
WHITE PAPER:

RFID Impact on the Enterprise

In recent years, Radio Frequency Identification (RFID) has emerged as an important new technology for many Enterprises. This whitepaper provides an introduction to RFID and a brief description of how the passive-tag version of the technology works. It then outlines the impact this new technology may have on the Enterprise as companies in multiple industries embrace RFID and move to production deployments.

Introduction

Radio Frequency Identification (RFID) is coming to many Enterprise networks.

By now you may have read articles about RFID technology or heard that Wal*Mart and the US Department of Defense (DoD) are already mandating its use. It is also possible that RFID is being utilized within your own company. Leaders in many industries, government agencies and regulatory bodies are evaluating the technology, learning how it works, and thinking of ways it can be leveraged to solve important problems. RFID is fundamentally about automating the process of data capture, particularly object-descriptive data that cannot be efficiently captured today. Once RFID data about an object has been captured, it can be used internally by applications within the enterprise or communicated via networks to external applications at other enterprises.

Some of the “magic” of RFID is that the data associated with the object can be captured without human intervention or line-of-sight between the RFID reader and the object’s tag. The ability of an RFID reader to record observations of hundreds of uniquely tagged objects per second creates myriad opportunities for businesses. Some of the RFID-enabled benefits being pursued by early adopters include improved retail product availability, reduced inventory levels, streamlined operations, automated audit trails, and a broad range of track-and-trace related applications. Additionally, RFID promises for many businesses the ability to transform and improve processes in ways that are too compelling to ignore.

According to experts in a diverse range of industries, RFID has the potential to become the most disruptive technology since the Internet. If your company is not deploying RFID today, it will likely consider doing so in the future. Whenever that time comes, there is something you should know: RFID will have a significant impact on your enterprise network.

Background

RFID is not new. The origins of the technology trace back to the birth of radar. Various forms of RFID tags have been used for decades in applications such as theft prevention, electronic toll booths, asset tracking and keyless entry systems.

So what is new? Much of the recent surge in interest in RFID is a direct result of the widespread attention being paid to UHF passive tag technology and its potential application for tracking goods in the global Supply Chain. UHF passive tags operate in the unlicensed 900 MHz radio frequency band in the U.S. and in similar bands around the globe. Led by Wal*Mart, major retailers are progressively mandating that their top suppliers implement this type of RFID tag technology on cases and pallets of their goods. A similar retailer-driven technology adoption process occurred 20 years ago when leading retailers mandated the use of barcodes on goods received from their suppliers.

The interest in RFID is not confined to retail industry alone:

- The US DoD has already mandated that suppliers of items ranging from food to ammunition begin tagging the products they ship to several Army depots. As many as 42,000 suppliers may be affected by the program.
- Pharmaceutical manufacturers and the FDA are investigating passive tags to track the pedigree of prescription and over-the-counter medicines.



- Hospitals are deploying RFID to track patients and equipment.
- Aerospace companies are considering tagging parts and assemblies to track them both during manufacturing and throughout their operating lifecycles.
- Even casinos are testing RFID applications for chips and slot machines.

While the current level of adoption varies by industry, the fact remains that many enterprises are piloting the technology and momentum is building for RFID initiatives.

How Passive RFID Works

An RFID tag is a microchip with memory and a connected antenna, usually embedded into some kind of label and applied to an item, package, tote, or pallet. As illustrated in figure 1, the microchip typically contains functional blocks such as a switch, a demodulation module, memory, control logic and a voltage converter.

UHF passive tags do not have a built-in power source or battery. Instead, the RFID reader is required to transmit a carrier wave that effectively powers the tag. Modulating some of these carrier wave transmissions are commands, which after demodulation can in turn cause the tag's control logic to execute a small program. One such program might cause the tag's switch to short out the antenna in a predetermined sequence to communicate to the reader an Electronic Product Code (EPC) contained in tag memory. This communication takes place via a technique commonly referred to as backscatter modulation.

