

Online Advertising

- Taxonomy and Engineering Perspectives

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Abstract

Since 1994 online advertising has been recognized as one of efficient and effective means for marketing and advertising due to its global visibility, low-cost, effective performance tracking and measurement. With the quick growth of Internet users and the fast advances of Internet technology and e-commerce, more businesses and manufactures began to pay their attention to online advertising. Although there are many articles discussing the business perspectives of online advertising in terms of its importance, effectiveness, and measurement, very few papers discussing its engineering perspectives, such as engineering approaches, processes, infrastructures, methods, and technologies. Today's online portal businesses and electronic advertising service companies have established their in-house enterprise solutions and infrastructures for online advertising. However, we are lack of articles that provide well-defined online advertising taxonomy, and discuss insights relating to the issues and solutions in engineering electronic advertising systems. This paper not only presents the basic concepts, approaches, business models, and taxonomy of online advertising, but also shares our insights of engineering processes, technical problems and solutions relating to advertisement posting, tracking, targeting and measurement of electronic advertising systems.

Keywords

Electronic advertising, online advertising, E-commerce, Web-based advertising system, and advertising systems.

1. Introduction

Since 1994 online advertising on the web has been recognized as one of efficient and effective means for marketing and advertising due to its global visibility, low-cost, effective performance tracking and measurement. With the quick growth of Internet user population and the fast advances of Internet technology and e-commerce, more businesses and manufactures began to

pay the attention to online advertising by spending a great deal of money on posting their advertisements over the Web. In 1997, \$906.5 million was spent on Internet advertising in the U.S. According to New York's PR Newswire on August 9th 2001, the release data from Jupiter Online Advertising Forum indicated that the top five web sites (Yahoo!, MSN, Excite, iWon, and Netscape) received over 10 billion U.S. Dollars from online advertising during the first half of 2001. They only occupy the 39% of the online advertising market. Figure 1 (a) shows the details. After 2000, many traditional businesses and fortune 500 companies are becoming the major online advertisers, and they have spent a great deal of marketing and advertising money on the Internet to promote their products and services. Figure 1 (b) shows the five top online advertisers in the first six months of 2001.

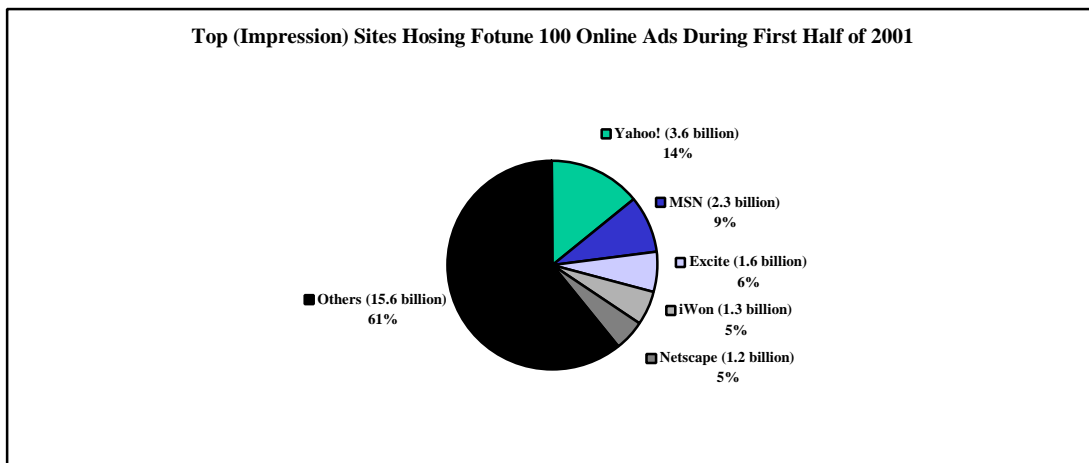


Figure 1 (a): Top Sites Hosting for Online Ads during First Half of 2001

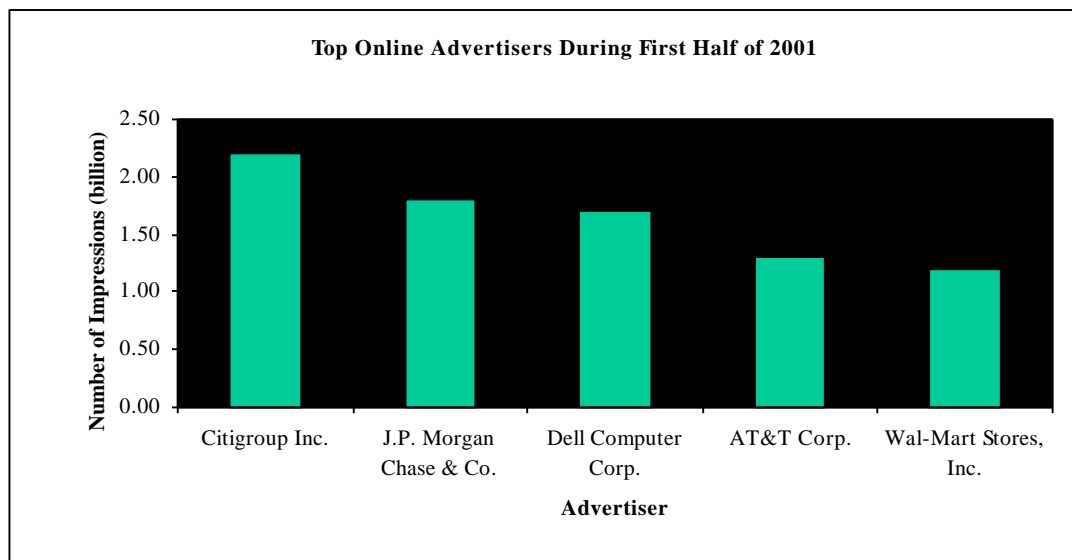


Figure 1 (b) : Top Online Advertisers and Their AD Spending during First Half of 2001

Online advertising is a rapidly growing business. According to the study of Jupiter Communications LLC, Internet advertising spending will rise to 17 billion U.S. Dollars by 2005 [1]. Figure 2 displays their global forecast on electronic advertising spending in the next five years. To fulfill the needs, people are looking for new business models, technology and solutions for next generation online and electronic advertising systems.

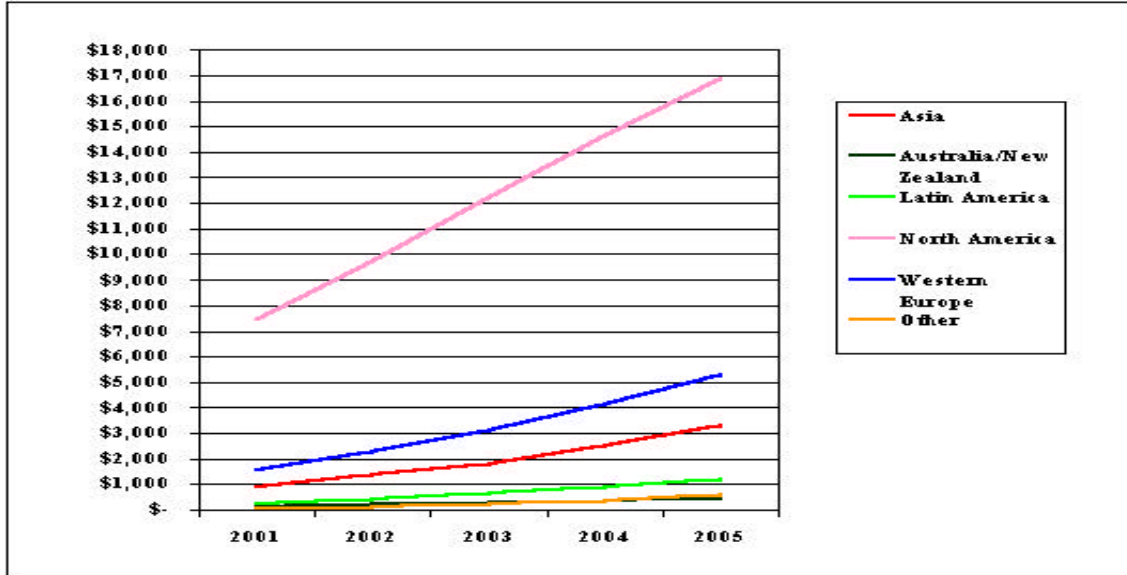


Figure 2: Global Online Ad Spending Forecast (U.S. Dollars, in Millions)

Although there is a number of published articles and books [1][2][3][4][5][6][7][8][9][10] discussing the business perspectives of online advertising in terms of its importance, effectiveness, and measurement, very few discuss the subject from engineering perspectives, such as engineering approaches, processes, infrastructures, methods, and technologies. Today's major online portal businesses and electronic advertising service companies have established their in-house enterprise solutions and infrastructures for online advertising. However, we are lack of articles that provide well-defined online advertising taxonomy, and discuss insights relating to the issues and solutions in engineering electronic advertising systems. This paper not only presents the basic concepts, approaches, business models, and taxonomy of electronic advertising, but also shares the deep insights of engineering processes, infrastructures, problems and solutions in building electronic advertising systems. Finally, we share our vision on the next generation of electronic advertising systems.

