

7 Looking Toward the Future of the Wireless World

In 1992, when Al Gore warned that the US would have to prepare for the arrival of the “information superhighway” if it was to maintain its competitive position in the global economy, few people knew what he was talking about. Now, a decade later, the information superhighway — i.e., the Internet — permeates almost every aspect of our lives. The amount of information that can be easily accessed, transmitted, and stored by computers, and the pervasive role of computers in our lives, could not have been imagined only a short time ago.

And the pace of change is accelerating. Having grown accustomed to the wired society of the 1990s, we now must adapt to a new, wireless world — a world in which we have the freedom to make our purchases, do our chores, be entertained, and send and receive a great range of information anytime, anywhere, from the air to the outback and everywhere in between, through the use of hand-held wireless devices.

Untethering the Internet

The shift from a computer-dependent, wired Internet to a mobile or wireless Internet does not simply mean the ability of wireless devices to handle current Internet applications. As the following examples illustrate, the mobility that wireless devices afford makes possible a multitude of new applications. In Europe, which is well ahead of the US in the use of cell phones, these devices are being used to execute banking transactions and purchase soda from vending machines.

In the US, the technology sell-off of 2001 put a crimp in plans to introduce some of the more fanciful and futuristic wireless devices then on the drawing boards. At the same time, the terrorist attacks of September 11 demonstrated the usefulness of wireless devices such as cell phones and pagers in a crisis. BlackBerry, the always-on, instant e-mail device, was especially useful and has been highly successful in the US — despite an initial cost of about \$400 and service costs of \$40 a month. While retail sales in general fell dramatically following the attacks, there was a surge in sales of wireless communications devices. Apparently, people increasingly view these products as a necessity, particularly parents wishing to keep close tabs on their children during difficult times. While the technology bubble has burst, there are still numerous products on the horizon that will undoubtedly succeed and become an integral part of our everyday lives. Like most changes, however, the shift to wireless is also claiming some victims. Pay phones, for instance, may soon be a thing of the past, with revenues plummeting as callers opt for the convenience of cell phones.

Locator Functions

Federal Communications Commission (FCC) regulations require that wireless carriers provide “automatic location identification” (ALI) for their cell phone subscribers. The purpose of this feature, which makes the caller’s geographical location known to the person receiving the call, is to facilitate the response of emergency workers to 911 calls. Twenty-five percent of newly activated cell phones in the US were supposed to have ALI capacity by December 2001, and 100 percent were to have it by December 2002.¹ The 2001 deadline was not met, however, and the carriers have asked for more time.

In addition to its use in emergencies, ALI promises to have many marketing applications. Retailers will be able to promote their products by sending messages to people passing by their stores: the Gap can send a message about a special sale on jeans and Starbucks can remind passersby to come in for a latte. Cell phone users will be able to summon a taxi to their precise location. Diners will be able to get descriptions of restaurants in the immediate vicinity. And there will be a proliferation of navigation systems for downloading maps and getting directions.

Thus, mobility does not just mean getting stock quotes or sports scores on the beach or on a ski lift. Rather, it offers a plethora of location-based services and information, including the ability to track the whereabouts of children, pets, workers, and equipment – getting lost may become an obsolete concept for denizens of the wireless world. International Data Corp., a market research firm, estimates the US market for locator-based services at \$6 billion annually by 2005.²

Two new locator products in the US are Wherify and Digital Angel, for locating children and the elderly. These are watch-like devices that track an individual's location and transmit the information to a relative or guardian through a secure web site. The marketing challenge is to get the cost of such devices low enough to appeal to the general public. At present they cost about \$300, with additional monthly subscription fees ranging from \$10 to \$40. Locator devices also raise privacy issues, since they will enable individuals to be tracked anywhere at any time.³

Wireless Connecting and Networking

Soon electronic devices will be able to communicate with one another without the need for wires. With new connecting technologies such as Bluetooth, HomeRF, and 802.11b, net-enabled cell phones will be able to download music or data from the web and send it to other devices instantly; at airports, travelers will be able to download the latest flight information directly onto their cell phones. According to Walter Mossberg, technology columnist at the *Wall Street Journal*, in the future, distinctions between hand-held devices will be based on whether they are “alive” or “dead.” A live device will be one that can instantly connect with other networks to exchange messages and download web content.⁴

