phone to realize and execute NFC services interactively.
   - The NFC Mobile Phone should utilize the communication functionality of the phone and support secure download and management of multiple trusted applications, such as personalization, locking, and unlocking.
   - The NFC Mobile Phone should permit multi-issuer coexistence on trusted execution environments and be able to support assignment of trusted areas for a service.
   - The NFC Mobile Phone should be able to have NFC communications with NFC devices and with existing legacy contactless infrastructures.
2. Recommendations for the NFC Trusted Service Manager
   - The NFC TSM should be able to authorize and securely download a trusted application to an NFC Mobile Phone.
   - The NFC TSM should be able to manage trusted applications on an NFC Mobile Phone.

2 Note that these recommendations are not intended to define new conformance requirements for NFC Mobile Phones, TSM, or Service Provisioning.

- The NFC TSM should permit multi-issuer coexistence on a trusted execution environment and be able to assign a trusted area to a service.
- The NFC TSM should be able to lock/unlock trusted applications.

3. Recommendations for NFC Service Provisioning
   - NFC Service Provisioning should be able to deliver the provisioning information of a trusted application to the TSM.

6 NFC Mobile Framework

This section describes the NFC Mobile Framework, based on the essential recommendations in this white paper. It helps players in the NFC Mobile Ecosystem to envision a generic and balanced end-to-end system. It shows how the pieces of technology are put together to provide successful NFC mobile services, and how existing and future systems and services are constructed.

This framework can be a reference for standardization work, but will not dictate what needs to be standardized by the NFC Forum. It will help audiences understand the relationships with other technology providers such as standards development organizations and industry forums.

The NFC Mobile Framework describes functionalities for realizing the end-to-end system. It consists of three groups: functionalities of NFC Mobile Phones, functionalities of the back-end server system, and functionalities of the targets with which mobile phones have NFC communication. The framework only defines functionalities and is not intended to restrict implementation.

