

MOBILE COMPUTING WITH WEB 2.0: CURRENT STATE-OF-THE-ART, ISSUES AND CHALLENGES

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ABSTRACT:

The mobile computing with web 2.0 is considered by many as the next big wave riding in the field of mobile computing. Many industry leaders in the web, telecom, and cell phone manufacturing arena are taking active interest in exploiting the power of web 2.0 and applying it on the mobile platform to bring to the users a set of new and innovative services. With the advanced mobile web services, there are challenges for the design and implementation of the user interfaces for these services. Further, issues such as the lack of open access from telecom carriers and lack of open standards for application development represent major hindrances to mobile web 2.0 becoming a true success in the mobile computing world. This paper describes essential characteristics of mobile web 2.0, mobile web 2.0 applications, future possibilities and challenges of mobile computing with Web 2.0.

Keywords: Mobile web 2.0, Web 2.0, Mobile 2.0.

INTRODUCTION

Web 2.0, the next generation web is all about making the web as platform, harnessing collective intelligence, lightweight and meshup programming models, providing rich user experiences, and approaching application development differently. With all these characteristics, web 2.0 is impacting various applications that have been available in traditional web such as personal websites, sharing and accessing data, connecting with other people over the web, etc. It is also having impact on the capabilities of different platforms/devices such as personal computers, mobile devices and other handheld devices that access such web applications. Specifically, the present mobile devices with their limited infrastructure restrict the users' interaction and limit their ability to interact with the web applications in a full-fledged manner.

The improvement and enrichment to mobile computing and its underlying structure to access the advanced features of the web is being referred to as *mobile web 2.0* or simply *mobile 2.0*. Mobile web 2.0, with myriad of possibilities to offer, is changing the way people interact with the web, pushing their limits up to levels that they could only imagine in the past using mobile

devices. It promises to transcend beyond the limitations of the previous generation of mobile devices, enhancing and enriching the overall experience of using the web through these tiny devices.

Mobile web 2.0 is about leveraging the power of the web, integrating the web services and their features on the mobile platform, and providing the users the rich experience they enjoy on desktop applications. Mobile web 2.0 focuses on harnessing the strength and capabilities of the applications supported by web 2.0 and extends them to the mobile platform, making it more powerful and usable. The concept of mobile 2.0 does not limit itself to only a traditional handheld device. In the future, mobile 2.0 devices would be so tiny that they could be implanted in our clothing, physical environment, accessories, and body parts, enabling us to instantaneously connect to other people laden with such devices, interact with the web subconsciously and perform other functions now only possible through desktops. This coincides with the W3C vision for the web—"Universal Web Access: The Web Anywhere, for Everyone, at Anytime, on Everything" [1].

ESSENTIAL CHARACTERISTICS OF MOBILE WEB 2.0

The concept of mobile web 2.0 and its applications are possible because of the underlying structure of mobile devices and the essential characteristics and guiding principles that serve as the building blocks on which mobile web 2.0 relies.

Openness: This is one of the most essential characteristics in making mobile web 2.0 a reality. Mobile web 2.0 emphasizes on *open standards*, *open source development*, and *open access*. This is why new generation web applications are being built with XHTML (W3C standard) to avoid cross-browser issues and provide consistent browsing across all the platforms and browsers. However, even though the major cell phone vendors support XHTML, there are still inconsistencies in many existing cell phones, unsettling the browsing experience of the user. *dotMobi* is a company formed by ICANN (Internet Corporation for Assigned Names and Numbers) dedicated to manage mobile devices and to also serve as the official registry for .mobi, a top level domain for mobile web

applications. W3C Mobile Web initiative efforts are also focused on standardizing mobile web to deal with cross-platform and cross-browser issues [2, 19].

The development of open source community on mobile web will be another important factor contributing to mobile web 2.0. The distribution of open-source applications will enable the users to have access to a wide range of mobile web applications without any licensing fee. It will also see a significant contribution from the users/developers further modifying and developing new applications, engendering an overall growth in the use of mobile web and population of its developers and users [2, 12, 19].

Lack of open access is seen as a hindrance to the widespread growth of mobile web 2.0. The mobile service providers are controlling the access of mobile users by enclosing them in the *walled gardens* and limiting their options. They are simply restricting the users to an exclusive set of information services and limiting their open accesses to the Internet content, e-commerce and the other Internet based services. With such a limited access to the Internet, the users will not be able to enjoy the services offered by mobile web 2.0 and its power will never be exploited. So for mobile web 2.0 to become a reality, the players in this market need to open up to this concept and embrace the new wave of mobile computing. This openness from the service providers is closer to reality in European countries but there is still a long way to go for the US and some Asian countries [2, 5, 12, 19].