Bluetooth (named after a tenth-century Danish king who united Denmark and Norway) was developed by a number of major electronic companies, including IBM, Ericsson, Nokia, Intel, and Toshiba. It automatically “unites” electronic devices within 30 feet of each other without a cable – an operating range about the size of a room. Its most widespread application is expected to be as an interface between a headset and a cell phone, permitting hands-free calling without any wires.⁵ Although high prices have slowed Bluetooth's acceptance, manufacturers hope to be able to add the technology to products for about \$5 – one-third the current price.⁶ The investment bank UBS Warburg estimates the market for Bluetooth at over \$1 billion worldwide – about \$900 million for cell phones alone by 2002.⁷

Bluetooth is now being challenged by two newer technologies, HomeRF and 802.11b. These operate at higher speeds and can cover a larger range – about 160 feet for HomeRF and about 300 feet for 802.11b. They also use more power and cost more, so Bluetooth has an advantage in small devices such as cell phones and personal digital assistants (PDAs).

Beyond Voice Communication

While voice may remain the dominant application for cell phones, text and graphic communications are also promising. In Europe and Asia, teenagers are enthralled by short message services (SMS), often sending as many

as 20 to 50 text messages each day. SMS has become extremely profitable for service providers, which charge by the message. In 2001, *Business Week* magazine predicted that Europeans would send 200 billion text messages by the end of that year and one trillion by 2003.⁸

In addition, people are increasingly using their phones to download text from the Internet. In 2000, the number of wireless Internet subscribers in the US was estimated at 5 million. Analysts expect this number to reach over 84 million by 2005.⁹

Along with voice and text, cell phones have been developed with the ability to send and receive photographs. Equipped with (or capable of connecting to) digital cameras, the phones can transmit images by e-mail. The Nokia 7650, for example, has a built-in digital camera; photos can be stored on the phone's "photo album" and sent to another phone.¹⁰

Monitoring the Body

The new wireless technologies also open up many possibilities for monitoring an individual's vital signs and other physical phenomena. Digital Angel (described above), in addition to providing the wearer's location, can monitor his or her vital signs, report the information to others, and summon emergency aid. The Smart Train sneaker, under development by Reebok, has a built-in microprocessor that provides instant feedback on the wearer's speed, distance covered, and calories burned (a feature to measure heart rate may be added). All of this information can be transmitted by radio to a wristwatch display. In partnership with Reebok, FitSense Technology has developed technology for relaying data from the wristwatch display to a personal computer.¹¹

BodyMedia, Inc., is pursuing "bioinformatics," which it describes as "the intersection of life sciences and digital technologies." Its SenseWear armband monitors the wearer's sleep patterns, blood pressure, and other vital signs and transmits them to a computer. The device can warn of medical problems and remind wearers to take their medication. Many companies are competing in this field. Hewlett-Packard has a healthcare solutions unit with 5000 employees and over \$1 billion in annual sales.¹² The management consulting firm McKinsey & Co. estimates that the US market for wireless monitoring devices will reach \$70 billion by 2005.¹³ More sophisticated monitoring devices are being developed for healthcare professionals.

Wearable Computers

The growth in wireless gadgets is leading to the development of a group of products known as "wearables." Some of these are traditional garments designed to carry small wireless devices, such as a raincoat with pockets labeled for a PDA and a cell phone. Phillips and Levi Strauss tried to take this idea one step further by introducing a jacket with electronic gadgetry built in. The \$900 garment came with an MP3 player, cell phone, headset, and remote control device, all interconnected by an electronic circuit woven into the fabric. Although this product was cumbersome and did not prove successful, it may have been a portent of things to come.¹⁴

According to Steven K. Feiner, a professor at Columbia University, computers are someday likely to be wired directly into our neural systems.¹⁵ In the meantime, his laboratory is developing complicated wearable computers, including a backpack filled with equipment that sends information to a display screen on a pair of goggles; a small hand-held computer communicates by radio with the backpack. Intended for military and commercial users, these models may be adapted for consumer use as their weight and cost come down.¹⁶

Some devices are even being incorporated into jewelry. Casio is selling digital watches that also function as MP3 players, digital cameras, voice recorders, global positioning system receivers, and personal organizers.¹⁷ A relative of wearables are “smart” garments. Clothing under development by Motorola, for example, can “tell” a washing machine how it should be washed.¹⁸

According to Edward Newman of Xybernaut Corp, “Every user of today’s 200 million cellular telephones is a target for a wearable computer.” Newman cites projections that the worldwide market for wearables will reach \$1.2 to \$1.4 billion by 2003, with about half the market being in the US.¹⁹

Kids Go Wireless

Many wireless gadgets have counterparts intended for children. These tend to be cheaper and less sophisticated, and come with lots of color and sound. Electronic organizers for kids generally cost under \$100 and provide phone books, planners, translation services, and cameras, as well as messaging services and music. According to the consulting firm Yankee Group, by 2005, the percentage of kids aged 10 to 19 using cell phones will reach 68 percent, surpassing the adult ownership rate of 62 percent.²⁰ Although kid-friendly wireless devices are a \$25 billion market in the US,²¹ their use has become a concern in some school districts, which have banned them in schools for being disruptive.

