

Design of a RFID-Based Ubiquitous Comparison Shopping System

Kyoung Jun Lee and Young Hwan Seo

Kyung Hee University, School of Business,
#1 Hoegi-dong Dongdaemun-Ku, Seoul 130-701, Korea
{klee, seoyun01}@khu.ac.kr

Abstract. With the spread of the so-called always-online environment that allows consumers to be online anytime, anyplace, the next step will be the integration of online and offline markets. Competition will be consequently further intensified and there is a probability that in the process the role of offline retailers will shift from that of a traditional retailer to a displayer role. When this occurs, appropriate technological devices and business models should be explored so that both displayers and retailers can benefit. To this end, this paper proposes an RFID (Radio Frequency Identification) technology-based pervasive comparison shopping business model. RFID will allow consumers to be seamlessly connected to the network, and the advent of a new shopping network will enable a smoothly functioning incentive mechanism between displayers and retailers. Ultimately, a new shopping network will enable consumers to be engaged in seamless commerce.

1 Introduction

The development of the Internet has greatly changed people's shopping patterns. In the traditional commercial transaction, people are required to visit shops to make a purchase. Now, thanks to the Internet, consumers can choose to use the Internet shopping to shop instead of physically visiting stores. In the current shopping environment, both types of consumers are faced with dilemmas: offline consumers cannot be sure whether they are getting a good price, while online consumers cannot be assured of the quality or design of the product they are getting or the credibility of the merchant selling the product. Due to these shortcomings, in brick and mortar commerce, shoppers must visit several stores to compare prices and other terms, while comparison shopping has emerged as a solution in the case of online shopping. Nevertheless, these two markets remain divided, with each constituting a distinct one. The only way to make comparisons between online and offline markets is to learn about the transaction terms of the offline market and then perform a search online or vice versa. The formation of a ubiquitous computing environment will allow these two divided markets to be integrated. This paper presents how the online and offline markets would be integrated in an always-online environment, possible consequential problems that might arise in the market, and business models and methods for overcoming those problems.

2 Evolution of Comparison Shopping

In traditional commerce, the product information of each retailer is dispersed and consumers must visit each of them to seek such information. Under these circumstances, the search cost may be greater than the benefit acquired through the search. Now, with the help of the Internet, consumers can easily find product and merchant information. There is no longer a need to pay a visit to physical stores and compare transaction terms. This led to the drastic diminishment of the search cost to be borne by consumers (Bakos 1997), but again the rapidly increasing number of retailers made it difficult for consumers to find what they are looking for (Santos et al 2001). In addition, due to the excessive amount of information available on the Internet, search costs are still incurred. This gave rise to comparison shopping agents to reduce search costs (Krulwich 1996: Kushmerich et al 1997: Yuan et al 2000). Comparison shopping helps consumers make wiser purchase decisions (Yuan 2002) and reduce search costs (Crowston 2001). However, the world-first comparison shopping agent Bargain Finder (Krulwich 1996) was blocked by some sellers feeling threats from it. After the Bargain Finder, various types of comparison shopping services have been developed such as client-based comparison shopping (Jango), collaborative filtering-based recommendation (Firefly.com), and knowledge-based comparison shopping (Personal-Logic). Finally, many commercially successful comparison shopping business came out such as mysimon.com, kelkoo.com, froogle.google.com, and shopping.com. Especially a new type of shopping portal site Become.com provides not only comparison of price but also news or data related shopping. Nevertheless, Internet-enabled comparison shopping only searches among registered online retailers rather than the offline market. In addition, though online comparison shopping services notably curtailed search costs, there remain issues such as the lack of opportunity to actually see and touch products and the question of the credibility of online merchants.

3 Comparison Shopping in Always On-Line Environment

What will happen to the comparison shopping environment when the always-online IT infrastructure and services are widespread, for example through mobile Internet (Wibro) and HSDPA (High Speed Downlink Packet Access)? This section offers a possible scenario.

3.1 Scenario 1

Tom, who owns a digital camera shop downtown, has recently been concerned. The number of consumers visiting his shop has not decreased, but the number of visits leading to actual purchases has dropped sharply. His operating cost is still the same, and reduced sales make it difficult to remain in business. People come to a shop to view products and ask relevant questions. Even those with the intention to make a purchase just browse products at physical shops and use online devices to comparison shop and ultimately purchase from another retailer offering a better deal than Tom. As a consequence, Tom has lost any drive to keep his store afloat and is not making any genuine effort to answer shoppers' questions.