Section 2 presents online advertising concepts, objectives, advantages, engineering scope and perspectives. In Section 3, existing business models in online advertising are discussed and

compared. Section 4 examines and classifies different types of online advertisements and their applications. In Section 5, we discuss enterprise-based and service-based engineering processes and workflow for electronic advertising. Section 6 discusses the technical issues and solutions in electronic advertising, such as presentation, tracking, targeting, and measurement. Finally, conclusion remarks and future needs in online advertising are given in Section 7.

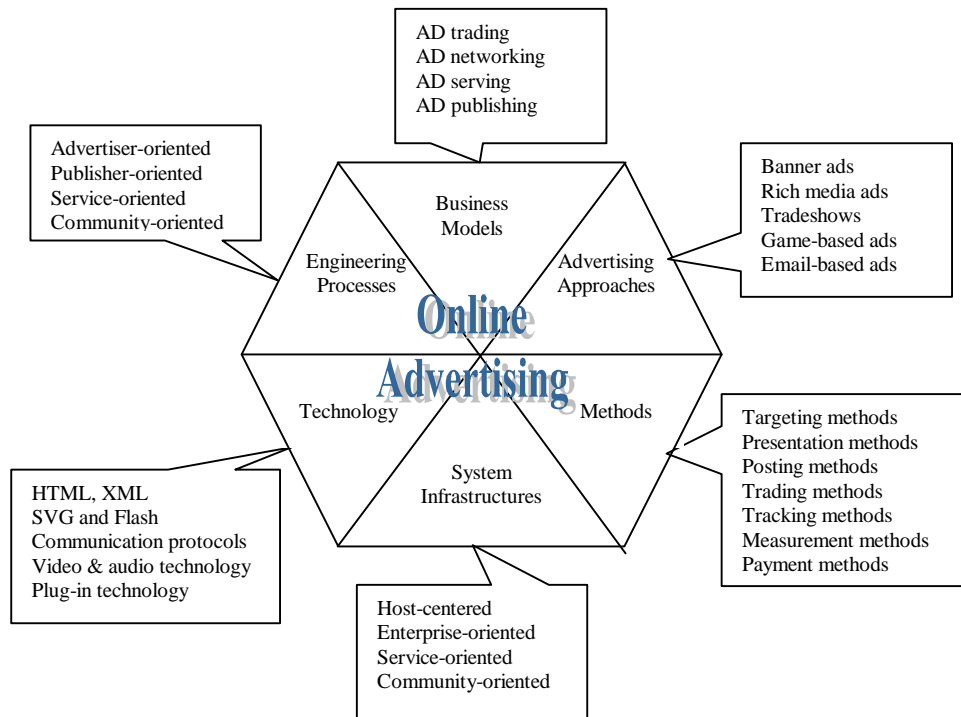


Figure 3. Engineering Scope of Electronic Advertising

2. Engineering Perspectives of Online Advertising

Online advertising refers to the use of the Internet as a communication media and channel to post online advertisements on the web. To support online advertising, online publishers and/or advertising service businesses provide systematic (or semi-automatic) electronic solutions to support advertisers and publishers to carry out an online advertising process and activities. In general speaking, an online advertising process involves advertisers, publishers, and service companies. They interact each other to conduct online advertising processes, activities and transactions. *Engineering online advertising* includes two folds. The first refers to the use of well-established business models, engineering processes, efficient approaches and methods, as well as automatic systems to achieve cost-effective online advertising on the Internet. The other refers to

the study of problems and solutions of electronic online advertising, including advertisement targeting and presentation, ad-space management and search, ad-Champaign and trading, system infrastructures, as well as evaluation and measurement.

Figure 3 presents the *scope of online advertising* from an engineering view. A cost-effective online advertising solution must address the issues and solutions in the following areas:

- *Business models.* A business model refers a business idea and a strategic plan about how to make money for a business. A cost-effective online advertising solution must implement and support an adverting business model, which is fundamental for a successful online advertising business.
- *Advertising approaches.* Advertising approaches refer to strategic ways to support advertisers to deliver advertisements to their customers in a selected media channel. They also provide the interaction methods between involved parties.
- *Engineering processes.* Well-defined and sound engineering processes are essential to establish an efficient enterprise solution for online advertising solution because they define are the basis for setting up a systematic solution to support internal and external workflow and activities for publishers, advertisers, as well as service companies.
- *System infrastructures.* For an advertising solution, system infrastructure is the essential part of its backbone, which depicts the system structures between functional components, and highlights the networking infrastructure that connects subsystems for involved parties.
- *Technologies.* Advanced technologies always play an important role in developing efficient online advertising solutions. They include online presentation technology (such as online graphic technology, like SVG and Flash), client technology (such as HTML Java, and JavaScript), middle-ware technology (such as Java and J2E), and communication protocols.
- *Methods.* Various methods and techniques are needed to support a) customer targeting and interaction, b) ad presentation and posting, c) ad-space trading and payment, e) ad tracking, and f) ad performance measurement.

Recently, with the fast increase of Internet usage, online advertising has penetrated general population much more rapidly than traditional media in the past. For instance, radio achieved 50

million users in 38 years after its introduction, television took 13 years to achieved the same goal after its introduction. However, the Internet only took 4 years [11].

Table 1: Comparison of Online Advertising and Traditional Advertising

| | Online Advertising | TV | Radio | Newspaper |
|-----------------------------------|--|--|--|--|
| Communication style | Interactive two-way communication supporting direct real time feedback | One-way communication | One-way communication | One-way communication |
| Availability and schedule | Highly available with 24/7/375 | Specific schedule with a very short display time | Specific schedule with a very limited audio time | Specific schedule with a very limited available time |
| Reachable Market | Global Internet viewers with access to attention | Regional viewers with access to attention | Regional viewers with access to attention | Local viewers with access to distribution and attention |
| Management Process | Systematic management processes for advertisers, publishers, and services | Manual or semi-automatic management | Manual or semi-automatic management | Manual or semi-automatic management |
| Direct linkage to product catalog | Supported | Not supported | Not supported | Not supported |
| Enabled direct product trading | Supported | Not Supported | Not Supported | Not Supported |
| AD targeting | Static and dynamic customer targeting based on content, personal profile, dynamic access and trading data. | No systematic targeting | No systematic targeting. | No systematic targeting |
| Ad tracking | Automatic tracking | Very limited tracking | Very limited tracking | No tracking |
| Performance evaluation | Automatic evaluation and measurement | No direct and automatic performance evaluation and measurement | No direct and automatic performance evaluation and measurement | No direct and automatic performance evaluation and measurement |
| Cost | Low | Very High | High | Middle |

As shown in Table 1, online advertising has its distinct features and advantages over the traditional advertising.

- *Creating an interactive media channel supporting two-way communications.* Online advertisements are interactive ads that support two-way communications between advertisers and ad viewers. Viewers not only receive ads, but also enable to send their feedback and questions regarding to products back to advertisers.
- *Providing a direct linkage to product catalogs.* Online advertisements have the advantage on providing viewers with a direct link to access the related product information and catalogs. This often leads to product trading, and increases business transactions.
- *Enabling static and dynamic customer targeting.* In online advertising, diverse customer targeting methods can be used to support static and dynamic advertisement selection, presentation, and display. They methods may be carried out based on page contents, customer profiles, and dynamic trading data.

- *Globally accessible and highly available.* Online advertisements are globally accessible and available in 24/7/365. This feature increases their visibility and enlarges their marketing scope.
- *Easily posted, maintained, and updated.* Online advertisements can be easily delivered, displayed, maintained and updated because of their digital nature. As a result of this, the life cycle of an advertising process is reduced.
- *Highly traceable and measurable.* Online advertisements are highly traceable and measurable due to digitalization. Diverse methods can be used to track and evaluate the performance and effectiveness of posted online advertisements.

3. Business Models

There is a number of established business models for online advertising. As shown in Table 3, they can be classified into six types of businesses: *content-based media, ISP-based, portal-based, ad serving, ad-network, and ad trading businesses.*

- ***Content-Based Media Businesses:***

Many web sites attract advertisers by generating high Internet traffics through interesting dynamic updated web contents [2]. These businesses conduct online advertising by selling their scheduled advertising spaces (such as web banner) based on web page contents. This model is one of most popular business model in online advertising. CBSSportsLine.com is one of examples. The major challenge in this model is to how generate and keep high online traffics to attract advertisers.

- ***ISP-Based Businesses:***

ISP-based businesses (such as AOL, EarthLink, and NetZerio) have a different online advertising model. They provide various Internet services to customers through consumer-oriented Internet access services, communication and message services (such as email, and instant messaging), news, GroupWare (such as chat room), and e-commerce retail shopping. AOL is one leading ISP business with more than 27 million Internet users. Unlike AOL, NetZero provides its 6 million registered customers with free Internet connection and service. Similar to content-based media businesses, they also sell scheduled ad-space to advertisers to post online advertisements. Although ISP-based businesses have

advantages to attract more advertisers due to their large number of subscribers and more stable Internet traffics, how to increase and keep their customers is the key for their success because their revenue highly depends on online advertising.

