

**ADS IN MOBILE APPLICATIONS**

by

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## ABSTRACT OF THE THESIS

Ads in Mobile Applications

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The usage of mobile applications has increased phenomenally with the growth of smart phones. According to Apple, as of Feb 2012, close to 800,000 third party applications were available on the App Store. They have been downloaded more than 15 billion times. The android platform is close behind with 450,000 apps in Google Play that have been downloaded more than 10 billion times.

When we look at Advertising revenues from mobile phones (app and browser included), in-app mobile Ads account for only a fraction of the total. IDC estimates 70% of Mobile Ad budgets are spent on search based advertising. The rest is a combination of placements in applications and content on the web. Compared to the application usage statistics for popular platforms, the revenue generated through Ads using these apps as the medium has just not kept pace. The numbers point to a lot of scope for growth. Moreover, with more and more apps becoming free to download, these Ads are here to stay. What makes in-app mobile Ads even more interesting is their potential to deliver highly targeted Ads.

In this paper, we study Ads in mobile applications. We limit the scope of our study to in-app mobile Ads, that appear anywhere within a mobile application when it is being used. This could be in the form of text, rich media or banner.

Our purpose is to understand how Ads in mobile apps work and how they can be used by advertisers to engage audiences with targeted Ads. To this end, we run Ad campaign experiments in select countries in Asia and North America. Through these experiments; we aim to study the factors affecting the performance of Ad campaigns and inferences that can be made from data obtained through the campaigning process.

## **Acknowledgements**

I sincerely thank Prof Muthu, for inspiring me to start and guiding me to finish this project.

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## **Introduction**

### **1. Background**

Mobile as a medium for advertising is steadily growing in importance (ref [1]). Advertisers have opportunities to reach users in ways not possible in traditional media (print, TV) or even other digital media like desktop browsers.

There are several reasons why advertising on the mobile platform can be a very attractive option.

Firstly, a mobile phone is usually associated with one person. Unlike a desktop computer, where there is ambiguity about exclusive usage, advertisers can be fairly certain that Ads on a particular mobile device will be viewed by a specific individual.

Secondly, it's a device that is almost always with users. If A goes to a mall for shopping, her mobile phone is most likely with her. Assuming highly granular location data is available; Ads can be very local and thus highly targeted. A can be shown Ads for a sale going on for some brand available in the mall.

Thirdly, in emerging markets, for a vast majority, the mobile phone is the only electronic communication device that is powered up and ready to use most of the time. Power infrastructure is often poor. Power blackouts by rotation are common and at any given time only 60 to 80% of a city may be receiving power supply. TV ads may not reach about 30% of the audience at any given time. Mobile ads can reach their audience almost all the time.

Finally, with the advent of 3G, which is 'key to the success of mobile internet', advertisers have more opportunity to engage with mobile users (through browsers and

applications) now than ever before. To quote some numbers, mobile phones account for 10% of website hits. In the US, 25% of mobile web users are mobile only, rarely using a desktop computer. The number of application downloads from Apple app store has crossed 15 billion. In short, mobile devices are increasingly becoming the preferred medium for consuming information and entertainment.

This is an exciting time for the industry and also for academic research in the area.

We present an overview of the different types of mobile Ads and take a detailed look at in-app mobile Ads.

Note that when we talk about mobile phones, we mean phones that can run third party applications and have internet connectivity through wi-fi or 3G.

A mobile phone offers advertisers several ways to engage with users. We list the most widely used ones here (ref [4]):

a) Mobile browser

- i) Web content – Any mobile or regular web site that can be displayed on the mobile browser.
- ii) Search – Any banner, text or location enabled Ad that appears along with search results.



1.1 Web content Ad

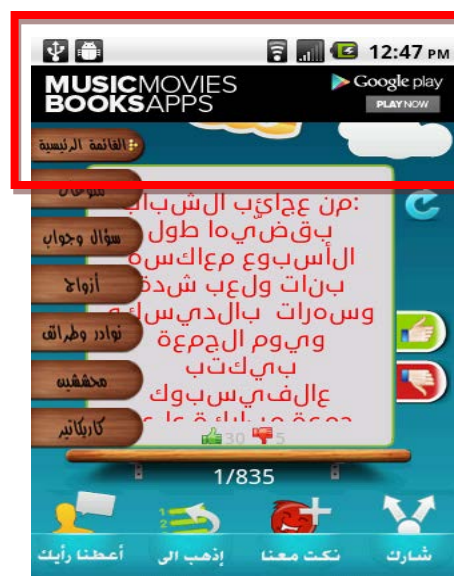
1.2 Search based Ad

b) Mobile applications

- i) Banner or click-to-action Ads in mobile apps – Plain text or rich media Ads that appear in any part of the application screen.
- ii) Interstitials and brand promotions within games- Interstitials typically appear before an application/game loads and typically between different levels of a game.



1.3 Interstitial



1.4 Banner Ad

### c) SMS/ MMS

These are text or multimedia messages sent to the users' phone. Such campaigns usually involve the phone's service provider. The user is given an opt-in/out option by the service provider. If a user opts-in, Ads from partner agencies are sent as SMS or MMS by the service provider.

Note that this is a totally different advertising model. This is not dynamic Ad placement and refresh of internet connected phones. Such campaigns don't need any internet connection. They also tend to have a much higher CTR and targeting as the users provide demographic information on sign-up.

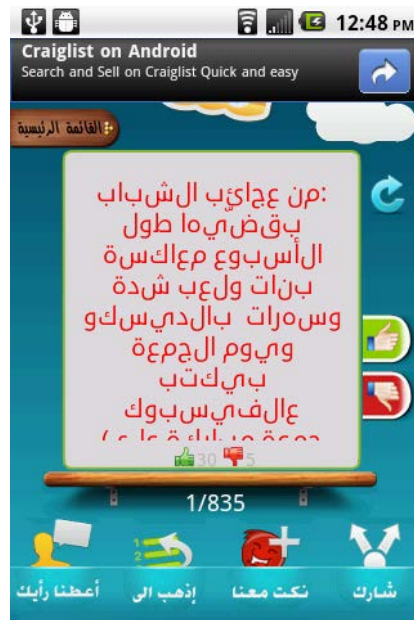
However, such campaigns usually involve a high starting budget. Service providers usually only engage with large advertisers with long running campaigns.

In this thesis, our focus is on 2.a) – Ads in mobile apps. We discuss two ways to classify Ads in mobile apps; based on call to action and based on Ad type. A few examples are explained through screen shots in each type (ref [8])

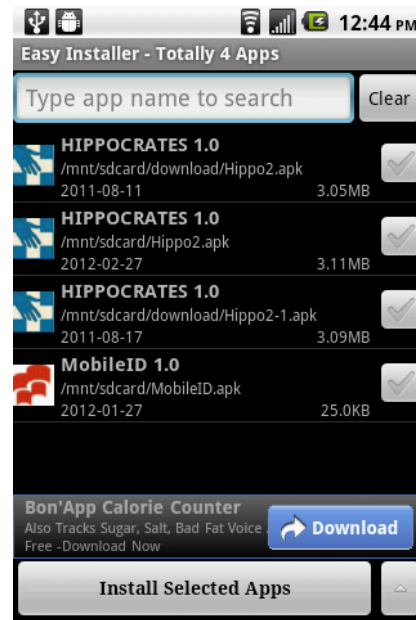
a) Based on even taking place on Ad click - Call to action.

A few popular types:

- Click to open URL in browser
- Click to call
- Click to open location in map
- Click to download app
- Click to video



1.5 Click to open URL



1.6 Click to download app





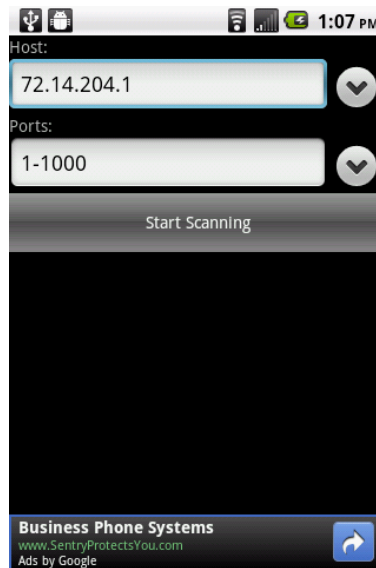
1.7 Click to open location in Map.



1.8 Click to call.

## b) Display and graphics

- Graphical banner Ads
- Text Ads
- Image Ads



1.9 Text Ad



1.10 Image Ad



1.11 Banner Ad

The classification is not strict. There are search based Ads that point to a download link when an app is searched. Some search based applications also display keyword based Ads, similar to browser search (Ref [6]).

In several respects, Ads in mobile apps are similar to browser based Ads. They also involve Advertisers, publishers and exchanges (explained further in II). They can be geographically and demographically targeted. These ad campaigns have the same metric as browser based Ads – Impressions, Clicks and click through rate (ref glossary).

However, there are some fundamental differences between browser based and application based Ads.

- a) Browser based Ads don't get refreshed until the web page is refreshed.

For Ads to refresh independently of page refresh, the website must use advanced technologies like AJAX. In contrast, mobile applications, by their very nature accommodate several different views in the same UI screen. These views can connect to the internet and refresh independently of the others.

This gives an important advantage to applications as a medium. The Ads in mobile apps can be refreshed more often than browser based Ads. This implies that applications display Ads at a higher rate than browsers. While display rate is a significant advantage, the display time gets reduced as the display rate increases. Mobile applications seldom display an ad for more than 15 s. The avg user engagement of a web page is around 30 s, which gives more opportunity for an Advertiser to engage with a user.

- b) A mobile application, because it uses the platform API, has greater access to the resources and information in the mobile phone. For instance, a mobile application can access the unique device identifier (IMEI) through code. It can also use the phone's built-in GPS for highly accurate location information. This kind of information, if available to advertisers via SDK, can have a huge impact on Ad

targeting. How much of sensitive device information and user location should be made available to Advertisers is a contentious issue. We will not discuss it in detail here. Interested readers would find reference (ref [5]) a helpful article.

It is still worth noting that application based Ads have a much greater potential for precise targeting than browser based Ads that have to rely on complex device fingerprinting techniques and IP based location information.

Taking a closer look at these differences helps us appreciate the unique sets of challenges and opportunity that mobile apps bring for Advertisers and publishers.

## 2. Problem description

This work was done to answer the following questions:

- a. How do Ads in mobile apps work?
- b. How users are targeted using mobile Ads?
- c. What can advertisers learn from Ad campaigns?

Therefore, the problem being addressed here is:

How to develop strategies for understanding in-app mobile Ads and the factors that influence the success of such campaigns?

Our approach to solve this problem:

Conducting Ad campaign experiments to analyze the effects of varying campaign parameters on performance.

### 3. Related work

Much of the work on mobile advertisements is based on statistical analysis of surveys. (Ref [2]) tests the drivers of consumer acceptance of mobile advertising. They first form a set of hypothesis and then test the hypothesis through statistical analysis of empirical data. While this is pertinent, the purpose and research methods of this paper are significantly different from ours. We make several references to MMA's (mobile marketing association) guidelines and overview papers on mobile advertising. These documents give a detailed description of the entire mobile advertising landscape. While we did describe the context of our work in this chapter, readers are advised to read [4] and [8] for a thorough introduction to mobile advertising.

The technical details of Ad placement in mobile apps have much in common with browser based Ads. The Ad Exchanges paper (ref [2]) discusses these details as an introduction. We refer to it in the second chapter. The paper proceeds to discuss research problems in Ad auction, which is beyond the scope of this work.

Summarily, the literature in this area is either standard work by organizations like MMA or survey based papers like [3], [7] etc. Apart from these and some of the reports or articles in popular media that are noteworthy, there is a dearth of material about app based Ads. A lot of exciting work is underway in traditional display advertising. Automatic browser profile generation, Ad collection and correlation with profiles is a new exciting area of research. Such a framework for analyzing application based mobile Ads does not exist as yet. Our work is one step towards developing a strategy for understanding and analyzing application based mobile advertising.

#### 4. Report organization

This report is organized into three chapters: Introduction, Technical details and campaign experiments. Chapter II discusses the technical details of Ad placement, refresh and reporting. Part 1 gives an overview of the business, with details about different ways the involved party's partner with each other. Part 2 has detailed description about every aspect of the technical process behind Ad display – registration, display and delivery, reporting. In part 3, we make observations about our findings from the technical study. Chapter III is about campaign experiments. Each campaign is described briefly, with an overview of campaign performance data. This is followed by our observations from the data. We also cross analyze campaigns to aggregate data and derive trends. The report finishes with the concluding chapter where we talk about our future directions.

### **How do Ads in mobile apps work?**

1. The business of Ads in mobile apps.

Ads on mobile apps follow the same interaction patterns as any traditional browser based advertising. On the one hand are a huge number of Advertisers who want to reach the users of mobile applications.

On the other hand are the thousands of mobile applications that are being developed, published and consumed at an unprecedented rate.

More precisely –

- Publishers – Create mobile applications and release them in the marketplace (Google play for android and the app store for iPhone).

They want to make a portion of their screen space available for displaying Ads to earn as much revenue as possible while incurring minimum overhead.

- Ad audience – Users of these applications. They are the consumers of services offered by these applications e.g.: social networking, entertainment through gaming, location based utilities etc. They want minimum distraction while they are using an application or game.

- Advertisers – want to reach the users of mobile applications through relevant Ads while spending the minimum amount of money.

The somewhat conflicting goals of these three parties and how they balance the system is an interesting study in itself. For instance, users would prefer using applications that don't host Ads at all. But such apps tend to be paid. The only means of revenue for freely

available applications is Ads. For publishers, usually hosting Ads is not a lot of overhead (extra lines of code, final application size). However, while hosting Ads in apps is a lucrative option involving little overhead, the system is yet to provide publishers with means to control the Ads displaying in their app, unless they partner directly with Advertisers.

This brings us to the important issue of how these three parties conduct business with each other. Publishers with screen space to host Ads and an audience for their content and advertisers with money to engage such an audience usually have a marketplace of sorts to exchange what each party has to offer.

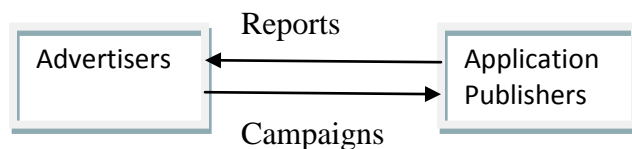
Broadly, they have three different ways to interact with each other.

We discuss these three categories of interaction with a high level architecture diagram and some examples.

a) Direct publisher-advertiser interaction –

This happens more in games, especially popular ones. Very popular publishers, like Angry Birds, can afford to be very selective about what Ads they display in their product and charge a very high price for it.

For sufficiently large Advertisers, it makes more sense to directly partner with popular publishers. It ensures minimum competition with other brands and a huge target audience.



2.1 Direct interaction



## b) Interaction through Ad Networks

An Ad network facilitates a many-to-many relationship between advertisers and publishers. It abstracts the complexity of Ad placements for Advertisers. Advertisers can focus on creating innovative and targeted Ad campaigns without concerning themselves with the technicality of delivering Ads to applications and aggregating metrics. For publishers, networks provide a platform specific integration library (the sdk for making Ad Network related API calls). Using this simple means of integration, applications can allocate screen space for Ads and place Ad requests with just a few lines of code.

The network handles the flow of money from advertisers to publishers.

They typically charge a commission that comes as a part of advertiser funds. The publishers therefore get paid a portion of the aggregated bid rates of Ads their users clicked on.

The Ad network has several conflicting demands to fulfill, while ensuring its own viability.

Some hard problems:

- i) How to get as much application and user information from publishers to offer better targeting criteria to advertisers subject to privacy concerns? For instance, if networks know the gender distribution of app users, it gives them the opportunity to offer demographic targeting to advertisers. If they know more about the content and purpose of an app, they can try to send highly relevant Ads to its users. Eg: university Ads for a high school math app.
- ii) How to make sense of the information obtained during communication with an application?

Some device specific information like location and IMEI number is also communicated during Ad display and refresh process. How can the network analyze it? Should it be analyzing it?

iii) Can the network analyze the Ad metrics for an application to get information relevant for targeting?

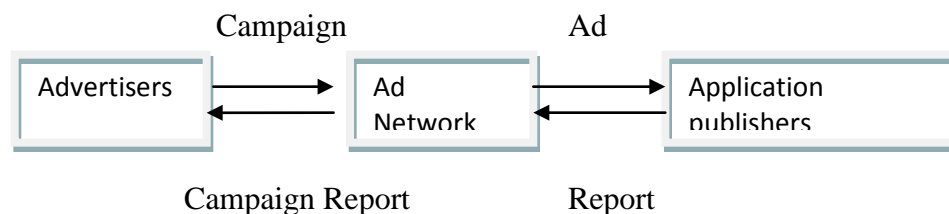
Eg: higher CTR at night vs morning, more clicks on matrimony Ads etc.

iv) In case of a conflict, what should be given preference while choosing the next ad to display- targeting criteria or bid-rate?

We will create a better context for these problems as we delve into more technicalities.

Advertisers need to register with the network (Ref: Appendix A), create their campaign with targeting information and create an Ad. They must transfer funds to the network for their Ads to start displaying. The application reports metrics like impression (when an Ad gets displayed) and click (when a user clicks on an Ad). These metrics are reported back to the advertiser, typically aggregated by time or location.

Ads are refreshed typically in 15-30 seconds. After an Ad is displayed in an app and reported, the network must choose the next Ad to be displayed from the pool of Advertisers whose targeting criteria is satisfied by the app. This process is discussed in further detail in section 2.



## 2.2 Interaction through Ad Networks

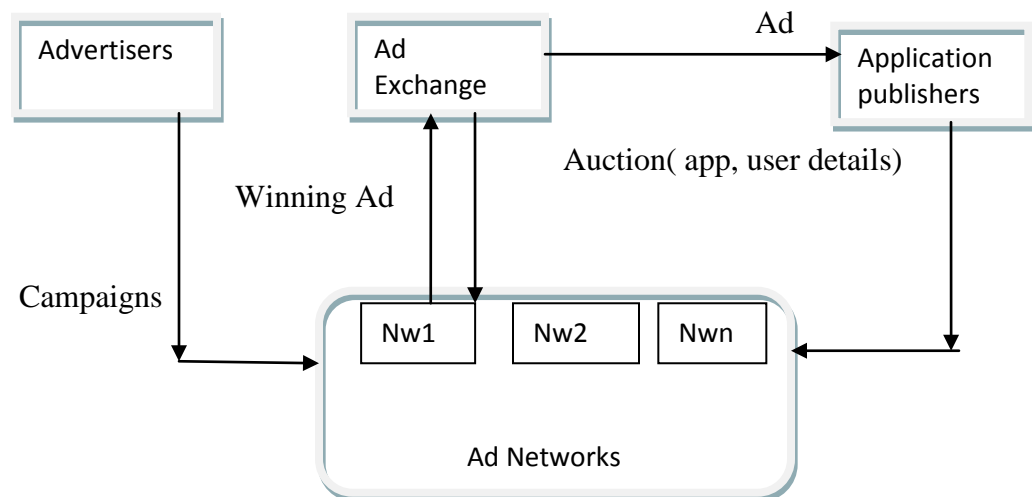
### c) Ad Exchanges

Ad exchanges introduce an added layer of abstraction between advertisers and publishers.