Context of use: Designing mobile web applications is much more challenging than designing their desktop counterparts because of various factors: small display, screen attributes, constrained processing power, and the limited keys [22]. Further, as given in [9], “The convergence of functions and constant addition of new features create layers of complexity in navigation and usability of mobile user interfaces.” To address these challenges, one of the most essential things for mobile developers to understand is the context of use. The questions of what, where, when how, and who with respect to mobile web access must be answered. A user may want to read the latest news, see the current soccer score, subscribe to a stock feed, publish and comment on blogs, find a restaurant in a given zip code, ping a friend and many more at any point in time [18, 20]. The application needs to provide the answers in the appropriate context.

An experiment to understand the different contextual aspects of mobile access was carried out at Gotomobile [20]. The experiment, which involves Sony-Ericsson v800 with different browsers (Obigo, Opera Mini, and

Google Mobile adapted content), centers around creating a small personalized tourist guide with carefully chosen options to develop a better understanding of contextual elements and browser environmental elements in mobile devices. It illustrates that the appropriate consideration of cell phone specific contextual elements is central to the designing, developing and deploying of mobile web applications with regards to their business and user goals.

Affordable pricing: With required support and infrastructure in place, the extent to which the high-end mobile web services will be accepted is still determined by their pricing. The users should be able to use network at very affordable price to be able to access the mobile web content and the services. If broadband access is still offered at high prices on the mobile platform, then YouTube, Flickr, Google maps, and other similar services requiring high rate of data transfer will remain rarely used on the mobile devices, limiting the capabilities of users using mobile web 2.0 [19].

Innovative business opportunities: The advent of advanced and innovative mobile web 2.0 applications will make it possible for more business opportunities to enter the market and attract even more mobile web related services such as Bluetooth, Wi-Fi Entertainment download zones and access spots, podcasting, cellcasting, blogcasting to cell phones, streaming video call to TV, moblogging, etc. There are solutions being proposed using QR (Quick Response) codes, image recognition, and augmented reality by the market players for easy deployment of the mobile services that will improve the usability experience of these services [19].

(More) user choices: Similar to web 2.0, there needs to be an abundance of choices available to the users of mobile web 2.0 for it to flourish. The users will expect to see various ways to communicate with others, share their experiences and content. This next generation of mobile web will need to provide a new dimension of social networking for connecting with people. Instead of the call a contact option in cell phones, there will be an option to connect to a contact, where one can chat, talk, leave a message, share content, and see each other through embedded cameras in the cell phones. There are many other innovative mobile web applications that have been envisioned, some of which are detailed in the next section.

APPLICATIONS OF MOBILE WEB 2.0

This section presents mobile web 2.0 applications that are more innovative and are gaining popularity among the advanced users of mobile web.

Heysan: A free mobile instant messaging service that integrates MSN, AIM, Yahoo and ICQ on a mobile device. It offers a single buddy list showing contacts from these different networks. It is a mobile browser based service and is currently supported only on iPhone. The mobile web browser needs to point to the URL: <http://m.heysan.com> [11].

Taptu: A search engine for mobile phones, acclaimed to be more efficient than other mobile search engines available (search and find useful content in first 10 hits or less compared to 30 or more in others). Taptu uses a different search technique called social assisted search [13], which is a combination of search algorithms and the human feedback. The search results from this approach improve over the time as they get more and more human feedback. The first publicly launched version of Taptu focuses on music and fact-finding, and it is expected to include more categories in the next release. It presents the search results in different types (Song, Wiki, Video, Artist and Lyrics). Taptu is available at <http://taptu.mobi>. The following figure shows the results for a song [16].

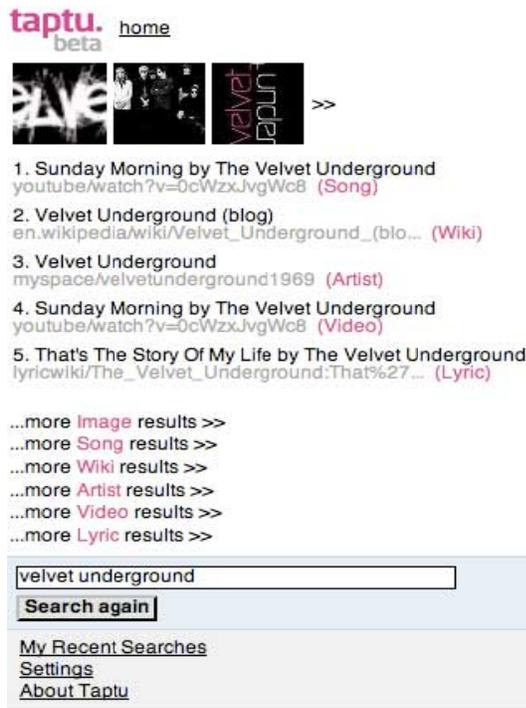


Figure 1: Searching results from Taptu [16]