The scenario above described what could happen to physical retailers when the always-online environment becomes prevalent. The commercialization of always-online technologies such as WiBro will make possible the two inherent characteristics of ubiquitousness; that is, anytime and anyplace computing. People will be able to connect to the network anytime, anyplace (Holtjona et al 2004). It will integrate online and offline markets that are currently separate, and, more specifically, enable a market where consumers can use always-online services in physical spaces. Against this backdrop, online and offline markets will no longer be distinct as they are now, and will have to compete fiercely with each other in a single integrated arena. Until now, the retailers in the offline market have had an advantage in terms of information, and consumers have been generally passive in accepting whatever terms they suggest. To overcome this disadvantage, consumers have employed such methods as physically visiting stores, comparing transaction terms, or trying to obtain a discount through negotiation. The tables will be turned in the always-online environment, and consumers will be able to proactively respond to transaction terms through searching and comparison. They will no longer have to accommodate the terms vendors offer without any effort to make them more favorable to themselves. They will be able to purchase products or services as closely in accordance as possible with the terms set by them. With heightening competition, a market equipped with competitiveness will be more active, and by comparison, relatively inferior markets will become lackluster. However these two markets are mutually complementary and both of them must exist for consumers. In this sense, a new market structure is required where markets can be both successful.

4 Pervasive Comparison Shopping Process in Always On-Line with RFID

This section is intended to demonstrate a process wherein the issues introduced in scenario 1 can be resolved using RFID technology and an appropriate business model.

4.1 Scenario 2

Jamie, who loves shopping, wants to buy new fall clothes. She finds an article of clothing she likes in a catalogue. She can buy it online, but wants to go see it for herself, and she enjoys shopping. Accordingly, she goes with a friend to a store located downtown. She is also concerned about costs and wants to buy it at a low price. She likes the product when she sees it, but a slightly high price makes her hesitate. So she uses her terminal to scan the RFID attached to the item to check the prices offered at other stores and to connect to a comparison shopping site. As she is interested only in prices after examining the product herself, she browses a list arranged in order of price. She selects Shopping Mall A, which is reliable and known for quick delivery, and makes a purchase.

This scenario depicts a process from the perspective of consumers. There is not much difference for consumers except that RFID enables seamless comparison shopping. Nevertheless, the relationship between offline stores and online shopping malls changes. If consumers only examine products at offline shops that spend money to display them and then buy elsewhere, offline shops will take countermeasures such as

hiding RFIDs or not providing information to prevent consumers from using RFIDs to engage in comparison shopping. This leads to a need for a business model that offsets the costs incurred to offline shops even when consumers use only the information provided at offline stores but make an actual purchase elsewhere.

4.2 Scenario 3

James, who owns a shop in a downtown shopping center, makes a genuine effort to explain about the products in his store to the many consumers who visit his shop on a holiday. Most consumers ask detailed questions, but make their purchase through RFID scan-enabled comparison shopping. Even now, he introduces the new fall products to a female consumer, and she evaluates and buys a product through comparison shopping. After the purchase is completed, the online shopping mall from which the female customer bought the product deposits a payment in James' bank account. Before RFID-based comparison shopping, James put great efforts into acquiring products at a lower price, needed a warehouse in which to store his stock, and bore logistics costs to maintain them. Now he is relieved of all these incidental expenses and all he has to do is to acquire and display products.

These scenarios are centered on offline stores. Offline stores have to deal with significant consumer traffic, which requires them to pay a considerable expense. Offline stores that have to bear such expense should be given incentive to allow the initiation of an RFID-based comparison shopping model. In the model in scenario 3, both physical retailers and displayers can benefit.

4.3 Economic Parties

Consumer: Those who consume products. They are engaged in comparison shopping both in physical spaces and using RFIDs in the always-online environment. Under such circumstances, the cost borne by consumers to research prices and services shrinks. Furthermore, seamless networking is made possible as the search method changes from keyword-based to RFID scanning.

Displayer: Without RFID technology, retailers' sales volumes diminish in contrast to their costs as consumers move away from brick and mortar stores through comparison shopping. When a comparison shopping network based on RFID takes root, they can receive incentives from other retailers, and it will change the focus of their business from sales to display.

Retailer: Once they are registered with a comparison shopping network and post information on their products, they can concentrate their efforts on sales without having to handle marketing. They can be offline retailers that enjoy relatively low maintenance costs thanks to low traffic or they can be online retailers.

Shopping network: Site to support RFID-enabled research and to connect physical product retailers and virtual product vendors displayed on the terminal using RFID.

4.4 Processes in the Scenario

The model in scenario 3 can be divided into two processes. In the first process, a search process, a consumer views the products of a displayer, signs onto a shopping network server, and receives information about retailers registered there. In the

second process, the consumer selects a product and makes a payment, and incentives are distributed.

4.4.1 Search Process

Definitions

DID: Displayer Identification that uniquely distinguishes a displayer to whom an incentive is given in a transaction.

RID: Retailer Identification that uniquely distinguishes a retailer for a consumer to communicate with through the shopping network.