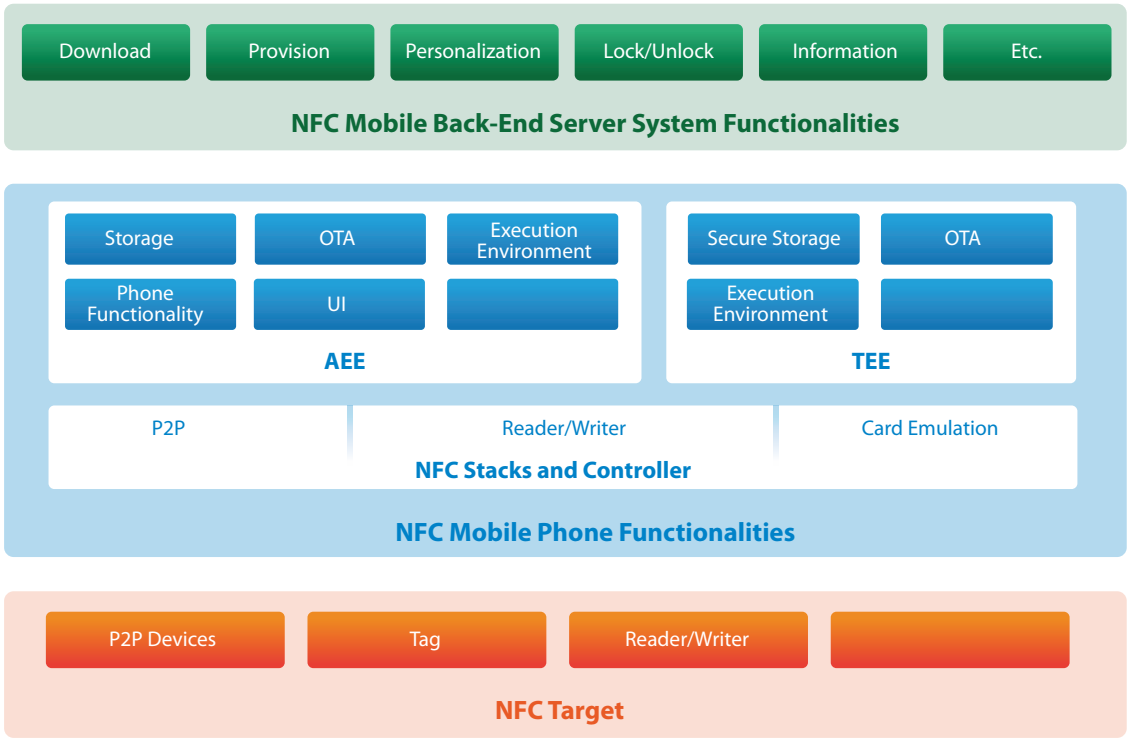

Figure 6.1 Functional Framework Overview

6.1 NFC Mobile Phone Functionalities

To realize NFC services, an NFC Mobile Phone should be able to utilize not only the functionalities of a contactless card but also the functionalities of a mobile phone.

6.1.1 Application Execution Environment (AEE)

An NFC Mobile Phone fulfills mobile phone functionalities and provides basic phone functionalities such as voice calling, packet communication, phonebook, browser, mailer, and so on. It also provides a user interface to execute phone services interactively. All these functionalities are used and expanded to realize NFC mobile services, and as a group are termed an Application Execution Environment (AEE). AEE supports data storage and processor capabilities and executes mobile phone services in a relatively secure manner, but this level of security may not be sufficient to meet the needs of all NFC service providers.

6.1.2 Trusted Execution Environment (TEE)

Some categories of NFC services, such as payment, require highly trusted environments, which are not necessarily realized by the AEE. A Trusted Execution Environment (TEE) executes security-relevant NFC applications in a trusted and secured environment. The TEE can have various form factors, some of which can be removable (or replaceable), but the most important characteristic from an interactive services point of view is that the TEE has an interface to the AEE.

A TEE provides secure data storage, secure management functionalities, secure execution environment and so on. The secure management functionality is utilized to realize over-the-air (OTA) downloading of applications and remote issuing/personalization of NFC mobile services. Some of these functionalities may share parts with the AEE, but the TEE enhances security to satisfy the requirements for trusted NFC services. On the other hand, the TEE can disclose a specific interface to the AEE and give permission to access the TEE through the interface. For example, the mobile phone browser may access data stored in the TEE.

An NFC Mobile Phone may potentially have more than one TEE. There are various reasons to provide these, including user control, different service providers requiring separate TEEs for their applications, different levels of security policies, etc.

6.1.3 NFC Stacks and Controller

NFC Stacks are functionalities for communicating with NFC targets using NFC capability. There are three kinds of stacks: the NFC Card Emulation Stack, the NFC Reader/Writer Stack, and the NFC Peer-to-Peer Stack. These functionalities are potentially provided by both the AEE and the TEE.

NFC Card Emulation Stack

The NFC Card Emulation Stack provides NFC Card Emulation Mode. It allows an NFC Mobile Phone to behave like a card or tag in front of a conventional Reader/Writer. This includes the emulation of memory cards/tags and the emulation of smart cards. Using this mode, existing infrastructures (e.g., for payment and ticketing) can communicate with NFC Mobile Phones supporting NFC Card Emulation mode.

NFC Reader/Writer Stack

The NFC Reader/Writer Stack provides NFC Reader/Writer Mode. In NFC Reader/Writer Mode the NFC Mobile Phone initiates the communication by generating the RF field and sending relevant commands to an NFC Tag, a contactless card, or an NFC Device in NFC Card Emulation Mode.

NFC Peer-to-Peer Stack

The NFC Peer-to-Peer Stack provides NFC Peer Mode. In NFC Peer Mode the initiator starts the Peer-to-Peer communication and the target responds to it. NFC Mobile Phones need to have the capability to be both initiator and target.

NFC Controller

The NFC Controller handles the physical transmission of data over the RF interface and antenna.

