

HOME AWARENESS

Delivering Value with Digital Convergence in the Home

Harbor Research was recently given the opportunity to examine prototypes of HomeHeartbeat™, a new smart-home platform from Eaton that takes a refreshingly “pervasive” perspective on home technology. HomeHeartbeat™ sidesteps the current market’s noise, clutter, and entertainment obsession by viewing core homeowner concerns as a single challenge that can be addressed by a single, scaleable solution. In so doing, Eaton has defined a new market meta-category and underscored the crucial importance of first-mover advantages in a networked world.

A HARBOR WHITE PAPER

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The term “convergence” implies unification, but you wouldn’t know it from today’s home technology market—a fragmented landscape full of narrow point-solutions, time-sink gadgetry, entertainment obsession, and software/platform incompatibility. Amid all the noise and clutter, a forthcoming smart-home platform from Eaton finally takes a “pervasive” approach to digital tools in the dwelling. HomeHeartbeat™ enables consumers to add simple, unobtrusive remote monitoring to ordinary household devices and systems. It treats all homeowner concerns—from comfort and convenience to safety and security—as a single problem that can be addressed by a single, scalable solution. In taking this perspective, Eaton has defined a new market meta-category with vast potential: Home Awareness.



Eaton's HomeHeartbeat™ base station with key-fob system monitor docked onto it.

Courtesy of Residential Products Division, Eaton's electrical business

THE FUTURE THAT NEVER HAPPENED

Visions of the “Home of the Future” have been in abundant supply for decades now. Buckminster Fuller, the famous creator of the geodesic dome (among many other things), was writing about the house as a “machine for living” as early as the 1930s. The “automated home” has been the dwelling place of futurist fiction characters since at least the 1950s, the subject of blueprints and schematics in *Popular Mechanics* and *Popular Electronics*, and a feature attraction at the 1964 World’s Fair in New York City, where visitors were transported through the “Home of Tomorrow” complete with domestic robotics and the perennially imminent videophone.

Since the 1964 World’s Fair, waves of promises about the “connected home,” the “networked home,” and “the digital home” have emerged every few years. The soft-

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ware industry has a term for such promises: vaporware. In the typical American home, products and systems are no more connected today than they were in 1964.

WE'VE HAD A LONG HISTORY OF RESIDENTIAL FUTURISM. UNTIL NOW, ALMOST NOTHING REAL HAS COME OF IT.

Consumers consequently now view the "intelligent home" as a mere merchandising slogan for bewildering and useless capabilities such as having your toaster talk to your microwave—capabilities that often turn out not to be real anyway. For consumer product companies, the phrase "home automation" has become so discredited that it now provokes fear and loathing rather than visions of glorious innovation.

Yes, we've had a long history of residential futurism. But to date, almost nothing of real significance has come of it—except a lot of naysaying and ridicule.

EATON HOMEHEARTBEAT™: HOME NETWORKING THAT WORKS

This white paper is about a fundamentally different way of approaching home technology: the pervasive way. It was provoked by a forthcoming smart-home product from Eaton's residential electrical business that Harbor Research recently had the opportunity to examine in prototype.

HomeHeartbeat™ is a low-bandwidth, machine-to-machine (M2M) platform that defines the market for scaleable, add-on device monitoring in the home.

What preys upon homeowners' peace of mind? What aspects of their home environment do they really worry about? What technology would they embrace if it could ease those worries? These are the issues that drove the development of Eaton's new product.

HomeHeartbeat™ is not about technological drama or "futurism." It's about matching feasible technology to real consumer needs.



One version of a typical HomeHeartbeat™ system: Base station with key-fob monitor and wireless modules for electrical on/off, window or door open/closed, water, and smoke/carbon monoxide.