Ad Exchanges partner with several networks that in turn partner with Advertisers. Having multiple networks and hence several more advertisers increases the pool of available Ads for an app to display. The exchange does the crucial job of choosing the next Ad to display on an application from a pool of available networks.

This choice is the result of an auction in which participating networks compete via bid-rates for Ads. The display of Ads is of course, subject to satisfying targeting criteria (ref [1]) for more details on the process and hard Ad auctioning problems.

Advertiser interactions remain unchanged, but for the very few cases in which Advertisers may directly partner with an exchange. The report from publishers now goes to the exchange in addition to reaching the appropriate Ad Network.



2.3 Interaction through Ad Exchange

An exchange for Ads in mobile apps is a very complex system. We unfortunately don't have more detailed implementation information about exchanges for mobile Ads. All such information is still proprietary and none of the associated technology is open source. The Ad Exchanges paper (ref [1]) explains Exchanges for browser based Ads. Interested readers would find the introduction section helpful for an understanding of the system and the research problems discussed very insightful.

## 2. Technical details – Mobile application Ad display, refresh and reporting process in Ad Whirl mediation server.

The previous section gave an overview of the various entities involved in the mobile Ads system and the different ways they can interact. We now move on to more technical details about the process of Mobile Ad display and metric reporting.

We discuss the technical details of in app mobile ads, through an analysis of the Ad Whirl mediation server and client. A mediation server is different from an exchange in that it does not have an auctioning process or any direct partnership with any Ad network. Ad Whirl, for example chooses the next network according to static weights assigned by publishers.

We chose Ad Whirl for being open source and fulfilling our purpose of understanding the technicalities of displaying Ads in mobile apps.

We divide the process of mobile Ad display, refresh and reporting into three stages:- registration, display and reporting. Doing so helps us explain with much better clarity and reduces clutter in the architecture diagrams.

This is followed by a timeline diagram of all events put together.

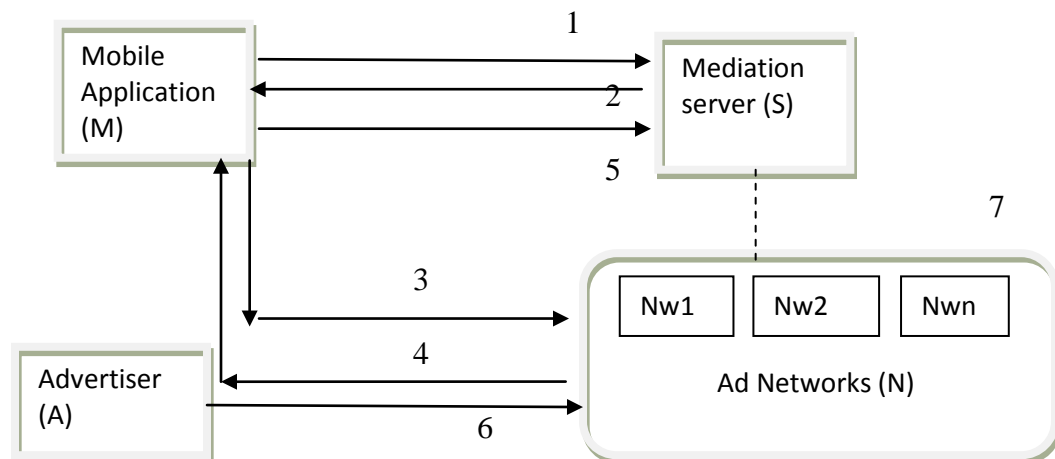
The Ad Whirl server is generically referred as ‘Mediation server’ in the following discussion.

a) The registration process.

Before publisher can host Ads in their mobile app, they have to register with the mediation server and other ‘partner’ networks. Similarly, an advertiser has to share campaign information and transfer funds to the Ad networks for running the campaign.

Mediation servers, like exchanges, typically require publisher sign-up. It’s very rare for them to run Ad campaigns. Advertisers register with Ad networks and the mediation server ensures refresh of Ads through these networks according to weights statically assigned by publishers. (Ref appendix A & B)

The process is explained through the following diagram:



## 2.4 Registration process

1. The publisher registers with the mediation server by providing the application name, (optionally) store URL and platform (Android or iPhone). Once registration is

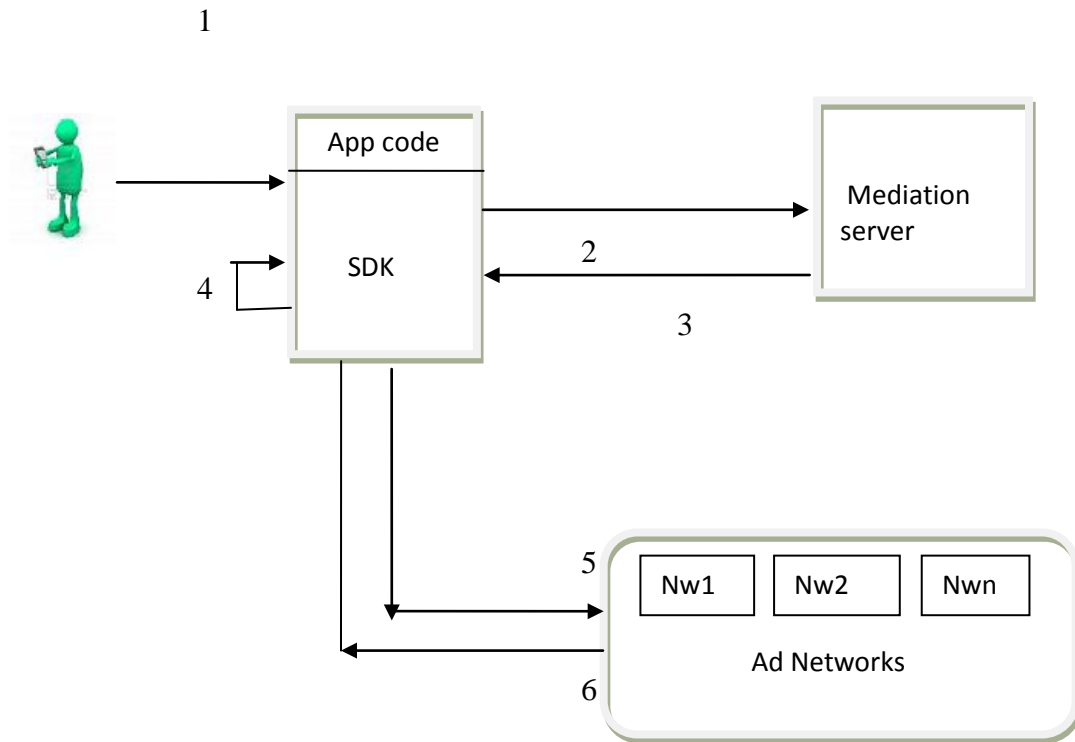
complete, the server sdk can be downloaded (usually as a library) and integrated with the client application. The components of the SDK and client server interactions are explained in more detail in the next diagram.

2. The mediation server provides a unique SDK id for the application that has to be used in all communication with Ad Whirl server.
3. The publisher also has to register with all the supported networks by providing the same information as 1.
4. Each network provides an id for the app that is unique to that particular network and a client side library to place Ad requests.
5. The publisher must report the id it received from each network to the mediation server.

This is done as part of the application configuration settings. Publishers can also choose what % of Ads they want to receive from each network.

6. Advertisers register with the Ad Network of their choice to run campaigns.  
They typically need to share campaign location, targeting and creative information.  
(Ref Appendix A).
7. Mediation servers don't have any official partnerships with the networks that a publisher might want to receive Ads from. Ad Whirl, for e.g. has a default list of around 10 networks publishers can choose from. However, Ad Whirl also facilitates addition of new networks not in the list. Partnerships, if any, are based on only an unofficial understanding.

b) Ad display and delivery process



### 2.5 Ad display and delivery process

The mediation logic is implemented using http requests between the client, integrated with application code and a remote server. Client side code is deployed as a library that the application can use to make API calls.

#### 1. App start

App display process starts when the app is opened by the user. The app could have been in paused, stopped or terminated state.

#### 2. Configuration request-

The first step is to send a configuration request to the mediation server. This is done by the client side code library. The request contains application id, version and client

platform. If identified successfully, the server returns Ad display settings and a list of networks with network specific app ids.

The Ad Whirl configuration request protocol:

Client->Server:

- app\_id: Ad Whirl SDK key for the app
- app\_version
- client: iPhone, android, blackberry etc

### 3. Configuration response –

The mediation server responds with display information and a list of networks and associated identifiers. The mediation client has no knowledge of the networks chosen by the publisher. A server request is necessary to get this list and the key given to the app by each network. The configuration request and response happens only once during the lifetime of the app (as long as the app is active). Any subsequent Ad request and refresh does not require a config request.

The Ad Whirl configuration response:

Server->Client:

- Display settings
  - location\_on: Does the app send location info?
  - background\_color\_rgb: Ad view background
  - text\_color\_rgb: text formatting
  - cycle\_time: how often do Ads get refreshed?
  - transition: Animation
- Network list:

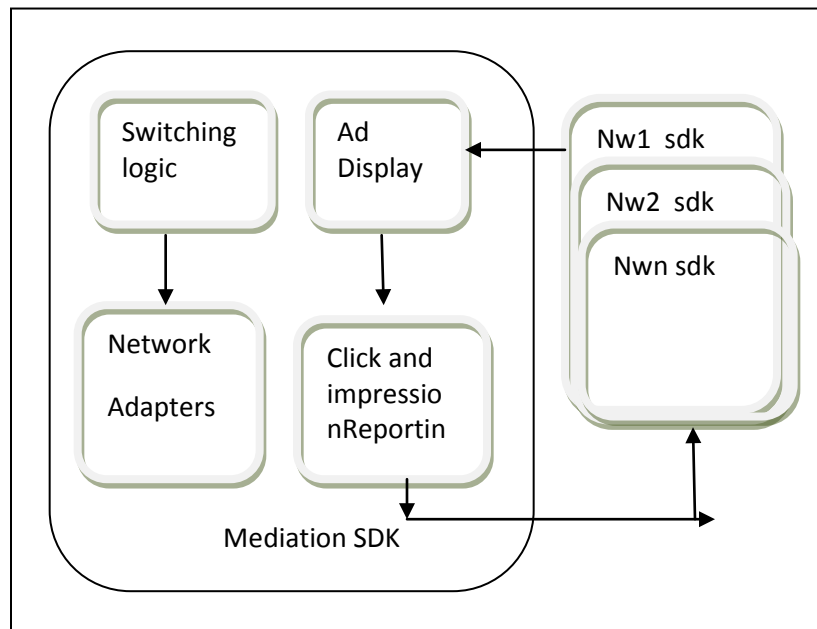


- **nid** : Application specific identification for the network
- **type**: A number to consistently identify the network on client and server side.
- **nname**: Ad Network name.
- **weight**: Used to choose next Ad Network. Weight is assigned by the publishers and its configurable online on the Ad Whirl website.
- **priority**: Static priority assigned by publisher to networks. In case no Ad is received from network selected on basis of weight, requests are sent on priority basis.
- **key**: Unique key used by the network to identify the app.

#### 4. Ad refresh

The logic to choose the next Ad Network is implemented at the client side. The choice is based on the fraction of Ad traffic assigned to each network by the publisher for the application. The default percentages determine the initial requests to networks. If these requests are not fulfilled by the network, the choice falls back to the priority settings. The requests begin from the highest priority network.

The client side sdk has several components to implement refresh, Ad request and display.



## 2.6 Mediation client

The switching logic selects the next network to place Ad request. The corresponding adapter for that network then creates the Ad request using network specific API. The Ad Request is placed through API calls and Ad obtained from the network is sent to the display unit. A single display of an Ad is an impression. This along with click event if applicable is sent to the reporting unit. From here, both mediation server and network get the impression and click info from the application.

## 5. Ad request

Once a network has been chosen for Ad request, an http request is sent to it with app identification information. This request, though prepared by network adapters as part of

mediation server SDK, is sent to the chosen network. Every network has a slightly different request and response protocol. We list some common fields here:

Client->Server:

- Appid: The AdWhirl SDK key for the application.
- Nid: The unique identifier for an application's ad network
- Uuid: The device's uuid. The client hashes the value to address
- privacy concerns.
- country\_code: locale (language and region) of the device
- location: latitude and longitude of user location
- location\_timestamp: time at which location was obtained from device
- appver: application version
- client: client platform
- age: user age or age group.
- gender

It is surprising how much user and device identification information is included with an Ad request. In the Android platform obtaining location and device id requires special permissions from the user, but the user is not usually aware that such information is being communicated to a third party Ad Network.

Age and gender need direct input from the user. There are also several user profiling services available from agencies like comScore for very popular applications.

While such information can be understood to be important to advertisers for sending highly targeted Ads, but done without detailed user permissions, can be a significant violation of privacy.

Our interest in this procedure is purely technical and we don't discuss privacy issues here, (ref [5]) is a relevant and interesting read in this area.

## 6. Ad display information

All information necessary for Ad display is sent to the application as response to Ad request.

Server->Client

- `img_url`: URL for fetching the image
- `redirect_url`: URL to open on click
- `metrics_url`: Click reporting URL
- `ad_type`: banner, Text etc
- `ad_text`: text content of Ad
- `launch_type`: browser or others
- `webview_animation_type`: Display animation

### c) Reporting process

We discuss the metric reporting process in a similar fashion. The glossary talks about the Ad metric terminology in further detail.

#### 1. Impression, click reporting

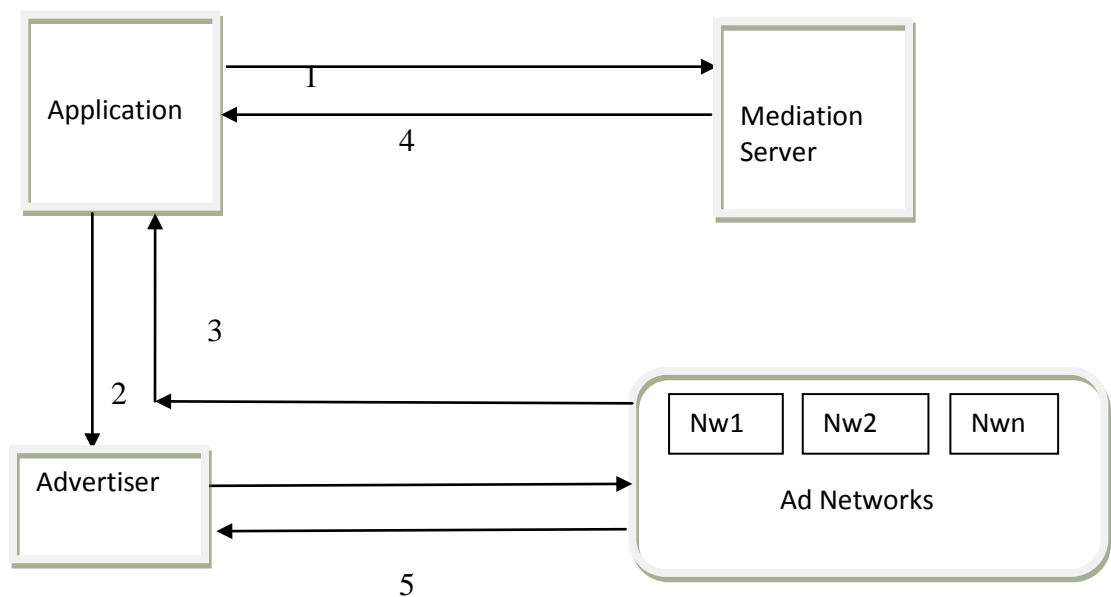
After the Ad has been displayed in the application, the display and/or click have to be reported to the mediation server.

The application sends identifying information along with the request and receives HTTP status message in response. Impression and click reporting have different URLs.

Ad Whirl requires the appid, nid, type, uuid, country\_code, appver, client fields.

## 2. Ad Server reporting

The same information must be communicated by the application to the Ad Network whose ad was displayed.



### 2.7 Reporting process

## 3. Ad Network reports

An application hosting Ads from a particular network, gets detailed aggregated reports about the Ads displayed on its screens.

The major metrics reported are total requests, Impressions, Fill rate, CTR, e CPM, Revenue.

The glossary discusses the metrics in more detail.

#### 4. Mediation server report

The mediation server only reports relative impressions from each Ad network. The application must check reports from individual Ad Networks for specific details.

#### 5. Advertiser reports

Advertiser reports consist primarily of Impressions, Clicks, CTR, Bid and Total Ad spend. The terms mean the same as for application reports, but from an Ad perspective. E.g. for impressions, how many total impressions of an Ad were made?

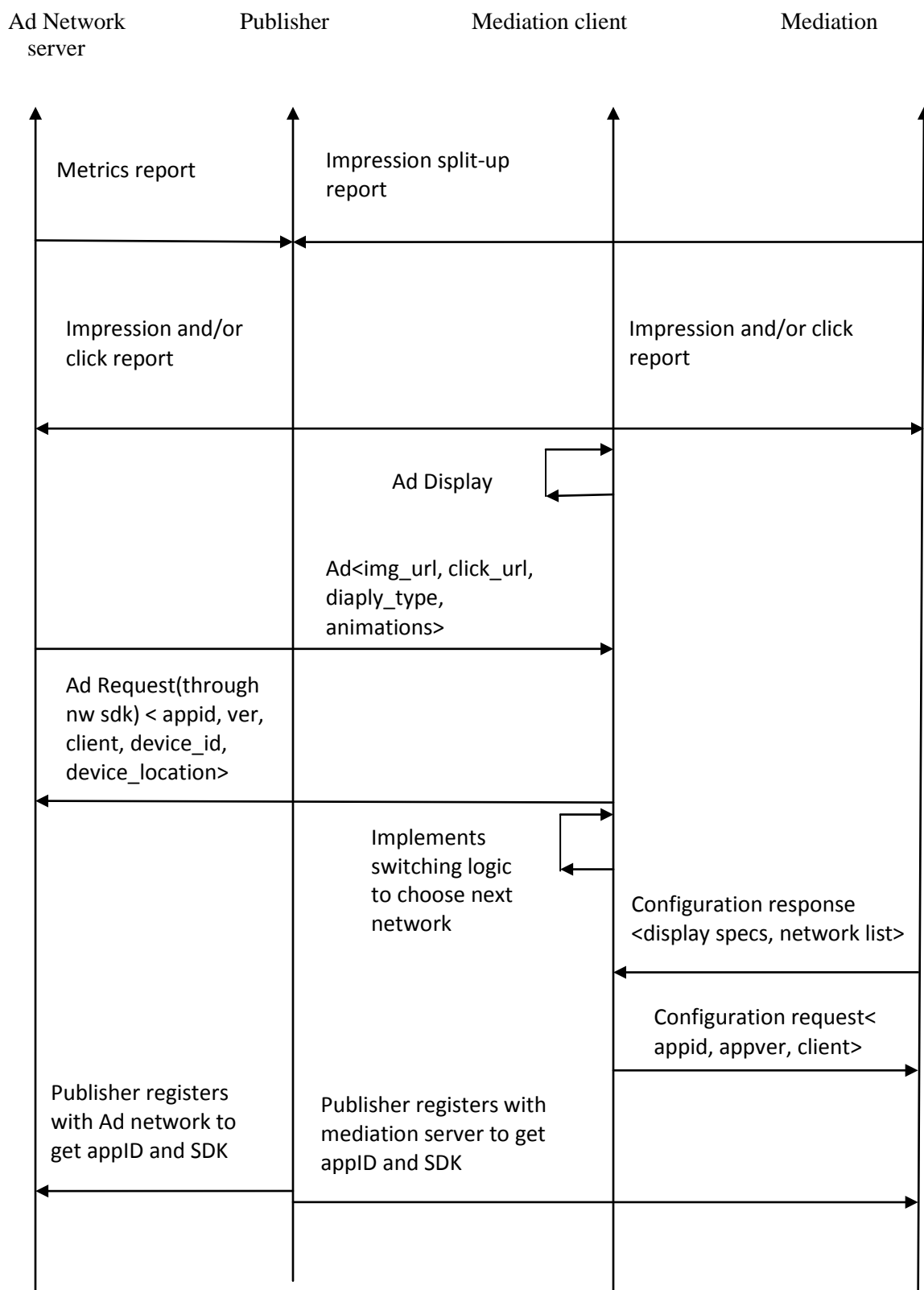
These reports are typically aggregated and can be viewed specific to location (country and in some cases, region) or time (weekly, monthly etc).

