Building the Business Case for Passive RFID Sensors in the Data Center

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Automatic asset monitoring in data centers using radio frequency identification (RFID) sensors can provide real- or near real-time accounting of items by location, time and date stamp. Recent enhancements in RF sensors enable supplementary data collection capabilities such as environmental assessment of temperature, humidity, vibration and moisture.

Appropriate selection of RF technologies depends largely on end users' objectives, defined scope of work, and data center environments and layouts. Generally, RFID technology will help with the following activities.

- Improving visibility into facilities and assets
- Improving real-time data flow into DCIM, finance, accounting, ITSM, ITAM, and security
- Streamlining and accurate inventory management
- Enhancing compliance with SARBOX, financial and accounting requirements
- Improving risk mitigation - reduced number of lost and missing IT assets
- Improving SLA performance through improved ITAM and ITSM integration, tracking and management of IT assets

There are many considerations for data center operators in determining the appropriate RF technologies and applications. While the result is more effective asset management and improved asset visibility, additional focus can involve improving physical asset governance, compliance and audit reporting. Due to optimized location, utilization reports and reduced time to locate assets, automated information updates can also support regulatory goals.

On average, using RFID saves 6.5 days when auditing 10,000 assets versus a manual process. The number of days saved using RFID versus barcodes for the same 10,000 assets is 1.5 days. It takes approximately 40 minutes to inventory 1000 assets using RFID, versus 5 hours if performed manually, or 2 hours using barcodes.

Number of IT Assets	Hours for IT Asset Tracking			RFID Resource Time Savings
	Manual	Barcode	RFID	
1,000	5	2	0.4	4.6 hours
5,000	25	8	2.2	3.0 days
10,000	50	16	4.4	6.5 days

Asset Tracking Challenges

Data center operators are not isolated from the challenges confronting any industry when implementing asset management systems. Historically, proprietary tracking solutions that require extensive fixed location and active asset tracking infrastructure have high up-front costs. Lower cost passive UHF tags significantly reduce up-front capital expense, so passive RFID is widely used in retail, pharmaceutical, food chain, data center and healthcare applications. Key considerations in selecting IT management solutions include the following.

Agility

Identifying key ROI factors affecting the cost of deploying automated data collection systems include assessing tangible costs, workflow changes and backend integration. Systems should be bundled into easy-to-deploy solutions that cause minimal disruption to current processes while meeting ROI thresholds. This requires analyzing current workflows and clearly identifying the processes for improvement. Calculating costs and benefits of components with a view to developing replicateable solutions and processes requires evaluating the ROI against the impact of any workflow changes. An agile approach using incremental implementation is best to test and evaluate results.

WI-FI & BLUETOOTH LOW-ENERGY (BLE)
PASSIVE/ACTIVE RFID
NEAR FIELD COMMUNICATIONS (NFC)
TEMPERATURE/HUMIDITY/MOISTURE
CELLULAR & MOBILE APPLICATIONS
REAL-TIME LOCATING SYSTEMS (RTLS)
ULTRA-WIDE BAND (UWB)
BARCODE TECHNOLOGIES
GPS-ENHANCED DEVICES
SENSOR-ENHANCED SECURITY ACCESS

Resources

Systems must be designed and employed to not over-burden already scarce IT staff through automating data collection, analysis, alerts and management.

Making It Fit

Non-standard rack selection and configurations offer a challenge to designing one-size-fits-all automated data collection equipment setup. While several different data collection hardware systems might be used data management can be standardized.

Technology Risk

Evolving RFID and sensor technologies used in data centers create a risk that equipment might be obsolete in as little as 18-24 months. Using only standards-based protocols such GS1, GEN2, ISO, and UL give some degree of validation that a system is current, adaptable and scalable to changing technologies.

Data Explosion

With the exponential growth in data generation, optimal sensor solutions for temperature, vibration, humidity and RFID need to be carefully evaluated so as to not overburden systems. Edge data collection, storage and management is increasingly seen as a necessary component and solution for data center operations.

Inventory Reconciliation

Establishing a baseline of accurate asset and related information through an initial inventory reconciliation at the beginning of any RFID project is critical. The process often identifies orphan assets that have not been tracked, contain sensitive data, and uncover unrecorded modifications to equipment. Focusing on initial protocols and assistance with asset inventory accuracy is required.