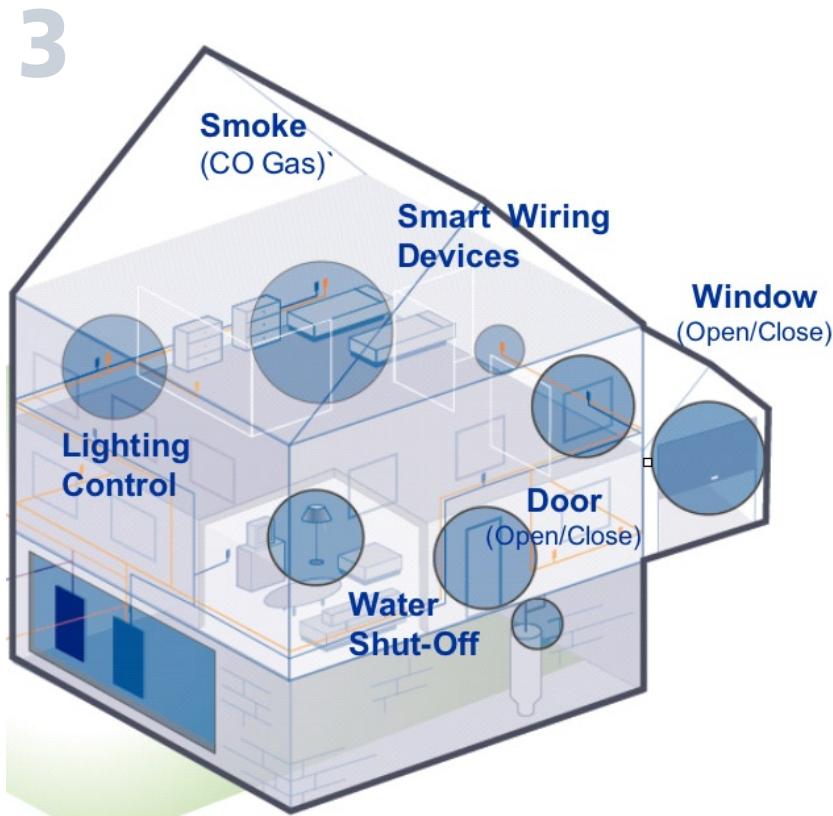
Courtesy of Residential Products Division, Eaton's electrical business

TECHNOLOGY LOVES ATTENTION

Some things that look easy turn out to be hard. That's part of the strange saga of the networked-home-that never-happened. But some things that should be kept simple are allowed to get unnecessarily complex, and that's the other part of the story.

The drive to develop technology can inspire grandiose visions that make simple think-





Typical locations and functions of HomeHeartbeat™ sensors in the home.

Courtesy of Residential Products Division, Eaton's electrical business

Telephony customers would be better served by something like “unified messaging” (we still don’t have it), whereby all communications intended for an individual—voice, text, facsimile, audio, pictures, or mixed media—could be managed by a single, seamless interface to the network. That’s decidedly less “sexy” than a videophone, but it offers a much higher intrinsic value to the consumer.

**THE SMART HOME IS
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THAN IT WAS IN 1964.**

Over the decades, the seductive images of the “home of tomorrow” have become part of public mythology. The “smart home” has to be a dwelling that “does things for you” in dramatic, futuristic ways. And so, for the last 40 years, the smart home has been expected to run before it ever learned to crawl. Not surprisingly, it has failed to meet that expectation.

HERE WE GO AGAIN

Now that always-on broadband Internet connections and short-range wireless LANs and PANs are common, the smart home is once again a hot topic. The underlying thinking, however, is not much different than it was in 1964.

Today’s discussions of next-generation home networking focus almost exclusively on the intrusive, resource-intensive, human-centric possibilities—in other words, on things that look good in marketing campaigns. The most popular current visions are all about media and entertainment, including

ing seem somehow embarrassing or not worthwhile. That’s understandable in science fiction or in the futuristic exhibits of a World’s Fair. But it’s not a good thing when defining real-world technology standards or delivering actual value in marketed products.

Good product development should always spring from genuine empathy with consumer needs, not merely from a desire to create new markets.

That persistent icon of the future called the videophone, for example, is not a real consumer need; it’s a technologist’s quest.

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video-on-demand, video-chat, voice-over-IP, and wirelessly integrated home theater.

Such things are perfectly valid high-bandwidth applications, and they will develop as network infrastructure evolves to support them. But focusing on them today as first-order business amounts to grabbing the wrong end of the technological stick. They steal the limelight and eclipse equally important possibilities that do not require intense network resources and bandwidth.

