

Web 3.0: A Vision for Bridging the Gap between Real and Virtual

Juan M. Silva

Multimedia Communications
Research Laboratory (mcrlab)
University of Ottawa

jsilva@mcrlab.uottawa.ca

Abu Saleh Md. Mahfujur Rahman

Multimedia Communications
Research Laboratory (mcrlab)
University of Ottawa

kafi@mcrlab.uottawa.ca

Abdulmotaleb El Saddik

Multimedia Communications
Research Laboratory (mcrlab)
University of Ottawa

abed@mcrlab.uottawa.ca

ABSTRACT

Version numbering of the Web has become a common practice in recent years. The latest version is the Web 3.0. However, this term is still somehow ambiguous and IT experts do not seem to agree on a specific definition. We present a review of such different trends for the next generation of the Web, while providing our own view for a next generation Web version that makes a convergence between the real world and the virtual means of communication and information access, enabling an ambient intelligence scenario of pervasive and ubiquitous computing.

Categories and Subject Descriptors

A.1 [General Literature]: Introductory and Survey

General Terms

Design, Human Factors, Standardization.

Keywords

Web 3.0, ubiquitous Web, ambient intelligence.

1. INTRODUCTION

In recent years we have had a new tendency to have version numbers for the World Wide Web. The latest version everybody is talking about is the Web 3.0. There is still plenty of debate about what technologies drive the third generation of Websites and Web applications. Experts do not seem to agree on a specific set of characteristics or technologies, or a definition for this third generation of the World Wide Web.

Although the definition for the term Web 3.0 is still ambiguous, the truth is that most of the technologies and paradigms that experts are talking about have been around for quite some time. At the Multimedia Communications Research Laboratory at the University of Ottawa, we think that it is not a matter of “which” new technologies will be widely available, but “how” these technologies will be applied and integrated to give structure to the next generation of the Web.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

CommunicabilityMS'08, October 31, 2008, Vancouver, BC, Canada.
Copyright 2008 ACM 978-1-60558-319-8/08/10...\$5.00.

The web is a medium of accessing and sharing information in our modern society. Considering human activities such as leisure, mobility, and health, we envision the Web3.0 to go beyond the use of the traditional web by including natural ways of interacting with real-life objects that typically have not been considered as computing entities, such as cars, health support equipments, clothing and even product packaging.

In our approach, the human is the focal point; therefore the Web 3.0 will be based mostly on pervasive and ubiquitous computing. Our ultimate goal would be to combine new technologies to open intelligent avenues for delivering dynamic, interactive and targeted contents specific to the user in an interesting smart interface. The future of the Web is omnipresent and fully integrated in our daily lives, and we can access information and media by using natural and multimodal user interfaces in an unconscious manner. This new Web should support our daily activities in such a way that it will no longer matter if the given interactions are human to human, human to computer or even computer to computer, while we will be able to access services, information and fulfill any other communication needs in a fully global and ubiquitous environment. To illustrate a usage scenario of the Web 3.0, a senior citizen who is continuously monitored for some health conditions should be able to go walking, shopping, and meeting friends while his health monitoring should be supported anywhere and anytime, e.g., at home, in the car, in the mall, etc. From the point of view of the ageing members of society, the Web 3.0 will improve autonomy and the quality of living as the human capabilities fade. Once stationary care is required, technological assistance can be used to reduce the burden on the care givers, comply with state mandated record keeping and improve the comfort of the elderly. The ageing part of society will be mostly concerned with issues related to health, leisure, mobility and to a lesser extent work. In contrast the working sector of society may take a more balanced look at the concerns of life while the youngest generation might be mostly concerned with mobility and entertainment. Still, they should all use a common framework, as different sectors of society will interact and rely on the same infrastructure.

In this paper, we start with a brief introduction and definitions to the previous two versions of the web, followed by a review of current approaches and visions from different IT experts in the field. Next, we identify the major technological trends that support such visions, quote some popular definitions out there, and finally we present our very own perspective on the matter.

2. ABOUT WEB 1.0 AND WEB 2.0

We are in the process of defining Web 3.0, however in order to really see what is new about it, we need to take a look at the characteristics that defined the previous two versions.

