Mobile Web 2.0. A Theoretical-Technical Framework and Developing Trends

Pardo Kuklinski, Hugo[1], Brandt, Joel[2] and Puerta, Juan Pablo[3]
[1] Universitat de Vic, Barcelona, Spain, [2] Stanford University, Palo Alto, USA,
[3] Craigslist, Inc, San Francisco, USA

***Abstract*—These More recently, synergy between novel technology and new usage patterns has enabled the convergence of mobile devices and Web 2.0 applications. This synthesis is embodied in a new conceptual and profitable space called *mobile Web 2.0*, where an *always on empowered web consumer*, is sought after by manufacturers, operators, business developers and media actors. In this article, we will mainly focus on *mobile Web 2.0* as defined above. This piece of research delineates an original theoretical and technical framework that helps introduce the reader to the *mobile Web 2.0* phenomenon. For this, the central aspects in the evolution of mobile phone usage towards Internet-based collaborative applications will be emphasized. In addition to it, the difficulties and limitations faced by the industry, the seven principles of Web 2.0 for mobile devices, and product, content and GUI aspects of this incipient market will be analyzed. A computer graphics have been included as a summary of this piece of research.**

***Index Terms*—mobile Internet, mobile Web 2.0, mobile data industry, point of inspiration, snippets, collective intelligence.**

I. INTRODUCTION: FROM MOBILE INTERNET TO MOBILE WEB 2.0

The *mobile network society* (Castells *et al*, 2006) is driven by wireless communication technology. The momentum given by hardware manufacturers and operators to the timely adoption of third generation (3G) [1] mobile devices has made available an infrastructure that promotes connected physical mobility, together with an attractive and incipient market for services. In this context, the term *mobile Internet* is used to describe Internet access using mobile devices [2]. More recently, synergy between novel technology and new usage patterns has enabled the convergence of mobile devices and Web 2.0 applications (O'Reilly, 2005; Cobo Romaní and Pardo Kuklinski, 2007). This synthesis is embodied in a new conceptual and profitable space called *mobile Web 2.0*, where an *always on empowered web consumer* (Wilson, 2006), is sought after by manufacturers, operators, business developers and media actors. In this article, we will mainly focus on *mobile Web 2.0* as defined above.

While mobile devices enable users to capture content at the point of inspiration (Jaokar and Fish 2006), Web 2.0 enriches the experience by leveraging collective intelligence –the wisdom of crows (Surowiecki, 2004)-. This collective intelligence is supported on a taxonomy of knowledge created by users themselves, which itself promotes a new emerging *mobile data industry* that is in harmony with the ethics of an *architecture of participation* that goes beyond text messaging, ringtones and other features promoted by the operators.

The emergence of 3G technology gives meaning to this ongoing transformation. If we see the first and the second generation of mobile phones as designed and optimized with an emphasis on voice communication, 3G derives its decisive advantage from its efficient connectivity to Internet resources and offering new complementary uses that rely on that technical capability.

Nevertheless, for the market to mature and move permanently from traditional mobile communications to first the *mobile Internet* and then to *mobile Web 2.0*, it is necessary that the industry modify its traditional strategies, which we will describe later in this article. In addition, users will need to positively perceive, as measured through their behavior as consumers of these services, the advantages of these devices in terms of convergence, ubiquity and increased productivity. Given the availability of handsets that are more powerful in terms of processing power, new multimedia capabilities, more network bandwidth available for Internet communication, more available Wi-Fi access points, more efficient web browsers, novel hybrid mobile applications, and massive online communities, convergence seems to be only a matter of time.

This piece of research delineates an original theoretical and technical framework that helps introduce the reader to the *mobile Web 2.0* phenomenon. For this, central aspects in the evolution of mobile phone usage towards Internet-based collaborative applications will be emphasized. In addition to it, difficulties and limitations faced by the industry, the seven principles of Web 2.0 for mobile devices, and product, content and GUI aspects of this incipient market will be analyzed. This work is part of our research planning on a wider theoretical framework titled "*Campus Móvil: Mobile devices and Web 2.0 applications. Towards a prototype design for university teaching innovation*", whose main goal is the design of a prototype Web 2.0 application for mobile devices geared towards higher education in Spanish-speaking markets.

