

# INCENTIVE-BASED AND PEER-ORIENTED DESIGN OF UBIQUITOUS COMMERCE

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**Keywords:** Ubiquitous Commerce, Seamlessness, Privacy, Business Model, Peer-Oriented, PIB(Personal Information Base).

**Abstract:** Seamlessness is the keyword of U-Commerce which may be defined as the commercial interaction among providers, consumers, products, and services, enabled and supported especially by the real-world seamless communication of each entity and object's digital information. However, the possibility of the seamless transactions increases the privacy risk of the entities involved. Therefore, the core issue of U-Commerce is how to promote seamless transactions while protecting the privacy. For the seamlessness, the role of incentive-emphasized business model is important since the seamlessness makes clear which economic entities contribute to a commercial transaction. Economic entities will reject the seamless transactions unless the sufficient incentives are given to them. In order to consider the privacy issue, we suggest an alternative U-Commerce architecture based on Hybrid P2P Model and Personal Information Base.

## 1 INTRODUCTION

U-Commerce research has been recently being done by ubiquitous computing and e-commerce researchers. According to Watson et al. (2002), U-commerce is defined as the use of ubiquitous networks to support personalized and uninterrupted communications and transactions between a firm and its various stakeholders to provide a level of value over, above, and beyond traditional commerce. Roussos & Moussouri (2004) defines U-commerce as any transaction with a monetary value that is conducted using ubiquitous computing technology.

We define U-Commerce as the commercial interaction among providers, consumers, products, and services, enabled and supported especially by (the real-world) seamless communication of each entity's (digital) information. The seamless communication is supported by the combination of automatic identification technologies (e.g. RFID), (wireless) communication technologies (e.g. bluetooth), positioning services (e.g. GPS), and sensor network technologies (e.g. Smart Dust).

Seamlessness and the subsequent integration of virtual digital space and physical space are the fundamentally distinctive feature of U-Commerce in comparison to the traditional commerce. The term

Seamlessness refers to the continuous and uninterrupted information flow of products, services, spaces and economic entities in commercial transaction process. Seamlessness of U-Commerce is made possible by embeddly digital information in every object. Such embedded digital information saves end users the cost to transfer analog information into digital one (e.g. typing) allowing the applicable information to flow seamlessly. In turn such uninterrupted exchange of information makes physical and virtual digital space integrated meaning that all information in physical space commerce activities is exchanged without any interruption and pause as it is in virtual digital space thereby eliminating the gap between the two different spaces. To understand such integration, Brock(2001) in MIT Auto-ID Center carried out Physical Markup Language (PML) study.

This highly functional U-Commerce environment reduces transaction costs, improves the quality of exchanged information and heightens the transparency of transaction to name a few. However, the new environment has dark side and negative potentials as well. Such an uninterrupted flow of information has possibility to infringe on individual's privacy depending on how and where the information is used and stored. It's because the continuity of information can be interpreted as

easiness in collecting information by certain entity. Furthermore, the systematic storage of data enabled by U-Commerce environment can worsen privacy impairment if misused and/or abused. Considering this, it's safe to say that seamless storage of information might be trade-off to privacy protection. To figure out the secret of such relations, Acquisti (2002) implemented a study that proved trade-off between incentives to share information and the ones to hide information.

Therefore U-Commerce technology should find the point where these two purposes can be harmonized in between and help each economic players not to leave away from U-Commerce by ensuring all incentives go to the right people. Figure 1 below shows the relationship between privacy and seamlessness and the need to discover ways to shift from point A to B where both privacy protection and seamlessness can be improved together (Fig. 1).

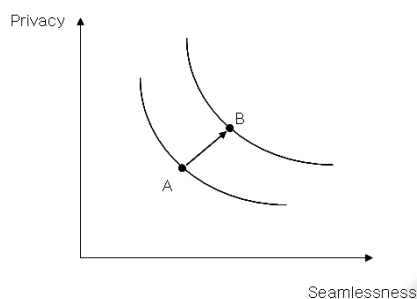


Figure 1: The Relationship of privacy and Seamlessness in U-Commerce environment.