PID: Product Identification that discriminates a product such as EPC (Electronic Product Code).

SNID (Shopping Network Identification): The address that consumers access the network for comparison shopping.

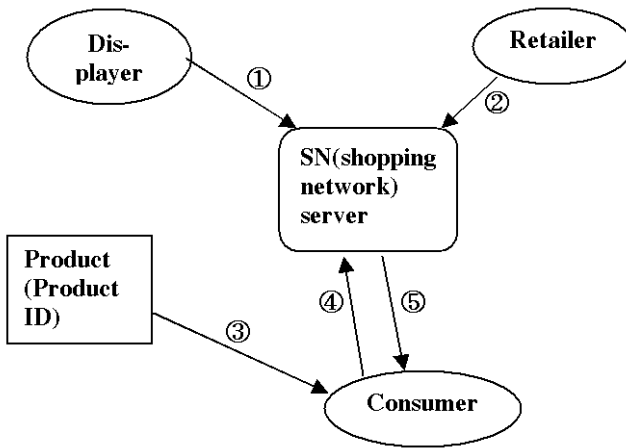


Fig. 1. Search Process of the Pervasive Comparison Shopping

- ① Displayer ID(DID), Product ID (PID)
- ② Retailer ID(RID), Product ID(PID), price and transaction condition/update
- ③ PID, SNID
- ④ PID
- ⑤ sorted-list which contains the RFIDs that meet the search criteria

In steps ① and ② of fig. 1, a shopping network recruits member companies before it commences service to ensure the smooth operation of its incentive system. This is because if the network gathers retailers' information through scraps to deliver a sorted list to consumers, retailers can refuse to pay incentives to displayers. However, consumers seek convenience and also prefer to do it their own way. In step ③, a PID ensures automatic and reliable connection to the shopping network. Finally, in steps ④ and ⑤, consumers are logged onto the shopping network and receive a sorted list of retailers that meet the search criteria.

4.4.2 Purchase and Payment Process

The purchase and payment process, which comes after the search process, can have two alternatives. The first alternative is described in fig. 2 where consumers pay through a shopping network.

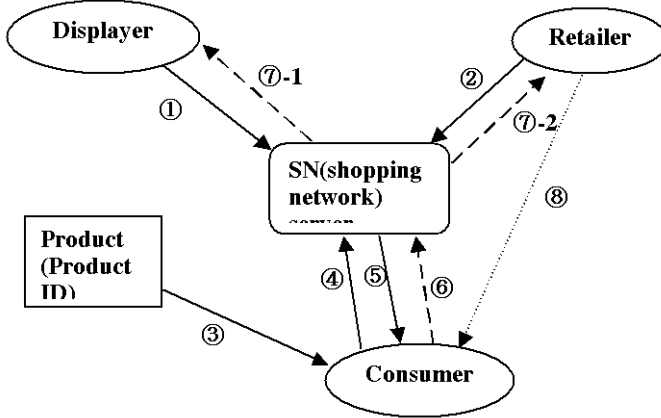


Fig. 2. Purchase & Payment Process: Alternative 1

There are the two kinds of profit sources for a shopping network: 1) the collection of registration fees from displays and retailers, and 2) ratings based on a CPA model through payment settlement.

Registration fee model

When a shopping network recruits member companies, to participate this service system (1 and 2), displayer and retailer pay registration fee to shopping network and they get each identification from shopping network.

CPA (Cost Per Action) model

After receiving full payment from a customer (6), the shopping network server pays an incentive to the displayer (7-1) and the remainder goes to the retailer (7-2) aside from the assigned commission. The retailer sends the corresponding product to the consumer after checking that payment has been remitted (8).

The biggest challenge currently faced in online shopping is that consumers' personal and transaction information is stored on the server, resulting in possible loopholes in privacy protection. This is because the entire process is centered on the service of the online shopping server. If consumers pay vendors directly, the shopping network cannot collect individuals' transaction information, thereby securing privacy protection as far as transactions are concerned. This is explained in the following example (Fig. 3).