II. MOBILE INDUSTRY LIMITATIONS

According to Castells (2006), in 2004 there were 1.2 billion landlines and 1.7 billion mobile handsets around the world, while only a decade before there were 643 million landlines and 56 million handsets. These figures continue to grow: ITU (2007) statistics show that there are 2.6 billion of mobile phone users around the world [3]. In 2002, the number of mobile handset overtook the number

of landlines, a trend that suggests that traditional landlines are facing eventual extinction. Nevertheless, there are historical factors behind current technical limitations that hinder the transition from mobile telephony to *mobile Internet* and subsequently to *mobile Web 2.0*. Current handsets have been designed to be conceptually and physically similar to traditional phones. Until now, manufacturers had focused on offering an experience that resembles as closely as possible the use of a traditional phone. Since there has not been an early standardization of manufacturing, application software, operating systems or user experience expectations, consumers ended being held hostage by mutually incompatible proprietary technologies. Users are penalized when they choose to use more communication technologies due to the ensuing higher degree of incompatibility between different platforms. In addition, power struggles between operators and manufacturers have historically dictated the economics in this industry: operators frequently incorporate proprietary services designed by manufacturers that are dependent on existing network infrastructure and in this way preclude third parties from accessing development opportunities. Operators increase the value of their network usage based on hardware or software upgrades. This corporate behavior pattern naturally leads to *de facto* monopolies in which subscriber finds limited options and that prevents the emergence of an applications and services ecosystem that could increase value of mobile devices. Because of this, in spite of their technological maturity, mobile devices are currently underutilized as multimedia devices. The operator-manufacturer partnership is based on mechanisms that prevent users as well as third-party developers the incorporation of software add-ons, generally trough the unavailability of APIs (Application Programming Interfaces), development libraries or OS internals [4].

Frequently, information technology is found to evolve in a doubly-Darwinian way. In this game, the consumer selects devices and technologies that better suit her needs, but at the same time, her choice is that of a mass consumer forced to adapt to business models that predate her needs. One preconception common in the IT and consumer electronics industry is to count on the first type of adaptation being resolved in an atomic form (the consumer selects handsets in an independent form) as opposed to a genetic way (the consumer selects independent features of each phone that are potentially useful to her). Even though IT industry has attempted to capture and take advantage of these behavioral patterns by creating and leveraging industry standards like Bluetooth and Wi-Fi, until now there has not been significant the standardization of hardware or software internals of mobile phones.

In this context, and because of the previously mentioned limitations in the industry, difficulties for software developers arise. The user faces a technology market fragmented into those of different manufacturers. This fragmentation forces software developers to face an increase in their costs because of: a) the adaptation of applications to devices with diverse hardware and OS characteristics, and b) complementary cost associated with payment of licenses and royalties to access to different OS-related libraries, SDKs, programming environments and specialized cross-compilers needed to target different devices [5].

Besides the intentional segmentation of market by the industry and the rationale behind built-in obsolescence, software developers frequently face limitations in the processing power of the handsets. Because the devices need to be portable, they usually rely on low power and small footprint solutions for their processing units. To make things worse, embedded or unrelated and downgraded versions of the popular operating systems, that they are completely different from their desktop counterparts in their internals, but frequently sold under the same brand for commercial purposes.

The increase of visualization interface on screen and web browser standardization found in newer devices constitutes the current window through which the use of different technologies is accessible to all users of the network. Software developers and online service providers can now start to focus on the creation of value and content visible to handsets made by different manufacturers using a single, inexpensive and open interface, while at the same time leveraging the preexisting web-based front-end technologies.

We should then expect – as happened with PCs - manufacturers to rely on the creation of browser extensions that are only semi-proprietary (open APIs, closed back-ends or patent-protected) for the creation of locked added-value applications in their handsets. In addition, it is then likely that current technologies will evolve favoring the adoption of fully open web browsing applications for mobile devices.

As for the web browser as a platform for development, a parallel technology for the use of web content in terminals that were not designed for web visualization or interaction is emerging. Proxy-based web browsers [6] divide the computational burden associated with download and rendering between the handset and an intermediate server located in the Internet (generally operated by the company supporting the web browser) configured as a proxy server. The proxy server captures the page request, downloads it, renders the page and the graphic content so it is adequate to the available bandwidth and handset computing power (using image compression, HTML simplification and/or conversion to XHTML) and finally passes the content to the phone. In keeping with the collaborative nature of Web 2.0, current research is looking towards the creation of these proxies by users rather than corporations (Cobo Romaní and Pardo Kuklinski, 2007). This trend of using a browser-proxy as a platform and intermediary [7] means that access to services that require heavy processing might be a real possibility for mobile devices. Moreover, it suggests another interesting trend involving the adaptation of systems designed for desktop systems as well the compatibility with traditional desktop hardware.

III. THE ADAPTATION OF CONSUMPTION MARKET

As it was mentioned, the main limitation of mobile handsets lies in the constraints that are imposed by actors in the market and their usage patterns, rather than in technological limitations. Beyond traditional uses of telephony (voice communications, voice mail), the more successful uses have been those that enhance communication capabilities at a very low cost or at no cost per usage unit (Kb, messages). For example, in Europe, the most noteworthy uses in this category are the use of

text messaging for short communications (user-to-user, corporate-to-user), the use of *pings* (text messages with confirmation of receipt) and the use of *lost calls* (calls that are not taken by the recipient, but encode time-sensitive binary information: "-I am waiting outside!"). These semi-traditional uses of communication technology have characteristics that are missing and not supported by the numerous software developments centered on mobile platforms. That is, they are standards-based, based on features natively supported by the handsets, have very simple and unambiguous interfaces and are universally deployed. Because of these reasons, diverse actors have started to use these patterns as an interaction method between users and traditionally web-based systems.