M2M, NOT ENTERTAINMENT, IS THE NEXT ERA OF HOME TECHNOLOGY

For pervasive computing applications, the significant feature of broadband connections is not their bandwidth (they require very little) but their “always-on” characteristic. The significant feature of the applications is not their gee-whiz factor (such as streaming high-definition video over the Internet) but precisely the opposite: the great convenience and service offered by their near-invisibility.

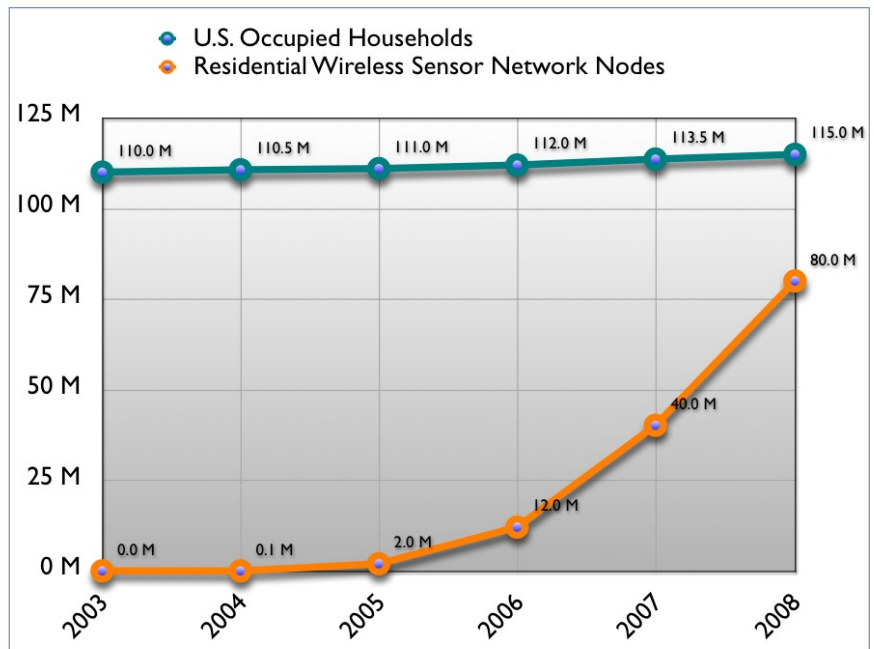
With a wireless LAN in the home, virtually any electronic product can automatically send a periodic signal about its status, with no human intervention or understanding needed. This may not be a dramatic application of intelligence and connectivity, but it is indisputably a highly useful one.

In the long run, such “invisible” machine-to-machine (M2M) applications will be much more important to business—and to the evolution of civilization—than dramatic and intrusive services that require human attention to deliver full value.

Much future M2M activity will depend upon manufacturers outfitting their products with intelligence and connectivity in order to drive growth with new services, and to achieve new levels of customer service and retention. This OEM activity has begun, and will increase exponentially during this decade.

IT'S UNDERSTANDABLY DIFFICULT FOR MANUFACTURERS TO ACCEPT THE IDEA THAT “INVISIBILITY” MIGHT BE A PRODUCT'S GREATEST VIRTUE.

This will often mean de-emphasizing products per se. That's an understandably difficult thing for product companies



The installation of wireless sensor nodes in U.S. homes will increase dramatically. In the case of HomeHeartbeat™, each of the product's wireless sensing modules would be considered a “node.”

Source: Harbor Research, Inc. & U.S. Census Bureau



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to do. After all, if they aren't selling material objects full of features that buyers touch and interact with and admire physically, then what are they selling?



The HomeHeartbeat™ key-fob. It slides onto the base station to be configured, and onto the sensing modules to configure them, acting as a tear-off display. On its own, the fob is the Interface to all system sensors—the remote dashboard of the home.

Courtesy of Residential Products Division, Eaton's electrical business

MANY PRODUCTS OF THE FUTURE WILL ACTUALLY BE PORTALS INTO NEXT-GENERATION SERVICES.

The short answer is that they will be selling elegant and unobtrusive—sometimes even invisible—portals into networked services. Before the end of this decade, many manufacturers will use smart, networked products to drive enormous growth with next-generation services. The details of how they will do this is beyond the scope of this paper, though it is a core focus at Harbor Research.

