Hybrid PDAs (Personal Communicators)

Hybrid PDAs combine three entirely different business and personal communication mechanisms (cell, e-mail, IM) into a single embraceable device. Their expected ubiquity will enable significant efficiency gains in our business and personal lives. Although many thought that the older PDAs would be a dominant device in our lives, they were unable to achieve penetration beyond a few small business circles. Hybrid PDAs will succeed because of three important conditions:

- Ubiquity of cell phone use. After all, it is no longer "weird" to be on your phone while in a supermarket, and you can be sure that someone next to you on the street is carrying a cell phone (to the same extent that you can be sure that those around you are wearing shoes).
- Seemingly overnight change from one type of cellular technology optimized for voice to a completely different architecture optimized for data, and without anyone even noticing.
- The increased business and social needs for higher immediacy of digital information sharing when *away* from a computer for down-right normal citizen needs (e.g., "Change of field for baseball practice tonight" or "Meeting at the alternate customer site up the road").

We use the term *hybrid PDA*, or simply HPDA, because some confusion exists within the industry as to the proper terminology. Existing PDAs that now have cell capabilities are called one thing by some manufacturers, and cell phones that now have e-mail are called something different. If the device is capable of voice, e-mail, and messaging, we call it an HPDA.

The trend toward holding your electronic life in the palm of your hand started when cell phones were crossed with PDAs. The result was a cell phone that could also keep your calendar and your contact database. Next, text messaging was added, and then Internet access and e-mail. There appears to be no end in sight to the future versatility of these multifunction handheld devices.

For example, NTT DoCoMo has introduced in Japan a cell phone with so many functions, one could get lost trying to find them all. This unit does the following:

- Sends and receives e-mail
- Plays games online
- Accesses iMode compatible Web sites and plays downloaded music
- Takes digital photographs
- Records sound
- Reads bar codes (and someday RFID tags)
- ... Oh, and makes phone calls

The phone also contains a specialized Sony-developed chip called a FeliCa chip or "smart card" that enables users to pay bills and make purchases over a wireless electronic banking system, operate appliances that can be controlled via a connection to the Internet, unlock doors, and the list goes on.

Consider the previous section where we examined various communication methodologies. Sometimes, an e-mail is the best way to deliver a message (perhaps something less time critical, possibly larger, or something that requires some deeper thought). Sometimes, IM is the best method (for quick and important correspondence). Sometimes, even a phone call is appropriate. Imagine the utility of having access to all those modes from a single device that you carry with you (pervasively) anyway.

The relevant point to Inescapable Data is that now we all carry with us an intelligent device that is wirelessly connected to the world's vast data networks continuously. This is monumental and has quietly snuck up on us. The utilities that will be discovered will be mind numbing.

Why Not Just Call Someone?

If we admit that we are heading toward a world where 100 percent of people carry cell phones, why not just call someone when you have a desire to communicate? The answer: because synchronous communication is a poor use of time. You have to interrupt your targeted party, the targeted party has to give you full attention for the duration of the exchange, and the targeted party cannot prioritize and optimize his or her communication exchanges. Furthermore, you cannot give the target the actual business object (e.g., the soccer schedule, the competitive analysis report, the "pictorial" directions to the airport). Even a message such as, "Mom, I'm outside Macy's waiting for you" is best delivered asynchronously yet immediately (given that Mom is finishing a client interview). The significance of cell phones *plus* text messaging is that these devices provide a way to reach nearly everyone nearly every hour of the day now, which is ideal for high-immediacy asynchronous communication without forcibly interrupting the target.

Video Cameras and Webcams

The popularity of consumer digital cameras has driven down the price of their main components and the quality up. The key component of a digital camera of any type is the CCD element (the chip that actually "sees" a scene and turns it into a digital blip); the price of this component has dropped so low that high-resolution color video-capture devices can be built in to nearly anything. In parallel, wireless networking stormed through the computer industry over the same time period and has a natural home with video cameras. It is now trivial to litter an environment with video-capture devices because the costs and wiring complexity have been nearly eliminated.

Certainly, we discuss the values of video in surveillance, for both home security and the larger societal (public) security. But as interesting is the deployment of this new source of data for real-time business optimizations—from observing shoppers' habits to tracking products to inspecting and controlling manufacturing machines. Advances in image-processing algorithms now enable machines to actually *understand* scenes. Video is perhaps the largest data source we have ever had to wrestle with in the computer world. Whereas a single text page may consume a mere 1,000 bytes of information, a single video frame typically contains megabytes of information. Multiply that by 30 frames per second and we are dealing with streams of data that are unprecedented.

