Mobile In-App Advertising Strategies

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By

Vinh Truong

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF EQUATIONS

ABBREVIATIONS AND GLOSSARIES

Ad: promotional component of message material that an advertiser charges or may pay for when a user views the content.

Ad space, or **ad slot**, is the allotted real estate on a website or app where an ad can be placed. Each space on a website or app is unique so several ad spaces may reside on a single page.

Advertiser: sometimes called marketer, the company pays for ad showing or tapping.

App: a programming program or software designed for a function that a person can download on their cell phone or other mobile devices.

Banner ad: a rectangular website and app ad typically designed to divert traffic to a particular address by connecting to the advertiser's domain.

Click: click an ad that brings a person to another location.

Click-through rate (CTR): the ratio of the number of clicks and the number of impressions.

Cost per click (CPC): Also called pay-per-click (PPC). It is an Internet measurement model used to direct visitors to websites where an advertiser pays a search engine (or publisher) when an online client clicks the ad.

Cost per mille (CPM): also known as pay-per-mille (PPM). It is an internet advertising calculation model used to guide visitors to websites where an advertiser pays a search engine (or publisher) whenever an online customer views the advertisement 1000 times.

Demand-side platform (DSP): An integrated advertiser bidding platform to get good impressions at low cost, engaging simultaneously in numerous auctions among various ad exchanges.

Display advertising: convey ads visually through text, icons, animations, images, photographs, or other graphics. Advertisers also target users with unique features to customise ads.

Email advertisement: Email advertising is an ad duplication or part of an email address. Email marketing may not be requested, in which case the sender may allow the recipient to opt out of future emails or with the recipient's prior permission (opt-in).

Expanding ad: An expanding ad is a rich media frame ad that changes dimensions in a predefined situation, such as the predetermined amount of time a visitor spends on a web page when the user clicks on

an ad, or the user's mouse cursor moves through an ad. Expanding advertising encourages advertisers to add small ad space details.

Experimental unit: often it is considered as an object. The user is an app's standard experimental unit. The overall metrics are calculated on each unit up to the average over the whole experiment. While specific metrics can include user-day, user-session, or page views as experimental units.

Factor: A controllable experimental element assumed to affect overall assessment parameters. Factors are given weights, often called Levels or Versions. Factors themselves are called variables. Quick A/B tests have one element of two values: A and B.

Frame ad (traditional banner): the first type of advertising. "Banner Advertising" also refers to traditional frame advertisements.

Floating ad: A floating ad is a form of rich media advertising usually superimposed on the content of the website. After a preset time, floating ads can vanish or become less obtrusive.

Global Positioning System (GPS): is a satellite-based navigation system that allows users to determine their precise location (latitude, longitude, and altitude) anywhere on Earth.

Impression: a consumer ad view on a web page or app. Notice that if the page has more than one ad space, a single page view will provide more than one impression.

Interstitial ad: An interstitial ad appears before a user can access the main content, even when the user is waiting to load the content. Interstitial advertisements are interruptive advertising.

Keyword: a particular word or combination of terms that a searcher can type into a search field. Advertisers can buy keywords to show their website and app content prominently.

Mobile ad: Mobile advertisements are ad copies made available by handheld users, including smartphones or tablets. Mobile advertising may take the form of mobile search ads, mobile website ads mobile application ads, or games ads. It may also take the form factor of static or dynamic display ads, short messages, or interactive ads.

Pop-ups/pop-unders: A pop-up ad is seen in a new window above the original window. A pop-under ad opens a new window under the original window.

Publisher: a person or association that plans, issues, and disseminates public content. Simply, a publisher has space to show advertisements.

Query: a set of words entered by a search engine searcher, starting a search and resulting in a search engine result page (SERP) of organic and paid listings.

Revenue Per Mille (RPM): is a metric used in digital advertising to measure the revenue earned for every 1,000 ad impressions.

Search engine: a software that indexes web pages and then seeks to align user search requests by relevance. Google, Bing, and Baidu are search engine instances.

Real-time bidding (RTB): ad inventory is purchased and sold per impression, via instant programmatic auction, close to financial markets.

Revenue Per Click (RPC): is a metric used in digital advertising to measure the amount of revenue generated each time a user clicks on an advertisement.

Search engine results page (SERP): a page that online users see after accessing the search box. Organic search results are webpage lists that more precisely complement the user's specific search query. Paid results are advertisements that companies have paid to advertise their web pages with specific keywords, so these lists appear as someone performs a search query with such keywords.

Search Engine Optimisation: SEO, aims to boost search rankings in SERPs by growing website content to search words. Search engines often adjust their algorithms to penalise low-quality, rank-fitting pages, making optimisation a moving target for advertisers. Many service vendors offer SEO.