(Report format in Appendix A & B)

### Timeline Diagram

We now put all the events discussed in 1, 2 and 3 above in a single timeline diagram.

## 2.8 Timeline diagram



### 3. Observations

- a) Applications share information about users with Ad Networks without their explicit permission.

In the android platform, Ad Network client libraries do not have to ask exclusive permissions from users. They can use the same permissions as the application to access device and location information. In most cases, users have no idea what data is being sent to Ad Networks for displaying Ads.

On the ios platform, applications undergo an opaque review process. Again, the user does not know data being accessed and communicated by the app. E.g. in the android manifest, these two permissions are enough for an application to access device ID and location:

```
<uses-permission
android:name="android.permission.READ_PHONE_STATE" />

<uses-permission
android:name="android.permission.ACCESS_FINE_LOCATION" />
```

In android the `getDeviceId()` method of `TelephonyManager` class returns the device IMEI or MEID. These numbers uniquely identify the mobile device. IMEI is of course, only available for devices with a SIM card. Tablets unless they are 3G enabled, do not have an IMEI.

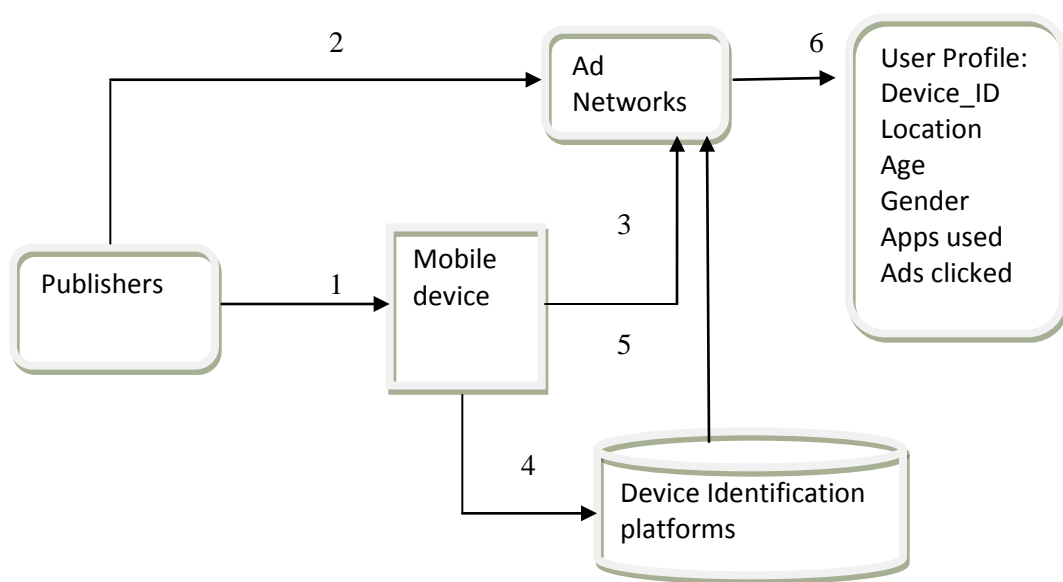
The device ID is usually hashed before its sent across the internet. This increases security, but still compromises privacy, as the device is uniquely identifiable with a hashed device ID.



Appendix B has the code snippets for accessing device ID and location.

- b) Ad Networks have much more information about an Advertiser's target audience than they reveal. It is unclear how this information is stored and validated.

For instance, consider this scenario:



## 2.9 Hypothetical scenario

1. Publishers release content on the mobile platform. This could be applications or mobile websites.
2. Publishers partner with Ad networks to host Ads on their mobile content. They provide information about their content to the Ad network. E.g. while registering a mobile app, publishers report name, OS platform, type of app etc.
3. As Ads are displayed, the application or website reports impressions and clicks to Ad networks.

They may also report unique device ID and user location.

4. Additionally, many Ad networks use the services of device identification platforms like Blue Cava to uniquely identify the device on which their Ads are getting displayed. This is more of a case on the mobile web than with apps.
5. These agencies report the identifier they generate for a device.
6. Aggregating all this information, Ad Networks can build a user profile of sorts as shown.

This is just a hypothetical situation. We do not know how user information is processed by Ad Networks. They do have data coming in from several sources. However, aggregating and validating and updating this data no easy task. This is just to show the scope of user data that Ad Networks can possibly get.

## Ad Campaign Experiments

### 1. Introduction

In order to get a complete understanding of Ads in mobile apps, we need to view the system from an Advertiser's perspective also. We now know what data passes between application, mediation client and server when an Ad gets displayed or refreshed. But this doesn't tell us anything related to the Ads themselves.

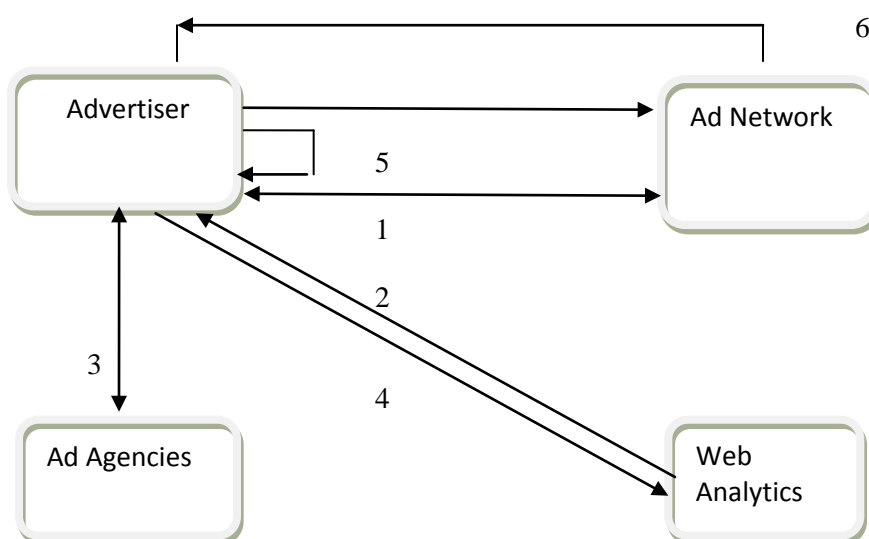
An advertiser trying to reach a certain audience through the mobile apps medium, would have several considerations:

- a) Making sure their Ads are reaching the right audience. In other words, running targeted Ad campaigns. For instance, a new restaurant in NYC would want to target people living in New York. It would be even more useful if their Ads are shown in a NYC restaurant rating application, or a search based app.
- b) Obtaining detailed campaign information that includes as much data about their audience as possible. Advertisers need detailed campaign information so that their performance can be analyzed to improve future campaigns. E.g. if a campaign had two Ads running in parallel, the advertiser would want to know which one did better in terms of people reached and user response. Also, campaigning is one way to understand the audience. Demographic information like age and gender of the user who responded to the Ad, technical information like the manufacturer and the OS platform of the phone they were using can be very valuable to advertisers.
- c) Both goals of running targeted campaigns and obtaining audience information should be met with the least amount of money spent. Advertisers would want to know how much difference bidding rate makes to the number of people reached etc.

A report on Ads in mobile Ads would be incomplete without an analysis of how Ad campaigns using the mobile apps medium work. For much of the future of this medium depends upon how relevant and targeted these Ads can be, while respecting user privacy.

We perform Ad Campaign experiments in select countries by actually designing and running campaigns through Ad networks. These experiments are performed in uncontrolled conditions, i.e. we do not select people to view our Ads. All our campaigns are run in the real market, and reach a general audience. We strictly do not track individuals but observe collective behavior through data obtained from different sources.

An Ad campaign has several variables like budget, location, technical and demographic targeting, ads, bidding rates of ads and more. The goal of these experiments is to know how the different variable parameters of a campaign impact its success. Our strategy is to vary a small subset of these parameters and observe the effects it has on the performance of the campaign. Before we start discussing the experiments and analyze the results, we will take a quick look at the advertising process.



3.1 Advertising process

1. Campaign initiation – Budget, targeting and media decisions.

This is when all the groundwork for the campaign is laid by the advertisers. The goal of the campaign, audience to be targeted, overall budget and advertising medium are all decided at this stage.

2. Network Partnership-

After mobile apps have been identified as a potential advertising medium, the advertisers must select an Ad Network among several potential options available in the market. This decision is based on targeting options, presence at the target location, partnering publishers etc.

3. Ad Agency partnership-

Advertisers usually partner with Ad agencies and professional web developers to create a good Ad. An Ad could be anything from a catchy slogan to a full-fledged web page with checkout. This step could happen even before partnering with an Ad network, but Ad Networks tend to have different specifications about the technical aspects of creatives like banner size. It would serve the advertisers better to commission or build these Ads according to these specifications.

4. Web analytics-

The most common call-to-action of a mobile Ad is a landing page that opens up in a browser. Several web analytics agents (Google analytics is one) can be integrated with these landing pages in a simple fashion, with just a few lines of code. Web analytics can give several insights about the users visiting the page. Advertisers stand to benefit significantly from a web analytics agent at literally no cost. Google

analytics is completely free of cost. Several Ad Networks also offer analytics for advertiser landing pages.

5. Campaign creation and management-

The advertiser now has a chosen Ad network to parent with, an Ad and any analytics associated with it if applicable and also a budget ready for the campaign. They can now start creating the campaign and transferring funds. Most Ad networks have a simple web interface for campaign creation. Appendix A, as mentioned, talks about this in detail. A campaign requires active management from the advertisers too. The bidding rate of an Ad might need to be changed depending upon performance, the same goes for the actual Ad. The next section has several such campaign experiments that would provide useful pointers to advertisers.

6. Campaign Reports-

The final leg of the advertising process is reporting. The Ad network provides aggregated reports of campaign performance like Ad impressions, clicks, CTR etc aggregated by time, location, mobile manufacturer, platform or carrier. The level of detail depends upon the granularity of targeting offered by the network. Appendix A provides detailed report formats.

7. Web analytics reports-

Web analytics agents provide detailed reports about users who visited the landing page. Advertisers can know how many page visits occurred in total and how many of them were unique. User engagement information like avg visit duration, pages/ visit and bounce rate is also provided. Such information can give advertisers significant insights about audience behavior.

Advertisers may gather additional information from the server side script of their web pages, if they had been programmed to record user information. Such reports tend to have similar but less detailed information than web analytics. More details are in Appendix A and the experiments we discuss in section 2.

We now begin detailing our campaign experiments. Some common facts about all the campaigns we have run so far:

2. We choose either InMobi or AdWords as Ad Networks.
3. Our campaigns are run in countries chosen from Mexico, UAE, Singapore, Lebanon, Jordan, or Oman.
4. They run from 1 week- 10 days.
5. All are poll based surveys. We do not advertise any brands and don't include any incentives.
6. We have 3 sources of data: Ad Network reports, Web server reports, Google Analytics

Ref [7] has a good discussion about survey based advertising. Though a little older, the work is about the success of survey based advertising in online media, which is very relevant here.

## 2. Campaign experiments

### a) Varying bids:

Ad Server: InMobi

Duration: 05/06/2012 – 05/14/2012 : 9 days

Countries: UAE and Mexico

Targeting:

Location – country based

Experiment:

Name: Varying bid rate

Goal: a) To observe the effects of changing bid rate on impressions of an Ad.

b) To compare these effects in UAE and Mexico.

c) Analyzing auxiliary data.

Hypothesis: Networks stand to profit more from serving impressions of Ads that have a higher CPC. Therefore, as the bid rate for an Ad increases, the number of impressions must increase. Absolute number of clicks may also increase, but we don't expect any significant effect on CTR.

Procedure:

The bid rate of Ads was changed periodically during the campaign.

The campaign had two Ads running, one in each country.

Ads: VaryingBids - UAE

VaryingBids – Mexico

Daily spend limit: \$10

Log of changes made to bid rates:



May 6th - Mexico - 0.04

UAE - 0.1

May 7<sup>th</sup> – No changes

May 8th - Mexico - 0.08

UAE - 0.2

May 9th - Mexico - 0.16

UAE - 0.4

May 10th -Mexico - 0.48

UAE - 1.2

May 11th -Mexico - 0.02

UAE - 0.1

Daily spend limit for both Ads changed to \$20

May 12<sup>th</sup> – No changes

The rate was doubled the first two times. Tripled the third time and finally reduced to the original bid.

We now discuss the data obtained from the experiment.

### Overview data

3.1.1 Consolidated campaign report: total impressions, clicks and CTR for the entire run of the campaign.

Campaign Name	Impressions	Clicks	CTR	eCPC	Total Ad Spend
VaryingBids	627,087	1,390	0.22	0.11	148.44

### 3.1.2 Consolidated Daily report: Same report split up daily:

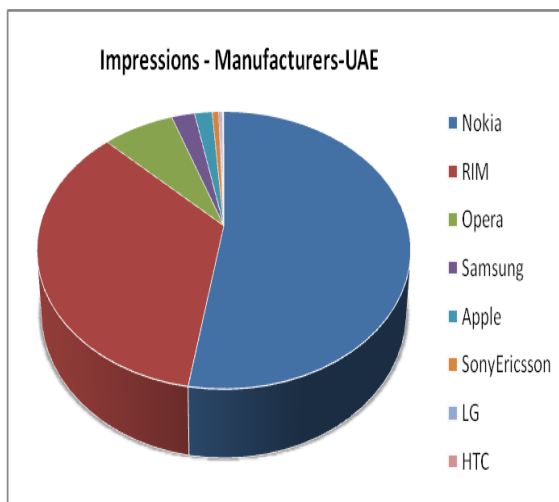
Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
6-May-12	107969	351	0.33	0.06	20
7-May-12	28459	212	0.74	0.06	12.14
8-May-12	123367	334	0.27	0.05	18.3
9-May-12	42736	141	0.33	0.12	17.2
10-May-12	158313	92	0.06	0.27	24.8
11-May-12	123150	55	0.04	0.65	35.6
12-May-12	158	4	2.53	0.1	0.4
13-May-12	26392	101	0.38	0.1	10
14-May-12	16543	100	0.6	0.1	10

3.1.3 Ad Groups: Two Ad Groups in the campaign, one targeting Mexico and the other UAE. Note the stark difference between the impressions. This data is not normalized. The higher impressions are due to the much larger audience being reached in Mexico. Also note the estimated CPC of UAE is more than double that of Mexico. This is understandable considering the higher number of impressions available in Mexico.

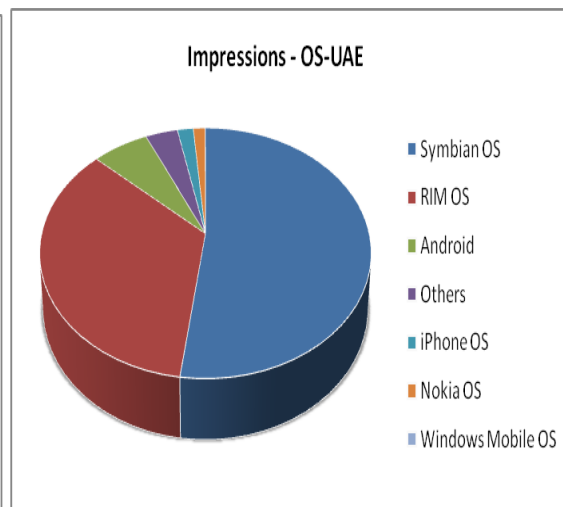
Ad Group Name	Impressions	Clicks	CTR	eCPC	Total Ad Spend
Bids-UAE	109,461	542	0.50	0.16	85.20
Bids-Mexico	517,626	848	0.16	0.07	63.24

Technical reports:

UAE:



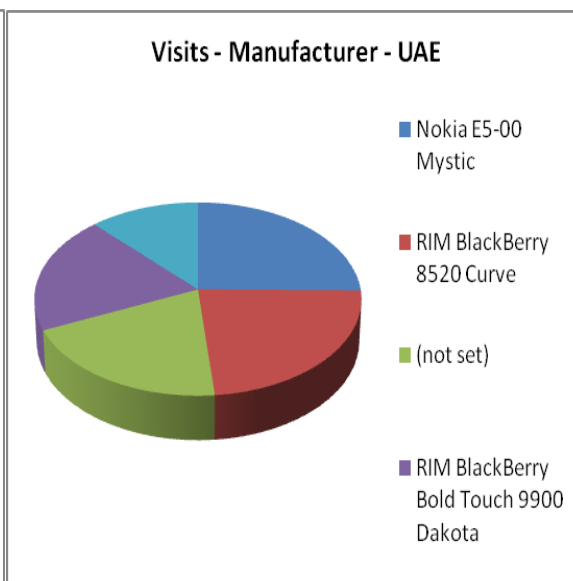
3.1.2 InMobi Manufacturer report



3.1.3 InMobi OS Platform report

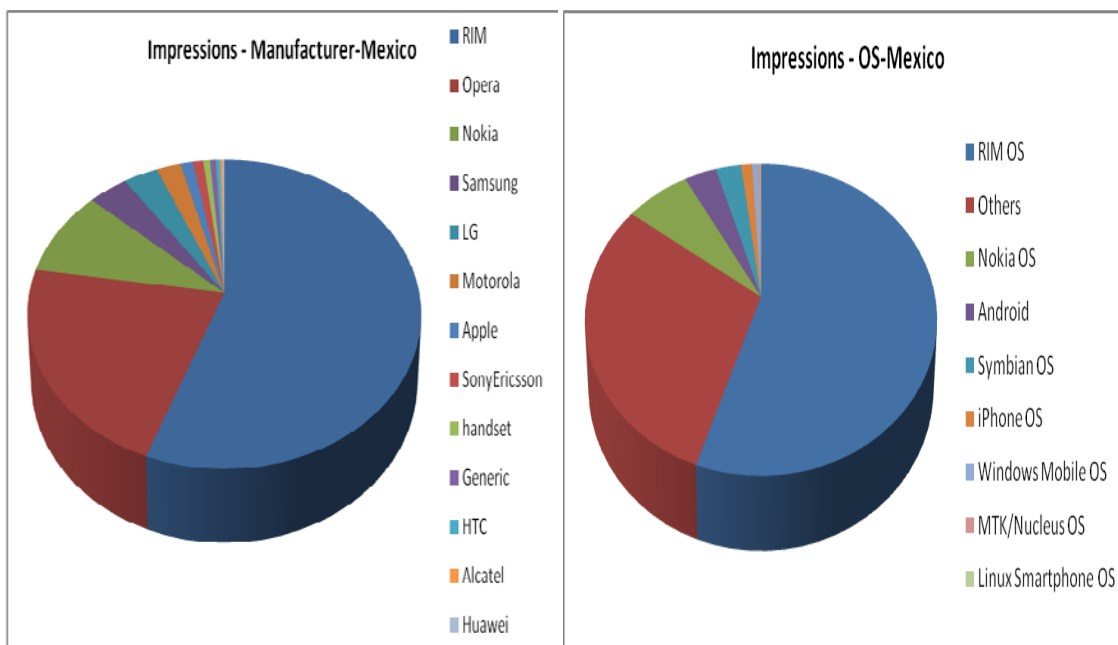


3.1.4 Google Analytics Browser



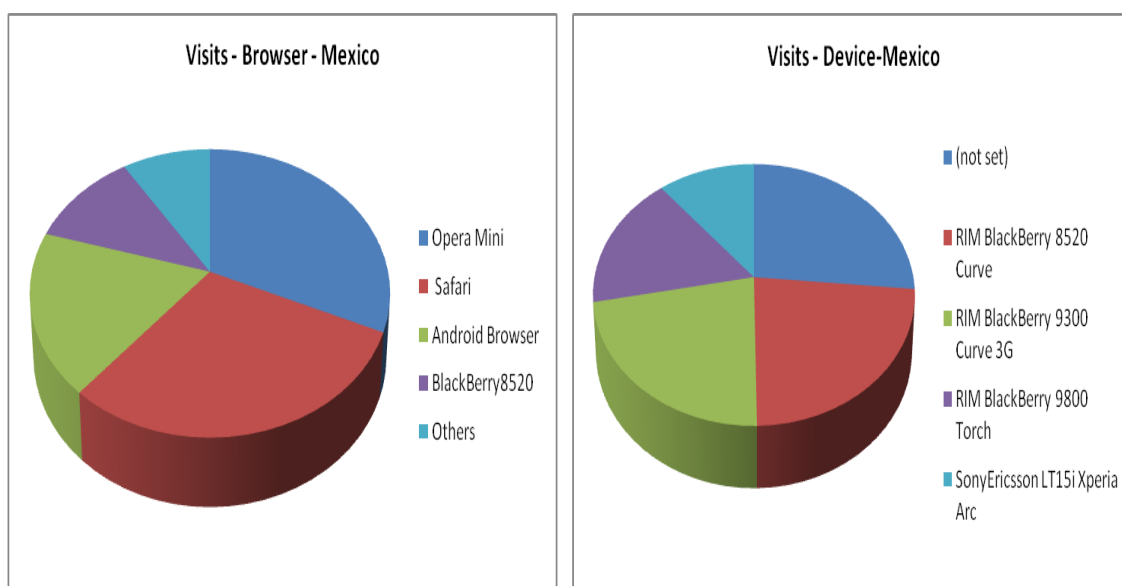
3.1.5 Google Analytics Manufacturer

Mexico:



3.1.6 InMobi Manufacturer report

3.1.7 InMobi OS Platform report



3.1.8 Google analytics browser report

3.1.9 Google analytics manufacturer report

**Observations:**

## 1. The bid rate of an Ad has a direct impact on impressions served.

When we look at the impression graph in the chart, we see that as we keep increasing the bids, the impressions get higher and higher. The impressions don't increase when the bid is not increased.

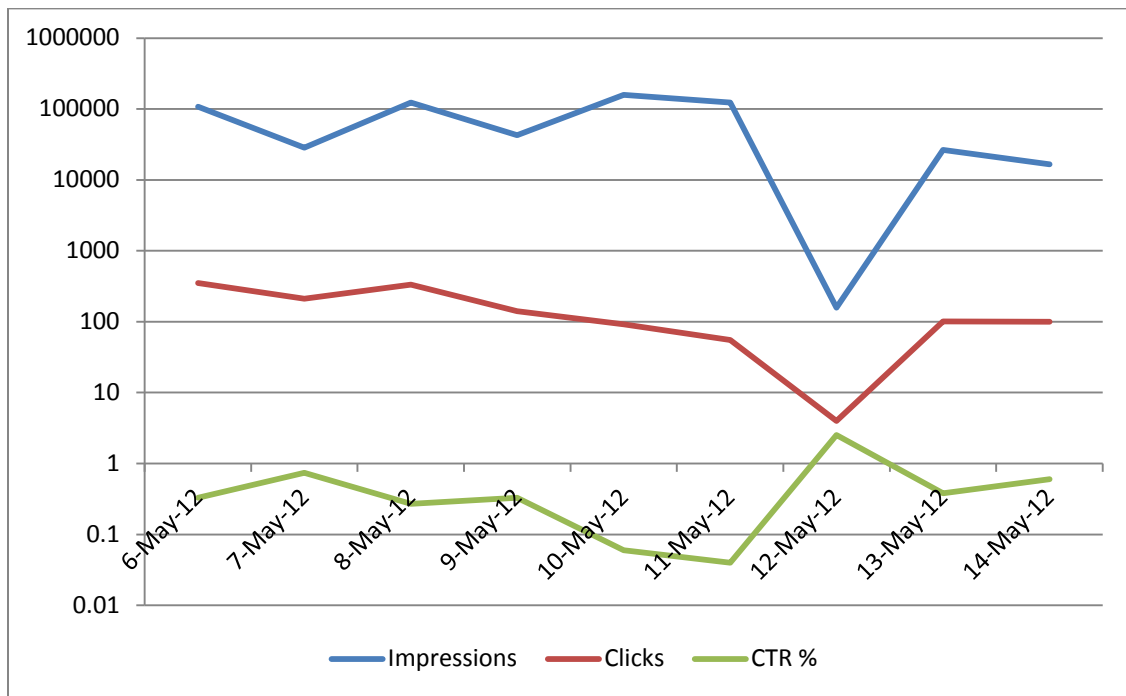
Though the starting bids of the Ads in both countries had minimum bid, first day impression count is quite high. The bids were not changed on day 2, May 7<sup>th</sup>. We see the impressions dropping for 7<sup>th</sup>. The count again increases for day 3 when the bids were doubled. We see a drop after this for day 4, in spite of doubling bids. This could be attributed to depleted funds that we overlooked. After funds were added on day 4, the impressions start creeping up again. They reach their peak on day 4-5, when the bidding is at its highest.

The final change was to bring the bids back to original on day 6 and increase the spend limit by \$10. We see a sudden drop in impressions on day 7 due to this change. The count bounces back a little after funds are added and then tapers down. The number of impressions recovers quite well on day 8 in spite of the low bids due to the increased spend limit.

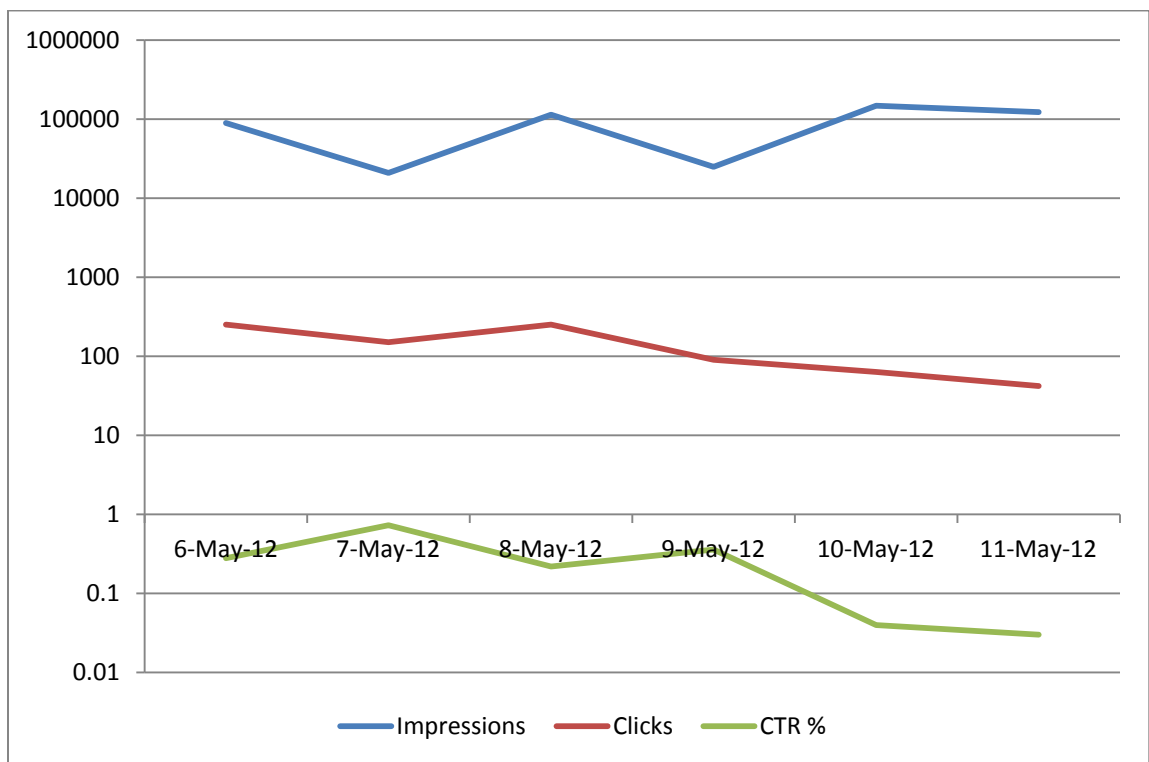
## 2. Clicks are not directly impacted by bid rates.

We do observe as expected, that initial increase in the Ad is quite high. The clicks also seems to increase along with impressions on day 3, but they don't follow the trajectory of impressions after that. When impressions really peak on day 4 and 5, the clicks actually decrease. This seems to follow the normal Ad lifecycle. There is high interest from the users for a new Ad but response decreases irrespective of higher exposure.

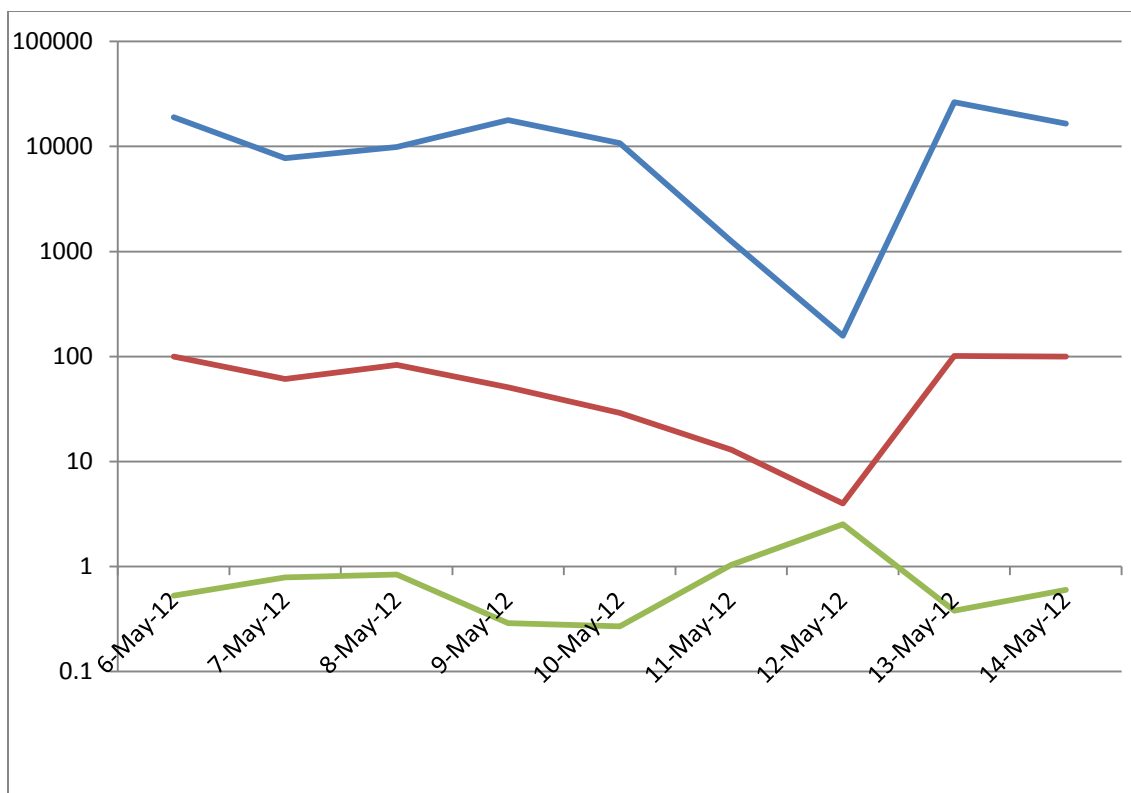
### 3.1.10 Campaign: Impressions, Clicks and CTR chart



3.1.11 Mexico : Daily report graph

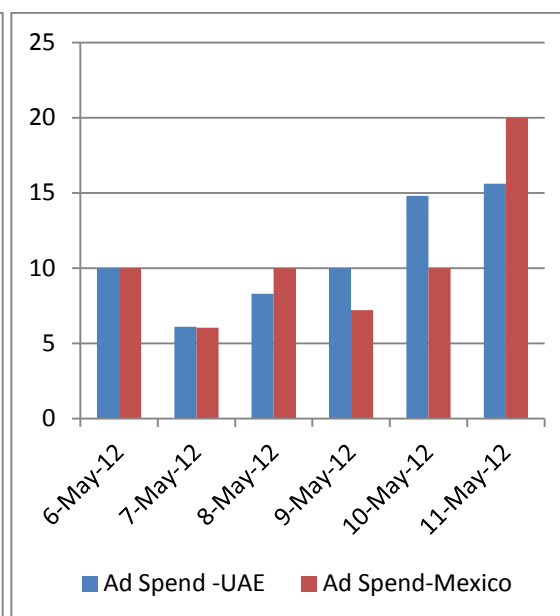
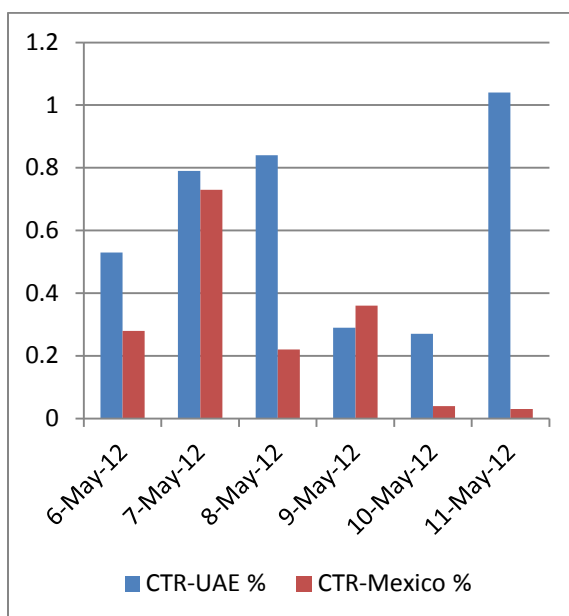


3.1.12 UAE: Daily report graph



3.1.13 UAE-Mexico-CTR graph

3.1.14 UAE-Mexico-Ad Spend graph



**3. Click through rate does not depend upon how many impressions are served.**

While impressions in Mexico are always higher than UAE, the CTR of UAE is consistently higher than that of Mexico.

This is further illustrated by the spike in CTR corresponding to the weekend – Friday and Saturday in the UAE. This spike happened in spite of much fewer impressions due to the reduced bid rate.

#### **4. Impressions do not depend on CTR**

The graphs do not point to any increase in impressions in response to high CTR in UAE.

Increasing impressions in response to a high CTR may increase revenue. But other considerations like daily spend limit and impressions available in a country, likely limit this option. Networks seem to be optimizing impressions and CPC to achieve maximum Ad Spend.

Even with fewer impressions in UAE, a comparable Ad Spend is possible due to higher min bid and higher CTR.

#### **5. Clicks do not always translate to user engagement with landing page**

When we look at the web server total visits and poll results numbers, we find that in both countries only about 17% people who visited the web page or clicked on the Ad actually participated in the poll. While this depends a lot upon content, we must note that many clicks are inadvertent and not out of interest in the Ad.

Google analytics data supports our observation. Both countries have a very high bounce rate. It's interesting to note that UAE has avg visit duration of almost 2



minutes! Considering the poor response to the polls, this data must be because of page load delays.

**6. Nokia and Blackberry are most popular in both countries. iPhone and Android lag far behind.**

The pie charts for device manufacturers in both countries point to the popularity of Nokia and Blackberry. In UAE 53% of impressions were on Nokia phones and 35% on RIM, while Mexico had 56% RIM, 22% Opera and 9% Nokia. Android and iPhone impressions are very low compared to Nokia and RIM. Only 6% of people reached in UAE had android OS and 2% ios. Opera is a browser not a phone manufacturer. However, it's an open source browser and the request could have originated on any phone. Comparing the Google Analytics and InMobi reports in the light of the browser report tells a different story. All the InMobi manufacturer and platform OS reports, not surprisingly, agree with each other. InMobi manufacturer and Google analytics device reports are also not way off. Considering Google analytics deals with page views and InMobi manufacturer report is about impressions, some deviation can be understood. But what is surprising is the Google Analytics browser report. Nokia and RIM receive the highest number of clicks, but the browser is Safari and Mozilla compatible agent. This means either that Google analytics device data does not agree with browser data, or that users are installing free browsers instead of using manufacturer defaults. The second option is more likely.

**b) Changing Ad Text and Picture**

Ad Server: InMobi

Duration: 05/16/2012 – 05/23/2012: 8 days

Countries: Lebanon and Jordan

Targeting:

Location – country based

Experiment Name: Changing Ad Text and Picture

Goal:

- a) To observe effects of changing Ad Text and brand image on CTR of an Ad
- b) To compare these effects in Lebanon and Jordan
- c) Analyzing auxiliary data.

Hypothesis: The response for an Ad would tend to decrease as exposure increases. The variable parameters of an Ad are its text and associated brand image. We expect an increase in CTR as Ad content changes. We don't expect impressions to significantly change, as bid rate is kept constant throughout the campaign.

Log of changes:

May 16<sup>th</sup> – First Ad: Ad1.

May 17<sup>th</sup> – No Change

May 18<sup>th</sup> – Ad1 stopped, new Ad with different text and same pic: Ad2

May 19<sup>th</sup> – No Change

May 20<sup>th</sup> - New Ad with same text and different pic: Ad3

May 21<sup>st</sup> – Ad2 stopped.