In our Inescapable Data world, we will see video capture everywhere, and forevermore video data streams will be an integral part of our information lives.

Wireless Pervasive Monitoring and Sensing Devices

It is now possible to equip just about any electronic sensing device with a wireless network interface such that the entire electronic package, including power source, is no larger than your thumb. These include chemical sensors that can alert people working in manufacturing plants of hazardous chemical spills, for example, or biosensors that can alert communities when a toxic airborne virus is released into the atmosphere by terrorists, or bracelets on your infant used to monitor body temperature. These interfaces can be wirelessly networked together to form an invisible sensory "mesh." The list of potential applications for these highly discreet but powerful sensory networks is nearly endless. Because the sensors themselves transmit their data over wireless networks, they are much easier and quicker to deploy than their wired counterparts and, therefore, will become far more pervasive.

We examine many such devices throughout a wide variety of industries. The point to Inescapable Data is this: We are entering an age where just about everything (and everyone) will be emitting data and forming ad-hoc data networks. Together, we will discover values in intertwining different data sources and trending and analyzing these new streams.

Enabling Pervasive Networking

The next element in the Inescapable Data world is pervasive networking. "If I asked my kids today what is Token Ring, they'd first look at me queerly and then cite some reference to a Hollywood movie about forest battles," says Robert LeBlanc, GM of IBM's Tivoli software division. "In what seems like overnight to me, we've gone from a business world that had very unique machinery and intermachinery connections to one whose foundation networking technologies are the same as we now use everyday in our own homes."

This comment came up in the middle of a conversation about the evolution of computer networking. LeBlanc was referring to the old IBM local area network (LAN) protocol that was prevalent during the late 1980s and 1990s. In fact, many other protocols also existed, such as AppleTalk, thin- and thick-wire Ethernet, and some other specialty types. In the early days of networking, there were many vendor-specific networking devices because, by and large, companies settled on a single vendor for the majority of their computing needs. As the mid and late 1990s rolled around, interoperability became paramount, and the world settled on Ethernet as the standard machine-to-machine network.

In the early years of this new century, communication chip speeds greatly increased, costs fell, and building devices around communication chips simplified; therefore, Ethernet-enabled devices proliferated. At the same time, a couple of other trends were taking place. Broadband connections (cable and DSL) to the home became prevalent. In addition, the appearance of the sub-$1,000 PCs made it possible, even desirable, to have more than one PC in the home. To receive broadband in the home, a special device is needed (to adopt the broadband protocol). It was trivial for manufacturers to add the chip set that allowed that device to also be a "networking hub," which enabled users to attach multiple computers to the same broadband connection. (Note that Microsoft did its part and finally made small area networking possible.) The home network was born (long after predicted), and made possible by the simple fact that the networking technology already in use by businesses was the same technology needed in the home. In fact, the mass market for networking gear created by home use brought the cost of networking gear down dramatically for home and business users alike.

Early on, home-based Ethernet networking (i.e., networking with physical wires) would only capture the interest of the techno-savvy. Thankfully, at the exact same time that broadband was entering more and more homes, wireless Ethernet technology (networking without physical wires) was turning a corner. Wireless Ethernet had been around for more than a decade, but had never taken hold; in fact, many of the companies that had painstakingly pioneered the technology went out of business. Why?

Prior to the early 2000s, the business desktop world was dominated by machines that were fixed to one spot in the office. The need for wireless computing was not acute. Soon enough, however, laptops became the dominant business PC platform. Laptops virtually scream *mobility*—take me with you wherever you go. As business laptop users exploited computing mobility, the need for wireless connectivity soared, which drove the prices down and the performance up. (Before this, wireless speeds were too slow for business users.)

However, as inexpensive as 802.11b (wireless Ethernet) has now become, it is not suitable for mass deployment into devices smaller than computers because of its size, power, and cost. We are increasingly a society that needs to have everything interconnected, and we are learning to hate anything wired. We expect our home phones to be cordless. We want the ear buds for our MP3 players to connect to our hip-side devices without dangles. We have tasted the freedom 802.11b gave, and we cherish the connectivity. Enter Bluetooth.

Bluetooth is a short-range wireless networking communication method that boasts low costs and low power consumption as its main features, enabling just about anything that runs on electricity (even tiny battery electricity) to communicate with something else (as long it is only a few feet away). The magic of Bluetooth is that any and every device that has even a wisp of electricity, from an ear bud to a toaster to a flat-panel display, will now have some type of wireless communication interface. As wireless communication needs and capabilities grow, a networking hierarchy will fall out of the process that will extend the tentacles of the Inescapable Data network to many of the most commonly used electrified devices in our lives. Computers within our living spaces will be connected to the Internet via broadband. In turn, our computers will communicate via Ethernet (wired and/or wireless or Bluetooth types of technology) with our refrigerators, ovens, air-conditioning systems—any electrified device or appliance.

