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LINK

Lava I/O News

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LAVA

RFID

What is RFID?

Radio Frequency Identification, or RFID, is a rapidly-emerging identification and logging technology. Whether or not you have come across RFID systems in your work, you have probably encountered RFID in your daily life, perhaps without even being aware of it. At their simplest, RFID systems use tiny chips, called "tags," to contain and transmit some piece of identifying information to an RFID reader,a device that in turn can interface with computers.

To begin understanding RFID, think of a conventional Point-of-Sale barcode reader scanning grocery barcodes. In its simplest form, an RFID system is much the same:it also can identify a package. However, unlike barcodes, RFID tags don't need a direct line of sight: within limits, we can now scan an unpacked skid of boxes. Next, think of RFID tags as mini databases, or as barcodes that can be written to, and that can accumulate information as they travel. At this point, RFID diverges qualitatively from barcoding, giving it great new potential.

How does RFID work?

In an RFID system, RFID tags are "interrogated" by an RFID reader. The tag reader generates a radio frequency "interrogation" signal that communicates with the tags. The reader also has a receiver that captures a reply signal from the tags, and decodes that signal. The reply signal from the tags reflects, *both literally and figuratively*, the tag's data content. The reply signal is created as passive "backscatter" (to use the radio term).

Passive tags

RFID has a couple of basic types of tag. Passive tags have no power source of their own, while active tags are self-powered, usually by some type of battery. Passive tags generally operate at a maximum distance of 3 meters or less, and have power only when in communication with an RFID reader. The simplest of these tags is capable of holding something in the range of 64 bits of factory-written unique data; these are called "Class 0" tags.

Active tags

Active tags, with their own power source, can actively and intensively transmit and processing data, and over considerable physical distances. Active tags can communicate with readers 100 meters or more away. Active tags need much less signal from the RFID reader than passive tags require, and so can contain sensors and data loggers, for instance, as they are continually powered. Active tags are also suited as data loggers because they can support a clock (for time-stamping data) and can contain significant amounts of memory. Also, active tags are much better suited than passive tags when a collection of tags needs to be simultaneously read: they do not all need to be in range of the reader at the same time.

The terms "passive" and "active" are however potentially confusing: in all cases of communication with a passive tag, the reader "talks" first; the RFID tag is essentially a server. But, in the case of active tags, communications can be initiated by either the tag or the reader. Also potentially confusing is the term "reader," for a reader can also *write* information to an RFID tag.

Both tagging technologies–active and passive–are needed for RFID to realize its full potential. The cost savings afforded by passive tags makes RFID tagging possible at a much lower price point than would be possible with active tags alone; on the other hand, active tags add functionality not possible with passive tags at this time.

Lava's Ether-Serial Links are becoming a popular tool for installers of RFID systems who wish to network-enable RFID readers.

How is RFID technology evolving?

RFID is evolving technologically on at least three fronts: readers,standards, and tags.

Reader development

RFID readers have evolved and are now frequently wireless handheld units that enable the user to roam through a warehouse, capturing RFID data wherever RFID tags are found. Some readers are adapters that add RFID reader capability to a PDA that can snap into a cradle. Readers are growing more RF senstive, and more capable of processing, as well asjust collecting,RFIDdata.

Standards development

RFID standards development, particularly for supply chain management, is becoming centralized internationally, primarily under the auspices of a new hybrid body, EAN.UCC. EAN.UCC combines two previously separate standards organizations: EAN ("European Article Numbering"), now EAN International, and the Uniform Code Council, Inc. (UCC). Together, these organizations standardize identification numbers, transaction sets,XML schemas, and other supply chain solutions. Within EAN.UCC are a number of sub-organizations. As far as RFID is concerned, EPCglobal is the most relevant. EPCglobal is a consortium of supply chain partners developing a system of Electronic Product Codes™ (EPC). The EPCglobal Network aims to provide immediate, automatic, and accurate identification of any item in the supply chain regardless of company, industry, or geography. The idea here is that products tagged by different manufacturers will all interoperate, and refer to the same database of company identifiers, much as barcodes do now.

To this end, EAN.UCC has recently defined a number of tag classes. The most complete definition currently is for the most basic RFID tag–the "Class 0" tag mentioned above. This is now and probably always will be the most common of tags. It is in the humble Class 0 RFID tag that the rubber hits the road, at least as far as retail and POS tagging are concerned. These tiny chips–by "tiny" I mean sometimes a quarter the size of a grain of sand–hold the internationally standardized RFID identity,the EPC. These tags are passive tags–they have no energy source of their own–and they are generally read-only.

