

# Cost-Per-Action 광고 방법을 이용한 Conversion Action Data 메커니즘의 평가

## Evaluation of Conversion Action Data Mechanisms in Cost-Per-Action Advertising

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### 요 약

온라인 광고모델의 기본 모델이 CPM (cost-per-mille) 기반 모델에서 CPC (cost-per-click) 기반 모델로 변화해왔으며, CPA (cost-per-action) 모델이 온라인 광고산업의 새로운 대안 모델로 제시되고 있다. CPA 모델에서는 사용자가 어떤 광고를 클릭했는 지에 관한 정보를 퍼블리셔(Publisher)가 보유할 수 있어야 하며, 그래서, CPA 모델의 핵심은 Conversation Action Data를 확보하는 것이다. 이 논문에서는 이를 획득하는 두 가지 기존 메커니즘을 소개하고, 이들의 특징을 비교하고, 각 메커니즘의 한계를 분석한다. 그 다음에 두 가지 새로운 메커니즘을 설계하고, 작동 요건을 분석하고, 실용성을 평가한다. 마지막으로, 기존의 메커니즘들과 새로운 메커니즘들의 특징을 비교하고, 각 메커니즘의 비즈니스 가치와 유용성, 응용 범위를 분석한다. 이 논문에서 제안된 2가지의 새로운 메커니즘과 기존 메커니즘과 비교 분석을 통해 퍼블리셔에게 최적 CPA 메커니즘에 관한 판단정보를 제공할 수 있을 것으로 판단된다.

**키워드 :** 온라인 광고, CPA(Cost Per Action), Conversion Action Data, 비즈니스 모델

## I. 서 론

Online advertising is one of the fastest growing segments in the marketing industry. One of the dominant business models in online advertising market is CPC(cost-per-click). But CPC business model has

several problems. In CPC, advertisers pay by the click-through rate. However, in many situations, a user may just click an advertisement but does not buy items. Good click-through rates are not the indication of good conversion rates. Another problem is Click Fraud which is considered by many experts as the biggest challenge facing by the online advertising industry(Crawford, 2004; Penenberg, 2004; Stone, 2005). Click Fraud is hard to solve, because in CPC business model, publishers do not know what will happen after a visitor clicks an advertisement (Tuzhi-

† This research is supported by the Ubiquitous Autonomic Computing and Network Project, the Ministry of Information and Communication (MIC) 21st Century Frontier R&D Program in Korea.

lin, A., 2006).

A natural solution for the problem of Click Fraud is to charge advertisers according to cost-per-action(CPA) (Nazerzadeh *et al.*, 2007). CPA means advertisers only pay after pre-setup-actions, such as downloading software, registering for a newsletter, a purchase. In CPA, publishers get the advertisement fee only after a user takes a specific action(e.g. a purchase). Therefore, the key in CPA model for publishers is to get the information about what happens after a user clicks an advertisement. Tuzhilin called the information about whether or not the user visited certain designated pages to do some pre-setup-actions as Conversion Action Data(Tuzhilin, A., 2006).

There are mainly two existing methods to get the CAD: 1) Advertisers collect users' CAD and report the data to publishers(see Section 2.1). 2) Publishers set up software(which is used to track users' conversion action data) in advertisers' websites and monitor users' action data via the software(see Section 2.2). But these methods face challenges: 1) Advertisers may not voluntarily provide the CAD or misreport the data to the publisher for some economic or private reasons(Mahdian and Tomak, 2007). 2) Advertisers may find a way to manipulate the software if they find it sufficiently profitable(Nazerzadeh *et al.*, 2007).

Therefore, this paper proposes two mechanisms to help publishers get CAD: 1) Publishers get the conversion action data from users(see Section 3.1). 2) Publishers take part in pre-setup-action to collect CAD(see Section 3.2).