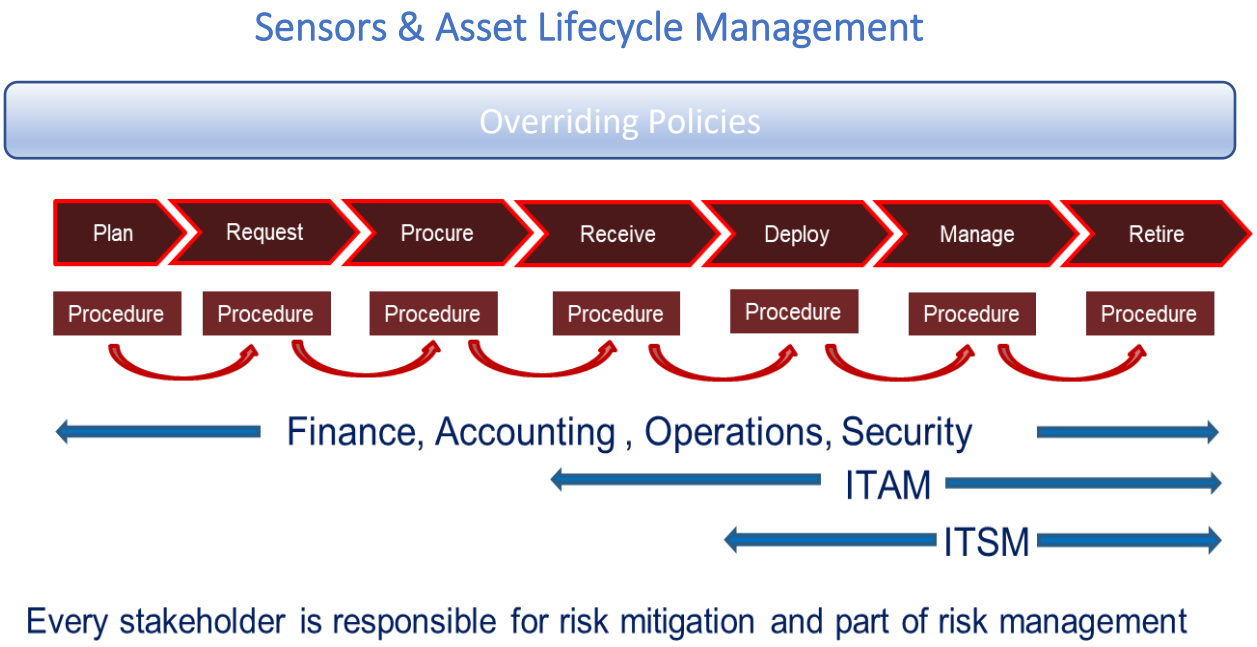
Security

Equipment tracking and monitoring systems are often not designed to be security systems. RFID-based data collection supports real-time security features such as sending alerts and turning on cameras. However, the technology is defeatable if tags and sensors are removed or blinded by obstructions.

Asset Lifecycle Management

Asset lifecycles need to be tracked for a variety of purposes. For financial compliance such as SARBOX, the requirements are different from operations requirements. While assets can be fully depreciated for financial reporting, relevant databases would be different from ITAM or DCIM databases since financially depreciated assets might still be operational and need to be tracked and monitored.

For data security, every asset needs to be accounted for through the asset's final disposition. A fully integrated cross functional tracking system would ideally have the following elements.



rfidCollect's numerous physical inventory counts show that data center operators frequently overlook protocols on asset decommissioning, disposition, and destruction. As such, close monitoring and tracking of data center equipment is critical to mitigating the risk of equipment and data loss. Relying on manual tracking is generally not efficient and it diminishes as the number of deployed assets increase.

While barcoding improves the accuracy of asset tracking, it is still prone to human error as it relies on users' ability to physically see each item. RFID is the ideal and the most accurate form of asset tracking since it automatically reads tags without human intervention.

In this regard, discovering the appropriate technologies to be used is critical for success. The more granular the item tracking becomes, the more complex and costly the solution becomes. At some point the cost benefit analysis becomes the overriding consideration.

Stranded Servers

With the exponential and accelerating growth in data generation and cloud computing, the liability for unaccounted data on active and decommissioned servers and IT assets is increasing. The pressure on data center managers to expand and upgrade facilities and equipment frequently means that inadequate attention is given to decommissioning and purging servers of sensitive data.

When removed from racks and formally processed through decommissioning and destruction, the financial value of servers and IT assets is equal - namely they both have zero value. However, decommissioned servers are frequently left in racks where they not only consume space and energy, but retain valuable data, which if mishandled, misplaced or stolen can result in extremely costly liabilities.