### 1.1 Seamlessness

Scenario A and B below shows an example of seamless commercial transaction in U-Commerce environment. Scenario A describes an instance where economic incentives flow to Displayer and Scenario B depicts an example where providers and users are encouraged to join U-Commerce via incentive-emphasized business model despite some privacy infringement. Both scenarios show the possibility to provide economic incentives thanks to the seamlessness.

#### A: Scenario 1

Tom visited nearby electronics shop to buy a digital camera and finally found an attractive one. The clerk kindly introduced the product that Tom chose. But he wanted to know more detailed information such as other users' comments on it. So he took out his terminal and scanned the product's embedded RFID Tag information. Related basic information was displayed on the screen and links of supportive

information were provided as well. He opened some of those linked pages to check unclear parts about the camera and after some more checkups he decided to buy the product in other shop located nearby which according to the linked pages sold the same product at lower price. The displayer in the first shop also received economic incentives being credited to display the product allowing the buyer to check linked information. (Lee, K. and Seo, Y., 2006)

#### B: Scenario 2

After work, Jane was on the subway to go to her friend's birthday party. She found the bag of the woman sitting in the opposite side of the car pretty cool. Doubtlessly it was difficult to talk to a total stranger. So Jane took out her RFID Reader-embedded terminal and read the tag attached to the bag. Then many tags of other products located within a 2 m radius were also scanned and Jane touched filtering button and extracted the information only about the bag. In addition to the basic information, she also got more specific data by logging on to web. And then she dropped by a shop close to her friend's house and bought the bag she searched about. The owner of the bag which Jane did scanning was provided some amount of compensation from the bag's manufacturer. (Lee, K. and Lee, J., 2006)

Scenario A shows how an end user obtains and utilizes the information of a certain product in a physical shop under U-Commerce environment. When he first acquired the product's information, Tom could avoid typing something but rather he just read embedded digital information. For this reason the information in the process of commercial transaction could flow without any interruption. Such a seamless information stream allowed the user to locate the sources of relevant information such as how, when and where the data was made and this leads to the creation of incentive system. Under the system, the displayer who provided information could receive incentives.

Scenario B is focused on providing incentives to business participants and thereby overcoming potential weak points despite some infringement on privacy. If people wear RFID-tagged clothes and a person can scan the tags with their portable devices, the end user's cloth can be used as advertisement sources as verbal marketing is. But here are hidden risk potentials. Too much exposure of the information about the clothes can have possibility to make clothes' owner feel "priced" just as his clothes. This way the owner can get the impression his

privacy is infringed. For this reason, Scenario B shows economic compensation is offered to encourage economic players' participation and ensure that seamless transaction. In section 2, let us look more deeply into the incentive system and its applicable business model under U-Commerce environment.

## 1.2 Privacy Issue

U-commerce environment upgrades the quality of commerce related information and in turn contributes to the establishment of incentive system. Looking at the other side of the coin, however, such a systematic accumulation of information can trigger individual's privacy infringement. Scenario B tries to overcome the privacy issue with a new business model. However no matter how many profits and benefits might be provided through a well-made incentive system to each economic player, some end users would not join U-Commerce activities if they find there are too numerous privacy-threatening factors to bear. The increase in "the dissatisfied" becomes an obstacle to network effect, if, then the two scenarios would have fewer chances to be realized. This is why solutions to protect privacy must be prepared without fail.

Many studies on ubiquitous computing have suggested methods how to protect privacy. Usually they've proposed principle or requirement for privacy protection such as Bellotti & Sellen (1993), Langheinrich (2001, 2002), Jiang (2002), Galanxhi-Janaqi & Nah (2004) or user modeling such as Jiang et al. (2002), Lederer et al. (2002).