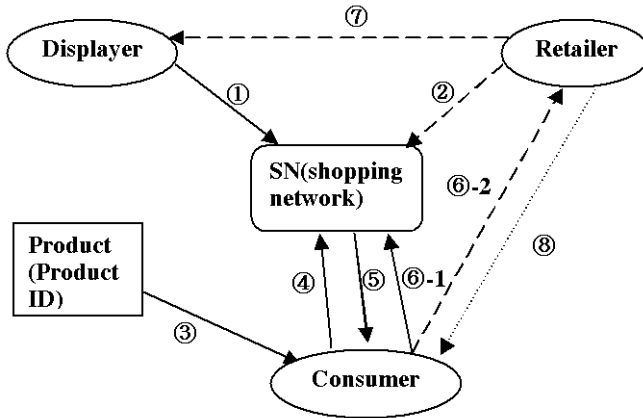


Fig. 3. Purchase & Payment Process: Alternative 2

The consumer decides to buy a product and pays the retailer directly. The displayer's ID is provided to allow the retailer to pay an incentive (⑥-2). In this case, the purchase decision by the consumer is automatically communicated to the shopping network to prevent the retailer from evade paying an incentive to the displayer (⑥-1). After the payment is made, the retailer uses the DID it has received to pay an incentive to the displayer (⑦), and lastly, it delivers the product to the consumer (⑧). Unlike the model in which payment is made through the shopping network server, the CPA method-based rating in this model is difficult to apply. When rating takes place using the CPA method, the retailer is required to pay both an incentive to the displayer and a commission to the shopping network. This may not be a practical model to apply as the retailer's overhead increases.

As seen in the examples above, a new business model is created in the offline market. Though the physical sales volume of products drops, the additional profit source of the commission arises in addition to the existing source of sales revenue. When the comparison shopping becomes more widespread and consumers become even more sensitive to prices, the sales revenue of physical retailers will further diminish and inventory and incidental costs will increase. Against this backdrop, a totally new business model of pervasive comparison shopping will emerge where physical retailers shift their focus from sales to the display of products and commission is the main profit source.

5 Evaluation of Pervasive Comparison Shopping Business Model

5.1 Analysis of the Business Model

Since ubiquitous computing environment is not the Garden of Eden, the service scenario should be based on the proper business model development by each business participants. U-commerce research should be based on the concrete methodology for business model definition, development, representation and evaluation. Creating a business model is a almost same as writing a new story and a good business model

starts with human motivations and ends of profits (Magretta, 2002). Scenario, the first step of business model should be plausible story and explained the role of all economic parties.

According to the business model definition by Timmers (Timmers, 1998), there are three components. The first part is an architecture for the product, service and information flows, including a description of the various business actors and their roles. We mentioned various business actors (such as consumers, displayers, retailers, and shopping network), their roles and information, product, and money flow with three parts of processes in previous section by Fig. 1, 2, and 3. The second and the third component of the business model according to Timmers are a description of the potential benefits for the various business actors and a description of the sources of revenues. We briefly describe the potential benefits of various business actors and the sources of revenues in Table 1.

Table 1. The Potential Benefit and Source of Revenue in Pervasive Comparison Shopping

	Potential benefits	Source of revenues
Consumer	- Convenient comparison shopping - Better services from displayer in always online environment	- Diminishing shopping cost
Displayer	- Logistic cost reduction	- Incentive
Retailer	- Reduction in marketing cost - Reduction in display cost	- Sales margin
SN(shopping network)	- A new business opportunity	- Registration fee - Cost-per-purchase revenue

5.2 Conditions for Working the Business Model

Several preconditions are required to work the pervasive comparison shopping business model. In this section, we will find some conditions, for SN-registered sellers competing with SN-unregistered sellers, cooperating with displayers (i.e. offline sellers). SN-registered sellers are those who register the pervasive comparison shopping network (SN) and SN-unregistered sellers are the sellers who do not have the shopping network membership.

Notations

CostOFF: The product unit cost of offline seller reflecting shop operating cost etc.

CostUN: The product unit cost of SN-unregistered seller reflecting marketing cost, web site operating cost and delivery cost etc.

CostSN: The product unit cost of SN-registered seller reflecting SN registration fee and delivery cost etc.

INCEN: The money (incentive) that SN-registered seller pays to Displayer (offline seller) when a transaction occurs by the shopping network.

SCOFF: Shopping cost¹ incurred to a consumer who is currently in front of the displayer when the consumer buys directly from the offline seller including delivery cost etc.

SCSN: Shopping cost incurred to the consumer when the consumer buys from SN-registered seller including delivery delay cost and seller trust cost etc.

SCUN: Shopping cost incurred to the consumer when the consumer buys from SN-unregistered seller including delivery delay cost, seller trust cost, search cost and memory cost etc.

5.2.1 The Condition to Work This Business Model

The minimum price of SN-registered seller is $CostSN + INCEN$ and the minimum price of offline seller is $CostOFF + INCEN$. If offline sellers set the price less than $CostOFF + INCEN$, they can sell products but they get less money than $INCEN$. So they tend to set the price more than $(CostOFF + INCEN)$. If SN-registered sellers set the price less than that of offline seller, offline sellers are hard to sell products, but offline seller can get profit as much as the incentive.