Sponsored search: often called sponsored links that allow the search result pages to contain advertising. This search ad is also sold via real-time bidding.

Supply-side platform (SSP): an integrated publisher platform to sell impressions at an optimal price. It created several auctions for the same impression in various ad exchanges to reach more bidding advertisers.

Text ads: or ads, also called text-based ads, contain either text or hyperlinks.

User: a person with the Internet, World Wide Web and app access and issues ad-hoc topics to communicate his or her knowledge needs, such as searching or browsing.

Webpage: a web presentation of knowledge. Websites consist of web pages, similar to a book's pages.

World Wide Web (www): is a system of interlinked hypertext documents and multimedia content accessed via the internet.

PREFACE

Mobile in-app advertising has emerged as a critical component of the digital marketing landscape, reflecting the rapid growth and ubiquity of mobile applications. As mobile devices become increasingly integral to daily life, the opportunities for reaching consumers through in-app advertisements have expanded significantly. This book provides a comprehensive overview of mobile in-app advertising, with a particular focus on the roles, goals, and factors controlled by all participants in the advertising ecosystem. By examining the interplay between these participants and the factors they control, the book offers an integrated framework for planning and optimising mobile in-app advertising campaigns.

The book also emphasises the crucial role of app publishers, who have traditionally received less attention in advertising campaigns compared to advertisers and ad networks. It delves into the four specific factors controlled by app publishers, including ad space duration, size, position and timing, each of which plays a critical role in determining the effectiveness of mobile in-app advertising. These factors form the basis for integrated strategies that can help publishers maximise their advertising revenue while maintaining a positive user experience.

One of the key contributions of this book is the introduction of a common goal and a unified outcome metric that serves as the indicator for mobile in-app advertising effectiveness both in the short and long term. This metric is designed to align the objectives of all participants in the mobile in-app advertising ecosystem, including app publishers, advertisers, consumers, and ad networks. By focusing on this unified outcome metric, stakeholders can measure the success of their advertising campaigns across different dimensions conveniently, ensuring that all participants are working in the same direction.

By enhancing this metric, stakeholders can achieve better results, benefiting all parties involved. For app publishers, this means optimising their ad placements, formats, and frequency to increase user engagement and maximise revenue. For advertisers, it means delivering ads that resonate with users and drive conversions. For consumers, it means experiencing ads that are relevant and non-intrusive, leading to a more enjoyable app experience. For ad networks, it means efficiently matching ads with the right audiences to maximise engagement and conversions.

The theoretical frameworks, especially the mobile in-app integrated effectiveness one, presented in the book provide a comprehensive guide for understanding the complex dynamics of mobile in-app advertising. It emphasises the importance of considering the roles and goals of all participants in the advertising ecosystem and provides a structured approach for optimising advertising strategies. By incorporating empirical data and real-world case studies, the guideline offers a robust foundation for both academic research and practical application.

While the book makes significant theoretical contributions, it also provides practical guidance for improving mobile in-app advertising strategies. By understanding and applying the integrated effectiveness framework, stakeholders can optimise their approaches to achieve better results, including higher revenues. The book suggests several innovative advertising strategies designed to enhance the effectiveness of mobile in-app advertising, helping stakeholders achieve their goals while maintaining a positive user experience overall.

One of the key practical insights offered by the book is the use of data analytics to track user interactions with ads. By leveraging data analytics, stakeholders can gain valuable insights into how users engage with ads, allowing for continuous optimisation of ad placements and formats. For example, publishers can use A/B testing to experiment with different ad placements and formats, determining which combinations yield the best results. This data-driven approach allows participants to make informed decisions about their advertising strategies, leading to better outcomes for all stakeholders.

A significant aspect of the book is the inclusion of a case study that provides empirical evidence of the effectiveness of the integrated strategies. A notable case study features data from over 15,000 ad impressions and more than 800 ad clicks from thousands of mobile users across more than 160 countries. This case study demonstrates the practical application of the integrated framework and provides valuable insights into how all participants can optimise their advertising strategies to achieve better outcomes. The examples provide actionable insights that can be directly applied in different businesses to enhance advertising effectiveness, making the book a valuable resource for practitioners in the field of mobile in-app advertising.

Overall, this book serves as a valuable resource for anyone involved in mobile in-app advertising, offering both theoretical insights and practical strategies. It emphasises the importance of considering the roles and goals of all participants and provides a framework for enhancing the effectiveness of mobile in-app advertising on a global scale. By focusing

on the integrated advertising effectiveness, the book offers a fresh perspective on this emerging field.

