Chapter 3: Taxonomy of Mobile Web Applications
from
A Taxonomy and Business Analysis for Mobile Web Applications

By
Kevin Hao Liu
Ph.D. Computer Science
Victoria University

Submitted to the System Design and Management Program
in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Management and Engineering

At the
Massachusetts Institute of Technology

February 2009
© 2009 Kevin H Liu. All rights reserved

The author hereby grants to MIT permission to reproduce and to distribute publicly paper and electronic
copies of this thesis document in whole or in part in any medium now known or hereafter created.

ABSTRACT

Mobile web applications refer to web applications on mobile devices, aimed at personalizing, integrating,
and discovering mobile contents in user contexts. This thesis presents a comprehensive study of mobile
web applications by proposing a new taxonomy for mobile web applications, and conducting a business
analysis in the field of mobile web applications.

The thesis reviews the current surrounding environment for mobile web applications, namely, web 2.0
and 3.0, wireless communication technology, and Smartphone platform. The recent entry and success of
Apple’s iPhone greatly enhanced the public awareness of the Smartphone technology. Google’s release
of open-source Android platform and T-Mobile’s deployment of Android-powered “Dream” Smartphone
not only intensify the competition among suppliers, but also provide an open-source foundation for
mobile web applications. This thesis introduces a new mobile web application taxonomy to
systematically study the values and the groupings of the mobile web applications. By introducing
features and categories, the taxonomy provides a framework so the related companies and businesses can
be comparatively analyzed and summarized. Selected case companies are studied in the light of the
taxonomy. The thesis discusses the key issues of mobile web aggregation, namely, mobile application
development platform, context modeling, mobile user interface, mobile application logic, and mobile web
aggregation strategy.
1. TAXONOMY OF MOBILE WEB APPLICATIONS

This section presents a systematic study of mobile web applications, which are software applications running on a mobile web platform.

Figure 1 shows the structure of the taxonomy in which mobile web applications are classified based on features and categories/subcategories.

Features are the unique values that mobile web applications can deliver to customers, whereas categories/subcategories are groupings so that companies and businesses can be comparatively analyzed and summarized.

![Taxonomy Diagram]

Figure 1  A Taxonomy for Mobile Web Applications

1.1 FEATURES

A mobile device such as a mobile phone is often carried by the user, and since the user is in motion, the device is moving from place to place. Current mobile devices usually are loaded with calendars, address books, tasks, and emails. A feature represents the unique value that mobile web applications
together with the mobile platform can deliver to a user. Mobile web applications have the following features:

- Context specific: Context refers to interrelated conditions in which something exists or occurs. In computing, context is related to the information used to characterize the situation of an entity, which is a person, place, or object considered relevant to the interaction between a user and an application, including the user and application themselves. Dourish in his 2004 paper on Personal and Ubiquitous Computing suggested that an individual’s experience and history is part of his/her current context [7]. Beale and Lonsdale in their 2004 paper present a hierarchical description of context in that they define context as “a dynamic process with historical dependencies”. The context is further described as “as set of changing relationships that may be shaped by the history of those relationships.” A user’s mobile phone contains the following information:
  - Location: a GPS phone can precisely pinpoint the user’s current location
  - Social network and status: names and contacts of one’s social network, e.g. via Facebook or Myspace. For status information, these friends can be characterized by their
    - Proximity to others
    - Social relationships
    - Collaborative tasks.
  - Address book
  - Personal information: age, gender, and language
  - Personal property: one may use mobile phone as a PDA (Personal Digital Assistant), which can store information on his/her personal property information, e.g. car online service account
  - Emails
  - Instant messages
  - Tasks
  - Calendars
  - Time: current time and time zone
  - Orientation: the orientation of a user to determine the direction the user is heading in and thus what is in front, behind, and to either side of them.
  - Favorite and historical bookmarks of the mobile web browser
  - Navigation history: allows the users to see where they have been and what they have seen and done.
  - Physical surroundings: mobile devices can be equipped with sensors to detect physical environment information such as temperature, lighting level (direct sunlight level), and noise level.
  - Mobile device system property: this describes the mobile device platform as well as bandwidth and the quality of the positioning information such as the GSP coverage.

The above information describes context in 6 aspects:
  - Spatial context: where you are?
  - Social context: who you are with?
  - Personal (interest) context: what are your past, current, and future interests?
  - Physical (surroundings) context: what is your environment?
  - System context: what is your platform?
Information context: what resources are nearby? Mobile web applications of this feature aims at context awareness. The device provides the context, whereas the service delivers feedback. In [9], user context is collected via “5 Ws”:

- Who – the ability of a device to identify not only its owner but also other people and devices in its vicinity within the environment
- What - the ability to interpret user activity and behavior, and using that information to infer what the user wants to do
- Where - the ability to interpret the location of the user and use that to tailor functionality
- When - the ability to understand the passage of time, use it to understand the activities around and to make inferences
- Why - the ability to understand the reasons behind certain user actions

- Ever present: worldwide mobile phone sales have surpassed PC sales for several years. A key reason of the popularity is people carry mobile phone (small but with needed functionality) not PC for their daily life. As mobile phones become more powerful and the wireline/wireless communication infrastructure becomes more wide spread, ubiquitous computing via mobile devices becomes reality. Mobile web applications on a ubiquitous platform need to satisfy these fundamental requirements:
  - Availability: a service should be available independent of context, and regardless of changes in user status, needs, and preferences.
  - Transparency: ideally, the applications in this space should allow users to perform tasks in non-intrusive way by hiding the underlying technology.