The simplest EPC currently defined is a 64 bit number. In addition, 96- and 256-bit data definitions are being framed. Within the 64-bit EPC definitions are header and definition bits, as well as bits for what are effectively a manufacturer number (called the "domain manager number"), a product number (called the "object class"), and a serial number. In effect, the EPC is like a combination of UPC bar code plus serialnumber.

Tag development

At this stage in the development of RFID,most business cases really boil down to the cost of RFID tags. The cheaper they are, the more deeply deployed RFID can be. Nobody is going to put three-cent RFID tags on one-dollar products. Looking ahead though, tags that today cost three cents are projected to cost one cent in a year, as volumes increase and manufacturing technologies improve.

At the other end of the scale, other business cases for more costly RFID tags can be found. The enhanced capabilities of active RFID tags, their increased distances of operation between the RFID tag and the reader, their continuous power capability, and so forth, make these tags suitable in higher-unit value situations–automobile tracking and anti-theft systems,for instance.

What are typical uses for RFID?

As the RFID marketplace evolves, more and more uses for the technology are being developed. First among them are applications that replicate the uses already in place for barcodes. The cost savings in scanning a grocery cart without the need to unpack each item is compelling. More sophisticated applications use the capability of RFID to receive and store data as well as simply to identify itself. This means that an RFID tag can carry along with it a history of transactions.

In addition, newly-developed tags can incorporate a sensor, making the tag now aware of its environment, after a fashion. The automotive industry is testing the capability of an RFID tag to sense tire pressure while a vehicle is in motion.

RFID has many applications in the security field, as can be imagined. The traditional magnetic-stripe security card used for access control is beginning to be supplanted by RFID tagged cards that can offer a greater degree of security and record-keeping. Toll-gates are another frequent application; vehicles can pass an RFID reader and have a toll deducted, often without slowing down.

RFID tags will replace printed bar codes where a business case can be made. An RFID tag that can write information to itself may be used to create an audit trail or tracking record, particularly for high-value goods. The cost of RFID tags will need to fall substantially before RFID will be a cost-effective means of coding inexpensive consumer goods, such as cereal boxes or candy bars.

How soon will RFID dominate as a means of identification on a broad scale? The answer to this question depends in part on simple computations of cost and benefit, but also on acceptance and "mood," for lack of a better word. Contributing to mood are factors such as the current political desire to enhance anti-terrorism security systems, or Wal-Mart's recent requirement that its top 100 suppliers ship cartons and pallets with RFID tags by January 2005. Wal-Mart's initial goal is to use RFID tags for tracking shipments and efficient warehousing; the longer-term goal in the retail industry is the "smart shelf" that can monitor stock levels on a more granular level. The problem of tracking individual items on store shelves is akin to the Internet problem of running fiberoptic cabling the "last mile" from the Internet backbone to the user: the cost increases exponentially as the deployment deepens. Correspondingly exponential reductions in costs, or exponential increases in savings, must ensue to make the case sell.

RFID: Technological challenges & business cases

RFID technology faces a number of challenges, and each is linked to the business case for RFID, at one level or another. Primary among these challenges are the cost of an RFID system (particularly the tags), the ability of an RFID reader to differentiate between a collection of RFID tags responding to the same reader at the same time ("tag contention"), the distance at which RFID tags can be read, and in some cases, the security implications of radio data transmission.

Supply chain management

The first of these challenges is key to many of the business cases for RFID. Supply chain management, in particular, is one of the first places where RFID can make a business case for itself. Supply chain applications are what drive the RFID implementation initiatives by both Wal-Mart and the US Department of Defense, two major organizations on the leading edge of RFID rollouts. For both of these entities, supply chain logistics are essential to their success. Wal-Mart's business model requires sophisticated supply chain logistics to enable the high rates of turnover that in turn enable it to often sell inventory to customers before suppliers require payment. For the Department of Defense, executing military operations in locations where infrastructure is weak or non-existent requires moving vast quantities of supplies quickly and efficiently. In both cases, the "depth" of an RFID deployment depends on reducing the costs of the tags themselves to the lowest point possible.

Similarly, supply chain users need to both differentiate individual tags ("tag singulation") and to be able to address or read large numbers of tags as groups ("tag aggregation"). Successful tag singulation is a function of the sensitivity of the RFID reader, the sophistication of the tag anti-collision algorithm used by the reader, and the uniqueness of the tag identification numbering. Tag singulation is what will allow that grocery cart to be successfully read in in a single pass.

On the other hand, successful tag aggregation is necessary to reduce RFID bandwidth requirements and to allow the selection of groups of tags for batch processing, sorting, "killing," and so forth. Carefully defined numbering systems, such as that being defined by EPCglobal, will assist in this area.