May 22<sup>nd</sup> - Banner Ad, Ad3 stopped

May 23<sup>rd</sup> - Banner Ad stopped

Overview data

3.2.1 Consolidated report: Entire campaign performance.

Campaign Name	Impressions	Clicks	CTR	eCPC	Total Ad Spend
Change_Text_Pic	121,099	859	0.71	0.09	77.08

### 3.2.2 Consolidated Daily report

Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
23-May-12	353	2	0.57	0.09	0.18
22-May-12	16792	105	0.63	0.09	9.45
21-May-12	10444	84	0.8	0.09	7.56
20-May-12	25406	223	0.88	0.09	20
19-May-12	13471	93	0.69	0.09	8.37
18-May-12	27902	224	0.8	0.09	20
17-May-12	11545	73	0.63	0.09	6.57
16-May-12	15186	55	0.36	0.09	4.95

3.2.3 Ad Report: Each Ad with unique content. The original Ads in both countries, Ads with text changed, Ads with same text but different picture than previous Ad and finally, banner Ads. We see hardly any impressions of banner Ads because we didn't have banners in different resolutions, which limited the scope of display.

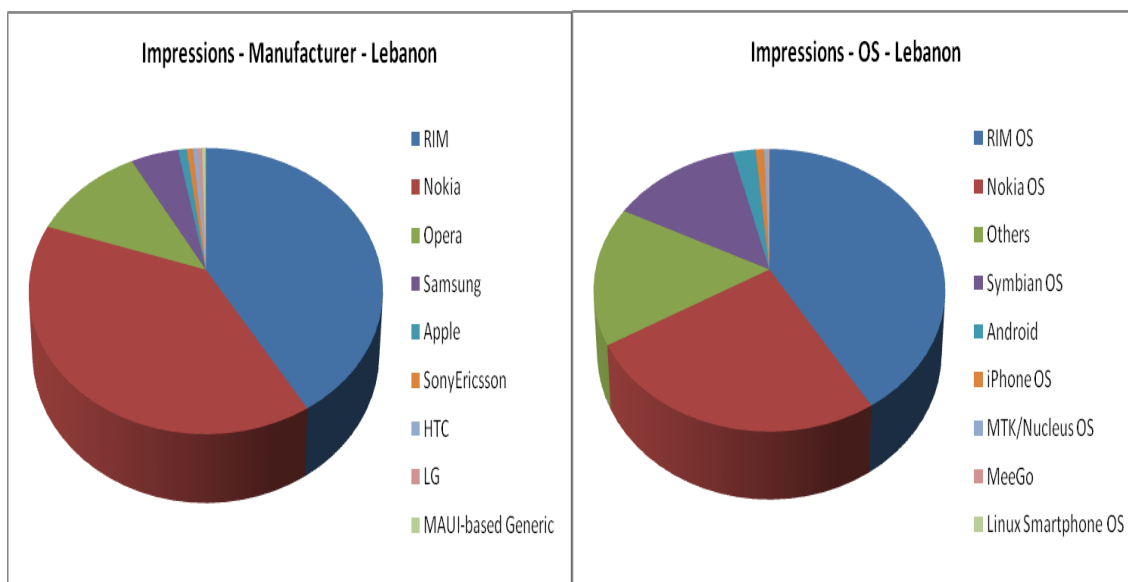
Ad Name	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
Lebanon original	12735	83	0.65	0.09	7.47
Jordan original	13996	45	0.32	0.09	4.05
Lebanon New Text	23708	219	0.92	0.09	19.63
Jordan New Text	28601	200	0.7	0.09	17.92
Lebanon New Pic	20134	158	0.78	0.09	14.15
Jordan New Pic	21282	148	0.7	0.09	13.32
Lebanon Banner Ad	480	2	0.42	0.09	0.18
Jordan Banner Ad	163	4	2.45	0.09	0.36

3.2.4 Country wise report: We see similar reach and response in the campaign in both countries. Both Lebanon and Jordan have same CPC.

Country Name	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
Jordan	64042	397	0.62	0.09	35.65
Lebanon	57057	462	0.81	0.09	41.43

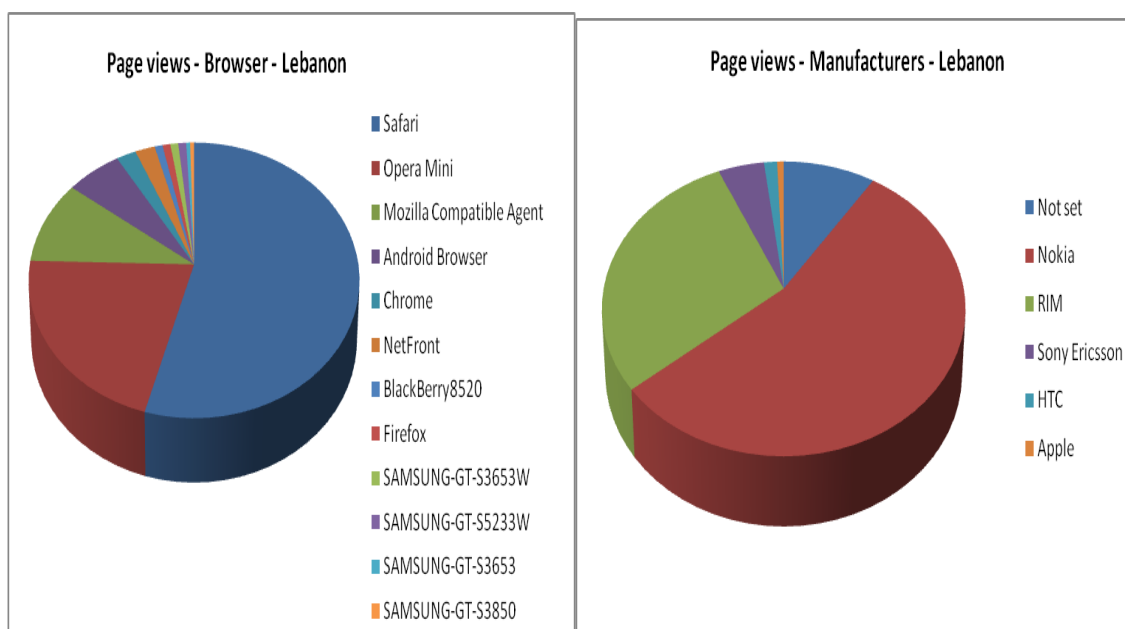
## Technical Reports:

Lebanon:



3.2.1 InMobi Manufacturer report

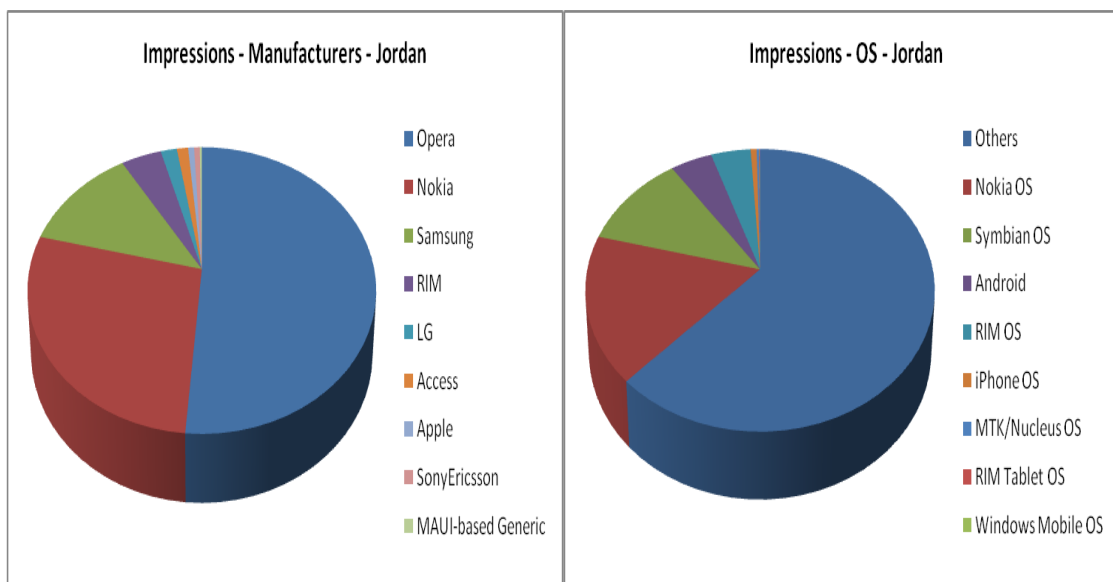
3.2.2 InMobi OS Platform report



3.2.3 Google Analytics browser report

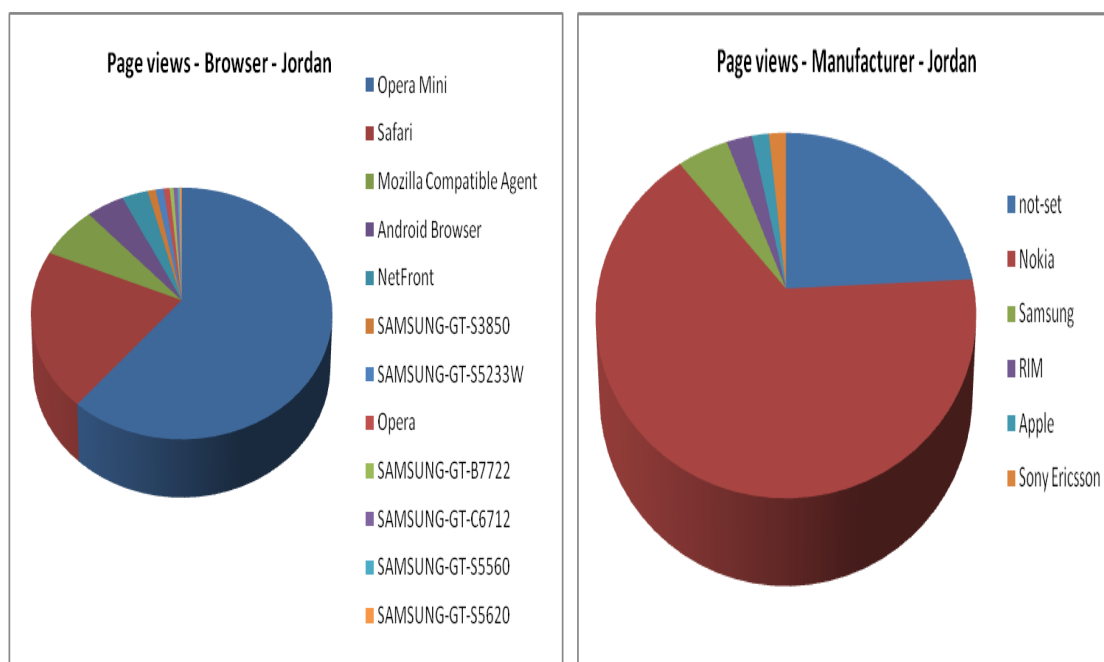
3.2.4 Google Analytics manufacturer report

Jordan:



3.2.5 InMobi Manufacturers report

3.2.6 InMobi OS Platform report



3.2.7 Google analytics browser report

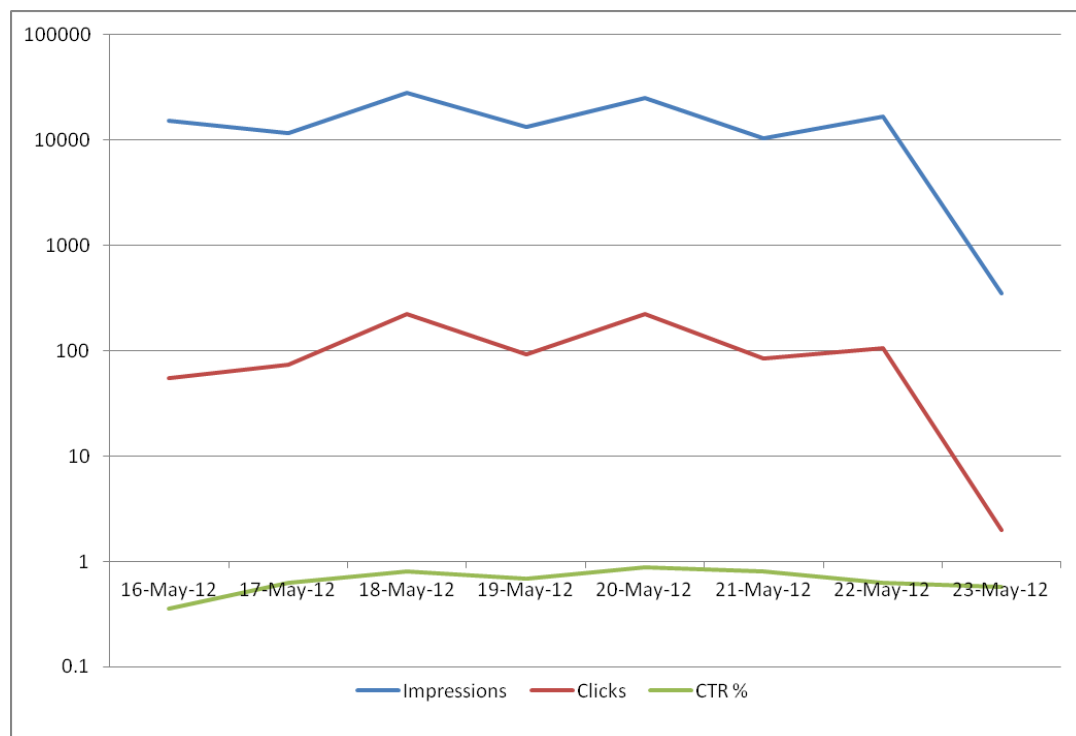
3.2.8 Google analytics Manufacturer

## Observations:

### 1. The Impressions and CTR of an Ad increases on change of content

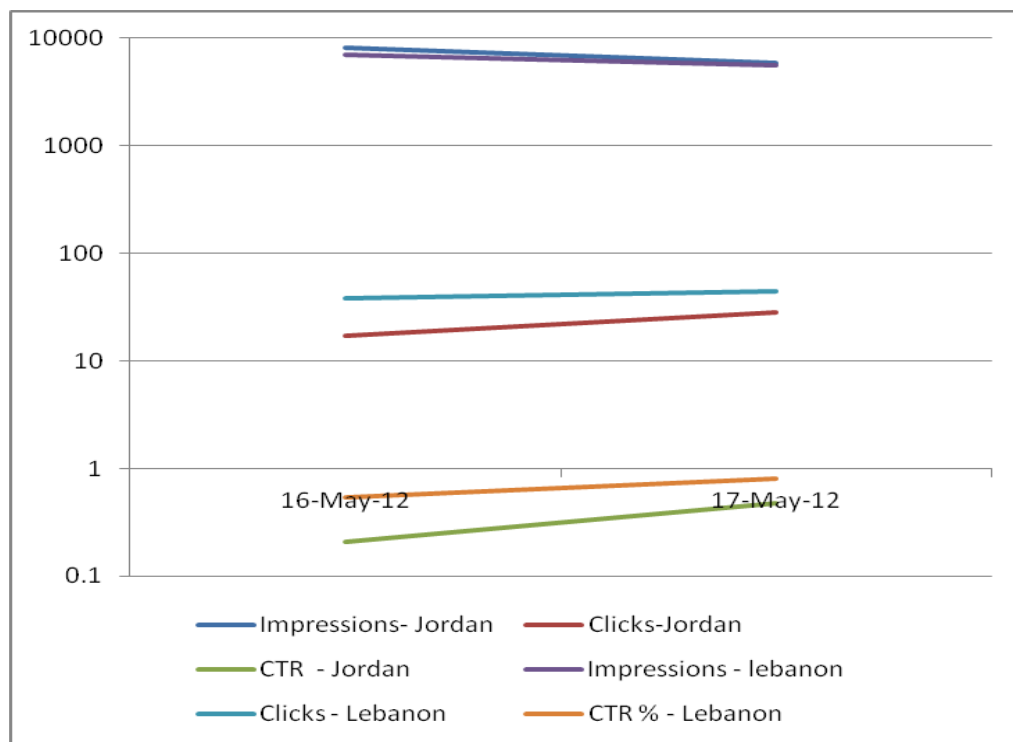
From the daily chart, we observe that spikes in impressions, clicks and CTR are in tandem with each other. The spikes coincide with the dates on which content was changed with either new text or picture. Our hypothesis was that clicks might increase due to increased user interest in the new Ad. But our data points to a similar increase in impressions too. The CTR line does not change as sharply as clicks or impressions as the change in impressions and clicks is quite uniform.

#### 3.2.9 Campaign daily graph

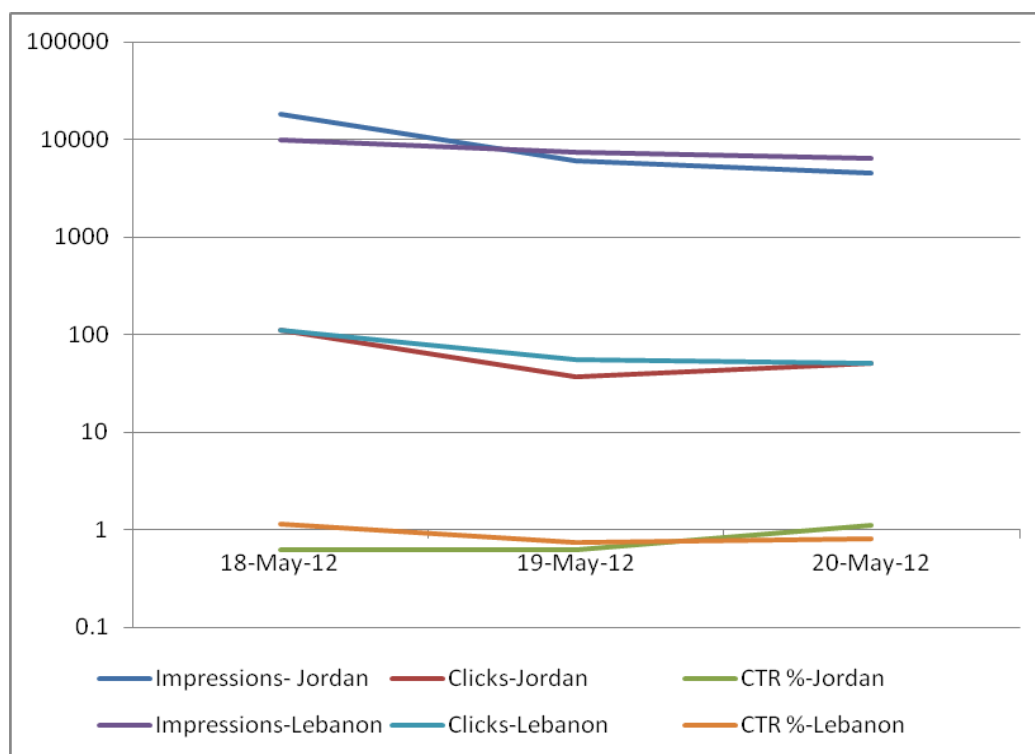


### 2. The pattern of changes is similar in Lebanon and Jordan: Interest spikes for a new Ad and then wanes until it's changed.