It's said privacy has been weakened very much in e-commerce because the transaction between providers and end users is a Client/Server structure and most information gatherers are servers. Regardless of the place, on-line shopping mall or off-line shop, where you buy a product the provider (e.g. credit card company) stores all information about your commercial transaction in his own server. Meanwhile end user does not have a good way to store all the information about his commercial activities in digital format. Under U-Commerce environment, however, computing capability is integrated to financial settlement methods (e.g. uDA: Ubiquitous Digital Assistant's settlement application) and therefore there can be many models which enable settlement without the need to send relevant information to server (e.g. P2P type electronic wallet). In addition information about transaction can be systematically stored in end user's

terminal. With this, privacy infringement problem can be overcome as well.

As method for end user to become the biggest information owner/collector, this paper suggests Peer-oriented architecture and proposes PIB(Personal Information Base) as supporting system for Peer-oriented architecture. These two issues will be covered in more detail in section 3.

## 2 THE ROLE OF BUSINESS MODEL FOR SEAMLESS U-COMMERCE

Unfortunately most of the existing U-Commerce studies have been just focused on suggesting ideal scenarios and implementing relevant technologies without verifying feasibility in business perspective. These types of researches have high possibility to draw results that will be disregarded by end users and/or providers in the real market. To be highly valued in the real world, every solution must go through business model development check-up before technology development phase since more thorough review including business entity perspective is implemented in business model stage than in scenario making a step. If scenario might be just a good story from end-user perspective that describes new exceptional utility to the end-user, business model goes further and pictures 1) the roles of participants in a business and the flow structure of value among them, 2) potential profits of participants, 3) profit sources of business providers (Timmers 1998). This means U-Commerce should be studied in the direction much more based on Chesbrough & Rosenbloom (2002)'s angle who finds business model located in-between technical and economic domains than on Magretta (2002)'s view who calls business model telling a good story at scenario level. Let us think what roles business model play in U-Commerce by reanalyzing scenario A and B in section 1 from the perspective of Timmers (1998)'s business model.

### 2.1 Comparison Shopping: RFID-based Comparison Shopping

Business participants of Scenario A are displayer, shopping network, retailer and customer. Value flows seamlessly and uniquely in comparison to the traditional commercial transaction as follows: the information embedded in a product's RFID tag is

read by user's terminal, purchase price is searched for via shopping network, finally a product is purchased. Thanks to this, displayer and retailer are guaranteed fair profits, Customer easy access to desired information and business providers commission made from their provision of shopping network.

RFID-based Comparison Shopping model is designed to channel incentives to displayer who provided product information in the off-line shop. In traditional commerce environment, an end user may first check price information of a product in web sites, visits shops to evaluate the product physically, bargains over product price and went to another shop if the first shop sells the product at far higher prices than he saw on the web site. This kind of sequence can explain one recent shopping trend. When young-aged students visit a big shopping mall, the clerk doesn't pay great attention to them because he assumes that those students might already have full knowledge about product price and expects the visitors will not buy a product if the shop sells products more expensively than on the internet. Under RFID-based comparison shopping, however, displayer receives certain incentives for offering product information and this encourages him not to give up his role as displayer, benefiting both visitors and displayer himself as win-win model. The displayer would do his best for visitors because he gets economic compensation in proportion to visitors' purchase frequency regardless of where they actually buy a product. RFID-based Comparison shopping model offer values to each displayer and end user and especially the value to displayer should be attractive enough so that the displayer doesn't have to feel the desire to become seller. Furthermore when this model is made public for the first time, potential rejection that participants might feel over the division of one role into two should be minimized so that more participation can be taken. Technical requirement to implement this model includes the installation of RFID reader module in end user's terminal and efficient display of diverse shopping information into small display screen that end users see.

## 2.2 U-Referral Marketing

In scenario B, business participants are referrer, business provider and buyer who scans information and purchases a product. Pertaining to value flow, buyer reads information embedded in product's tag via his terminal and searches products based on DB provided by business providers and finally buys the

product. Referrer also gets incentives. Potential benefits of participants include easy access to information for buyer, economic compensation for referrer and promotion effect for business provider.