The holistic approach taken by the book ensures that all stakeholders, from advertisers to consumers, benefit from the insights provided. By acknowledging and addressing the unique challenges and objectives of each participant, the book provides a comprehensive guide for optimising advertising strategies. The inclusion of empirical data and real-world case studies adds credibility and practical relevance to the theoretical concepts discussed, making the book a must-read for anyone looking to deepen their understanding and their usage of mobile in-app advertising.

Whether you are an app publisher, advertiser, consumer, or ad network, the insights provided in this book can help you navigate the complexities of mobile in-app advertising and achieve your goals more effectively. It also offers a roadmap for creating a more effective and balanced mobile in-app advertising ecosystem. Through this approach, all participants can work together to enhance the overall effectiveness of mobile in-app advertising, leading to better outcomes for everyone involved.

Keywords: mobile in-app advertising, programmatic advertising, effectiveness framework, advertising factors, ad clicks, ad space, advertisements, integrated strategy

CHAPTER 1

INTRODUCTION

Mobile in-app advertising has undergone a remarkable transformation since its inception, evolving from simple, rudimentary banner ads into a sophisticated and integral component of digital marketing strategies. Despite its relatively recent emergence, this form of advertising has significantly reshaped the digital landscape, establishing a ubiquitous presence across mobile devices worldwide. The progression from basic, repurposed advertisements to today's advanced, personalised formats underscores the dynamic and adaptive nature of mobile in-app advertising, effectively meeting the evolving needs of both advertisers and consumers. This success is deeply rooted in the foundational principles of earlier online advertising strategies, which paved the way for the development and refinement of this powerful marketing medium.

At its core, mobile in-app advertising encompasses ads and programmatic ad campaigns that are specifically tailored for mobile application environments. To fully comprehend the complexities and effectiveness of this advertising approach, it is important to first explore the broader concepts that underpin it: online advertising, programmatic advertising, and mobile advertising. These fundamental elements collectively provide the necessary context and framework for understanding how in-app advertising on mobile platforms has emerged as a highly targeted and efficient method for engaging consumers.

This chapter, therefore, is structured into three comprehensive sections that delve into these foundational concepts. The first section examines the history and evolution of online advertising, tracing its development and impact on the digital marketing sphere. The second section explores programmatic advertising, discussing its mechanisms and its pivotal role in modern digital marketing by enabling automated, data-driven ad buying and placement. The final section focuses on mobile advertising, highlighting its unique characteristics, advantages, and the importance of optimising ad formats to enhance user experience within mobile contexts.

1.1 Online Advertising

Advertisements, often referred to as ads, are a fundamental aspect of marketing and communication. The core objective of advertisements, as defined by Richards and Curran (2002), is to prompt a behavioural change or decision-making action from the audience. This definition underscores the primary purpose of ads: to influence the public to take action, either immediately or shortly. This can range from purchasing a product, subscribing to a service, or even changing an opinion or behaviour.

The nature of advertising is inherently commercial, as it is usually paid for by a known source, whether an individual, a company, or an organisation (Kotler 2017). The paid aspect is crucial as it distinguishes advertisements from other forms of communication that might not have a direct financial intent, such as public service announcements or informational messages. Advertising is also versatile, capable of being transmitted through various media.

In the past, advertising was primarily disseminated through print media, radio, and television. These channels offered broad reach but were limited in terms of targeting and interactivity. However, traditional advertising has many drawbacks as shown in Figure 1. The figure is divided into five segments, each representing a specific obstacle, with corresponding percentages indicating the relative severity of each issue.
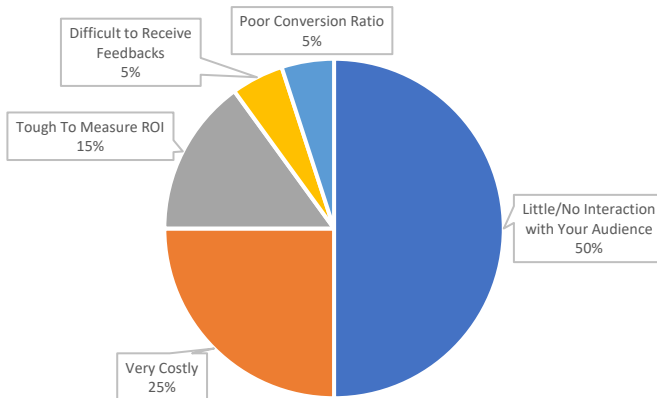
Fig. 1 Drawbacks of traditional advertising (Lui 2021)

The largest segment, occupying 50% of the chart, highlights the challenge of "Little/No Interaction with Your Audience." This suggests that a significant portion of traditional advertising efforts fail to effectively engage consumers, leading to low levels of interaction and limited impact. The second-largest segment, at 25%, is labelled "Very Costly." This indicates that traditional advertising can be a substantial financial investment, particularly for businesses with limited budgets. The high cost associated with advertising can make it difficult to achieve a positive return on investment (ROI).