Certainly, more time is needed to assess how consumer market will finally respond to 3G technology. The more optimistic prospects point to an unstoppable evolutionary change (Levinson, 2004; Thompson, 2005; Steinbock, 2003, 2005). Steinbock (2005) underlines a transition from the voice communication business to the content watching business, where the hybridization of mobile devices towards integrated Web 2.0 use makes sense the most. Levinson (2004) analyzes this phenomenon and concludes that – in the context of the USA – the observed trends point to a culture of mobility that will eventually absorb the entire Internet, that is, users will consume much more content through their mobile devices than they do through their desktop computers. On one side, this is a plausible scenario today in the USA and Asia, with current offerings of mobile Internet at flat rates (for example, examine the joint venture between AT&T and Apple Computer for deploying their *iPhone* handset) and the widespread availability of Wi-Fi meshes in urban settings.

Even though mobile communication was originally geared towards corporate and professional uses, the market evolution resulted in broader use within workplace and use within interpersonal communications. Later, teenagers and young adults became the driving force in the market, and it is this segment that is leading the consumption of Web 2.0 products. In addition, this segment is the one that contributes more early adopters for the trial and error strategies of Web 2.0 startups as well as of manufacturers and carriers. Similarities between these two consumer segments –mobile communications and Web 2.0— reinforce even more the potential of the convergence analyzed in this piece of research.

In 2000, the European carriers invested significant amounts of capital with the goal of securing licenses to operate portions of the 3G frequency range in the entire EU [8]. Yet, after seven years, they have been unable to recoup the costs associated with that investment (Wilson, 2006). At that time, operators and regulators assumed that 3G technologies would offer a wide range of multimedia services that users would be willing to pay for. This has not been the case and thus pressure to capitalize that investment has been building up, compounded by the threat of built-in obsolescence materialized by the advent of 4G mobile communication handsets.

Besides the limitations to evolution in the industry already pointed out, another reason for slow adoption of *mobile Internet* and *mobile Web 2.0* lies on the limited plans for innovation by carriers. Other reasons for the lack of widespread embracing of *mobile Internet* are: high connection costs, slowness of web surfing via mobile devices, handicapped usability of mobile interfaces (sequential display) and slow familiarity with its use. Computer desktop is still more efficient and economical for web browsing and Web 2.0 applications uses. However, the text messaging and ringtones experience suggest that, when there are pre-existing conditions that user can benefit from, there is a consumer market that is eager to adopt new technologies.

Finally, one last significant obstacle is that of diverse standards. GUIs vary from device to device and, to compound the problem, handsets from different manufacturers do not support the same software platform, since carriers frequently lock and limit the level of functionality according to their commercial strategy. The same way it happened in the early 90s, when the market for web browsers was embryonic, W3C [9] is pushing for a standard of use for mobile web applications that promotes integration between computers and mobile devices without differentiation. This will not only be hard to police, but could also turn into a limitation for some types of applications that aim at being more specific to mobile communications.

IV. THE MOBILE WEB 2.0 CONCEPT AND THE SEVEN O'REILLY PRINCIPLES

Current technological innovation, directed towards the definitive positioning of smartphone [10], has supported the creation of new users. The social trends emerged as a product of the gradual introduction of mobile phones, back in the 80s, and their evolution along 21st century mobile devices justify the integration of new value-added tools to these devices.

It is then natural that the alliance between mobile devices and Web 2.0 applications is in line with the Web 2.0 principles (O'Reilly, 2005) and exhibits points of strategic convergence:

The Web as platform. Even though the cost and power of chipsets available improves constantly, a mobile device with necessarily never have as much computational power or storage capacity as its non-mobile counterpart. As such, the Web as a platform emerges as a strong synergizing agent for mobile devices.

The database management as a core competence. The alliance between mobile devices and Web 2.0 applications allows the integration of efficient data classification with the ease of quick access to them from any place and at any moment, supporting data ubiquity. The convergence of location-based services and capturing of the point of inspiration using databases tailored to these uses can potentially lead to attractive services and strong business opportunities.

End of the software release cycle. The possibility of direct access to online software that does not require software updates or patches using a handset frees mobile devices from the need to frequently download the latest versions of each installed software package. This represents a clear advantage, given certain system characteristics of these devices, like reduced memory, minimal GUIs and the associated security risk associated with the installation of third-party developers software (viruses, spyware, etc.).

Lightweight programming models and the search for simplicity. This principle is one that best suits the convergence found in *mobile Web 2.0*. With reduced

interfaces and limited storage system, graphical austerity as well as the use of application protocols will be the base of any implementation, be it programming or interface design. Very often, the information that a user needs to communicate using a mobile device has a temporal value (*e.g.* if data is related to arrival at or delay to physical locations, this data will be useless after certain time delay). The usage patterns found for text messaging in Europe and Japan show that users prefer, in certain contexts, to adopt quick and simple ways of communication instead of more complex and powerful applications.