Since users carry mobile phone wherever they go, it is convenient for users to make purchase, watch news, and play games in addition to read emails and voice mails via the mobile phone platform. There are also a number of mobile web infrastructure software developed on the mobile web such as mobile Instant Massager and Widgets. PDA (Personal Digital Assistance) software is also in this category.

- Mobility: Mobile web applications can provide value by leveraging original mobile network characteristics. For instance, parents can use mobile web on their mobile phone to watch real time video and retrieve information on their babies in infant day care center via sensors and webcams. Diabetes patients can use cell phone together with a glucose meter to report blood sugar levels to doctors for regular checkup. mobile networks originally are developed for the following reasons
  - Ease of deployment: mobile infrastructure is cheaper and easier to deploy especially in a foreign environment or a remote region
  - Use of sensors: cost-efficient to use sensors to collect information and/or provide real time monitoring
  - Safety and emergency: provides a unique solution for user emergency and safety

To sum up, given the 3 features of the taxonomy, mobile web applications should focus on the key values of each feature

- Context: Emphasizing context results in **intelligent** application providing **context-awareness**.
- Ever-present: applications with this feature are **always available, transparent** applications providing **user convenience**.
• Mobility: applications with this feature are *easy to deploy, configure, and maintain* applications providing *cost-efficiency.*

### 1.2 Categories

In the light of the features introduced in the previous section, mobile web applications can be grouped into categories and sub categories for comparative market analysis. Each feature has multiple categories. A category is a collection of businesses and/or companies that are related in a certain way.

![Diagram showing categories]

**Figure 2** LBS

### 1.2.1 Feature -- Context

Context related categories include:

• Location based services (LBS): LBS are information and entertainment service that are accessible with mobile devices through the mobile network and utilizing the ability to use the geographical position of the mobile device. Figure 2 shows the LBS are the intersection of 3 technologies: mobile devices and wireless communication, Internet and Web, and Geographical Information System (GIS) and spatial database. GIS and LBS have similarities in relation to the handling of data with positional reference and spatial analysis functions. For example, both are interested in answers to these questions: where am I, what is nearby, and how can I go to a specific location. However, GIS and LBS are developed for different
user groups and therefore have different requirements. GIS is designed for professional geographic users and requires extensive computing resources, whereas LBS is targeted for mobile web users and operates under the restriction of mobile platform environment like low computational power, small displays, and limited run-time battery of the mobile devices.

An important topic of LBS is a spatial information process model that usually contains a model of possible user questions, defines queries of geographic base data and location information, and specifies possible answers. Figure 3 shows an example of the cartographic information process if a user asks for positions of restaurants close to his/her current position. There are 4 steps in the process: target space to define communication goals, query space to determine spatial grounding, problem space to apply known attributes, and answer space to locate context and answers.

LBS can be a push or pull based service. A push based service acts on an event and is not bound on user interactions. For instance, when a specific area is entered, a user receives a notification or an alert. A push system can be configured through user needs and preferences. A pull based service delivers information directly requested by the user. A pull service can be functional or informational. For example, an information pull service is needed when a user wants to know the closest Japanese restaurant to his current location; a functional pull service is involved when a user needs a taxi in his current location.

![Figure 3 GIS Information Processing](Source: [8])

LBS is one of the most promising, valuable mobile web application categories. There are potentially a wide range of LBS services developed or to be developed across many industry sectors. Figure 4 shows a taxonomy to group LBS according to the categories of navigation, tracking, management, advertising, information, and billing. Each subcategory may have multiple domains. For example, a navigation LBS service can be used to provide directions, indoor routing, traffic management, and car park guidance. Likewise, a tracking LBS service
can be applied to people, product, or vehicle. A management LBS service can be centered at infrastructure, facility, customer relationship, security, fleet scheduling, or environment. A billing LBS service is either road tolling related or location sensitive billing. An information LBS service can be based on traveling, shopping, or yellow page.