Jott Links: This service lets users interact with websites and other online services by voice over the phone. The users can record and send emails, text messages and to-do lists using the service. It also has a notification service where users can record events, specify a date

and time, and choose to be alerted by SMS or email. Jott Links allows users to post blogs to Blogger, send updates to Twitter (social networking and micro-messaging service), checkout product information from Amazon, post calendar items to 30Boxes (calendar service), get housing *Zestimates* from Zillow (online real estate service), manage your tasks at RememberTheMilk (online to-do list and task management), voice your opinions to Yahoo Groups, among other things. By providing the voice-over- phone interface to these services, a user does not even realize that he/she is interacting with other third-party services, making the overall usability experience a seamless one.

The following shows a user interacting with Twitter using Jott Links. This service further offers APIs for developers to build their customized interfaces. Jot links is available at <http://www.jott.com/jott-links/> [6].

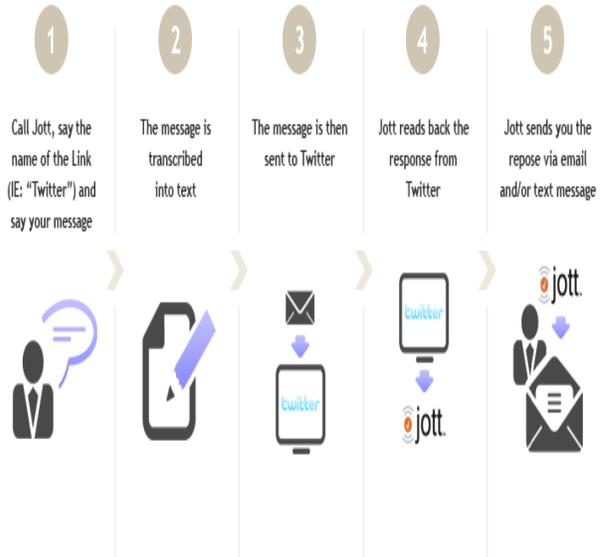


Figure 2: Interacting with Twitter using Jott Links[6]

Plazes: Plazes connects users to their friends around them by sharing their activities. A user can create an activity on the go using a cell phone by sharing his/her location and what he/she is doing and when. The user can then spread the word thorough text messaging with friends and meet up with them. One can also find out what one's friends are up to and join them. Further, one can look for a favorite pubs, restaurant, or café, and save it as a plaze. With this, one can also look for other friends using the Plazes and add them to friends list. Lastly, one can read a Plazes map to see where the really happening Plazes are and create one's activities there accordingly. This service is available at <http://plazes.com/>. [8]

SoonR: It is a service offered on mobile phones that powers up a mobile phone like a desktop by providing access to applications and files on one's desktop even when it is turned off. It lets a user perform a desktop search, chat through the IM on the desktop, access the Outlook, Mac Mail, files, and folders. The following figure shows the interface of *SoonR* on a mobile phone. This service can be found at <http://www.soonr.com> [7].

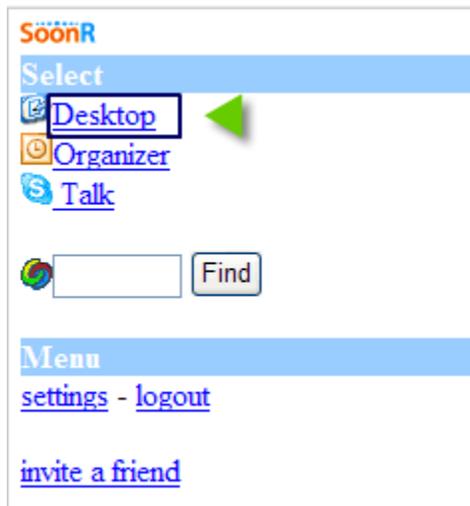


Figure 3: *SoonR* user interface [17]

Widsets: *WidSets* is a mobile based service that brings information normally accessed via the Internet, directly into a mobile phone using mini applications called widsets. This service uses RSS feeds to bring information to a mobile phone from the chosen websites. The widsets can be configured to display information from the chosen websites by the users. An alert is sent the minute any of the chosen websites is updated, keeping one always up-to-date. The following figure shows different widsets displaying information from blog, weather forecast service, RSS feeds, etc. This service is available at <http://www.widsets.com> [15].



