

# Advertising in a Pervasive Computing Environment

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## ABSTRACT\*

The advent of the internet has revolutionized the field of advertising by providing a whole new path for reaching potential customers. Studies show that online advertising is, on the whole, extremely effective and that consumer acceptance of online advertising is comparable to traditional media[7][8]. One of the reasons for the high effectiveness of online advertising is that users interact with the web at a far more personal and intimate level than they interact with other advertising media like the radio or television. Pervasive computing environments deal with users at an even more intimate level; hence such environments are even better advertising platforms than the web. Pervasive environments allow the delivery of relevant advertising in suitable ways to selected consumers. In this paper, we examine some of the possibilities of pervasive advertising as well as some of the issues involved.

## Categories and Subject Descriptors

D.4.7 [Operating Systems]: Organization and Design – *Distributed Systems, Interactive Systems.*

## General Terms

Management, Design, Economics, Human Factors

## Keywords

Electronic Commerce, Advertising, Pervasive Computing

## 1. INTRODUCTION

Companies constantly struggle to find the best advertising strategies to promote their goods and services. They need to be able to reach the segment of population that is potentially interested in their products. They need to deliver the advertising in an appropriate manner that will “stick” in the users’ minds. They need to make sure that the products and services they

advertise are those that meet the user’s needs. And they also need to ensure that their advertising does not annoy anybody, since that could result in a negative impact.

To meet these constraints, companies hire advertising agencies to help plan suitable advertising strategies. These agencies promote the companies’ products and services through a variety of media like newspapers, billboards, radio, TV, direct mail, telemarketing, etc. Lately, email and internet ads have also become advertising media. The agencies try to choose the means of advertising that would best reach the target audience and make the greatest possible impact within the budgetary constraints. Pervasive computing environments could provide a really powerful platform for these agencies to advertise their clients’ products and services.

Studies show that online advertising – banners on websites, popup ads, email offers and so on – is very effective and provides significant brand communication power[7][8]. In fact, the studies indicate that online advertising dramatically increases product awareness after just a single exposure. Another interesting result is that click-throughs (consumers clicking on the ad) are not necessary for impactful brand communication; in fact, click-throughs don’t add very much. So, just being exposed to ads is enough to create an impact.

If online advertising can be so effective, ads in pervasive environments can be even more so. Pervasive ads can be even more personalized than online ads and they can make use of various pervasive devices to deliver ads with greater impact. Just as new display and sound technologies can make a theatre out of a living room, these technologies can also make ads so much more appealing.

Advertising is one of the major sources of revenue for many websites, not to mention radio stations, TV stations and newspapers. In fact, online advertising provided a major financial thrust to the explosive growth of the internet. It is, thus, conceivable that pervasive advertising could also provide a major financial boost to the development and deployment of pervasive computing environments. So, a pervasive computing architecture that aids effective advertising would have a better chance at succeeding in getting widely deployed. In fact, advertising alone could pay for the deployment and maintenance of pervasive environments, and the actual people who use the environment could get the service free of cost.

Advertising is different from traditional publish-subscribe systems or notification services. Notification services are generally user-driven, i.e., they allow users to specify various conditions and be notified when these conditions become true. Advertising, however, does not work the same way. Although users could subscribe to receive certain kinds of advertisements (like subscribing for email offers), most advertisements are not

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subscribed for. They are pushed by the company to the user in the hope that the advertisement could kindle a latent need for the company's product or service. Serendipity plays a major role in advertising - companies hope to entice new consumers into buying their products even when they are not specifically looking for it.

The advertiser, thus, wants to push as many advertisements as possible towards the user, though the consumer wants to receive only a few selected advertisements. There is a tug-of-war between the advertiser's interests and the consumer's interests. The pervasive computing environment has to reconcile these two opposing forces. Pervasive environments are in a good position to selectively deliver relevant ads to the right set of people at the right time. They also have a wide range of delivery mechanisms to users like SMS to cell-phones, email, large displays on walls and audio in rooms. They can, thus, deliver the ads in a way that would annoy the users the least while communicating as much information about the product as possible.

