



Fish and chips >

By Glover T. Ferguson

Using microprocessors and sensors to make ordinary objects both intelligent and interactive, silent commerce opens up business opportunities and the possibility of new business models.



When the subject is e-commerce, the talk is likely to be about, well, *talk*—about how people communicate. That might mean using computers or PDAs or mobile phones. Whatever the means of communication, a person is doing the communicating.

But now another form of communication is quietly taking hold. This time objects are doing the talking—to people and even to other objects. This is the basis of the *silent commerce* that takes place without human intervention. By making objects of all sorts both intelligent and interactive, silent commerce opens up business opportunities and the possibility of new business models.

Is this just another channel? Not at all. Silent commerce is a key aspect of the larger phenomenon we call u-commerce—commerce that is ubiquitous, untethered by hard wires and unbounded by traditional definitions of commercial exchange (see “Cutting loose,” *Outlook*, January 2001). U-commerce encompasses the entire flow of information between a business and its employees, supply chain partners and customers, as well as all the objects and components that are involved in that flow. It’s about the “always on, always aware” exchange of information.

Of course, people aren’t always on the job or aware of everything going on around them. But “smart” objects that have been embedded with microprocessors and sensors can be. Indeed, almost any tangible item can provide a wealth of information, have a unique, verifiable identity, and sense and respond to needs within context, around the clock. Smart objects, in other words, can communicate and then take action based on the information that’s communicated.

Imagine what this could mean for your business.

- Need to manage a complex inventory or an extended supply chain? Imagine that you could track each individual item, ensuring it is in the right place or being deployed most efficiently.
- Responsible for sensitive materials? Consider the value of being able to precisely locate every canister of hazardous material, every vital or confidential file.
- Concerned about safety? What if you had the technology to verify that your employees are properly trained and equipped before starting a complex job?
- Worried about counterfeiting or shrinkage? Smart devices exist that can authenticate your product with 100 percent accuracy and protect against its diversion or misuse.
- Want to enhance revenues? You can create a new service or product feature that makes life more convenient for your customers or helps them do their jobs better.
- Want to get or maintain a competitive advantage? Silent commerce can help you leapfrog competitors by using a new business model.

Here’s how it works. A radio frequency identification device (RFID) can be attached to or embedded into almost any object at any time. This tag can link to a wealth of information about the product, including where and how it was made. These tags could replace the relatively crude bar-coding system in use today, since every item would have a unique identity, and information could be shared without needing a line of sight to scan the contents.

(For a more detailed description, see sidebar, page 31.)

When you combine RFIDs with microsensors or microelectromechanical systems (MEMS) that can actively sense, record and transmit information about an object, you make it possible to confirm the conditions under which an object has been handled or stored. So you can tell whether the fish is fresh, the beer has ever been warmed or the equipment has been exposed to moisture.

It's only a small leap to imagine these smart objects everywhere, actively transmitting data, recording and responding to the environment, even taking action on their own. Homes, offices and factories could be monitored remotely or programmed to make changes as needed or desired. Major appliances and manufacturing equipment—even your family car—could schedule their own maintenance or call for repairs before they actually break down.

Smaller, smarter, cheaper

Smart tags and sensors per se are nothing new. RFIDs have been around since World War II, and sensors even longer. So why is silent commerce taking off now?

For one thing, the technology is advancing, which means that smart tags and sensors are capable of doing more than ever before. RFIDs and MEMS are becoming smaller and more sophisticated. Access to technologies such as the Global Positioning System make it possible to locate and track smart objects. The advent of the Internet and cellular communication can put these objects in continuous communication.

In addition, the demand is growing. Enterprise resource planning and supply chain systems have matured,

making it possible at last to use information generated by RFID readers to manage and improve operations. And as supply chain partners become better integrated, the requirements for greater product and supply chain information increase.

Finally, costs are falling. A simple RFID, for example, now costs only about 50 cents, and that price is expected to drop to pennies in a few years. MEMS and sensors are also coming down in price. As the cost of a device declines relative to the cost of an object, smart-tagging becomes economically feasible for more and more products.

So the sky is the limit? Yes—but not quite yet. Some of the more spectacular or sweeping applications of silent commerce technology—like being able to roll your cart out of the grocery store without stopping to pay—will not be fully possible until there are broadly accepted standards and a more extensive global infrastructure in place.