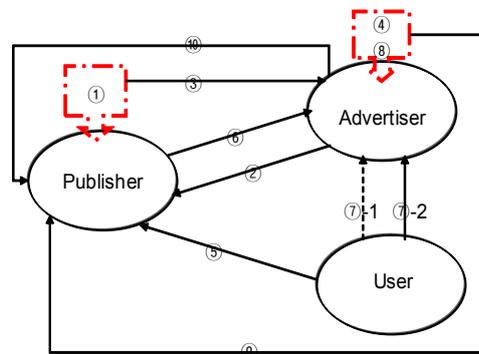
Section 2 will introduce two existing models, compare their characteristics and analyze their limitations. Section 3 will suggest two new models. Section 4 will analyze the requirements of the new models. Section 5 will use assumptions-based assessment (Shin, 2006) to evaluate new models' feasibility and

analyze entities' potential benefits and source of revenues based on Timmers' business model definition(Timmers, 1998). Section 6 will compare the existing and new models, summarize each model's element, value, Application Area and limitation, and discuss the limitation and future works.

## II. Related Works

### 2.1 Conversion Tracking Software-based Mechanism

In this mechanism, a publisher invents software to track users' Conversion Action Data(e.g. cookie). Advertisers set up this software in their websites and this software automatically monitors the users' actions that take place in advertisers' websites and reports the CAD to the publisher. Google is testing its pay-per-action in this way([services.google.com/pay-peraction](http://services.google.com/pay-peraction)). The process <Figure 1>, value, application areas, and the limitation are summarized as below.



<Figure 1> Process of Conversion Tracking Software-based Mechanism

- ① A publisher invents software to track users' CAD.
- ② An advertiser defines an action and creates ad-

vertisement in the publisher's website with CPA model.

- ③ The publisher provides the software to the advertiser.
- ④ The advertiser installs the software in her/his website.
- ⑤ A user searches information in the publisher's website.
- ⑥ The publisher exposes the advertiser's advertisement and link URL.
- ⑦-1 The user clicks the ad but does not do pre-setup-action.
- ⑦-2 The user clicks this ad and does pre-setup-action.
- ⑧ The software automatically monitors user's CAD.
- ⑨ The software reports user's CAD to the publisher.
- ⑩ The advertiser pays the advertisement fee when Conversion Action has occurred.

- **Value:** Conversion Tracking Software-based Mechanism helps the small and medium advertisers to gather CAD. It also can prevent the misreporting, because publisher can use the software to directly monitor the user's conversion action.

- **Application Area:**

- a. It can be used by the advertisers who are not capable to collect CAD.
- b. It can be used by the publishers who want to prevent advertisers misreporting the data.

- **Limitation:**

- a: Publishers need to get permission from advertisers for installing software in advertisers' websites.

b: It can not work when advertisers consider the CAD as confidential information and do not want to share.

c: Advertisers will find a way to manipulate the software if they find it sufficiently profitable.

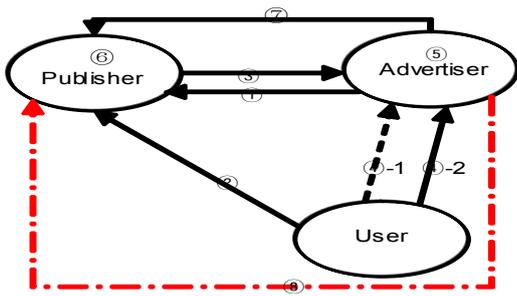
## 2.2 Mahdian and Tomak's Mechanism

In this mechanism, advertisers collect users' CAD and report the data to publishers. It means that a publisher gets the data from advertisers' reports. In CPA model, an advertiser charges a fixed amount per action, she or he might benefit from not reporting some of the actions. To prevent misreporting situation, this mechanism uses click-fraud-resistant learning algorithms(Immorlica *et al.*, 2005) and rank-by-revenue system(Mahdian and Tomak, 2007). An advertiser can not gain any significant amount by misreporting the actions.