- ***Portal-Based Media Businesses:***

Portal is another effective business model for online advertising, such as Yahoo. The portal businesses provide an entry to the Web with an effective search engine and/or directory that classifies diverse web pages based on indexing keywords, and provides a search capability to support Internet users to find relevant web pages and links to the desirable web sites. A web spider is usually used to crawl the Web periodically to update the back-end indexing and a related search repository. According to a study by Cyveillance [12], today search engine is the most useful tool to the web surfers because they spend about 71 percent of their online time on information search through search engines. Now www.yahoo.com is one of the most popular web sites that provide a well-classified search directory and search tool. Due to the high traffic on its portal site, online advertising naturally becomes the major income resource for its revenue. In the first half of 2001, Yahoo has been ranked the number one in the top 100 hosting list for online advertising.

- ◆ ***Ad-Serving Businesses:***

Ad-serving businesses provide online advertising services for advertisers to post advertisements on selected web sites. They play as an online advertising broker role to help advertisers in advertising campaign, ad space search, delivery and display, as well as ad tracking and performance measurement. They charge their customers service fees and data analysis cost using a special payment method. In many cases, they can sell their ad tracking data to business marketing groups. Currently, there are a number of private businesses adopting this business model. The typical examples are DoubleClick, Adknowledge, AdForce, AdManager and MatchLogic, etc.

- ◆ ***Ad-Network Businesses:***

Ad-Network businesses provide a direct advertising network between publishers and advertisers with a huge supply of advertisements and a large ad space inventory. They play as a matcher-maker role in online advertising. Whenever an online ad publisher wants to find customers to sale its available ad-space, it can interact with an ad-network business to get the

potential customers who are not sure where (or which web sites) they should post their online ads. The ad-network business collects its share whenever an online advertising business deal is made between its customers. *Ad-networking* is very useful for large online ad publishers (or web sites) because they usually can't sell their surplus ad space inventory by themselves. Therefore, they need ad-network companies to help them sell their unscheduled ad space in a short timeline at reasonable cost. Small businesses may find using an ad-network is more cost-effective approach for them than through an ad-serving business due to its low cost and primitive services. Some ad-network businesses also provide limited services for both advertisers and publishers, such as ad tracking, analysis, and reporting. *24/7 media* uses the ad-network business model. Its ad-network is one of the largest ad-networks in the U.S. The company reaches more than half of all online users in the country. *Flycase* is another example, it has over 922 web sites and reaches more than 22 million customer per month.

◆ ***Ad Trading Businesses:***

Ad-trading businesses focus on online ad space trading instead of advertising services. They play as an intermediate between advertisers and ad publishers by providing an ad brokerage marketplace, which supports online ad space trading, auction, or exchanges over the Internet. They allow online ad publishers (or web sites) to post unscheduled ad spaces to attract advertisers to purchase. Whenever a deal is settled between an advertiser and a publisher, the ad trading business gets its commission fee. There are three ways to carry this business model: a) *sell-and-purchase*, b) *ad auction*, and c) *ad exchange*. In *ad auction*, online ad spaces are posted on an auction marketplace to allow advertisers to bid based on a pre-defined auction model and rules. In *ad exchange*, online advertisements and/or ad spaces can be exchanged between advertisers and/or online ad publishers through an interaction channel, such as ad exchanged marketplace. *OneMediaPlace*, formerly *Adauction.com*, hosts real-time auctions that provide media buyers and sellers with an online exchange of ad space at market-driven prices. It sells Internet advertising space through an auction. *AdOutlet.com* is an e-commerce marketplace between publishers and media buyers facilitating opportunistic buying and selling of media. Through its over 3,000 registered media buyers, *AdOutlet.com* provides publishers with exposure and branding opportunities with their target audience on a daily basis.

Table 3: Online Advertising Business Models and Major Players

| Business Model | Products | Customers | Samples of Major Players |
|-------------------------|-------------------------------------|--------------------------------------|--|
| Content-based web sites | Web ad spaces | Online advertisers | CBSSportsline.com, etc. |
| Portal-Based | Web ad spaces | Online advertisers | Yahoo!, AltaVista, Lycos, Google |
| ISP-Based | Web ad spaces | Online advertisers | AOL, NetZero |
| Ad Network | Brokerage service for web ad spaces | Online advertisers and ad publishers | 24/7, L90P, Click2Net, Flycast, ValueClick, AdVenture |
| Ad Trading | Online ad trading services | Online advertisers and ad publishers | AdOutlet, OneMediaPlace |
| Ad Serving | Online advertising services | Online advertisers | DoubleClick, AdKnowledge, AdForce, MatchLogic, AdManager |

4. Classifications of Online Advertisements

There are several types of online advertisements. The common types are banners, rich media banners, emails, and game-based advertisements. Table 4 compares them in terms of their characteristics.

Table 4: Types of Online Advertisements:

| | Banners | Rich Media Banner | Commercial Emails | Game-based Advertisements |
|--------------------------------|---|---|--|--|
| Ad Presentation Format | Static Banners Animated/Dynamic Banners Interactive Banners | Rich Media Banners | Broadcasting Email Messages Email Newsletters Discussion Lists | Game-based Advertisements |
| Payment Methods | Pay-by-click Pay-by-meter Pay-by-impression | Pay-by-click Pay-by-meter | Pay-by-view Pay-by-message | Pay-by-display Pay-by-click |
| Design and Posting Cost | Low | High | Very Low | Varied |
| Advertising Application | Product Marketing and Sales Brand Building | Product Marketing and Sales Brand Building | Product promotion Sales promotion | Brand Building Product Marketing |
| Download Speed | Fast | Slow | Fast | Varied |
| Supporting Technology | HTML, GIF, JavaScript, and Java Applets, and Animated GIF. | Rich media technology, such as Flash, SVG, InterVU, RealAudio, RealVideo. | Internet Email | Integrated with game technology |
| Ad Viewers | Limited to users who accessed the online ad page. | Limited to users who accessed the online ad page. | Anyone with available email addresses | Limited to game players. |
| Performance | High impression rate Low click-through rate | Low impression rate, High click-through rate | Low display rate Low click-through rate | Low impression rate High click-through rate |
| Attraction to Viewers | Low | Very High | Low | High |

Banners

Static and dynamic banners are the most popular format for online advertisements due to its low cost in design and posting. *Static banners* refer to HTML-based regular banners that present advertisements using static images with fixed sizes. Since they have been used in many web sites, they have a high impression rate. However, their click-through rate is low[13]. *Animated banners* (or *dynamic banners*) integrate animations with static banners based on JavaScript and HTML. They usually have a higher click-through rate than static banners due to animation. Both static and dynamic banners are very useful for brand building in online advertising. There is another type banner, called *interactive banners*[7][14], which become popular because they provide users a two-way communication channel to interact with advertisers. For instance, they provide a pull down menu and an edit box for viewers to input information and response with actions. Interactive banners are frequently used in online shopping, online registration, etc. In most cases, interactive banners are created using HTML, Java Script or/and Java Applets. Today, online banners have standardized advertising formats, and their presentation sizes and styles can be found in [2].

Rich Media Banners

Rich media banners on the web use multi-media technology (such as audio, video, and graphics) to present advertisements [15]. The major purpose of rich media banners is to draw viewers' attention using dynamic video and graphics, effective images and sounds. *Rich media banners* not only provide web surfers with new experience, such as advanced animation, audio/video support and advanced tracking, but also invites them to interact with advertisements to gain additional information about the target products or services. Comparing with banners, rich media banners depend on much more complicated multimedia technology. InterVU, RealAudio, RealVideo, Flash, and SVG technology are typical examples. This suggest that rich media banners have a higher cost in design and presentation than regular banners, and require much more complicated technology support on web surfers' machines. Although many people, today, are reluctant to use *rich media banners* because of their high design cost and slow download speed, they are very effective and useful for brand building in online advertising. According to the Wired Digital Rich Media study of tracking brand perceptions of three leading online advertisers, Intel Corp., Novell, and barnesandnoble.com, rich media ads fueled significant enhancements over traditional animated GIF banner advertisements. The study found that 61 percent of the survey population noticed rich media ads and remembered them, versus 30 percent of the control population, which

viewed an animated GIF banner. This result suggests that “while rich media banners may cost more to create than traditional banner advertising, the increases in performance are significant and appear to be worth the incremental costs”[15].

Game-Based Online Advertisements

Entertainment is a very traditional ad-supported medium[16]. Based on the latest study from Interactive Digital Software Association (IDSA), nearly 60% of all Americans, or 145 million people, play computer or video games. This makes the online computer games the natural fit for online advertising. Unlike online banners, the publishers of game-based online advertisements are online game vendors instead of web publishers. They use two ways to post advertisements to game players. The common approach is to replace online game images by textures having advertisement implemented therein. The game players are visually influenced by advertisements when they are viewing the virtual world of games. Another approach is to separate the whole game into several episodes. Game players have to view and interact with certain advertisement before going to another episode. In this approach, advertisements usually receive more interactive responses from players because it takes the advantage of the eagerness of players to continue the game.

