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Prototype Design of NFC-Based Electronic Coupon Ecosystem with Object Memory Model

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Abstract

In this paper, a Prototype design of electronic coupons ecosystem using NFC (Near Field Communication) in smart phones with OMM (Object Memory Model) is presented. The goal of OMM is to support the life cycle of NFC-based Electronic Coupon ecosystem for profile and usage, from E-Coupon push service and to E-Coupon clearance, using smart phone based on NFC devices. We propose the E-Coupon with OMM based on NFC, and present software design of E-Coupon among server and users.

Keywords: NFC, Electronic Coupon, Object Memory Model

1 Introduction

The gift certificate is a type of coupon; the coupon has emerged from a sophisticated financial sector. In the early 19th century, the coupon was derived on the certificate of a square piece. The electronic payment method using electronic voucher based on NFC has been studied for mobile electronic payments. And, the researches on an electronic payment system using electronic voucher

have also been conducted to avoid the risk of forgery, copy, and loss of electronic voucher. In future, if E-Commerce is activated by e-voucher, the usage path and distribution information of e-voucher can be used in marketing. For this purpose, we propose the E-Coupon (Electronic Coupon) with OMM (Object Memory Model) as a way to store useful data of life cycle from E-Coupon push service and to E-Coupon clearance in this paper.

2 Related Works

In this section, we describe the technologies, research report, and market status related to e-voucher.

2.1 Electronic Vouchers and Object Memory Model

Gauthier et al. have presented a practical offline payment system based on digital vouchers using NFC in mobile phone (Nokia 6131 NFC mobile phone) in IBBT NFC-Voucher project. The goal of the project is to assess the feasibility of such a system, from a technical and security perspective, using tangible NFC devices such as the Nokia 6131 NFC mobile phone. This involved an in-depth technical and security analysis of all actors in the system and a rigorous elaboration of the practical security requirements and assumptions. In the architecture implementing and connecting all the different actors of this voucher payment system, no compromises regarding security were made [1].

Digital Object Memories are a novel application of the Internet of Things (IoT) that paves new ways to interact with real-world objects in situ. Tagging technologies such as RFID (NFC) and QR codes, which are increasingly available on mobiles, can enable in situ engagement with these digital object memories. However, there is a lack of an agreed format for the description of the structure of object memories that are applicable across different application domains. The Object Memory Model (OMM) aims to define a generic and extended structure for digital object memories. This structure builds on widely used protocols and best practices with the aim to provide an open and flexible architecture for the augmentation of real-world objects with a digital memory [2, 3].

2.2 Electronic Vouchers and Object Memory Model

According to a recent Juniper Research study, mobile vouchers are expected to be one of the biggest winners of the current global recession. Juniper Research forecasts that the redemption value of mobile coupons will increase over 30% by 2010. The increase will result from a combination of consumers seeking discounts and merchants looking for increased sales. Report author Howard Wilcox says in a statement, "We believe that merchants will see targeted, quick, one-to-one marketing campaigns via mobile coupons as a valuable marketing weapon. Considering that mobile coupons offer much better redemption rates and are more cost effective, they represent a win-win approach for innovative retailers." [4]

SK Planet, SK Telecom's mobile platform arm, said that it will launch a NFC-based coupon service in Japan, the first in the country. In collaboration with Japan's No.2 and No.3 mobile operators (KDDI and Softbank), SK Planet will open "NFC Zone" in Shin-Okubo, Tokyo and allow nearly 100 stores to offer Japan's first-ever NFC coupon service. The combined number of the two Japanese mobile operators' subscribers has reached 80 million. As most of the smartphones released in Japan since early this year come with NFC functions, the penetration of NFC-enabled smart phones has risen. Shin-Okubo, the center of the Korean wave in Tokyo, is packed with stores selling Korean food, K-pop, etc. KDDI and Softbank's subscribers can install the "Shin-Okubo" app on their smartphones and download myriads of discount coupons and free service vouchers issued by nearly 100 stores in Shin-Okubo. Simply placing their NFC-enabled smartphones against NFC readers installed in each store will enable users to redeem their coupons [5].