Pervasive computing environments hold great potential for the field of advertising. This paper describes our vision for pervasive advertising. We examine some of the possibilities of advertising in pervasive environments as well as the challenges involved in this area. In Section 2, we present some of the challenges of pervasive advertising. In Section 3, we provide some insight into how some of these challenges could be overcome. This section also describes some of the functionalities a pervasive computing environment must support in order to be a good platform for advertising. Section 4 describes related work and Section 5 concludes the paper.

## **2. CHALLENGES**

Advertising in pervasive computing environments presents some unique challenges. In this section, a few of these challenges are presented. Some of the challenges exist in any advertising scenario while others are specific to pervasive environments.

### **2.1 Reaching the right people with the right ads**

The first challenge is to deliver the right ads to the right people. We have at one end advertisers with ads for their products and services. At the other end are consumers with their needs. The advertising system needs to match the two to create the greatest possible impact on the customers.

### **2.2 Delivering ads at the right time**

Even after we narrow down the target audience for a particular ad, we need to ensure that the ad is delivered to the user at a suitable time. It should definitely not be delivered to him when he is in a meeting or is driving. It should preferably be delivered to him when he is relatively free or is in a relaxed environment. Also certain types of ads may have greater impact when the user is in a particular context. For example, a beer ad or a pizza delivery ad may gain better mileage when it is played to a group of men who are watching a football game.

### **2.3 Delivering ads in the best way**

Once we have decided the target audience for an ad and the time to deliver the ad, we need to choose the appropriate means of delivering the ad. Besides the traditional means of delivering ads like print, radio, TV, telemarketing, billboards, email and internet ads, pervasive environments allow newer delivery mechanisms. They can deliver ads via WAP or SMS to cell-phones or to instant messaging clients. Audio clips with advertisements could be played to people in their offices or in common areas like inside elevators. Pervasive environments may have a large variety of displays like video-walls, displays on doors or in corridors, or a number of other novel display platforms. If video-on-demand and network TV (where movies and TV programs are stored on a server and downloaded by viewers on demand) catch on, it would even be possible to place personalized ads on them. From this wide array of delivery mechanisms, advertisers have to choose the medium that will make the greatest impact at the least cost. At the same time, the medium chosen should not greatly distract the user from what he is doing and annoy him. For example, a cell-phone may be an excellent advertising means at some times (for example, a fast-food joint could advertise a special sale to all cell-phones in the area at that time). At other times, the cell-phone may not be the best way of advertising (like when the person is in a meeting or watching a play).

### **2.4 Serendipitous advertising**

Serendipitous advertising is advertising which may not seem to meet a person's specific needs at that point of time, but which may interest him or her enough to buy the product or at least get more information about it. Serendipitous advertising is useful when advertisers are trying to interest people who may never have heard of their company or their product. The publish-subscribe system does not support serendipitous advertising. However, traditional media like TV, radio and print are great for serendipitous advertising. A pervasive computing environment offers plenty of new scope for serendipitous advertising. Wall displays in corridors could display random ads as people walk by. Screensavers could play ads too. Elevators and corridors can also play audio ads.

### **2.5 Providing a means for users to follow up on the ad**

Providing interested users an easy way to respond to an ad is critical in advertising. Traditional media like TV, print and radio could only give a store location or toll free number to interested users. Online ads allowed people to click their way to the company's website directly. Pervasive computing environments can do more. They can allow a user to experience more of the good or service is possible. For example, if a user is piqued by an online ad describing a cruise to the Bahamas, he could request a promotional video of the cruise to be played on his large wall display with surround sound. He could instantly get in touch with any company representative using any means of his choice - phone, instant-message, email, etc. There should be a supporting payment infrastructure that allows him to reserve seats on the cruise immediately.

At the same time, there should also be a way for users to indicate that they do not wish to receive any more ads from that company or of that product. Such a negative feedback mechanism is

necessary to prevent users from getting annoyed and forming a negative opinion of the company sending the annoying ads.

## 2.6 How should advertising revenue be collected in a pervasive environment?

Pervasive environments pose certain challenges in collecting revenue from advertisers. Should revenue be collected every time an ad is shown or delivered to a person? Or should it be collected only if the person responds in some way to the ad? Or should it depend on how many people were around when the ad was shown?