This system can be used to prevent those advertisers who have the capability to gather true CAD but probable to misreport the data because of economic reasons or privacy. The aim of this mechanism is to get truthful action data from advertisers. A detailed step toward this goal was taken in the paper of Mahdian and Tomak(2007), here we just use its result:

$$P_m = \min (b_m, p) \text{ and } p_a = (p-p_m/AR)$$

The value of  $p$  is the bid of the next advertiser or the reserved price,  $p_m$  means the charge for every impression,  $b_m$  is the bid per impression,  $p_a$  means the charge for an action and AR is the current estimate of the action rate. The process <Figure 2>, value, application areas, and the limitation are summarized as below.



〈Figure 2〉 Process of Mahdian and Tomak's Mechanism

- ① An advertiser defines an action and creates advertisement in a publisher's website with CPA model.
- ② A user searches information in the publisher's website.
- ③ The publisher exposes the advertiser's advertisement and link URL.
- ④-1 The user clicks the ad but does not do pre-setup-action.
- ④-2 The user clicks this ad and does pre-setup-action.
- ⑤ The advertiser collects users' CAD.
- ⑥ The publisher uses Mahdian and Tomak's Theorem to price the action.
- ⑦ The advertiser reports the data to the publisher.
- ⑧ The advertiser pays the advertisement fee when Conversion Action has occurred.

- **Value:** In this system, an advertiser can not gain more than 0 per impression by misreporting the actions(Mahdian and Tomak, 2007). Therefore, if a publisher uses this mechanism, its advertisers will not misreport the CAD.
- **Application Area:** This mechanism can be used by the publishers who want to prevent those

advertisers who have the capability to gather the true CAD but probable to misreport the data because of economic reasons.

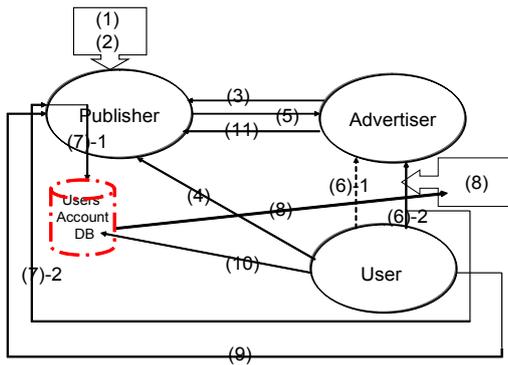
- **Limitation:** It is based on the condition that advertisers have the capability to collect the Conversion Action Data. Therefore,
  - a: It is difficult to adopt for many small and medium advertisers who do not have the capability to collect the CAD.
  - b: Also difficult to adopt for some big advertisers who consider the conversion data as confidential information.

### III. Suggestion of New Models

#### 3.1 SSO-based Mechanism

In this mechanism, a publisher does not get CAD from advertisers but from users. Users submit the action data to the publisher. The key of this mechanism is to let users submit the true CAD.

The architecture is designed as below: using SSO (single-sign-on) method to link advertiser's website and publisher's website together. Before a user does pre-setup-action in advertiser's website, she/he needs to open an account in publisher's website. This account information(ID and PW) will be used to sign in advertisers' websites. After the user does pre-setup-action in an advertiser's website, the page(in advertiser's website) is automatically redirected to Conversion Confirmation Request Page(in publisher's website). The user is asked to submit her/his action to publisher in this page. A user owns an account in publisher's website which can be used in all advertisers' websites. After the user submits her/his action data in Confirmation Request Page(in publisher's website), the data will be saved in her/his account.



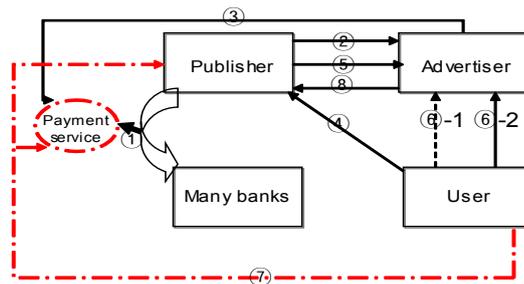
〈Figure 3〉 Process of SSO-based Mechanism