6.2 NFC Mobile Back-End Server System Functionalities

NFC mobile back-end server system functionalities are required to realize end-to-end NFC mobile services. These functionalities are not indicated explicitly in the current NFC framework. NFC Mobile Phones leverage unique advantages by adding mobile phone functionalities such as remote multi-application management and remote user management.

Download

Download functionalities are utilized to download a mobile application securely to an NFC Mobile Phone. Some applications may be stored in the AEE (for example, a UI application) and others in the TEE (for example, a smart card application).

Provision

Provision functionalities are utilized to initiate a TEE and assign a trusted area within a trusted execution environment to a specific service. These functionalities could be delegated by the original issuer of the TEE to a third party.

Personalization

Personalization functionalities are utilized to configure application- or user-specific data to an application. These functionalities could be delegated by the service provider to a third party.

Lock/Unlock

Lock/Unlock functionalities are utilized to lock, unlock, and delete previously provisioned applications corresponding to the request from a user or a Service Provisioning.

Information

Information functionalities are utilized to provide information to or get information from an NFC Mobile Phone. Typical examples are an NFC Mobile Phone's browser accessing Web servers and its mailer receiving information by email.

6.3 NFC Target

An NFC Target is a device or piece of equipment to which an NFC Mobile Phone connects via NFC Stacks and Controller. It is a P2P device, tag, reader/writer, or other equipment with NFC capability.

7 Conclusion

Contactless card services have been coming into widespread use in recent years. They have the potential to develop new business areas and enhance existing ones by adapting them to the mobile world. This white paper described a “big picture” of an NFC mobile world, primarily focusing on the aspect of card emulation mode, and considered recommendations for accelerating the development of NFC mobile services and the functionalities for realizing them.

The contactless card has evolved into an NFC Mobile Phone by adding the functionalities of a mobile phone. An NFC Mobile Phone has three advantages compared to existing contactless cards: interactivity, remote multi-application management, and remote user management, as detailed in Section 2.

To realize these advantages, a stand-alone NFC Mobile Phone is not sufficient, as cooperation with back-end server functionalities is necessary. New players who provide such new functionalities need to be added, and the current contactless ecosystem will expand into the NFC Mobile Ecosystem. Because there are multiple possibilities as to which ecosystem players will provide which new functionalities, this white paper has identified them as functionalities instead of specifying players:

- The TSM provides a contact point for connecting service providers and NFC Mobile Phones through mobile networks, and realizes remote multi-application management functionality.
- MNP (Mobile Network Provisioning) provides mobile communication functionalities.
- Service Provisioning provides NFC services and remote user management functionalities.

NFC mobile services are at an emerging stage, and this white paper is a “snapshot” of the current phase. The contactless card business and the mobile communication business have developed on different paths and have different business cultures. To create and expand the new ecosystem, the participation of new players from different business domains should be encouraged.

There are two key factors in ensuring success for NFC mobile services:

- The first is that the NFC Mobile Ecosystem should support a variety of existing and future business models. The ecosystem should embrace new players as well as industries having well established business models in place. To be successful it must support a win-win relationship among all the ecosystem players.
- The second is that the responsibilities of each ecosystem player should be clearly specified within a specific model.

The roles of the players change based on phases of ecosystem maturity, geographic regions, and target vertical industries. The example of FeliCa, in the Appendix, shows that an integrated mobile contactless solution is effective at the early stage of innovative business deployment. However, a variety of solutions should be available in conjunction with development of NFC mobile services, and these solutions should be selected based on support for a viable ecosystem.

The mobile NFC ecosystem represents a convergence of differing business cultures. This presents an opportunity to develop new businesses and markets. The variety of ecosystem players involved will stimulate the development of new NFC mobile services and the intent of this white paper is to contribute to this activity.