Accessories

Accessories for wireless devices are also proliferating. These include adapters, headsets, carrying cases, antennae, charger kits, and all kinds of cables and connectors for devices not yet interconnected through wireless technology such as Bluetooth. Fashion plays a role, and designer face plates for cell phones can be purchased in colors to match one’s wardrobe or adorned with cartoon characters. These products present a substantial waste problem because they may weigh more than the devices themselves and they are not standardized for different makes and models. As a result, each device has its own array of accessories, which generally cannot be used when a new phone is purchased.

Convergence versus Differentiation

The text, photo, locator, and other functions described in the previous sections exemplify the explosion now under way in new applications for wireless devices. This has resulted in two simultaneous trends: convergence and differentiation. On the one hand, wireless devices continue to be designed for specific functions such as voice communication or personal organizing. On the other hand, engineers are aiming to create devices that offer some combination these functions, along with others such as music and video, web browsing, e-mail, and short-text messaging.

Most major producers are introducing products with convergent functions. For example, Kyocera, Ericsson, Nokia, and NeoPoint are marketing PDA-equipped phones with web access. By 2004, the percentage of cell phones with Internet access is expected to rise to 94 percent, from only 2.4 percent in 1999.²²

Handspring, a maker of PDAs, has announced a new product line called Treo — devices that combine a mobile phone, wireless e-mail, and web browsing, as well as providing the usual features of hand-held computers such as calendars and address books.²³ Another converged product, which was a big hit at the Spring 2001 Consumer Electronics Show, is the PC-Ephone. This is a Windows-based PDA with built-in phone capability. Using Bluetooth technology, the PDA communicates with a tiny phone that resembles a fat pen. This pen also acts as a pointer for the PDA’s touch screen. The device fits in the palm of the hand and sells for about \$1500.²⁴

Research In Motion (RIM) Ltd.'s BlackBerry e-mail devices have been successful primarily because of their simplicity. Now, however, the producer is adding features such as the ability to make cell phone calls. RIM is even considering the addition of document editing, web surfing, and banking services, so the device can function "as a remote control for your office PC."²⁵

Such "converged" devices are desirable to consumers because they reduce the load of equipment they have to carry around. But they present challenges for designers. Placing multiple functions on a single device can compromise the quality of individual functions and make the product complicated to use. Also, all-in-one devices are often expensive and therefore attractive mainly to business users. According to Jeff Hawkes, co-founder of Palm, Inc., "People would rather have a single device, but they won't put up with major compromises."²⁶

As convergence proceeds, so too does differentiation. According to an article that appeared the *Wall Street Journal*, some people regularly carry eight or more different wireless devices at the same time. The article gives the example of an investment banker who carries a BlackBerry, a Palm Pilot PDA, a Compaq iPaq PC, two cell phones, an e-book, and two MP3 players.²⁷ It remains to be seen whether the demand for single-function devices that are lightweight and simple to operate will exceed the demand for more complex converged devices with combined functions. Currently, both trends seem strong and have tended to offset one another.

The waste implications of convergence versus differentiation are also unclear. Convergence could result in decreased waste, since the weight of a single product with multiple functions will be less than the combined weight of all the single-function devices it replaces. On the other hand, a converged device is likely to weigh more than any single-function product. One thing is certain, however: the rapid increase in applications for wireless devices will bring an overall increase in the amount of waste from these products.

The Throwaway Cell Phone

There have been numerous reports in the media over the past few years about the imminent introduction of disposable cell phones, but so far these have failed to materialize.²⁸ Several companies, however, have reportedly developed such phones and have plans to market them. Regardless of whether or not these particular products become successful, the widespread use of disposable phones is a real possibility. If this comes about, the amount of waste from cell phones would increase substantially, unless steps are taken to recover the phones for reuse or recycling.

