

Simplification of Real-time Location Systems Using the Radio Frequency Identification Integration Platform

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Abstract: The Radio Frequency Identification (RFID) buzz has permeated almost every industry around the globe. The promises made by the RFID development community have propelled the technology to mythical proportions. As RFID solutions are implemented, businesses are beginning to realize that RFID is not as easy to install, maintain, and use as the experts promised. If RFID is going to live up to the hype, it must be easy to install, easy to maintain, cost effective and provide the information that businesses need. Lost Recovery Network has identified these basic needs and has accomplished to simplify the technology to a level that will allow businesses to use the technology effectively.

The Problem

RFID has no merit on its own. It cannot single handedly streamline a supply chain or secure hazardous materials. However, RFID is an integral part in a solution that can accomplish these tasks. The value of an RFID enabled solution should be determined by the business case and not by the technology that enables the solution. Today, RFID enabled solutions are being designed and implemented based on the technology and not the business need. Businesses must be presented with RFID as one of the many tools in their tool belt with which they can provide solutions to their business problems. LRNI has defined a system that takes the power away from the technology and places it back in the hands of the business.

Simplification

Lost Recovery Network's driving motto is, "simplicity by design." LRNI's antennas, RFID Integration Platform (RfIP) devices, and RFID intelligent middleware, solutions are the new standard for the RFID industry. *The new standard enables real-world RFID solutions to be designed and implemented in a fraction of the time and cost.*

Antennas

LRNI offers a suite of antennas that can be leveraged to target any installation need. The antennas exhibit unique characteristics desirable in RFID solutions. These characteristics include:

- ✓ Reading active RFID tags consistently in close proximity
- ✓ Defining coverage areas from a 5 x 5 centimeter area to a 1 x 1 kilometer area
- ✓ Defining coverage to one room in a multistory building without bleed between floors
- ✓ Radio frequency spectrum agility
- ✓ Specific coverage
- ✓ Easy installation
- ✓ Cost effective

Antennas found in most RFID installations today are connected directly to the RFID reader and provide little or no coverage definition capabilities. These types of antennas provide a booming area of coverage that must be controlled directly, if possible, by the RFID reader. LRNI antennas can be connected directly to the reader or can be installed in a remote configuration spanning distances of over 100 meters from the reader. The remote configuration allows for the reader to be placed in an inconspicuous location such as a maintenance or server closet while the antenna is placed in the desired area of coverage. *The innate abilities of*

LRNI's antennas and methodology are scaleable to any desired level of granularity.

RFID Integration Platform (RfIP)

The RfIP, pronounced "rip", devices are LRNI's edge device offering. Traditionally, edge devices were used as a hardware conversion point from legacy computer network systems to newer systems. Today, edge devices are any device that receives data from outside the centralized computer network. The RfIP device is an advanced piece of networking and computational hardware that is responsible for receiving RFID tag broadcasts, processing the broadcast data, and reporting the data to a data sink. *First and foremost, RfIP devices offer a tremendous savings over conventional edge devices because RfIP devices can read data from multiple locations when deployed in conjunction with LRNI's patented antennas.* Conventional systems require one RFID reader per covered location while a RfIP device can cover up to 16 individual locations for a fraction of the cost.

Beyond the cost savings is the scalability of a RfIP driven solution. *RfIP devices can be arranged in a myriad of configurations such that extraneous data can be removed from the data stream at the earliest possible moment.* Active RFID tags broadcast at a standard rate. This rate could be every one second up to every one minute. No matter what the broadcast rate is, there is always redundant information that could be removed. For example, if an RFID tag is in the same location for every broadcast, there is no reason to propagate that data across the entire RFID network and store the data in a database. The changes in location, disappearance, or appearance of a tag are important and should be recorded. The RfIP device enables the type of intelligent processing mentioned in the previous example. RfIP devices can be arranged in a flat or tree structure type configuration, and they can communicate in real-time or in batch.

