

**Perceiving the Digital Landscape**  
**Are cell phone prototypes well suited for the wireless internet?**

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***1. Introduction and Background.***

***Looking forward.***

Will the wireless internet of the future be viewed on cell phones or on some other type of device? To find out, this research looked at the interfaces of prototype cell phones with the question: "How well suited are they for the wireless internet?" While predicting the future may be a dicey proposition, the seeds of tomorrow's products are often found in obvious places today.

The "wireless internet" is currently offered in western nations as "WAP" (Wireless Application Protocol) and in Japan as "i-mode". While WAP has not been well received as a "usable" technology (Nielsen, 2000), i-mode has signed up over 25 million customers within 3 years, and is well on its way to becoming the world's largest internet service provider. (Nippon Telephone and Telegraph, 2001).

Meanwhile, homes, offices, and schools in the US are slowly being filled with "smart" appliances that communicate with each other through wireless LAN (local area network) systems (Bard, 2001). The human user will view and interact with this ubiquitous "digital landscape" with a personal "access device"- a small, portable viewer with a screen ("Sheltering from the storm," 2001).

Current designs for wireless devices center on the cell phone handset as the main platform for these viewers. Based on the dial-up internet access model, handsets were the first units to be outfitted for a wireless internet. In the process the handset has evolved from being simply a cell phone to becoming the standard personal access device to wireless services.

The question is still open however, as to whether the cell phone based viewer is ideal for both cell and LAN applications.

***Review of related literature.***

The question may arise as to whether these "viewers" will be outfitted with any features at all that could be considered standard or "suitable", because the functions they will perform will be so diverse. Might a plethora of digital devices emerge that are specialized for different applications and different markets?

In the article, Design Darwinism, as published by *The Economist* on April 4, 2001, it is emphasized that basic usability of internet web pages has been difficult to achieve by web designers even when data about

what users want is available. Principles of two design firms argue here that completely customized interfaces will emerge for wireless devices.

Rich Refredi of Pixo claims that “depending on the target group for a product, they (wireless devices) can, and should, look very different.” Tim Brown CEO of Ideo claims, “once electronic devices become more pervasive, the idea of a generic interface becomes obsolete” (“Design Darwinism,” 2001.).

Do these speculations match our experiences in reality, however? Consider the interfaces of common appliances such as toasters, light switches and dimmer controls, telephones, stereo equipment, TVs, or auto instrument consoles. Are there any examples of interfaces that *haven't* become standardized? Even web pages, after a brief flowering of artistic anarchy, have by necessity, adopted standardized navigation features like “Contact Us” and “About the Company”.

The standardized Windows interface with its icons, menus, and pointer *is the very reason* for the immediate and widespread usability of advanced computer functions. Previously, only a trained technical staff could operate these programs. A standardized interface is what makes a device usable.

Dedicated devices will certainly be used for many applications. An example of this would be wall mounted room thermostats, with their dedicated function and purpose. However, experience shows, with Windows software as the example, once electronic devices become more pervasive the idea of a generic interface becomes *essential*.

So, if devices tend toward a standard interface, problems still remain as to what qualifies a “standard” feature and how those features are chosen by the manufacturer. Previous functional success and cross breeding of devices will shape the evolution of this final product- the handheld internet viewer.

The standard viewer we have now is the cell phone based device, but is it being outfitted with features broad enough to access a richer array of web capabilities? Are the recently proposed models “dressed for the occasion”?

### ***The devices and characteristics studied.***

To answer the question this study compared new internet cell phone prototypes with the already successful interfaces of 1.) handheld games and consoles 2.) personal digital assistants (PDAs) 3.) e-book readers and 4.) PC based browsers.

The cell phone based prototypes for this study were taken from “3g-generation.com”, online media sources that chronicle wireless developments, and from device manufacturer’s websites. Current video games were selected from available games on the shelf at Toys-R-Us, and some were selected from Amazon.com’s toy section. Vintage handheld video games were selected from the book, *Electronic Plastic* by Jaro Gielens, a compendium this class of units dating back to the 1980s. The ebooks, browsers, PDAs and game console controllers represent essentially all the models on the market today in their respective classes.

The common button interface factors that were found and analyzed were:

1. the 4-directional button (4dir)
2. up/down button
3. left/right button
4. numeric keypad (9#)
5. alphabet keypad (QWERTY)

6. is the device used or held in two hands?
7. touch screen
8. stylus
9. dedicated buttons with assigned functions
10. on screen cursor
11. gel or disposable casing
12. special factors

These features were tabulated for each type of device. Then, a comparison was made between the features carried on cell phone prototypes, with the features currently employed on the other four types of devices.