The disposable cell phones now under development are targeted at vacationers, business travelers, travelers from abroad (who cannot use their own cell phones in the US because of incompatible technical standards), and children considered too young to use conventional cell phones. Manufacturers have not provided details on the material composition of these products, but presumably they and their power supplies will contain toxic substances similar to those found in conventional cell phones and other wireless electronic products.

The following companies have plans to market disposable cell phones:

- **Dieceland Technologies** hopes to sell its disposable cell phone, the Phone-Card-Phone, at locations such as grocery stores, fast food restaurants, bars, airports, hotels, and car rental offices.²⁹ It expects to offer the phone, equipped for outgoing calls only and with 60 minutes of airtime, for approximately \$9.99.³⁰ The company claims to have received 100 million purchase orders in the US and 300 million globally.³¹ Dieceland has entered into an agreement with GE Capital to market and distribute the phone through GE's Prepaid operation.

The Phone-Card-Phone is approximately two inches by three inches and about three credit cards thick. It is manufactured by printing cell phone circuitry onto a paper substrate, which is then sealed and laminated.³² Metallic inks are used instead of real wires: the ink is printed onto the paper substrate and other components are then inserted into or fixed to the substrate surface.³³ A plastic battery case with one AAA alkaline battery slips onto one end of the phone and a reusable headset plugs into one corner.³⁴ GE has indicated that the Phone-Card-Phone can be returned to retailers for a refund of \$2.00 to \$3.00 each, but has provided no details on what it plans to do with the returned products.³⁵

- **Hop-On Wireless** has developed a voice-activated wallet-sized disposable phone, for outgoing calls only, that will cost approximately \$30 for 60 minutes of airtime.³⁶ The company expects to sell the phones at national drug stores, convenience stores, and variety stores in all major US metropolitan areas served by its network.³⁷ The phone consists of a biodegradable plastic handset 2.25 inches wide by 4.25 inches long by .40 inch thick that will have two buttons, “call” and “end.”³⁸ It will have an internal antenna, an earbud/microphone, and a zinc-air battery that is expected to last three to six months.³⁹

Hop-On Wireless has indicated that consumers bringing their phones back to the place of purchase will receive a refund, but the size of the refund has not been specified.⁴⁰ The company claims it is committed to getting the phones back, from an “environmental and economic standpoint.” A confusing label bearing the words “Disposable. Please Recycle” is to be attached.⁴¹ Upon receipt of the returned phones, Hop-On Wireless plans to melt down the casing, recast it, recharge the phone with calling minutes, and send it back to the marketplace for resale.⁴² Fuji Films is working with Hop-On Wireless to cross-promote its cameras and the Hop-On Wireless disposable phone as part of a “tourist” package.⁴³

- **New Horizons Technologies International Inc.** describes its Cyclone phone as “the next generation disposable cell phone.”⁴⁴ The phone will cost approximately \$39.95, which will include 60 minutes of nationwide airtime.⁴⁵ New Horizons will offer the Cyclone nationwide early in 2002, initially through wireless service providers and later at gas stations, convenience stores, groceries, and drug stores.⁴⁶ The company also anticipates offering a “travel fun kit” for tourists featuring both a Cyclone phone and a disposable camera.⁴⁷

The Cyclone is equipped to make and receive calls and comes with a replaceable case.⁴⁸ It is a simplified version of a conventional cell phone, but without such features as a display screen or voice mail. It is 4.3 inches long by 2.1 inches high by 1.2 inches wide and weighs less than five ounces (including three AA alkaline batteries).⁴⁹ New Horizons has an agreement with Duracell whereby the latter will be the exclusive provider of batteries included with each phone.⁵⁰

Once the initial 60 minutes of airtime are depleted, purchasers of the Cyclone may either buy more airtime or return the phone to New Horizons (or participating stores) for a \$5.00 rebate.⁵¹ Returned phones will be sent for recycling; those with usable printed wiring boards will receive a new plastic case and be resold.⁵² According to New Horizons, it is “encouraging people to recycle the phones, although they are priced so that they are disposable.”⁵³

In addition, **Telespree Communications** is developing wireless software technologies with potential applications in a variety of communication devices. Contrary to reports that the company is developing a disposable cell phone,⁵⁴ Telespree executives say they have no plans to manufacture such a product.⁵⁵

An outstanding question is whether disposable cell phones are cost-effective for wireless carriers, which will have to add subscribers for short periods of time. Proponents believe they can be profitable for wireless carriers

as well as manufacturers, especially if customers have the option of reusing their phones by adding airtime and components are reused or recycled.⁵⁶ However, in an investigative report, the *San Francisco Chronicle* described disposable cell phones as “all promise, no delivery,” citing the small size of the manufacturers involved and the legal problems incurred by one of them.⁵⁷ Nevertheless, the prospect remains that some company will introduce such phones in the future, even if the products described above never make it to market or become widely used. If and when such phones do become available, it is important to ensure that reuse and recycling programs are in place. Otherwise, the additional waste they generate will become the burden of municipal waste facilities and the taxpayers who fund them.