First Era (Web 1.0): Most experts agree that this era corresponds to the early years of the World Wide Web. In the beginning the Web was a collection of (mostly) static pages that hold information and content created by companies or some other organizations that created the site or Web pages. There is a general consensus that during this time, the creation of content was a task performed by experts and it was not so easy to have personal web pages or post personal content to the Web. Users were mere information consumers in this first version. In addition pages were discrete units. To view information from different sources, one should move from one site to the next and losing sight of information contained in the previous sites.

Second Era (Web 2.0): The second generation of the Web is defined by the empowerment of the end user to actively create content and participate in the Web to expose themselves and relate to other users. The emphasis here is on technologies that enable collaboration such as social networks, RSS Feeds, Blogs, and content publishing services (images, text and video). Most of these tools are considerably easy to use, which allows virtually anyone to publish many different multimedia contents in the Web. Particularly RSS feeds allowed for the fragmentation of the “discrete page” concept from Web 1.0. With powerful technologies such as AJAX [3] in Web 2.0, it has become easy to create dynamic and interactive pages that are built by taking information from different sources into one single page, according to the user interests.

In addition to the differences addressed above, we can also see that as the web evolves, higher bandwidth rates are available, and access to the Web itself is more widely spread, including the ability to connect using a diversity of mobile devices such as laptops, PDAs, phones etc.

3. THIRD ERA: WEB 3.0

The set of next generation Web technologies that will define the Web 3.0 is still blurry. Major IT experts in the field support different approaches to what they foresee as the future Web. As one would expect, such visions are biased by the sort of business they conduct or their research interests.

Tim Berners-Lee, the expert who is responsible for the core principles that originated the World Wide Web, coined the term “Semantic Web”, and he seems to advocate the idea of converting the Web into a huge database, where we can make very sophisticated and complex queries.

“I think maybe when you've got an overlay of scalable vector graphics - everything rippling and folding and looking misty - on Web 2.0 and access to a semantic Web integrated across a huge space of data, you'll have access to an unbelievable data resource.” —Tim Berners-Lee [25]

Yahoo founder, Jerry Yang thinks that with the new generation of tools for the creation of content and online applications there will be a blurring in the distinction of professionals, semi professionals and consumers. At the Technet Summit in November 2006, he stated:

“...you don't have to be a computer scientist to create a program. We are seeing that manifest in Web 2.0 and 3.0 will be a great extension of that, a true communal medium...the distinction between professional, semi-professional and consumers will get blurred, creating a network effect of business and applications.” — Jerry Yang [5]

Netflix founder, Reed Hastings goes for a definition related to the amount of bandwidth available; he thinks the increase of bandwidth will allow for the full video Web.

“Web 1.0 was dial-up, 50K average bandwidth, Web 2.0 is an average 1 megabit of bandwidth and Web 3.0 will be 10 megabits of bandwidth all the time, which will be the full video Web, and that will feel like Web 3.0” — Reed Hastings [5]

Nova Spivak from Radar Networks believes that the semantic Web will play a central role in the new generation, although he recognizes that there will be other important technologies that should have a great impact as well [17]. Spivak also suggests that the versioning should be used to refer to decades of development on the Web, instead to specific sets of features that define them [18]. Finally when Google’s CEO, Eric Schmidt, was asked to define Web 2.0 and Web 3.0 he said:

“...If I were to guess what Web 3.0 is, I would tell you that it's a different way of building applications... My prediction would be that Web 3.0 will ultimately be seen as applications which are pieced together. There are a number of characteristics: the applications are relatively small, the data is in the cloud, the applications can run on any device, PC or mobile phone, the applications are very fast and they're very customizable. Furthermore, the applications are distributed virally: literally by social networks, by email. You won't go to the store and purchase them....”[26]

These are just a few examples of the different perceptions of experts in the information technology industry. It is obvious that the goal of the World Wide Web is to enable universal information access, which considers the delivery of content under different usage environments. This goal, including many others, drives the vision of Ambient Intelligence¹ (AmI) that will enable technology to become unobtrusive, embedded in our natural surroundings, adaptive to the response of people and their context, and predictive to assist humans [6,12]. In such an atmosphere, web content will be accessible by any user from anywhere at anytime, renderable to any device over heterogeneous networks. In order to realize the above vision, several technological and human-computer interaction challenges need to be undertaken. From the inter-device communication point of view, there is a need to overcome the difficulties posed by heterogeneous hardware architectures and networks.