Figure 4: Examples of *WidSets* [21]

BuzzD: A premier mobile, local search service providing real-time information for bars, clubs and restaurants on the mobile device. This mobile application allows consumers to know what's happening at any venue right now, rate events, and connect with friends and people in the area. This application has recently been declared a winner at Barcelona Peer

Awards during the Mobile World Congress in Barcelona. *BuzzD* is available at <http://www.buzzd.com> [4].

With the mention of the above innovative mobile web 2.0 applications, one should note also that the major players like Google, Yahoo, Skype, Opera and many others are actively participating in this mobile web 2.0 bandwagon as well. For example, Google is offering its Java based version of Gmail and Google Maps for mobile phone. Yahoo is offering Yahoo Go 2.0 service that lets users access everything from their Yahoo account—email, Flickr photos, news, and search, videos, etc. while on the go. Its oneConnect, to be released as part of Yahoo Go 3.0, is shaping up to be a mobile portal for the social Web, pulling together contacts from Facebook, Twitter, LinkedIn, MySpace, etc. Skype is coming up with a mobile version of Skype. Opera Mini is getting a lot of attention as a mobile web browser that supports cross platform and efficient web browsing. It offers features that allow for quicker scrolling, auto-sizing, faster page rendering, full page zoom-out and also intelligent web page reformatting for better viewing.

FUTURE POSSIBILITIES WITH MOBILE WEB 2.0

The applications showcased in the previous section only show the beginning of mobile web 2.0 era and give a glimpse of what is yet to unfold for the future. Below is brief look at the (near) future possibilities. Note that at the time of publication, one or more of the discussion items may be obsolete—very representative of the speed of IT evolution.

It is speculated that Gphone, if Google decides to launch it, will change the face of the wireless industry. This is because with or without Gphone, Google has launched its own open-source mobile operating system, called Android, to achieve seamless integration of applications and properties in the mobile platform. Android will be available for any cell phone manufacturer to deploy in the cell phones and build applications on it [14].

Also, Gphone with Android will be wireless carrier agnostic and used internationally supporting both GSM and CDMA standards of mobile telephony. It will also have support for Wi-Fi and 3G for wireless data transfer enabling VOIP service in the mobile phone. No doubt, Gphone will not only showcase its own suite of applications and properties—Gmail, Gcal, Goffice, YouTube, Google Maps, Blogger, Picasa, and so on but also other non-Google applications like Flickr. One can then use the digital camera in the phone to take a picture and upload it to Picasa/Flickr or make a video recording and upload it straight to YouTube. Also speculated is

that the Google phone might include GPS using Google Maps, making it a true location-aware mobile phone. It could be imagined that addresses in Gmail or in Gcal are automatically mapped and plotted for real-time travel. Gphone may include a social aggregator as people use more than one social-network (FaceBook, MySpace, Twitter, LinkedIn, so on). Google might also be on the mobile advertising bandwagon with Gphone. This may keep the monthly billings and cost of the phone low by having *ticker ads* appear on mobile phones with users' discretion. Note that for the above, Google happens to be the company that initiates the platform. The effect and impact would be comparable even if it was from another company (provided there are buy-ins from the carriers and developers).

Another service in the glare of publicity is Google's ZagMe service. When shoppers are out shopping, this application will alert them about the offers and ad words from the shopkeepers around that think the shoppers will like. This service also lets the shopper make a price offer to the shopkeepers and pops a message on the mobile phone if shopkeeper is willing to sell the item at that price and vice-versa. On key feature of ZagMe is that it is a self-learning application that will not alert a shopper about offers from merchant/brand that the shopper does not like or for a product that shopper has recently bought. One can always set the preferences as to which offers one wants to always see and which never. A user can also pay using Google's wallet, which is not only a payment system but also a feedback loop, providing information to the ZagMe ad server. For instance, if a shopper just dined at a restaurant, it is not going to give him/her any ads from a restaurant for the next 4 hours. It builds up a pattern of your responses and presents ads and offers in the future accordingly [3].