Figure 4  LBS Taxonomy

- Mobile search: refers to information retrieval services on a mobile device platform such as mobile phone. Mobile search is not just simply a spatial shift of PC web search to mobile equipment, but it requires innovation from both mobile contents and mobile use interface. According to eMarketer, a leading market research firm, by 2011, mobile search will account for around $715 million, or 15% of that total mobile advertising market worth nearly $4.7 billion (see Figure 5, source: eMarketer). Mobile content refers to any type of media that is viewed or used on mobile phones. Examples of mobile contents include ringtones, graphics, discount offers, games, and movies. Senior Analyst at eMarketer used the following prediction on mobile search, “whoever cracks the consumer and commercial code for delivering and monetizing relevant answers for people on the go will secure a license to print money, at least for a time.” As the number of mobile search users and mobile Internet users continues to increase in the next few years (see Figure 5), the mobile search ad revenue will increase dramatically.
Figure 5  U.S. Mobile Internet and Search Users, and Search Revenues
(Source: http://www.emarketer.com)

Figure 6 shows the taxonomy of mobile search with the categories of mobile discovery service, mobile directory search, question and answer service, and mobile optimized search engine. Discovery service offers user recommendation on what they should do next. For example, based on the news the user is currently reading in his current location, discovery service will suggest relevant news that the user should read next. Directory search allows users to find local services in the vicinity of their current location, e.g. call a taxi. Mobile question and answer service allow a user to text a question to a server and receive a reply using text, e.g. via SMS messages. Mobile optimized search engines refer to search engines optimized for mobile search and mobile platform, i.e. optimization in relation to network bandwidth, user location, and mobile user interface of limited screen display.
• Mobile social network: Wikipedia defines a social network as a social structure made of nodes (individuals or organizations) that are tied by one or more specific types of interdependency such as values, visions, ideas, financial exchange, friendship, kinship, dislike, conflict or trade. With Internet, web, and mobile device, social networking has reached a new height. Facebook and MySpace are well known social networking web sites that allow a user to establish and maintain his/her own social networks. Mobile social networks refer to the social network activities on a mobile phone platform. Based on mobile application configuration, there are 2 types of mobile social network:
  o On-deck mobile social network: by working with the network carrier, the community via the default start page on the mobile phone browser is distributed to users. An example of this type of business is JuiceCaster.
  o Off-deck mobile social network: the most common type of mobile social network. A user can download the mobile web application and sign in to start to create his/her mobile social network. Examples are MocoSpace and Bluepulse.

An example of mobile social network application is, on a Friday night, a user wants to know if any of his friends are in a bar near here.

1.2.2 FEATURE -- EVER PRESENT

Ever present categories include

• Mobile infrastructure software and widgets: infrastructure software and/or application that are built for mobile phone platform to enable valuable services. Mobile widgets are mobile applications that can be installed on mobile phone/device to add functionality to the device. Mobile widgets can easily be downloaded to the mobile phone via the Internet or often times from the Web directly from the mobile device. Many cell phones even come with widgets already installed, ready to customize and begin using them. For instance, eBay offers a mobile widget ticker for all of one’s bids.
  o Instant Messenger (IM): IM built for mobile device platform
- Multimedia support: various image, video, audio formats’ coder and decoder on a mobile device platform
- Microblog: a form of blogging that allows users to write brief text (less than 200 characters) and publish the text. Twitter is the most popular microblog and allows text messaging for blog posting via mobile phones.

- Mobile Wallet: mobile wallet is to use a mobile phone as an e-wallet. NTT DoCoMo developed “Osaifu-Keitai”, literally meaning “Wallet Mobile” in Japanese, the de facto standard mobile payment system in Japan. Osaifu-Keitai services include electronic money, identify card, royalty card, fare collection of public transits (including railways, buses, and airplanes), or credit cards. A mobile wallet can be used for 2 purposes:
  - Mobile banking: banking via mobile phone. For example, mFoundary, a startup company in the mobile financial service space, offers regular banking needs such as Bill Payments, Fund Transfers, ATM and Branch Locator, Customer Service Support, Integrated Messaging Services (SMS & Alert), Account Information (Account Balance, Status, Transaction Search) via mobile phone. In remote regions of developing countries, people may not have a computer and certainly require lots of training before they can use the computer. However, all these people have access to mobile phones.
  - Mobile payment: e-payment via mobile phone. Settling your payment directly using your phone. For instance, one can directly use his mobile phone for subway and train usage charges.

- Mobile Entertainment: entertainment services via mobile phone. Figure 7 shows the taxonomy of mobile entertainment with the categories of gaming, gambling, music and infotainment, mobile TV, and mobile UGC (User Generated Contents).

![Figure 7 Mobile Entertainment Taxonomy](image-url)
Based on the eMarketer projection, the current major categories of mobile entertainment include music, images, video, games, adult, gambling, and TV. By 2011, the three leading categories of mobile entertainment are mobile music, mobile games, and mobile video. The 2006 market of mobile music is $7.4 billion and the 2011 market of mobile music will be $13.6 billion (see Figure 8).