### ***Definitions and delimitations used.***

In the study, it is assumed that the specialized interfaces of video games, PDAs, ebooks, and browsers offer the best solutions to their particular functions of gaming, inputting short messages, reading, and browsing.

Telephones with dials or numeric keypads were never meant for any of these functions. They were meant for entering a short sequence of numbers only. Therefore, the essential purpose of this research is to find out if they are now being outfitted with appropriate features to allow them to perform well on the wireless internet they will soon access.

This preliminary study is meant to simply be a practical overview of new interface features that are emerging on the phones. As such, the following topics, although related, were not investigated at this time:

- the emergence of disposable / limited use cell phone models
- desktop computers and their use (except for browser software, keyboard, and mouse)
- the evolution of home based game consoles (except for their interfaces)
- home entertainment equipment and wireless remote controls
- dedicated personal music devices (tape/CD/MP3 players) – this is an auxiliary function
- PDAs that will not or do not accept or send data externally
- dedicated watches or cameras - this is an auxiliary function
- competing frequency transmission standards (Bluetooth, 802.11, 900mhz, etc.)

### ***Industrial and economic significance.***

Some basic functionality and usage patterns of the desktop internet will translate to the mobile internet as well. Therefore, some of the same industrial relationships will carry over to wireless industries.

These will include gaming and game developers (Shackman, 1999) business to consumer websites, personal home pages, mass production hardware and accessory manufacturers, mobile device software developers, desktop software developers, vending machine operators, businesses, airports, and other public facilities. Each segment of the economy will need to know what types of device interfaces will be in use, so that they can design their data access accordingly.

This is not as futuristic a situation as it sounds. Public schoolchildren are being issued wireless laptop units (May, 2001). Wireless corporate networks are being installed in offices, even being hacked into from company parking lots. Bill Gates stated recently, "Every business, every home, every convention center will be wired up with high capacity 802.11 (LAN). That's finally the way that we will have information anywhere we want it" (Frishberg, 2001).

Simultaneously, Motorola estimates that by 2005, the number of wireless devices on the internet will exceed the number of wired ones ("In search of," 1999). Starbucks has begun installation of wireless LAN access capacity in all 3,000 of its North American coffee shops (Brewing, 2001). In Japan, NTT DoCoMo has signed up over 25 million paying subscribers to its i-mode service since March 1999 (Nippon Telephone and Telegraph, 2001). Europe is betting heavily on the future of wireless access and its earning potential. There, the entire telecommunications industry is saddled with an enormous debt incurred as a result of paying out \$125 billion collectively for their frequency licenses alone ("Telecoms begging," 2001).

Steven Milunovich, the Global Technology Strategist for Merrill Lynch, was recently asked on nationwide television what communications technologies he was looking to for growth. His immediate answer? "Wireless LAN and communications devices that will allow you to sit in a chair and browse the net". Milunovich states that we are in a "deployment period" in which recent high-end advances in microprocessors are being practically applied in products (Milunovich, 2001).

Literally thousands of companies, investors, and school districts are banking on new opportunities to integrate and market mobile devices with digital transmission ("In search of," 1999). All of these huge investments depend on the basic usability and popularity of the mobile units that will access them. Each manufacturer will be challenged to either produce a device that is usable for the new wireless functions, or lose market share (Hua, 2001).

Forecasted revenue in various wireless categories by 2006 include, \$250 billion for corporate and consumer voice transmission, \$300 billion for consumer data, and \$230 billion corporate data, for a total of \$780 billion total ("Why mobile is different," 2001).

This technology will affect every area of our lives, in ways that are not even apparent yet. Most appliances will be directly connected and accessible through this wireless network. The human user will require a device to access and manipulate the data in many situations throughout the day.

The immediate question arises- what will such a device look like? Is it already visible in an emerging device or form? How well are manufacturers assessing this pressing functional need?

## ***2. Methodology, sub-problems, and operating environment considered.***

### ***Sample selection.***

The base sample consisted of 167 cell phone based prototypes from approximately 28 manufacturers from Europe, Asia, and the US. The photos were examined one by one, and the occurrence of each button type or interface feature was then tabulated. The sum of the number of feature occurrences in each class was then determined. This revealed the basic configuration of the device.

This research was conducted as a content analysis (Leedy & Ormrod, 2001), and can be replicated for any group of appliances or machines in which the "theme" of the interfaces needs to be revealed. In this case, the navigation of screen space is the common denominator function of the buttons on the units studied.

Internal software assigns the functions of each button, if it has not already been determined at the time of manufacture.