“PEACE OF MIND” TECHNOLOGY

As we've said, HomeHeartbeat™ is an excellent example of the valuable applications of M2M that can be imple-

mented now, even without the re-design of existing products and services. In the home market, this possibility offers both immediate and future opportunity.

Eaton describes the product and its capabilities as “Home Awareness.” Another term might simply be “Peace of Mind technology.”

HomeHeartbeat™ is not home security or home automation, although it delivers many of the benefits of both. What makes it different?

A typical “home automation” scenario goes something like this:

- X You walk into your home. Your home recognizes that it's you, and begins to activate the preferences you have on file for this time of day. It lowers the window blinds, turns on certain lights, dims those lights, turns on the TV, switches the TV to a certain channel, mutes the telephone, and adjusts the climate system to your liking.

Sounds a bit like the 1964 World's Fair, doesn't it? Such home automation scenarios place technologists' dreams before the genuine and fulfillable needs of consumers.

Typical home automation is not about peace of mind; it's about gadgetry and control. Various quasi-standards and connection protocols have been available for years. You can buy kits at the big-box retailers and online. If you haven't heard about most of these products, it may be because you have a life to lead. The statistics on home automation success and satisfaction are even more dismal than those for programming a VCR.

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WHAT DOES THE “AWARE” HOME LOOK LIKE? IT LOOKS LIKE A HOME. “PEACE OF MIND” TECHNOLOGY IS ESSENTIALLY INVISIBLE— AS IT SHOULD BE.

Here are two Home Awareness scenarios:

- ✓ You walk into your home. It looks just the way your home always looks. Nothing happens because nothing is wrong.
- ✓ You leave your home. It’s wintertime and you’ve been running an electric space heater in your home office. Halfway to the supermarket, you cannot remember if you turned the heater off. But a sensor that you’ve added to the space heater has been programmed to send a text message if the heater is on when you are not there. You check your mobile phone: there is no message from the space heater. It is, in fact, turned off.

HOME AWARENESS SHOULD BE SIMPLE AND SEAMLESS

Well-designed “Peace of Mind” technology for the home should:

- ▶ Be inexpensive, wireless, and easy to install.
- ▶ Be easy, intuitive, and pleasurable to use (excellent interface and industrial design).
- ▶ Add adequate “smartness” to existing home appliances and systems without a wasteful, bewildering array of features.

- ▶ Be modular and easy to extend throughout the home over time.
- ▶ Be extensible (new sensors work with the existing system, preserving buyer investment).
- ▶ Offer varying degrees of remote control where desired (such as activating a water shut-off in the event of a leak).
- ▶ Deliver value without third-party monitoring fees (but can inform third parties if desired).
- ▶ Deliver value transparently, in the background, without requiring full owner attention.

HOW HOME AWARENESS WORKS

Home Awareness is “the connected home” done right. It uses seamless computing and communications to provide painless peace of mind about the most valuable thing that most people own.

HOME AWARENESS USES SIMPLE COMPUTING AND COMMUNICATIONS TO ACHIEVE PAINLESS PEACE OF MIND.

Home Awareness is not gadgetry; most of the time, you don’t even know it’s there. It offers only features you really need because it’s designed for what people really care about. It lets you decide how to apply those features. It lets you, not product manufacturers, decide how much of it you want. And it lets you do it right now.



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IT MAKES SENSE TO ADD NETWORKING TO MANY HOME DEVICES BY USING A SINGLE SYSTEM AND INTERFACE. EATON SAW THIS OPPORTUNITY.

No manufacturer offers a remotely monitorable space heater and we're not recommending it. There's little incentive to do so because a product like a space heater will not become a portal into a widening array of services. There's even less in it for the consumer. What happens when you also want remote awareness of your electric garage door, your stove, your hot water heater, a hot halogen floor lamp, or burst pipes in your basement? Would you want separate connections and propri-



One example of the retail packaging of HomeHeartbeat™.
Courtesy of Residential Products Division, Eaton's electrical business

etary interfaces for all these things? How many user manuals do you want to read?