U-Referral marketing model ensures economic incentives to information providers when an end user obtains product information by scanning another end user's product and finally purchases a product. U-Referral marketing is quite an interesting model in that product-consuming end users function as advertisement model, promotes products and receives economic compensation instead of advertiser employs a model to promote his product via TV, magazines, the Internet, etc. Verbal marketing or Amway model can be seen as the most similar model to this new marketing model in the pre U-Commerce times. But verbal marketing doesn't have incentive system to use and Amway model albeit having incentive system has potentials to bother buyers. In this regard U-Referral marketing model is more reasonable because under the model incentive system is available since a person who scans a product can identify the information sources and it is more acceptable since all participants can enjoy certain level of freedom in scanning and/or being scanned and therefore stay free from unwanted bothering. Incentives provided to U-Referral marketing's participants include cyber money, premiums and gift certificate to name a few.

As RFID-based comparison shopping model does, U-Referral marketing model also requires some technical feasibility such as the installation of RFID reader module in end user's terminal. Considering great numbers of participants and broad service range, however, the technical feasibility related to security and accurate information control here is seen to be higher than the former model. As social requirement protecting privacy is a critical issue. End users, referrer, should be offered authority to decide on information provision easily and anonymity should be guaranteed so that end users who do scanning can not identify referrers who give product information. To make U-Referral marketing model successful, it's important to create an environment where end users accept and enjoy the process of information collecting via product scanning and incentive offering to information providers as part of cultural phenomenon.

Both U-Referral marketing and RFID-based comparison shopping business models are designed to give economic compensation to information providers. These two models show incentive provision is attributed to seamlessness and such un-stopped information flow is credited to the incentive

system in turn. Also they show how an institutional system of business model can attract “runaways” concerned about seamless related privacy risk back into the new commerce environment.

Different scholars express different opinions over business model and among them this paper analyzes two business models based on Timmers (1998)’s view who interprets business model from the perspective of an entire flow. The analysis clearly shows the flow of value which was not identified at scenario level, potential benefits that participants can get and the role of business model in U-Commerce. The next section suggests how to resolve privacy infringement issue via technical methods.

### 3 SUGGESTIONS FOR PRIVACY-ENHANCED U-COMMERCE

Seamlessness facilitates information linkage and in turn it improves the quality of exchanged information. It also enables systematic incentive system. But ironically the same feature which allows accurate location of information sources and systematic storage of such information threatens individuals’ privacy. In order to decrease these privacy-intimidating factors, this paper proposes Peer-Oriented service architecture as a solution.

#### 3.1 Peer-Oriented Architecture

In U-Commerce environment, seamless flow of information helps economic players gather needed information easily and this can also mean business providers do not have difficulties in collecting and storing end users’ information. To protect privacy intact in these circumstances, decentralization of information storage among participants should be accomplished so that business providers might not monopolize information. In other words, a specific architecture should be designed under which information-generating end user can be the biggest owner of such information and other participants can store only part of the entire information.

Such a Peer-Oriented architecture shares the essence of ubiquitous environment since ubiquitous environment itself is based on P2P (Takemoto 2002). Considering that WWW was created based on Client/Server architecture where web server and client’s web browser interacts it was quite natural that Web-based commerce was designed to make all relevant information was stored and many work was

done in business provider’s servers. However, P2P is a natural format for U-Commerce environment. Service structure in this P2P form which does not burden business provider’s servers is also expected to enhance the efficiency and expansibility of information processing and computing power (Morikawa & Aoyama 2004). Section 3.2 introduces two scenarios related to Peer-Oriented Architecture and explains why such architecture is required in U-Commerce environment.