"Tough to Measure ROI" is the next challenge identified, accounting for 15% of the chart. This reflects the difficulty in accurately tracking and quantifying the results of traditional advertising campaigns. The lack of clear measurement metrics can make it challenging to assess the effectiveness of advertising efforts and make informed decisions about future investments. The remaining two segments, "Difficult to Poor Conversion Ratio" and "Feedback," each represent 5% of the pie chart. These challenges highlight the difficulties in converting website visitors into paying customers and the importance of obtaining feedback from customers to improve advertising strategies.

Figure 1 effectively summarizes the major obstacles faced by businesses in the realm of traditional advertising. With the advent of the internet, the scope and capabilities of advertising expanded dramatically. Online platforms introduced new possibilities for reaching audiences in more personalised and interactive ways. This shift from traditional to digital media has been one of the most significant transformations in the advertising industry, leading to the rise of advertising over the Internet as a new dominant force.

The history of advertising over the Internet can be traced back to May 3, 1978, when Gary Thuerk, a marketing manager at Digital Equipment Corporation (DEC), sent the first unsolicited mass email, often referred to as the first online advertisement (Hedley 2006). This email was sent to around 400 users on the West Coast of the United States, inviting them to attend a product demonstration for DEC. While Thuerk's email is considered a pioneering effort in digital marketing, it was met with mixed reactions.

The email campaign led to a significant backlash, with many recipients expressing irritation at receiving unsolicited messages. Thuerk's initiative laid the groundwork for what would later become known as spam, highlighting the challenges and ethical considerations associated with online advertising. Despite the negative reactions, this event marked the

beginning of advertising over the internet, demonstrating the potential of the internet as a new medium for reaching consumers.

On the mass scale, online advertising also has its roots in the early days of the Internet, with the first banner ad appearing in 1994 (Cho 2003). This marked the beginning of a new era in display advertising, as businesses quickly recognised the potential of the Internet as a platform for reaching large audiences. Early online display ads were primarily static images or simple text-based banners, which were often disruptive and poorly integrated into the user experience. However, these ads laid the groundwork for more sophisticated forms of digital advertising.

The early days of online advertising were, therefore, characterized by experimentation and learning. As more businesses recognised the potential of the Internet for reaching large audiences, the number of online ads grew rapidly. However, these initial attempts were often met with resistance from users who were unaccustomed to receiving unsolicited commercial messages in their digital spaces.

Despite these challenges, the online advertising industry continued to grow. The internet's ability to deliver content instantly to a global audience, combined with its interactive capabilities, made it an attractive platform for advertisers. Over time, advancements in technology and the development of more sophisticated advertising techniques helped to overcome some of the early resistance, leading to a gradual acceptance of online ads by users.

By the second decade of the 21st century, online advertising had evolved into a multi-billion-dollar industry, with companies like Google and Facebook leading the charge. The business models of these tech giants are heavily reliant on advertising revenue, demonstrating the significant economic impact of online advertising. For instance, according to Statista (2018), the U.S. online advertising market alone generated $107 billion in revenue in 2018, marking an 18% increase from the previous year.

This explosive growth in online advertising revenue is a testament to the effectiveness and efficiency of digital marketing strategies. Unlike traditional advertising methods, which often require substantial investment for broad, untargeted reach, online advertising allows for highly targeted campaigns that can reach specific audiences based on demographics, behaviour, and interests. This level of precision has made online advertising an essential tool for businesses looking to maximise their marketing efforts.

As the internet evolved, so did online advertising. The introduction of search engines and the development of search engine marketing (SEM) and search engine optimisation (SEO) allowed advertisers to target users

based on their search queries. This was a significant advancement, as it enabled more relevant and personalised advertising. The rise of social media further transformed online advertising by providing platforms where businesses could engage with users in more interactive and meaningful ways.

The commercial intent of advertising is gradually becoming a defining feature that shapes its content, format, and distribution. Advertisers aim to reach a specific audience with a carefully crafted message designed to evoke a particular response. The mediums through which these messages are delivered have evolved significantly over time, adapting to technological advancements and changes in consumer behaviour.

Figure 2 presents a clear visual representation of the shift in advertising spending from traditional to digital channels. The chart, spanning the years 2017 to 2024, shows a steady increase in digital advertising spending while traditional advertising has remained relatively stagnant.

One of the most striking trends revealed in the figure is the rapid growth of digital advertising. The lower segment representing digital spending consistently increases over the years, reaching nearly two-thirds of the total ad spending by 2024. This indicates a significant preference for digital platforms among advertisers.