Since most advanced online games usually are multimedia-based, game-based advertisements cost more to create and implement due their dependency on complicated technology. Although game-based advertising usually is very effective to drive the attention of game players, its audience is limited to game players only. In many cases, game players may feel annoyed with advertisements while they are playing games.

Email-Based Advertisements

Email has been used to conduct marketing and advertising for a long time. With the increase of Internet users, email is becoming another effective mean for online advertising. According to Jupiter Communications, the average number of annual commercial emails, received by US consumers, increases from 40 in 1999 to more than 1,600 in 2005 [2]. Advertising through emails provides an extremely cost-effective, high-response-rate marketing vehicle. It enables businesses to acquire and retain consumers, sell and promote products, drive loyalty, and reinforce branding efforts.

There are several types of email advertisements. The first type is email newsletters which are created by businesses or their sales representatives to focus on a group of people who share the common interests on product and business news and updates of product services. In many cases, email newsletters are sent out periodically to potential customers with their permission, and they can cancel them at anytime. The second type is known as email discussion lists, which are created among a group of members who are interested in a particular topic. Email messages, made up of “conversations” on a special topic, are sent to the subscribers in a discussion list. Most good email discussion lists have a moderator who reviews all of the messages and decides which are appropriate to be sent to the entire list. The third type includes the subscribed email marketing channels that offer subscribed Web surfers real-time broadcasting commercial emails based on their interested channels. Each channel focuses on dynamic product and service news and advertisements for a special business category. The information and messages are updated dynamically at the real-time base.

Since commercial emails can be easily created and delivered using Internet email, email-based advertising offers inexpensive and effective advertising opportunities for advertisers to reach a targeted set of audience in a niche market. Moreover, advertising performance analysis and campaign can be easily carried out based on the total number of web users who receive the commercial email messages. However, email-based advertising has its drawbacks. The first problem is that many web users frequently receive a great number of unsolicited and unwanted commercial emails on the Internet. This creates a negative impression on email advertising among web users. Consequently, they would delete these commercial emails whenever they receive them. The other problem is that not all email servers support the HTML format. This makes the difficult to implement the click-through capability in email messages.

5. Engineering Processes in Online Advertising

Engineering online advertising must understand the involved engineering processes and workflow. They are very important for advertisers, publishers, and advertising service businesses to establish enterprise electronic advertising systems and infrastructures. Well-defined online advertising processes not only define the electronic advertising procedures and workflow, but also provide the basis to build automatic cost-effective solutions for online advertising and services. This section discusses three types of engineering processes: an enterprise-oriented

process for advertisers, an enterprise-oriented process for publishers, and a service-oriented process for advertising agencies.

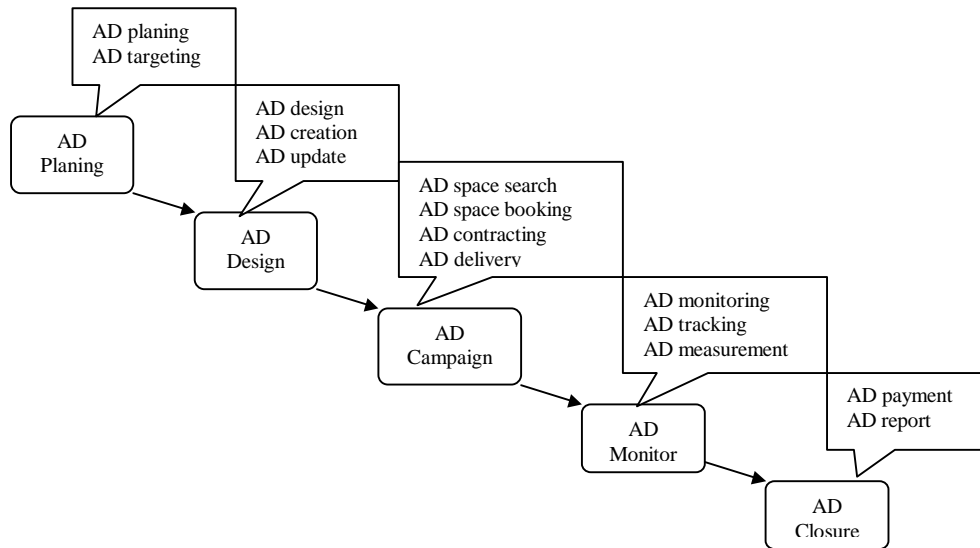


Figure 4. A Engineering Process for Advertisers

5.1. An Engineering Process for Advertisers

Figure 4 shows the basic steps and functions in an engineering process for advertisers to support electronic advertising. The process consists of five phases. They are:

- *Advertisement planing (AD planing)* - In this phase, marketing people draw out a plan for advertising based on a well-defined marketing strategy and analysis. They must conduct product targeting analysis and customer targeting analysis. Based on these analysis results, they come out a plan that specifies the decisions related to the media and publisher selection, presentation approach, targeted audience, posting schedule, and advertisement content.
- *Advertisement design (AD design)* - This phase allows AD designers conduct the design, creation, and modification for specific advertisements.
- *Advertisement campaign (AD campaign)* - During this phase, advertisers conduct an AD campaign for each advertisement. They interact the selected publishers to find the desirable AD spaces and available schedules. Then, they negotiate with publishers to

reach a business deal. As a result of their negotiation, an advertising contract is generated for each schedule ad space. It specifies the AD space selection, schedule, payment method, and cost. Later, the created ads are delivered to publishers for posting.

- *Advertisement measurement (AD measurement)* - During this phase, the collected performance data of advertisements are analyzed and evaluated to check their problems and effectiveness to online viewers.
- *Advertisement closure (AD closure)* - After ad posting, advertisers make the payment transactions to publishers for posted advertisements based on a contracted payment method.

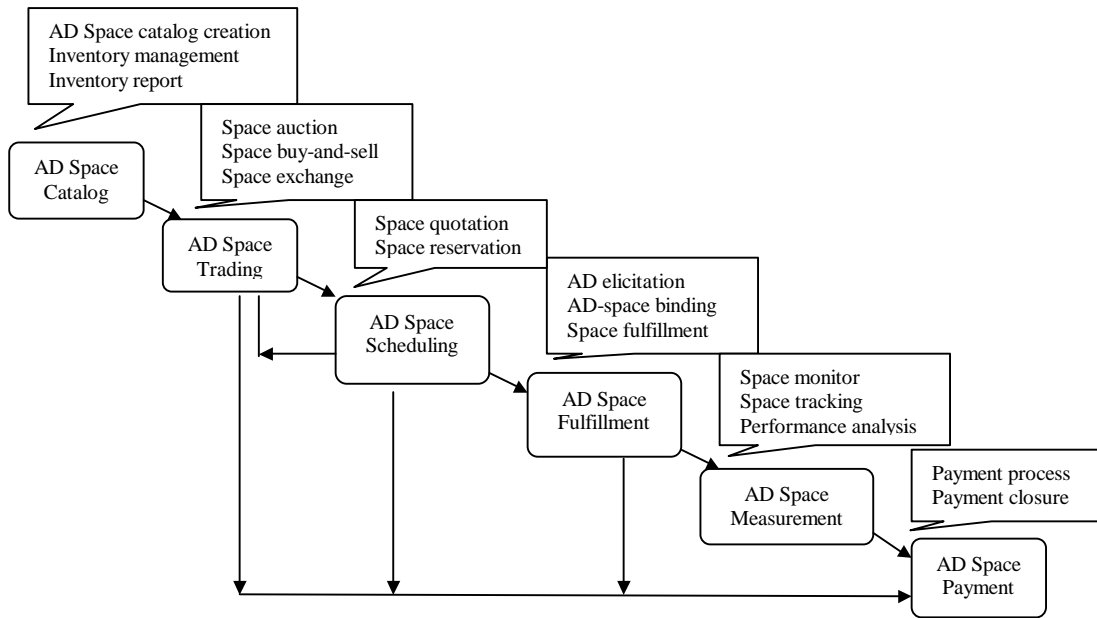


Figure 5. An Engineering Process for Publishers

5.2. Engineering Process for Electronic Advertising Publishers

As shown in Figure 5, the basic engineering process for a publisher consists of the following steps and functions.

- **Step #1: AD Space Catalog** - In this phase, an ad-space catalog is created and maintained. Each ad space is listed and managed in terms of its space profile,

including space location and presentation, scheduling method and payment information, as well as its availability status.