From the consumer side, the minimum price slightly changes due to the shopping cost difference. The minimum price that consumer feels from the SN-registered seller becomes $CostSN + INCEN + SCSN$ and the minimum price that consumer feels from the offline seller becomes $CostOFF + INCEN + SCOFF$. If we assume that the two parties have the perfect information on each other, then each party will be able to set the maximum price using the other party's information. Therefore, the price that consumer feels will be determined at the $MAX(CostSN + INCEN + SCSN, CostOFF + INCEN + SCOFF)$. If a SN-registered seller wins, its profit becomes $(CostOFF - CostSN) + (SCOFF - SCSN)$ and the offline seller gets the incentive as a displayer. If the offline seller wins, there is no profit for the SN-registered seller is zero and the profit of the offline seller becomes $INCEN + (SCSN - SCOFF) + (CostSN - CostOFF)$. The analysis is summarized in Table 2.

Table 2. Comparison of the price and profit between SN-registered seller and offline seller

	SN-registered seller	Offline seller
Minimum price of seller	$CostSN + INCEN$	$CostOFF + INCEN$
Minimum price that consumer feels	$CostSN + INCEN + SCSN$	$CostOFF + INCEN + SCOFF$
Profit of seller	$MAX((CostOFF - CostSN) + (SCOFF - SCSN), 0)$	$MAX(INCEN + (CostSN - CostOFF) + (SCSN - SCOFF), INCEN)$

From the analysis, we can see that the condition for the SN-registered sellers to participate the pervasive comparison shopping is that $CostSN + INCEN + SCSN < CostOFF + INCEN + SCOFF$. The condition can be rewritten as $(CostOFF - CostSN) + (SCOFF - SCSN) > 0$. Especially, the so called Win/Win condition for both the SN-registered seller and offline seller is the point where the profit of each side is the same. There for the Win/Win condition is $(CostOFF - CostSN) + (SCOFF - SCSN) = INCEN$.

¹ Shopping Cost is invisible cost that consumers always consider when they do shopping.

5.2.2 The Condition for SN-Registered Seller Competing with SN-Unregistered Seller

In the real world, there is a probability that SN-registered sellers have to compete with other online sellers which are not registered to SN. So, we need to consider conditions including other SN-unregistered sellers.

The minimum price of SN-registered seller is $CostSN + INCEN$ while the minimum price of SN-unregistered seller is just $CostUN$. Since the SN-registered sellers should pay the incentive to offline seller in this model, they should set the price no less than $CostSN + INCEN$. However, the SN-unregistered seller does not have to pay anything to offline seller.

From the consumer side, the minimum price slightly changes due to the shopping cost difference as in previous analysis. The minimum price that consumer feels from the SN-registered seller becomes $CostSN + INCEN + SCSN$ and the minimum price that consumer feels from the SN-unregistered seller becomes $CostUN + SCUN$. If we assume that the two parties have the perfect information on each other, then each party will be able to set the maximum price using the other party's information. Therefore, the price that consumer feels will be determined at the $MAX(CostUN + SCUN, CostSN + INCEN + SCSN)$. If a SN-unregistered seller wins, its profit becomes $((CostSN + INCEN + SCSN) - (CostUN + SCUN))$. If the SN-registered seller wins, the profit becomes $(CostUN + SCUN) - (CostSN + INCEN + SCSN)$. The analysis is summarized in Table 3.

Table 3. Comparison of the price between SN-unregistered seller and SN-registered seller

	SN-unregistered seller	SN-registered seller
Minimum price of seller	$CostUN$	$CostSN + INCEN$
Minimum price that consumer feels	$CostUN + SCUN$	$CostSN + INCEN + SCSN$
Profit of seller	$MAX((CostSN + INCEN + SCSN) - (CostUN + SCUN), 0)$	$MAX((CostUN + SCUN) - (CostSN + INCEN + SCSN), 0)$

For a SN-registered seller to compete with SN-unregistered seller, the profit of the SN-registered seller should be higher than zero. So, the first condition is $(CostUN + SCUN) > (CostSN + INCEN + SCSN)$. In this formula, we can infer the condition for a seller to register SN. We can also infer the range of incentive as $INCEN < (CostUN + SCUN) - (CostSN + SCSN)$. The win-win condition between offline seller and SN-registered seller is $INCEN = (CostUN + SCUN) - (CostSN + INCEN + SCSN)$. So, The second incentive condition is $INCEN = [(CostUN + SCUN) - (CostSN + SCSN)]/2$. To consider the two Win/Win conditions together, the final incentive can be set as the $MIN((CostOFF - CostSN) + (SCOFF - SCSN), [(CostUN + SCUN) - (CostSN + SCSN)]/2)$.

5.2.3 Example

For the illustration of the above analysis, we assign some values to the variables as follows.

