Executive Summary

With the proliferation of many different RFID vendors and the intensifying demand for RFID technology, there is an evolutionary need in the field for the standardization of RFID reader controls. RAIN® Communication Interface (RCI) standardizes RFID reader controls to streamline value chains, create interoperability, allow for multiple sourcing, and to rely on global frequencies for adoption worldwide. RCI is available on JADAK devices, the first devices in the market to incorporate the RAIN RFID technology and RCI: the plug-in-play Elara USB Reader, and the EL6e Smart Module.

Introduction

In 2017, more than 16.7 billion RFID tags were sold across all RFID types equating to an $11.1 billion market and a growth potential expecting to exceed $14.1 billion in 2022. RFID technology is found in many industries, including retail, logistics, healthcare, government, and grocery/food industry, and has impacted a number of areas including employee productivity (sometimes upwards of 96% in retail) decreased inventory mistakes (over 98% in some cases), returned its investment in less than a year, and has reduced shrink (up to 70%).

RAIN RFID is a global alliance promoting the adoption of UHF RFID and promises to transform the RFID industry using the GS1 UHF Gen2 protocol, standardized by the ISO/IEC into the 18000-63 ISO standard. The standardization provided by RAIN RFID has established industry confidence by streamlining value chains, creating interoperability, allowing multiple sourcing, and utilizing global frequencies for adoption worldwide. These have all contributed to consistent technological improvements (~10% RFID sensitivity improvements year over year), a reliable low-cost technology, and a "turn-key" solution.

JADAK, provider of machine vision, RFID, barcode, printing products, and services for original equipment manufacturers (OEMs), introduces a new product incorporating the RAIN RCI to its ThingMagic® RFID line of products, the EL6e smart module and the Elara plug-and-play USB reader. These new products are based on the proven ThingMagic® Nano module and are designed to simplify RAIN® RFID integration by adding interface and operability features that allow engineers to minimize design efforts and quickly implement RFID in any application that requires mid- or short-range read distance.

Both products feature autonomous workflows permitting rapid creation of solutions without RFID expertise, nor the use of SDKs and integration tools, and are among the first products in the industry to support a new developer-friendly interface between applications and RAIN RFID readers, the RAIN Communication Interface (RCI).

What is RAIN?

According to the RAIN RFID organization (www.rainrfid.org), RAIN RFID is "a wireless technology that connects billions of everyday items to the internet." RFID is a ubiquitous technology, using radio frequencies to communicate with tags that are found in many industries, like logistics to track packages, in retail to track products, used in credit cards to make payments, and for automatic payment devices at toll roads.

RAIN RFID is a new ISO standard and was so named as a nod to the cloud capability now included in the UHF RFID technology. RAIN RFID can store RFID data to the cloud, manage that data, and share it via the internet, and through RAIN RFID readers it can read and write to a tagged item, manage that data and take action on that data.

What is the problem that RAIN is looking to solve?

A look at the current industry shows that there is a proliferation of different vendors, creating an inconsistent language and structure in the ecosystem of RFID technology. This creates challenges amongst technology manufacturers, and end users. The current adopted model of RFID looks similar to the diagram below, creating a scenario of duplicated effort:
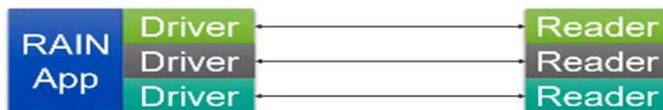
Inconsistent language and structure

The next step to overcome is standardizing the language, which allows developers to create technology that can communicate more easily, and new manufacturers can produce products without concerns for interoperability. The RAIN Communication Interface is the solution to the language problem. The new model for adoption looks similar to below:
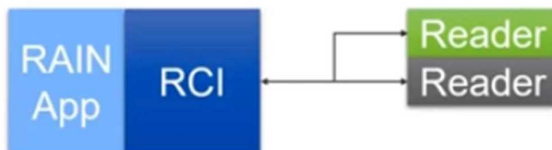
RAIN® Communication Interface (RCI)

What is RCI?
The aim of RCI was to standardize RFID reader controls. Now, with RCI, interfacing with the RFID reader has become extremely simple and standard: readers now issue commands in *JavaScript Object Notation (JSON)* which can combine reader commands using profiles. No need to send multiple commands to RFID readers, now a series of commands can be executed using one profile command. This has removed the need for reader specific APIs/libraries for development. And since JSON is both human and machine-readable, commands can easily be interpreted in many scenarios. But, RCI is not a limited standard and allows for vendor specific extension if the need should arise.

The main features of RCI:
- Simple to use, and simple to implement
- Use any interface that can stream serial data (USB, TCP/IP, Bluetooth, RS-232, etc.)
- Allows for implementation on low-resource or high-resource platforms (CPU, memory, communication bandwidth)
- Extendable to allow vendors to add their own feature
- Settled on human readable syntax (JSON based)
- Supported by many software tools and libraries
- Allows for vendor specific extensions

Using RCI with Elara/EL6e Readers

In 2017, JADAK acquired ThingMagic® and incorporated their ThingMagic® module technology, and now JADAK offers the first products in the market to take advantage of the new RCI developer-friendly interface, the Elara and the EL6e readers.