Nevertheless, real value is possible today, particularly through so-called four-wall applications that can be implemented within a given department or company. Several companies are already reaping gains in a number of areas.

Improving operational efficiency

Consider Star City Casino, a fixture on the nightlife scene in Sydney, Australia. Star City includes a round-the-clock gaming floor, a theater, a showroom, a nightclub, more than 350 guest rooms, plus related support facilities. Managing its inventory of some 80,000 themed uniforms was a major logistical challenge.

Working with Accenture, Star City designed a first-ever wardrobe control system. By embedding smart tags in the waistband, shirttail or collar of each

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In Barcelona, trashcans are embedded with tiny chips that communicate how full the can is; sanitation workers stop only for cans that need to be emptied, saving time and money.

uniform, the casino can track each garment from point of issue through the laundry process and back to the wearer. The result is fewer lost garments, reduced labor costs and lower cleaning bills—plus the assurance that each garment will be in the right place and ready to wear at each shift change.

A number of major retailers have already begun using silent commerce technology to control the flow of products along their supply or delivery chains. Procter & Gamble is testing RFID technology to replace bar codes for tracking goods, with remarkable early results: The company achieved 99.8 percent accuracy in tracking and was able to scan the contents of a carton in the same few seconds it normally takes to scan a single bar-coded item. Gap, a US manufacturer and retailer of leisure clothing, is attaching intelligent tags to garments during their manufacture so that the company can obtain dynamic information about each item all along the supply chain.

Airlines, too, have discovered the virtue of smart tags, which they are using to manage the flow of baggage and cargo. In 1999 British Airways, in conjunction with Philips Semiconductors, tested smart tags sandwiched inside baggage tags, which could be scanned several at a time from a few feet away. The system speeded baggage handling, reduced lost luggage and ensured that each checked bag was matched with an on-board passenger. Airports such as San Francisco International are following suit. Singapore Airlines is using silent commerce technology to track commercial cargo.

This technology can also improve efficiency by optimizing the use of expensive equipment and infrastructure. The Swiss Federal Railway has implemented an RFID-based Automatic Vehicle Identification system that

tracks all rolling stock as it passes key checkpoints. Vehicle utilization is up, the amount of time trains spend in stations has been reduced and the need for weekly physical inventories at local stations has been all but eliminated. In Scotland, the city of Edinburgh is using technology that automatically gives buses a green light. This reduces the time it takes, depending on traffic, for a bus to complete its route by up to 10 percent, thereby encouraging the use of public transportation.

The use of staff time can also be optimized. A community library outside Detroit has smart-tagged all its books: Checkout is up to 40 percent faster, and conducting an inventory is as simple as walking down the aisles with an RFID wand. In Barcelona trashcans are embedded with tiny chips that communicate how full the can is; sanitation workers stop only for cans that need to be emptied, saving time and money.

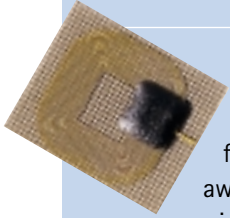
Increasing security

More than ever, security is an issue. Silent commerce technology can help.

Smart ID can verify personal identity. The government of Malaysia has already introduced a multipurpose smart card that serves as an identity card, a driver's license, a passport and e-cash; Hong Kong has plans for a similar program. In the private sector, FedEx couriers wear Velcro wristbands embedded with RFID transponders; these confirm the couriers' identities as they approach their vehicles and allow them to operate the trucks without keys, which can be lost or stolen.

Manufacturers can protect themselves by using silent commerce technology to authenticate their products. Tire manufacturers are experimenting with embedded RFIDs to ensure that tires put on vehicles are genuine and that

How it works



Silent commerce is the result of several converging technologies that make it possible for enabled objects to be information-rich, aware and even active in responding to their environment.

RFID tags

Radio frequency identification devices (RFIDs) are most often passive electronic tags that emit information to readers or reflect signals from readers, and that are part of a wireless network. An RFID can be as small as a matchstick, holding as little as a unit of basic identifying information, or as large as a brick, storing vast quantities of data. These tags make it possible to track relatively stationary items such as library books as well as more mobile inventory ranging from roving animals to expensive hospital equipment.

While RFID tags are generally passive (that is, they are not powered by batteries or some other source), active RFID tags also exist. A well-known example is the commuter transit pass, which allows drivers to zip through tollbooths without stopping to count out change.