- Mobile Marketing: describes marketing on or with a mobile device. Marketing on a mobile phone has become increasingly popular ever since the rise of SMS (Short Message Service) in the early 2000s in Europe and some parts of Asia. There are several means that marketing messages can reach a mobile device:
  - SMS: in fact, SMS marketing has become a legitimate advertising channel in some parts of the world. Network carriers in these countries provision specific channels for marketers so the SMS messages are different from the usage of email messages that are sent over the public Internet. The carriers charge marketers based on usage, e.g. how many SMS messages are sent, how large is the SMS message, and how many times the SMS messages need to be sent.
  - MMS (Multimedia Message Service): MMS contains images, text, audio, and video contents. MMS can be considered as multimedia enhancements to SMS.
  - Bluetooth: these are offered as hotspot systems that consist of content-management system with Bluetooth distribution function. Once a user registers in a hotspot area via his mobile phone, he will receive emails, SMS, and/or MMS messages from the hotspot content management system.
  - Infrared: some European companies offer “shopping window marketing” via free infrared waves.
Figure 9 shows the taxonomy of mobile marketing with the categories of in-game mobile marketing, mobile web marketing, user-controlled media, and mobile viral marketing. As the gaming industry grows in the Internet and mobile web sector, games become more sophisticated and complex such as interactive real-time 3D and massive multi-player games. Brands and businesses can deliver promotional messages within mobile games or sponsoring entire games to drive consumer engagement. Advertising on mobile web pages are similar to the advertising on PC web pages except that mobile web advertising need to be aware of mobile properties such as locations and mobile platforms. User controlled media refers to advertising that is initiated by the consumer. Mobile viral marketing relies on consumers to transmit content via mobile devices to other potential consumers in their social network and to animate these contacts to also transmit the content.

According to eMarketer estimation, the world wide general mobile advertising spending is slightly over $4 billion in 2008 and will reach $12 billion in 2011 (see Figure 10).
1.2.3 Feature – Mobility

A mobile network via mobile devices and sensors can be deployed quickly to achieve a number of objectives. Mobile web application leveraging mobility can greatly enhance operation efficiency as well as improve operation safety.

- Data collection: mobile devices can be used in various industrial engineering projects to improve operation efficiency and reduce operation costs. For example, periodical medical measurements or readings can be collected through mobile phones instead of frequent doctor visits by the patients.

- Real time monitoring: sensors can provide real time monitoring and sampling, and provide feedback for intelligent, automatic management systems. For instance, a traffic mobile web application can provide real time traffic monitoring and congestion report for subscribers.

- Safety and emergency: mobile devices with mobile web applications can provide unique solutions to cope with various safety and emergency situations. For example, after earthquake, wireless communication provides the quickest recovery for the communication infrastructure. Mobile web applications can also be used for logistics coordination during disaster recovery.

1.3 Examples of Existing Mobile Web Applications

In the taxonomy, the features emphasize the unique values that the mobile web applications deliver to the customers, and the categories refer to the groupings under each feature. This section goes through example companies in selected categories to highlight their market, product, and their competitive strengths. Figure 11 shows the list of companies in each category; some companies are well-known companies such as Yahoo and Google but others are still in startup stage such as MobiLuck.
Figure 11 Example Companies for Mobile Web Application Taxonomy

Due to the space limitation of the thesis, the following companies are selected for report in the thesis.

- **Context Specific**
  - Location Based Service (LBS): Loopt
  - Mobile Search: Google’s mobile search
  - Mobile Social Network: Trutap

- **Ever Present**
  - Mobile Infrastructure Software: eBuddy

- **Mobility**
  - Mobile Health Care & Data Collection: MedApps

### 1.3.1 LOOPT (WWW.LOOPT.COM)

Loopt is a mobile social mapping application company that offers social networking tools via GPS maps. The company is based in Mountain View, California. The Loopt application shows friends on a map in relation to their current location and status such as available or away. The users can request
alerts when friends are within a certain distance. The users can also broadcast emails, messages, images, or videos to friends in a specific region, and tag and blog the physical location so that friends can access through the Loopt application.

![Loopt Application Screenshots](http://www.loopt.com)

**Figure 12** Loopt
(Source: http://www.loopt.com)

Loopt was founded in 2005, and received seed funding from Y Combinator. The company received $5 million in Series A funding from Sequoia Capital and New Enterprise Associates and launched its service on Boost Mobile networks in September 2007. In August 2007, Loopt started services on selected phones for Sprint, and in June 2008, the company started its service on Verizon networks.

As of October 21, 2008, the Loopt application is available at the networks of Verizon, AT&T, Sprint, Nextel, T-Mobile, Boost Mobile, and MetroPCS over 100 types of phones, most notable RIM’s Blackberry (Pearl, Curve, and World 8830) and Apple’s iPhone (original iPhone and 3G iPhone).

Figure 12 shows the Loopt application on 3G iPhone, Blackberry Pearl, and the blog. The Loopt blog provides Journal widgets to allow users share their blogs and multimedia contents with their friends easily.

The main products from Loopt’s geosocial networking services include:

- **Mobile web application**: provides real-time location updating. Users can use Loopt application to update location, status and share social and location information with friends. For iPhones, in addition to real-time location and status tracking, Loopt also integrated Yelp contents to the iPhone platform. The Loopt application also integrated Twitter status and Facebook status.

- **Web portal**: Loopt provides a web portal that is synchronized with the mobile version of the Loopt service.

- **Facebook application**: use Loopt as an application of the Facebook to leverage one’s Facebook social network.
Loopt user requires registration that includes full name, phone number, date of birth, and email address. Through profile settings, a user can choose the receiving of geo-social information and/or alert.