CostOFF = \$400

CostUN = \$370

CostSN = \$350

SCOFF = \$10

SCUN = \$40

SCSN = \$20

INCEN = \$20 = [(\$370 + \$40) - (\$350 + \$20)]/2

Table 4. Example simulation

	SN-unregistered seller	SN-registered seller	Offline seller
The Cost of seller	\$370	\$350	\$400
Minimum price of seller	\$370	\$370	\$400
Price range of seller	Higher than \$370	\$370~\$400	Higher than \$400
Minimum price that consumer feels	\$410	\$390	\$430
Profit of seller	0	Up to \$20	\$20

The simulation result confirms the conditions for working the pervasive comparison shopping business model.

6 Implementation Issue of Pervasive Comparison Shopping

6.1 Why Not Barcode But RFID?

To work this business model, we propose to use RFID as an auto-identification technology instead of barcode. From the point of view that consumers get information from the tag attached to a product through wireless network, barcode can be acceptable as in the applications such as Pocket BargainFinder (Brody et al 1999) and Scanning Objects in the Wild (Brush et al 2004). However, only with the barcode system, we cannot make the mechanism that gives incentive to the participants because there is no way to distinguish each displayer with the barcode system. With the RFID, we can identify each product since there is EPC (Electronic Product Code) system to distinguish each product. In addition, according to many industrial reports (Accenture 2005; Deloitte 2005; Intermec 2005; Symbol 2005), the world trend of the retail industry shows that we can expect RFID-based retail industry instead of barcode. Nowadays major retailers such as Metro AG, Tesco, and Seven-Eleven consider the benefit of RFID (Levinson 2005) and many experts expect that the price of tag will drop down before long even though the current price of RFID is not cost effective for retailers.

6.2 Which RFID Can Be Used?

Nowadays in global market, RFID has been greatly developed and tried to apply to a vast range of business. But it is difficult to define which RFID can be used or required in business area due to the diverse and complex type of features. Type of RFID tag can be divided as fig. 4.

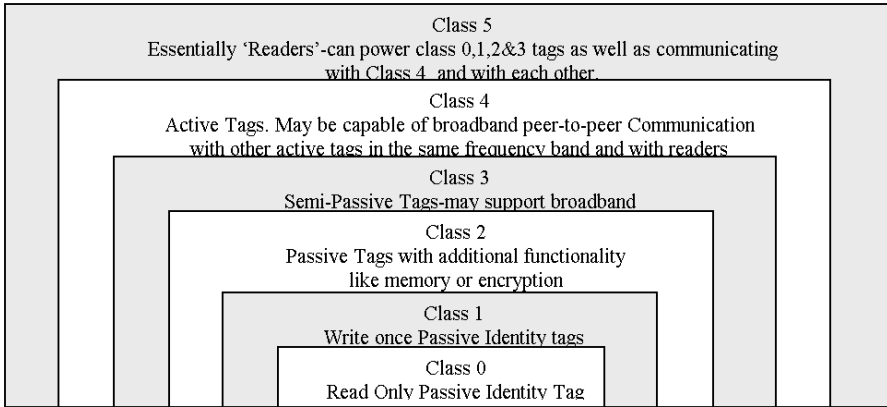


Fig. 4. EPC Class (Source: MIT Auto-ID Center)

In this picture, we can conclude that minimum specification of the tag to work our business model is Class 0. Because the tag does not need to be writable and active.

According to a taxonomy for RFID (Hassan et al 2006), there are four types of signal ranges. Three RFID frequencies such as 135 KHz, 13.56 MHz and 2.45 GHz, are used as a de facto standard in Europe, North America, Japan and Korea. But UHF (Ultra High Frequency) is different depending on countries. The characteristic of each frequency is summarized in table 5.

Table 5. The characteristic of each frequency (Source: IBM Business Consulting Services)

Frequency	Benefits	Drawbacks
Low (125-134 KHz)	- Works Near Metal - In Wide Use Today	- < 1.5m read range - Not in EPC Standards
High (13.56 MHz)	- Works in Most Environments - In Wide Use Today	- < 1.5m read range - Does not work near metal
Ultra High (0.3-1.2 GHz)	- Longer Read-Range Potential - Growing Commercial Use	- Does not work in moist environments
Microwave (2.45 or 5.8 GHz)	- Longer Read-Range Potential, - > 1.5M read range	- Complex Systems Development

Even though all types of frequency range are acceptable to work our business model, High and Ultra High Frequency will be more acceptable than Low Frequency which is relatively high cost. In addition, Ultra High Frequency will be the most appropriate in the future, because the research & development on the UHF has been most active in worldwide. Although the lack of standardization of frequency spectrum was the obstacle to spread of RFID, UHF Gen 2, approved by EPC global in December 2004, is very promising and expected to be improved continuously. In addition, since Gen 2 has the function such as permanent kill capability, it will be useful for privacy protection from scanning after purchase when the user wants.