Automatic asset tracking can be conducted at a highly granular level, such as associating servers, locations and components. However, the economics and ROI sometime do not justify deployment of the necessary technologies. At its most basic level, assets should be RFID tagged when

Geo-fencing

It is generally not necessary to track assets as they are moved around a data center. It is enough to geo-fence locations and identify when assets are being removed from one zone to another other, such as from a server isle to a storage area, or from storage to a decommissioning area.

Associated with this is the ability to use an RFID readers' GPIO ports to trigger cameras, alerts and alarms to record the movement of assets between areas.

As a security extension of this feature, employees and visitors to data centers could have UHF RFID tags affixed to or embedded in ID cards, with the reader software associating individuals with assets being removed from racks or being moved outside of specific read zones.

initially acquired and commissioned so that they can be tracked into the data center, at their operational location, when they are moved for servicing, when they are retired from operations and when they are disposed of for destruction or to be wiped clean.

Baseline Information and Asset Tagging

Assets should ideally be tagged at the point of manufacture so that when they are delivered to the end user they can be automatically identified and entered into backend systems for asset management. While there is a trend towards this, items already deployed or delivered to an end user need to be tagged and an accurate count be made of all assets being tracked.

In order to get a valid baseline, data center operators often hire a third party to conduct a physical inventory count and reconciliation with customers' existing databases. In a recent physical inventory reconciliation of a global social media's data centers, it was found that numerous assets were not where their recorded location indicated and that subcomponents were often misidentified.

This situation generally occurs when there is rapid expansion of data center server requirements. In this case, approximately 10,000 assets had duplicate asset tags. Over the course of the reconciliation half of the assets were retagged. During the project approximately 90% of the expected assets were correctly identified by location, however between 25-50% of the associated asset information, such as related to replaced disk drives, was also incorrect. The percentage varied by data center. At the time of reconciliation, assets were tagged with combination RFID/barcode and human readable tags to ensure that an RFID tag could still be identified if the chip were damaged.

System Selection

Basic system components include tags/sensors, scanners/readers, antennas and a database. RFID tags come in many forms, including HF, UHF for real-time location systems (RTLS), active and passive UHF and Bluetooth beacons. The basic advantages and disadvantages of each type are summarized below.

High Frequency (HF)

Primary frequency range: 13.56 MHz
Read range: touch or near contact – 2-3 inches.
Average tag cost: $0.20 - $10.00
Applications: access control, library books, ID Cards, gaming chips
Disadvantages: short read range, low data transmission rate

Active Ultra-High Frequency (UHF)

Primary frequency ranges: 433 MHz, 860 - 960 MHz (US) and 865 - 868 MHz (ETSI)
Read range: 100 - 300+ feet.
Average tag cost: $5.00-$10.00
Applications: vehicle tracking, auto manufacturing, oil & gas, data centers
Advantages: very long read range, low infrastructure cost, large memory capacity, high data transmission rates, global standards
Disadvantages: high tag cost, battery life, complex software requirements, high interference from metal and liquids, few global standards

Passive Ultra-high Frequency (UHF)

Primary frequency ranges: 860 - 960 MHz
Read range: up to 25 feet.
Average cost per tag: $0.09 - $2.00
Applications: supply chain tracking, manufacturing, pharmaceuticals, electronic tolling, inventory and asset tracking
Advantages: International standards based, medium distance read range, low tag cost, wide variety of tag sizes and shapes, global standards, high data transmission rates
Disadvantages: moderately high infrastructure costs, moderate memory capacity, high metal and liquid interference

Bluetooth (BLE)

Primary frequency ranges: 2400 MHz – 2480 MHz
Read range: Use case 30 feet, capable of up to 200 feet with direct line of sight between scanner to tag.
Average cost per tag: $4.00 - $18.00
Applications: large asset tracking, manufacturing, electronic tolling, asset geo-fencing
Advantages: standards are globally unlicensed (but not unregulated), longer distance read range, mid-range tag cost, wide variety of tag sizes and shapes, global standards, high data transmission rates
Disadvantages: mid-range infrastructure costs, moderate memory capacity, high metal and liquid interference

Passive RFID is the best overall solution for data centers because new technologies require fewer readers to be deployed with a larger array of antennas, which brings down infrastructure deployment costs. With low-cost combination RFID/temperature and humidity tags, assets can not only be tracked, but the localized environmental condition in which they reside can also be mapped and assessed for equipment malfunction or cooling system adjustments.