- (1) A publisher makes a page for users to submit CA information(Conversion Confirmation Request Page).
- (2) The publisher links its website, advertiser's website and Conversion Confirmation Request Page together.
- (3) An advertiser defines an action and creates advertisement in the publisher's website with CPA model.
- (4) A user searches information in the publisher's search website.
- (5) The publisher exposes the advertiser's ad and link URL.
- (6)-1 The user only clicks the advertiser's website and does not do pre-setup-action in the advertiser's website. This is an invalid click and the site will not automatically be redirected to Conversion Confirmation Request Page.
- (6)-2 The user clicks advertiser's website and plans to do pre-setup-action in advertiser's website.
- (7)-1 The user registers and gets an ID and PW in the publisher's website.
- (7)-2 The publisher saves the user's registration information in her/his database.

- (8) The user signs in advertiser's website with the account information in publisher's website(SSO). The advertiser calls the publisher to authenticate user's identification.
- (9) After the user does pre-setup-action in advertiser's website, the site will be automatically redirected to Conversion Confirmation Request Page.
- (10) The user submits her/his CAD in Conversion Confirmation Request Page and the CAD will be saved in the user's account.
- (11) The advertiser pays the advertisement fee when Conversion Action has occurred.

### 3.2 Publisher's Pre-setup-action-based Mechanism

In the existing mechanism, after a user clicks an advertisement, the user leaves the domain of the publisher and enters the advertiser's website. Because publishers do not participate in advertisers' domains, they can not get the Conversion Action in the first hand. In Publisher's Pre-setup-action-based Mechanism, publishers will take part in pre-setup-action following a click. Publishers collect users' data by themselves not from advertisers. This mechanism is based on the three assumptions as follows:



〈Figure 4〉 Publisher's Pre-setup-action-based Mechanism

- 1) A publisher owns an online payment service.
- 2) In cost-per-sale, the pre-setup-action is a successful purchase.
- 3) If advertisers and users use the publisher's online payment service to pay, the publisher can collect the Conversion Action Data by itself.

- ① A publisher builds a Payment Service and cooperates with many banks.
- ② An advertiser creates advertisement in the publisher's website with CPS(Cost-Per-Sales) model.
- ③ The advertiser sets up Payment Service as her/his only online payment system.
- ④ A user searches information in the publisher's search website.
- ⑤ The publisher exposes advertiser's advertisement and link URL.
- ⑥-1 The user only clicks advertiser's website and doesn't purchase advertiser's items.
- ⑥-2 The user clicks advertiser's website and purchases advertiser's items.
- ⑦ The user uses Payment Service to pay:
  - a: The user registers an account for Payment Service.
  - b: The user adds her/his bank card to payment card.
  - c: The user pays via Payment Service.
- ⑧ The advertiser pays the advertisement fee when Conversion Action has occurred.

## IV. Requirement Analysis of New Models

### 4.1 Conditions of SSO-based Mechanism

- Publisher needs to help advertisers(especially small and medium advertisers) to build SSO.

- Publisher should build a database about user's information(e.g. ID, PW) and help advertisers to verify users' identify.
- Publisher needs to protect user's privacy.

### 4.2 Conditions of Publisher's Pre-setup actions Mechanism

- Publishers need to confirm the security and privacy while using her/his service.
- Publishers need to own a payment service which cooperates with enough banks.
- A user at least has one bank card that accepts this payment service.

## V. Evaluation of New Models

In this chapter, we will explore the feasibility of new models from the perspective of Assumptions-based Assessment(Shin, 2006), and use Timmers business model definition to analyze entities' potential benefits and source of revenues.

### 5.1 Assumption Analysis of New Models

Shin(2006) proposed the assumption analysis methodology as a way of evaluating business models. The assumptions underlying a business model are analyzed from the perspectives of the four core dimensions of value proposition in business model: Customer value propositions, Business value propositions, Value network and Value creation among model dimensions(Shin, 2006).

- ① Customer value propositions: are benefits customers recognize from an offering(e.g. goods, services, knowledge)
- ② Business value propositions: represent financial

and non-financial benefits a business model offer to an adopting company and its value network stakeholders.

