

# -Digital Signage in the Age of Ubiquitous Internet

## Market outlook for Digital Signage and location-based services

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**Abstract**— The Industrial Age has run its course and mankind has now entered the Information Age. This new Age promises to fundamentally transform how we live and work. Computation and sensing are becoming more pervasive and will soon be ubiquitous. Digital signage is the precursor to this new age. This research examines the market for digital signage, trends in terms of signage technology and potential applications and offers recommendations on how to proceed with signage solutions in light of these trends.

**Keywords:** *Digital signage; Web 2.0; location-based services.*

### I. RESEARCH QUESTIONS

- Overview of potential applications including:
  - ShopTV, MallTV
  - Use of guidance systems
  - Applications in connection with the intelligent bus station
  - Consumer applications
  - Interactive applications
  - Interactive games as ways of conveying information
  - Applications for young and older (focus on user-friendliness)
- Review of potential locations for digital signage – where people have time to view signage
- Increasing effectiveness through interactive applications
- Business models
- Content and data transfer issues, how can large files be transferred to information points
- Aspects of interface with handheld devices, potential applications
- Digital signage to support day-to-day activities
- Touchscreen capable interfaces
- Potential applications for handhelds to guide users to the locations of partners
- Smart homes and digital signage – support for older people, special needs

### II. INTRODUCTION

Today, the Industrial Age has run its course and mankind has now entered the Information Age. Like the technological revolutions that preceded it (Agricultural and Industrial), this

new Information Revolution promises to fundamentally transform how we live and work. It heralds the dawn of a new society – the Information Society. In this new age, devices will work twenty-four/seven, they will be linked; they will think. To date, the Internet has been focused on connecting people, in the future it will connect things. Computation and sensing are becoming more pervasive and will soon be ubiquitous. At the same time, the information relayed by such devices is ever more accessible as large panel displays and screens are installed in public and private spaces and handheld devices begin to replace the computer as the main gateways to the Internet. The informational landscape of the Internet – the Infoscape – is being combined with the urban landscape of cities and the first ubiquitous cities (where virtually everything is linked through wireless technologies) have arisen. The Information Society will be defined by new means of seeing, hearing, touching and sensing information. More people will be released from their computers as interfaces are distributed not only around their architectural environment, but also to their handheld devices and eventually even to the things they wear. In the not so distant future, it is possible that architecture as a whole will evolve into “a gigantic immersive interface” for sending and receiving information.<sup>1</sup> *Digital signage is the precursor to this new age.* This research explores the current state of digital signage and the opportunities that future developments will offer.

### III. WHAT IS DIGITAL SIGNAGE?

The term digital signage refers to electronic displays that are installed in public or private places for the main purpose of informing, entertaining or advertising. The displays can be scrolling message boards, LCD or plasma panels, electronic billboards, projection screens or any other of a variety of emerging technologies including Organic LED screens that can be controlled electronically (and often remotely) using a computer or similar device. The main advantage of digital signs compared to their traditional counterparts relates to the ability to effortlessly change content and show animation or video. Such signs can be adapted to the characteristics of the audience (*including their location*) and even be interactive. The signage content scheduling and playback can either be controlled via simple, non-networked media players outputting basic loops of MPEG-2 video to complex N-tier player networks that offer centralized control of many displays located in various venues. In general, the return on investment (ROI) associated with digital signage is better than that of

printed signs (wikipedia). This is because the creation, distribution and installation (CDI) of conventional (printed) signs is costly in terms of labor and material. Moreover, the CDI cycle is slow – consuming from days to weeks – which can lead to lost opportunity for marketing executives that wish to respond quickly to opportunities. Lost revenue from such missed opportunity can often dwarf the CDI costs. Lastly, unlike with digital signage, messages from conventional signage can not be tailored to specific groups of individuals. <sup>ii</sup>

In light of their significant benefits especially with respect to ROI, digital signs are becoming commonplace especially among retailers, but also in movie theaters, fast food restaurants, grocery stores, pharmacies and doctors offices, airports, train stations, bus stops, gaming and entertainment complexes, sports arenas, schools and even corporate and government facilities.<sup>iii</sup> Although the emergence of digital signage is a global phenomenon, China currently leads the world in the number of deployed digital signage displays (over 100 000) and the number of NASDAQ IPOs (collective market capitalization of over \$10 billion) (wikipedia). Examples even exist of mobile digital signage such as taxi-mounted advertising that „changes from block to block as demographics and situation are modified.” Titan Digital Worldwide’s GPS-enabled digital billboards are popping up on public transit in major cities. The advertisement on the screen changes as the vehicle moves into new areas, allowing location-based selling. Such mobile signage reacts to time of day, location, as well as pedestrian and vehicle traffic patterns. In the future, as sensors are added to the network and signage enhanced with composite applications, signage will also be able to react to other factors such as weather. Current mobile systems are centrally managed and can be scaled to hundreds of end display units managing hundreds of simultaneous client campaigns.<sup>iv</sup> As technologies mature, the manageable number of end displays will grow into the thousands.