2.3. Virtual Currency and Bitcoin

The integration of the real world and the virtual world is going on technologies such as Ubiquitous Computing, Internet of Things (IoT), and Cyber Physical System (CPS). In aspect of international currency, the interchange of real and virtual life was accelerated by the various electronic money, voucher, and Bitcoin [6]. Fig. 1 shows the structure comparison diagram of the virtual currency system in European Central Bank (ECB). Specially, Bitcoin of type 3 is spreading rapidly throughout the world and has been the subject of interest. Bitcoin uses peer-to-peer technology to operate with no central authority or banks; managing transactions and the issuing of Bitcoin is carried out collectively by the network. Bitcoin is open-source; its design is public, nobody owns or controls Bitcoin and everyone can take part. Through many of its unique properties, Bitcoin allows exciting uses that could not be covered by any previous payment system.

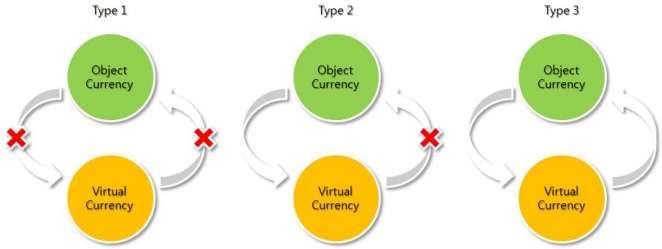

Figure 1. Structure Comparison Diagram of Virtual Currency System

3. Concept Design of NFC-based E-Coupon eco-system

In this section, we propose the concept design of NFC-based E-Coupon eco-system among issuer, beneficiary, and affiliate as shown in Fig. 2. The Fig. 3 presents the flowchart of NFC based E-Coupon among issuer, beneficiary, and

affiliate. Fig. 3, (0) presents the deployment and installation of NFC based E-Coupon Apps. Fig. 3, (1) shows the E-Coupon purchase request, payment, and E-Coupon push service by SMS between issuer and beneficiary. Fig. 3, (2) presents the E-Coupon transfer by NFC and SMS between beneficiaries. And Fig. 3, (3) shows real goods purchase by E-Coupon in smart phone between affiliate and beneficiary and clearance process between issuer and affiliate.

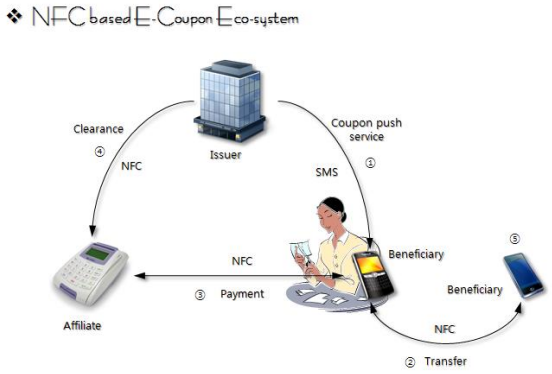

Figure 2. The NFC based E-Coupon Eco-system

The event of state change is generated by E-Coupon transactions among issuer, beneficiary, and affiliate as shown in Fig. 4, Fig. 5, and Fig. 6. By OMM, this event of state change stores the data (date, from, to, transfer method, and so on) in Object Memory. They are raw data for profile or life cycle of E-Coupon. These data make the distribution information, usage path, social relationship, and so on. And in future, these data will present the info-graphics by D3 (Data-Driven Documents) [7] tools.