¹ The term Ambient Intelligence is defined by the Advisory Group to the European Community's Information Society Technology Program (ISTAG) as "the convergence of ubiquitous computing, ubiquitous communication, and interfaces adapting to the user". It deals with environments that are more immersive, more adaptive, more intelligent, and more interactive.

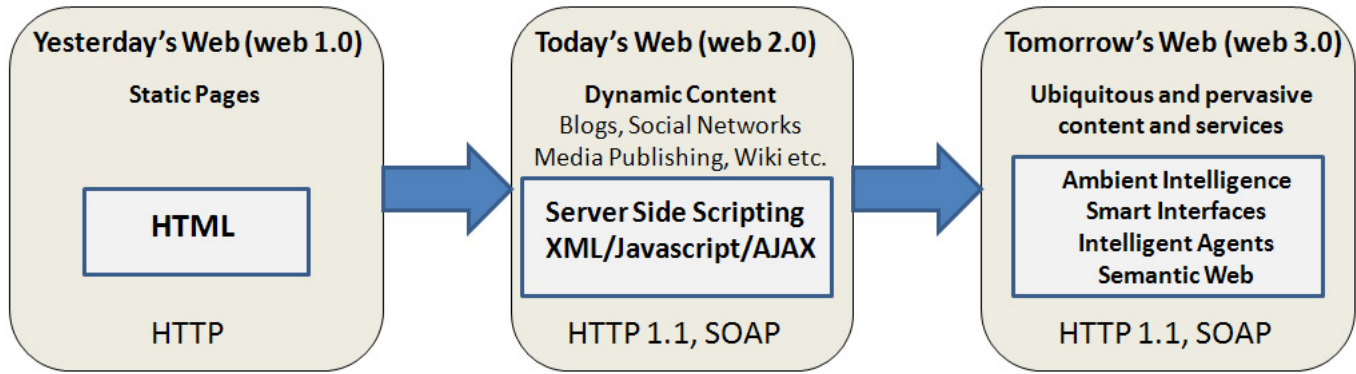


Figure 1: Web evolution

Fortunately, these have been naturally addressed by Internet protocols and technologies since the Web is currently independent of the underlying hardware and communication infrastructure. However, we believe that the next generation of such protocols and standards are the ones that can truly leverage the potential of ubiquitous communications and semantic oriented applications. In the following section we analyze the different technologies that would support most of the visions from such experts.

4. TECHNOLOGY TRENDS FOR WEB 3.0

Regardless of the formal definition, it is likely that the new generation of web applications will have some specific core technologies to support them. In this section, we present some of the major trends in terms of technologies that might become the building blocks of the next generation of the Web. Figure 1 depicts the evolution of the web in terms of the core technologies, and the content or services available to end users.

4.1 Semantic Web

Everyone seems to agree that semantics should definitely be a part of the next generation of the Web. If we want to have a more intelligent Web, with tools that allow us to find the information that we need and when we need it, it is necessary to make more sense out of the information published out there. The information has to be structured in such a way that machines can read it and understand it as much as humans can, without ambiguity. This will allow for very sophisticated queries and will be the basis for intelligent agents that could act on our behalf and retrieve exactly what we need the same way we would do it ourselves.

The Semantic Web is not a new concept. It has been around for quite some time without really having a great impact. The semantic web faces two main challenges towards its growth. The first is the effort to link existing content to semantic meaning by using some sort of metadata. The challenge is to enable the general users who are not expert in logic to create machine-understandable semantic content. One particular approach to partially address this issue would be to provide an easy way to mark up content with semantic tags, which should be done automatically and should be lower in cost or even free [10]. The second challenge is to develop a set of applications that make use of this newly generated metadata-based knowledge. It is clear that having such data structure on the web would allow one to basically convert it into one big database, but the cost/benefit in

the short term is the main drawback of such an ambitious schema for making better sense of the information already published [4].

However, it is important to note that many of the ideas of the semantic Web have made their way into current Web services and applications. Examples of these are Oracle's Spatial 11g [20], Radar Networks [22], Garlik for personal data management on the Web [8], Yahoo Food Site [27], and Joost Internet TV Platform [11].

A better possible approach to semantics on the Web is inferring the semantic information from the currently available data, instead of adding semantic information as metadata. These techniques are based on natural language processing, through which we can build smart agents that can infer the semantic meaning from the content of existing Web pages.