#### IV. THE MARKET FOR DIGITAL SIGNAGE

Despite the increasing prevalence of digital signage as an advertising medium, there are a number of factors which must be overcome to foster overall growth in this market. These include:

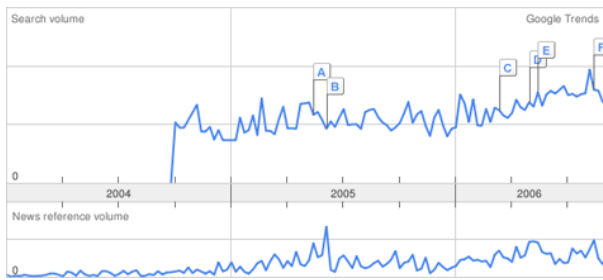
- Lack of interoperability – Today’s digital signage products tend to be closed, proprietary systems. Since it is impossible to advertise across digital signage networks that run on different solutions, the emerging medium remains inferior to television and Internet. Moreover, the lack of a common communication protocol prevents the mixing of products from different vendors, rendering the systems expensive and hard to expand.
- Complex value chain – digital signage networks often involve at least the following vendors: displays, media player, management software, project planning, installation, field service, network connectivity, bandwidth, content creation, and advertising sales. Managing such a complex value chain is a challenging

endeavor for all the parties involved and introduces a variety of risk factors into any given project.

These problems are currently being addressed. Industry organizations including the POPAI (Point-of-Purchase Advertising International) and OAAA (Outdoor Advertising Association of America) are developing and promoting technical standards that will make it possible to communicate across digital signage networks made by different vendors. Increased interoperability will increase competition in the supply chain lowering costs and making ROI much more attractive. New business entities ranging from system vendors to digital signage service providers and advertising services are arising that are consolidating various segments of the value chain. This consolidation will eventually increase efficiency and reduce project risks.

As these issues are being addressed, a number of other factors point to sustained growth in the digital signage market. A recent study on digital billboards by Arbitron commissioned by the Outdoor Advertising Association of America finds that such (digital) ads have a high recall rate and are excellent for targeting the elusive 18-34 year-old consumer market - a target group that many advertisers have sought in vain to reach via social network sites. They also find that such signage is noticed by most drivers who appreciate it as attractive and useful.<sup>v</sup>

A recent eMarketer report found that consumers are spending twice as much time away from home than they did 30 years ago. Digital signage offers a means of reaching out to these consumers and, according to analysts, the overall growth prospects for the digital signage industry look extremely good. In a recent post, the Digital Outsider newsletter views digital signage advertising “among the fastest growing ad-supported media over the next few years”, and it expects it to begin to rival traditional outdoor advertising by 2012. Driving this market are the falling costs of flat panel LCDs and the emergence of IP and wireless Internet technologies (Europe boasts more than 50000 Wi-Fi hotspots and growth rates in business parks and city centers are over 500%). The digital signage market place has been likened to the explosive growth of the early Internet. Some analysts even predict faster growth than the early Internet days owing to the ability of this medium to reach consumers when they are away from home, its unobtrusive nature, and its proximity to point of purchase and point of decision. Thus, fueling growth is the recent revelation in a North American Study that noted a dramatic jump to 70 percent of consumer decisions being made on the spot as opposed to the 50 percent level that had held sway over the past 20 years.<sup>vi</sup> The following Google trends graph based on searches on the term „digital signage” highlights the overall interest in this market.



Even more telling for the overall market is a view of the related searches stemming from Europe and Asia:

Regions	Cities	Languages
1. Malaysia	1. Kuala Lumpur, Malaysia	1. Korean
2. United Arab Emirates	2. Taipei, Taiwan	2. English
3. South Africa	3. Mumbai, India	3. Swedish
4. Taiwan	4. Delhi, India	4. Italian
5. India	5. Minneapolis, MN, USA	5. Thai
6. Singapore	6. Singapore, Singapore	6. Dutch
7. South Korea	7. Toronto, Canada	7. Portuguese
8. Greece	8. San Francisco, CA, USA	8. German
9. Philippines	9. Pleasanton, CA, USA	9. Chinese
10. New Zealand	10. Auckland, New Zealand	10. French