Next, the results from the group of cell phone prototypes were compared to the other device groups in order to reveal the shared or differentiating features. A feature was marked as appearing if it appeared anywhere on the device (back, front, or on accessory pieces). For the purpose of the study, any alphabetical keyboard was counted as a QWERTY (typewriter style) keyboard, whether the numeric keys appeared in that order or not.

### ***Subproblems.***

One sub-problem that needed to be worked out before the determination of the appropriateness of the cell phone interfaces was, exactly what functions will the wireless internet device need to perform?

The obvious uses include the ones analyzed in the research directly: gaming, reading, sending of email, and browsing “pages” of information. Less obvious uses that will evolve depend on the introduction of LAN systems and include: controlling other devices remotely, entering into LAN spaces and viewing locally broadcast data, paying for goods at a point of purchase or vending machine, exchanging data actively or passively with holders of similar devices, controlling data flow from PC’s to other devices (Cybiko, 2001). All of these functions are currently offered to users of some corporate wireless networks, and are accomplished on some toy units such as the Cybiko. In another example, Sony corporation is developing all of its new home audio equipment with wireless net capacity (Case, 2001).

It was determined in the research that to access and perform this list of functions would not require any exotic extensions or buttons. For example, the Cybiko unit accomplishes most of these functions with the same basic set of buttons as found on other units in the study. It will be left to the wireless software to assign functions to the buttons or the screen items. This again shows the necessity of knowing exactly which buttons will be present on the “typical” device.

Secondly, it was expected that these prototypes might not have been designed with high quality gaming or browsing in mind in the first place. It is possible that the manufacturers had not considered such an extensive range of possibilities for their cell phones. Among technical staff however, the notion is well established that people will want to play video games on whatever device happens to be available, and the challenge to create games on limited use machines is alluring to programmers (Baard, 2001, November 6). No sooner, for example did i-mode proliferate than one could find hundreds of “personal websites” and games to play on them. Given that the devices in the sample were published as “3G” phones, meaning they are meant to access high quality video content, it was determined that a wide range of future functions had been considered for these prototypes.

Lastly, it was considered likely that some proposed designs are merely fanciful, or outrageous for publicity’s sake. After careful inspection of the prototype units and their comparative “feasibility” using existing technology, we did not find evidence of this.

### ***Why LAN is so important.***

What will the LAN environment of local services look like? The LAN environment is a local “field” in which one will be able to access the “internet” or any part of it that is being hosted on the location’s specific servers. It is a local broadcast of digital data on a frequency near the range on which 900mhz cordless phones operate.

A number of high profile advocates of the technology are absolutely starry eyed about the future of LAN. Anthony Citrano, who hosts an annual conference called Pop Tech, was recently quoted as saying, “we are not far from a world where all of human knowledge is accessible to you instantly from the ether” (Anderson, 2001).

The early adopters of LAN systems thus far have included cafes (Brewing, 2001) and a significant number of supermarkets (Symbol Inc., 2001). If the entirety of human knowledge proves to be too much to sort through, one would expect that in the future we will at least be able to determine the location of the Ritz crackers in the next isle.

LAN applications are so important because they operate locally, on frequencies that are not as tightly regulated as current cell phone frequencies. They are like “mini TV stations” of broadcast data. LAN systems will be the most useful and versatile wireless frequencies available until cell transmission capacities catch up (Nielsen, 2001). As mentioned, European cell phone service providers shelled out billions in 2000 to stake out their portions of frequencies that can send and receive over wide areas. The FCC plans a similar auction of the airwaves in the United States.

There remains one painful detail inhibiting this rollout of the longer range wireless internet. The frequencies planned for the wireless internet in America are the same frequencies now occupied by many local TV stations. *The Economist* reports, “Winning bidders will first have to coax the stations to give up their valuable frequencies. If the stations do not give way, the wireless licenses will be useless” (“Battle of the airwaves,” 2000). Although legislation dictates that TV stations must vacate these frequencies by 2006, they do not have to do so if fewer than 85% of American viewers have switched to digital TVs. This same article in *The Economist* notes that color TV took 22 years to reach 85% penetration and VCRs took 16 years to do so. The best way to hasten the wireless internet into reality is then, to first buy a digital TV.

### ***3. Trends Revealed in the Data and Research.***

#### ***The results.***

1. *The four directional navigation button has become the standard navigation tool of digital devices with or without screens.* It takes on varied shapes but the basic configuration is a “+” shaped button or pad. This feature migrated from game consoles, like the Gameboy. It now appears on nearly every cell phone, as well as on home stereo equipment. It is a simplified interface for accessing multi-level menus of digital data, in which a larger keyboard or joystick is not an option. In some cell phone models it may become the only button used for input. This navigational device appears on 51% of the cell phone prototypes, more than the numeric keypad. It also appears on nearly all the “non-phone” games, organizers, and special service devices studied.