The two main competitors of Loopt are Jaiku and Dodgeball. According to the web site statistics, Loopt has performed well in the past year by increasing the unique number of visitors by 370.5% (see Figure 13). By comparison, its main competitor, Jaiku, only improved 7.4%. Although Jaiku started business early than Loopt, Loopt has been doing well in the past year and attracted more attentions than any of its competitors. However, the data also shows that success can be very transient.

![Unique Visitors Graph](http://www.compete.com)

**Figure 13** Comparison of Loopt.com, Dodgeball.com, and Jaiku.com
(Source: http://www.compete.com)

Loopt is still an early stage startup company. The company is actively working closely with wireless network carriers to roll out value-added location-based revenue services requiring user subscription. The company’s revenue comes from Loopt service subscription.

### 1.3.2 Google (WWW.GOOGLE.COM) Mobile Search

Google is the leading web search engine in the USA, earning revenues from advertising related to web search, email, on-line mapping, office productivity, social networking, and video sharing. The company is co-founded by Larry Page and Sergey Brin in late 1990s, and the company’s headquarter is located at Mountain View, California. Google became a public company in August 2004 making it a $23 billion dollar company; in Jan 2008, Google had a market cap of over $200 billion US dollars. Google’s main mobile products include

- Mobile search: web search from mobile devices
- SMS: use text messages to get quick information from Google, including local listings, sport scores, weather conditions, and real time flight information
Google’s main competitors include Yahoo, MSN, and ASK. In May 2008, Google’s search accounts for 68% of the search in the US while Yahoo is in the distant second, with 20% of the search market (see Table 1 for competitor analysis). Comparing with a year ago, Google improves its lead by 3% while Yahoo loses 1% of the US market share. In the UK, Google’s dominance is even bigger. In May 2008, Google has 87% of the UK search market, which represents 12% increase over the year before. The rest of the UK search market is divided as follows: Yahoo 4.09%, MSN 3.72%, and ASK 3.07%. In the mobile search area, Google continues its dominance according to Nielsen Mobile. It is estimated that Google has the 61% of the US mobile search market in the first quarter of 2008 (Table 2). Yahoo came in second at 18%, and MSN has around 5% of the mobile search market. According to Compete.com, the number of unique users for Google web search continued to increase by 3.5% while the number of Yahoo’s users decreased by 2.6% (see Figure 14). Ongoing research indicates finding satisfactory results is still a bit of a challenge when it comes to mobile search. Only 44% of Google searchers and 40% of Yahoo searchers rated their experience in the 8-10 range on a scale of 10.

<table>
<thead>
<tr>
<th>Percentage of U.S. searches among leading search engine providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
</tr>
<tr>
<td>Google.com</td>
</tr>
<tr>
<td>Search.yahoo.com</td>
</tr>
<tr>
<td>Search.msn.com</td>
</tr>
<tr>
<td>Ask.com</td>
</tr>
</tbody>
</table>

Table 1 U.S. Web Search Market
(Source: http://www.nielsenmobile.com )

<table>
<thead>
<tr>
<th>Google Mobile Search</th>
<th>Yahoo Mobile Search</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>33%</td>
</tr>
<tr>
<td>Local Listings</td>
<td>29%</td>
</tr>
<tr>
<td>Websites/navigation</td>
<td>27%</td>
</tr>
<tr>
<td>Others</td>
<td>11%</td>
</tr>
<tr>
<td>Male vs Female User</td>
<td>65% vs. 35%</td>
</tr>
</tbody>
</table>

Table 2 Google and Yahoo Mobile Search Revenue Decomposition
(Source: http://www.nielsenmobile.com )
Mobile search revenues come from advertisement that posted by companies and businesses selling products and services. In Google’s 3rd quarter 2008 SEC filing ended September 2008, Google’s advertising revenues from online search (including mobile search) made up 97% of total revenues, over 5.5 Billion US dollars. Google AdWords is an automated online program that enables advertisers to place targeted text-based and display ads on Google web sites and Google Network members’ web sites. Most of AdWords customers pay on a cost-per-click basis, which means that an advertiser pays only when a user clicks on one of its ads. Google AdWords is also offered on a cost-per-impression basis that enables advertisers to pay based on the number of times their ads appear on the web sites and Google Network members’ web sites as specified by the advertiser. Google AdSense refers to the online programs through which Google distributes advertisers’ AdWords ads for display on the web sites of Google Network members as well as programs to deliver audio ads on radio broadcasts, print ads for display in newspapers and magazines, and ads on television broadcasts. The AdSense programs include AdSense for search and AdSense for content. For online AdSense program, Google advertisers pay a fee each time a user clicks on one of advertisers’ ads displayed on the Google Network members’ web sites or, for those advertisers who choose cost-per-impression pricing, as their ads are displayed.

In Google’s SEC yearly report, the company share a portion of the advertise revenues from online search (including mobile search) with Google Network members as traffic acquisition costs under cost of revenues. Google Network members do not pay any fees associated with the use of AdSense program on their web sites.