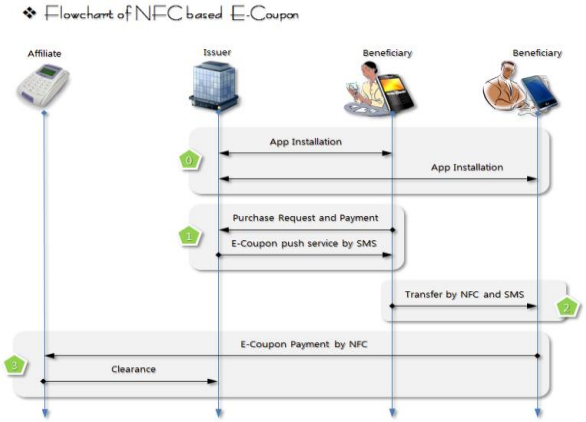

Figure 3. NFC based E-Coupon among issuer, beneficiary, and affiliate

4 Software Design of NFC-based E-Coupon Eco-system

Software design is the process of defining software methods, functions, objects, and the overall structure and interaction of software codes so that the resulting functionality will satisfy user's requirements. In this section, we present the diagrams of run flows, server architecture, and UI architecture.

4.1 Deployment and Installation of NFC based E-Coupon App between Issuer and Beneficiaries

Fig. 4 presents the deployment and installation of E-Coupon App like billfold in Fig. 3, (0). The beneficiaries download E-Coupon app from issuer, and interchange unique identification information between issuer and beneficiary. Fig. 5 shows the initialization and E-Coupon issue between issuer and beneficiaries. The E-Coupon of beneficiaries are initialized by connection, synchronization, and exchanging public key. And beneficiary 1 pays issuer the real currency, and receives the E-Coupon from the issuer.

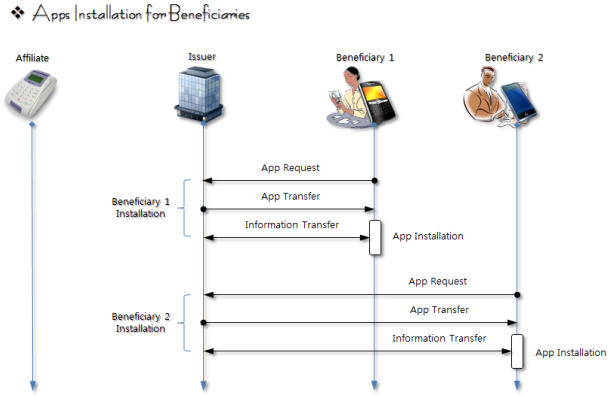

Figure 4. Deployment and Installation between Issuer and Beneficiaries

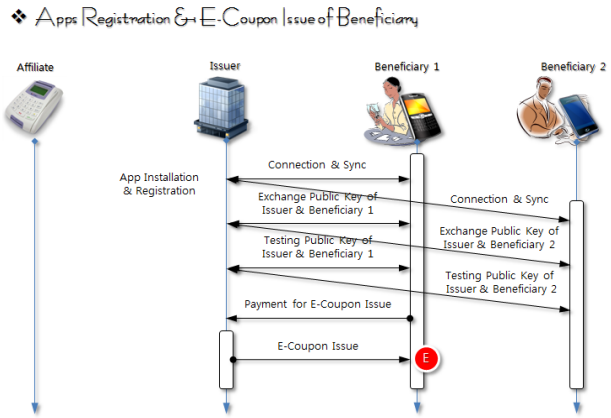

Figure 5. Initialization and E-Coupon Issue between Issuer and Beneficiaries

4.2. E-Coupon transfer and E-Coupon Transaction among Issuer, Beneficiary, and Affiliate

In this subsection, we present the transfer and re-registration of E-Coupon between beneficiaries. The beneficiary 1 has the E-Coupon in Fig. 5, transfer the message of E-Coupon Cancel to the issuer, and transfer the E-Coupon to the beneficiary 2 in Fig. 6. And the beneficiary 2 transfers issuer the re-registration message of transferred E-Coupon. The Fig. 7 shows the payment by NFC and clearance of Fig. 3, (3). The beneficiary 2 transfers the transferred E-Coupon from beneficiary 1 to affiliate. The affiliate receiving E-Coupon from beneficiary 2 requests issuer the payment of transferred E-Coupon. Then, the issuer wants beneficiary 2 to accept the right of using E-coupon. As a result of beneficiary 2's acceptance, the issuer will pay the values of E-Coupon. Lastly, the beneficiary 2 will receive the receipt of E-Coupon payment.