- **Step #2: AD Space Trading** - During this phase, space sale agents in publishers interact with advertisers to carry on ad space trading transactions. There are three basic trading types: a) *buy-and-sell*, b) *space-auction*, and c) *space-exchange*. In the *buy-and-sell* trading, ad publishers sell their ad space schedules to advertisers in a first-come-first-serve approach. In the *space-auction* trading, trading deals for ad spaces are settled through a pre-defined auction bidding process based on auction rules. In the *space-exchange* trading, different publishers interact with each other to reach various space-exchange deals to increase the utilization of their ad spaces with available schedules that have not sold.
- **Step #3: AD Space Scheduling** - In this phase, online advertising schedules for each AD spaces are created and maintained by online publishers. They support advertisers to book, purchase, and confirm various schedules for an online advertisement.
- **Step #4: AD Space Fulfillment** - In this phase, online publishers collect advertisements from advertisers according to the pre-defined schedules, and then fulfill the specified ad spaces by delivering and displaying advertisements based on the specified schedules.
- **Step #5: AD Space Measurement** - All active ad spaces in a publisher are monitored, tracked, and measured. During this phase, all status of ad spaces are monitored and tracked for space management. Meanwhile, the performance data of active ad spaces are tracked, and their effectiveness is measured.
- **Step #6: AD Space Payment** - After ad posting in ad spaces, the final payment process is performed according to the contract generated during AD space trading.

5.3. An Engineering Process for Online Advertising Services

Providing online advertising services between advertisers and online ad publishers also need a cost-effective engineering process. Figure 6 shows an example, which consists of the following steps.

- **Step #1: AD Request Processing** - At the first, the requests for online advertising services are received and processed by ad service agencies. Through this stage, each advertising service request from advertisers is elicited and documented in details, including requirements on the expected schedule, planing budget, targeting audience, advertising content, potential publishers or web sites. The result of this stage is a complete documented service contract between an advertiser and its agency.
- **Step #2: AD Space Campaign** – After understanding the advertising requests from advertisers, an online ad-service agency searches for available ad spaces of different ad publishers, and launches an advertising campaign based on the given requirements from advertisers, such as targeted audience, page content, posting schedule, and budget. The result of a space campaign is a finalized advertising schedule and a campaign contract between ad publishers and the agency (or advertiser).
- **Step #3: Ad Space Trading** - In this step, the ad space inventory is presented to the advertisers and agencies for them to purchase ad spaces. The space trading is conducted in different forms. For each form, the system defines the communication protocols, payment methods and other regulations.
- **Step #4: Ad Delivery and Posting** - As soon as an advertising contract for an online ad space is settled with online ad publishers, the advertiser is responsible to deliver online advertisements (say banners) to its service agency before ad posting schedule. The service agency posts the received advertisements onto a contracted advertising space based its pre-defined schedule. While ad posting, different ad presentation methods and targeting techniques may be used to improve the presentation and targeting effect.
- **Step #5: AD Monitor and Tracking** - During the posting period of an online advertisement, the related ad service agency monitors and tracks its performance by collecting various performance data, and reports its active status according to specific requirements given by its advertiser.
- **Step #6: AD Performance Measurement** - Upon the requests from advertisers, ad service agencies may provide performance analysis and measurement services for advertisers. They use diverse methods to analyze the collected performance data, and

report the results of performance measurement to advertisers to help them understand the effectiveness and responses from ad viewers.

- **Step #7: AD Service Payment** - This is the last step, in which the online advertising service payment is processed and business payment transactions are carried out.

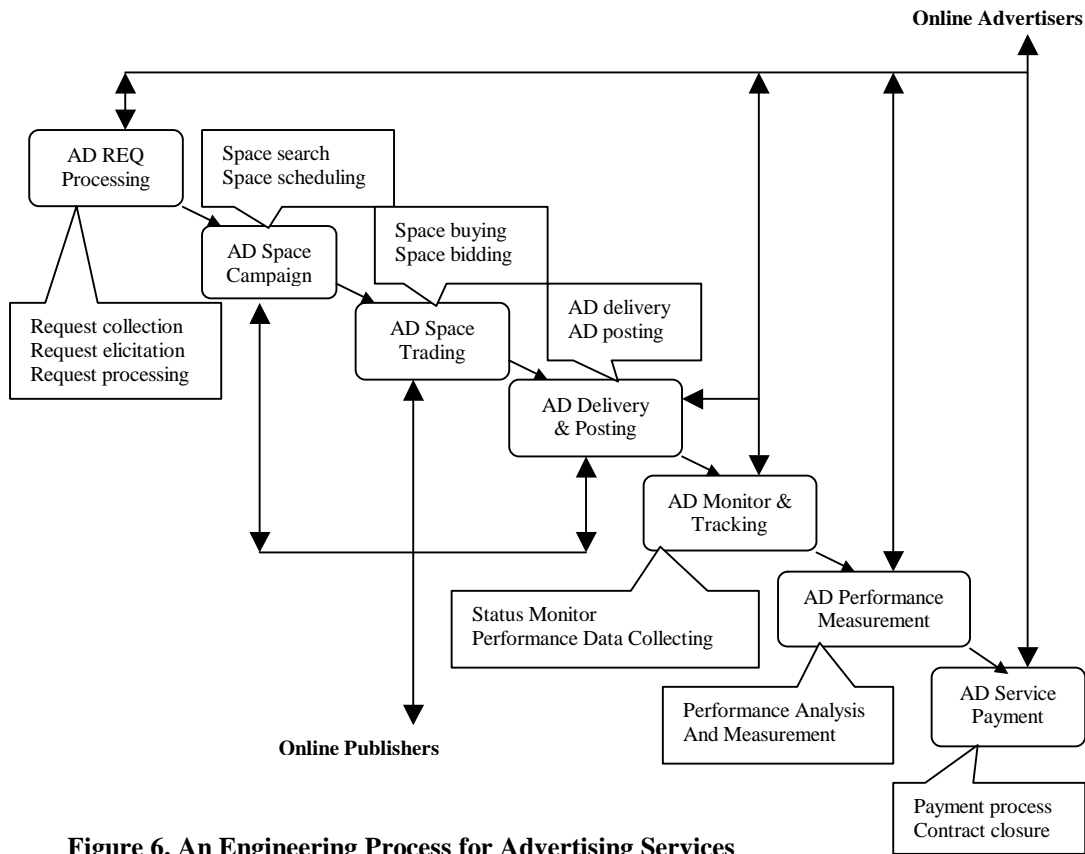


Figure 6. An Engineering Process for Advertising Services

Table 4: Online Advertising Services Provided by Major Players

| Company | System | Media Plan | Ad-Space Trading | Ad-Campaign Management | Ad-Space Inventory Management | Targeting | Tracking | Measurement |
|-------------|-------------|------------|------------------|------------------------|-------------------------------|-----------|----------|-------------|
| AdKnowledge | AdKnowledge | Yes | No | Yes | No | Yes | Yes | No |
| DoubleClick | DART | Yes | No | No | No | Yes | Yes | Yes |
| AdForce | AdForce | Yes | No | Yes | Yes | Yes | Yes | No |
| MatchLogic | MatchLogic | No | No | No | No | Yes | Yes | No |
| AdManager | Sobright | No | Yes | No | Yes | Yes | Yes | No |

Table 4 lists current major players in online advertising service. According to their posted service information, the services they provided all fit into the presented process in Figure

6 except media planing and space inventory management services. All of them provide ad tracking and targeting services to their customers. However, some of them do not offer services on space trading, ad campaign, and performance measurement.

6. Technical Solutions for Online Advertising

There are a number of technical issues in online advertising. To establish a cost-effective online advertising solution, we must understand these problems, and find efficient and effective techniques to deal with them. These technical issues classified into five areas of online advertising. They are a) advertisement posting, b) advertisement tracking and monitoring, c) advertisement targeting, d) performance measurement and analysis, and e) advertising payment. This section discusses these problems and solutions.

6.1. Online Advertisement Posting

In traditional advertising, posting and delivery of advertisements is very simple due to the static one-to-one mapping between an advertisement and an advertising space (or a time slot) and the independence between advertisements. However, the advertisement posting in online advertising becomes more complicated due to the following two reasons:

- Due to the digital implementation in online advertising, the mapping relationship between an advertising space and an advertisement during a scheduled advertising time slot becomes much more complicated than the one in traditional advertising.
- Due to the advantage of digital advertising, advertisements can be structured in a more complex way to achieve diverse marketing goals and implement complex business roles.

Mapping Relationships

As shown in Figure 7, four types of mapping relationships between advertisements and advertising spaces can be implemented. They are *one-to-one*, *one-to-many*, and *many-to-one*. *One-to-one mapping* refers to a unique binding between an ad space and an advertisement during a scheduled advertising time slot. This suggests that only one advertisement be posted in its advertising space during the time slot. *Many-to-one mapping* refers to the case in which more than one advertisement will be posted on an advertising space during a given time slot. This implies that they share the same space during the time slot, and they would be posted in a

sequence on a time-sharing base. *One-to-many mapping* refers to the case in which an advertisement may be bound to more than several advertising spaces, and it will be posted on them during a scheduled time slot.

