An Oracle White Paper
January 2011

How to Track Your Oracle Sun System Assets by Using RFID

ORACLE

Disclaimer

Oracle Inc acquired Sun Microsystems Inc. on February 14, 2010. Some activities in this whitepaper occurred prior to Oracle Inc.'s acquisition of Sun Microsystems, Inc.

Introduction

Radio Frequency Identification (RFID) is a method for identifying objects using low-range wireless radio frequencies. RFID has been used for more than two decades to improve business efficiencies in supply chain, transportation and inventory management across many commercial industries as well as in government.

Oracle has written this paper to assist our customers in understanding the new 2nd generation RFID tags that are being shipped on every Oracle hardware product.

This paper will explain how the RFID technology works, the context for which our tags were developed, the standards they adhere to and how to leverage them to augment your IT asset management lifecycle.

.

History of RFID

RFID has been around for many decades. It became commercially mainstream technology in the early 2000s when retailers like Walmart, Home Depot, Target and Lowes mandated that their top suppliers begin affixing RFID tags to pallets and crates of merchandise. Over time, as the cost of the RFID technologies dropped and the range and function of the technologies expanded, RFID has been used to tag and track animate and inanimate objects in ever evolving ways.

From livestock to telephones, practical uses for RFID are limited only by the imagination. RFID is a routine technology used around us every day. Examples of how RFID isused below;

- Passports
- Healthcare – patient, hospital tracking
- Livestock management
- Access and tolls to buildings, transportation, bridges and roadways.
- Government inventory and logistics
- Inventory and supply chain management from supplier to checkout
- Corporate Asset tracking

In the latter half of 2000s, several large banking institutions facing rigorous Sarbanes Oxley regulations, requested the Financial Services Technology Consortium (FSTC) to define standards for using RFID as an augmentation to the automation capabilities that barcodes provided.

To benefit our customers, Oracle decided to include RFID tags on all server and storage products to facilitate automated asset tracking.

Since the FSTC proposed standard was for US markets only, Oracle worked with partner RCD Technology to incorporate not only US radio frequency bands, but expanded the RF ranges of the tag to simultaneiously support US and Itinternational frequeny bands. This makes the RFID Oracle tag universally effective.

The RFID tag used by Oracle is a superset of the FSTC standard. The Oracle RFID tag meets FSTC requirements, Department of Defense (DoD) requirements as well as the EPCglobal Specifications.

Benefits of RFID for Asset Tracking

One of the large financial institutions set up a pilot project using RFID and reported an increase in accuracy of 15% over using bar codes and also reported that the time to inventory one isle of their data center went from 2 hours to 1 minute. In summary the benefits of using RFID to track IT assets are:

- Improves accuracy of current asset inventories
- Eases labor requirements of inventory and location processes

- Enables detection and recording of asset movement and location
- Enables reduction in operational expenses
- Enables loss detection and often aids in loss prevention

How Does RFID Work

RFID enables identifying information to be transmitted from a very small specialized tag via low-range radio waves to a nearby reader that collects the data.

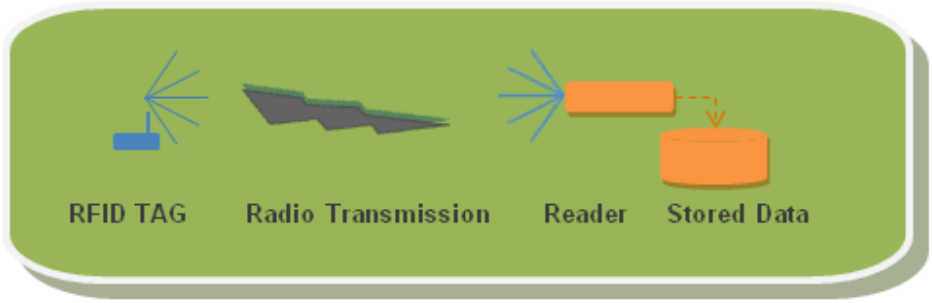


Figure 1. RFID: How it works.

What Does an RFID Tag Look Like?