Closely related to supply chain management are other areas, such as healthcare and animal tagging, that are growing areas for RFID tagging. In the health care field, tracking inventories and and dosages of medicines is essential; in the cattle industry, concerns about mad cow disease are impelling cattle producers to look at ways to track a cow from birth to table. In some of these areas passive tags may not have the range needed, and active tags might be used to increase the distance at which a tag can communicate with a reader.

Identification and security

A second obvious area where RFID makes immediate economic sense is in areas where costs of failure are great. RFID is an ideal means of tracking and authenticating movements of people, and security is frequently an area where a premium is placed on preventing problems before they occur. One of the earliest RFID implementations was part of an authentication system to prevent welfare fraud. RFID systems are still evolving in this area to broaden their value for security uses. For example, developing secure transmission protocols requires a means of negotiation a tag identity without also revealing its data. Perhaps revealing even the number of tags being identified would represent a security concern. Identifiers dynamically derived as pseudo-random numbers based on a portion of the unique user data might be a solution here, at the cost of a more complex reader implementation.

Also related to security concerns is the distance at which RFID systems operate. Eavesdropping is possible, particularly on the reader transmit channel, as it has the highest power level. Implementing methods of encryption will help here.

Whatever the hurdles, the cost savings RFID can offer provide a strong incentive for technology breakthroughs and innovation.

Upcoming Shows

Lava will be attending the following shows in the next few months:

Supercomm 2004
Chicago, Illinois
June 20-24, 2004

Assembly Tech
Chicago, Illinois
September 28-30, 2004

Global Gaming Expo
Las Vegas, Nevada
October 5-7, 2004

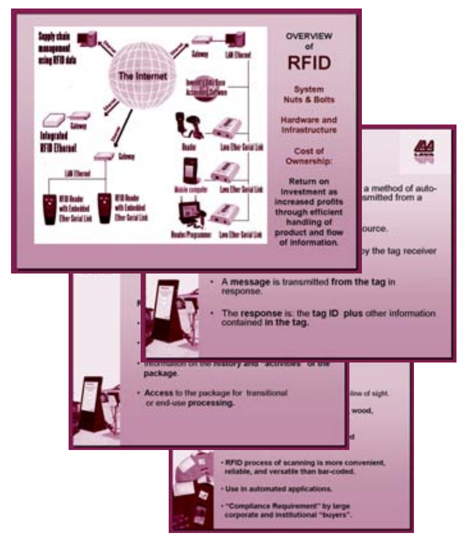
We'd love to see you at one of these shows!

Coming in the next LINK

The next issue of LINK will investigate the kiosk market for Lava products. The kiosk market is diverse and growing, with numerous needs in serial and serial-to-network interfacing.

Read the next issue of LINK for the details.

Downloadable RFID presentation



Lava has available a PDF version of its RFID presentation given at this year's RFIDworld conference. It can be found at:

www.lavalink.com/company/newsletter/06.04/rfid.pdf

LIFETIME WARRANTY

ETHER-SERIAL LINK PRODUCT SUMMARY

	Ports					Connectors			Modes			
Product	**1**	**2**	**4**	**8**	**16**	**DB-9**	**RJ-45**	**Powered**	**RS-232**	**RS-422**	**RS-485**	**TTL**
Ether-Serial Link 1-DB9	✔					✔			✔			
Ether-Serial Link 2-DB9		✔				✔			✔			
Ether-Serial Link 4-DB9			✔			✔			✔			
Ether-Serial Link 8-DB9				✔		✔			✔			
Ether-Serial Link 16-DB9					✔	✔			✔			
Ether-Serial Link 1-RJ45	✔						✔	✔	✔			
Ether-Serial Link 2-RJ45		✔					✔	✔	✔			
Ether-Serial Link 4-RJ45			✔				✔	✔	✔			
Ether-Serial Link 8-RJ45				✔			✔	✔	✔			
Ether-Serial Link 16-RJ45					✔		✔	✔	✔			
Ether-Serial Link 1-DB9/422	✔					✔				✔		
Ether-Serial Link 2-DB9/422		✔				✔				✔		
Ether-Serial Link 4-DB9/422			✔			✔				✔		
Ether-Serial Link 8-DB9/422				✔		✔				✔		
Ether-Serial Link 16-DB9/422					✔	✔				✔		
Ether-Serial Link 1-RJ45/422	✔						✔	✔		✔		
Ether-Serial Link 2-RJ45/422		✔					✔	✔		✔		
Ether-Serial Link 4-RJ45/422			✔				✔	✔		✔		
Ether-Serial Link 8-RJ45/422				✔			✔	✔		✔		
Ether-Serial Link 16-RJ45/422					✔		✔	✔		✔		
Ether-Serial Link 1-DB9/485	✔					✔					✔	
Ether-Serial Link 2-DB9/485		✔				✔					✔	
Ether-Serial Link 1-RJ45/485	✔						✔	✔			✔	
Ether-Serial Link 2-RJ45/485		✔					✔	✔			✔	
Ether-Serial Link 4-RJ45/485			✔				✔	✔			✔	
Ether-Serial Link 1-TTL	✔											✔