April 2005, a Korean venture (<http://www.myuzone.com>) developed a RFID-enabled Mobile Phone. At the end of 2006, Samsung Electronics Co., Ltd.

(<http://www.sec.co.kr>) and LG Electronics Inc. (<http://www.lge.co.kr>) are planning to sell a mobile phone embedded a RFID reader-featured chip (900MHz range band). The phone is available to the consumers just with additional cost \$10~20.

6.3 System Architecture

Fig. 5 is the system architecture based on the EPC framework we propose. The flows among the system components are described sequentially in table 6.

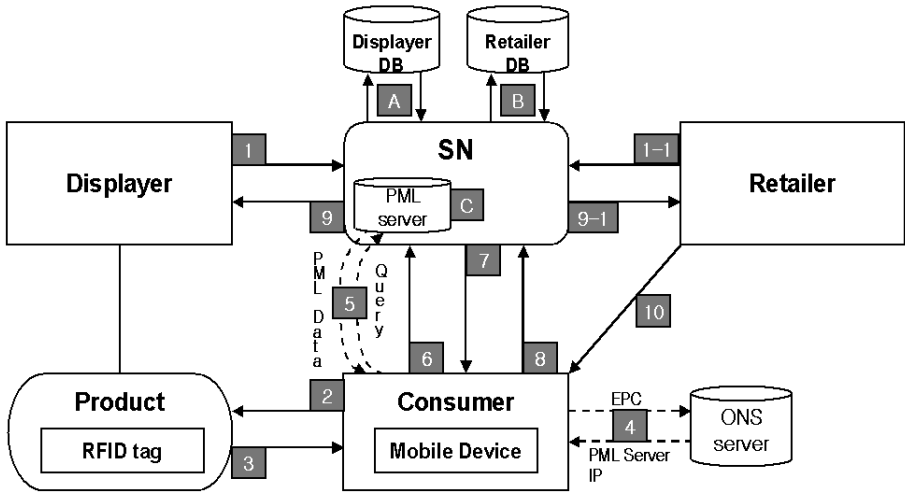


Fig. 5. System Architecture

Table 6. Process description of system architecture

Flow	Description
1	Displayer inputs DID and EPC (Electronic Product Code) to SN
1-1	Retailer inputs RID, EPC and PI (Product Information) to SN
A	SN saves DID into Displayer DB
B	SN saves RID into Retailer DB
C	SN saves PI into PML server
2	Consumer scans RFID tag with Mobile Device
3	Consumer gets EPC
4	Finding IP Address to connect to PML server
5	Getting Product Information
6	Request of Retailers list
B	Searching Retailer DB
7	Getting sorted-list that meets the search criteria
8	Full Payment
A	Find Displayer matched with EPC through searching Displayer DB
9	Giving incentive
9-1	Payment with removed incentive (& commission)
10	Product Delivery

7 Comparison with the Related Works

Up to the present, there are some attempts to integrate online market place with off-line market place. As a initial venture using desktop was Webstickers(Ljungstrand et al 2000) that let the users take advantage in the physical environment when sharing and organizing bookmarks with standard barcode readers and adhesive stickers. With development of mobile devices and wireless networks, QueryLens(Konomi 2002) tried to access ID-based(barcode or RFID) information. QueryLens used PDAs with ID readers to allow users to scan physical objects and accumulate queries to connect to relevant physical object and capture answers.

Among the related works, we compare the four core works such as Pocket BargainFinder, Easishop, context-aware comparative shopping and Scanning Objects in the Wild with the pervasive comparison shopping we suggest in this paper.

Pocket BargainFinder (Brody et al 1999) is a research on the world where consumer visits the physical store to confirm the product and then turn to on-line to find the best price and transaction conditions. This enables the consumer to browse in the physical store and then buy in the retailer of cyberspace. Pocket BargainFinder consists of a barcode scanner and the portability of a PDA. Those can bring a convergence of physical and cyber commerce called 'augmented commerce'. The authors claim that the result that consumers become able to search the best price and transaction conditions lets the physical retailer left at a disadvantage.

Easishop (Keegan et al 2004) is to deliver cross merchant product comparison shopping for the mobile user. Easishop supports mobile shopper through a context-sensitive shopping assistant. Each user has own device (PDA) that includes an elementary user profile containing shopping preferences (the shopping list) and is the host of Easishop PDA Agent. When the user walks down near Easishop Hotspot, the PDA Agent communicates with the Store Agents that represents a multitude of relevant retail outlets and matches the shopping list. PDA Agent and the Store Agent migrate to the Easishop Marketplace providing an auctioneering forum and the Stall Manager Agent is created to make the imminent auction. After completing a purchase, a special Secure Transaction Agent processes payment with ordered the agreed amount. What Easishop differs from our Pervasive Comparison Shopping is user intervention. With user shopping preferences (the shopping list), Easishop PDA Agent purchases the product on behalf of the user through communication with agents. But in Pervasive Comparison Shopping, instead of agent, the user purchases the product directly.