## 2.7 Privacy and Security

Privacy is a big concern in a pervasive environment. Users' preferences with regard to advertisements they would like to receive is personal data and should not be exposed to untrusted parties. The exact mechanism used to deliver advertisements to users is also private information since it could indicate the location of the user or his activity. Any architecture for supporting advertisements should respect the privacy of the consumers in the environment.

## 3. OVERCOMING THE CHALLENGES

In this section, we talk about some of the ways in which the challenges mentioned above may be overcome. Various functionalities that must be supported by pervasive computing environments for effective advertising are highlighted.

In the old world (which includes the present), advertisers would deal with the various possible advertising media individually. They would buy time or space from different media like newspapers, radio, TV, billboards, internet banners, etc. separately and show their ads on these media independently of one another. In a pervasive world, however, many different kinds of media can be unified. Advertisers would make use of businesses called pervasive service providers to deliver their ads to consumers in a pervasive manner as shown in Figure 1.

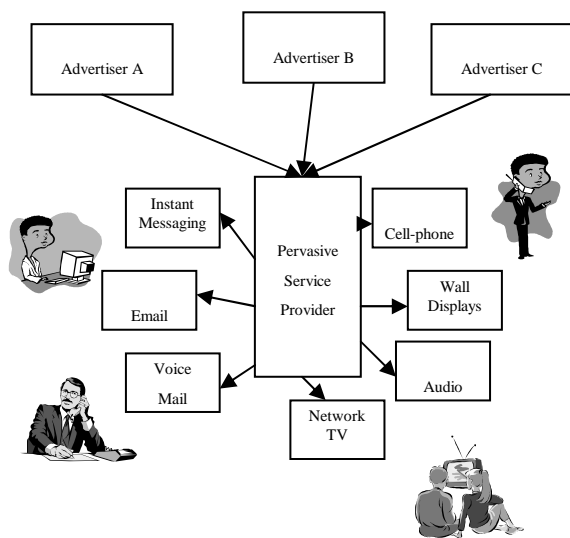


Figure 1. Pervasive Advertising Architecture

## 3.1 Pervasive Service Providers

Just as today's world has service providers that provide services like cell-phone, cable TV, Internet, etc., we envision that tomorrow's world would have pervasive service providers that deploy and run pervasive computing environments. Pervasive service providers may run pervasive computing environments at a variety of locations – in homes, offices, airports, malls, parks, or even an entire city. These pervasive service providers would deploy a variety of sensors in these environments to detect or track various contexts like location of people, temperature and activities of people or groups of people. They would also have access to a variety of ways of sending information to an individual like instant messaging, email, voice-mail, cell-phone, speech, displays (either personal monitors or wall displays), network TV, electronic billboards, etc. They would run middleware on which various pervasive applications could run. They would also run services that facilitate commerce in the pervasive environment like advertisement services and payment services. It is also possible that multiple pervasive service providers could serve the same area, thus providing competition. Pervasive service providers could either charge subscription fees from users or they could depend on advertising for revenue.

## 3.2 Process of pervasive advertising

Advertisers would buy advertising time and space from these pervasive service providers. They would then deliver their ads to the providers. The provider would then deliver the ads to its subscribers at appropriate times and in appropriate ways. The following paragraphs describe the process of advertising in pervasive environments.

### 3.2.1 Creating the ads

The first step in pervasive advertising is actually making the ads. The advertisers have to decide on which media to show ads on and develop ads for those media. They could develop ads in the form of video clips to be played on TV or wall displays; audio clips to be played to a person or a group of people; text messages to be sent to instant messenger clients or SMS; interactive ads (say, in the form of applets) to be run on displays with touch screens or other interactive devices, etc. It may be necessary to transform the ads to ensure that the data format is suitable for the device on which it is presented. For example, video clips may have to be suitably modified to allow them to be displayed on big video walls, computer monitors or handheld devices. The pervasive computing middleware should be able to handle these kinds of data transformations. The pervasive environment must also provide an easy interface for advertisers to upload new versions of ads easily.