4.3 OMM and Prototype Implementation

The object memory model is recorded by a particular event. The case of particular event is E-coupon issue, E-Coupon transfer, re-registration, and acceptance of E-Coupon payment. As we have described, the OMM is to support the life cycle of E-Coupon and basic data for various services. And Fig. 8 presents the E-Coupon transfer between Android smart phones.

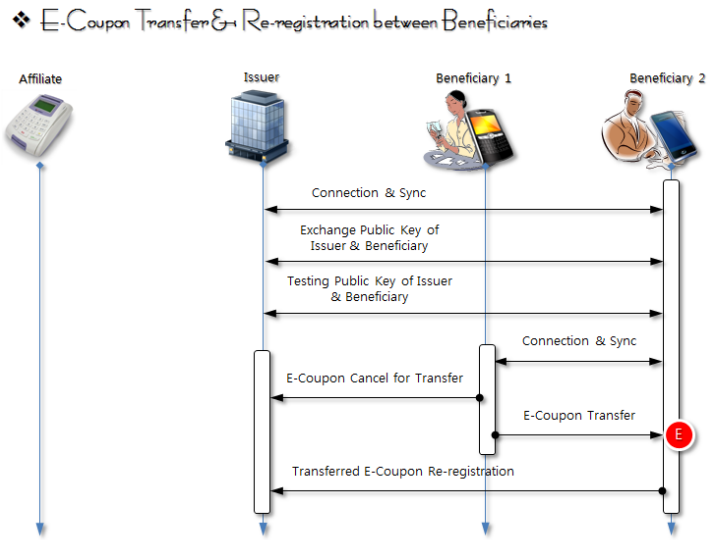

Figure 6. Diagram of E-Coupon transfer and re-registration between beneficiaries

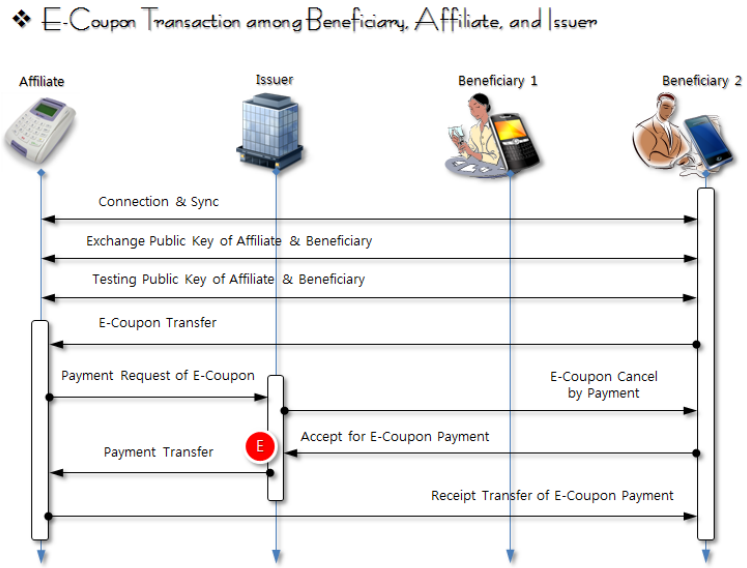

Fig. 7. Diagram of NFC based E-Coupon among issuer, beneficiary, and affiliate

Figure 8. Implementation of E-Coupon Prototype

5. Conclusions

In this paper, a prototype design of electronic coupons using NFC (Near Field Communication) in smart phones with OMM (Object Memory Model) was

presented. The goal of OMM is to support the life cycle of NFC-based Electronic Coupon for profile and usage, from E-Coupon push service and to E-Coupon clearance, using smart phone based on NFC devices.

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