Elara USB Reader
Designed as a plug-and-play RFID reader for short- and mid-range applications, such as for healthcare, return stations, tag commissioning stations, and hospitality and event registrations, the Elara supports autonomous workflows as an immediate solution and without the need for RFID expertise nor the use of SDKs or integration tools.
Elara features and functions:
- Built around proven ThingMagic® technology
- ARM based Cortex-M4 architecture and integrated antenna with read range up to 2 meters
- Standard USB interface with keyboard emulation and bi-directional COM interface capability
- Enclosure made of healthcare plastics
- Pre-loaded Autonomous Workflows simplify integration, and enable software-free operation

- RAIN Communication Interface supports RAIN RFID technology standards
- Support for EPCglobal Gen 2V2 Protocol (ISO 18000-63)

EL6e Smart Module
Similar to the plug-and-play Elara USB reader, the EL6e is an all-in-one modular version for embedded RFID, and can be used in applications like medical equipment, kit assembly, access gates, and ski lift gates. Designed to minimize RFID module footprint, the EL6e can be embedded quickly into existing applications, and it supports autonomous workflows for rapid development without RFID expertise or the use of integration tools.

EL6e features and functions:
- Built around proven ThingMagic® Nano module
- Highly integrated UHF RFID reader with ARM based Cortex-M4 architecture
- Optional board-mounted antenna with read range up to 2 meters
- Standard options for USB or Serial RS232 interface, and custom configurations for SPI, I2C or RS485
- Pre-loaded Autonomous Workflows simplify integration
- RAIN Communication Interface supports RAIN RFID technology standards

ThingMagic® Configuration Tool

The ThingMagic® Configuration Tool (TCT) Executable is a desktop application developed using the Java language and built in javafx technology. TCT is used to connect, configure and read tags. Currently this tool will be supported only in Windows 64-bit operating system.

Case Studies

Quickly Deployable RFID Reader

The system integrator, 7iD, an Internet of Things (IoT) software developer, required fast deploying RFID readers that were using a common language for easy interoperability.

The system integrator discovered the JADAK Elara, the first plug-in-play RFID reader built on the ThingMagic® module and employing the new RAIN Communication Interface (RCI).

RAIN Communication Interface supports the RAIN RFID technology standards, and the Elara plug-in-play was said by 7iD after extensive testing that they are "convinced that ThingMagic® Elara significantly helps to deploy RFID solutions faster and with less complexity."

Developer's Perspective

Thanks to the Internet of Things (IoT), a technological movement that has extended the interconnectivity of the internet into physical devices and everyday objects, RFID has seen a tremendous uptick in applicable scenarios.

According to David Ciampi, RAIN Developer at Licensys, he recounts a progression of thought around the use of IoT and RFID that has led to the adoption of the advanced RAIN RFID and RCI interface.

The first realization, to "sense and observe" the real world and combine that with machine learning and artificial intelligence with the aim of improving automation processes, proved to be a significant leap, he recalls, fusing sensor data "creates a rich set of validated information about items and [the] environment."

The second realization focused on identifying specific "things" as they move around and through the world.

Enter RAIN RFID, an inexpensive, batteryless electronic tag that can be reliably read as it passes through a read zone. RAIN RFID tags are feature rich, and have the capability of carrying additional data including

attributes and sensor data used for security and privacy. Attached to nearly anything, RFID tags can be used to uniquely identify and track an object as it passes through a reader.

The idea of RAIN RFID pushes the details and complexities of observation to low-level real-time systems, effectively reallocating the computing power needed to the edge and removing that responsibility from central systems that can in turn redistribute computing power to other tasks.

With the advent of the RAIN Communication Interface (RCI), a standard communication protocol (defined using JSON) between readers and application software is now available to all vendors. RCI offers:

1. Using schemas to tell a reader which tags is to be observed, how to access the tag, what data needs to be reported and what the report should look like.
2. Encapsulate the complexities of accessing (talking) to a tag in the reader. The reader reports the outcome of that access.
3. Ensure that interoperability with data systems are achieved with backwards compatibility and extensibility.
4. Ensures that all types of readers provide interoperable and valid RAIN RFID tag data and spot (the instance of seeing, accessing a tag) information.

A TRUSTED PARTNER

Powered by renowned ThingMagic technology, our RFID solutions utilize the broadest low-frequency (LF), high-frequency (HF), ultra-high-frequency (UHF/RAIN®) portfolio in the industry. Whether you require RFID-only or a combination of RFID and barcode scanning, we have the right solution for your unique application: embedded modules, fixed-mount readers, handheld scanners, and more.

JADAK's deep knowledge of machine vision, RFID, and barcode in the medical industry, makes them uniquely positioned to solve many different types of challenges. By embedding the right technology into new and existing products, OEMs can gain the product differentiation and competitive advantage, while protecting revenue streams and brand integrity.

About JADAK

JADAK, a business unit of Novanta, is a market leader in machine vision, RFID, barcode, printing, and color and light measurement products and services for original equipment manufacturers. The business designs and manufactures detection and analysis solutions that help customers solve unique inspection, tracking,

scanning and documenting challenges. JADAK is based in Syracuse, New York, with sales and technical locations across the globe.

About Novanta
Novanta is a trusted technology partner to OEMs in the medical and advanced industrial technology markets, with deep proprietary expertise in photonics, vision and precision motion technologies.