Newer types of ads that take advantage of the pervasive infrastructure can also be developed. Ads that make use of a variety of displays, sound systems, touch panels and other novel interfaces could create a great impact on the minds of users. For example, ads for tourist locations could be really effective if there are videos of the place and great sound effects surrounding the consumer. Since these ads would have to be developed by the advertisers, different pervasive service providers would have to provide a common interface for running these kinds of ads.

### 3.2.2 *Sending the ads to the right people*

The next step in advertising is to identify the right people to send the ad to. This is where the pervasive service provider could really help in getting advertisements to the right people. People could indicate their preferences to the pervasive service provider. They could request ads from a certain company or about a certain kind of product or service. They could even place priorities on the ads. So, ads with a higher priority could be delivered to cell-phones or instant messaging clients and ads with lower priority could just be delivered to email or voice-mail.

Even if people do not explicitly indicate their preferences, it is possible to guess what they may be interested in. Amazon, for instance makes recommendations of books or music to buy based on your previous buying habits. Since pervasive computing environments track a user's activities more closely than a website, these environments can do a better job at guessing the user's preferences. For example, a pervasive office environment can detect the fact that a user often stays back late in the office. It could then show him ads about fast food delivery services that deliver late at night. Or if can detect the fact that the user often goes to buy coffee at the cafeteria, it could show ads for coffee makers. A pervasive home environment could monitor the user's buying patterns and keep stock of what the user needs to buy. It could then deliver selective ads to the occupant in the home. It is also possible to identify target audiences based on where people are and what they are doing. For example, ads about flight deals could be delivered to all people in the ticketing and reservations section of the airport. Ads about bookstores or new books could be delivered to people who are waiting in bus or train stations and airports.

Context can also be used to identify potential customers. For example, if a person has an entry in his schedule for a meeting or a vacation in Hawaii, selective airline ads could be delivered to him.

Trying to guess a user's preferences eventually boils down to discovering user intent. If it were possible to know exactly what a user wants (even without the user exactly knowing what he wants) it would be possible to show him ads he would definitely be interested in. Pervasive computing environments could go some way in discovering user intent.

### 3.2.3 *How and When to deliver ads?*

Once we have identified the target audience for an ad, we need to figure out the best possible time for and the best possible way of delivering the ad. Context can help us figure out the best time and the best delivery mechanism. The ad should be delivered to the user when he is relatively free. Pervasive environments can monitor the user's activities using a variety of techniques like looking at his schedule, looking at what applications he is running, seeing whether any other people are in the same room as him, etc. So, ads can be delivered at a time when the user is free enough to actually follow up on the ad. Also, the people a user is with at any point of time influences the kinds of ads that should be delivered to him. Certain ads (like ads for diamonds) may have greater impact when it is delivered to a man, who is, at that moment, with his wife. At the same time, some other ads may be inappropriate when a person is with a certain company.

Ads need to be delivered in a way that would create the greatest impact. The kind of ad is an important factor. An ad that wants to make the user almost experience the product (like an ad for a car) could have greater impact if it is played on a wall display or on multiple screens with surround sound. However, an ad that merely announces a sale could be fairly effective as just a text message to a cell-phone or to an instant messaging client. Context data could also be used in choosing the appropriate device. For example, if we know the direction a user is facing, an ad can be played on a display close to where he is looking. Pervasive environments also allow the delivery of serendipitous advertising. Such ads could be displayed on peripheral displays in offices, screens in corridors as people walk by, or played in cafeterias or in elevators, etc.

The decision of when and how to deliver the ad could be made by the pervasive service provider, the advertiser or both. The advertiser could define some rules as to how and when it wants certain types of ads to be presented. It could also give the pervasive service provider some flexibility, so that the provider could choose the best time and mechanism depending on context. Pervasive environments need to have mechanisms that allow advertisers to define rules for delivering advertisements. An advertiser could also indicate that it would like its ads to be delivered in a serendipitous manner too. Then, the environment could play these ads to a user even if there is no specific reason to believe that the user may be interested in such an ad. Of course, the ad has to be played in a manner that would not be too annoying for the user and the user should be able to turn off the ad easily. The pervasive environment could also have its own rules on how and when advertisements can be delivered. For example, an elderly home environment may not want ads to be delivered to residents after a certain time. Coming up with a good generic interface for pervasive service providers whereby advertisers could specify rules for delivering advertisements is not an easy problem.