In contrast, the upper segment representing traditional advertising remains relatively flat. While there are minor fluctuations, the overall trend suggests a decline in the popularity of traditional advertising channels such as print, radio, and television over time.
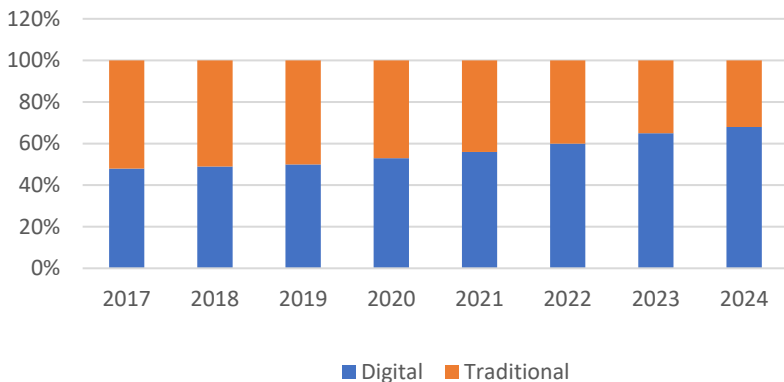
Fig. 2 Digital and traditional advertising spending (Buchholz 2020)

The data presented in the figure highlights the increasing effectiveness and efficiency of digital advertising. The ability to target specific audiences, track performance, and make real-time adjustments has made digital advertising a more attractive option for businesses.

Figure 2 provides a compelling visual narrative of the ongoing shift from traditional to digital advertising. The data clearly demonstrates the growing dominance of digital channels and the declining popularity of traditional advertising. As technology continues to advance, digital advertising with its variants will likely play an even more prominent role in the future of marketing and communication.

Display advertising

Display advertising is characterized by its flexibility in formats, which can include banners, videos, animations, and interactive ads (Choi et al. 2017). Unlike search ads, which are text-based and limited in format, display ads can be visually rich and engaging, making them suitable for a wide range of creative executions.

Display ads are typically placed on websites, social media platforms, and mobile apps, where they can be seen by users as they browse content. These ads can be static or dynamic, with some incorporating multimedia elements such as video clips, sound, and animations to capture the user's attention. The versatility of display ads allows advertisers to create more immersive and interactive experiences, which can lead to higher engagement rates.

The Cost Per Mille (CPM) pricing model is commonly used in display advertising. Mille, meaning thousand, refers to the cost per thousand impressions, where advertisers pay for every thousand times their ad is displayed, regardless of whether it is clicked (Rosenkrans and Myers 2012). This model is often used for brand awareness campaigns, where the goal is to maximise visibility rather than direct engagement.

Display advertising has traditionally been supported by web publishers who provide free content or services to users, with the revenue generated from ads covering the operational costs. This model has been successful in sustaining a wide range of online services, from news websites to social media platforms, making display advertising one of the most prevalent forms of online advertising (Goldfarb and Tucker 2011).

Rich media ads represent an evolution in display advertising, offering more interactive and engaging experiences. These ads can include elements such as video, audio, and interactive features that encourage user interaction (Lipsman et al. 2012). The use of rich media has been shown to

increase engagement rates and improve brand recall, making it a popular choice for advertisers looking to create impactful campaigns.

The late 1990s saw significant developments in online advertising, particularly with the introduction of interstitial ads. Interstitial ads are full-page ads that appear before the user reaches their desired content, offering a high-impact format that captures the user's attention (Moe & Trusov, 2011). These ads are often used on sports and entertainment websites, where they can deliver rich, immersive experiences.

Search advertising

Search advertising, also known as sponsored search advertising, is a type of online advertising where ads are displayed alongside search engine results based on user queries (De Corniere 2016). This form of advertising is driven by user behaviour, as the ads are triggered by specific keywords entered by users in the search engine. The query terms entered by the user provide valuable context, allowing advertisers to target their ads more effectively (Bayer et al. 2020).

One of the defining features of search advertising is its reliance on the user's intent, as expressed through their search query. This explicit intent makes search advertising highly effective, as it ensures that the ads are relevant to what the user is looking for. Search engines use complex algorithms to analyse the user's query, browsing history, and other data points to deliver the most relevant ads.

Keywords play a central role in search advertising. They are the terms or phrases that users enter into the search engine, and advertisers bid on these keywords to have their ads displayed alongside the search results. The effectiveness of search advertising is largely dependent on the accuracy and relevance of the keywords chosen by advertisers.

Search Engine Results Pages (SERPs) typically display two types of listings: organic and paid. Organic listings are non-paid search results that appear based on the relevance and quality of the content, while paid listings are advertisements that appear based on the advertiser's bid for specific keywords. The placement of these ads on the SERP is determined by a combination of factors, including the bid amount, ad relevance, and the quality score assigned by the search engine.