Sensors and MEMS

More complex than RFID tags, sensors are able to detect, transmit or react to information about the surrounding environment. Recent advances in manufacturing and engineering have produced sensors that are more precise and accurate, and less expensive, than those that were available before.

Technological advances have also given us microelectro-mechanical systems (MEMS), a class of tiny sensors and actuator systems with both electrical and mechanical components. If sensors give objects a sense of feel, sight, smell and sound, then actuators give them hands and feet—that is, the ability to act on what they sense. The device that operates the air bag in your car is a MEMS: An accelerometer (sensor) detects the car's sudden deceleration and the MEMS activates the air bag. MEMS use the same fabrication technology as computer chips but can be adapted to sense and act on a variety of physical phenomena.

RFID tags, sensors and MEMS make it possible for any object or device to be, to varying degrees, "smart."

Location-based capabilities

Many silent commerce applications require knowing where an

object is located to trace its movement or have it respond appropriately to the surrounding environment.

Location sensing can take place in several ways, over varying distances. At close range, passive RFID tags can indicate their locations by being read as they pass by. Marathon runners, for example, now wear tagged shoes so that race officials can be sure each runner has passed each station on the course.

Active RFID tags can transmit their identity a bit further. Emerging wireless technologies, such as Bluetooth, let smart objects "know" when they are close to another smart object so that they can communicate with each other. A Bluetooth-enabled vending machine, for example, allows you to make a purchase without fumbling for change; now you can walk up to the machine, make your selection and pay for your soft drink with a few quick keystrokes on your mobile phone.

When the distance is greater, more technology comes into play. Mobile phones, for example, "ping" their identities and can be located according to the cell they are in, or their triangulated position among several cells.

For objects that move across substantial distances, location tracking can be done using the Global Positioning System. This is a worldwide-satellite-based radio navigation system, long used by the military, in which radio signals are transmitted from satellites, triangulated by a receiver, and used for positioning and timing. GPS commercial potential results from a May 2000 US presidential directive that made the pinpoint accuracy of GPS fully available to commercial and personal users.

Always-on connectivity

When we log on to the Internet or pick up a telephone, we're preparing to transmit data for a finite length of time. Now usage doesn't have to be so limited. An increasing number of communication protocols, including the Internet itself and new broadband wireless standards such as 2.5 G, enable devices to be "always on." As a result, any number of devices, from mobile phones to MEMS, can now be continuously aware of their environment, ready to send and receive information whenever needed.

The convergence of all these technologies, new or old, has made it possible for everyone and everything to be in uninterrupted contact—the foundation for u-commerce.



A peek at tomorrow

Not too many years from now, silent commerce may fundamentally change the way business gets done. Want a glimpse of the future? Researchers at Accenture Technology Labs have already developed prototypes that suggest intriguing possibilities.

For example, there is a chair containing a microscopic sensor that accommodates a clock and reacts to weight and temperature. This chair knows when it is being used and, to some extent, by whom. Picture it in use at a European sidewalk café. Today you buy a cup of expensive coffee but are free to linger all afternoon watching the world go by. Suppose the coffee was reasonably priced but you paid a surcharge for the time spent sitting in the café. That's a new pricing model.

A more likely application might be used in your car. Imagine a "smart seat" that knew which family member was at the wheel, and a tag on the windshield that provided the car's geographic location. Insurance rates could be set according to who was driving, when and where. Give your teenage son the keys or park in a high-crime neighborhood, and the rates would be rise during that period of use.

Selling, too, might change, by moving outside of the store and away from the traditional sales force. One Accenture prototype makes the purchases themselves—garments, appliances and furniture—part of an always-on shopping channel. RFID tags embedded in the items during production would (assuming the buyer is willing) be left in after purchase. Suppose you're at a reception and you see someone in a really great sports coat. You could just pull out your smart cell phone or PDA to get the details and even buy the coat on the spot. You would get instant gratification; the wearer might even get a credited commission.

Another prototype is, in essence, an always-aware closet. Each RFID-tagged garment that you hang inside is read by the closet and logged into your wardrobe inventory. Equipped with a flat-panel monitor on the door that links to the Internet, your personal calendar and your favorite retailers, the closet itself can suggest outfits appropriate to the day's weather and activities—and offer additional clothing items that you could buy with the push of a button.