4.2 The 3D Web or Web 3D²

This trend of the future Web refers to the creation of virtual 3-dimensional worlds. Recently several Internet-based virtual worlds, such as Second Life [24], IMVU [9], Active Worlds [2], and Red Light Center [23], have gained huge attention by the public. For instance, at the end of March 2008, Second Life has more than 13 million accounts with around 38,000 users logged on at any particular moment [7]. These environments allow users to live in a virtual world the way they may never live in real life! Users create avatars and make them live the virtual world on their behalf. The residents of the virtual world can explore, meet other residents, socialize, participate in individual and/or group activities, and create and trade items and services from one another. Nonetheless, all social interactions in online virtual worlds occur through text messaging, audio, and/or video.

Traditional 3D virtual environments imitate real life objects and reproduce them in the virtual world. Furthermore, all the interactions occurring between avatars are kept in the virtual world and are not reflected back to real users in real-time. Reflecting inter-avatar communications to the real world would increase the level of involvement and make these environments more entertaining and exciting.

A new interaction dimension that can be incorporated with online social virtual worlds is the sense of touch, or haptics [1]. Haptics refers to manual interactions with the ambient

² <http://www.web3d.org/>

environment, such as exploration for information extraction or manipulation for modifying the environment. A potential application for haptics is to enhance interpersonal communication to express affection, intention or emotion through physical contact; such as a handshake or a hug [1]. Therefore, adding haptics to social virtual worlds through the Web enhances the benefits and opens new possibilities for the participants.

4.3 The Media Centric Web

This approach refers to the use of media objects as the main element to find other media. Future search engines should take media as input and be able to search for similar media objects based on its features and not only based on textual metadata. This way, for example, to search images about boats, we just need to provide a picture of a boat and the search engine should be able to retrieve images of boats with similar features. The same should apply with other media objects such as audio, and video. Some examples of this kind of technology can be found on software like Ojos Riya photo sharing tool that allow to automatically tag images using face recognition [19], or Like.com which enables the user to search for products based on similar images [15].

Furthermore, user interfaces need to evolve into intelligent, natural and multimodal interaction. Systems should be able to recognize hand gestures, voice, and even people's faces and moods, and respond in a multimodal fashion as well, making use of mixed media, possibly in a personalized 3D graphical user interface. Additionally, by adding the sense of touch to the media environments, new haptics research will allow the users to interact and socialize in a more convenient and interesting manner [1]. Within this context, 3D graphical user interfaces will act as a powerful platform for the users to participate and perform collaborative activities, sharing results and exchanging media information among participants in a more natural way. This leads into an Ambient Intelligence scenario which will be enabled through the Web services and applications disseminated over every component (either virtual or real) of the environment.

4.4 The Social Web

The Social Web describes how people socialize and/or interact with each other throughout the World Wide Web. Such people are brought together through a variety of shared interests. Many social networking and Livecasting technologies and frameworks are present since their introduction a decade ago. They are popular means of connecting with the community of interest (COI), and sharing one's feelings with the community members either on-line or off-line using text and/or other media such as audio and video. They are proven as an attractive way of connecting people around the globe. Instead of linking documents, the Social Web will link people, organizations, and concepts. Although the social web components have been put in place since web 2.0, this is a field that will evolve along with the Web itself, and because of this it will should be taken into account when considering the evolution to the next generation web.

4.5 The Pervasive and Ubiquitous Web

This concept refers to a Web that is virtually everywhere, on every computer, every mobile device, and even in common everyday objects such as your clothes furniture, appliances etc. The idea is that people are permanently connected to the Web without even thinking about it. We can access services that are

available on the Web, but we don't have the need to consciously invoke them. Every connected device or artifact in our lives do it for themselves, and acts accordingly in order to provide us with a specific service or information update. In this concept we can find anything from windows and curtains that check the weather and open and close accordingly, to home appliances that know our daily routines and communicate to each other to provide us with a more comfortable living.

One piece of technology that will enable this vision is the Web services for devices profile. This is a lightweight version of Web services, and it allows for embedding a Web service architecture based program into any device, in order to request services through open Web standards (basically XML and SOAP). Microsoft has released a development API [16] and Exceptional Innovations featured product called "Life Ware" [14], which is an excellent example of what this technology can bring in the future. The communication between devices and the Web should be guided by service oriented architectures using the popular SOAP message delivery protocol. In this fashion all devices should provide services through open standards to ensure cross-platform interoperability.