Source: Google Trends and Digital Signage <sup>vii</sup>

Another report found that digital signage advertising revenues in Western Europe will quadruple over the next five years from 160 million USD in 2007 to 626 million USD by 2012. Owing to the migration to digital media, the report views this sector as the only traditional advertising media expected to post real revenue growth over the next five years. For the US market, projections are similar with growth rates for 2009 expected at 11.3 (8.71 billion USD) and for 2010 at 11.5 percent (9.72 billion USD), respectively (compared to the current 3.7 percent rate for the entire US ad economy). As the drop in hardware price for digital displays combines with lower maintenance costs and higher revenues, this media will not only be increasingly used to upgrade static poster format sites, but also to conquer new spaces for advertising. <sup>viii</sup>

These predictions have a caveat, however. When budgets are tight such as in the current period of extreme financial instability, advertisers tend to look for proven methods such as ads placed alongside a Google or Yahoo search and place less emphasis on experimental media such as digital signage or other forms of mobile advertising. This fact should by all means be taken into consideration when assessing the short term prospects for growth in this market.

## V. TRENDS

To better understand the digital signage market, it is useful to examine the trends in digital signage that are on the horizon. Currently, screens are screen-shaped – they resemble traditional displays. In the near future, however, some screens will no longer look much like screens. In many instances, unless the image is moving, viewers will not even know that they are looking at screens at all. More portrait installations will be seen than landscape (which will dramatically decline). Especially, in retail and outdoor signage, there will be an amazing variety of shapes and sizes of screens. This variety

will also fuel the number of types of applications that will be run on such signs. We will examine this aspect of digital signage later.

Device-based signage solutions will become dominant. *Personal Computers, especially PCs running Windows are not and will not be the sort of devices that should run digital signage solutions.* The large installs of the future will be based upon devices and appliances. Especially in Retail, Retailers will buy Screens with a signage solution built-in. They will choose to buy screens with intelligence as opposed to signage players.

*Street furniture will soon turn digital.* Beyond the current parking meters, toilets and bus shelters that can already be found with integrated digital screens, will come a broad variety of other street furniture including double-sided screens for indoor and outdoor use. In fact, for those interested in entering the Outdoor Media market, Street Furniture will be THE biggest market segment. One notable example of this sort of display is the touchable interactive wall. Such displays can be simultaneously manipulated by multiple users whereby even very broad physical input – waving a hand – can create large and dramatic results. <sup>ix</sup>

In coming years, there will be an increasing focus on content (especially context-based) in the digital signage sector. Display objectives will be better clarified, the standards of practice in composition improved and more attention paid to measurement in an effort to optimize content to temporal, demographic and other (locational) considerations. A trend towards better audience targeting is underway and display use will be ever more focused on „content” spots that fulfill communication objectives with target audiences. The increased focus on targeted objectives will also go hand-in-hand with increased attention to measuring. Firms will introduce tools for automated audience measurement to improve location-based advertising.

*This focus on content will coincide with an increased interest in User Generated Content (UGC) and interactivity which is the hallmark of the Age of Web 2.0.* More networks will accept and make use of UGC ranging from SMS and MMS to video alá YouTube, CurrentTV, etc. Such UGC will help fill the content void which is beginning to appear in the area of digital signage. Since moderation of such content will be an issue for the near term, early uses may be limited to interactive competitions where an element of control can be maintained. The desire of brands to „connect with consumers” will drive more event-based UGC and the market will also see more branded shop window, shopping mall and airport experiential marketing revolving primarily around digital screens.

In keeping with the Web 2.0 trend will be the networking of displays whereby users at different displays can interact not only with the signs, but also with each other. *This development will enhance the social dimension of digital signage.* Examples already exist of interactive games that can involve

players located in different cities (e.g., London and New York). Alternatively, users can interact with virtual doubles of real products such as music players or cars.<sup>x</sup>

Another key trend in digital signage will involve its application in existing infrastructure such as an intranet or integration with other operating applications such as point-of-sale or supply/inventory management systems. An example of such two-way integration is the combination of digital signage with loss prevention systems (Closed Circuit TV monitoring). Data on store traffic from the monitors can be used to trigger changes in content or loop pace. The displays for in-store monitors can also be used to present branding or advertising messages. Not only does this sooth the negative impact of such displays, but it can also prevent shoplifters from identifying blindspots.<sup>xi</sup>

The exploding market for handheld devices and smart phones will also impact both the digital signage market and advertising in general. In the U.S., Apple's iPhone is currently outpacing the sales of virtually all other phones including Motorola's Razr. According to a recent Piper Jaffray survey of 769 U.S. students, 8% of teens already own iPhones, while 22% said they will buy an iPhone within the next six months. The emergence of the iPhone has also opened a floodgate of iPhone clones. In September 2008, Google responded to the iPhone in the most anticipated mobile-phone launch since Apple released its iPhone, T-Mobile unveiled the G1. The G1 is the brainchild of one of tech's most innovative companies; it is the first phone boasting the Android software created by a Google-led consortium. Similar to Apple's music-playing handset, the G1 features a full Web browser and connects to the Internet via Wi-Fi technology. G1 also boasts a large touchscreen and lets users download games and tools from an online bazaar akin to the Apple App Store. In coming years, driven by the iPhone, G1 and their many clones, such handsets will evolve into the gateway to the Internet for most people. In line with this, the business models related to the integration of digital signage with SMS, text messaging and other mobile commerce will be developed further.<sup>xii</sup> It is expected that within the decade, mobile access to the Web will dwarf desktop access, and this will deeply transform the Web, creating important new media forms that are not merely personal, but intimate. The following table describes the key differances between fixed and mobile Internet models:

Fixed Internet	Mobile Internet
Search is key	Context is key
Finding	Being found
Email	VoIP & IM

The world is outside	The world is around me
Web surfing	Web services
PC & laptop	Many devices

Source: IBrussels<sup>xiii</sup>

Wireless technology will not only transform digital signage on the supply side by offering opportunities for low-cost near real-time distribution and installation, but also will change consumer experience. As previously mentioned, Wireless LAN capabilities will enable consumers to interact with the displays to obtain more information on products. These devices are driving a surge in new Location-based services (LBS). Thanks to the iPhone, the increasing ubiquity of connectivity and a number of other factors, the stars have finally aligned for LBS. Market researchers such as ABIresearch see the long predicted billions in sales finally coming to fruition by 2013 at the latest. By then, sales are expected to jump from last year's 515 million to 13,3 billion USD! *The growth will be driven by navigation services, mobile social networks, local searches, tracking solutions for children, seniors, pets, and personal items, general logistics and even location-based games.* However, the real dam-breaker is expected to be friend-finding services. ABIresearch also found that whereas sales in LBS are presently concentrated in North America (81 percent). By 2013, this share will drop to 32 percent as sales in Europe jumps from 5 to 31 percent. The growth in Europe will be driven by the increased market penetration of GPS-capable GSM handsets and the worldwide rollout of 3G services.<sup>xiv</sup> Map Interfaces

## VI. LOCATION-BASED START-UPS

Since there is a growing trend towards the integration of location- and context-based elements into digital signage, it is worth examining what type of applications and business models are arising on this front. A number of start-ups and projects are currently seeking to take advantage of the new trend towards LBS offerings.

One of the first pieces of mobile social software was Dodgeball (dodgeball.com), which sends registered participants text messages when other participants (or their friends) are nearby. Other recent LBS projects include Sociallight (sociallight.com), which lets users put virtual Post-it notes in places where other users can see them; Rabble (rabble.com), a mobile blogging tool that allows posts to be linked to a location (think of a mobile MySpace); and StreetHive (streethive.com), which combines the virtual Post-it idea with social networking à la Dodgeball.

In the future, users may subscribe to the mobile posts of bloggers who review neighborhood lunch spots or to business travelers who share city-specific survival tips. On the Web, your location may not matter, but on the geospatial Web, location is crucial in determining the kind of information you

will receive. A list of some more notable location-based start-ups follows:

a. AdMob

Founded in 2006, AdMob runs a mobile advertising marketplace serving over 1.5 billion targeted ads per month. The company recently launched a new product called AdMonitor that presents live data on who is viewing mobile ads around the world, including which phones and which network operators they are using. In November, AdMob released an application that allows third-party developers to embed mobile advertising into the popular social networking site Facebook.

b. Zyb

This company wants to shape the future of mobile social networking by acting as the missing link between online social networks and the mobile phone. The company's solution enables users to store their mobile-phone contacts, calendar, and pictures online. When using Zyb, the user gets an online interface and the ability to subscribe to auto-updates from friends and import public calendars into the phone. Zyb feels its service will resonate with consumers well because it allows them to store and categorize their network of family members and close friends under mobile numbers. To date, Zyb has signed deals with operators in five countries, and the service is available in five languages. Its primary focus is now on Europe, but it later plans to expand into Asia and the U.S

c. Refresh Mobile

This company's Mippin service aims to deliver the latest news, blogs, and other Web content in the perfect format to your phone, giving mobile-phone users the ability to discover and share what they want. Its competitors include PluMo, Winksite, FeedM8, and Mofuse. The company plans to target the U.S., Britain, South Africa, and India over the next 15 months.

d. Qype

Qype is a local search service that allows people to share views on everything from the most reliable plumber to the best restaurant. The site has more than 45,000 registered users in Germany and is now expanding across Europe. French and British sites will be launched in December, with Spain and Italy to follow in 2008. Plans are to add event reviews and access from mobile phones. Competitors include townster.de, trustedplaces.co.uk, and welovelocal.com.

e. Loco

Loco is a mobile social network built on top an Android phone's contact manager. The application identifies anyone in a user's contact list as a "friend". With the application, users can view and track where their friends are located using Google Maps and real-time geolocation.