8 References

[1] SONY Global – FeliCa, http://www.sony.net/Products/felica/

[2] Mifare.net, http://mifare.net/

[3] ISO/IEC 14443

[4] ISO/IEC 18092

[5] JIS X 6319-4, http://www.jisc.go.jp/app/JPS/JPSO0020.html

[6] Mobile NFC Services
http://www.gsmworld.com/documents/prd/aa9310.pdf

[7] Mobile NFC Technical Guidelines - Version 2
http://www.gsmworld.com/documents/nfc/gsma_nfc2_wp.pdf

[8] Pay-Buy-Mobile Business Opportunity Analysis -- Public White Paper
http://www.gsmworld.com/documents/pbm/gsma_pbm_wp.pdf

[9] Calypso, http://www.calypsonet-asso.org/index.php

[10] Best Practice for Mobile Financial Services Enrolment Business Model Analysis
http://www.mobeyforum.org/files/bestpractice/Best%20Practices%20for%20MFS%20Enrolment%20Business%20model%20analysis%20final.pdf

[11] The Role and Scope of EMVCo in Standardisation the Mobile Payment Infrastructure
http://www.emvco.com/documents/mobile/view/EMV%20Mobile%20Contactless%20Payment%20White%20Paper%20Version%201.0%20Final.pdf

[12] EMV Mobile Contactless Payment, Technical Issues and Position Paper
http://www.emvco.com/documents/mobile/view/EMV%20Mobile%20Contactless%20Payment%20Technical%20Issues%20Version%201.0%20Final.pdf

[13] StoLPaN Dynamic Management of Multi-Secure Elements
http://www.stolpan.com/index.php?do=topic&topic=1" (Information is required to get access to this paper from this page)

[14] ITSO, http://www.itso.org.uk/

[15] ICAO, http://www.icao.int/

[16] NFC Forum Marketing White Paper: The Key to Truly Interoperable Communications
http://www.nfc-forum.org/resources/white_papers/

9 Acronyms

AEE	Application Execution Environment
GP	Global Platform
MNO	Mobile Network Operator
MNP	Mobile Network Provisioning
NFC	Near Field Communication
OTA	Over the Air
SAM	Secure Access Module
SP	Service Provider
TEE	Trusted Execution Environment
TSM	Trusted Service Manager
UI	User Interface
UICC	Universal Integrated Circuit Card

A Appendix. Examples

This section describes examples of possible solutions for contactless services. They include existing and proposed solutions based on combinations of standards and technologies using current contactless infrastructures. These examples are given to provide insight into the current status of the contactless services and into how the key functionalities are mapped within the different frameworks.

FeliCa and MIFARE are introduced as examples of existing and potential solutions, while the industry association of mobile network operators presents its proposal for NFC mobile services in the GSMA Guidelines. Although these three solutions are well known in the contactless industry, the list is not exhaustive. Additional examples include: Calypso [9], which is an existing solution in the ticketing area and will potentially be applied to mobile use; the NFC mobile white papers that have been released by Mobey Forum [10], EMVCo [11][12], and StoLPaN [13]; and activities applying contactless technologies to transportation services from the service-side perspective by transportation-related organizations such as ITSO (former Integrated Transport Smartcard Organization) [14] and ICAO (International Civil Aviation Organization) [15]. Please refer to the list of references in Section 8 for the details.

Please note that the solutions described in this section are examples. The NFC Forum does not endorse any of these examples, nor does it guarantee interoperability based on the NFC Forum specifications.

A.1 FeliCa

FeliCa [1] is a contactless technology based on ISO18092 (212k/424k NFCIP1 Passive) [4] as the RF and on JIS X 6319-4 [5] as the command set. FeliCa is used in various commercial platforms, not only for cards but also for mobile, PCs, and consumer electronics.

Mobile FeliCa started its mobile contactless commercial service in 2004. It now has over 70 applications running in different technical environments from three MNOs, providing interoperability among over 100 models of handsets. As a result, there are 74 million Mobile FeliCa handsets in Japan.

A.1.1 Mapping to NFC Mobile Framework

The most important reason Mobile FeliCa has achieved commercial success in Japan is its foundation of “just one TSM,” FeliCa Networks. All Mobile FeliCa frameworks are managed by FeliCa Networks.