Mobile web 2.0 is about leveraging the power of web 2.0, extending it to the mobile platform and capturing the rich functionalities and the user experiences it offers on desktops. The mobile web applications are now being increasingly hosted on *.mobi* top domain level to identify them explicitly as mobile web applications and facilitate the rendering on mobile web browsers. Taking a shift from this phenomenon, in future there is also a possibility of developing web applications for universal purposes and not enclosing them in the platform boundary. It is plausible that the deployment of mobile web applications be done in a manner that they be hosted on a traditional web server and be intelligently adapted to the access platform—be it from mobile phone, desktop or any other futuristic platform.

Other industry news that is hot off the press (March, 2008) is that various industry giants including Google, Comcast, Time Warner, Intel, and Sprint are investing

\$3-\$4 billions on the 4G WiMax technology as the network that will deliver the next generation of applications. WiMax, with speed that competes with broadband DSL, will certainly bring mobile web 2.0 to the forefront mobility. Along the line of funding, it should also be noted that famed venture capitalists Kleiner, Perkins and company have recently established the \$100 million iFund to invest in mobile applications for the iPhone, while Google has its own Android Developer Challenge, a developer contest with \$10 million in total prize money.

CHALLENGES

Some of the characteristics described as fundamental to mobile web 2.0 will impose challenges impeding the wider deployment of mobile 2.0. The most important characteristic to appear as a challenge is openness—open standards, open source for mobile web applications, and open access from carriers. Openness is not impossible to achieve but it needs industry wide coordination and collaboration for it to happen. The telecom carriers need to take the roadblocks off by not enclosing the users in the walled gardens and allowing them into the new world of openness and freedom of access. An open source mobile platform like Android is step in the right direction.

Designing and developing mobile web applications is indeed becoming a challenge for designers and developers as they need to come up with user-friendly interfaces under the constraints such as small display screens, limited text input, short battery life, and modest processing power. The amount of information mobile devices needs to convey increases with them becoming more and more compact. The websites on the mobile devices should show only the necessary and relevant information to the users so that they are not overwhelmed by the amount of information being presented to them through the tiny screens. The mobile designers and developers need to create the best user interface considering the physical constraints of mobile devices. There is also the need for research efforts to go into the field of creating better user interfaces for small devices [2, 9, 10].

Affordability of the services on mobile phones will be the most decisive factor, after openness, determining the penetration of mobile web 2.0 services into people's lives. Noted by some as the "gadget factor," there are still a lot of mobile users who do not have the necessary technological features (e.g., GPS functionality) to take advantage of mobile 2.0. Some users do not even recognize the existence of the features on their mobile phones due to lack of education. With the support from the industry players, the affordability of these services

will never become much of an issue. On the contrary, if the service providers and telecom carriers collaborate to offer the services at very affordable prices for its mass penetration, they are the ones that are going to benefit the most.

The use of mobile web 2.0 applications may also bring some privacy and security issues to the users. There are applications (e.g., calendars, address books) that a user may need to access regularly, at anytime from anywhere, even when the mobile device is not connected to the network. In order to provide such continuous access, these applications would need to store data offline and access information available locally on user's mobile device. These locally running applications may transmit the information to the network servers for storage when the device regains network connectivity and also send the user's geographical information while the user is interacting with online services or transferring files, thus exposing the privacy of the users to the outside world.

These applications with access to the user's local information are bound to have privacy and security issues, which need to be handled with the greatest care. While mobile 2.0 provides users the ability to interact and use online services in an unrestrained manner, the users would tend to store more and more of their confidential and sensitive information on their mobile devices. Also, application providers, perhaps without the user's knowledge, may embed program code in these locally running applications, recording the entire user's personal information and sending them to the agents that may benefit from this information. The moderate processing power of the mobile devices may not allow the use of powerful cryptographic algorithms, as they will require high processing speed to encrypt the information being passed back and forth from a user's mobile device to ensure the privacy and security of the users' transaction. These measures need to be built into the browsers effectively to give the users' confidence in using web over the mobile platform.

CONCLUSION

Mobile web 2.0 promises to change the face of the mobile computing in the years to come as industry players continue/begin to invest vastly into the burgeoning field. It will change the way people interact with mobile phones and the way they carry out their daily lives. It will also expose them to services that could not have been imagined to exist through a mobile phone just a few years ago. They include services such as GPS, Maps, mobile wallet, social networking and the list goes on. Although there are many challenges that are going to obstruct the expansive implementation of

mobile web 2.0, the industry efforts will overcome the challenges to make mobile web 2.0 a true reality, if history (of IT innovation) is of any guidance.

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