In search advertising, the Cost Per Click (CPC) model is commonly used, where advertisers pay only when a user clicks on their ad (Ren et al. 2018). This performance-based pricing model ensures that advertisers are charged only when their ad generates tangible engagement, making it a cost-effective option for many businesses.

The Generalized Second Price (GSP) auction is another important aspect of search advertising. In this auction model, advertisers bid for ad placements, but the winner is charged based on the second-highest bid, adjusted by their quality score. This system incentivizes advertisers to improve the quality of their ads, as a higher quality score can reduce the cost per click and improve the ad's position on the SERP (Qi et al. 2020).

Current strategies

Personalisation is a key factor in the effectiveness of online advertising. By tailoring ads to the preferences, behaviours, and demographics of individual users, advertisers can create more relevant and engaging content. Personalisation enhances the user experience, leading to higher levels of satisfaction and engagement, which in turn improves the performance of advertising campaigns.

The ability to deliver personalised ads is made possible by advances in data processing and machine learning, which allow advertisers to analyse vast amounts of user data and generate insights that inform ad targeting. This approach contrasts with traditional advertising methods, which often rely on broad demographic categories and general audience characteristics. By leveraging personalisation, online advertisers can deliver highly relevant ads that resonate with users on a personal level.

Targeted advertising is an important strategy within the realm of personalisation. Targeted advertising involves delivering ads to specific user segments based on criteria such as age, gender, location, and browsing history. This method ensures that the ads are relevant to the interests and needs of the target audience, increasing the likelihood of engagement.

Contextual advertising strategy, on the other hand, focuses on the context in which the ad is displayed. This strategy involves placing ads in environments that are relevant to the ad's content, such as displaying a sports-related ad on a sports news website. Contextual advertising enhances the relevance of the ad by aligning it with the content that the user is already interested in, leading to higher engagement rates.

Contextual advertising, as previously discussed, leverages the content of the web page to deliver relevant ads. This technique was first introduced in 1998 and has since become a cornerstone of online advertising (H. Lee and Cho 2020). Contextual ads enhance the relevance of the message by aligning it with the content that the user is actively engaging with, improving the overall effectiveness of the ad campaign.

Advanced targeting techniques, such as behavioural targeting and programmatic advertising, have further enhanced the effectiveness of online advertising. Behavioural targeting uses data on user behaviour, such as browsing history and past purchases, to deliver highly relevant ads. Programmatic advertising, on the other hand, uses automated systems to buy and place ads in real-time, optimising the ad placement based on various factors such as user demographics, context, and bidding strategies.

Current challenges

Despite the significant advancements in online advertising, several challenges remain. The interdisciplinary nature of online advertising requires continuous collaboration between fields such as computer science, economics, and marketing to develop effective strategies. One of the key challenges is the integration of these diverse fields to create cohesive advertising strategies that deliver measurable results.

For example, re-targeting models that follow users across the web can be seen as invasive, leading to privacy concerns and potential backlash from users. To address these concerns, advertisers must strike a balance between personalisation and privacy, ensuring that their strategies are both effective and ethical.

The future of online advertising lies in ongoing research and innovation. As technology continues to evolve, new opportunities will emerge for advertisers to reach their audiences in more effective and engaging ways. Areas such as artificial intelligence, machine learning, and data analytics will play a crucial role in shaping the future of online advertising, enabling more sophisticated targeting, personalisation, and optimisation techniques.

The most pressing challenge, however, is that advertisers had to negotiate directly with individual website owners, a process that was both time-consuming and fragmented. This made it difficult to manage large-scale campaigns, particularly as the number of websites proliferated. There is also a need to better measure the effectiveness of their campaigns and optimise their strategies in real time.

1.2 Programmatic Advertising

The evolution of online advertising has been marked by significant milestones, each of which has contributed to the industry's current complexity and efficiency. The next development in this journey was the introduction of ad networks in 1997. Ad networks were designed to solve

a critical problem facing advertisers at the time: the difficulty of reaching audiences across multiple websites simultaneously. Before ad networks, advertisers had to negotiate individually with each website to place their ads, a process that was both time-consuming and inefficient.

Ad networks changed this by acting as intermediaries between advertisers and websites (also known as publishers). By aggregating ad inventory from various publishers, ad networks provided advertisers with the scale they were accustomed to from traditional media channels like television. This allowed for more widespread reach and simplified the ad-buying process, making online advertising more accessible and effective.

Ad networks

One of the pioneering companies in the ad network space was Oingo, Inc., founded by Adam Weissman and Gilad Elbaz (Ungureanu and Popescu 2022). They developed a proprietary search algorithm based on a comprehensive lexicon called WordNet. This algorithm allowed advertisers to target ads more effectively by matching them with relevant web content. In April 2003, Google acquired Oingo and rebranded it as AdSense, a system that would become one of the most influential platforms in online advertising (Srinivasan 2020).