Kwon and Sadeh (2004) proposed context-aware comparative shopping with case-based reasoning and multi-agent intelligent system. In offline environment, this model can let consumer compare online and offline sellers with negotiation between B-agent (buyer agent) and S-agents (seller agent). In addition, they considered contextual information such as location, weather and calendar, and case-based reasoning to find user preference. The goals are aimed fitting buyers' preferences, considering context awareness of external sources and negotiation to provide better transaction conditions. The flow is that after consumer gives a message what he/she wants to buy to B-agent, he/she gets bidding results while Negotiator operates bidding system among S-agents. At this time, S-agent delegated by the own user can negotiate by modifying its own price condition within the allowable price level.

Scanning Objects in the Wild (Brush et al 2005) is the challenge that has been linking physical objects and relevant online information. They conducted experiment with twenty participants over five weeks with a ARUA system that is commercially available pocket computers two parts such as Client Application including barcode scanner and Web Portal to make private and public ratings and comments of the item that user scanned. This study aimed four points, “How do people use the AURA system?”, “Do People find AURA system functional and useful?”, “Does the privacy model meet users’ needs?”, “How do people use the sharing features?” What ever the results did not come out as well as expected, this study is well worth enough in view of experiment in the real world. But this study still consider of convenience of consumer not offline seller.

That’s why we suggest a so-called win-win(Displayer & Seller) business model to overcome the disadvantage of physical retailer. In addition, rather than using bar code, our business model is based on the RFID technology that can contain and transform information. It maintains the market mechanism where retailers can give incentives to displayers. We briefly describe each characteristic as Table 7.

Table 7. Comparing Pervasive Comparison Shopping with Related Works

	Pocket Bargain-Finder	Easishop	Scanning Objects in the Wild	Context-aware comparative shopping	Pervasive Comparison Shopping
Information Infrastructure	Barcode	HotSpot	Barcode	Query from consumer	RFID
Range of search	Unlimited	Limited location	Unlimited	Unlimited	Unlimited
Personalization	Non-existing	Existing	Non-existing	Existing	Non-existing
Seller Trust	Medium	High	High	Medium	Medium
User intervention	High	Low	High	Medium	High
Role of displayer	Existing	Non-existing	Existing	Existing	Existing
Incentive mechanism	Non-existing	Non-existing	Non-existing	Non-existing	Existing

8 Conclusions

The expansion of the pervasive comparison shopping we suggest will give rise to a new and different marketplace. Currently, high-traffic spaces are occupied by billboards. These ads enable consumers only see products, but do not offer purchase opportunities. They are simply for marketing purposes. However, with the help of RFID, consumers can view advertisements and receive information on the products featured in the ads. If they like what they see, actual purchases can be made. People who have to shop online due to their busy schedule can browse and purchase products shown on billboards in a subway station or on the street during their commute. In addition, people can contain product information by scanning, using this information, they can be connected to the network to purchase the product anytime. Spaces that have been used solely for advertising are turning into unmanned stores where consumers can buy goods on favorable terms through comparison shopping.

Further, displayer does not have to be the store. A woman wearing a dress can be called a displayer because she can serve the role of marketing as a displayer. If we connect retailers and the 'displayer' through a proper incentive mechanism, we are able to make a new market mechanism. Although consumers have been playing a sole role as a buyer so far, with this business model, the consumers can easily become a displayer.

In e-commerce, comparison shopping is divided into online and offline markets. Ubiquitous computing will allow consumers to be connected to the Internet anytime, anyplace, and will consequently lead to the integration of these two markets. The resultant intensification of competition will call for a new business model, and this paper responds to this call with a RFID-based model. Until now, RFID research has focused primarily on supplier management or consumers' simple usage of information provided by RFID. Unlike its predecessors, this paper discusses the changes experienced by each economic player in the always-online environment, uses RFID technology as a solution to the issues brought about by these changes, and offers a new business model that enables seamless networking.

An incentive-based model in which each relevant party can participate is required to allow seamless networking in ubiquitous commerce. It will be a wholly different business model and new spaces can be created through its expansion.

In this paper, we compare the transaction conditions only in terms of price. When consumers make a decision to purchase they consider not only the price but also multi-criteria purchase conditions such as payment options, supplier reputations, a burden of products, multi-item selection, price discount, delivery cost and payment methods that are diverse and complex. To solve this problem, Chang and Lee (2006) suggested a study provides a hybrid model for comparison shopping with "what-if analysis of a Quadratic Integer Programming model". Even though this study explores not only price but multi-criteria purchase conditions, it still remains to study in the online environment. In the future, we need to find a solution including even offline sellers.

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