Software above the level of a single device. This principle was specifically created as part of the convergence between Web 2.0 applications and mobile devices. Software as well as applications has been designed being used on multiple hardware platforms, most commonly personal computers and mobile devices.

Both *rich user experiences* and *harnessing collective intelligence* occur as the users seize mobile devices as web browsing and web consumption tools. Here lies the key to future development given a current environment in which the *mobile data industry* is based on content provided by the carriers.

V. MAIN ATTRIBUTES OF *MOBILE WEB 2.0*

To the seven principles of Web 2.0 mentioned above, Jaokar and Fish (2006) add seven attributes of *mobile Web 2.0* that help point out the main aspects of the convergence discussed in this article.

The content created in mobile devices that are integrated to Web 2.0 applications could change the balance of power in the media industry. The ubiquity of mobile devices allows the capture of the point of inspiration of the user, turning phones as a means to consume primary information into a tool for content creation by users themselves. The new kind of consumer behavior to turn very personal and defines identity.

The user is no longer a phone number, but bears a tag. These tags provide a means for the handling of the multiple numbers associated with our identity, that are used in everyday life in a natural and intuitive way, freeing the users from the restrictions posed by carriers. Most users store personal contact data in their devices, but their replacement (due to theft, aging or loss), trouble associated with porting data between terminals and the widespread use of fixed location services independent of the carrier (email, IM, VoIP) force users to manage and maintain copies of their data on online contact servers (web based or using specialized protocols, like LDAP). Open access to this data using standard protocols for the description of social networks, contact information and personal information (using protocols like FOAF [11]) could promote – as opposed to a traditional phone book – the creation of a decentralized taxonomy that gives meaning to personal information snippets distributed in a network of users. This taxonomy, known as a *folksonomy*, will enable, with the aid of the information collected from the phone and other communication devices, the creation of advice services based on geographical location and/or new and more personal forms of social contact much in the same way as current Web 2.0 applications do today.

Global nodes and multi-language access. Localization is a complex exercise in traditional mobile networks. The *mobile Web 2.0* network is destined to be a worldwide web-based mobile network with multi-language access. This is a desirable scenario where there is no roaming charges, international calls, monopolistic or duopolistic abuses and with the competition of VoIP telephony reducing the cost of voice calls and increasing the chance of locating users independently of which network or country they are on.

Mobile Web 2.0 enables synergies between applications through *mashups*. This refers to new functionality created from the combination of preexisting products with a focus on efficient use associated to mobility. The extended use of *mashups* of, for example, Google Maps on mobile devices (especially in the USA) is an example. Alternatively, virtual presence or remote interaction technologies (software that allows access to a terminal from another device by using a network connection) will enable the management of big volumes of data that "live" in other systems (desktops, laptops, servers, web services, remote services) from anywhere using handsets. Classical interaction technologies like Webex/Cisco are giving way to systems of interaction much more constrained and multiplatform [12] that enable the administration, consumption and editing of information stored in remote terminals and collaboration between an individual and a group as well as between groups.

AJAX as a basic system for interaction with the user (better interaction flexibility) as well as for optimization of network usage (compare the burden associated with downloading a complete HTML or XHTML to the ease of delivering a snippet formatted using XML or JSON). AJAX can be used together with the browser interactivity features (geographical mapping of phone services), to enable interaction with the application using the keyboard the same way it happens when users use keyboard shortcuts in services based in AJAX geared towards desktops (Gmail and Yahoo! Mail use keyboard shortcuts to access different services and menus). This enables the creation of applications that are sensitive to the mobile device context and to the interaction habits of users.

Mobile Web 2.0 will lead the location-based services, since this is the distinct feature of mobile devices against which other tools cannot compete. Mobility contributes to data management from different geographical locations. In addition, the architecture of participation could potentially yield truly meaningful in terms of context-based needs, suggesting an organic use of the device in contrast to the limited current offerings of the carriers.

Mobile Web 2.0 expresses mobile search for information in a way that is very different to what is expected from an interface desktop search, emphasizing context: strong time, event and location dependence. In addition, there is a lower tolerance for serendipity and lack of patience on the part of the user. Taking these differences into account, and given the specific consumer needs and the need to present little information in a sequential way, the user expects more efficiency in the results. Still in its early stages [13], the development of efficient search engines centered on *mobile Web 2.0* and the data mining of usage patterns might be a decisive contribution towards the realization of a *semantic web*.

VI. TRENDS IN CONTENT AND GUIS

One of the main questions in analyzing the convergence between mobile devices and applications Web 2.0 is what types of content will users want to consume through mobile devices. The underlying question is: how can mobility add value to content? Tanya Price, Head of Business Development de BBC Broadcast (Wilson, 2006) points out:

• Users will want to amuse themselves with short, direct and fund multimedia content in every situation where they are traveling and out of their office or home.