RFID tags are typically small labels, rigid or flexible, that provides its contents (identification information) via short distance radio waves to an RFID reader or sensor. The RFID tags, depending on their purpose, can be battery powered, passive or a hybrid. RFID tags that defined as passive, do not have their own power source. Passive tags must be energized by an energizing device in order for them to have sufficient power to transmit their contents. Oracle RFID tags are passive. They only transmit their contents when an energizing reader is within the 6 to 9 feet required.

The tags designed for use on the Oracle products had to fit within a specific size envelope (~36x10x5mm), be able to respond while attached to either a metal or plastic surface and meet the distance and read velocity requirements specified by the FSTC. While the battery powered and hybrid tags would likely meet the distance requirements, they are simply too large to be accommodated on the front surface of many of Oracle's products without adversely blocking airflow.

Other passive tags, such as an EPIC tags shown below, although commonly used for retail and manufacturing supply chain management do not respond when attached directly to a metal surface making them unusable on most IT assets.

EPIC tags are also too large to fit on the front of many IT products.

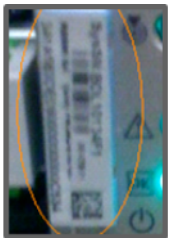
Visual Comparison of Common RFID Tags.

RFID tags come in many form factors and each serves a different purpose. Below you will see pictures of tags that were designed for retail and manufacturing purposes. These tags, although not suitable for the typical IT asset, are still widely used in their domains.

EPIC Tag

The most commonly used RFID Tag in retail and manufacturing is the EPIC tag. (shown to the left). These are widely adopted, but unfortunately would not properly energize when attached to a metal or metal-backed surface, which most IT assets have.

Oracle 1st Implementation RFID Tag



Oracle's 1st implementation RFID tag was fine for its time but ill-suited to meet the changing requirements from EPCglobal and the Department of Defense (DoD). This tag would only respond and communicate with readers designed for the United States frequency bands. It was shipped very briefly and was quickly replaced with the 2nd implementation tag to support global standardization.

Oracle 2nd Implementation RFID Tag

In 2010, In order to meet the operational needs of RFID for IT asset management in typical data center usage scenarios, Oracle selected the globally usable, metal-attachable, FSTC compatible, Tag manufactured by RCD Technology

To the left, is a picture of the rigid multi-band RFID tag shipped on the front of Oracle products. This tag is consistently applied to the front of the equipment and is readable by a portable or stationary RFID reader within a 9 FT range in all global radio frequency bands.

Comparison for Dipole Alien Tags and RCD Sentry-M WW Tags

To the right is an internal view of an Alien dipole tag alongside an Oracle tag. The dipole tag is flexible and is used heavily in supply chain and inventory processes. Besides its obvious physical differences, it did not meet the functional requirements needed for a global IT asset tracking device nor does it work when affixed to metal objects like servers and storage devices shipped by Oracle. Like the EPIC tag, Alien's Dipole tags are widely used in many other tracking scenarios.

RFID Readers

RFID readers (also called sensors) are manufactured and sold by many vendors and come in two form factors: stationary and mobile. In some cases assets may be tracked and managed with both forms of readers.

Stationary Readers

Stationary RFID readers are often mounted at all entrances and exits to a data center facility. The act of moving an asset with an RFID tag through the portal causes the RFID tag to be energized and then read by the reader. The reader records the item and movement (including direction) typically to a network repository, where the information is available for programmatic use.

The detection of the asset passing through the sensor field would be logged as an event in the data repository, then the software framework in place to manage the events would handle notifying all the upstream enterprise systems such as help-desk systems, ticketing systems and other asset management systems.

Sample IT Asset Lifecycle

Below is a numbered diagram that is followed by a numbered narrative that should help illustrate how a data center can be fitted with stationary RFID readers to track which assets come in and which assets come out.