- ③ Value networks: more business and customer values are created at the relationship level, defined in terms of main stakeholders and service, product, or information flows among them.
- ④ Value creation: represents resources, assets,

processes, and activities implicated to the creation of customer and business values.

Meanwhile, all the assumptions can be divided into two types: load-bearing and non-load-bearing. When the fallacy of an assumption demands significant changes in the business model design, it will be called as a load-bearing assumption. When the fallacy of

<Table 1> Assumption Analysis of BM-SSO-based mechanism

	Business model assumption	Value creation	Customer value propositions	Value network	Business value propositions	User	Advertiser	Publisher	Load-bearing	Non-load-bearing
1	Using SSO method to link advertiser's website and publisher's website together.						√	√		√
2	Publisher builds a database of user's information.							√		√
3	Publisher helps advertiser to verify user's identity(the database of user's information).						√	√	√	
4	User opens an account in publisher's website.					√		√		√
5	The account information(ID, PW) in publisher's website can also be used to sign in advertisers' websites.			√		√				√
6	User submits action data to Conversion Confirmation Request Page.			√		√			√	
7	The submitting process is simple.					√			√	
8	The CA Data will be kept in secret to protect user's privacy.							√	√	
9	The cost for using SSO-based mechanism to collect action data is cheaper than using existing mechanisms.				√				√	
10	CPA model is better than CPC and CPM model for advertisers.	√					√		√	
11	User can use his account in publisher's website to manage his entire action information.		√						√	
12	The conversion action data that are submitted by users are true.	√							√	
13	Advertiser agrees to use SSO.						√	√		√
14	Publisher helps advertiser to build SSO.						√	√		√

an assumption causes the fail of the business model, it is called non-load-bearing(Dewar, 2002).

**SSO-based Mechanism:** We use 14 assumptions to analyze this business model: six assumptions are non-load-bearing assumptions and the other nine are load-bearing assumptions. Non-load-bearing assump-

tions are the assumptions about single sign-on infrastructure. Load-bearing assumptions are the relationship among users, advertisers and publishers as in <Table 1>.

**Publisher’s Pre-setup-action-based Mechanism:** There are 13 assumptions: three assumptions are non-

<Table 2> Assumption Analysis of BM- Publisher’s Pre-setup-action-based Mechanism

	Business model assumption	Value creation	Customer value propositions	Value network	Business value propositions	User	Advertiser	Publisher	bank	Load-bearing	Non-load-bearing
1	Publisher has a payment service.							√			√
2	This payment service cooperates with enough banks all over the world.								√	√	
3	A user at least has one bank card that accepts this payment service.					√				√	
4	The payment process is safe and simply.	√									√
5	Advertiser can get more profit by using this payment than other payment services.(ex: saves commission charge, more safe)	√					√			√	
6	User can get more benefit by using this payment.		√			√				√	
7	Advertiser defines sale as the pre-setup action(CPS).						√			√	
8	Users’ purchase information will be kept in secret.							√		√	
9	The cost of using Publisher’s Pre-setup Action Mechanism to collect action data is cheaper than using existing mechanisms.				√			√		√	
10	The only payment method is the publisher’s Payment Service.			√			√				√
11	Bank will get more benefit after accepting this payment service.	√							√	√	
12	The value of the benefit by using this payment service is more than the value of the cost by using this payment service.							√		√	
13	CPA model is better than CPC and CPM model for advertisers.	√					√			√	

<Table 3> The Potential Benefits and Source of Revenues in SSO-based Mechanism

Entity	Potential Benefits	Source of Revenues
Publisher	<ul style="list-style-type: none"> <li>◦ Get CAD.</li> <li>◦ Save the cost for collecting action data.</li> <li>◦ Escape from advertiser's misreporting.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Make a Conversion Confirmation Request Page to let users submit CAD.</li> </ul>
Advertiser	<ul style="list-style-type: none"> <li>◦ Save advertisement fee.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Only pay for pre-setup-action.</li> </ul>
User	<ul style="list-style-type: none"> <li>◦ Easily manage her/his total action information.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Register an account in publisher's site and submit her/his conversion action to her/his account.</li> </ul>

load-bearing assumptions and the other ten assumptions are load-bearing assumptions. Non-load-bearing assumptions are the assumption that publisher has a Payment Service. Load-bearing assumptions are the relationship among users, advertisers, publishers and banks as in <Table 2>.