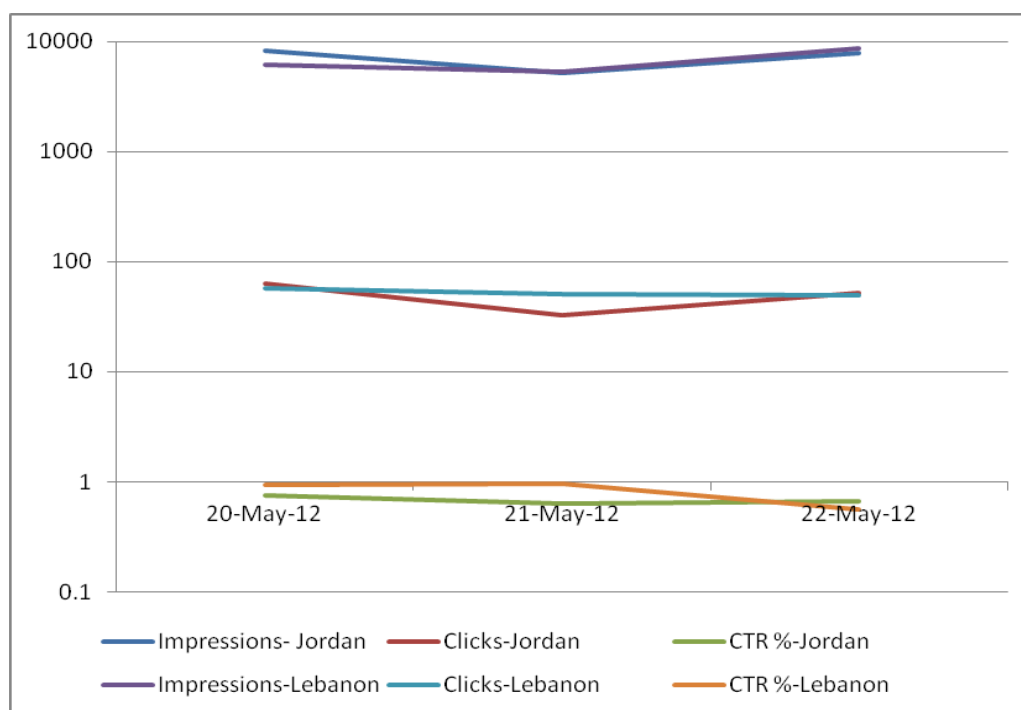
### 3.2.9 Ad1: Lebanon and Jordan graph



### 3.2.10 Ad2: Same picture, different text



### 3.2.11 Ad3: Same text, different picture



We don't discuss the banner Ad as it was not displayed extensively. We had only one Ad size. Unless we have several different banner sizes available, the display location will be constrained.

### 3. Lebanon and Jordan do not show a trend of CTR spikes on weekends

From the individual Ad charts, we see that Jordan and Lebanon do not exhibit the pronounced 'weekend effect' that we saw with UAE earlier. Jordan has a Friday, Saturday (18th and 19<sup>th</sup>) while Lebanon has a regular Sat and Sunday weekend.

We observe that CTR spikes correspond more with Ad change than weekends.

We also record the technical information from InMobi and Google Analytics. The data will be aggregated to reveal trends after a few more experiments.

### 4. Nokia and RIM are top phones in Lebanon.



The number of people reached in Lebanon, based on manufacturers show a similar trend as UAE and Mexico. Nokia had 42% and RIM 49% of impressions. Google analytics manufacturer based report has similar numbers. The browser based report shows 54% Safari and 21% Opera mini. (also similar to previous reports).

#### **5. Jordan has predominantly non-major manufacturers**

Jordan has a surprising distribution of impressions by manufacturer. 62% impressions are from other OS platforms ( not android, ios, RIM or Symbian). The Google analytics reports for browser are similar to Lebanon, UAE and Mexico. Most visits are from Safari and Opera mini.

#### **c) Comparing regions within a country**

1. Ad Server: InMobi

2. Duration: 05/30/2012 – 06/03/2012: 5 days

Weekend: 2<sup>nd</sup> and 3<sup>rd</sup>

3. Countries: Lebanon, Jordan & Oman

4. Targeting: Location – Region Wise

Jordan South – Al Aqabah, Al Karak, AT Tafilah, Maan

Jordan North – Ajlun, Al Balqa, Al Mafraq, Amman, Az Zarqa, Irbid, Madaba

Lebanon South – Beqaa, Liban-Sud, Nabatiye

Lebanon North – Beyrouth, Liban-Nord

Oman I – Masqat

Oman II – Al Wusta, Zufar

## 5. Experiment:

Name: Region Wise targeting

Goal: a) To compare the campaign performance in two different  
b) Analyzing auxiliary data.

Hypothesis: We expect different regions of a country to show difference in performance. We do not expect technical data to differ a lot. All three countries were divided into regions such that the entire capital region falls into one group. We expect the group with capital region to show better performance.

### Overview data:

#### 3.3.1 Consolidated report

Campaign Name	Impressions	Clicks	CTR	eCPC	Total Ad Spend
Region Wise	146,030	589	0.40	0.09	53.01

#### 3.3.2 Consolidated Daily report

Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
30-May-12	33908	153	0.45	0.09	13.77
31-May-12	28505	149	0.52	0.09	13.41
1-Jun-12	34194	110	0.32	0.09	9.90
2-Jun-12	25631	89	0.35	0.09	8.01
3-Jun-12	23,792	88	0.37	0.09	7.92

#### 3.3.3 Ad Report:

Ad Name	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
Lebanon South	31394	164	0.52	0.09	14.76
Lebanon North	28713	116	0.40	0.09	10.44
Jordan South	27644	79	0.29	0.09	7.11
Jordan North	20025	67	0.33	0.09	6.03
Oman Muscat	23882	117	0.49	0.09	10.53
Oman Others	14372	46	0.32	0.09	4.14

## 3.3.4 Country wise report:

Country Name	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
Jordan	47669	146	0.31	0.09	13.14
Lebanon	60107	280	0.47	0.09	25.20
Oman	38254	163	0.43	0.09	14.67

## 3.3.5 Jordan south daily report

Jordan South:					
Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
30-May-12	4256	12	0.28	0.09	1.08
31-May-12	5332	20	0.38	0.09	1.80
1-Jun-12	6268	11	0.18	0.09	0.99
2-Jun-12	7263	18	0.25	0.09	1.62
3-Jun-12	4525	18	0.40	0.09	1.62

## 3.3.6 Jordan north daily report

Jordan North:					
Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
30-May-12	4282	11	0.26	0.09	0.99
31-May-12	4839	19	0.39	0.09	1.71
1-Jun-12	2747	7	0.25	0.09	0.63
2-Jun-12	4326	11	0.25	0.09	0.99
3-Jun-12	3831	19	0.50	0.09	1.71

## 3.3.7 Lebanon south daily report

Lebanon South:					
Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
30-May-12	7676	41	0.53	0.09	3.69
31-May-12	5304	37	0.7	0.09	3.33
1-Jun-12	6894	31	0.45	0.09	2.79
2-Jun-12	5813	25	0.43	0.09	2.25
3-Jun-12	5707	30	0.53	0.09	2.7

## 3.3.8 Lebanon North daily report

Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
30-May-12	3790	24	0.63	0.09	2.16
31-May-12	6438	46	0.71	0.09	4.14
1-Jun-12	3400	15	0.44	0.09	1.35
2-Jun-12	2956	9	0.3	0.09	0.81
3-Jun-12	12129	22	0.18	0.09	1.98

## 3.3.9 Oman-Muscat daily report

Oman Muscat					
Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
30-May-12	12041	62	0.51	0.09	5.58
31-May-12	2943	17	0.58	0.09	1.53
1-Jun-12	2343	11	0.47	0.09	0.99
2-Jun-12	2669	14	0.52	0.09	1.26
3-Jun-12	3886	13	0.33	0.09	1.17

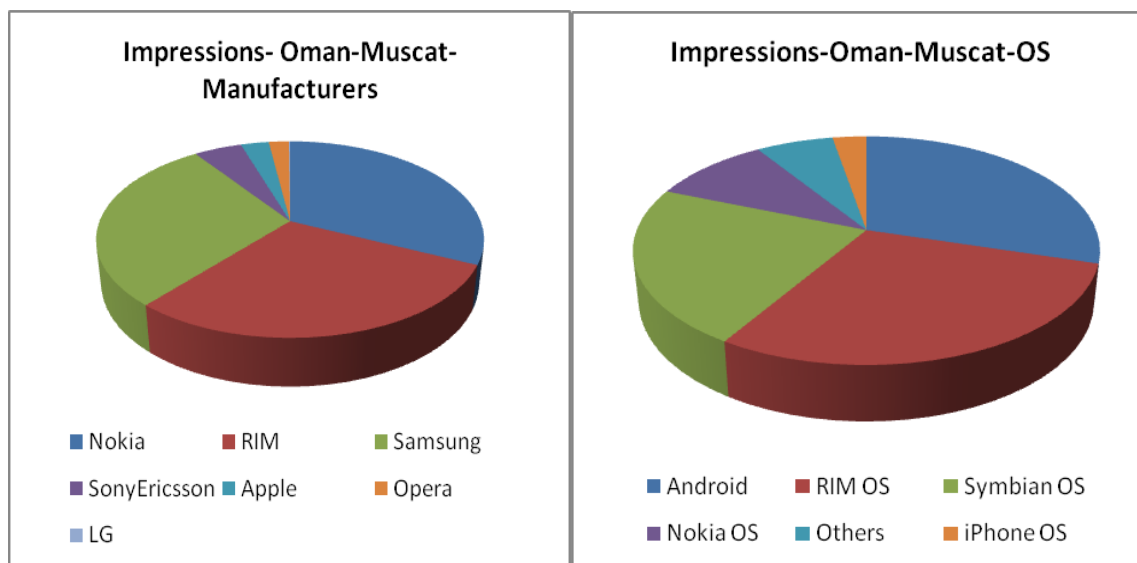
## 3.3.10 Oman-Others daily report

Oman Others					
Date/Time	Impressions	Clicks	CTR %	CPC (USD)	Ad Spend (USD)
30-May-12	1863	3	0.16	0.09	0.27
31-May-12	3649	10	0.27	0.09	0.9
1-Jun-12	2140	13	0.61	0.09	1.17
2-Jun-12	2604	12	0.46	0.09	1.08
3-Jun-12	4116	8	0.19	0.09	0.72

## Technical Reports:

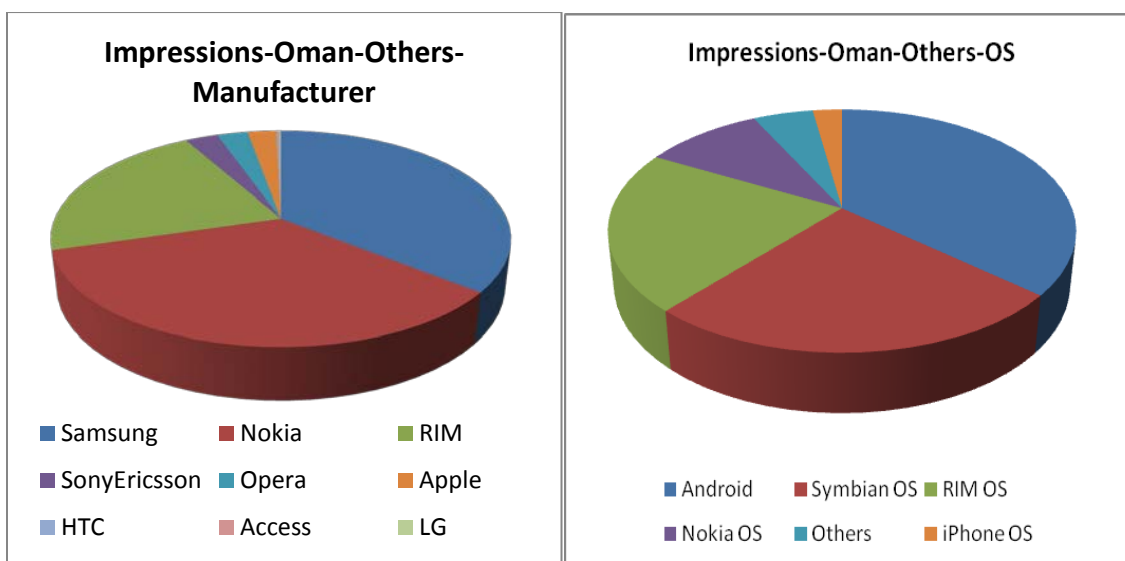
## Oman:

Both set of regions in Oman show a similar distribution of impressions among manufacturers. Major manufacturers in the Muscat region are Nokia, Samsung and RIM. All other regions have the same split-up, but for a few percentage point differences. The OS platform data is in accordance with manufacturer data.



3.3.1 Oman Muscat Manufacturers

3.3.2 Oman Muscat OS

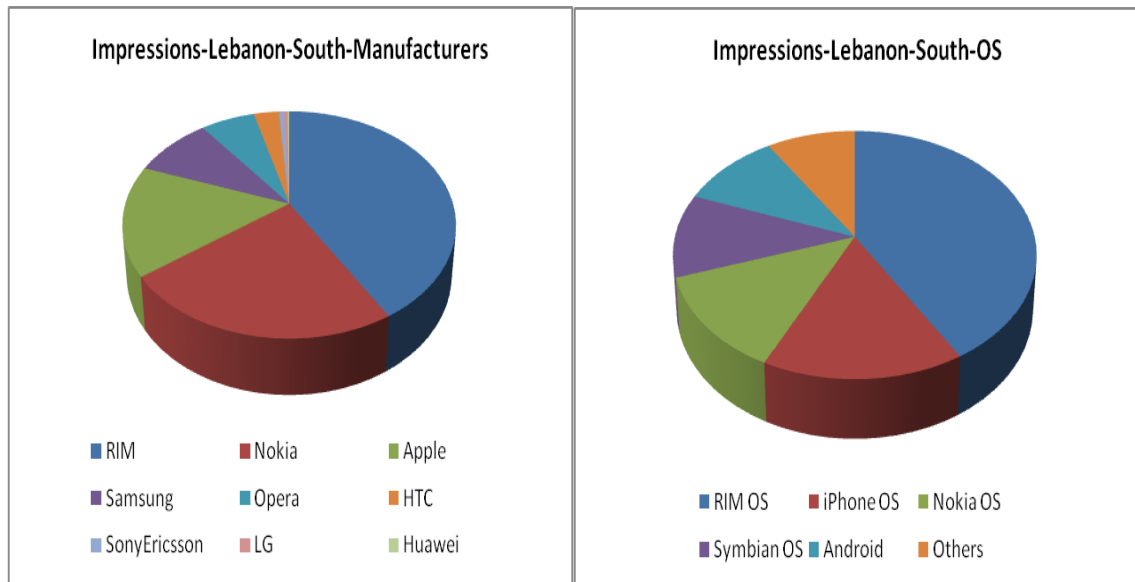


3.3.2 Oman others manufacturers

3.3.3 Oman others OS

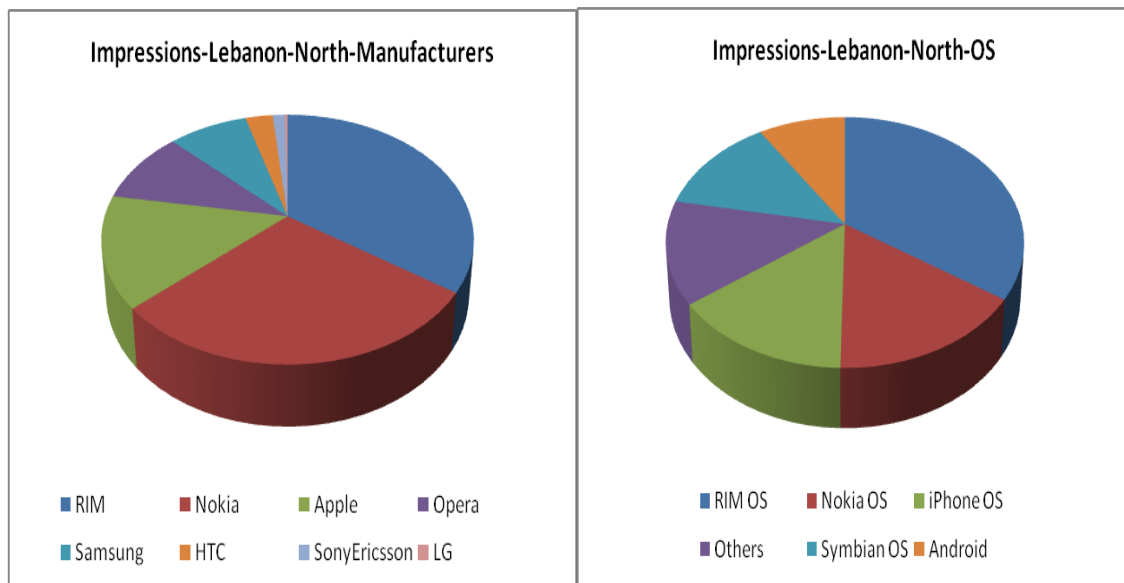
### Lebanon

RIM, Nokia and Apple are the top manufacturers in north and south Lebanon. The data confirms the earlier observation about RIM and Nokia being top manufacturers. But the surprise entrant in this campaign is Apple. It's got around 30% share in the impressions made. Otherwise, we find a similar distribution in both regions.



3.3.4 Lebanon south manufacturers

3.3.5 Lebanon south OS

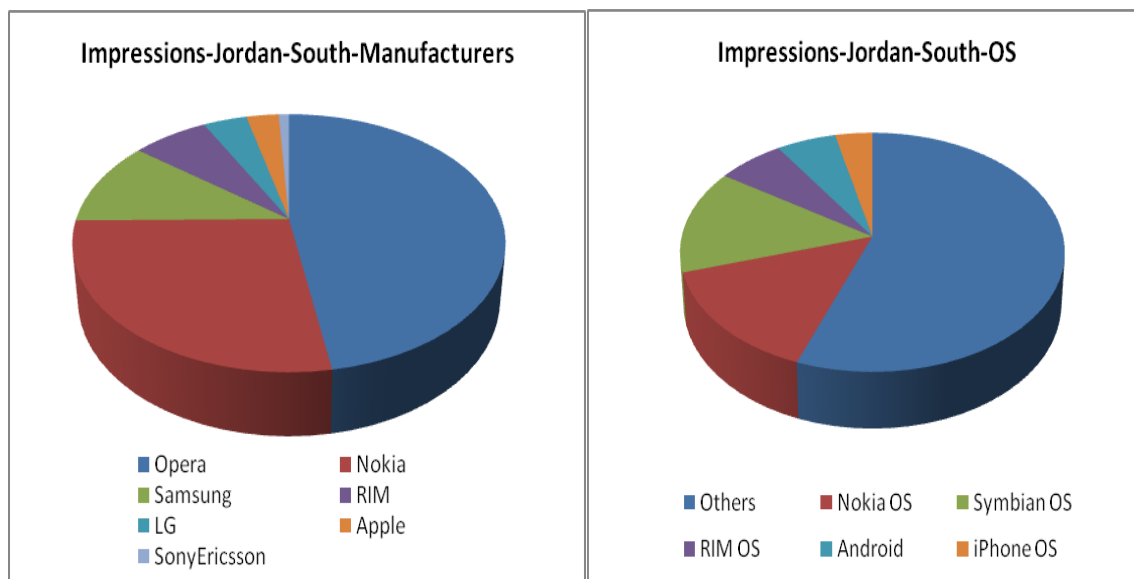


3.3.6 Lebanon north manufacturers

3.3.7 Lebanon north OS

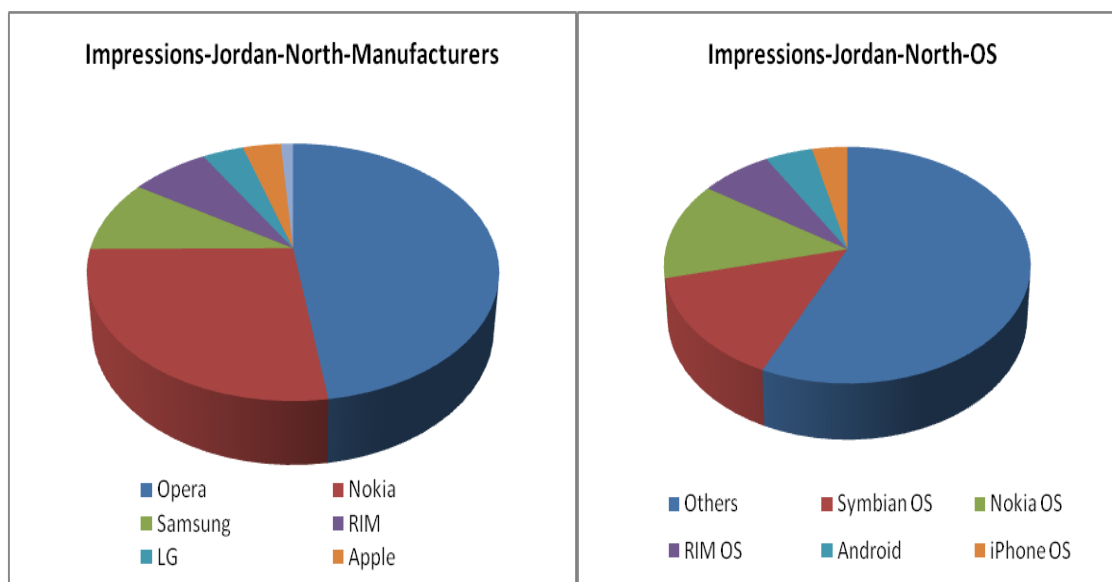
## Jordan

Jordan north and south have a remarkable similar distribution of manufacturers. The data is also in accordance with our observations on Jordan in Expt2.