### 3.2.4 *Consumers following up on ads*

One advantage an ad in a pervasive environment has over ads in traditional media is that users can follow up on the ads very easily. Users can save or bookmark ads for future reference. They can request more information about the ad easily (like in online ads, one can just click on the ad to get more details). They can discuss the product with other people easily, whether they are colleagues, friends or other people who have bought the same product. They can also make payments so that they can buy the advertised product immediately. Besides, pervasive environments should also handle negative feedback from users. Users should be able to specify that they don't want to receive certain kinds of ads. They could develop block lists of ads. They could also indicate that they do not want to receive certain ads on certain media.

Pervasive computing environments need to develop a good interface for users to follow up on ads. Users could potentially use any device to follow up – touch screens, SMS, instant messaging, voice, etc. Developing a common, intuitive user interface for all these devices is also an interesting problem.

### 3.2.5 *Privacy*

A big issue in any pervasive environment and especially in advertising is privacy and security. Since advertisements are pushed by the advertisers and the environment onto users, instead

of users explicitly looking for them, the issue of privacy is even greater. The pervasive service provider should not expose to the advertiser how and when the ad was delivered to the user since that could reveal private information. Users should also be able to control the amount of advertising they receive, at least to a certain extent. They should be able to block off annoying ads or indicate that they don't want to receive any ads during certain times.

Some unfortunate aspects of online advertising are spam email and annoying popup ads. It is possible to prevent pervasive advertising from following into the same pitfall. Since it is the pervasive computing environment that is delivering the ad to the user and not the advertisers themselves, they would hopefully be more responsive to the users' concerns and privacy. They know that if they annoy a user sufficiently, it is possible that the user may switch to another pervasive service provider.

### 3.2.6 How to collect revenue for ads?

Since advertisers aren't guaranteed time or space for ads to be displayed, collecting revenue for the ads is a bit tricky. Some ads may get delivered a lot more because more people are interested in the product. We envision that there may be several classes of service that pervasive service providers could offer advertisers. One class could only deliver ads if a user specifically indicates it in his preferences. Another class could deliver ads if the pervasive environment guesses that the user may be interested in the product. Another class could cover serendipitous advertising. There may also be different rates for the different kinds of media that may be used – displays, email, instant messaging, etc.

On the whole, the pervasive environment would have to balance the privacy the user with the interests of the advertisers. If the users of the environment choose to block off most ads, then that would translate to less ad revenue for the pervasive service provider, which may result in more subscription fees for the users.

## 4. RELATED WORK

There is plenty of related work in the area of event systems and notification systems. Systems like SIENA[2], Gryphon[1] and Elvin[13] allow delivery of events that satisfy certain constraints from publishers to subscribers in large scale distributed systems. However, advertising doesn't really fall under event systems in the sense that advertisements are not really events although their delivery mechanism resembles the delivery of events.

Two systems that try to direct communication to the most suitable endpoint are the Universal Inbox and the Mobile People Architecture. The Universal Inbox[12] project redirects communication to different user endpoints based on his preferences. The Mobile Person Architecture[9] has a proxy for every person, which accepts communications on his behalf and routes it to the most appropriate device. Ideas behind such systems could play a role in designing the best ways to deliver ads to consumers.

There has been a lot of work in developing different kinds of pervasive computing environments such as Easyliving[4], Cooltown[3], Gaia[6], Oxygen[10], the Future Computing Environments[5], Project Aura[11] and AT&T's Sentient Computing[14]. All these environments try to make life easier for users by deploying various devices and supporting middleware. They have sensors to sense different types of contexts and they

make use of these contexts, in varying degrees, to tailor application behavior. With suitable enhancements, all these environments could potentially support pervasive advertising.

## 5. CONCLUSION

Advertising is certain to play a huge role in pervasive computing environments. Pervasive service providers that make it easy for advertisers to deliver high quality ads to consumers creating the greatest possible impact would be able to get more advertising revenue that could finance their operations. Pervasive advertising would open whole new dimensions to the field of advertising just as online advertising did a few years back. One of the main challenges of advertising is balancing the interests of the consumers and the advertisers; and pervasive computing environments are in a very good position for dealing with that challenge.

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