Short-Term Phone Rentals

An alternative to disposable phones is short-term phone rentals, which at least a dozen companies are offering for international travelers. Some airports already have kiosks where arriving passengers can rent phones, or they can be obtained directly through rental companies or service providers. Rental costs are high, however: Roberts Rent-a-Phone in New York City charges \$40 per week for a phone and \$10 to ship it to the customer, in addition to per minute charges for incoming and outgoing calls. Calling the US from Europe costs \$2.25 per minute. Some of the large US service providers are also entering the rental business, with Nextel Worldwide and AT&T’s World Connect programs both offering international rental options.⁵⁸

Kodak’s Throwaway Camera: A Model for Reuse/Recycling

Introduced less than 15 years ago, single-use cameras currently produce one out of every five color negatives made by amateurs worldwide.⁵⁹ Some have predicted that the impact of the throwaway cell phone on communications will be similar to that of the single-use camera on photography.⁶⁰ But these observers are overlooking a crucial lesson from the history of single-use cameras.

When Kodak came out with the disposable Fling in 1988, it met with an outcry from consumers and environmentalists because of the waste it would generate. In response, the company changed the camera’s name to the Fun Saver and announced it would take back and recycle the product. Kodak likewise changed its marketing campaign to one that promoted a “recyclable” camera.

The end result was a camera redesigned to maximize value after recovery, a strategy Kodak has found to be extremely profitable. The company is able to reuse most of the parts, with the remainder being recycled and used as feedstock in the manufacture of new cameras. Usually, only the battery and lens need to be replaced; the rest of the camera can be reused about ten times.

Kodak reports having reused/recycled over 420 million cameras since 1990, with reuse/recycling rates of over 75 percent in the US and 60 percent worldwide.⁶¹ Kodak, Fuji, and Konica now collect each other’s cameras and exchange them for reuse and recycling. Kodak, originally chastised with a “Wastemaker Award” for the Fling, has now earned numerous environmental awards for its Fun Saver take-back program.

Kodak’s program is not completely applicable to cell phones, since the company gets its cameras back from photofinishers rather than consumers, which is much easier. However, many aspects of its experience are relevant, particularly the way the product has been redesigned to maximize value at end of life. To facilitate recycling, Kodak replaced the camera welds with snap fasteners and used more-robust components to permit reuse. Kodak

reports that its take-back program and focus on design for recycling captures significant savings in energy, raw materials, and labor, with new cameras using only 25 percent of the raw materials and 33 percent of the energy needed to produce the original Fling.⁶²

The Challenge for Cell Phones

Initial promotion of throwaway cell phones, like that of the single-use camera, has emphasized the convenience of their disposability. Kodak, however, soon realized it would have to take back and recycle its product to make it acceptable to consumers. Now concern is mounting about the waste that disposable phones could create. In New York State, draft legislation is being circulated that would ban disposable phones from incinerators and landfills, and require sellers to take them back free of charge and reuse and recycle them.⁶³ In this climate, the makers of disposable cell phones are likewise beginning to talk about their products' recyclability.

The success of camera reuse and recycling indicates that this can be profitable for small, inexpensive products. In the case of disposable phones, the challenge is that they will have to be collected from consumers directly, but this is not an insurmountable problem. Take-back programs can be designed that provide consumers with economic incentives to return their used products, such as deposit/refund systems or discounts on new phones when used phones are returned.

For manufacturers, cost-effective reuse and recycling of disposable cell phones will depend on factoring end-of-life management issues into the design of their products. The challenge is to design the phones in ways that facilitate disassembly and reuse of components, and to make them from materials that are economical to recycle.

Because wireless technology is changing so rapidly, this is an opportune moment to address the waste these products create. Cell phones and other wireless products are constantly being redesigned and new ones introduced. To encourage creation of products that are easier to reuse and recycle, design criteria need to be broadened to include these goals. Designing products that generate less waste and are easier to disassemble, reuse, and recycle is a far more practical strategy than waiting for a deluge of wireless products to enter the waste stream and then searching for ways to manage this waste in an environmentally responsible manner.