3.3.8 Jordan south manufacturers

3.3.9 Jordan south OS



3.3.10 Jordan north manufacturers

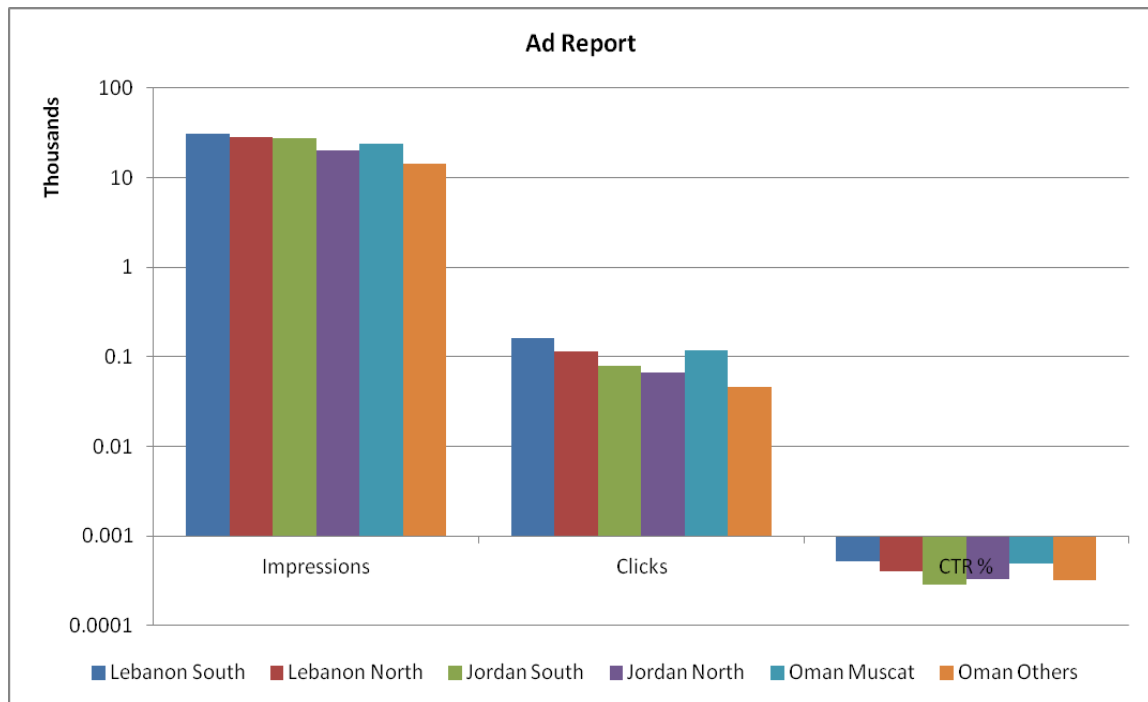
3.3.11 Jordan north OS

**Observations:**

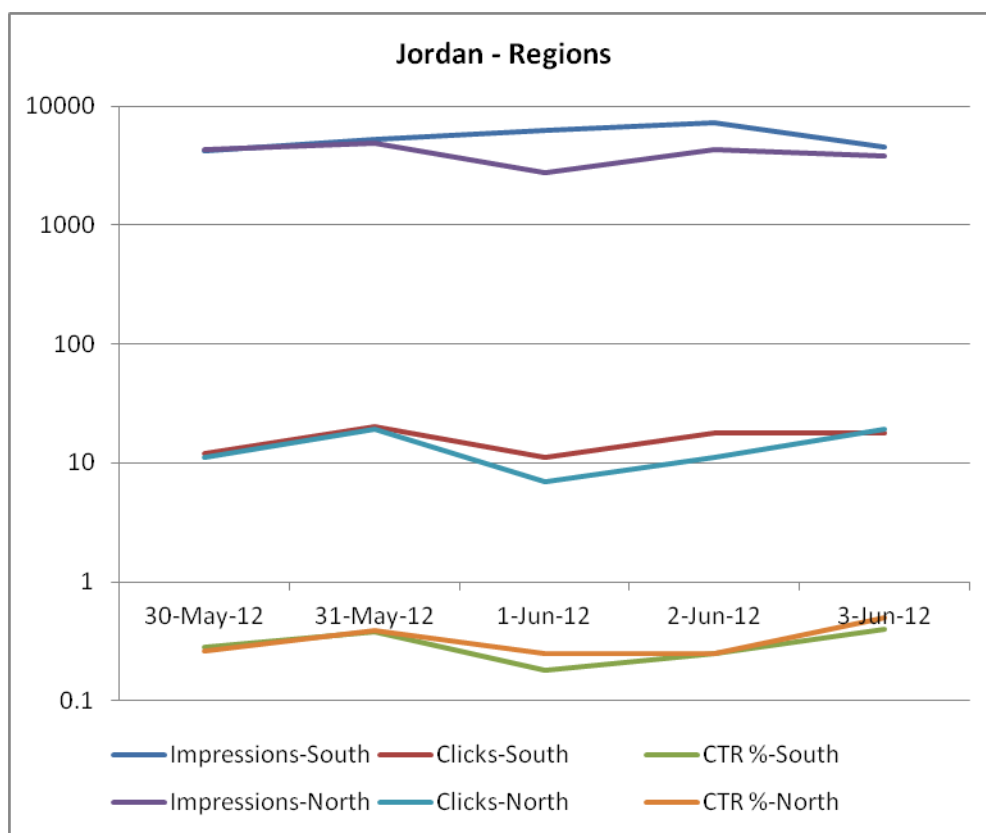
1. Ads in both regions of Lebanon and Jordan show comparable performance.

The metrics don't vary much but there are some interesting trends. The capital regions of both countries Lebanon and Jordan fall in the north. Both Lebanon north and Jordan north show a marked drop in impressions, clicks and CTR. This is evidence of much higher competition for Ad space in the capital regions during the weekly holiday. However, the CTR does not increase during this period, confirming our earlier observation that Lebanon and Jordan don't show any weekend effect of increased CTR.

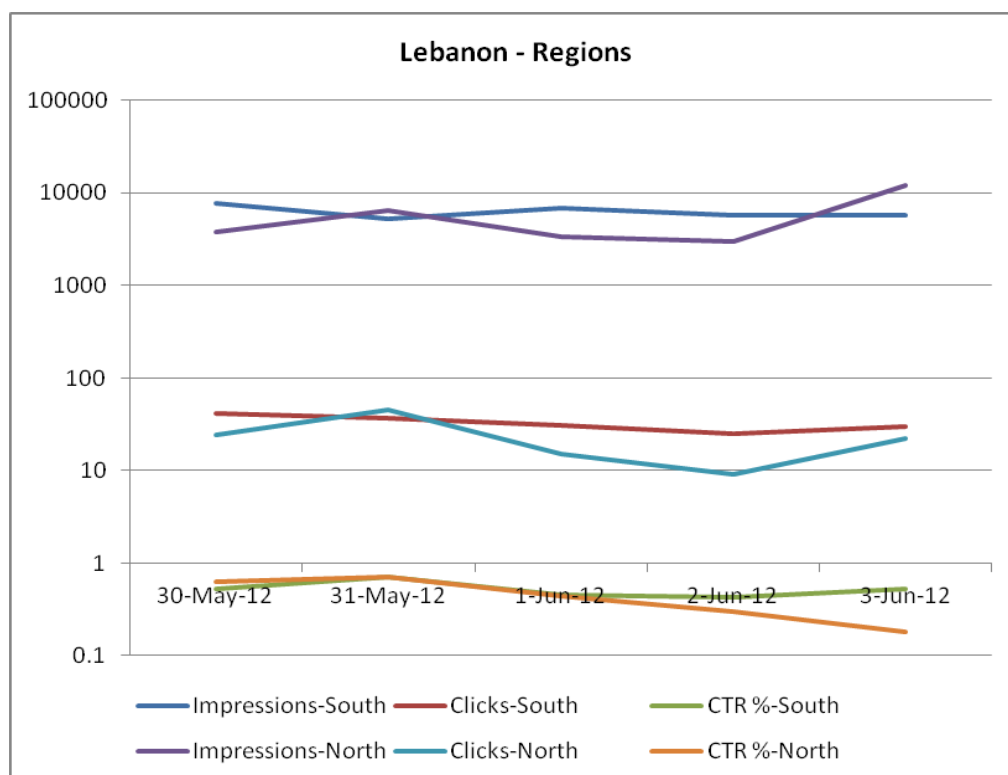
### 3.3.12 Ad Report graph



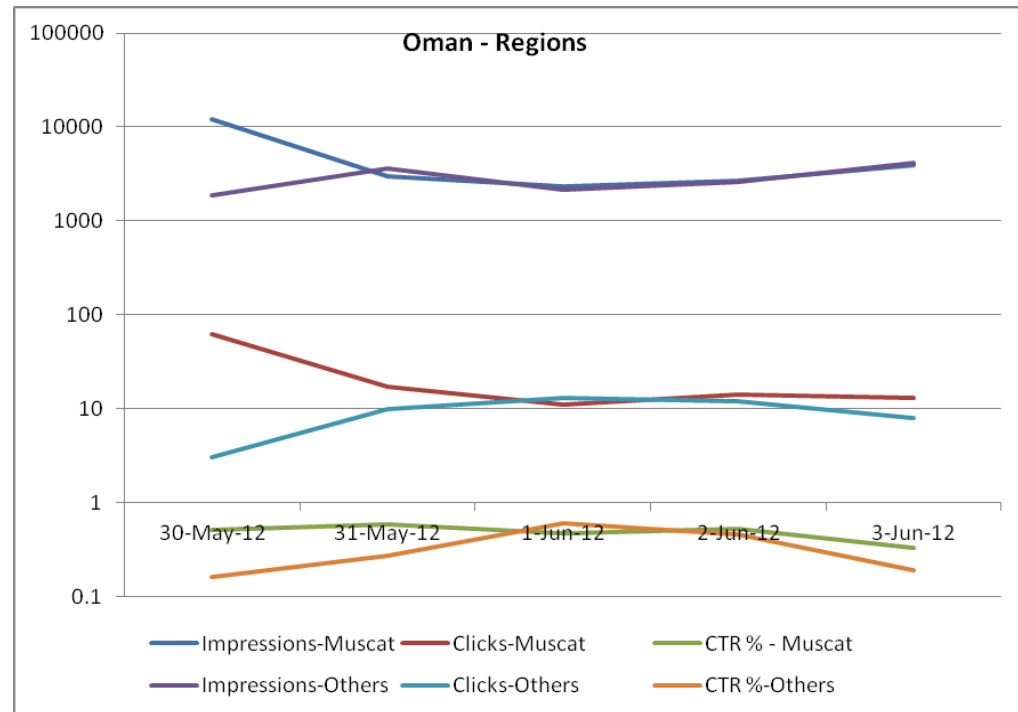




3.3.13 Jordan regions graph



### 3.3.14 Lebanon regions graph



### 3.3.15 Oman regions graph

#### 2. **Oman had much more activity in Muscat than in other regions.**

The number of impressions clicks and CTR are all higher on all days for Muscat than other regions.

3. **In regions in Oman, the impressions decrease and CTR increases corresponding to Friday.** There is no such holiday effect in Lebanon and Jordan, as observed in the changing text and picture experiment.
4. **There are freak days.** The Muscat region in Oman on Wednesday (May-30) and Lebanon on Sunday (Jun 3) had impressions above 12,000. This was not followed by any remarkably high clicks or CTR. This must be due to a higher number of impressions available that day.

**5. Different regions of Oman, Lebanon and Jordan have the same distribution of manufacturer based reach**

As observed in the technical reports, data from different regions have very minor differences in manufacturer based distribution.

## **Future Directions**

### 1. Ad Auctioning in mobile applications:

We now understand how Ad mediation works in mobile advertising through an analysis of the AdWhirl server and client. However, we know little about an actual Ad Auction in application based mobile Ads. More and more mobile publishers are switching to auctioning sites like MobClix to maximize the fill-rate of their inventory. An in-depth analysis of auctions for mobile apps will prove invaluable to publishers and advertisers alike. While much is known about online browser based Ad auctions, research in this area is lacking. We expect the higher refresh rate of Ads and greater user information available on the mobile platform to significantly impact how the auction process works for Ads in mobile apps.

### 2. Third party software for collecting Ads shown to users.

Our approach for collecting data about Ads in mobile apps took the advertiser perspective. We ran Ad campaign experiments to understand the factors impacting campaign performance and to examine data from all possible sources. However, there are two more parties involved in the system whose perspectives are equally important.

#### a) Users

What Ads are users seeing in the apps they use? Is it possible to get all the Ads they are shown, any time they use an app on their mobile device? Ad collection software that can talk to other applications do exist. The challenges in collecting Ad information through this process could be:

#### i) How to successfully deploy such an application?

ii) How to validate the data collected by the application?

b) Publishers

From a publisher's perspective, Ads shown in their application, how they differ for different users and across different Ad Networks can be very useful information. Collecting this information boils down to intercepting Ads that are shown in the app via Ad Networks or Exchanges. The challenge is again in deploying such an application and validating the data it collects.

3. Role of third party organizations.

We know that Blue Kai is an active online user data gathering and analytics agency. We also understand how such an agency might gather user information through browser based content. What are the corresponding agencies in mobile advertising? ComScore has mobile measurement products that are effective in the North American market. Blue Cava and Ad Truth are device fingerprinting agencies. We expect these third party organizations to gain in importance as the mobile advertising market matures. For still, there are no products or solutions in the market that focus exclusively on apps as a medium.

We also don't know at what stage in the Ad display and delivery process these solutions gather information. Third party data analytics products for mobile content are an important piece of the puzzle for mobile advertising.

4. Dealing with privacy issues

The most contentious issue in application based mobile Ads is user information being sent to Ad networks. Applications routinely access device ID and location

through platform API. Is it ethical for Ad libraries to piggyback on app permissions and use such information for targeting purposes?

Awareness about such issues is much higher now. For any targeting advertisers want to do and any user information that Ad Networks are seeking, they will have to keep these issues in mind. How to deliver better targeted Ads and collect more user information without violating their privacy is an important research issue.

## Appendix A

### Advertiser registration with Ad Networks and reports.

We show the campaign creation process through an example with screen shots from the InMobi Ad network.

#### 1. Registration:

The first step for the advertiser is to register with the network. This is an online process for most networks. But some do insist on a telephonic conference to discuss the Advertisers priorities. This is the preferred first step for big advertisers with long term campaigns. It is preferable to speak in person for a long term partnership.

#### 2. Campaign creation:

After registration is complete the advertiser is ready to start creating campaigns.

#### Create: New Campaign


---

Campaign Name :   
*Maximum 40 characters*

Campaign Budget :   
*Minimum USD 10*

Daily Budget :   
*Minimum USD 10*

Start Date : 14/06/2012 

End Date :    
*(Optional)*

---

Campaign Objective : Based on the objective selected, we recommend multiple options to engage with your consumers.

- ☐ Promote App
- ☐ Generate Leads
- ☐ Promote Content
- ☐ Drive Traffic
- ☐ Generate Awareness
- ☐ Others

---

Campaign Description :    
*(Optional)*  
*Maximum 250 characters*

Campaign objective is chosen at this point. The call-to-action options are determined based on this objective. For instance, a promote app objective will have a store URL call to action. Daily budget for the campaign is optional.

### 3. Ad Group

An Ad Group is a set of Ads having the same bid rate, targeting the same audience. E.g. all iPhone users in NYC at 0.9 dollars per click.

#### a) Ad group creation

### Create: New Ad Group

---

1

2

3


Ad Group      Define Users      Bid

---

Country :

Campaign Objective :  ▼


Call to Action :  ▼



URL:

Example: <http://wap.inmobi.com>

Ad Group Name : 

25characters remaining

Start Date:   12

End Date :   12   

(Optional)

Pricing Model :  ▼

---

Call to action in this case is a URL. All Ads in this Ad Group open the same web page in the browser on click.

#### b) Targeting



**Regions & Carriers :** Target users by region and carrier

Regions	Carriers
<input type="text" value="Quick Search"/>	<input type="text" value="Quick Search"/>
<input checked="" type="checkbox"/> All Regions	<input checked="" type="checkbox"/> All Carriers <input checked="" type="checkbox"/> Iusacell MX <input checked="" type="checkbox"/> Movistar MX <input checked="" type="checkbox"/> Nextel MX <input checked="" type="checkbox"/> Telcel MX <input checked="" type="checkbox"/> WiFi

**Device Targeting :** Target users by device and platform

☐ All   
 ☒ Custom   
 ☐ Specific Models

Choose Handset Groups

By Operating System	▼
By Manufacturer	
By Operating System	✓

Targeting is region, carriers, device OS and manufacturer based. In certain countries more granular region-wise targeting is possible. Carriers, manufacturers and devices have a wide range of targeting options.

### c) Bidding

**Create: New Ad Group**

---

1 Ad Group    2 Define Users    3 Bid

---

**Bid**

Selected Pricing Model: CPC

The minimum bid is indicative of the demand for the targeting profile selected. It is recommended to enter a bid higher than the minimum bid to get a greater exposure.