TEE

Mobile FeliCa employs an embedded TEE chip technology, which provides a multi-application solution environment, resulting in neutrality among MNOs, service providers, and handset manufacturers.

AEE

FeliCa Networks defines a single API to achieve application interoperability between different platforms from MNOs. It also provides middleware to three MNOs for each platform (NTT DOCOMO: DoJa, au: BREW, SoftBank Mobile: MIDP).

NFC Stacks and Controller

Since Mobile FeliCa launched before the NFC Forum was established, it does not comply with the full NFC Stacks and Controller architecture. However, it employs the same concept for its functionality. The RF chip is capable of Card Emulation, reader/writer, and peer-to-peer, on top of ISO/IEC18092 212k/424k mode RF, and this RF technology is also supported by the NFC Forum digital protocol specification.

NFC Mobile Back-End Server System Functionalities

OTA functionalities of Mobile FeliCa are provided by MNOs, Service Providers, and FeliCa Networks to satisfy each role. Functions related to subscriber authentication, such as secure download or chip lock/unlock, are provided by MNOs. FeliCa Networks manages Mobile FeliCa's TEE via OTA. FeliCa Networks assigns a domain for each SP in TEE, enabling a multiple application environment. Once a domain is assigned, the SP manages the key for the domain by itself and is enabled to provide functions such as issuing, personalization, and value download via OTA.

A.1.2 The Japanese Experience

In Japan, it was effective for one trusted third party to lead the whole NFC Mobile Ecosystem in the early stage of business development. FeliCa Networks assumed two roles to launch the ecosystem quickly. As the TSM, it provided an integrated mobile contactless solution and made it possible for service providers to concentrate on business enhancement. In addition, FeliCa Networks defined implementation, coordinated licenses, and ensured interoperability. The establishment of a cost-effective work-sharing and risk-sharing operation for new business model development was thus achieved among Mobile FeliCa Ecosystem players.

A.2 MIFARE

MIFARE [2] is the most broadly deployed contactless card technology in the world. MIFARE is widely used to manage the flow of passengers commuting in big metropolitan areas every day, and it is also used in many other market segments, such as access management and event ticketing.

In order to help service providers such as transport operators adopt NFC mobile phones in their respective ecosystems and to take full advantage of mobile phone functionalities, there is a need for an end-to-end mechanism managing MIFARE in mobile phones. MIFARE4Mobile has been created to serve this purpose and to offer secured and interoperable interfaces to software developers.

The MIFARE4Mobile platform handles the different variants of the MIFARE product family and manages the full life cycle of NFC applications, including top-up mechanisms.

A.2.1 MIFARE4Mobile

Application Life Cycle Management

The MIFARE4Mobile platform maintains a service provider's application throughout its entire lifecycle. The standard lifecycle of an NFC application comprises its issuance, personalization, update and revocation. Additionally, the extradition/transfer and temporary deactivation of an application are included in its lifecycle management.

Reloading Services

Reloading an NFC application consists of adding incremental value to the application's balance. This involves augmenting balances of prepaid units, ticket fares, loyalty points, etc. This service item may be triggered from a Web portal or from the end-user's mobile phone (top-up). Reloading services are enabled by interfaces with payment processors.