1.3.3 TRUTAP (WWW.TRUTAP.COM)

Trutap Limited (Trutap) develops mobile social networking applications to allow users to stay connected to their social lives wherever they go. These applications provide an integrated, social networking mobile platform, which let users to chat friends on their mobile phones, get live updates
from friends and meet new people, share and download games, sports, news, horoscopes, and ringtones, and allow users to post blogs and photos all from their mobile phones.

The company was funded in 2007 by Doug Richard and David Whitewood. In September 2007, Trutap received $13 million US dollars in series A funding led by Tudor Group. When asked for Trutap’s market position, Trutap’s CEO, Doug Richard has the following statement:

“We are passionate about building our free service and offering, an easy way for people to stay connected to their social lives. Aimed at 18-24 year olds, Trutap is the first service to combine all the elements of a young person’s social life into one. We see huge market demand in our service and this new infusion of capital will enable us to continue broadening our services and accelerate our leadership position in the industry.”

TruTap’s product combines several elements of a young person’s social life into one mobile web application, and offers the ability to IM (MSN, Yahoo!, AIM (AOL), GoogleTalk, Jabber.org, ICQ, Rediff Bol, and Facebook), group message, upload text and pictures to blogs and send pictures via a mobile, specifically

- IM – access all accounts and converse with everyone at the same time
- Blog and Photo Sharing sites – supports Blogger, Blog.com, Livejournal, Flickr, NyOpera, Photobucket, Typepad, Friendster, Xanga, and WordPress so text and pictures can be uploaded
- Messaging – picture messaging, online status and group message with ‘all’ reply functionality

TruTap’s applications are free to download http://trutap.com/?trigger=download, and they are ranked as top recommended applications by Nokia. The major mobile phone platforms supported are Nokia, Sony Ericsson, Motorola, LG, Samsung, and Panasonic smartphones and selected main mobile phone platforms on GSM networks. The application itself does not require special configuration, and offers a privacy setting that can restrict access and block users. Trutap can also be used via a web browser from a Windows desktop and/or laptop computer.
The main competitors of Trutap include Bluepulse.com and BuzzCity.com. According to Compete.com, the visitors to TruTap in the year of 2008 increased by 454.4%.

Trutap is still an early stage startup company. Its revenues come from online advertising, a similar business model as Facebook and MySpace.

1.3.4 eBUDDY (WWW.EBUDDY.COM)

EBuddy is a web based instant messaging aggregation service that enables users to chat with their Yahoo, Google Talk, MSN, MySpace, Facebook, ICQ, and AIM buddies. By leveraging the web, the service is not only available via mobile phones but is independent of network carrier or device via WAP or mobile Internet browser. E buddy software allows multiple instant messaging networks in one interface.

The company was founded by Paulo Taylor in 2003. The original name of the company was e-messenger. In 2006, e-messenger was renamed to EBuddy.

EBuddy software can be downloaded at http://get.ebuddy.com. It supports these platforms: Blackberry, HTC, LG, Motorola, Palm, iPhone, Nokia, PocketPC, SonyEricsson, Samsung, T-Mobile, Orange, Qtek, Sharp, and Siemens. The service requires the creation of a login ID at EBuddy.

The company offers a secure login option. Users can also indicate if they wish to sign on invisibly. The chat client includes a tab mode setting to differentiate chat windows, similar to tabbed web browsing (see Figure 16).
EBuddy’s competitors are listed in Table 3. According to EBuddy web site, the company has active users of 60 millions.

<table>
<thead>
<tr>
<th>Product/Service Name</th>
<th>User count</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tencent QQ</td>
<td>40.3 million peak online (majority in China)</td>
<td>May 2008</td>
</tr>
<tr>
<td></td>
<td>317.9 million &quot;active&quot; (majority in China)</td>
<td>May 2008</td>
</tr>
<tr>
<td></td>
<td>783 million total accounts “active” (majority in China)</td>
<td>May 2008</td>
</tr>
<tr>
<td>Windows Live Messenger</td>
<td>300 million active worldwide</td>
<td>November 2007</td>
</tr>
<tr>
<td>Yahoo! Messenger</td>
<td>248 million active registered Yahoo global users</td>
<td>January 2008</td>
</tr>
<tr>
<td>Skype</td>
<td>12 million peak online</td>
<td>February 2008</td>
</tr>
<tr>
<td></td>
<td>309 million total</td>
<td>April 2008</td>
</tr>
<tr>
<td>AIM</td>
<td>53 million active</td>
<td>September 2006</td>
</tr>
<tr>
<td></td>
<td>&gt;100 million total</td>
<td>January 2006</td>
</tr>
<tr>
<td>eBuddy</td>
<td>60 million total</td>
<td>December 2008</td>
</tr>
<tr>
<td>IBM Lotus Sametime</td>
<td>17 million total (private, in enterprises)</td>
<td>November 2007</td>
</tr>
<tr>
<td>ICQ</td>
<td>15 million active</td>
<td>July 2006</td>
</tr>
<tr>
<td>Xfire</td>
<td>11.5 million total</td>
<td>October 2008</td>
</tr>
<tr>
<td>Gadu-Gadu</td>
<td>6 million active (majority in Poland)</td>
<td>June 2008</td>
</tr>
<tr>
<td>PalTalk</td>
<td>3.3 million unique visitors per month</td>
<td>August 2006</td>
</tr>
<tr>
<td>IMVU</td>
<td>1 million total</td>
<td>June 2007</td>
</tr>
<tr>
<td>Mail.ru Agent</td>
<td>1 million active (daily)</td>
<td>September 2006</td>
</tr>
<tr>
<td>Meebo</td>
<td>1 million total</td>
<td>October 2006</td>
</tr>
</tbody>
</table>