2. *On screen “Block Navigation” rather than cursor navigation is the established format for wireless units.* This means that the user will select data units by moving from adjacent sections on the screen, rather than pointing to them with mouse type navigation. Only 2 units out of 167 in our study appeared to have an on screen cursor. NTT DoCoMo’s i-mode service and current WAP services employ block navigation for accessing data on their tiny screens. It is an extension of earlier screens that could be “scrolled” up and down

by wheels on the equipped cell phones. This type of navigation is also found on video game and DVD start menus, as well as on stand-alone kiosks.

3. *The touch screen interface is not common on the new cell phone prototypes, reflecting this input method's inferiority for typing and browsing.* Touch screen PDAs are likely to remain PDAs only, and not become browsers. It is more likely that the phone will encompass the PDA function. In this case, operation by two hands required, not optional. It occurs on less than 10% of the new devices. It has been determined that touch screen interfaces are not ideal for games (Baard, 2001, November 6). Although beyond the scope of this research, it is practically clear that cell phones are often dialed and used with one hand. Wireless internet use will also require this degree of mobility and flexibility.

4. *The limited functionality of ebook readers is likely to keep them to specialized use only.* These devices have actually been on the market longer than PDAs, and during that time the number of models has actually decreased and the two-button interface has remained the same. E-book readers are not likely to become "standard" viewers, and the current and planned phones can encompass their scrolling features easily.

5. *"Desktop type" web pages are not likely to be viewed anytime soon on tiny cell phones* ("Battle of the airwaves," 2001). PC based browsers represent the greatest range of functionality for the obvious reason that they are not riding on mobile units. The web pages we know today will not be viewed anytime soon on handsets due to extremely limited transmission speeds and inability to be navigated without cursors. Mobile sites, by nature, must be instantly navigable with one hand. They must be cursorless, fast sites, because the viewers will not have cursors. One significant benefit of the handheld unit is the ability to dial a phone number directly from the web page, a feature currently enjoyed by i-mode users in Japan.

6. *Increasing technology could cause the cell phone to "disintegrate" and be replaced with ear mounted cartilage transponders and voice input for dialing* (Osterhout, 2000). This research does not indicate that this is a possibility in the near future, However, due to the other planned uses of a phone with a screen, and the immense market in selling these units and their services. It was found that Motorola currently sells 5 million cell phones per month in China alone. ("Dangerous Straights," 2001)

7. *Digital cameras are appearing as a standard feature on the prototypes.* One can imagine that either the device manufacturers believe there will be a demand for this feature, or have included it in their prototypes simply because the technology exists and can be offered. Emailing of photos is becoming a significant and immediate way of sharing vacation images, for example. In practical use, it must be imagined that many callers to the cell phones of the future will be treated to high-resolution live feeds of the sides of heads and close-ups of ears. This feature occurs on approximately one in three of the prototype phones.

8. *LAN systems are up and running now.* Long before the much hyped mobile "3G" networks come online, this technology is already common in kids toys and video games such as POX. Children are already using LAN systems at home and school, so in the future the concept of "dialup" will be left behind entirely. The *location itself* is the "wired" area (Baard, 2001, August 30). The physical location is also its website and network area.

9. *The QWERTY keyboard occurs on only 4% of the future prototypes.* Despite the lack of a full keyboard however, today's cell phone users send billions of text messages very successfully. This indicates that the QWERTY keyboard is not likely to migrate to the phone based device from the typewriter, as the 4direrectional "+" has done from the gaming units. Currently, 40 billion text messages are sent per month from cell phones at an average cost of \$.10 each, resulting in revenues of \$3 billion per month ("The joy of text," 2001). One billion text messages are sent per month in Europe alone ("In search of," 1999). Although the phone is not an ideal interface for typing, by any measure this functionality is a practical success. Our handheld web browser of the future will function quite well without a typewriter keyboard for text input.

#### ***4. Interpretations and conclusions.***

##### ***A new generic interface.***

The essence of the results show that the cell phone platform has sufficiently evolved to function adequately on the wireless net, whether the data is downloaded by long distance cell connections or inside LAN spaces. A new type of device is emerging – a camera / phone / game / viewer that will function as the person's personal perceiver of the data field that surrounds us in nearly every environment, and that is broadcast by electronic appliances.