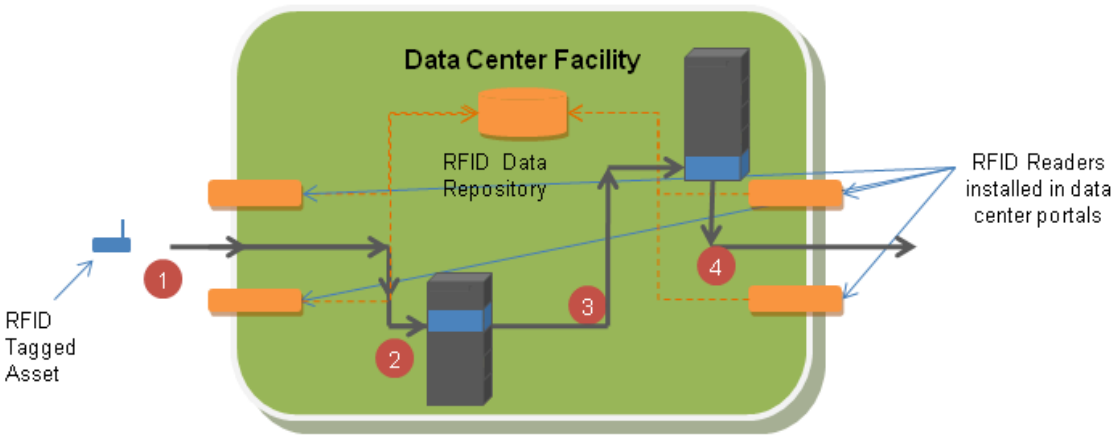


Figure 2. Sample asset flow through data center using stationary readers. (stationary readers are often called portal readers)

RFID tagged asset would pass through the RFID sensors at an entrance. The sensors would first energize the tag, and the tag would transmit its unique EPC code via radio waves. The sensors would receive the EPC transmission from the tag and would log an event with the EPC code, the direction of the movement and location of the tracking event to the RFID data repository.

1. The asset would enter the data center
2. The asset would be installed within the facility, usually a rack.
3. A year or two later the asset may move to another rack within the facility.
4. The asset is removed from the facility where again, the sensors energize the RFID tag, the tag transmits its unique EPC code via radio waves. The portal sensors would receive the EPC transmission from the tag and would log an event with the EPC code, the outbound direction of the movement and door location to the repository.

With the use of software, hybrid usage of door sensors combined with mobile readers (not depicted above) can yield an overall set of event data that supports reconciliation and location of assets at any point in time.

Mobile Readers

Mobile Readers come in various configurations with different types of antennas, different power profiles and different ranges of use. Many support 2D barcode scanning as well as RFID tag reading.

Hand-held units use about half the power of a stationary reader and therefore read from a shorter distance. To make up for the distance limitation some readers are available with a polarized antenna, however, this requires the orientation of the reader to be in the same plane as the tag. Circular antennas are able to read the tag regardless of orientation, however, these antennas work from a shorter distance.

If you use a hand-held reader, make sure you choose the right one for your needs.

In the picture below, a cart-mounted stationary reader is transformed into a mobile asset tracking machine by adding a laptop to capture the data from the RFID reader which is powered by a battery mounted on the cart. The reader is pushed along the front of computer racks, where the asset-affixed RFID tags are energized and transmit their EPC codes. The RF information is collected and stored in a local repository on the laptop. Once local to the laptop, it can be transferred to other systems for reconciliation, inventory updates etc.

Figure 3 Cart-mounted RFID reader with four antennae being rolled down IT aisles, collecting real time inventory data.

Note: Some people have an unfounded fear that the RFID transmissions from the RFID tags or the RFID Reader could cause running servers to crash. Oracle server and storage products are designed to be resistant to radio frequency energy fields. Oracle products are routinely tested for energy fields much greater than the signal strength of an RFID reader or the tag.

Asset Tracking With RFID

How to Get Started with Computing Asset Tracking Using RFID

RFID usage can range from simplistic asset inventories using a single mobile device to complete fabrics of stationary and mobile readers working in concert to inventory and track and locate assets whenever needed.

This document assumes that if you have RFID technologies already available to you in your enterprise, that you will follow your enterprise's architectural framework. EPCglobal publishes a publically available Architecture Framework Reference Model that is a great starting point for establishing your own enterprise architecture and to which most RFID vendors comply.