Following the success of AdSense, other major platforms emerged, including Yahoo Publish Network, Microsoft adCenter, and Advertising.com Sponsored Listings.(Liu-Thompkins 2019) These platforms expanded the capabilities of ad networks to include a diverse range of media, such as video, audio, and web information networks. This expansion allowed publishers to monetize not only their websites but also other forms of digital content, such as video clips and mobile apps.

A significant shift in online advertising occurred on February 21, 1998, when GoTo.com launched a sponsored search business model (Jacksi and Abass 2019). This model represented a departure from the traditional method of ranking websites based solely on their relevance to a user's search query. Instead, GoTo.com ranked websites based on how much advertisers were willing to pay for better positioning in search results. This real-time bidding model prioritised advertisers who offered higher per-click payments, ensuring that their ads appeared more prominently.

This cost-per-click (CPC) model was revolutionary because it allowed advertisers to target their ads more precisely and pay only when users clicked on them. The CPC model quickly gained traction, and by the early 2000s, it had become a standard in the industry. However, the initial implementation of this model was not without its flaws. The GoTo auction

model, known as a general first-price auction (GFP), had several drawbacks. One of the most significant issues was that advertisers who responded quickly to competitors' bids could gain an unfair advantage, leading to inefficient investments and unpredictable pricing.

To address these issues, Google launched its AdWords platform in February 2002 (Mitti 2018). AdWords introduced several key innovations that improved upon the GoTo model. One of the most important changes was the transition from a print-based cost-per-mille (CPM) model, where advertisers paid per thousand impressions, to a CPC model, which was more performance-oriented. Additionally, Google implemented a generalized second-price (GSP) auction system, which considered both the bid amount and the ad's click-through rate (CTR) when determining ad rankings. This approach ensured a fairer and more effective allocation of ad spaces, benefiting both advertisers and users.

While ad networks brought significant advancements to online advertising, they also had limitations. One of the main issues was the presence of multiple intermediaries between publishers and advertisers. These intermediaries often led to inefficiencies, as advertisers had to choose the best network for purchasing ad inventory from a wide array of options. This complexity made it difficult for advertisers to optimise their campaigns and achieve the best possible outcomes.

Ad exchanges

In response to these challenges, the industry saw the introduction of ad exchanges. Ad exchanges were designed as centralized marketplaces where advertisers could buy and sell ad inventory from various ad networks in a more streamlined and efficient manner. Major acquisitions in 2007, such as Yahoo's purchase of Right Media, Google's acquisition of DoubleClick, and Microsoft's acquisition of AdECN, consolidated large pools of ad inventory (Mansour, Muthukrishnan, and Nisan 2012). These acquisitions significantly enhanced the transaction experience by providing advertisers with access to a broader range of ad placements and more precise targeting options.

Ad exchanges also allowed advertisers to plan their strategies, set goals, and monitor performance across multiple networks, all from a single platform. This centralization maximised revenue with minimal manual intervention and simplified the advertising process. By combining multiple ad networks, ad exchanges facilitated better alignment between customer demand and supply, making online advertising more efficient and effective.

The advent of ad exchanges paved the way for one of the most significant developments in online advertising: real-time bidding (RTB). RTB revolutionised the industry by allowing advertisers to bid on individual ad impressions in real-time (Wang and Yuan 2015). This development made the ad-buying process more efficient, data-driven, and precise, as advertisers could now target specific user profiles and backgrounds with unparalleled accuracy.

Before RTB, advertisers faced significant challenges when buying ad inventory from multiple exchanges, each with its own system. These challenges led to inefficiencies, as advertisers had to navigate different platforms, often resulting in limited campaign reach and suboptimal performance. RTB addressed these issues by creating a unified platform where advertisers could bid on ad impressions across multiple exchanges simultaneously. This real-time approach enabled advertisers to make more informed decisions, resulting in better-targeted ads and higher returns on investment.

Real-time bidding (RTB) is a cornerstone of programmatic advertising. It allows advertisers to bid on individual ad impressions as they become available, ensuring that their ads are displayed to the most relevant audience. This process occurs in milliseconds, enabling advertisers to reach users in real time with ads that are tailored to their current activity or context.

RTB has had a profound impact on the advertising industry, as it has significantly increased the efficiency of ad placements. Advertisers no longer need to negotiate directly with publishers, as the bidding process is automated and occurs in real time. This has led to a more dynamic and competitive advertising landscape, where ad impressions are allocated based on their value to advertisers.

The ability to target users with such precision has made RTB an essential tool for mobile in-app advertising. By leveraging the data available through mobile devices, advertisers can bid on impressions that are most likely to result in engagement or conversion. This has led to more effective and efficient ad campaigns, as advertisers can optimise their spending by focusing on the most valuable impressions.