Users can search within the application for events or items that have been tagged by friends. For example a user could search for "party" and see a bunch of events that have been tagged by friends with "party". Users can also access files (e.g., photos) associated with the tagged items.

f. Snap

Snap is kind of like Digg on a map. People can tag certain places and then other users can vote that particular attraction up or down. With this solution, visitors to a city can pull up their current location and find things around them that other people think are interesting. If there's a particular user that's uploaded a bunch of cool stuff, users can subscribe to his or her stuff. Arrows on the map change color the more popular they get.

g. Yelp

Yelp is an application similar to Snap which is based on Google Maps. Business owners can register their establishments on the map. Users can Browse or Search to locate top businesses on the map. The application also allows users to leave reviews for the various locations.

h. Whrrl

Whrrl, is a location-based "social utility" that uses recommendations from a user's network of friends to suggest, say, a nearby restaurant or fun thing to do. The application was created by Seattle-based Pellago and is already available on other mobile devices, Whrrl's iPhone version launched with the opening of Apple's App Store on July 11, 2008.

i. MECOMO AG

This company out of Munich has worked since its foundation in 2000 on the sale of location-based content such as the implementation of mobile solutions. Their main activity is LBS for business and private customers related to media content.

j. Gate5

A firm out of Berlin offers commercial locational and navigation applications including the Falk City-Guide which is a mix of an interactive streetmap, an event calendar and a route planner. The firm provides its partner Falk with content that can be easily and quickly accessed via a smart phone.

k. T-Info

The affiliate of T-Online has recently launched a new LBS for mobile and online customers. The route planner covers 13 European countries and allows drivers and pedestrians alike to get to their destination faster. Via an events calendar, users can find nearby concerts, movies and restaurants. The services are available on WAP cell phones and PDAs. Although over the

Internet the services are free, they cost mobile users about 50 cents for 30 minutes.

l. Viag Interkom

This company lets users access information on nearby bars, gas stations or ATMs via SMS based on their location.

m. Intervista

For the integration of location-based information, this company ([www.intervista-ag.de](http://www.intervista-ag.de)) developed their own service called dicos that can be used to track cell phones.

n. m<sup>3</sup>

This service was developed within a project at the University of Applied Sciences FH JOANNEUM in Graz/Austria. They provide a flexible solution for mobile identification of places and objects. They offer:

- Sightseeing tours
- Tours of special interest
- Customer retention programs
- Outdoor games
- M-Commerce applications

o. Enkin

"Enkin" represents the future of LBS based on the Google Android platform. It is a new handheld navigation concept. The application displays location-based content in a unique way that bridges the gap between reality and classic map-like representations. It combines GPS, orientation sensors, 3D graphics, live video, several web services, and a novel user interface into an intuitive and light navigation system for mobile devices.

p. GyPsii

GyPsii is a social networking platform headquartered in Amsterdam, the Netherlands. Recently, it partnered with Shanghai Rannuo and China Unicom to launch its GyPsii service during the 2008 Olympic Games in Beijing. In China, GyPsii is encouraging its network users to send back location information via mobile devices and integrate it into the digital map. Other users (who are also content creators) then, can experience a seamless mobile lifestyle, connecting with friends and communities, searching UGC and viewing maps and directions to points of interest.

q. Other future applications

Recently, a Website was launched on the Internet that collects ideas from users on applications that could take advantage of the coming ubiquitous Internet.<sup>xv</sup> Some of the more interesting contributions are listed below:

A user marks a place as one of his personal favorites. After he has done this with several places, the system detects other

persons with a similar taste in places and recommends their favorites to the user. According to the "small network theory" such a system could easily recommend places even very far away.

It is possible to link information with objects or places. If a user searches for information about a table in a kind of "object-wikipedia" they will find something about the designer of the table or the manufacturer. Some users may place a virtual vase on it or draw a digital graffiti over it.

Users leave digital musical or voice messages wherever they want. They decide the place, where to put the sounds by choosing the place on a digital map or by simply going there. Users can decide what persons should hear the sounds. Only the user? Your friends? All users of the system?

Historical sites are overlaid with all sort of historical information. An example would be the remains of a castle overlaid with the outline of the original castle.

In the future, letters could be delivered without any written information on them. A stamp containing an ID-chip would make it possible to debit the postage directly from the account of the sender. Sender and addressee would be recorded digitally. If the sender changes his mind about the letter, he can just call it back.

## VII. TECHNOLOGICAL DEVELOPMENTS

In addition to the trends described above, a number of technological developments will impact digital signage and the implementation of such solutions.