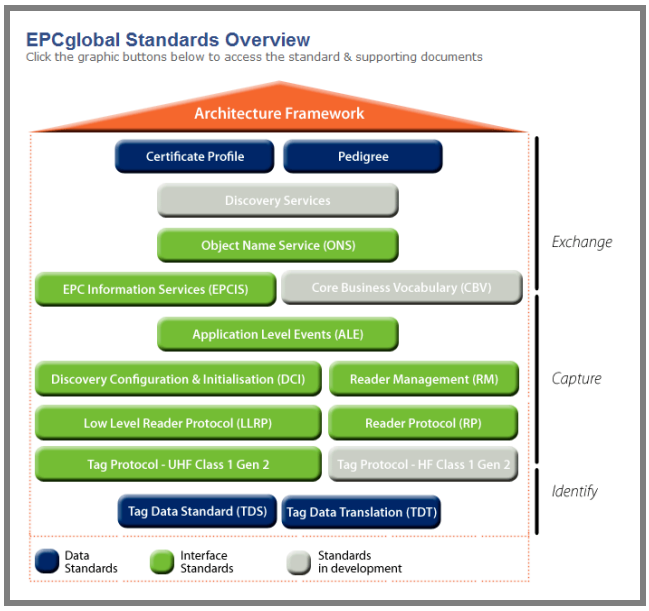


Figure 4 EPCglobal Architecture Framework

The EPCglobal Architecture Framework was created to enable customers to quickly utilize EPCglobal's standards within their enterprise and expose those interfaces to other parties. Using EPCglobal's framework provides you with out-of-the-box integration with many edge-ware vendors. Oracle's complete RFID partner list can be found at URL **http://www.oracle.com/technologies/rfid/partners.html**

If you are new to RFID, you may be surprised to learn how easy it is to utilize the rudimentary capabilities of RFID for inventorying your assets and creating a data repository for asset management.

The processes below describe a sample process to collect Oracle RFID and product serial number information together.

Tools Needed for Semi-Manual Inventory Process

- An RFID reader and its control software.
- Local data repository (typically a laptop or PC)

It will be much simpler for your asset management staff if they are provided an RFID reader that minimally supports the following features;

- RFID UHF Gen1 and UHF Gen2 compatible
- RFID programming
- 2D Barcode scanning
- Data collection and intuitive correlation of EPC with other inputs
- Data output in spreadsheet format (i.e., .csv)

- Customizable input fields such as Rack, Location, Business Unit, etc
- Laptop (if/as required by the RFID reader you choose)

Sample Inventory Collection Process upon Receipt

1. Read about and configure your RFID Reader. (See Tips and Tricks Section for advice on how to set the field focus and to orient for your reader's antenna.)
2. Configure your reader software package to support custom fields you would like to collect for the initial data collection along with the RFID Tag EPC number. (i.e asset owner, location identifiers such as rack and row numbers, cage number etc.)
3. For best results, place the RFID reader within 6 ft of the RFID tag on the front of the hardware and search for RFID Tags. If you are near other devices with RFID tags, you will need to select the right one for your device (read the label on the tag if you to discern from several) then store it.
4. Your reader, as you configured in step 1a, will prompt for other fields including the serial number of the product which can be scanned with the barcode reader, or typed in by reading the Customer Information Sheet that ships with each Oracle hardware product.
5. Once the data field are stored together, the data can be exported for input into other systems.
6. Once the correlated data has been stored in an upstream database, future inventories will only require the collection of the EPC which can be used to access the other stored information such as the serial number and location of asset.
7. Typically the most efficient way to do point-in-time inventories of your data center, is to row-by-row, open the front doors of your racks, and walk a mobile reader down the aisle, and discover all the RFID tags for reconciliation.

RFID Security

By its nature, RFID technologies in use today are not secure. RFID transmissions are subject to close-range eavesdropping. RFID tags can be energized and read within a 6 to 9 foot proximity.

RFID is provided as a convenience to our customers who wish to use it. If RFID is prohibited in your enterprise, one of these three options exists for you to disable or remove the RFID tag from Oracle products.