## 5.2 Potential Benefits and Source of Revenues

Timmers(1998) defines business model as 1) An architecture for the product, service and information flows. Including a description of the various business actors and their roles, 2) A description of the potential benefits for the various business actors, 3) A description of the sources of revenues.

**SSO-based Mechanism:** Participants can be classified into three entities: publishers, advertisers and users as in <Table 3>.

**Publisher's Pre-setup-action-based Mechanism:** The participants can be classified as publishers, advertisers, users and banks as in <Table 4>.

## VI. Conclusion

### 6.1 Summary

In CPA model, the core for publishers to do is to collect user's conversion action data. After analyzing the existing models, we found their application

<Table 4> The Potential Benefits and Source of Revenues in Publisher's Pre- setup-action Mechanism

Entity	Potential Benefits	Source of Revenues
Publisher	<ul style="list-style-type: none"> <li>◦ Escape from the economic loss for misreporting action data.</li> <li>◦ Ad income.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Take part in pre-setup-action.</li> <li>◦ Expose advertisement.</li> </ul>
Advertiser	<ul style="list-style-type: none"> <li>◦ Save advertisement fee.</li> <li>◦ More benefit</li> </ul>	<ul style="list-style-type: none"> <li>◦ Only pay for pre-setup-action.</li> <li>◦ Pay via publisher's payment service.</li> </ul>
Bank	<ul style="list-style-type: none"> <li>◦ Commission charge</li> </ul>	<ul style="list-style-type: none"> <li>◦ Get more customers(advertisers).</li> </ul>
User	<ul style="list-style-type: none"> <li>◦ An account can be used to pay all the trade.</li> <li>◦ More benefit.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Pay via publisher's payment service.</li> </ul>

areas are too limited. Because of the reason, this paper proposed new models, which are SSO-based Mechanism and Publisher's Pre-setup-action-based Mechanism. This research analyzed the future business possibilities of new models based on their value

and identified the areas of application based on their requirements. To deepen the understanding of the suggested models, we showed scenarios, architectures, business models. Finally, we compared the elements, value and Application Area of the existing

<Table 5> Comparison of Existing and New Mechanisms

	Conversion Tracking Software-based Mechanism	Mahdian and Tomak's Mechanism	SSO-based Mechanism	Publisher's Pre-setup-action-based Mechanism
Elements	<ul style="list-style-type: none"> <li>◦ Publishers install software in advertisers' website to monitor users' action data.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Advertisers collect users' CAD and report the data to publishers</li> <li>◦ Mahdian and Tomak's Mechanism.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Use SSO to link advertisers' websites and publisher's website together.</li> <li>◦ User submits her/his action data to the publisher.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Publishers take part in pre-setup-action after a click and collect CAD during the action.</li> </ul>
Value	<ul style="list-style-type: none"> <li>◦ Publishers can collect truthful CAD from the advertisers who do not have the capability to collect CAD.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Advertisers will not misreport action data.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Publishers can get the true CAD from users.</li> <li>◦ User will own an account to manage all her/his action information.</li> <li>◦ Publisher will confirm trade's security.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Publishers collect true CAD by themselves without advertisers.</li> </ul>
Application Area	<ul style="list-style-type: none"> <li>◦ The advertisers are not capable to collect CAD(small, middle advertisers).</li> <li>◦ The advertisers agree publisher to install software in their websites.</li> </ul>	<ul style="list-style-type: none"> <li>◦ The publishers want to prevent the advertisers who have the capability to gather the true CAD but probable to misreport the data because of economic reasons.</li> </ul>	<ul style="list-style-type: none"> <li>◦ All the entities agree to use SSO.</li> <li>◦ Publishers have the capability to make and manage a database about users' information.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Publishers own a service which can be used by both of advertisers and users to do pre-setup-action.</li> </ul>
Limitations	<ul style="list-style-type: none"> <li>◦ Publishers need to get permission from advertisers for installing software.</li> <li>◦ It can not work when advertisers consider the CAD as confidential information and do not want to share.</li> <li>◦ Advertisers will find a way to manipulate the software if they find it profitable.</li> </ul>	<ul style="list-style-type: none"> <li>◦ It is ineffective for many small and medium advertisers who do not have the capability to collect the CAD or some big advertisers who consider the conversion data as confidential information and do not want to share.</li> </ul>	<ul style="list-style-type: none"> <li>◦ This mechanism is based on all the entities(advertiser, publisher and user) agree to uses single-sign-on technology.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Publisher needs to own a service for pre-setup-action.</li> <li>◦ Both advertisers and users can only use this service to do pre-setup-action.</li> </ul>
Reference	<ul style="list-style-type: none"> <li>◦ Google Pay-per-action beta test.</li> </ul>	<ul style="list-style-type: none"> <li>◦ "Pay-per-action" model for online advertising"(Mahdian and Tomak, 2007).</li> </ul>	-	-