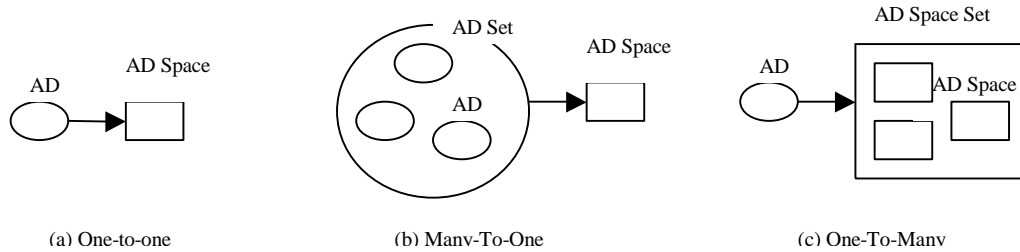


Figure 7. Mapping Relationships between Advertising Spaces and Advertisements

Advertisement Posting on the Web

Online publishers (or advertising service agencies) post online advertisements on the Web according to pre-contracted schedules. When there is a one-to-one mapping between an advertisement and an advertising space, this can be easily performed by posting the advertisement onto the corresponding advertising space in a target page based on its schedule. As soon as its posting time is over, it will be replaced by another advertisement.

Advertisement posting becomes little complicated when there is a one-to-many (or many-to-one) mapping between advertisements and advertising spaces. In the case of one-to-many mapping, an advertisement will be posted onto more than one targeted advertising spaces based on the schedule. This becomes complex when the targeted advertising spaces belong to different web sites (or publishers). In the case of many-to-one mapping, several advertisements share the same advertising space in a scheduled time period. For example, a business may purchase a scheduled advertising space to post its advertisements for different products. Posting in this case needs some kind of time-sharing algorithms to implement dynamic advertisement selection and posting during the scheduled time period. Two typical used time-sharing methods are *random data generation*, and b) *round robing rotation*. Both methods partition a scheduled time period into a number of time intervals (or slots). The major difference between them is how to select an advertisement for posting in a time slot during a scheduled time period. In the first method, at the, a random data parameter is generated dynamically as a key to find an index for selecting an advertisement to post onto the advertising space. However, in the round robing rotation method,

for each time slot a different advertisement is selected at a rotation base and posted in the same targeted advertising space so that all advertisements share the same posting time.

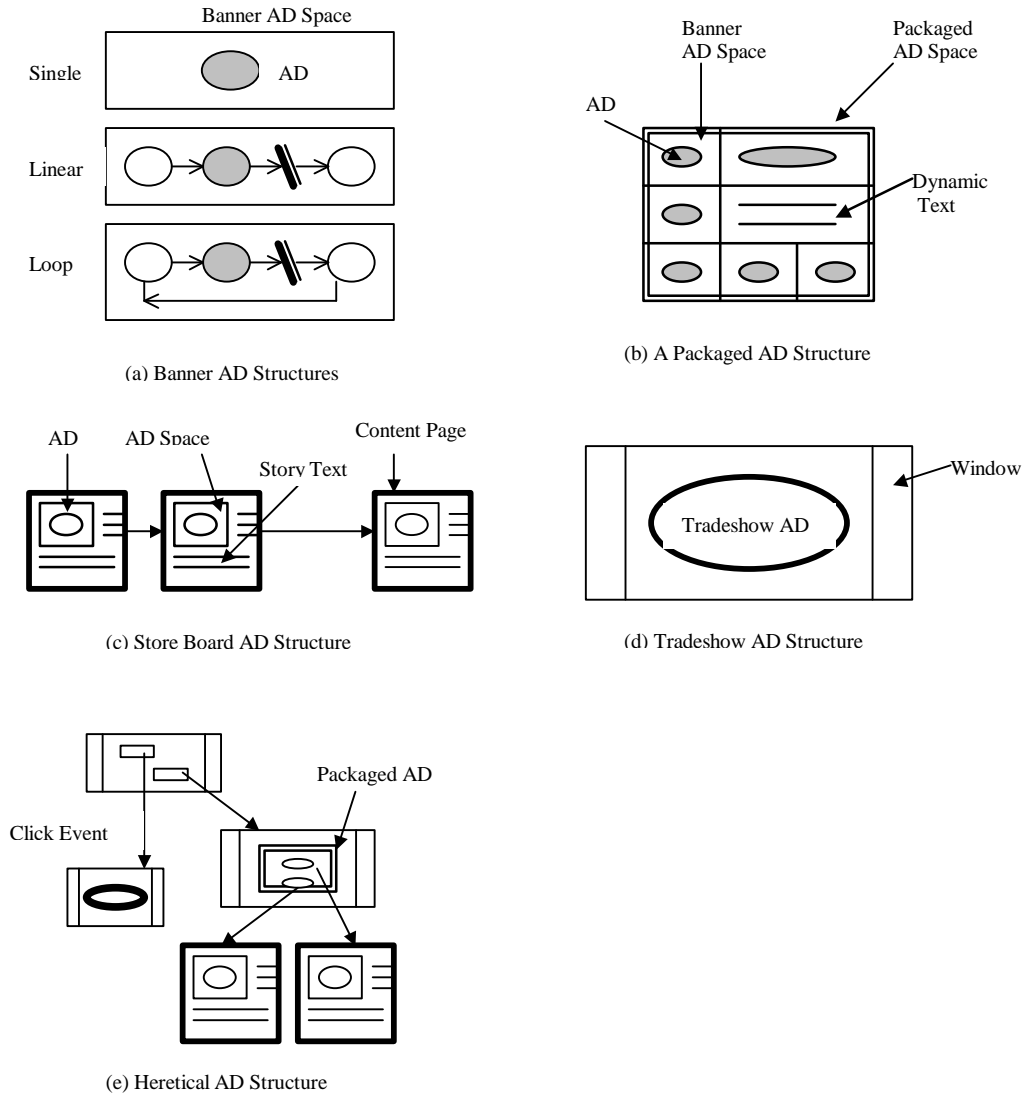


Figure 8. Different Types of Online Advertising Structures

Advertising Structure

With the advantage of digital nature of online advertisements, we can easily construct and implement various posting structures for advertisements. *Advertising structures* refer to the posting structures and relationships between advertisements in different advertising spaces. Good advertising structures enables advertisers to conduct effective advertising by implementing diverse business marketing techniques.

Figure 8 shows five classes of advertising structures. The first class (see Figure 8(a)) includes three types of *banner advertisement structures*: single, linear, and loop. An online banner may consist more than one banner advertisement space. Each space only shows one advertisement at any time. As mentioned before, a dynamic posting method will be used when several advertisements share the same space for a scheduled time period. To facility posting, a linear (or loop) structure can be used to post these advertisements one by one based on a time interval.

The second class refers to a *packaged advertising structure* in which a number of advertising spaces are structured together in a styled format. The packaged advertising structure usually is posted as a pop-up window or panel. It is very useful for marketing package deals, season sales, crossing advertising because it is able to post advertisements for businesses, products and services that are closely related.

Storyboard advertising structure usually consists of a number of content-based (or story-based) web pages. Each page may contain a number of banner spaces for content related advertisements. This kind of advertising structures is very useful for advertising in e-books and store-based web sites.

As the advances of multimedia technology, tradeshow advertising is becoming a popular way to present multimedia advertisements in a pop-up window. In many cases, this structure is used with banner advertising structures together. The typical applications of this structure are live business tradeshows, live product shows, and live entertainment shows.

The last class refers to the heretical advertising structure that represents a dynamic posting structure for online advertisements. This structure could be modeled a tree (or a graph). Each node is a pop-up window that includes different structured advertising spaces. Whenever an advertisement is clicked in a node, a new node will be created and posted dynamically. This kind of advertising structures is very useful and effective for marketing in the following areas:

- Virtual galleries and online museums
- Marketing for businesses with diverse products and information
- Marketing for products and their parts
- Marketing for package deals and crossing sales

6.2. Online Advertisement Tracking

In traditional advertising, tracking the detailed information of a posting (or posted) advertisement is difficult or even impossible. For example, advertisers are interested in to find the answers to the following questions:

- When and where has an advertisement been published (or posted)? Is it posted with a good format according to its schedule?
- How many people have seen the advertisement? Where and when do they see the advertisement? Who are they? What are their profiles?
- How many of them have shown their interests? Who are they? What are their profiles?
- How many of them finally purchased the product or remember the product (or brand) name? Where and when do they purchase the product? Who are they? What are their profiles?

However, online advertising has its distinct advantage on advertisement tracking because advertisements are delivered, posted, viewed, and accessed through digital solutions over the Internet.

What is online advertisement tracking? Intuitively, online advertisement tracking refers to activities and provided services for advertisers to monitor and track the posting status of an advertisement, and collect and report the tracking data. Today, most online advertising service companies provide this feature to serve their customers in advertisement monitor, tracking, and report, as well as data collection. It is not only used for product-oriented advertisements, but also used for tracking brand-building advertisements[17].