• Users will want to see those images for which they are cannot wait until they get home and they would be even willing to pay for it (*e.g.* real-time scores for a favorite sports team or scores during an intermission in the game).

• Users will want to have content of high added value in specific situations when away from home.

These comments, coming from a traditional content producer like the BBC, have obvious overtones of a situation in which the media industry produced content, people in turn consumed that content and absolute power was in the hands of editors. In Web 2.0, the role of the editor is now transferred to the user. This way, the consumption of mobile devices is not just of items offered by the carriers. It might be that the answer is not delivering some high value content or recycled mass media content, but lies in generating platforms for user connectivity, visibility and participation that revolve around mobile entertainment or professional life. It is there where there are more similarities between the Web 2.0 architecture and mobile communications and it is about providers facilitating through a platform for an end user that has turned into editor of the content it consumes.

Even though there are a number of possibilities in terms of potential usage, one can point out three main needs of the *mobile Web 2.0* user that can be used to formulate attractive business models: a) management of mobile data from the point of inspiration, b) generating snippets which can be retrieved and reused on other computing environments. One of the possible applications that would fulfill this two needs would be a platform dedicated to the transfer of snippets from a handset to a server and from there to a web application for its potential editing and enhancement, much like an diary or similar knowledge management system (Brandt, Weiss, and Klemmer, 2007). Finally, c) taking advantage of the without computing availability and network access (public transportation, dead time, public spaces as pubs, restaurants, theaters) for keeping connected and having access to multimedia content and network interaction.

With respect to GUIs, it is well know that mobile devices present a challenge because of their reduced screen. Given that Web 2.0 applications were originally designed to be navigated from a computer, with a 1024 x 768 pixel resolution, mouse, keyboard and drag-and-drop features: what is the best way to adapt Web 2.0 to mobile interfaces that are only 240 pixels wide and have only limited graphical capabilities?

The advent of the touch-screen technology that Apple Computer have introduced with the launch of the *iPhone* in June 2007, which enables the user to visit websites in their original version with no resizing or changes in layout, could result in a new design paradigm for all manufacturers. When companies had just started developing dual versions of their websites (normal and for mobile devices), the navigation style proposed by the *iPhone* departs from that logic and enables access to standard websites, significantly improving the usability of the system and avoiding the need for mobile-only versions of sites.

Beyond this recent innovation, the main distinguishing patterns of portability are still little weight, small screen, sequential display, content prioritization and understanding of the user needs (Lindholm, Keinonen and Kiljander, 2003). Moreover, in the end, simplicity is still the main goal. This is because, as opposed to the use of bigger GUIs, like those found on desktop computers, where all the attention is directed at the screen, the interaction on mobile devices happens in a different context where the physical environment plays a role of interface, and in which the user is carrying over its primary activity as it uses the phone (Brandt, Weiss, and Klemmer, 2007b). According to Lindholm, Keinonen and Kiljander (2003), the current goal of graphic designers in mobile interfaces is the miniaturization, as well as the enhancement of applications and of features. Both themes, seemingly contradictory, share the same obstacle: the technical constraints on the GUI. You can do lots of new things on smaller mobile tools, but how can we distribute all that information over such a small screen? To make things worse, it is hard to transition as changes to the interfaces are made. Given that one of the tenets of the Web 2.0 are the use lightweight programming frameworks and the search for simplicity, it is apparent that there is no room for over-specification. As we mentioned, users do not have time to use all possible features of the product and any added complexity must be avoided. A graph has been included as a summary of this piece of research (fig. 1).

VII. FUTURE WORK

The piece of research detailed above attempts to establish a theoretical-technical framework and the developing trends to study Web 2.0 applications for mobile devices. The final goal of this study is to design a prototype Web 2.0 application for mobile devices that is centered on higher education. Nevertheless, for the lack of space in this presentation, we do not discuss the following tasks that would complete an entire scenario about *mobile Web 2.0* as well as the specifics of a prototype application.

The design of a map of current online *mobile Web 2.0* applications. The statement of categories of analysis emphasizing their services and content policies. Underline successful as well as recently launched products.

Identification of possible future *mobile Web 2.0* application development trends. Especially those geared towards academic uses and higher education institutional management.

The development of a global *mobile Web 2.0* application project for use in higher education. Preparation of a business plan stating: central features of the project, pros and cons of operating in this particular market, main application concepts, design of the user interface for both versions (mobile and standard web), technological infrastructure, budget, stages of product development, growth strategy and business model.

Mobile Web 2.0

Theoretical-technical framework and developing trends.

Hugo Pardo Kuklinski
Grupo de Investigación en Interacciones Digitales.
Universitat de Vic, España.

Joel Brandt
Human-Computer Interaction Group.
Stanford University, EEUU.