1. Reprogram the RFID tag
2. Permanently disable the RFID tag's RF transmission capability
3. Physically remove the RFID tag (along with the complimentary barcode and DoD labels)

Reprogram the Tag

In order to reprogram the RFID tag, you will need a reader that also supports reprogramming the tag. Since the RFID tag is passive, the reader will energize it in order to be reprogrammed, so be sure to place the reader in very close proximity before attempting to reprogram a tag.

The tags used on Oracle equipment are logically locked, and they must be unlocked in order to reprogram the tag.

1. Put the reader in program mode
2. Select the tag you wish to re-program
3. Give the reader the command to Unlock the EPC
4. Enter the new EPC that you wish to program into the tag
5. Give the reader the command to Program the EPC
6. Give the reader the command to Lock the EPC

Permanently Disable the Tag

In order to permanently disable the RFID tag, you will need a reader that also supports the tag KILL command. As in the reprogramming sequence above, be sure to place the reader in very close proximity before attempting to kill the tag.

The tags used on Oracle equipment are logically locked; they must be unlocked in order to Kill the tag. The tags used on Oracle equipment do not have a Kill password programmed into the device, a Kill password must be programmed into the device before the device will accept the Kill command.

1. Put the reader in program mode
2. Select the tag you wish to Kill
3. Give the reader the command to Unlock the Kill password
4. Enter the Kill password of your choice
5. Give the reader the command to program the Kill password
6. Give the Kill command three consecutive times

Remove the RFID Tag

Most enterprise customers will never have a reason to remove an RFID tag. There are some instances where removal is desirable and the process to safely remove the tag is outlined here.

Beware, as there are implications of removing the tag.

The label on surface of the RFID tag includes the printed serial number of the product as well as 2D barcodes. Removing the RFID tag removes the barcodes and also eliminates the front accessible

equipment serial number. Although the product serial number can still be read off the back of the equipment, the access is more cumbersome and prone to human error.

Before complete removal of an RFID Tag, consider disabling it instead.

Tools Needed to Remove the Tag

Pliers.

Steps to Remove the Tag

1. On the front exterior of the server or storage unit locate the RFID tag.
2. Using a pair of pliers, firmly grasp the tag on its sides, (the long access) in a way that avoids damaging the equipment.

Then gently rock the tag back and forth to pry off of the equipment.

RFID Standards Organizations

There are several standards bodies related to RFID technology. Most had their genesis in specific industries or sectors. Two significant RFID standards bodies include EPCglobal (EPC) and Financial Services Technology Consortium (FSTC).

EPCglobal

EPCglobal is the worldwide body that develops standards for RFID, barcoding and high quality data exchange between enterprises in the global economy. EPCglobal is a partnership between GS1 and GS1 US organizations.

Financial Services Technology Consortium

FSTC has leveraged the architectural underpinnings and standards defined by EPCglobal and has incrementally defined RFID tagging requirements for computer and storage manufacturers that ensure RFID is compliant with IT asset tracking needs within financial services. When the FSTC approached Oracle to comply with their RFID direction Oracle was more than happy to do so.

FSTC RFID Tag Requirements

The FSTC required that all vendor products ship with a pre-programmed RFID tag affixed to the front of the asset that followed the EPCG1G2 encoding specification, supported the US, radio frequency bands and would support a 6-9ft span of separation between the tag and sensor and movement at the rate of 1 meter /sec while being rotated up to 90°.

They also required printed facades that included human readable and machine-readable 2D barcode representations of the ID.