Why tracking online advertisements? The major motivation is to answer the previous questions by providing tracked data. There are two major purposes. The first is to confirm advertisers about the delivery and posting of their advertisements according to contracted schedules by providing the related posting states, data, and reports. The other is to help advertisers to collect the tracked data about advertisement posting, audience viewing and accesses. These data will be very useful for performance analysis and measurement of advertisements.

What kinds of traceable data are interested for online tracking? In general, online tracking enables advertisers and publishers as well as service vendors to collect data to find the answers to the questions like:

- Which advertisement has been posted and where and when?
- Who has viewed the advertisement, where and when? What are the reaction and/or response?

As shown in Table 7, each advertisement has six types of traceable information in online tracking, including client machine profile, advertisement profile, viewers' profile, posting information, posting status, and reactions and interactions from viewers. Each group of tracking data has its usage to find out the answers to the previous questions. The traceable data usually are collected and provided in a systematic way by publishers or service vendors according to the requirements and interests from advertisers.

Table 7: Traceable Data Types for Online Advertisement Tracking

| Traceable Data Type | Detailed Traceable Data | Applications and Usefulness |
|---|---|---|
| Client Machine Information | <ul style="list-style-type: none"> • IP Address • Computer Platform • Browser Type and Version | To track and understand: <ul style="list-style-type: none"> • Where Ads have been posted • Which machines on the Internet |
| AD Profile | <ul style="list-style-type: none"> • AD ID • Page ID and AD Space ID • Advertiser's Information • Service Company's Information | To track understand: <ul style="list-style-type: none"> • Which Ads have been posted? • Which service companies are involved? • Who are the advertisers for the ads? |
| Viewers' Profile | <ul style="list-style-type: none"> • User ID • User Access Time • User Access Contents and Pages • User Access Behaviors and Patterns | To track and understand: <ul style="list-style-type: none"> • Who have viewed and accessed the ads? • What are their online access behaviors and web surfing patterns? • When and where have the ads been viewed frequently? |
| Posting Information | <ul style="list-style-type: none"> • AD Page Impression Count • AD Impression Count • AD Posting Time | To track and understand: <ul style="list-style-type: none"> • What is the impression count for an advertisement? • What is the impression for a page • What is total posting time for a specific ad? |
| Posting Status | <ul style="list-style-type: none"> • Delivered/Undelivered • Posted/Un-Posted/Posting • Posting:IDEL/RUN | To track and monitor: <ul style="list-style-type: none"> • The workflow posting status for each ad |
| Reactions and Interactions from Viewers | <ul style="list-style-type: none"> • AD Click Events • AD Click-through Events • Mouse-Over Events • Inputs from Viewers | To track and understand: <ul style="list-style-type: none"> • The AD interactions with viewers • The responding actions and feed backs from viewers |

How to track online advertisements?

Implementation of online tracking for advertisements depends on a) the technology which is used to create advertisements, b) the advertising approach, and c) the structure types of advertisements.

Thus, a number of methods have been used to track and monitor different online advertisements. A typical tracking solution consists of three parts:

- A tracking repository which is used to store and maintain all types of tracking data for advertisements
- A client-based tracking module that monitors and collect tracking data of advertisements at the client side
- A server-based tracking module that controls the tracking functions and mechanisms at the sever side.

The implementation of the client-based tracking mechanism depends on the used technology. Cookie (downloaded on client machines), for example, was used as one popular method to track the internet access of web users, including browser information, accessed pages, accessing time, and behavior. Later, the Cookie will pass the tracked information to the server whenever a user connects to it later. Although it is a very effective approach, it is very intrusive and controversial for many users due to its problems in security and personal privacy.

For a Java-based (or a JavaScript) based HTML web pages, client-side tracking can be implemented in real-time by tracking a user's access behaviors and responses to the posted ads. Unlike Cookie-based tracking, this method passes the tracking data to a tracking server directly in real time. The problem of this method is that it might affect the web access performance because real-time tracking increases the network traffic.

In the server-based tracking, the information of advertisement click-through, impression, and the time of entering the pages are directly sent back to the tracking server through HTTP requests. This is usually used with client-based tracking together to carry on the tracking job for online advertisements.

6.3. Advertisement Targeting over the Internet

Using effective ways to find and deliver the right advertisements to the potential interested customers is known as advertisement targeting. In traditional advertising, marketing people only can perform pre-advertisement targeting during the advertisement planing through historical data analysis, product survey and analysis. Online advertising allows advertisers to conduct advertisement targeting in real-time because of the following reasons:

- The performance of online advertisements can be tracked and analyzed in real-time.
- The customer accesses, interactions, and responses can be tracked and collected in a systematic way.
- Posting and delivery of online advertisements is done dynamically in real-time.

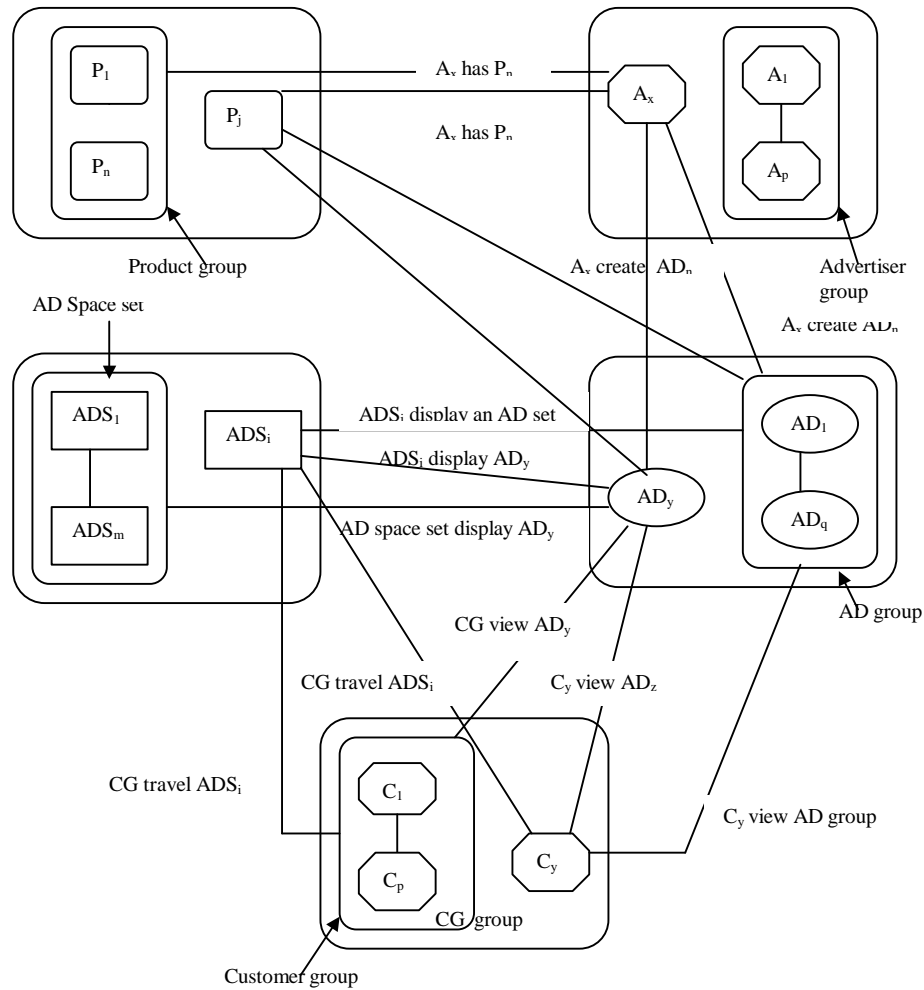


Figure 8. Different Mapping Relationships for Targeting

What is online targeting for advertisements?

Online targeting for advertisements refers to the activities and services that use real-time data and systematic methods to select and post the advertisements to potential or targeted customers at the right time and the right place. The primary challenge here is how to identify various mapping relationships among advertisers, products, advertising spaces, advertisements and customers in a static and/or dynamic manner. Advertisement targeting over the Internet has two types: *product-oriented targeting*, and customer-oriented targeting. In the *product-oriented targeting*, the basic

task is to identify potential customers for a product advertisement, and deliver it to them based on their subscriptions or memberships. For example, we can increase the success rate of email-based advertisements by conducting a *product-oriented advertising* based on customer profiles, membership databases, or a subscription list. The major task of *the customer-oriented targeting* is to select, deliver, and present the right advertisements to online users with a real time solution. For example, in banner-based advertising, we use the customer-oriented targeting to make sure that the right product advertisements always delivered and posted on the banners of the current access page for an online user.

Why is targeting important for online advertising?

The major purpose of advertisement targeting is to increase the effectiveness of online advertisements by posting the appropriate advertisements for online users in the right place at the right time. The implementation of an effective targeting may bring out:

- A higher access rate for online advertisements.
- A better responding rate in advertising responses and reactions.
- An improved successful rate in product trading and transactions.

How to implement online advertisement targeting on the Web?