Predictions related to the fate of Bluetooth as an out of home medium are contradictory. Some argue that this medium, which has not really gotten off the ground, will die and be replaced by Wi-Fi.<sup>xvi</sup> Others, however, note two clever enhancements currently under development that will "allow the ubiquitous – but slow – Bluetooth technology to handle much larger amounts of data at much higher speeds". Experts at ABI Research indicate that work is ongoing on an alternate MAC PHY known as AMP that is a combination of Bluetooth and Wi-Fi. This software upgrade for devices equipped with both Bluetooth and Wi-Fi chips will allow Bluetooth to "piggyback" on Wi-Fi for the transmission of large files. The long term goal for the cellular market is to enable Bluetooth to work with ultra-wideband (UWB) as an integrated solution, for an even faster transfer of larger files. That would open the possibility of the Bluetooth platform as a video connectivity solution. In this manner, classic Bluetooth can be used to manage voice applications, AMP Bluetooth for larger data volumes on an ad hoc basis and, "further down the road, high-speed Bluetooth with UWB will offer huge data rates."

As noted earlier, interactivity will be a key element of future digital signage. This is because, interacting with digital signage networks, billboards and screens enables consumers to better connect with brands and provides them with a richer

overall experience. *“Interactivity drives consumer participation, loyalty, and adds exponential value to digital signage...contributing to what draws people to look at, and pay attention to, digital screens.”* A primary example of such interactivity is the growing interest in gaming on the part of advertisers. Driving this interest is the realization that – as underscored in a recent survey by the Pew foundation of young people in the United States – *ninety-seven percent of respondents play video games!* That is 99 percent of boys and 94 percent of girls regardless of race, ethnic group or income level. And, they play often – half of respondents had played a video game the previous day.

In the U.S., movie theater audiences can play interactive ad games such as one sponsored by Volvo whereby their joint movements form human joysticks that control gaming elements on the big screen. The audience leans right or left to steer an image of a car through an obstacle course.<sup>xvii</sup> Other games such as those rereleased by a company called MegaPhone can be controlled via cell phone. Players join games by making a regular phone call. Inputs to the display can be sent either by keypad or voice. The keypad can be used much like a video game controller, and the volume and pitch of the phone's microphone can also become input in the game. Such games can support hundreds or even thousands of players limited only by the size of the screen and the game design. Games can be distributed over different locations – even internationally.

Some of the most radical developments in User Interfaces and controllers are also outgrowths of the gaming industry and most notably Nintendo's Wii controller. However, *software is now available that will allow an iPhone to behave like a Wii controller.* Moreover, new prototypes not only register the movements of individuals to control software, but also are capable of providing context-based information based on the characteristics of the user (including their age, sex or race). Looking further into the future, NAU – an international design collective that aims to revolutionize how people interact with computers – recently develop the Immersive Cocoon. This walk-in virtual-reality pod features a 360 degree display screen and full surround sound and relies on motion-tracking cameras to follow the movements of a user's arms, legs and face. Beyond, gaming of course, its uses range from providing educational historical journeys to enhanced online shopping in 3D environments.<sup>xviii</sup>

In addition to the interactivity of ad-based gaming, new prototypes are also available that provide passive interactivity via sensors and projectors that can not only read a shoppers face and determine their demographic characteristics, but can also identify what products the customer may currently be holding or looking at. *„With this information brands can quickly and easily identify key competitors in their market along with ways to create stronger product differentiation for their target segment.”* Other external factors such as location, time of year (or day) and weather can also be taken into consideration. The firm Brand Experience Lab claims that such marketing can increase sales by up to 300%. Such

context-based information also forms the basis of the services offered by the so-called Shopping Buddy device available in some grocery stores. The wireless touchscreen attaches to the handle of a shopping cart and delivers personalized services and incentives to customers while they shop. The device is capable of discerning a shopper's location in a store to ensure that recommendations are relevant to the products the customer currently sees.<sup>xix</sup>

Another technological development by IBM which will also assuredly affect digital signage in the future is a system that allows the projection of images on walls at any angle. By putting this new technology in the corner of a room, the image could be projected on all four walls of a room, maximizing the effect. Naturally, the chief advantage of such a system is the fact that the projectors are much cheaper than the plasma displays currently being used.

## VIII. POTENTIAL LOCATIONS

Digital signage can essentially be placed in any area that is frequented by people and, in the case of digital walls, wherever crowds are appropriate. Digital signage can currently be found in locations ranging from shopping malls, doctors' offices, bus and train stations, subways and airports to corporate headquarters and college campuses. Digital signage is also being deployed in gaming centers and children's play centers. And, hotels have begun experimenting with digital signage in rooms to provide targeted information and entertainment content to guests as a means of instilling greater guest satisfaction. Although, traditionally, digital signage is an out-of-home medium, *interest in the living room browser market has also recently reemerged (from the days of WebTV) with the rapid growth of HD and extensive interest in pushing Web content from the PC screen to the living room.* Also driving growth is the development of widgets for living room Web applications. „The availability of widgets for popular Web applications that can run on top of a browser or other Web services environments, such as AIR on Linux, Microsoft, or other embedded operating systems, will be one of the big trends emerging in the second half of 2008 and going into 2009.” Moreover, ABI Research predicts that eventually all forms of consumer electronics will have their own version of Web-enabled TV.