It makes great sense to add intelligence and networking to most ordinary products after the fact, with a single system and interface.

How do you make something like a space heater "aware"? A small, inexpensive sensing and communicating module is plugged into the wall outlet, and the space heater is plugged into that. The sensor, which detects whether or not the heater is drawing power, communicates its state to a wireless base station in the home, which in turn communicates with the user via low-cost text messaging to a mobile phone, pager, or other device, or via email.

STRATEGIC ALLIANCES AND GREAT DESIGN

Creative, far-sighted business alliances and partnerships will be one of the most important factors in the creation and acceptance of device networking solutions. To create HomeHeartbeat™, Eaton partnered with two pioneers: MAYA Design, Inc. of Pittsburgh for the industrial design and software, and Ember Corporation of Boston for the wireless connectivity.

THE RIGHT BUSINESS ALLIANCES WILL BE CRITICAL TO THE CREATION AND ACCEPTANCE OF DEVICE NETWORKING SOLUTIONS.

The "face" of HomeHeartbeat™ takes the form of a key-fob—an object to which you attach your keys. Sticking with the metaphor, the HomeHeartbeat™ fob resembles an oversized electronic key. The beauty of its design suggests that Eaton and MAYA

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took a page from the book of Apple Computer: Many consumers will find the key-fob reminiscent of Apple's iPod™.

Like the latest iPods™, the HomeHeartbeat™ key-fob has only one control: a scrollable, clickable wheel-button. You hold the key-fob in one hand and operate it with one thumb. You can easily scroll through all the sensors on your HomeHeartbeat™ network in seconds.

CONSUMERS WILL FIND THE HOMEHEARTBEAT™ KEY-FOB REMINISCENT OF APPLE'S IPOD™.

The key-fob's most inspired feature is that it acts as a "tear-off" display for programming the system's base station and sensing modules, and for checking status when the fob is within range of the HomeHeartbeat™ mesh-network. Slide the fob onto the base station and it becomes the display for configuring the overall system. Slide it onto any of the sensing modules and it becomes the display for configuring that module.

AC-powered sensors—like the one for electrical on/off—are always on and extend the range of the base station and key-fob. Battery-powered sensors remain in "drowse" mode until needed, to prolong battery life, which is projected to be three to five years.

Eaton and MAYA knew that consumer expectations for a product like this would be very high, so they paid great attention to design. Are you left-handed, or have you installed any sensing module so that only its left side is accessible? Slide the key-fob onto the left side of the base station or any sensor, rather

than the right side, and the display automatically flips to create a left-handed fob.

DELIVERING VALUE AND PROTECTING INVESTMENT

In their consumer research, Eaton and MAYA found that homeowners cared most about dangerous system failures such as ruptured water heaters, gas leaks, and the presence of smoke. Second on the list was concern about family members. Is a child who should be doing homework watching TV? Is a memory-impaired parent using the stove? Is a pet out of food or water?

With the exception of potentially catastrophic events such as smoke or water leaks, remote *awareness* mattered more than remote *control* to surveyed homeowners. As a result of this research, most sensors in the initial release of HomeHeartbeat™—electrical on/off, window or door open/closed, smoke/carbon monoxide, and timed reminder—are designed for awareness, not control.

SURVEYED HOMEOWNERS CARED MORE ABOUT AWARENESS THAN CONTROL.

Even the first shipments of HomeHeartbeat™, however, will also include a mechanism that shuts off the water supply if a leak is detected—a welcome "peace of mind" boost as well as a demonstration that significant control is possible.

Eaton's first-mover advantage in Home Awareness is notably strengthened by the flexibility of HomeHeartbeat™. The system delivers real value today, but it was also conceived as a foundation for rapid development of new functionality. Eaton



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intends to have the evolution of HomeHeartbeat™ driven by consumer demand, not by internal top-down decisions.

Future enhancements of HomeHeartbeat™ will offer, among other things, more kinds of sensors and remote control, based upon consumer studies. All additional functionality will be modular and backwardly compatible with the existing base station and key-fob.