Table 3 List of eBuddy Competitors
(Source: http://en.wikipedia.org/wiki/Instant_messaging)

EBuddy’s revenues come from online advertising. Its software and service are free for end users.
1.3.5 MedApps (WWW.MEDAPPS.NET)

MedApps is a health monitoring product innovation company that offers products and solutions to replace expensive, hard-wired monitoring systems with mobile wireless technology in portable mobile devices. The MedApps solution allows users to use off-the-shelf medical devices to collect their health readings. The company believes that there are many diseases that can be managed at home by patients in coordination with their health care providers. MedApps’ mobile applications extend these benefits. When patients are compliant and regularly monitored, the benefits are two-fold:

- the patient’s quality of life can be improved through a slower progression of their diseases
- the healthcare costs can decrease as patients are delayed or kept from progressing to costlier disease states, resulting in fewer doctor office visits and hospital stays.

MedApps’s headquarters is located in Scottsdale, Arizona. MedApps’s products are designed to address the challenges of chronic care management, connecting large health care enterprises with their members for efficient, near real-time medical monitoring. The MedApps’s system includes individual technology products for collecting and transmitting patient-monitored information, and software applications used by health care providers to receive, analyze and store the patient information (see Figure 17).

Figure 17 MedApps Applications
(Source: http://www.medaps.net)

Specifically, MedApps’s product lines include
• HealthPAL: Portable hub embedded with Bluetooth and M2M cellular chip, which allows wireless collection and transmission of data from inexpensive, off-the-shelf medical devices.
• HealthPOD: A docking station for HealthPAL that acts as charger. It allows multiple device inputs and transmission of data via phone line.
• HealthLINK: Wireless adapter allows additional, low-cost, off-the-shelf, medical devices to communicate to HealthPAL.
• HealthCOM: Complete server software for online remote patient management and data storage.
• VoicePAL: Provides off-the-shelf medical devices the ability to “speak” readings to patients (audio only / no transmitting functionality).
• MedPAL: Medication storage, reminder, and alert system that communicates through HealthPAL.

MedApps’s products and solution currently has the following market focus:
• Disease Management: offering 3 steps product in disease management
  o Recording and transmitting patient monitor readings
  o Receiving, storing and analyzing patient-sent data
  o Viewing, monitoring and acting upon patient-sent data.
• Corporate Wellness: Preventative health programs, otherwise known as “wellness programs,” are activities that help to prevent chronic conditions. These programs are viewed as a way of proactively reducing healthcare consumption, which results from chronic illnesses, by implementing preventative or self-managed healthcare programs. These programs motivate their participants to engage in fitness programs, maintain balanced diets and encourage other health promoting activities in order to avoid costly chronic conditions in the future.
• Consumer DTC: automatically sending the consumers personal health data to a central repository (e.g., Microsoft HealthVault, Google Health) so that it can be reviewed and/or analyzed at a later stage.
• Implanted Devices: designed to be able to incorporate different configurations to meet the requirements of Implanted Devices, including Loop Recorders, Continuous Glucose Monitors (CGM) and Insulin Pumps.
• PERS (Personal Emergency Response System): the ability to provide both an active and a passive PERS feature.

1.4 Mobile Web Applications vs. Native Mobile Applications

Native mobile applications are traditional mobile applications for mobile devices whereas mobile web applications are web applications on mobile devices. The key difference is to leverage the web standard in the mobile web applications. As such, mobile web or native mobile applications are implementation issues from the taxonomy perspective, and does not have direct impact on the features and categories in this taxonomy.

Since the birth of PDA (Personal Digital Assistant) and smartphones, there are a number of native mobile applications developed on various mobile phone platforms. For instance, Palm native software application development was very popular a few years ago and the Palm development
conference of the year of 2005 attracted over 100,000 people. At one time, it was estimated that there are over 130,000 Palm native mobile application developers worldwide. However, with the strong competition from RIM and HTC and the recent iPhone effort from Apple, the mobile application space has changed dramatically. Leveraging the web and the browser, mobile web application development has several advantages:

- Web browser: supporting mobile applications directly over native mobile phone platforms has been a challenge since their inception. Sometimes, even one product may have several versions, and unfortunately these versions are not backward compatible. From product management perspective, a mobile application software company has to select and manage the set of target market platforms. The web browser plays the roles of a universal client program over all mobile phone platforms. A mobile web application is able to reach a larger market as long as it can run inside a web browser. Table 4 lists the popular mobile browsers by vendor in the current market.