and the new mechanisms summarized in <Table 5>.

## 6.2 Limitations and Future Work

This paper is a kind of exploratory research. Exploratory research is a type of research conducted because a certain problem has not been clearly defined. This paper has a limitation of exploratory research; it is not certain if these models will succeed in real market practice. On the other hand, all the mechanisms referred in this paper are from publishers' perspective, advertisers accept the mechanisms passively. Therefore, in the next step, advertisers' requirement may be analyzed from the question on what kind of mechanism is easiest to be accepted by advertisers.

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## Evaluation of Conversion Action Data Mechanisms in Cost-Per-Action Advertising

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### Abstract

The online advertising industry's business model undertakes the change from CPM (cost-per-mille)-based to CPC(cost-per-click)-based. However, due to the problem of 'Click Fraud', CPA (cost-per-action) has been regarded as a new step. For CPA, publishers need to get information after a user clicks an advertisement. Therefore, in CPA, the key is to get Conversion Action Data (CAD). This paper introduces two existing mechanisms for getting CAD, compare their characteristics, and analyze their limitations. Then the two new mechanisms are introduced and their requirements and feasibility are analyzed. Lastly, we compare the existing two and the new two mechanisms, and point out each mechanism's business possibility, value and Application Area. This paper will help publishers choose the most appropriate mechanism on the basis of their situation.

**Keywords:** *Internet Advertising, CPA(Cost Per Action), Conversion Action Data, Business Model*

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한국과학기술원 경영과학과 학사, 석사, 박사학위를 취득하고, 서울대 행정대학원 행정학 석사, 박사수료 하였다. 미국 Carnegie Mellon University 초빙과학자, 국제전자상거래연구센터 책임연구원, 고려대 경영대학 조교수, 서울대 행정대학원 초빙조교수를 역임하고, 현재 경희대학교 경영대학 부교수로 재직하고 있다. 1995년과 1997년 2회에 걸쳐 미국인공지능학회(AAAI)가 수여하는 혁신적 인공지능 응용상(Innovative Applications of Artificial Intelligence)을 수상하였다. AI Magazines, Decision Support Systems, Organizational Computing and Electronic Commerce, Expert Systems with Applications, Electronic Markets 등의 학술지에 논문을 게재하였다. 최근 Ubiquitous Commerce, Ubiquitous Media 비즈니스 모델과 비즈니스 메쏘드 연구에 주력하고 있다.

본 논문은 지난 2008 한국경영정보학회 춘계학술대회에서 우수논문상을 수상했으며 Information Systems Review 편집위원회에 의해 8월 2일 게재확정된 논문임을 알려드립니다.