5. OUR VISION: BRIDGING THE GAP BETWEEN REAL AND VIRTUAL

The concept of Web 3.0, as we foresee it, brings to reality the vision of an Information society. We think that the future Web will be realized mostly by pervasive and ubiquitous computing scenarios. Not that the Web as we know it will disappear, but it will evolve and extend to be omnipresent in our daily lives. Access to all kinds of information from the Web will be as natural as looking at the time on our watch. Not only will the information be available for us to consult it, but sometimes it will also affect our environment without us even noticing. The reality of our lives will merge with the virtuality of the web applications and services that will be available everywhere. People we talk to, objects we interact with and machines we operate will be fully connected to the Web, which will eventually allow us to interact with other people and the surrounding environment either through virtual means or in the real world, without caring about the difference.

Today we can see a strong trend towards home automation systems, where intelligent houses help to secure and comfort the members of the family. But this will extend beyond the boundaries of homes. The ubiquitous Web will be at work, at schools, outdoor public places, and in our personal area network. This means that all devices that we carry with us and eventually everyday objects, (such as clothing, furniture, appliances etc.) will be connected.

As technologies continue to advance, devices become more context-aware and intelligent, and as the web continues to evolve, there is an increasing concern about the control of this "fast moving train". In any case, the two key terms in the future Web are "Intelligence" and "Context Awareness". Software agents need to know more about the user and about the data they search. This knowledge, along with the intelligence to know how and what to do with it, will bring high quality services to the users. Below are some of the salient challenges to enabling Web3.0:

5.1 Technology Challenges

New technologies will either succeed or fail depending how they present themselves to the user. Steep learning curves always imply slow adoption and less penetration. The user interface is very important to the adoption of Web 3.0. Importantly, Web 3.0 promises to meet the users' needs in many ways – adoption should be as natural as possible with user interfaces that are very cognitive. Interoperability is also important to meeting the user's needs. Overcoming technological challenges will eventually occur through collective intelligence and more collaborative research efforts that is offered by the Internet.

The emergence of well-structured and distributed multimedia web services will ensure a ubiquitous search for information. The delivery of search results to the end user should be based on automated decision services or agents that would pre-process information in order to support sophisticated, intelligent applications. However, for this to happen, we need to find a way to improve the way that software agents process the information available. At some point semantics should play a role and the Semantic Web is certainly a very comprehensive solution, but the full implementation would take quite some time. Also, in some application scenarios it would not be necessary to have a full implementation to the Semantic Web to still get the necessary information for providing a service to the user. For such cases light implementations of semantics inclusion on web pages would ease the search for information. That is the case of Microformats, which are considered the lowercase Semantic Web [13].

5.2 Privacy, Security and Legal issues

As technology gets embedded into devices and in our everyday lives, there is an increasing concern over our personal information and the control of its digital distribution. Privacy is a big issue; the web as it is today has proven very unmanageable in terms of addressing issues of security of personal information of its users. Web 3.0 needs to address these issues and how they relate to human-to-machine interactions. According to [21], "interactions will shift from an explicit paradigm to an implicit paradigm in which interfaces themselves will proactively drive human attention when required". People need to know and control what information gets shared on the web. They need to know why, when, for how long and even control who the recipients share such data with. That is surely a big challenge for the future.

5.3 Social, Ethical and Cultural Issues

Humans love being in control. Culturally and ethically, we cherish ownership of properties and ideas. [21] pointed out that providing effective and efficient human control for dynamic and distributed systems is a critical component for its adoption. There is the need to establish the appropriate balance between automation, human behavior patterns, and those human interventions necessary to mediate the environment. This balance could be difficult to achieve. This has always been portrayed in science fiction movies as a world where machines are seen to learn so much that they eventually took over the control of our world. These Hollywood movies like "Matrix", and "Total Recall" show the extreme picture of a world where humans and machines failed to coexist happily.

These fears in the social circles on the effects of Web 3.0 are spun out of these misconceptions. We already have cases of

Internet addiction by many, people failing to socialize with others but rather prefer to bury themselves in the unrealistic world of the Internet. An Ambient Intelligence (AmI) enabled web could result in humans trusting machines more than we do ourselves. It will not improve our dying social environment and human-to-human interactions, which is a concern for the older generations. It is a serious impediment to research efforts in this field but like a rocking boat in a tide, it is not so much under our control. We can set the sails to increase our control and maneuverability or sink within the waves. Alongside the great contributions that AmI will bring to our lives, we must also develop controls and triggers to help us mediate our AmI devices and their interactions on the Web 3.0.