Synergy between novel technology and use patterns has enabled the convergence of mobile devices and web 2.0 applications. This synthesis is a new conceptual space called mobile Web 2.0.

Planeta Web 2.0
Mobile Web 2.0. Future Text
Mobile Communication and Society
Web 2.0 Summit
Mobile 2.0 Conference
Mobile Web 2.0. AMF Ventures
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CONVERGENCE: EVOLUTIONARY ASPECTS

	Before 1980	1980/89	1990/99	2000/05	2007/2010
MOBILE TELEPHONY — Social	Mobile technology starts in the 50s, centered around military uses and later business uses (on vehicles) with high costs. Technology restrictions, a complex regulation, lack of commercial interest and limited facilities delay the mobile evolution until 1990.	Commercial mobile telephony starts, with big and expensive devices. Manufacturers focus on offering an experience as close as possible to use of the traditional phone. Voice transmission is the exclusive traffic. Mobile telephony is a luxury for rich people.	Users must adapt to pre-existing business models. A slow overcrowding starts, mainly in business uses. Mobile data industry (SMS, ringtones, etc) emerges, but the mobile Internet does not exist in the majority of world markets.	(2002) More mobile phones than land lines. Twice as many mobile phones as PC's. Slow introduction of the Internet and smartphone. Users locked in to incompatible proprietary technologies. Business is based on a manufacturer-carrier power relationship. Services are dependent on the carriers' networks.	(2007) 2.6 billion mobile phone users around the World. Only 200 million 3G users (6.7%). The transition to 4G and a new in-built obsolescence of devices is predicted for 2010. Mobile Web is slowed down by the high costs of Internet connection in the majority of countries. A slow migration to flat rate data plans.
MOBILE TELEPHONY — Technical	The 0G preceeds cellular technology. That represents the start of the industry, with portability and coverage problems. (1956) Ericsson launches a 40 kilos device. (1972) The first mobile phone is launched by B-Netz in Germany without human operators for connecting calls.	The first generation (1G) of wireless telephony is born, with analog radio signals. It permits only voice. Low capacity of traffic and security. The FCC establishes the first market regulation, at the request of AT&T 10 years earlier.	The second generation (2G) of wireless telephony, with digital radio signals. Voice data can be compressed and transmitted with a higher efficiency. Smaller devices and a better use of battery. The mobile data industry starts, but HTML is too heavyweight.	(2003) The third generation (3G), digital with a larger compression capacity and data transmission (5-10 MB/sec) with lower costs. The business model impedes third-party developers by means of property APIs, libraries, and OSes.	A bigger interface and standard browser facilitate the mobile Internet and the network technologies. Software and service companies to focus on the creation of value. (2010?) 4G will be an integrated IP system. 100 MB to 1 GB/sec. Bigger capacity of distribution and access to multimedia contents.
INTERNET WORLD WIDE WEB — Social	(1977) 111 Internet servers around the World, in research and government offices. Computers or Internet consumption do not exist outside of this environment. Two milestones: (1971) Intel develops the microchip and (1976) Apple designs the first personal computer.	(1983) The Defense Department gives up the Internet control. E-mail is the main killer app, with Telnet for accessing remote machines, Gopher and Archie for shared directories. (1981) The first PC is launched by IBM. (1984) The Macintosh is born.	(1993) Web connections are 1% of Internet traffic. Netscape sets records in the stock market and the Web increases to 16 million users. Since 1994 technical and political-economic aspects are developed in parallel helping success of Internet via Web.	(2000) Hundreds of overvalued companies operating on Internet without profitability fall down. Static webs with low interaction are changed by communities based on collective intelligence. Web 2.0 is born. The market is rebuilt with the Google leadership.	Development of an "always-on" and "in-motion" active web consumer. More collaborative applications. Will the Internet economy be a new bubble or an ads-based model? More powerful search engines and folksonomies to improve information access. Will the semantic Web be developed?
INTERNET WORLD WIDE WEB — Technical	(1966) L.Roberts develops at MIT the concept of the computer network. (1969) 4 computers are connected in an embryonic Internet. (1972) ARPANET introduces the first killer app: e-mail.	Convergence conditions to personal Internet consumption. The development of LANs and Ethernet and the improvement of CPUs lays the groundwork for wide-spread Internet use. The Minitel system in France. Limited communication by e-mail. 1024 Internet	Berners-Lee creates a solution for network connectivity on the Internet. The World Wide Web is built. Convergence of: computers with capacity of working on the network, efficient browsers, optimal speed of data transmission and business interest.	256KB to 2 MB/sec. Surfing speed is doubled. Transmission of big text and picture files is facilitated with an adequate speed. Standards like Bluetooth and Wi-Fi permit the ubiquitous connection of computers to Internet.	Tens of MB/sec. Good quality of image and sound on the network. Sophisticated graphics and creation of 3D virtual worlds. Will the Web be the whole platform?