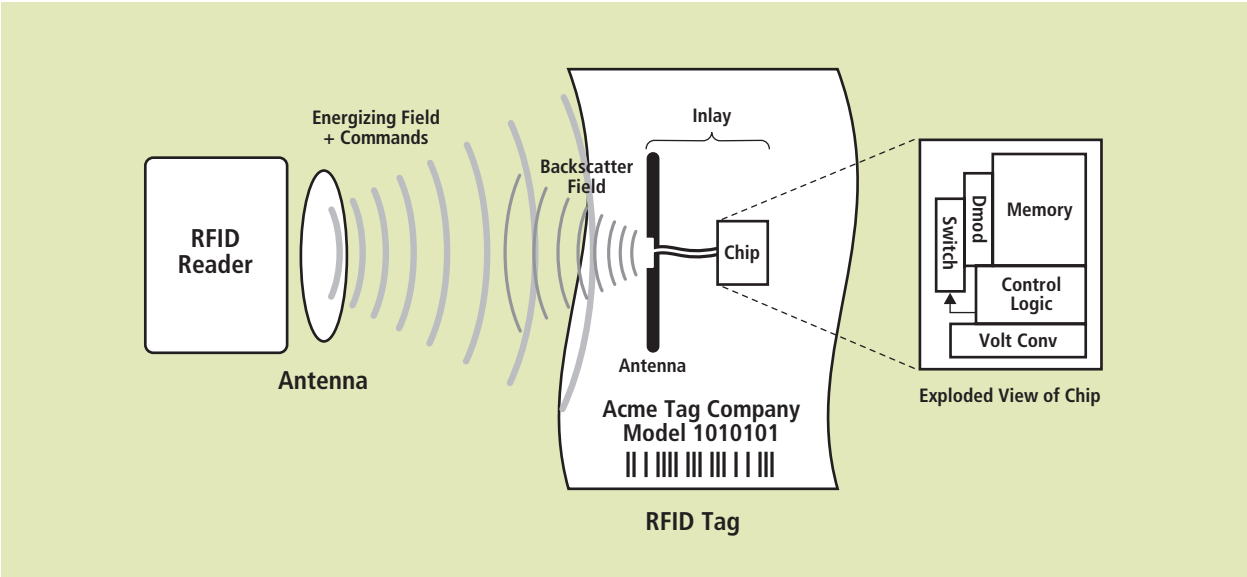


Figure 1. Reader—Tag Interaction



Tag read ranges (the distance at which an RFID reader can successfully read a tag) are dictated by this process. Tag read ranges of 5-10 meters are typically quoted by reader manufacturers for passive UHF RFID tags. Based on this, you might assume that you can deploy readers every 10 meters or so and expect to capture any tag that moves by. In reality, deploying multiple readers is not straight forward.

While a reader can only power a tag over short ranges, the RF energy that the reader generates has the potential to propagate for miles, certainly throughout a facility in which the reader is being operated. This leads to the possibility of reader-to-tag interference where a tag hears the transmissions of more than one reader and is unable to successfully decode the commands telling it what it is supposed to do. Additionally, readers can directly interfere with each other. In this scenario, a reader that is trying to listen to the relatively faint backscatter from a tag is prevented from doing so when the tag response is obscured by the powerful transmissions of another reader somewhere else in the facility.

These fundamental operating modes dictate that the operation of RFID readers must be controlled or coordinated when multiple readers are deployed in the same facility.

Impact on Enterprise Networking

Until quite recently, the majority of RFID readers were operated as peripheral devices, serially-connected to PCs. In response to market demands, readers have evolved into Ethernet-connected appliances running full TCP/IP stacks. Several vendors have also introduced Power-over-Ethernet (PoE)-enabled RFID readers. For mobile applications like handhelds or forklift mounted readers, manufacturers are developing readers that communicate with their controlling systems using the wireless 802.11 protocol.

The impact of RFID readers on enterprise networks is more complex than the simple connection of a new class of networked device. There are several dimensions.

Scale

Many companies are expected to deploy tens or hundreds of readers within individual facilities, with thousands deployed across the enterprise. One estimate claims that, by 2015, as many as one hundred million RFID readers could be connected to networks around the world. Even if this number proves to be exaggerated, for many enterprises the RFID reader may still become the most numerous type of network-connected device.

Connectivity and Manageability

Since networked RFID readers will be deployed at the edge of the enterprise, in environments ranging from shop floors and retail stores to hospital rooms and warehouses, most of the people responsible for running and managing these networks will never see the readers. Centralized or remote management capabilities will be critical for production rollouts. This makes device connectivity and remote manageability an obvious concern for network administrators.



Network Capacity and Reader Control

Individual RFID readers are currently designed to read hundreds of tags per second and each read cycle for a single reader consumes RF bandwidth. The available RF bandwidth in the 900MHz band is a finite resource that every reader in a facility must share. Data can only be captured if the reader that can see a tag has available bandwidth (i.e. it operates on a frequency that isn't being consumed/obscured by another reader). Tight control of reader operations is necessary to achieve the tag read rates enterprises need and expect.

Additionally, readers have the capacity to generate large volumes of redundant data. Some early adopters have reported that as few as two or three uncontrolled readers slowed their local area networks considerably before they established proper operating configurations. As RFID proliferates, the potential to tax networks with increased traffic increases; this will make bandwidth management through correct network configuration and reader control a clear priority for the enterprise.

Application Support and Data Management

RFID data is most useful when an application can apply meaningful context to it. Many enterprises will find value in tracking product movements and understanding product status at critical times and locations. To do this, the raw data must be processed into a usable form before applications consume it. Consider the generation of thousands of reports from Readers A, B and C as they observe Tag 123 in Locations X, Y and Z during a given time period. Without additional information about the location being observed by the readers, as well as the business context surrounding those events, an enterprise application would have a difficult time making use of this data stream. It is important in the design of RFID networks to adopt a standard contextual reference for the capture of RFID data. This might resolve to the business locations that applications care about and insulate the applications from the specifics of the data-capture devices themselves. Abstracting away reader details from the application-level data is a primary concern when dealing with production implementations.

In Supply Chain applications, RFID tags are encoded with an Electronic Product Code (EPC), which is a number that uniquely identifies the object the tag is attached to. Unlike the Universal Product Code (UPC) barcode that you are used to seeing scanned at your local supermarket, EPCs are serialized. This means that two RFID tagged cases of like items each have their own unique EPC, even though they may share the same UPC. The serialization aspect of RFID offers many benefits, particularly for products that are subject to counterfeiting risks, chain-of-custody regulations, and expiration dating, but it also introduces data management requirements that are several orders of magnitude more challenging than those of barcodes. Therefore, a robust data management strategy is a key component to any RFID initiative.

Conclusion

Many industries will consider, test, and deploy RFID technology as part of their automated data collection infrastructure. The potential benefits are compelling.

As RFID proliferates and production deployments roll out, there will be significant impacts to consider and address from an enterprise networking perspective.







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