Call to Action	Minimum Bid (USD)	Enter Your Bid (USD)
URL	0.040	<input type="text" value="0.050"/>

**Daily Spend Limit (Optional)**

Enter the amount you want to spend on this ad group each day. If your campaign has only one ad group, it is recommended not to set the daily spend limit.

Set Daily Spend Limit: USD  Minimum USD 10

---

◀ Define Users

The network indicates the minimum bid for the country being targeted. Ad groups within a campaign can have their own spend limits.

### 4. Creative

Creatives are the Ads in an Ad group. InMobi allows text and banner Ads. More options are available in other networks. Ad Words for instance, allows video Ads.

The Advertiser registration and targeting process in InMobi is representative of many networks, with minor differences. We briefly discuss some finer points of Google AdWords where it differs from major networks.

Text Ad:

## Create: New Creative

### Brand Tile Image



The brand tile image will be displayed only on smartphones, alongside your ad. It is recommended that you upload an image to promote your brand or any relevant image to capture user attention.

Ensure that your images are 38x38 px in size.

[Upload](#)

### Creatives:

1

Ad Type: Banner Ad

Ad Name :

Maximum 40 characters

Alt Text :

Maximum 40 characters

**Banner :** The recommended dimensions for this ad group are 300 x 50 , 320 x 48 , 300 x 250 , 728 x 90 , 468 x 60 , 640 x 100 , 320 x 53 , 300 x 30 dimension.  
Please upload at least one of the recommended banners  
The accepted banner formats are JPG, GIF, PNG. The maximum banner size is 100 KB.

[Add Files](#) [Upload](#)

☐ Track Creative Performance

### Banner Ad

## Create: New Creative

### Brand Tile Image



The brand tile image will be displayed only on smartphones, alongside your ad. It is recommended that you upload an image to promote your brand or any relevant image to capture user attention.

Ensure that your images are 38x38 px in size.

[Upload](#)

### Creatives:

1

Ad Type: Banner Ad

Ad Name :

Maximum 40 characters

Alt Text :

Maximum 40 characters

**Banner :** The recommended dimensions for this ad group are 300 x 50 , 320 x 48 , 300 x 250 , 728 x 90 , 468 x 60 , 640 x 100 , 320 x 53 , 300 x 30 dimension.  
Please upload at least one of the recommended banners  
The accepted banner formats are JPG, GIF, PNG. The maximum banner size is 100 KB.

[Add Files](#) [Upload](#)

☐ Track Creative Performance

## Google AdWords

### 1. Location based targeting:

In select locations, very fine location based targeting is possible. For instance, in the US, advertisers can select a radius around a particular city or even a particular zip code.

**Choose your locations**

Search | Radius targeting | Bulk locations

new Search

Matches	Reach	
New York, New York, United States - city	8,810,000	Add   Exclude   Nearby
New York, United States - state	12,700,000	Add   Exclude   Nearby
New Orleans, Louisiana, United States - city	358,000	Add   Exclude   Nearby
New South Wales, Australia - state	7,510,000	Add   Exclude   Nearby
New Jersey, United States - state	4,400,000	Add   Exclude   Nearby
New Zealand - country	3,000,000	Add   Exclude   Nearby
New Mexico, United States - state	684,000	Add   Exclude   Nearby
New Haven, Connecticut, United States - city	182,000	Add   Exclude   Nearby
New Hampshire, United States - state	658,000	Add   Exclude   Nearby
Locations that enclose: New York, New York, United States		
New York NY, United States - metro	15,300,000	Add   Exclude   Nearby
New York, United States - state	12,700,000	Add   Exclude   Nearby
United States - country	182,000,000	Add   Exclude   Nearby

United States (country)  
Reach: 182,000,000  
Added | Remove | Nearby

Hide locations on map

Send feedback

### 1. Mobile targeting

## Networks and devices

Networks ? All Edit

Devices ?

☐ All available devices (Recommended for new advertisers)
 ☒ Let me choose...
 


☐ Desktop and laptop computers
 ☒ Mobile devices with full browsers
 ☒ Tablets with full browsers
 

☐ Advanced mobile and tablet options

**Operating systems ?**
☒ All available operating systems
 ☐ Let me choose...

**Device models ?**
☒ All available devices
 ☐ Let me choose...

**Carriers and Wi-Fi ?**
☒ All available carriers and Wi-Fi
 ☐ Let me choose...

 Your ads won't show on desktop and laptop computers.

## 2. Demographic targeting

### Demographic exclusions and reporting

This summary shows how your ads have performed on sites that offer demographic data. You can prevent your ads from showing to a specific demographic group by excluding the group below.

0.00% of total impressions are from sites with demographic data. ?

#### Traffic Reports by Gender and Age (for last 7 days)

Gender	Exclude	Clicks	Impr.	CTR	Avg. CPC	Cost
Male	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
Female	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
Undetermined		0	0	0.00%	\$0.00	\$0.00

Age	Exclude	Clicks	Impr.	CTR	Avg. CPC	Cost
18-24	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
25-34	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
35-44	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
45-54	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
55-64	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
65+	<input type="checkbox"/>	0	0	0.00%	\$0.00	\$0.00
Undetermined	<input type="checkbox"/> ?	0	0	0.00%	\$0.00	\$0.00

### 3. Ad placements

It's possible to select applications or sites where Ads from a campaign should be shown.

It does not guarantee impressions in the selected content.

Placement	Placement Type	Ad Types
<input type="checkbox"/> kizi.com » Game page, Multiple locations ▾	Site	 
<input type="checkbox"/> kizi.com » Game Pages, Top center ▾	Site	 
<input type="checkbox"/> kizi.com » Game pages, Middle right ▾	Site	 
<input type="checkbox"/> kizi.com ▾	Site	 
<input type="checkbox"/> koodosgames.net » Homepage, Bottom ▾	Site	
<input type="checkbox"/> koodosgames.net ▾	Game	
<input type="checkbox"/> 217533d8dc5a703f.anonymous.google ▾	Site	 
<input type="checkbox"/> Games: playedom.com » fullscreen ▾	Game	 
<input type="checkbox"/> Games: playedom.com » Fullscreen ▾	Game	 
<input type="checkbox"/> Games: playedom.com ▾	Game	 

### 4. Placement reports

Adsenseformobileapps.com is clicks and impressions in mobile apps. The rest are

AdWords placements in various sites.

Automatic placements				
<div> Manage placement and bid Exclude from targeting See URL list ▾ Filter ▾ Columns ▾ Download </div>				
<input type="checkbox"/> Sites	Ad group	Clicks	Impr.	CTR <sup>?</sup>
<input type="checkbox"/> arab4mb3.com	uae_dress	2	0	0.00%
<input type="checkbox"/> alazkar.net	uae_dress	1	1	100.00%
<input type="checkbox"/> dar-alhayat.com	uae_dress	1	1	100.00%
<input type="checkbox"/> hwaml.com	uae_dress	1	1	100.00%
<input type="checkbox"/> adsenseformobileapps.com	uae_dress	68	16,424	0.41%
<input type="checkbox"/> lamees.com	uae_dress	1	2	50.00%
<input type="checkbox"/> livearabictv.org	uae_dress	1	17	5.88%
Other domains <sup>?</sup>		0	2,232	0.00%
<b>Total - Automatic Placements</b>		<b>75</b>	<b>18,643</b>	<b>0.40%</b>
<b>Total - Display Network</b>		<b>75</b>	<b>18,678</b>	<b>0.40%</b>

## Appendix B

Publisher registration, reports and integration code – AdWhirl mediation server.

We show the step by step procedure for publishers to register their applications with the AdWhirl mediation server.

### 1. Application registration

After the publisher has created an account with Ad Whirl, they can proceed with registering their application(s)

The screenshot shows the 'Add a new App' interface. At the top, there's a navigation bar with 'Apps', 'House Ads', 'Reports', and 'Dev Resources'. Below this is a breadcrumb 'App List > Create App'. The main heading is 'Add a new App'. The form is organized into two main sections: 'Application Information' and 'Ad Serving Settings (Optional)'. In the 'Application Information' section, there are input fields for 'Name' and 'URL', and a 'Platform' dropdown menu currently showing 'iPhone'. The 'Ad Serving Settings (Optional)' section contains several settings: 'Background Color' (a text input with 'FFFFFF (default)'), 'Text Color' (a text input with '000000 (default)'), 'Refresh Rate' (a dropdown menu showing '30 seconds'), 'Transition Animation' (a dropdown menu showing 'Random'), and 'Allow Location Access' (a toggle switch currently set to 'OFF'). At the bottom right of the form, there are two buttons: 'Add App' and 'Cancel'.

Publishers need to provide app name, store url for download (optional), choose the platform and display specs. They also need to specify if they will provide permissions for client code to access user location via platform API. On registration, AdWhirl provides an SDK key that is used by the mediation client to talk to the server.

### 2. Network traffic allocation


The publisher must now allocate traffic to the networks supported by AdWhirl. Additionally, they must register with each individual network they are allocating traffic to and obtain the nw specific publisher ID. This ID should now be entered for each network in the allocation page. Unless the publisher supplies this ID, AdWhirl client will not be able to request Ads from the network for display.

**Banner Details** SDK Key:bc438e53d1de4e91a9c94ead4f179218 Switch App ▾

**Ad Network Settings**  
Backfill Priority  
House Ads  
App Settings

**Networks**

[+ Add Custom Event](#)

Ad Network		
AdMob		
Google AdSense		
InMobi		
MdotM		
Millennial Media	Not Configured	-- %
Nexage	Not Configured	-- %
OneRiot	Not Configured	-- %
Quattro	Not Configured	-- %
ZestADZ	Not Configured	-- %

Total Allocation: 0%

**AdMob**

PublisherID:

[Save Changes](#) [Disable](#) [Cancel](#)

[Network Website >>](#)

**How to Activate Networks**

- Click on the key and provide the required keys to activate the explicitly supported networks
- Use the "+ Add Custom Events" button at the top of the table to add another network to this app. Be sure to provide a name and function name.

### 3. Mediation client integration:

#### a) AdWhirl Layout:

The layout of the first app screen in XML; note that AdWhirl layout is included here as an object.



```

<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res/com.adwhirl"
    android:orientation="vertical"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent"
    android:id="@+id/layout_main" >
    <TextView
        android:layout_width="fill_parent"
        android:layout_height="wrap_content"
        android:text="@string/hello" />
    <com.adwhirl.AdWhirlLayout
        android:id="@+id/adwhirl_layout"
        android:layout_width="fill_parent"
        android:layout_height="wrap_content" />
    <TextView
        android:layout_width="fill_parent"
        android:layout_height="wrap_content"
        android:gravity="center_horizontal"
        android:text="@string/below_layout_xml" />
</LinearLayout>

```

- b) Code for the main activity that launches on application start. The activity layout is assigned, targeting information is set and the application context is passed to the layout. The Ad display and refresh process is now taken over by the AdWhirl layout.

```

public class Invoker extends Activity implements AdWhirlInterface {

    /** Called when the activity is first created. */
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);

        setContentView(R.layout.main);
        LinearLayout layout = (LinearLayout) findViewById(R.id.layout_main);

        if (layout == null) {
            Log.e("AdWhirl", "Layout is null!");
            return;
        }

        // These are density-independent pixel units, as defined in
        // http://developer.android.com/guide/practices/screens_support.html
        int width = 320;
        int height = 52;

        DisplayMetrics displayMetrics = getResources().getDisplayMetrics();
        float density = displayMetrics.density;

        width = (int) (width * density);
        height = (int) (height * density);

        // Targeting information being added using client API.
        AdWhirlTargeting.setAge(23);
        AdWhirlTargeting.setGender(AdWhirlTargeting.Gender.MALE);
        String keywords[] = { "online", "games", "gaming" };
        AdWhirlTargeting.setKeywordSet(new
HashSet<String>(Arrays.asList(keywords)));
        AdWhirlTargeting.setPostalCode("94123");
        AdWhirlTargeting.setTestMode(false);

        //Application name
        AdWhirlAdapter.setGoogleAdSenseAppName("AdWhirl Test App");
        AdWhirlAdapter.setGoogleAdSenseCompanyName("AdWhirl");

        // Optional, will fetch new config if necessary after five minutes.
        AdWhirlManager.setConfigExpireTimeout(1000 * 60 * 5);

        // References AdWhirlLayout defined in the layout XML.
        AdWhirlLayout adWhirlLayout = (AdWhirlLayout)
findViewById(R.id.adwhirl_layout);
        adWhirlLayout.setAdWhirlInterface(this);
        adWhirlLayout.setMaxWidth(width);
        adWhirlLayout.setMaxHeight(height);

    }

    public void adWhirlGeneric() {
        Log.e(AdWhirlUtil.ADWHIRL, "In adWhirlGeneric()");
    }
}

```

## c) Getting user location using platform API

```

public Location getLocation() {
    if (contextReference == null) {
        return null;
    }
    Log.i(AdWhirlUtil.ADWHIRL, "Admanager: getLocation() ");

    Context context = contextReference.get();
    if (context == null) {
        return null;
    }

    Location location = null;

    if (context
        .checkCallingOrSelfPermission(android.Manifest.permission.ACCESS_FINE_LOCATION) == PackageManager.PERMISSION_GRANTED) {
        LocationManager lm = (LocationManager) context
            .getSystemService(Context.LOCATION_SERVICE);
        location = lm.getLastKnownLocation(LocationManager.GPS_PROVIDER);
    } else if (context
        .checkCallingOrSelfPermission(android.Manifest.permission.ACCESS_COARSE_LOCATION) == PackageManager.PERMISSION_GRANTED) {
        LocationManager lm = (LocationManager) context
            .getSystemService(Context.LOCATION_SERVICE);
        location = lm.getLastKnownLocation(LocationManager.NETWORK_PROVIDER);
    }
    return location;
}

```

## d) Getting device ID

```

public AdWhirlManager(WeakReference<Context> contextReference,
    String keyAdWhirl) {
    Log.i(AdWhirlUtil.ADWHIRL, "Creating adWhirlManager...");
    this.contextReference = contextReference;
    this.keyAdWhirl = keyAdWhirl;

    localeString = Locale.getDefault().toString();
    Log.d(AdWhirlUtil.ADWHIRL, "AdManager: Locale is: " + localeString);

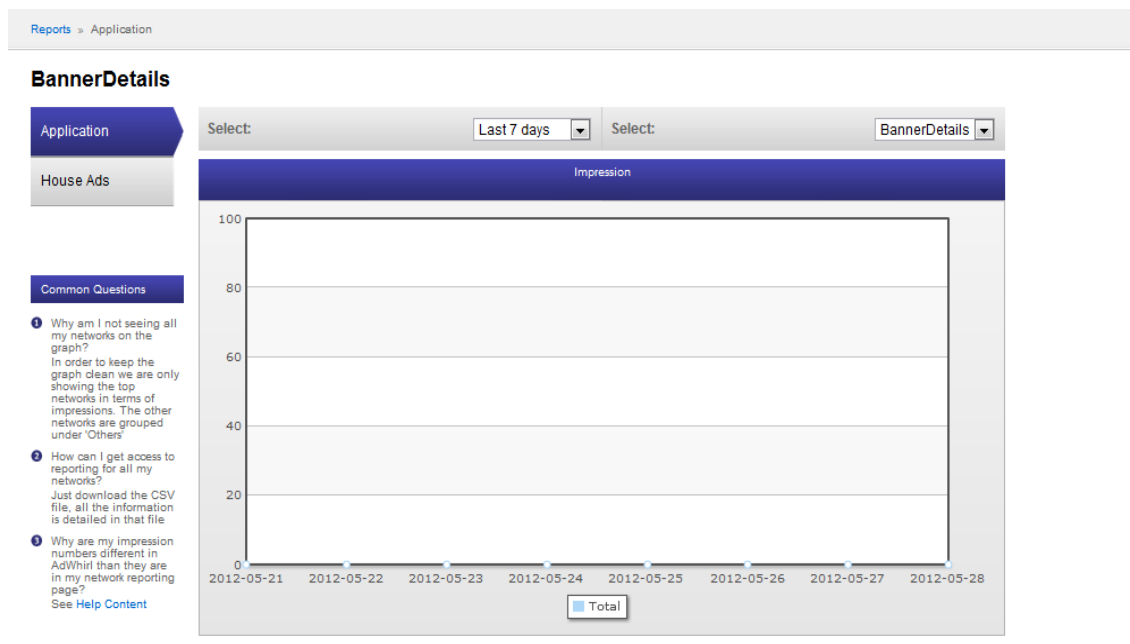
    MessageDigest md;
    try {
        md = MessageDigest.getInstance("MD5");
        StringBuffer deviceIDString = new StringBuffer(Secure.ANDROID_ID);
        deviceIDString.append("AdWhirl");
        deviceIDHash = AdWhirlUtil.convertToHex(md.digest(deviceIDString
            .toString().getBytes()));
    } catch (NoSuchAlgorithmException e) {
        deviceIDHash = "00000000000000000000000000000000";
    }
    Log.d(AdWhirlUtil.ADWHIRL, "AdManager: Hashed device ID is: " +
deviceIDHash);

    Log.i(AdWhirlUtil.ADWHIRL, "Admanager: Finished creating
adWhirlManager");
}

```

#### 4. Publisher reports

AdWhirl provides impressions report to publishers. It tells them how many impressions of Ads were shown by each network and their relative contributions.



## Glossary

- Ad:** A creative communication method, used to capture the attention of the audience to persuade them to take action as desired by advertising entity. A mobile Ad is a digital Ad that appears in any mobile content like app, games or web page or as search results.
- Advertiser:** Organizations/individuals who have to motive to engage an audience and choose to do it through Ads.
- Ad Group:** A set of Ads targeting audience from the same location, with the same objective and with same bid rates. An Ad group can have several Ads.
- Ad Campaign:** A set of Ads that have the same objective and usually run by the same advertiser. An Ad campaign can contain several Ad Groups.
- Ad Network:** An intermediary between advertisers and publishers. They enable multiple advertisers and publishers to engage with each other in an opaque fashion. They aggregate ad space from partner publishers and make it available to advertrisers.
- Ad Exchange:** An intermediary between publishers and ad networks. Ads from multiple networks are aggregated to fill Ad space inventory in online content. An Ad is chosen from the network that wins an auction based on bid rate for Ads.

<b>Application:</b>	Mobile content that is installed on the platform OS. It provides entertainment, utility, location or networking services to its users. Their developers are mobile publishers.
<b>Bid Rate:</b>	The cost an advertiser is willing to pay an Ad network in the event that a user clicks on an Ad (CPC) or sees an Ad (CPM).
<b>Bounce Rate:</b>	In web analytics, percentage of users who leave the site after viewing the first page.
<b>Click:</b>	The event of user clicking on an Ad after being shown the Ad.
<b>CPC:</b>	Amount charged to advertiser when user clicks on an Ad.
<b>CPM:</b>	Amount charged to Advertiser when a thousand impressions of an Ad have been made.
<b>CTR:</b>	Number of clicks/ Number of impressions of an Ad.
<b>Fill-rate:</b>	For publishers hosting Ads, number of Ads shown divided by total number of times Ad request is made to the network.
<b>Impression:</b>	A display of an individual Ad to the user.
<b>Publisher:</b>	Individuals/ Organizations releasing content like apps, games or web pages on the mobile markets.

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