PHYSICAL MOBILITY + CONVERGENCE CONNECTIVITY

MOBILE WEB 2.0 PRINCIPLES

O'REILLY
The adaptation of O'Reilly's Web 2.0 principles (2005)

The Web as a platform is a good paradigm for mobile devices due to their low memory and processing power.

Mobile Web 2.0 allows the integration of *database access*. Ubiquity more an efficient classification.

The end of the software release cycle liberates users from expensive and slow updates of their mobile devices.

Lightweight programming models. In small interfaces and limited memory: graphical austerity and protocols.

Software above the level of a single device. Multiplatform apps (computers and mobile devices) and complementarity.

Rich user experiences. Web searching, location-based services and short content production.

Collective intelligence. Challenges the mobile data industry model of locked contents from carriers.

Mobile search is based on context of place and time. Users have less patience and less interest in serendipity.

Location-based services are a distinctive attribute. Web 2.0 offers organic data based on context.

AJAX as a flexible system with a better interaction and optimization of network resources.

Assembling of apps. More efficient uses of mobility and capture of point of inspiration.

Global networks that can be accessed outside the user's home country. No roaming or monopoly markets.

Tags allow multiple phone numbers in a intuitive way, decreasing carriers restrictions.

Ubiquity and multimedia capacity of mobile devices turn information consumers into content creators.

JAOKAR; FISH
Mobile Web 2,0 (2006)

MOBILE INDUSTRY. LIMITATIONES AND BUSINESS MODELS

LIMITATIONS
Originally designed like traditional phones. Slow evolution to smartphone.

Under-utilized devices due to carriers' business model and their limitations of third-party development.

High cost of software development due to poor programming environments, incompatible OS libraries and the need for cross-compilation of code.

The technology's inherent need for low power consumption and reduced physical size place large constraints on interaction and computational power.

Limited innovation of carriers. Fear to changes the status quo in mobile data industry (around voice, text messaging and ringtones).

Despite use of common protocols like Bluetooth and Wi-Fi, users are locked into incompatible proprietary technologies.

Difficulties in promoting web standards. The W3C impulses the integration between computers and mobile devices.

Touch-screen interfaces (iPhone, HTC, Nokia, LG) permit the use of desktop websites, enabling better usability without sequential access.

To take advantage of time without computing power (transportation, public places, etc.) by staying connected.

Mobile devices allow users to capture snippets at the point of inspiration and then retrieve and reuse them via desktop websites.

Mobile Web 2.0 services will allow capture of multimedia data while mobile and management of that data via web apps.

Transition of voice to watch and listen business. High added value (live sports, the latest news) that users cannot wait to consume at home.

Users will want entertain themselves and others with short multimedia contents while in mobile situations.

BUSINESS MODELS
Encourage low cost standards and natives apps with simple interfaces.

APPLICATIONS SELECTION

Multimedia

mosh beta NOKIA · YouTube · myspay · yelago · Vringo · facebook · mystrands · mozeo

Location-based services

meetmoi · SignalMap · SOCIALIGHT · PLAZES · dodgeball · loopt

Capturing the point of inspiration

twitter · bluepulse · jaiku · AbbyMe

The long tail

FUNAMBOL · Gumiyo · BUDDYBUZZ · campusmóvil

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[1] Analog mobile phones are usually considered the first generation in mobile telephony technology (1G), digital cellular phones are considered the second generation (2G), and the high-speed digital broadband devices are considered the third generation (3G) (Castells *et al*; 2006). Besides providing faster Internet connections, 3G phones provide a more sophisticated use of the handset that converges with multimedia applications. 3G technology describes a range of communication protocols that transmits and receives at higher speeds and makes mobile Internet connections with speeds similar to wired broadband access possible.

[2] The manufacturers in this industry have stopped calling their devices *cell phones* or *mobile phones* and now the more generalized term is *mobile devices*. Usually, this category includes mobile phones, PDAs, MP3 players and personal video players, but does not include portable computers. The features and uses that usually are in a 3G mobile device include: phone, video capture, camera, multimedia player, Internet connection using either Wi-Fi or a proprietary cellular network, web browser, email client, calendar, games and, in some cases, basic laptop features as ability to edit documents. We should note that even though new features and applications are added constantly, there is a wide array of products and not all of them have all the features mentioned above.

[3] ITU September 2007 data. Retrieved from AFP commentary located on: http://afp.google.com/article/ALeqM5iqxtfxK0op09jqpbJht2Ahp5Vgyw. As one of example of the markets we are interested the most, Spain is one of the countries with the highest density of mobile phones per habitant. As of July 2007, there were 48 million users and a level of penetration of 107.46 subscriber lines per 100 habitants. http://sociedaddelainformacion.telefonica.es/jsp/articulos/detalle.jsp?elem=5107

[4] The strategic positioning of the carriers resembles the attempt by old Internet service providers and email, like AOL and Compuserve, to create closed proprietary technologies to be used in a market strategy aimed at convincing the consumer of their value. This business model coexisted with an increasingly consolidated non-commercial internet ecosystem, where more and more value was generated based on *mashups* or the recombination of information with no limitation from licenses to access closed proprietary technology.