It is both interesting and important that the general tools and technologies used throughout office buildings are now the same as those used in our own homes. This enables an acceleration of technology use. Similar to how we all instinctively know how to drive a car on any road in any city, we now all know how to live and work in any modern location. LeBlanc added, "My kids come into the office here and walk the hallways. They see an occasional Ethernet wire and a smattering of wireless hubs on the ceilings and walls, ultimately leading to the Internet, which is where they work and play, as do we. Do you see? The home and business worlds have blurred."

Question: In a world where everything is a source of data connected to a vast network with global reach, is it realistic to expect any really useful exchange of data between all these very different devices? And will information then rise to the surface of these oceans of data? If history has shown us anything in the computer world, useful information exchange has always been challenging, if not elusive, between disparate machines. XML, discussed next, holds at least part of the solution.

XML...Describing It All

The data communication world has seen so many challenges over the decades that it is difficult to point out any single one as the most troublesome. If we were to choose one, however, it would be a lack of interoperability between devices, characterized by dissimilar computing machinery, incompatible wiring types and protocols, and dissimilar data protocols. Luckily, the computing world has now embraced the notion that nonproprietary standards for physical networking are good and that we all win when devices talk to each other no matter what they do or who made them. Even if new networking technologies come forward, the people designing and building the gear are now more willing to work together to standardize on their interface than ever before. But what about the actual data being exchanged?

The last element in the Inescapable Data world is intelligent and simple information exchange by using self-describing data techniques.

Until fairly recently, storing, processing, and managing large amounts of data was expensive. It was expensive to store on disk, expensive to move through networks, and expensive to process. In the early 2000s, we saw a dramatic drop in the cost of data storage because disk-drive manufacturers could double the capacity of a single drive without substantially increasing the cost to manufacture that drive. (Laptops, a case in point, will soon be sold with 1 terabyte—1,000 gigabyte—disks). We similarly saw networking performance go from 10 megabits per second to 100 to 1,000 and now 10,000 megabits per second with no increase in device cost. Of course, CPU processing power has followed Moore's law all the while (doubling every 18 months) without doubling in cost. We think that these advances, when combined, have enabled something magical to occur: We can now be more "verbose" in our data usage. We have the processing power, the data storage, and the network bandwidth to actually *describe* data as it is used and transferred. This capability would have been unheard of prior to the dawn of the twenty-first century.

So what does it mean to describe data? Typically, data in a computer is stored in binary form and stored in its most compact state. The numeral 5, for example, might be stored in as few as 8 bits (1 byte). With such a tight format, there is little room left to include information to tell what that 5 might actually represent. Does it mean 5 dollars? Five cents? Is it what your balance due is, or the cost of a particular item?

For years, computer systems could easily talk to each other electrically (via Ethernet) but labored to exchange meaningful information. It took teams of well-trained people to write special software that could decompose business databases created for a single use into data that could be used in other contexts and by other software applications. To some extent, this was acceptable because business systems were fairly customized to a particular business or business process. However, the Web dissolved business barriers and created a need for business information exchange. All of a sudden, the need to exchange information between millions of computers materialized, almost overnight.

At the inception of the Web, people first thought that the Web would be so vast that we would need special sites just to collect other sites and help us navigate through the maze. History has often taught us that hierarchical organizations are what we deploy to solve problems of complexity. Look, for example, at your local library—painstakingly, every book is cross-referenced in three directions and stored in a massive index. Hierarchical and index solutions work as an organizational tool for large data sets, but fail for massive ones—such as the Web—which need ad-hoc and quasi relationships.

The Web dictated that to display information, you had to first format it in a simple text-describing nomenclature called Hypertext Markup Language (HTML). A Web page is a collection of text and pictures with various formatting information. Unlike databases, the language of the formatting is human readable and human understandable. For example, a Web page may have such statements as <Title>This is my title</Title><Body>This is the main text area</Body>, where <Title> and <Body> are known as tags.

HTML represents a special kind of magic—a blending of human and machine intelligence. Web "pages" written in HTML are readable by machines and humans alike. As such, it is simple to create search tools that just run around surfing the Web much like we do, but they can read and index the content they find far faster and present it back to us in human-readable form. As an added bonus, they do so continuously without breaks for meals, sleep, or days off from work. Every Web page contains vast amounts of associated information, such as the author, the hosting company site, adjacent pages, pages it references, and pages that reference it. Google and other search engines use all this plus the embedded "tag" information to provide a detailed inventory of this massive resource.