OTHER LAVA PRODUCTS

Serial Boards

PCI	SSerial-PCI	Single 9-pin serial, 16550 UART
	SSerial-PCI/LP	Single 25-pin serial, 16550 UART, low profile
	SSerial-PCI 3.3V	Single 9-pin serial, 16550 UART, for 3.3 volt PCI
	RS422 SS-PCI	Single 9-pin serial, 16550 UART, RS-422 pinouts
	DSerial-PCI	Dual 9-pin serial, 16550 UARTs
	DSerial-PCI/LP	Dual 9-pin serial, 16550 UARTs, low profile
	DSerial-PCI 3.3V	Dual 9-pin serial, 16550 UARTs, for 3.3 volt PCI
	RS422 DS-PCI	Dual 9-pin serial, 16550 UARTs, RS-422 pinouts
	Quattro-PCI	Four-port 9-pin serial, 16550 UARTs
	Quattro-PCI 3.3V	Four-port 9-pin serial, 16550 UARTs, for 3.3 volt PCI
	Quattro-550/RJ	Four 10-wire RJ-45 serial, 16550 UARTs
	Quattro-950/RJ	Four 10-wire RJ-45 serial, 16950 UARTs
	RS422 Quattro-PCI	Four-port 9-pin serial, 16550 UARTs, RS-422 pinouts
	Octopus-550	Eight-port 9-pin serial, 16550 UARTs
	LavaPort-650	Single 9-pin serial, 16650 UART
	LavaPort-PCI	Dual 9-pin serial, 16650 UARTs
	LavaPort-Quad	Four-port 9-pin serial, 16650 UARTs
ISA	SSerial-550	Single 25-pin serial, Com 1-4,16550 UART,IRQ 3/4/5/7
	DSerial-550	Dual 9-pin serial, Com 1-4,16550 UARTs, IRQ 2/3/4/5/7/10/11/12/15
	RS422-550	Dual 9-pin serial, 16550 UARTs, RS-422 pinout
	LavaPort-ISA	Single 9-pin serial, Com 1-4,16650 UART, IRQ 2/3/4/5/10/11/12/15
	LavaPort-PnP	Single 9-pin serial, 16650 UART, Plug and Play

Serial Port Bank

PCI	SPB-16/RJ	Sixteen port 10-wire RJ-45 serial, 16550 UARTs, 1U rack mount, with switching power supply and PCI interface board

Parallel Boards

PCI	Parallel-PCI	Single EPP parallel
	Parallel-PCI/LP	Single EPP parallel, low profile
	Parallel-PCI 3.3V	Single EPP parallel, for 3.3 volt PCI
	Dual Parallel-PCI	Dual EPP parallel
ISA	Parallel Bi-dir.	Single bi-directional parallel port, LPT 1/2/3, IRQ 5/7
	Parallel-ECP/EPP	Single ECP/EPP parallel, LPT 1-6,IRQ 2/3/4/5/7/10/11/12

Combo Boards

PCI	SP-PCI	Single 9-pin serial, 16550 UART + single bi-directional parallel
	2SP-PCI	Dual serial (9 & 25-pin), 16550 UARTs + single EPP parallel
	LavaPort-Plus	Dual serial (9 & 25 pin), 16650 UARTs + single EPP parallel
ISA	2SP-550	Dual 9-pin serial, Com 1-4,16550 UARTs + single bi-dir. parallel,LPT 1-2

USB 2.0 & 1.1 Devices

USB 2.0 Host	Dual USB 2.0 ports, 480 Mbps, fits in PCI slot
USB 1.1 Host	Dual USB 1.1 ports, 12 Mbps, fits in PCI slot
SPH-USB 1.1 Hub	Three powered USB 1.1 ports, parallel port, serial port, connects to USB

IEEE 1394 (FireWire®) Devices

IEEE 1394 FireHost	Dual IEEE 1394 ports, 400 Mbps, fits in PCI slot
IEEE 1394/IDE Controller	FireWire®-to-IDE hard drive interface

Specialty Boards

PCI	8255-PIO	8255 PIO interface card

Speak to us about your design needs. Apart from the products listed here, Lava customizes and modifies designs to suit specific customer needs.

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