With the use of passive UHF RFID in data centers, two types of tags should be considered – standard tags with a read range that adequately covers the typical distance between server racks (assumed to be equal to or less than 10 feet) and battery assisted passive (BAP) tags with read distances of 100+ feet. Battery assisted tags require the monitoring of battery life, are significantly more expensive than standard tags, and have unnecessarily long read distances. The cost of BAP tags does not justify their use in data centers.

An additional consideration in determining the appropriate choice of tags is whether it is necessary to track the physical movement of tagged assets using RTLS or whether it is sufficient to know when a tagged asset was last seen at a location or zone. RTLS systems require significant reader/antenna infrastructure to triangulate tag movements over short periods, and in aggregate over long periods, even when items are not being moved. The expense and difficulty of tuning and maintaining RTLS systems cannot generally be justified on an ROI basis.

Passive RFID Tag Selection

Equipment tag selection in data centers is influenced by several environmental, handling and physical considerations. While tags are generally selected based on trials and evaluations following site surveys and testing, the primary considerations in tag selection include the following:

- Larger tags provide better read rates, however, there is frequently insufficient surface space to apply large tags, so tag sizes need to be carefully assessed.
- Equipment tags need to be oriented towards RFID antennas to maximize tags' internal antennas to reader transmit/receive antennas.
- Since metal surfaces deflect RF signals special tags to accommodate the distortion need to be evaluated.

Tags generally fall into these categories:

- Metal mount tags that adhere to the surface and use the metal surface to amplify tag signal transmission.

RFID/IoT Edge Devices

New edge devices allow code and commands to be pushed down to the device level. This boosts cybersecurity and reduces data volume, storage requirements, the need for expanded transmission pipes.

Advanced GPIO connectors allow integration to CCTV and peripheral equipment.

Advanced IoT data collection devices are capable of additional sensor management such as temperature, humidity, vibration and moisture data management on the edge.

Recent edge scanners are compatible with Microsoft Azure, IBM, Google, AWS, and most major operating systems.

- Metal shielded tags that have a barrier between tag RFID chip/antenna inlays and the surface to which they are attached.
- Flag tags which are generally paper, or polyester covered with part of the tag adhesive coated to attach to the equipment surface while the inlay portion of the tag is elevated off the surface.
- Hang tags that are attached to equipment with a short tether that ensures the tag RF transmission is not affected by the equipment's metal surface.
- Metal mount and metal shielded tags are relatively expensive but have the advantage of being more rugged and robust and less susceptible to accidental damage. Flag and hang tags, while considerably less expensive, are more vulnerable to accidental damage.

Software

A fully integrated turnkey RFID application generally provides basic functionality that is standard across most solutions. The current application code for RFID software includes event handlers, filters and device drivers that are fundamental for data collection and transfer usage. Off-the-shelf applications are typically tailored based on user requirements. Applications can be either installed client-side on a customer's on-premises server, or securely hosted outside. An emblematic software stack is comprised of the following tools:

Core Code: Used for identifying a component that has item identification and methods shared across all software subsystems and used to configure data for readers connected to a node.

Database: A JSON script used for the object/relational mapping (ORM) layer. It is used to read and write data between a relational database and configuration nodes. It maps items, assets types, attributes and locations.

Sensors: The sensor level interface for tag data encoded via the LLRP client interface.

Web: A web service interface that provides a RESTful API to allow access to various subsystem components.

Web-UI: A customizable web-based user interface or console for viewing and updating database tables.

Elements of the software stack are central to an integrated solution's efficiency that sorts and filters data flows by relevance to required workflow and data management to collect, store and analyze. The fundamental application goal is to create a simple-to-deploy and use tool that doesn't require major integration costs, and easily integrates with ERP/SAP systems.

Passive RFID Capability for Generalized Tracking

People

- Track personnel use badges, key chains, or wristbands.
- Collect and match personnel data with location and equipment.
- Build entry/exit reports.
- Trigger alerts for no-go zones and geo-fencing.

Assets & Inventory

- Identify and track equipment, hard drives, large and small parts for asset lifecycle management.
- Monitor storage room entry/exit.
- Manage office assets, machines, equipment, tools, and inventory.
- Track item movement, maintenance, decommissioning and disposition certification.
- Automated inventory counts and reconciliations.

Using a handheld RFID reader for inventory verification thousands of items and related accessories can be verified in a fraction of the time, and with higher accuracy, that can be manually counted.

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