## IX. OTHER APPLICATIONS

### Wayfinding

Digital signage and LBS technologies can also be applied to assist in way-finding for individuals with disabilities – a fact that has considerable relevance considering current demographic trends. Populations in the U.S. and Europe are aging. The graying of society goes hand-in-hand with increased prevalence of disabilities including visual impairments. Studies estimate that in the U.S. by 2020, the

number of older individuals (>40 years) with visual impairments will increase by 70 percent. Trends in Europe are similar. Unfortunately, these visual impairments are often accompanied by other impairments including hearing loss, sensory or cognitive losses that impact their ability to acquire the needed skills for orientation and mobility and can thus severely limit them in their ability to travel independently. *Reduced mobility and resulting social isolation are among the most debilitating consequences of these physical impairments.*<sup>xx</sup>

A growing number of technologies related to digital signage are currently available to address these issues and thereby improve the mobility of older individuals with visual impairments. These assistive technologies include braille signs, talking signs, talking lights, RFID tags, dead reckoning via gyroscopic systems or computer-readable pedometers, Wi-Fi positioning and digital sign systems incorporating infrared (IR) machine vision for detecting and identifying specially designed tags. This latter system has been demonstrated to be among the most effective for wayfinding. Using such a system, visually-impaired users locate tags via either a handheld device or an interactive badge. Tags are located strategically around a building to assist wayfind and information stored on the tags are managed remotely via a central database which also contains information on the spatial layout of the building. Information is generally passed on real-time (as a tag is approached) to users via a text message that is converted to audio form for the users to listen to.<sup>xxi</sup>

By 2013, it is predicted that 70% of the GPS market will be based on use in cell phones. Considering the proliferation of such smart phones with in-built GPS and WPS positioning systems, it is likely that technological solutions for outdoor wayfinding will also soon become available. In fact, market researchers RNCOS predicts that the market for GPS products and applications will hit \$75 billion by 2013.<sup>xxii</sup> Driving these services is the fact that the graying of society is also accompanied by an increased acceptance level for technology on the part of older generations. „Whereas in 2000 only 63% of the Austrian population (in particular men and persons under 29 years of age) and merely a third of people over the age of 60 years disposed of a mobile phone, nowadays nine out of ten Austrians own a cellular phone. Especially within in the segment of people over 60 years of age, the amount of those using a mobile phone has more than doubled since 2000, with a significantly increasing annual growth rate in recent years. (Integral, 2007) Regarding Internet use, trends are comparable. New information- and communication technologies receive great attention throughout the society. 43% of total population attach great relevance to the internet, while 34% of Austrians expect a further increase in importance of mobile communication technologies.”<sup>xxiii</sup>

#### *Location-based Services*

Through location-based services (LBS), people can interact with their communities. Users can access the special offers of stores, restaurants and other businesses in their vicinity or

along their intended route, filtered and customized to their characteristics or needs (e.g. language, age group, etc.). The services can include private citizens to evolve into a virtual garage sale; even real estate can be offered to potential buyers based on their current position. Eyesores (graffiti, abandoned vehicles, dead animals, litter) or public nuisances (potholes, loose manholes, broken infrastructure) can be reported to the responsible authorities with the click of a button and even accompanied by a geo-tagged digital image created by the handheld device. Tourism can also get a boost from such applications as users use them to easily access the historical background or significance of cultural or natural amenities that they encounter and be guided to other similar points of interest in the vicinity. Users can also obtain information or leave their comments on a range of establishments including museums, hotels, restaurants and shops.

Via LBS, authorized users can locate friends, children, people with special needs (such as dementia) using their mobile devices, even pets and misplaced item can be tracked with the help of RFID microwave technology. Such tracking possibilities also opens up a range of applications related to sports and recreation such as the planning of jogging or biking routes, calculation of average speeds or calories burned, etc.