<table>
<thead>
<tr>
<th>Mobile Phone and/or PDA Vendor</th>
<th>Mobile Web Browser(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm</td>
<td>Blazer (based on NetFront), iPanel, Handspring Bluelark</td>
</tr>
<tr>
<td>RIM Blackberry</td>
<td>Proprietary Blackberry Browser</td>
</tr>
<tr>
<td>Apple iPhone</td>
<td>Safari (based on WebKit)</td>
</tr>
<tr>
<td>Google</td>
<td>Chrome – Android platform</td>
</tr>
<tr>
<td>Microsoft</td>
<td>IE Mobile, Deepfish</td>
</tr>
<tr>
<td>Jataayu Software - Symbian Series 60, Windows Mobile and Linux platforms</td>
<td>jB5 Mobile Browser</td>
</tr>
<tr>
<td>Danger, T-Mobile Sidekick</td>
<td>Proprietary Danger Browser</td>
</tr>
<tr>
<td>Infraware</td>
<td>Embider</td>
</tr>
<tr>
<td>Motorola</td>
<td>MOTOMAGX (based on WebKit)</td>
</tr>
<tr>
<td>ACCESS CO</td>
<td>NetFront</td>
</tr>
<tr>
<td>Nokia</td>
<td>Nokia Series 40, Web Browser for S60</td>
</tr>
<tr>
<td>Obigo AB owned by Teleca AB</td>
<td>Obigo Browser</td>
</tr>
<tr>
<td>Purple Labs</td>
<td>Openwave Mobile Browser</td>
</tr>
<tr>
<td>Opera Software ASA</td>
<td>Opera Mobile, Opera Mini</td>
</tr>
<tr>
<td>Picsel Technologies</td>
<td>Picsel Browser</td>
</tr>
<tr>
<td>Sony</td>
<td>PlayStation Portable Web Browser</td>
</tr>
<tr>
<td>Torch Mobile</td>
<td>Iris Browser</td>
</tr>
<tr>
<td>Digital Airways</td>
<td>Wapaka Browser</td>
</tr>
<tr>
<td>Sun Microsystems</td>
<td>Pixo</td>
</tr>
<tr>
<td>Mozilla Foundation</td>
<td>Minimo</td>
</tr>
</tbody>
</table>

Table 4 List of Mobile Web Browsers

- Lower cost: even for mobile application companies that have customers and existing products and platforms, leveraging the web and the browser potentially lowers operation costs. For instance, leveraging the standard web technology and existing web browsers can reduce the complexity in quality assurance testing and product development.

- Business model: most importantly, with the advance of Internet, mobile technology, and the web, the mobile web applications are moving towards the cloud computing business model, i.e. software as a service (SaaS). Instead of mobile application software development, a company may transform to become a web service company to directly reach consumers not only enterprise customers.
1.5 **MOBILE WEB APPLICATIONS VS. MOBILE WEB AGGREGATION**

Mobile web aggregation is a special type of mobile web application, which requires integrating data from multiple sources, at least one of the data sources from the web. For the features in the taxonomy,

- **Context specific**: applications providing context specific features are naturally mobile web aggregation applications. Since the applications need to be context aware, the context information must be integrated into the applications.
- **Ever present**: applications providing ever present features may or may be mobile web aggregation applications. The value of these applications is to provide user convenience. For the categories under this feature in the taxonomy,
  - **Mobile wallet**: mobile web applications in this category are not mobile web aggregation applications.
  - **Mobile entertainment**: mobile web applications in this category are not mobile web aggregation applications.
  - **Mobile infrastructure software and widgets**: usually infrastructure software and widgets enable certain features on mobile platform. Software itself is not a mobile web aggregation application. However, customizing the widget and software to provide user convenience may become a mobile web aggregation application.
  - **Mobile marketing**: the concept and the means to reach the consumer, e.g. SMS, are not mobile web aggregation. However, an effective mobile marketing application may integrate data from multiple sources including web source. Only then, a mobile marketing application becomes a mobile web aggregation application.
- **Mobility**: applications providing mobility features may or may be mobile web aggregation applications. For the categories under this feature in the taxonomy,
  - **Data collection**: if the application is simply to collect data and forward to a backend server for processing, this application is not mobile web aggregation. However, if the application also processes and integrates data from multiple sources including web source, the application is mobile web aggregation.
  - **Safety**: if the safety application integrates data from multiple sources including web source, this application is mobile web aggregation application.
  - **Emergency**: if the emergency application integrates data from multiple sources including web source, this application is mobile web aggregation application.

A mobility application can be as simply as a sensor data collection application or as comprehensive as a vertical domain application, e.g. a mobile medicare system. As the application logic becomes complex, it should takes advantage of the information available on the Internet. Therefore, complex mobility applications are usually mobile web aggregation applications.