Oracle Maximum Physical Dimensions of an RFID Tag

DIMENSIONS	INCHES	MILLIMETERS
LENGTH	1.430 ± 0.015 Inch	36.3 ± 0.381 mm
WIDTH	0.430 ± 0.015 Inch	10.9 ± 0.381 mm
DEPTH	0.214 ± 0.008 Inch	5.44 ± 0.203 mm

Oracle Protocol and Frequency Range Requirements for RFID Tag

CHARACTERISTIC	VALUE
READ DISTANCES	6ft Stationary, 3 ft Mobile (hand-held)
COMMUNICATION PROTOCOL	UHF EPC Class 1 Gen 2
RADIO FREQUENCY RANGE	860 Mhz to 960 Mhz

Oracle RFID Tag Encoding

The data contained in the RFID tag is called the Electronic Product Code, (EPC). EPCglobal defines the EPC content specification. This number, the serial number of the RFID tag, identifies the brand of the IT asset, the tag manufacturer, the type of tag and a unique identifier. FSTC incorporates EPCglobal standard, EPC C1G2.

The Electronic Product Code (EPC)

The tags contain a 96-bit EPCnumber that conforms to the FSTC numbering scheme that consists of five numbers, that when combined, uniquely identify the asset to which they are assigned. These five numbers are referred to as the Header, the Filter, the Partition, the Company Prefix and the Individual Asset Reference. In addition to these five numbers the Individual Asset Reference number is broken into three sub fields, the tag vendor, tag version and unique identifier. Absolute uniqueness is obtained by combining the Company Prefix and the Individual Asset Reference.

NOTE: For desired reasons mentioned in the EPC standards, the serial number of the RFID TAG is NOT the same as the serial number of the Oracle product to which it is affixed. The product serial number must be collected and associated to the RFID tag serial number in a data repository for ongoing cross referencing. It is important to understand this distinction, as the product serial number is needed for service entitlement.

	HEADER	FILTER	PARTITION	COMPANY PREFIX	INDIVIDUAL ASSET REFERENCE
NUMBER OF BITS	8	3	3	20	62
BINARY VALUE	0011 0100	000	110	1001 0110 0000 1111 0111	See below

The Company Prefix number is assigned by EPCglobal, Oracle Sun brand company prefix number is 0x960F7 hex or 0614647 decimal.

Individual Asset Reference (Oracle Field)

The "Individual Asset Reference" always has bit 61 set as 1 and the lower 54 bits contain a number assigned by the tag vendor, who is responsible to ensure the uniqueness of the number.

INDIVIDUAL ASSET REFERENCE FIELD				
BIT LOCATION	61	60 . 58	57 . 55	54.....0
FIELD VALUES	1	<Tag Vendor>	<Tag Version>	<Unique ID>
		000 - Omni-ID	000 – Not Used	
		001 - RCD	001 – US Region	
		010 - …….	010 - Global	
		011 – 111 Rsvd	011 – 111 Rsvd	

Radio Frequency

Different countries allow and use different radio frequency bands for RFID, although not all countries use RFID. Countries that do not participate in global trade are typically the countries that do not specify nor subscribe to RFID.

Global tags have a single 96-bit EPC code and the antenna is tuned for 860 to 960 Mhz, which includes EU, US and Japan RFID frequency bands.

US tags have a single 96-bit EPC code and the antenna is tuned for 902 to 928 Mhz, which only works North and South America.

Oracle RFID Tag markings

The tag contains 3 other markings, a 24 digit hexidecimal version of the 96-bit EPC number, a 2D data matrix labeled FSTC which also contains the 96 bit EPC number and another 2D data matrix that contains the Department of Defense Unique Individual Identifier

Oracle EZ label

Most products that have RFID tags also have the system serial number on a label that overlays the upper left portion of the tag. This label contains a human readable system serial number as well as a 1D code 128 bar code of that same serial number.

DoD UII

The DoD UII uses both the company prefix and the individual asset reference fields of the EPC number. DoD UII code contains a ISO 15434 Message header, followed by a format code, then a group separator, the GIAI Application identifier, the company prefix in decimal, the individual asset reference in Hexadecimal, the record separator and end of transmission character.

ISO 15434 MESSAGE HEADER	FORMAT CODE	GROUP SEPARATOR	GIAI APPLICATION IDENIIFIER	COMPANY PREFIX	INDIVIDUAL ASSET REFERENCE	RECORD SEPARATOR	END OF TRANSMISSION CHARACTER
[]>$^{R}_{S}$	05	$^{G}_{S}$	8004	0614647	–	$^{R}_{S}$	$^{E}O_{T}$

Conclusion

RFID is a very simple technology that works much like an electronic bar code, although it is much faster and more accurate. The RFID tags contain a single 96-bit number that when cross referenced to a back end database can identify the item being scanned.