[5] *Cross-compiling* is the technique by which code can be compiled (translated from source code, that is readable by humans, into machine code, that can be interpreted by hardware) in a different environment from the used by the final application. *Cross-compiling* enables the development of embedded applications by allowing the programmer to work in a familiar environment (a workstation or desktop PC) using known tools that are generally more powerful that those that could run in the target device.

[6] The proxy web browsers (Opera Mini and Teashak among others) are applications designed for mobile handsets, and adapted to the limited processing power and the connection speed of these devices. These applications, instead of connecting directly to the Internet, send their requests to an intermediate server (a proxy server) that fetches the content on behalf of the user and relies it to the handset in a compressed, simplified and compatible form that is accessible to the user in a mobile device.

[7] This is a trend promoted by the work of two independent companies: Opera in its 'Advanced for java MIDP2' and 'Basic for MIDP2'; and Teashark. They have been inspired in the original work by Japanese DoCoMo in the late 90s.

[8] More information about European carriers investments on 3G frequency use licenses in Can Mobile Telephony Become an Architecture of Participation?, by Jason Wilson (2006).

[9] The W3C Mobile Web Initiative, embodied in the Mobile Web Best Practices 1.0, suggests steps to follow to ensure standards for this type of web applications, in line with the philosophy of experts as Berners-Lee, who believe that the design of specialized applications for mobile devices can fragment the web. Along the same lines, other authors criticize the development of specific platforms for accessing certain websites, like it happened when Japanese Mobile Web developed (that is, a number of different standards, one for each carrier). Please see Andreas Bovens, "Mobile Web development in Japan: A Tag Soup Tale" for more information about this. The policies of the ICANN (Internet Corporation for Assigned Names and Numbers) point towards more integration, which include, for example, the introduction of the .mobi domain to be used by developers exclusively for mobile platforms. MobiOnly.com is a platform that is leading the way in as part of the .mobi Initiative.

[10] A mobile device is called a *smartphone* when it features 3G and increasing integration with multimedia applications. Smaller-size storage devices with increasing capacity ease this transition towards mobile devices as a new content platform. For example, GPS is an example of widespread use of wireless tools. See http://en.wikipedia.org/wiki/Smartphone for a definition of *smartphone*.

[11] http://www.foaf-project.org

[12] Same as with the protocols and open systems NX or VNC, or as with commercial system Yugma (http://www.yugma.com).

[13] During the 3GSM 2007 meeting in Barcelona, seven European carriers (Vodafone, France Telecom, Telefónica, Deutsche Telekom, Hutchison Whampoa, Telecom Italia y Singular) met with the goal of promoting a strategic alliance with the aim of creating a tool that would compete with Google - Internet search engine leader - and obtain a share of its advertising revenue. Another trend in mobile Internet search that is worth noting is the service posting technology based on DNS originally created by Apple (Zeroconf/Bonjour) and made available to the public for free under an Apache 2.0 license. This technology, used for commercial purposes on iTunes, iPhoto and iChat enables users connected with different clients to a single network to publish content that is served to rest of the network (songs on iTunes, pictures, web services, instant messaging and telephony). This technology creates a location-based consumer market that could be interesting in the mobile environmental, because it discloses to neighboring terminals (the same Wi-Fi net or cell node) the disposition to chat, share songs (mobile p2p), post snippets (ads, political content, discount coupons) or the free access to information available in private networks. This being a technology created originally by Apple, this protocol is usually included on iPhone handsets. Nevertheless, the trend is to include this technology using the compatible technology Avahi (included by default in the latest Linux distributions) since this library is included in the base mobile Gnome distribution and in the embedded distribution created by the Gnome foundation in April 2007 (http://www.gnome.org/press/releases/gmae.html) and is to be adopted soon in handsets using this OS (like in Openmoko, see http://www.openmoko.com/).

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AUTHORS

Pardo Kuklinski, Hugo is a member of Digital Interactions Research Group (GRID), University of Vic, Spain. CEO of Campus Móvil Project. Visiting Professor at Human-Computer Interaction Group, Stanford University, USA (2007). (e-mail: hugo.pardo@uvic.cat, (http://www.uvic.cat/fec/recerca/en/grid/hugo_pardo.html)

Brandt, Joel is a Ph.D. Student in the HCI Group, part of the Computer Science Department at Stanford University. USA, http://graphics.stanford.edu/~jbrandt, (e-mail: jbrandt@stanford.edu).

Puerta, Juan Pablo is a member of the development team at Craigslist.org, Inc, San Francisco. USA (e-mail: ews@sindominio.net), http://blog.folksonomy.com

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