The RfIP deployment topology is also not limited to distance. RfIP devices can be installed in remote locations around the globe and should be secured over the business' virtual private network (VPN). RfIP devices can even be deployed as a mobile unit. RfIP devices can communicate the data they have collected through queues, web services, direct database connections, FTP, SMTP, or direct TCP/IP or UDP socket connections. The pluggable software framework inside each RfIP device can also be extended per any business need. For example, some remote RfIP devices may need to provide data logging capabilities locally in the event that the connection with the data sink is lost. In the case of a mobile RfIP device in which connectivity is provided across a cellular, satellite, or other wireless network, network, connectivity could be lost at any time. If the data is logged locally with the corresponding timestamp at which the event occurred, the RfIP device could then upload all of the logged data when connectivity with the data sink is reestablished. *The RfIP provides the lossless data backbone required for mission critical applications.*

Tag Enclosures

RFID tags must be able to be deployed in any location necessary to fit the business need. These locations may include extreme temperature environments or locations where there is a tremendous amount of vibration. For these target environments, LRNI has developed an array of high durability enclosures. *The high durability enclosures have been six sigma tested in a group of test including:*



LRNI Badge



LRNI Badge w/distress function

- ✓ Exposed to temperatures above 2,200 degrees Fahrenheit, direct acetylene torch blast for 6 seconds
- ✓ Pummeled with metallic beads at high velocity for several minutes
- ✓ Withstood the extreme pressure exerted on the enclosure in excess of 5,000 pounds
- ✓ Water proof
- ✓ Shock resistant



LRNI Enhanced Durability Enclosure with active RFID tag

LRNI has also developed a product line of tag enclosures and fasteners for specific markets. For the healthcare industry, LRNI developed a disposable RFID tag wristband that meets the health care industry standards. The wristbands are designed to be durable and comfortable while providing adequate protection for the enclosed RFID tag. A multipurpose identification badge tag has also been developed for any application where an employee may be tracked for security purposes. The badge has an additional feature that includes a distress button that can be pressed at any time to alert that the employee is in need of assistance. These badges also include a visible indicator that lights up when the badge has notified the proper persons. The distress functionality ties into the rest of the LRNI product offering mentioned later.



LRNI Wristband

RfIP Software Framework

The applications of RFID are limitless and LRNI cannot single handedly develop applications for every industry that has a need. *To solve this problem LRNI has built a framework that enables 3rd party developers to build their applications on top of LRNI's antenna and RfIP device framework.* The software development kit provides 3rd party developers with a standard web service interface through which they can programmatically administer the RfIP framework and monitor RFID tags across the RfIP network. In the future, LRNI will also offer other messaging interfaces, such as queues, to 3rd party applications.

Out of the box the RfIP framework offers a centralized point of configuration and management called **Monarch**. As an installation approaches an enterprise scale, centralization of control becomes paramount from an administration perspective. *Monarch supports configuration of all RfIP devices across the RfIP network as well as a centralized deployment point for software upgrades across the entire RfIP network.*

Back Office Hardware

There are three factors that must be taken into account when designing the back office infrastructure required to effectively support the backend applications and services required by the RfIP Framework and applications. The first factor is the extensiveness of the install. If the back office support applications will be servicing hundreds of locations and tens of thousands of tags, the install will require more powerful hardware. For example, a 300 location install with approximately ten thousand tags will require a two or four way database server with a raid level five hard drive configuration for the database files. A server quality network card is a requirement as well.

The second factor is the number of users of the system. The number of users directly impacts the web server configuration and the database server configuration. As the user base increases above 100 concurrent users, the web server hardware and server clustering become important. Please note that 100 concurrent users may equate to a total user base of well over 1000 users. It is not expected that all 1000 users will be using the system at the exact same time.

The last factor is the criticalness of the applications to the business. If the applications are deemed mission critical, redundancy and failover mechanisms are key to responding to hardware malfunctions. The rule of thumb is to double everything. For example, a basic installation should have two web servers and two database servers. All data should be mirrored across both servers in the case of failure.

Back Office Software

The back office software runs on top of a Windows platform. Today, the standard software configuration is:

- ✓ Microsoft Windows Server 2003 Standard Edition
- ✓ Microsoft SQL Server 2005
- ✓ Microsoft .NET Framework 2.0
- ✓ Monarch (RFID Management System)

As the installation requirements grow, the selection of server software and databases will expand accordingly. *For information technology departments that have existing hardware and software that can be leveraged, LRNI can build an install and configuration plan to fit almost any requirement.*