Using RFID significantly improves the time and expense of tracking IT assets and therefore eases the ability for large data center operations to comply with Sarbanes Oxley and other regulatory requirements.

RFID also provides for new ways to detect and record asset movement as well as prevent losses.

Oracle Consulting can offer specific consulting packages, which are designed to understand the framework, customize it for particular needs or integrate it with other Oracle solutions and products.

Tips & Tricks for Common RFID Problems

1. If you plan on using a hand-held unit to read the bar codes on a nearby RFID tag, ensure that unit is set to **near field focus**, most units default to far field focus.
2. If the hand held reader has a polarized antenna remember to align the reader along the same plane as the tag. See your RFID Reader user guide for orientation and alignment requirements.
3. The performance of a stationary reader with a built in antenna can be significantly improved by adding a second antenna to the unit.
4. Consistently placing a reader antenna within 6 inches of a tag to read it could burn out the tag.
5. Most stationary readers have General Purpose IO signals that can be used to trigger alarms, cameras or status lights if a RFID tag is detected within the read range.
    - This feature can be utilized for detecting asset movement, which could lead to proper asset removal procedures, loss prevention, data protection, etc.

Glossary

DOD	Department of Defense (DoD)
EPC	Electronic Product Code
EPCGLOBAL	Joint Venture between GS1 and GS1 US. http://www.epcglobalinc.org/home/
FSTC	Financial Services Technology Consortium
GS1	International not-for-profit association dedicated to the development of global standards aimed at improving efficiency and visibility of supply and demand chains (http://en.wikipedia.org/wiki/GS1)
GS1 US	US member of the GS1 (http://en.wikipedia.org/wiki/GS1_US) http://www.gs1us.org/
IT ASSET	Information Technology Assets – typically hardware items such as servers, storage, networking and other types of physical infrastructure.
RCD TECHNOLOGY	RCD Technology – RFID Tag Componentry provider used by Oracle
RF	Radio Frequency
RFID	Radio Frequency IDentification
RFID TAG	Passive or non-passive device that is incorporated into or affixed to a device that uses radio frequency waves to transmit an identifier.
RFID READER	A device that can read radio frequency waves generated by an RFID Tag
RFID SENSOR	see RFID Reader
UHF	Ultra High Frequency

FOR MORE INFORMATION

- General Information on Oracle Products and Services visit **www.oracle.com**
- General Information on EPCGlobal specifications visit www.epcglobalinc.org/home/
- General Information on the Financial Services Technical Consortium visit www.FSTC.org
- General Information on RFID visit www.rfidjournal.com
- To learn how Oracle Consulting Services can help your company architect and design full feature RFID solutions, please contact the Oracle Center of Excellence by contacting;

Grzegorz Wójcik

Oracle EE & CIS Center of Excellence

Sienna 75, 00-833 Warsaw, Poland

Email: grzegorz.wojcik@oracle.com

How to Track Your Oracle Sun System Assets by Using RFID
January 2011
Author: Fred Ceraukis and Tracy Shintaku

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200

oracle.com

Oracle is committed to developing practices and products that help protect the environment

Copyright © 2011, Oracle and/or its affiliates. All rights reserved. This document is provided for information purposes only and the contents hereof are subject to change without notice. This document is not warranted to be error-free, nor subject to any other warranties or conditions, whether expressed orally or implied in law, including implied warranties and conditions of merchantability or fitness for a particular purpose. We specifically disclaim any liability with respect to this document and no contractual obligations are formed either directly or indirectly by this document. This document may not be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without our prior written permission.

Oracle and Java are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

AMD, Opteron, the AMD logo, and the AMD Opteron logo are trademarks or registered trademarks of Advanced Micro Devices. Intel and Intel Xeon are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. UNIX is a registered trademark licensed through X/Open Company, Ltd. 1010

Hardware and Software, Engineered to Work Together