Although there is a number of systematic solutions to implement online targeting, they can be classified into two groups: *static approaches* and *dynamic approaches*. *Static approaches* refer to the methods that perform static bindings for targeting based on available static data before posting schedules. Static data includes product profile, advertisement profile, membership information, historical access data, and web page contents. The *content-based targeting method* is a popular static method in which advertisements are delivered and posted in advertising spaces based on the content types of web pages. For example, in this method a banner space of a financial web page always posts advertisements relating to financial programs (or services) no matter which online user is accessing this page. In this case, targeting is done as soon as a banner space schedule for a financial program (or service) advertisement is contracted. With this method, we can reach to all of users who access the same web page in a specific subject.

Dynamic approaches refer to the targeting methods that use real time data to perform dynamic bindings among online users, advertising spaces, advertisements, and products. One example of dynamic methods is known as *user profile-based targeting*. In this approach, online user profiles (such as membership information, subscription data, online survey results) are used to help

dynamic selection and posting of advertisements for a current online user. To implement this, targeting software must access a user profile repository first whenever a new access session begins, then select and post advertisements onto the current access page. This approach is very useful to implement diverse targeting business rules and marketing strategies. For instance, a fur coat advertisement may not be selected and posted to a visitor lived in Los Angeles, because he or she usually does not need a fur coat.

Dynamic targeting also can be implemented based on the real time access behaviors of online users. For instance, we can select and post more related product advertisements for an online user whenever he (or she) clicks an advertisement on the current page. We can implement this by tracking the interactions between users and advertisements. This technique is known *as behavior-based targeting*. Clearly, this method is very useful for crossing sales and packaging sales.

Recently, some intelligent-based methods have been developed to assist online targeting. Iona College's Machine Intelligence Institute [18] is developing fuzzy-set-based intelligent agents to determine which ad to display on a web site based on the characteristics of online users. The approach is useful when several advertisers must compete for one advertising space in the same schedule. Each advertiser may have a set of advertisements for the same advertising space. This method assumes that each web site has a collection of advertising subscribers. Each advertiser can provide an intelligent agent to find out the possible interest of an online visitor and select an advertisement for posting. All agents send their bids for a schedule advertising space. Only the winner gets the chance to post its selected advertisement in the space.

6.4. Performance Measurement for Online Advertising

In general speaking, performance measurement is an effective means for marketing people to help them understand and analyze the effectiveness of performance of posted advertisements. In traditional advertising, performance measurement for advertisements is costly, difficult, and inefficient because it is frequently conducted using various types of marketing surveys. Since surveys are usually carried out in telephones, mails (or emails), and interviews, their results are primitive and static with a very limited coverage. However, performance measurement of online advertisements can be carried out in a systematic manner due to the advantage of online

advertising in global access, dynamic interaction, digital presentation, real-time tracking, as well as measurable reactions and sales [9][10].

What is performance measurement?

Performance measurement for online advertisements refers to the activities and services that use systematic methods and solutions to measure and analyze the effectiveness of their performance. Advertisers want to use performance measurement to find the answers to the following questions.

- Has the ad reached to the right audience?
- Has the ad received expected attention and reaction from viewers?
- Is the ad posted in a right place and displayed at a right schedule?
- Does the ad lead to product sales? How well?
- Does the ad create an expected impact on audience?

Why performance measurement?

The primary purpose is to measure the effectiveness of online advertisements using systematic solutions to help marketing people in the following aspects:

- *Performance evaluation* – The result of performance measurement is able to help them evaluate the effectiveness of online advertisements from different perspectives, including advertisement attraction and visibility scale, viewers' responses and reactions, direct sales, and advertisement impacts.
- *Problem identification* – Based on the evaluation, the causes of the success or failure can be analyzed. The typical problems are inappropriate content, low attraction, incorrect targeting groups, wrong place, and wrong time.
- *Advertising adjustment* – The analysis result of performance measurement provides a very useful reference for updates of online advertisements and adjustments of the underlying advertising strategy.
- *Sales estimation and prediction* – They can use the static and dynamic analysis results of the performance measurement to come out sales estimation and make the future prediction.
- *Market analysis and forecast* – They can use the real-time results of the performance measurement to analyze the current product market, and forecast the future market in a short term and a long term.

What should be measured?

In the performance measurement, The major tasks of performance advertisement is to find the answers to the following questions:

- How many people have received and seen the advertisement? When and where? What is the distribution in terms of marketing customer groups?
- How well does the advertisement stir the interests or draw the attentions from its viewers?
- What kinds of direct and indirect responses and reactions to the advertisement?
- How many direct or indirect sales transactions have received from this advertisement?
- What is the direct and indirect impact on customers in brand name, business reputation, and product sales?

Table 8: Measurable Data for Performance Measurement

| Measurable Data Groups | Performance Measures for Performance Evaluation | Performance Measures for Performance Analysis |
|-------------------------------|---|---|
| Visibility Indicators | <ul style="list-style-type: none"> • Page impression for each Ad space • Ad impression count and display time for each ad space [1] • Ad impression count and display time for each web site • Ad impression count and display time for each group of viewers | <ul style="list-style-type: none"> • Ad visibility comparison between different content pages (or web sites) • Ad visibility comparison between different ad appearances • Ad visibility comparison between different schedules and display time • Ad visibility comparisons among different groups of viewers. |
| Attention Indicators | <ul style="list-style-type: none"> • Ad click rate [1] • Ad click-through rate [1] • Mouse over rate • Ad feedback or interaction rate • Response rate | <ul style="list-style-type: none"> • Comparisons of advertisement attention and reaction between different content pages (or web sites) • Comparisons of advertisement attention and reaction between different schedules and display time • Comparisons of advertisement attention and reaction between different groups of viewers |
| Forcing sale Indicators | <ul style="list-style-type: none"> • Purchase initiation rate • Sale transaction rate • Sale closure rate • Membership registration rate • Product/service registration rate | <ul style="list-style-type: none"> • Comparisons of ad forcing sales between different content pages (or web sites) • Comparisons of ad forcing sales between different schedules and display time • Comparisons of ad forcing sales between different groups of viewers |
| Impact Indicators | Direct impact: <ul style="list-style-type: none"> • All visibility indicators • All attention indicators • All leading sales indicators Post-Impact: <ul style="list-style-type: none"> • Increasing the purchase rate after ad posting • Increasing the popularity after ad posting | <ul style="list-style-type: none"> • Comparisons of ad direct impacts between different content pages (or web sites) • Comparisons of ad direct impact between different posting schedules • Comparisons of ad direct impact between different groups of viewers • Analysis ad post-impact based on different groups of customers |

In online advertising, performance measurement highly depends on the collected performance data from online advertisement tracking. It is conducted based on the tracked raw data and a set

of pre-defined metrics. As shown in Table 8, the measurable performance data for online advertisements can be classified into four classes: visibility indicators, attraction indicators, forcing sale indicators, and impact indicators. Performance evaluation focuses on collecting and processing these indicators, and generates a report about how well an ad perform in terms of visibility, attraction, forcing sales capability, and impact. Using the evaluation results advertisers could conduct a performance analysis to answer the following questions.

- Which ad space (or content page, or web site) delivers the best performance?
- When does the ad receive good attention and reaction from viewers?
- Which advertisement design is best because it has the best visibility and attention from viewers?
- Which group of viewers has a better response to the ad?

In performance analysis, ad performance data are analyzed between different groups of viewers based on their gender, age, income, geometric regions, etc. Moreover, the ad performance data is also analyzed according to its presentations, posting locations, ad spaces, and display schedules.

How to analyze and measure the performance of online advertisements?

To support a performance measurement function, an online advertising service system needs a program (or a server) which processes various advertisement performance data using a set of well-defined metrics for performance evaluation and analysis. There are two ways to run this program. The first is known as *off-line measurement*. In off-line measurement approach, the performance measurement program only runs as standalone software. It is only used after ad posting schedule. It processes the collected ad performance data stored in a repository by a tracking server, and generates various performance evaluation reports and analysis results. The other approach is known as *real-time online measurement*. In this approach, the performance measurement program runs as an online server. It collects the dynamic performance data from an advertisement tracking sever, evaluates and analyzes them based on pre-defined metrics.

7. Conclusion Remarks

Comparing with the traditional advertising, online advertising has many distinct advantages. Although online advertising has been widely accepted and used in today's real world, there are many engineering issues and technical challenges in building cost-effective online advertising systems. This paper presents a comprehensive taxonomy on online advertising, discusses the business models, classifications of online advertisements, engineering processes, as well as the basic concepts and technical solutions in online advertising, including advertisement posting, targeting, tracking, and performance measurements.

Due to the limitations of the current banner-based online advertising [19], people are looking for new online advertising systems and solutions to provide more efficient, effective, and intelligent solutions for online advertising. Business and marketing people are looking for new business models and innovative approaches to set up new businesses and advanced global community environment and infrastructure to support electronic advertising because of the introduction of wireless networking and personal mobile access devices. Business advertisers are expecting new advanced online advertising systems supporting flexible business models, complex marketing logic and rules, real-time management and service for advertisement posting [20], update and replacement over the Internet. New standards are needed for online advertising, such as standards for presenting online multimedia tradeshow.

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