Maybe you won't even have to trigger the purchase. Accenture researchers have developed a smart doll able



An online medicine cabinet

to react to other tagged objects and respond appropriately. For example, the doll can be programmed to buy only the latest fashions, or be limited to purchases that fit an "expense account." You may not be brave enough to give your eight-year-old such a doll—but the same technology in some other smart object could work for you by searching out and buying whatever is on your wish list.

Silent commerce technology could also extend service into the home, after you've bought the product. One example is an online medicine cabinet whose mirror can recognize the family member standing in front of it. It can call up current medical information for that person (the pollen count for Susie, who has asthma, or recent weight control information for big Bob), remind him or her to take their medicine and actually track which pills he or she takes off the cabinet shelf. Think of the advantages in helping older people live longer unassisted, or in ensuring that patients on multiple medications take the right doses at the right times.

And the same technology can be put to other uses. Imagine a refrigerator that suggests recipes based on what's inside and, through its link to a grocery store, reorders staple supplies when they run low. Or a house that adjusts the thermostat according to the preferences of the family members who are actually home.

Sound fanciful? The technology exists, and it works. Soon we'll be limited only by our imaginations.

they meet automaker specifications. Smart chips may soon be embedded in currency or official documents, helping to foil counterfeiters.

The technology can also be used to help prevent product theft or diversion. In the United Kingdom, for example, a distributor of expensive single malt whiskeys is using RFID readers as part of a new warehouse security system designed to prevent the product from being accidentally or deliberately misrouted. Other retail companies are looking at ways to use tags to reduce shrinkage, which is estimated at \$32 billion annually in the US retail sector alone.

Generating additional revenue

These same technologies are also helping companies expand their market share and generate additional revenues by offering new customer services. For example, one upscale luggage maker is embedding smart tags during manufacturing. When a bag is purchased, the customer can register it with a unique ID so that it can be tracked and recovered if it's ever lost.

Companies can also offer customers the added convenience of cash-free transactions. Mobil's Speedpass is a smart keychain that customers can wave in front of the pump for gas or related purchases. According to Mobil, it has proved especially popular with many of the company's female customers, who appreciate not having to grope through their purses for a credit card. Speedpass offers additional convenience—it works not only at participating Mobil and Exxon stations but at selected other retailers as well, including participating McDonald's—thereby encouraging customer loyalty.

All these examples have this in common: They take place “inside the box.” That's where we believe most companies should start. These four-wall solu-

tions can pay for themselves within a short period of time by reducing costs.

Just as important, these inside-the-box applications position a company advantageously for the future by moving its employees along the learning curve. Having people inside the company working with silent commerce applications, even in their simpler forms, gives them hands-on familiarity with the technology, helps them envision its possibilities, and prepares the company to move quickly as standards are established, infrastructure is created and even more dramatic opportunities arise.

But four-wall applications have to be done right. They need to be integrated into existing processes and legacy systems. Some overall planning or control is important to prevent a plethora of individual applications based on different systems and technologies.

If silent commerce is valuable today, it will be vital tomorrow. The improvements it makes possible in operational efficiency and increased security will be taken for granted. In the future, its real power will lie in the creation of new ways of doing business that can generate additional revenue.

Prototypes are being developed, for example, to enable very different ways to price products and services, offer them for sale or control their optimum usage after sale (see sidebar, opposite). The global infrastructure and standards that will make silent commerce an underpinning of the economy will soon be in place. Already, companies are working together to create regional systems and applications.

In Tulsa, Oklahoma, participating companies are being wired with analog RFID equipment for tracking microchipped packages. The work is being done by Auto-ID Center, an industry-funded research program

based at Massachusetts Institute of Technology and the Institute for Manufacturing in Cambridge, England. The 36 corporate sponsors and participants include Wal-Mart, Gillette, Philip Morris, Procter & Gamble, International Paper and Accenture. Tulsa is a key element of a test bed for a system that will be able to track goods from plant to store shelf, without human intervention.

How fast will a global standard and infrastructure be developed? No one knows for sure. Leaders of larger companies, though, may want to move toward this broader future immediately, even while continuing to apply inside-the-box solutions that offer immediate payoffs. They might want to take part in consortium research or in projects to install regional infrastructures, like the one in Tulsa. And leaders of all businesses will want to listen closely for news of silent commerce.

The promise of silent commerce is all but unlimited. Sooner or later—probably sooner—the infrastructure will be in place and the standards developed. It's inevitable. Silent commerce is not a stand-alone development—it's an integral part of the unifying future called u-commerce, which will bring everyone and everything together. ■

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