The Install Process

In addition to the exponential savings afforded by having 16 location RfIP devices, there are also savings inherent in the LRNI site survey and installation process. Conventional, RFID installation teams would require an in-depth survey of the install site. The survey would include measurements of the RF spectrum using advanced RF spectrum analysis devices. These tests would look for environmental conditions that degrade the propagation of electro-magnetic radiation. Time based tests would also be conducted that measured changes in the spectrum over a normal day as people, carts, and other mobile objects moved through the interrogated areas. Each test is conducted in every zone that is to be monitored by the system. In addition, the survey team would install a temporary system in each zone in order to determine the RFID reader settings required to define coverage to the desired boundaries. It is easy to see that specialized skills are needed to accurately perform a site survey for a legacy system. Most site survey teams are comprised of engineers or a group of highly trained and experienced RFID experts. This is a definite cost factor to be reckoned with. *Through the LRNI simplification process, all of these issues have been eliminated.* The LRNI antennas and software provide the necessary environmental buffering that is required to accurately determine the position of an asset without the extensive RF spectrum analysis and site survey team testing. The LRNI process is very simple. It is so simple that the LRNI team can determine, in most cases, the correct placement of antennas and RfIP devices required to meet the coverage expectations without even visiting the install site. The team that performs the installation can be virtually anyone who knows how to read a building architectural diagram. This level of flexibility allows organizations to choose the team that they trust and work with regularly, or LRNI's team can handle some or all of the install needs. LRNI provides the install team with the exact antenna and RfIP device locations. These points are plotted on any existing building architectural plans so that the install team can easily pinpoint the install locations. Once the install has been performed, the

system can be turned on and verified. The verification process may involve tweaks to the system, but the tweaks are strictly software configuration changes. The validation process does not involve moving hardware or antennas. In most cases, the verification can be performed remotely.

The Difference

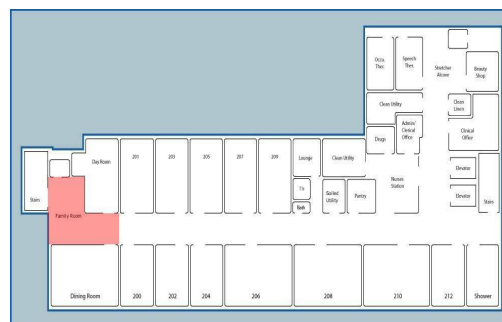
There is a difference between conventional RFID systems and the LRNI RfIP Framework. The difference involves a paradigm shift in the way in which Real Time Location Systems (RTLS) are viewed. The legacy systems attempt to define a coverage area by either attenuating the antennas or minimizing the read range of the RFID reader. LRNI makes the case that it is better to see an RFID tag than to not see one. When RFID systems are attenuated using the conventional process, there may be corners or edges of zones that are sacrificed so that the reader's interrogation area does not bleed over into adjacent zones. In contrast, the LRNI paradigm allows the tag to be seen by multiple antennas so that there are no dead zones in the corners of rooms. The intelligence in the software and the RfIP devices pinpoint the location of the tag. It is important to note that the placement and types of antennas used do contribute to the effectiveness of the install and that LRNI can craft a solution to fit the needs of even the most extremely harsh RF environments.

Monarch

Monarch is the users view into the RfIP Framework. Monarch is a web base management console and data reporting tool. Basic users and administrators can perform the following.

Administrators:

- ✓ Manage RFID tags
- ✓ Assign RFID tags to physical assets
- ✓ Group assets in categories
- ✓ Manage RFID enabled zones
- ✓ Map RFID enabled zones to real world locations such as buildings, floors, or rooms



Floor plan w/highlighted coverage area

Users:

- ✓ Find an asset's location on the actual floor plan for the facility
- ✓ Get a listing of all assets in one or all of the RFID enabled locations
- ✓ View an asset's history of locations visited
- ✓ Pinpoint the location of an asset at a specific point in time in the past
- ✓ Generate reports that include:
 - Missing tags
 - Tag interactions
 - Location of tags in a given category

Through the RfIP Framework 3rd party developer's interface any report needed can be created as an add-on to Monarch or integrated into a 3rd party application.

The LRNI Advantage

LRNI has the advantage over other RFID systems because LRNI brings a complete package to the table. These advantages include:

- ✓ Antennas
- ✓ RfIP
- ✓ Software
- ✓ Tag Enclosures
- ✓ Know How

LRNI will work with any business at the level desired. The following business model option showcase how LRNI can tailor the required involvement based on the business' needs. Businesses can work directly with LRNI or work with an LRNI distributor that has experience in the business' vertical market.

Business Model Options

Installation

The flexibility of the LRNI install process allows for the business to choose its own install team or allow LRNI to furnish the team. If a business already has a facilities group or a preferred contractor, using a known team may be the best option for the business.

Requirements Gathering

For LRNI partners and distributors, the option exists to allow LRNI to manage the requirements gather process. This process includes:

- ✓ Sitting down with the customer to understand the business need

- ✓ Design the required coverage areas
- ✓ Work with the information technology department to integrate the system into the business' existing technology architecture

Software and System Configuration

For LRNI partners and distributors, the option exists to allow the partner or distributor to install and configure the system to meet the customer's needs. This involves training and understanding of how to validate the install and tweak the configuration.



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