6. CONCLUSION

Only time will tell what the next generation of the Web will become. But whatever it is, it should be a shift of paradigm. The user should be at the center and technologies and services should be placed around her/him. The pervasive and ubiquitous Web concepts seem to do just that, allowing the user to do their activities while having a great amount of available resources coming from the Web.

Furthermore, in our vision of the Web 3.0, we foresee a scenario where such ubiquitous technologies will create a convergence of real and virtual environments, where the user will seamlessly interact with humans and machines either through virtual means or in the real world.

7. REFERENCES

- [1] Abdulmotaleb El Saddik "The Potential of Haptics Technologies" *IEEE Instrumentation & Measurement*, pp. 10 – 17 February, 2007
- [2] Active Words Website: <http://www.activeworlds.com>
- [3] AJAX Programming, <http://en.wikipedia.org/wiki/AJAX>
- [4] Ayers, D., "The Shortest Path to the Future Web," *Internet Computing*, IEEE , vol.10, no.6, pp.76-79, Nov.-Dec. 2006
- [5] Dan Farber & Larry Dignan "TechNet Summit: The new era of innovation". *ZDNet blog*. Posted November 15th, 2006 <http://blogs.zdnet.com/BTL/?p=3959>
- [6] E. Aarts, Ambient Intelligence: A Multimedia Perspective. *IEEE Multimedia*, 11, 1 (Jan.-Mar., 2004), pp. 12-19.
- [7] Economic Statistics: http://secondlife.com/whatis/economy_stats.php.
- [8] Garlik <http://www.garlik.com/>
- [9] IMVU Official Website: <http://www.imvu.com>
- [10] J. Hendler, "Agents and the Semantic Web," *IEEE Intelligent Systems*, vol. 16, no. 2, Mar./Apr. 2001, pp. 30-37.
- [11] Joost TV. <http://www.joost.com>
- [12] K. Ducatel, M. Bogdanowicz, F. Scapolo, J. Leijten, and J.C. Burgelman, "Scenarios for Ambient Intelligence in 2010," *IST Advisory Group Final Report*, Seville, 2001. Available at: <ftp://ftp.cordis.lu/pub/ist/docs/istagscenarios2010.pdf>.

- [13] Khare, R., "Microformats: the next (small) thing on the semantic Web?," *Internet Computing, IEEE* , vol.10, no.1, pp. 68-75, Jan.-Feb. 2006
- [14] LifeWare. <http://www.exceptionalinnovation.com>
- [15] Like.com. <http://www.like.com/>
- [16] Microsoft WSD [http://msdn.microsoft.com/en-us/library/aa826001\(VS.85\).aspx](http://msdn.microsoft.com/en-us/library/aa826001(VS.85).aspx)
- [17] Nova Spivak "Gartner is Wrong about Web 3.0". *Minding The Planet* blog. Posted September 24, 2007
http://novaspivack.typepad.com/nova_spivacks_Weblog/2007/09/gartner-is-wron.html
- [18] Nova Spivak "Web 3.0 -- The Best Official Definition Imaginable". *Minding The Planet* blog
Posted October 04, 2007.
http://novaspivack.typepad.com/nova_spivacks_Weblog/2007/10/Web-30----the-a.html
- [19] Ojos Riya <http://riya.com/>
- [20] Oracle Spatial 11g
<http://www.oracle.com/technology/products/spatial/index.html>
- [21] P.L. Emiliani and C. Stephanidis (2005). Universal access to ambient intelligence environments: Opportunities and challenges for people wit disabilities. *IBM Research Journal*
<http://www.research.ibm.com/journal/sj/443/emiliani.pdf>
- [22] Radar Networks <http://www.radarnetworks.com/>
- [23] Red Light Official Website: <http://redlightcenter.com>.
- [24] Second Life Official Website: <http://secondlife.com>
- [25] Victoria Shannon "A 'more revolutionary' Web". *International Herald Tribune*.
Published: Wednesday, May 24, 2006. 1
<http://www.iht.com/articles/2006/05/23/business/Web.php>
- [26] Web 3.0 Wikipedia Definition. Extracted on July 9th, 2008
http://en.wikipedia.org/wiki/Web_3.0
- [27] Yahoo Food. <http://food.yahoo.com/>