All this leads us to eXtensible Markup Language (XML), which is much like the Web language HTML. Documents are not binary; instead, they are human-readable text, and every element is encapsulated within human-readable tags. We might have a brief XML document such as the following:

```
<CustomerRecord>
 <ItemPurchased>
 <ItemType> Shoes </ItemType>
 <ItemPrice> 5.00 </ItemPrice>
</ItemPurchased>
<ItemPurchased>
 <ItemType> Toys </ItemType>
 <ItemPrice> 3.45 </ItemPrice>
</ItemPurchased>
</CustomerRecord>
```

XML formatting allows proprietary databases and records to now have a nearly universal method for describing their contents. The binary representation of 5.00 from our example is now clearly a price, and the price of a specific type of shoe. You do not need to be a sophisticated programmer who understands how to read a "schema" document or how to encode SQL statements to make sense of XML statements. Your 13-year-old could happen upon such an XML fragment and derive some value from it. He or she could likely import it into a favorite spreadsheet package and sort or average or trend it with a few keystrokes. We refer to this capability often in later chapters.

Suppose, for example, that airline landing data was available nationwide in XML format (listing the airline, flight number, time of arrival, arrival airport, and so forth). A college student in Ludwig, Texas, with an interest in statistics and the correlation of flights to weather to economic conditions could, without ever writing any specialty software, correlate massive tables of flight data and massive tables of weather data along with published economic data from the Federal Reserve, all without changing out of his or her pajamas. Using some macros in an Excel spreadsheet and some cross-tabulation tricks, the student might tease out a relationship that was somewhat counterintuitive. This "tidbit" then becomes a tool for investment transactions or a tip back to an airline for an efficiency-consulting arrangement.

Note that this brief XML document is perhaps 100 times thicker (data-wise) than a simple 5, and therefore has a comparatively huge impact on the amount of disk space required to store the document and the bandwidth required to send it from one computer to another, not to mention the processing power needed to translate the human-readable statements into machine-readable form, and back again. This is why XML was not practical until available networking bandwidth, CPU horsepower, and storage densities hit their current levels.

Business back ends are now XML crazy. Any information that needs to be expressed to another computer system is now expressed in some XML format. (Data might still be stored in databases in a more native format, but we predict that these formats will eventually disappear.) Most significantly, XML enables far higher business-to-business cooperation squarely aligned with the Web's chief goal: information exchange (as opposed to data exchange). XML has been wholeheartedly embraced by business and is allowing for significant efficiency gains and better customer experiences. We are now finding XML reaching into the consumer world and our homes for many of the same values. To the Inescapable Data world, XML is the magic glue that allows all the vast sources of data and internetworking to now have real value through information sharing.

Summary: The Final Blend of Ingredients

So what does this all mean? We believe that without any significant investment, and little specialized training, virtually anyone will be able to interconnect pieces of data—data, created by prolific devices connected to us, over broadband and wireless interconnections—at blazing speeds. The data we collect in aggregate can be transformed—sometimes in real time—into information that yields new levels of business or personal value. This is the essence of Inescapable Data.

The key ingredients of Inescapable Data are communications, wireless networks, data, and data descriptions. The power of Inescapable Data is that both people and organizations with similarly scant resources can knit together divergent sources of information that yield new, highly valued capabilities, and create new sources of information that were once only available to those blessed with very large computing facilities, data archives, and specialized skills. Because we *can* interconnect data now, we *will*, and we will do so more and more in the future.

The Inescapable Data vision we seek to verify says that when a technology is good for both businesses and consumers alike, there results an exponential growth in the use of that technology as well as additional knowledge gains that were not previously anticipated, all driven by the massive ubiquity of data-producing devices. In this chapter, we brought the foundations of Inescapable Data together. Imagine every device in your home equipped with some amount of wireless connectivity, including your desk and chairs—with every device being able to emit information in XML format. Imagine every business machine and home appliance able to accept instructions and commands via human- understandable text XML, wirelessly. Imagine your supplier's inventory available (through a secure gateway, of course) in XML format, as are your MasterCard charges for the past 10 years. This represents massive amounts of data (some real time, some historical), and all physically (wirelessly) interconnected. Most importantly, however, all this data can be intelligently exchanged as "information" (rather than just raw data). We now ask whether this massive interconnectivity will usher in unprecedented and unforeseen efficiencies in our lives.

Let's explore.