The emergence of demand-side platforms (DSPs) and supply-side platforms (SSPs) further streamlined the RTB process. DSPs allowed advertisers to purchase ad inventory from multiple exchanges through a single interface, while SSPs enabled publishers to manage and sell their ad inventory more effectively. Together, these platforms made programmatic advertising possible, where ads are bought and sold automatically using complex algorithms and data analysis.

Figure 3 offers a comprehensive overview of the growth and evolution of programmatic digital display ad spending in the United States from 2018 to 2024. The visual representation, using a combination of bar graphs and line charts, effectively highlights key trends and patterns within the industry.
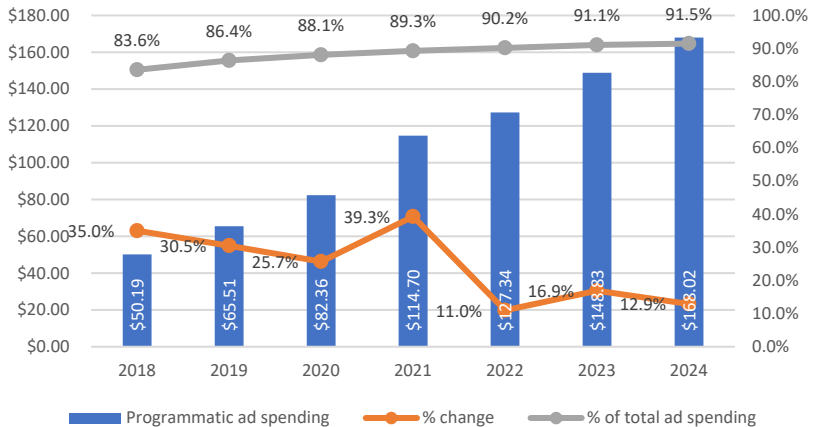
Fig. 3 Programmatic advertising spending (Mitchell-Wolf 2023)

One of the most striking observations is the consistent and substantial increase in programmatic digital display ad spending over the six years. The bar graph, representing the spending in billions of dollars, clearly demonstrates a steady upward trajectory. This growth is further emphasised by the accompanying line chart, which shows the percentage change in spending year over year.

Another notable trend is the increasing dominance of programmatic digital display ads within the overall digital display ad market. The line chart illustrating the percentage of total digital display ad spending attributed to programmatic channels reveals a steady upward climb, reaching a significant portion in 2024. This indicates a growing preference for programmatic advertising among advertisers and publishers alike.

The figure also provides insights into the factors driving this growth. The note accompanying the visualisation clarifies that programmatic advertising encompasses a wide range of ad formats and delivery methods, including native ads and social media advertising. This versatility has likely contributed to its popularity and adoption.

Apparently, Figure 3 presented a compelling visual narrative of the US programmatic digital display ad market. The data clearly demonstrates a sustained period of growth, driven by factors such as increased adoption and the versatility of programmatic advertising. As the industry continues to evolve, it will be interesting to observe how these trends shape the future of digital advertising.

Current strategies

Programmatic advertising has revolutionised the digital advertising industry by automating the buying and selling of ad inventory. This process involves real-time bidding (RTB), where advertisers bid on ad impressions in real-time, and the highest bidder wins the opportunity to display their ad. This automation makes ad placements more efficient and cost-effective, as it eliminates the need for manual negotiations between advertisers and publishers.

The key components of programmatic advertising include demand-side platforms (DSPs), supply-side platforms (SSPs), and ad exchanges. DSPs allow advertisers to manage and optimise their ad campaigns across multiple publishers, while SSPs enable publishers to maximise the value of their ad inventory. Ad exchanges serve as the marketplace where these transactions occur, facilitating the real-time bidding process.

Programmatic advertising operates within a complex ecosystem that involves various intermediaries, each playing a crucial role in the ad-buying process. These intermediaries, such as DSPs, SSPs, and ad exchanges, are compensated based on the number of impressions and clicks generated by the ads they facilitate. This compensation model ensures that all parties involved in the ecosystem are incentivized to deliver effective and relevant ads to consumers.

Programmatic advertising's ability to deliver highly personalised and relevant ads has been a game-changer for the industry. By using advanced algorithms and machine learning, advertisers can analyse vast amounts of data to identify the most effective ad placements for their target audience. This level of precision and efficiency is essential for the success of digital advertising.

Personalisation and relevance are key drivers of success in programmatic advertising. By analysing user data, advertisers can deliver ads that are tailored to the individual's preferences, behaviour, and context. This level of personalisation is achieved through the use of advanced algorithms and machine learning, which enable advertisers to identify patterns and trends in user data.