About the ZigBee™ Alliance

An industry consortium devoted to wireless sensing solutions, the ZigBee™ Alliance is developing the technical specification of ZigBee™ (IEEE 801.15.4) itself, as well as promoting understanding of the opportunities that the technology will enable.

The Alliance has quickly grown to include over 90 member companies. Core members include Ember, Invensys, Motorola, Samsung, Honeywell, Mitsubishi Electric, and Philips. Among the participating members are Analog Devices, Chipcon, Crossbow, Siemens, and many others, including Eaton itself.

More information on the ZigBee™ Alliance may be found at www.zigbee.org.

ZIGBEE™ WIRELESS NETWORKING

Eaton's HomeHeartbeat™ comes ready for the new ZigBee™ (IEEE 802.15.4) wireless networking standard. ZigBee™ is the low-power, device-oriented cousin of Wi-Fi® (IEEE 802.11) and Bluetooth. Wi-Fi connects laptops and PDAs with a lot of bandwidth. Bluetooth provides moderate bandwidth for connecting devices such as keyboards, mice, game controllers and cell phones to computers and game consoles. In contrast, ZigBee™—which may well prove to be the missing piece of the wireless device networking puzzle—connects small, embedded sensors and transmitters that don't need much bandwidth, but that do need long battery life,

built-in network security, and scalability.

Technically, a product like HomeHeartbeat™ would have been possible without ZigBee™, and indeed, previous generations of home networking products have used other—largely non-standard—protocols.

However, ZigBee™ is a major advance over earlier approaches to wireless device networking and will be a crucial enabler throughout this decade, not only in the home, but in many other markets as well.

ZIGBEE™ MAY WELL PROVE TO BE THE MISSING PIECE OF THE WIRELESS DEVICE NETWORKING PUZZLE.

Ember Corporation, creator of the RF chip at the heart of HomeHeartbeat™, holds a seat on the ZigBee™ Alliance board, where the new standard is being designed and finalized. Though Eaton will begin shipping HomeHeartbeat™ before the ZigBee™ specification is finalized and published, the Ember partnership ensures that Eaton's home awareness platform will be fully ZigBee™ compliant.

GETTING THERE FIRST

In this decade, networked smart devices will transform public and private life more than any computing development since the PC. But many companies find it difficult to envision the impact, and they are reluctant to embrace an embryonic development in the face of technological and competitive uncertainties. Even companies that understand M2M, and know that it will radically change their business models, are waiting for the phenomenon to "shake out" or "get safe."

FOR TECHNOLOGY ADOPTERS, THE RISK OF "STANDING PAT" IS NOW GREATER THAN THE RISK OF TAKING ACTION.

This posture is a major mistake. We believe that the risk of staying out is now

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greater than the risk of getting in. Networking changes everything, and the first-mover advantages in many markets will be close to incalculable.

Once device networking begins to be adopted in a market, it will create significant barriers to vendor-switching because suppliers will become deeply involved in adopter operations and new business models, and adopters will become deeply involved in their customers' lives throughout the product life-cycle. While we don't believe there will be a Microsoft of pervasive computing, we do believe that early action will obstruct entry by the laggards and will enable companies to effectively own pieces of markets.

THE OPPORTUNITIES CREATED BY NETWORKED SMART DEVICES WILL DWARF THOSE OF THE HUMAN-CENTRIC PC ERA.

In a volatile environment of rapidly evolving technologies and opportunities, strong leadership will require having the vision and courage to act in defining new markets and models.

Eaton has long held a prominent position in the residential electrical market, but the company's existing products are most often found in the utility room or the basement. With HomeHeartbeat™, Eaton makes a powerful bid to move from the utility room to the living room. HomeHeartbeat™ is Eaton's new beachhead in the home, and we see no significant corresponding activity by the company's direct competitors.

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Another view of the HomeHeartbeat™ key-fob.

Courtesy of Residential Products Division, t

About Harbor Research, Inc.

Founded in 1983, Harbor Research Inc. has more than twenty years of experience in providing strategic consulting and research services that enable our clients to understand and capitalize on emergent and disruptive opportunities in high technology.

The firm has established a unique competence in developing business strategy for the convergence of pervasive computing and global networking.

Harbor's clients are leaders in communications, computing, control, and content.



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