#### 3.2 U-Recommendation & U-Payment through Peer-Oriented Architecture

Until now concerning recommendation, most information ranging from private information including customer ID to commercial transaction information has been stored in the server of business providers and pertaining to e-commerce payment. In U-Commerce, the possibility and need of recommendation has increased but privacy-protecting model has not been proposed. In these circumstances we need to study how to safeguard privacy while utilizing conveniences of U-Commerce by constructing Peer-Oriented architecture.

First, the recommendation can be made via temporary peer network rather than by merchant’s servers which analyze the ID and tastes of buyers. Some incentives are provided to players who participate in the recommendation. When end users holding UDA (Ubiquitous Digital Assistant) which is similar to PDA enter Uzone (Ubiquitous Recommendation Zone) the UDAs start P2P communication. If one end user’s UDA agent detects relevant content, event-driven agent pushes the content and in turn Top-k filtering agent recommends it and neighbor reformation agent monitors end user’s decision. If the end user actually chooses the product following the recommendation of the neighbor, all neighbors involved in the recommendation receive  $1/n$  amount of incentives. For sure the amount of such incentives is different on how much a neighbor contributes to the process. Figure below is the Architecture for P2P recommendation.

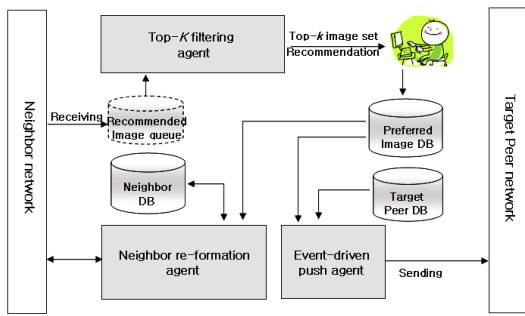


Figure 2: Peer Oriented Architecture for ubiquitous recommendation (Kim, H., Lee, K., Kim, J., 2006).

In commercial transaction process payment is the weakest spot to privacy infringement. At least before payment stage each end user can make efforts not to expose his personal information. However once the payment is made, other people also come to be able to know who bought the product. We can consider a scenario in which seamlessness is preserved and end user's privacy is safeguarded at the same time. The scenario goes: end user James tries to pay for a one-piece dress; shop clerk reads the product's tag information; settlement information application is executed on James's terminal; James gives authentication and orders payment; an amount of money is deposited into the shop's bank account on the screen; James gets electronic receipt to his terminal.

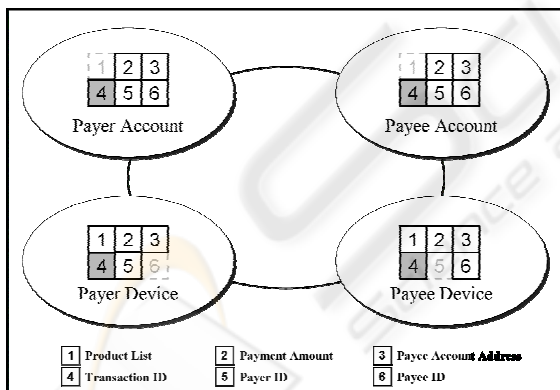


Figure 3: The Structure of Payment-Related Information Possession in Each Entity (Lee, K., Jeong, M., Ju, J., 2006).

This scenario is distinctive from the traditional C/S system in three perspectives: first, the payment system starts from the end user's terminal; second, the scenario involves only necessary participants in the payment process such as payer, payee and main banks while in the pre-U Commerce setting, one's credit card and payment information has to go

through intermediate vendors on its way to a credit card company; and third, newly created transaction ID allows fund settlement through financial institutions without exposing the IDs of payer and payee. In every deal one unique transaction ID is generated out of payer and payee's transaction IDs and participants in payment process possess only essential information.