#### *Urban Planning*

Some cities have already begun using such LBS as a means of improving their planning processes. Cities like Mülheim an der Ruhr (Nord-Rhein-Westfalen) and Baltimore, USA, offer a variety of information to citizens as kmz data that can be viewed in Google-Earth. Available information ranges from tourist-related attractions, hotels, etc. to planning documents, quality of sidewalks and bike paths as well as data on recently granted permits and current and proposed capital improvement projects. When combined with ubiquitous Internet access or digital signage, planning processes can be enhanced with a great deal of interactivity e.g. through the advent of place-based forums, geo-tagged photos, etc.<sup>xxiv</sup>

#### *Intelligent Bus Stop prototype*

Public transport Wi-Fi is gaining attention all over the world because more people are using public transport (owing to traffic jams, high cost of fuel, and increased environmental consciousness) and public transport operators are trying to get passengers onto their buses and trains by offering more amenities. A number of digital signage prototypes focus on bus stops themselves as public spaces and aims at using Internet connectivity and interactive Web 2.0 tools as a catalyst for boosting attention to and ridership on public transportation. These projects intend on creating a unique bus stop, one that is connected to a larger communications network. They feature displays that will not only tell when, exactly, the next bus will arrive, but also offer information about the community in the vicinity of the stop. The bus stops

are, in a word, intelligent. The projects also provide citizens a taste of the new era of the Internet – where connectivity will be ubiquitous and location-based tools will play an important role in our lives.

A significant portion of revenue from bus stops and on the buses themselves currently stems from advertising. Digital signage can augment the ability of public transportation firms to increase revenues through targeted advertising and the introduction of various location- and context-based services.

## X. CASE STUDY EXAMPLES

*iBrussels* is a recently launched service that allows users to experience their city in a new way. “Instead of boring cityguide, on iBrussels you find the people and places you love. Even better: you can add your own content and take it with you on your mobile phone.” As a service, iBrussels focuses on touching citizens, local shops, government, IT companies and visitors and aims at stimulating the economy and enhancing community interaction. The Web-based service focuses on mobile Internet users and offers a number of services that combine virtual and physical experience. Services include:

- Mobile promotions – location-based coupons, based on user profiles, opt-in model, DIY Websites for businesses, loyalty cards, instant auctions
- Friend-finding, location-based social networks, POI and event searches – Interaction of local businesses, organizations, governments and people through community-based sites
- Selling online – virtual shops, wish lists and e-presents, virtual transactions cleared in bricks and mortar establishments (combining online shopping with retail)

The key characteristics of iBrussels are:

- Works offline: permanent presence on users phone
- Automated update via web services
- Easy distribution
- Integration with social networks
- Works on 80 percent of mobile phones
- User-driven content
- Local blogs

*Qiro* was conceived by Deutsche Telekom Laboratories in Berlin. The service is centered on addressing the question of: „how can we obtain information at the right time and in the right place?” It is a combined location-based community platform for mobile users. According to their CEO, few companies worldwide have a similar level of know-how in this area. An example of one of their services is a collaboration with the bike rental service of Deutsche Bahn. Using a Java-enabled cell phone, users can see where the nearest available bicycle is. The platform offers over 800 000 points-of-interest (POIs) across Germany including ATMs, movie theaters, bike rentals, pharmacies and hotspots. 30 000 events have also been registered with the service. Users can simultaneously view up

to four categories on their cell phone. Moreover, users can comment on and rate the POIs. The service offers:

- Automated positioning – With the push of a button, Qiro shows your position on a map
- Friend finding – Qiro also knows where your friends are (provided they want to be found) and lets you know who is close to you. Instant Messaging allows you to set up a spontaneous meeting
- Information on the go – Is there a movie theater near here? Where can I find an ATM? I want to find a City Bike. A glance at the map will help you find POIs such as these and more. You can even obtain more detailed information such as the movie program.
- Bookmarking – what is playing in your favorite movie theater? I like this restaurant. Bookmark your favorite locations and these POIs can easily be recalled, when you want to find them again.
- Qiro Online – Manage all your information – your friends, POIs, etc. – online from your PC. Check out what is going on: parties, movie programs, etc., bookmark your POIs before you leave home so you can take them with you on your phone.
- Chat – Instant message with your friends either over your computer or via your telephone so you can keep tabs on what is going on.
- Privacy – Don’t want to be found? Just click on an icon in the start menu and you are invisible. Want to be found? Just click the icon again and you are visible again.

## XI. RECOMMENDATIONS

- Examine mobile advertising and context-based advertising as a means to improve effectiveness of digital signage
- Introduce the centralized management of signage via Wi-Fi networks
- Adopt standards where possible when implementing signage solutions; move away from Windows and PC-based solutions and towards screens with signage solutions built in
- Adopt non-traditional screens including integration into street furniture and double-sided screens
- Interactivity is key – increase focus on UGC and interaction with consumers
- Improve targeting based on location, context (demographics), time of day, etc.
- Use measurement to assess effectiveness of signage solutions
- Interface with mobile devices and use mobile devices as an extension to signage-based advertising
- Integrate AMP Bluetooth solutions to support large data transfers to mobile devices e.g., mobile devices as extension of signage (city guides)
- Integrate games into signage solutions esp. when targeting younger demographics

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