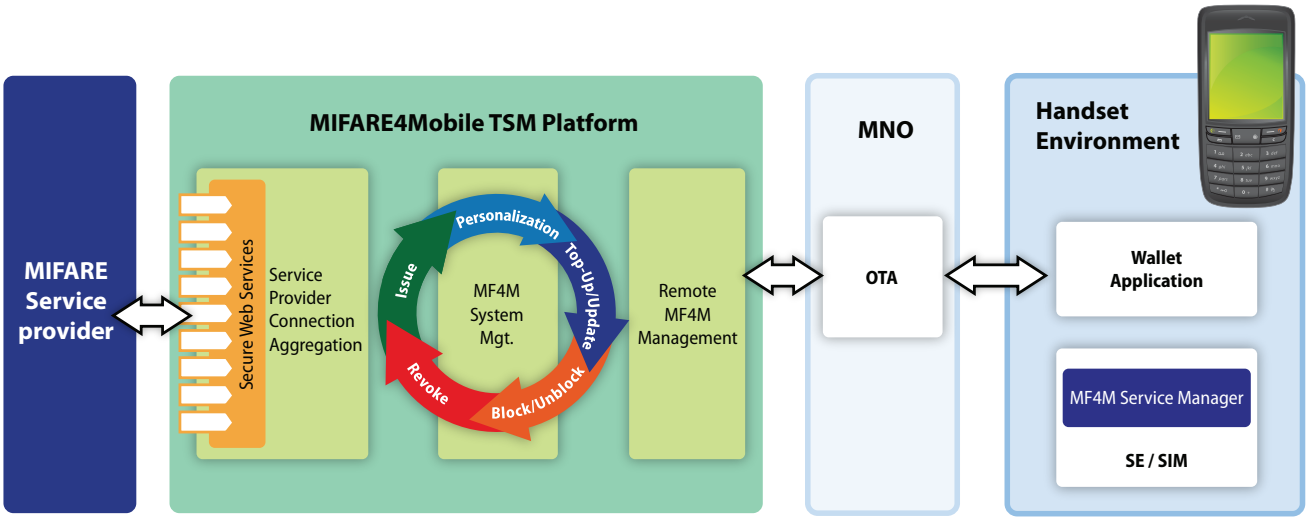

Figure A.1 MIFARE4Mobile

A.3 GSMA White Paper Recommendation

The GSMA Association released study results on a vision for NFC mobile services and how to build an NFC mobile ecosystem, in the form of three white papers [6][7][8].

These documents (collectively referred to as “the GSMA Guidelines”) specifically focus on the architecture with a TEE in the UICC. The GSMA Guidelines describe requirements and refer to corresponding standardized specifications. These requirements are generally aligned to the recommendations in Section 5 of this white paper. Since the GSMA Guidelines consist of new recommendations, they include references to specifications at various levels of development.

TSM

In order to enable the multi-application use that is one of the advantages of NFC mobile service, the GSMA Guidelines assert the importance of a contact point that connects multiple issuers, service providers, mobile network operators and users. The GSMA Guidelines define the TSM (Trusted Service Manager) as a player in the NFC ecosystem.

The GSMA Guidelines recommend that the TSM collaborate with mobile network providers and service providers to provide OTA functionality. OTA functionality includes UICC management, applet issuance, UI application issuance, service management, mobile device management, applet personalization management, security domain management, and applet transport management.

A.3.1 Mapping to the NFC Mobile Framework

TEE

The GSMA Guidelines recommend the UICC as the most appropriate NFC Secure Element in mobile phones. (NFC Secure Element corresponds to TEE in this white paper.) According to the GSMA Guidelines, this recommendation is based on the following features of the UICC: wide user coverage (two billion users), high

degree of service portability, remote management capability, availability of standard technology, and a longer lifecycle than a mobile device.

The GSMA Guidelines point to the importance of OTA functionality for adding new services through the mobile network, after issuing the UICC to the user. It recommends using the Global Platform (GP) specification (the de facto standard for smart cards) for creating a Secure Domain (SD) within the UICC and for installing applets into an SD. The most recent GP Card Specification (version 2.2, as of this writing) has been extended to include OTA functionality.

AEE

One of the advantages of an NFC mobile service is the availability of the mobile phone's User Interface (UI). The GSMA Guidelines recommend using a Smart Card Web Server and Java (J2ME) technology to make use of the mobile phone's UI functionality.

NFC mobile services can be realized with applets in the UICC, and it is necessary to link these applets to applications in the AEE in order to have a user-friendly interface. It is important to make sure that the linkage implementation will not introduce security concerns.

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