The phones studied can be used by two hands rather easily, and while not ideal, are certainly usable for games. Although voice input may emerge, there are several compelling reasons why voice input is less than desirable than button input. In one study, fewer than 40% prefer voice to touchtone entry of data (Dawson, 2001). The social cost of having device owners yelling not only at callers but also at the phones themselves must be estimated. Even the very act of human-to-human voice input is known to be flawed in an overwhelming number of instances. This research determined that cell phone prototypes should be adequate for a wide variety of games, and that hard-shell cases with buttons are not likely to become obsolete even if voice input becomes more widespread.

Although "chat" is a major desired use of the desktop internet, it is not likely that cell phones would be used for this function. While the Cybiko unit offers a full QWERTY keyboard, and achieves "good basic chat capability" (Munro, 2000) as does the Handspring Treo, when it comes to "chat" in these instances you would just simply place a voice call. If the LAN environment is considered, "with a 300ft range..., you could just yell to them" (Amazon.com, 2001).

The wireless handheld unit is the next step as the ability to access data becomes independent of the fixed line desktop computer. It is the birth of a new type of device that is more than a phone, but less than a "computer" because its computing functions are not the main function of the unit. Its main purpose is to read and access already stored data from larger computers. Because the cell phone platform is well established, and already "ubiquitous", it becomes the natural platform for these services (Batista, 2001).

##### ***Pressures for standardization.***

In his book, *The Invisible Computer*, Donald Norman observes that "business wants standards before elegance". Standardized devices allow large numbers of people to utilize new technologies. The wireless internet devices will be no different, and this study has shown that a new standard device has emerged through the cell phone platform. It includes a numeric keypad, a four directional "+" button, dedicated function buttons, and probably, a digital camera.

Device manufacturers will gravitate towards a standard for obvious business reasons. Imagine a situation in which a fad video game swept the nation or the world, but could not be played on certain units. The makers of the unit in question would be irreparably damaged by not having a standardized interface. The manufacturers of stand-alone appliances will also be looking to the hand held devices for remote operation. This will allow TVs, stereos, and refrigerators to offer complex functions without having their own extensive

interfaces. Operators of home and business LAN areas can develop functions and content as the need fits, all with a standardized interface.

The desktop internet blossomed specifically because of standardization. The lack of standardization of both devices and frequencies is the main reason why the wireless internet is not widely available now (Case, 2001) (Wooley, 2001).

### **A segmented market.**

The modern marketplace is now able to serve up electronics as commodity items. The personal computer itself has become an essentially undifferentiated good, the usefulness of which depends upon its connection to a network. A recent ad offers five cell phones for free just for signing up for a service. Likewise, the wireless internet industry, which may be dominated by existing cell phone provider firms, does and will continue to be based on service revenues.

With this in mind, it becomes obvious that the wireless internet devices in this study will continue to be marketed as part of a service, not for their individual distinctions. A likely scenario may include a three-tiered market similar to the camera market today. High end, brand names take the top end, drugstore varieties service the low to middle market segments, and a significant disposable market to satisfy the low commitment end.

Cell phones have become segmented in the same way. The emergence of disposable cell phones completes the conversion of the technology from high-end to commodity. There is no reason to consider that wireless internet viewers would not follow the same patterns. The number of commercial applications for cheap or disposable internet viewers is certainly huge. In this case, the interface could be infinitely customized for local uses. The technology is becoming more affordable, and the potential uses for cell and LAN wireless systems are only beginning to be understood.

### ***An invisible landscape.***

Designers and developers should design for a wireless internet that is accessed by a four directional button, that is fast to use with one hand, and that navigates onscreen without a cursor. Despite the fact that the cell phone is a device with its own uses, capability, and future, it has emerged as a wireless internet viewer. It is the default device that everyone already has in his or her hand. The amount of cell phones per person in many countries already outnumbers the number of fixed phone lines (Batista, 2001).

What is at hand is an animated and vivid landscape filled with remotely updated screens of data. There will be screens on signs, products, and even clothing that are affected by LAN data spaces. Developers may look forward to a trend towards standardization amongst hand held devices. Meanwhile, the overall pattern will resemble an explosion of silicon chips that embed themselves into every conceivable location in our environment. The types of wirelessly connected applications that are now in use in police cars, rental car lots, and on waiters and waitresses will find extensive uses in the home and car (Garbosky, 2001).

Are cell phone prototypes well suited as viewers for the wireless net? Yes, and their role will only increase and expand. No other device has even begun to emerge that can replicate its flexibility of functions. We are witnessing its evolution now. It faces us now, shaping the reality we thought would always be "the future".

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