Picture above shows what information payment process participants have. Payer's device does not have payee's ID and payee's device does not contain payer's ID. Since they do not share each other's IDs, those two economic players do not know each other. But still they can enjoy product/service provision, payment, and even after services including refund without any problem. Payer account and payee account do not possess product lists and thereby protect the privacy of end user, payer. Furthermore designed to resemble the cash payment structure in off-line commercial transaction as much as possible, this model tries to ensure smooth P2P communications between economic entities involved in payment process. In the past only big-scale business providers which could afford C/S architecture had digitalized and systematically-stored information. Meanwhile U-Commerce is expected to enable Payer, i.e. end user, and even small product/service providers to systematically store and manage their information by upgraded computing power.

Under e-Commerce environment end users had to disclose all of their private information to provider's servers for recommendation and/or payment. Unlike this, Peer-Oriented networking service prevents diverse information from being concentrated on one side and therefore protects privacy.

While P2P type service architecture preserves privacy, dispersed information storage in the process can be an obstacle to the best service. Section 3.3 proposes to tackle this problem via the so-called PIB (Personal Information Base).

### 3.3 PIB (Personal Information Base) for Peer-Oriented Architecture

Information storage supporting system is inevitable to execute Peer-Oriented architecture successfully. In P2P architecture information is stored in a decentralized manner and this can interfere with seamless accumulation and storage of information. To overcome this shortcoming, PIB (Personal Information Base), i.e. individual's information collection space, is made. Although PIB is used to

support Peer-Oriented architecture designed to protect privacy, the fact that all information about commercial transactions remain in end user's device plays as environment that leads to the establishment of PIB as well.

PIB can be summed up as critical module to be stored in end user's terminal. Such information includes individual's ID and profile which explain who an end user is, all kinds of Personal Information made by end users, digital certificate settlement related information, etc. Information which goes to PIB covers age, gender, nationality, income, activity, interest, schedule, wish list and so on.

Besides tackling P2P architecture's problem of dispersed information accumulation, PIB also has many other merits such as improvement of use's privacy and service quality. For example, in a restaurant a clerk asks a customer, "Do you like something hot and spicy?" and the customer says, "Yes." In this situation, the clerk can do the recommendation of appropriate meal without knowing the end user's ID. If PIB shows the preference of the end user without revealing his ID, it means that the clerk can do recommendation successfully while the customer can keep his privacy safe. This structure of PIB makes a stark contrast to C/S structure e-commerce in which one person makes his identification proved by inputting his unique ID and has all of his relevant information stored in server to get services. To be short, under the new structure end users can enjoy proper product recommendation and services fit to each different situation as PIB allots specific places for keeping the preference and/or commercial dealing information of individual user. Furthermore PIB has other features related to commercial transaction information such as wish list or purchase list. It can also provide similar concepts to 'To Do List' suggested in Carolis et al. (2004). Gemmell et al. (2003) in studies on My Life Bits System aimed at recording all relevant information of one person.

The existence of PIB emphasizes the need of agent that will utilize it instead of human user. In e-commerce environment, the performance and usage of agent was not active since the place to store individual's information did not exist. With affluent PIBs in place, it would be easier for agents to carry out services on behalf of their owners by referring to various preferences and/or decision records of former specific cases. Search, comparison, negotiation and recommendation functions are expected to strengthen for agents to ease Users' burden in decision making.

## 4 CONCLUSION

Seamlessness is the core concept of U-Commerce. This seamless flow results in positive effect such as the improvement of exchanged information. But it also has risk factors such as privacy infringement. So to make the best use of Seamlessness it is critical to develop business model constructed to prevent economic players from leaving away from the new type of commerce and to come up with a fundamental solution to minimize privacy threatening elements in the first place. This paper attempts to resolve this privacy related problem by introducing U-Referral marketing and RFID-based Comparison Shopping as examples of incentive-emphasized business models and suggesting Peer-Oriented architecture and PIB as supportive tool. PIB not only helps the protection of privacy by providing product recommendation and other services without disclosing user's ID but also helps end users store and collect information systematically. In addition, Peer-Oriented architecture contributes much to privacy protection by preventing excessive concentration of information on one place.

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