White Paper

# Radio Frequency Identification on Cisco Catalyst Switches

## Overview

RFID is part of the Automatic Identification and Data Capture (AIDC) technology, and it is similar to bar code technology. However, RFID is an automatic identification technology that uses radio waves to capture data from tags, rather than optically scanning the bar codes on a label. One of the primary benefits of an RFID system is that the tag or transponder does not need to be in the line of sight of the reader to read its stored data, and multiple tags (tens to hundreds) can be read simultaneously.

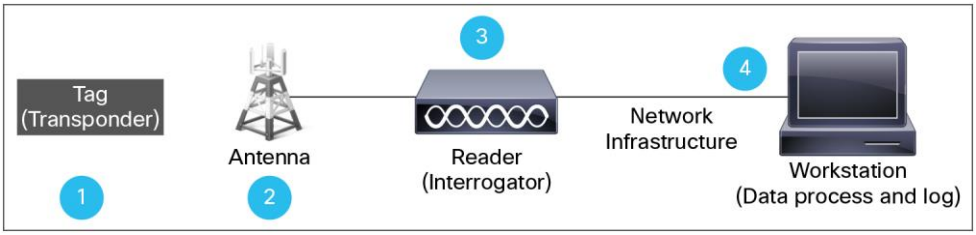
Common areas of RFID usage are:

- Inventory/asset management
- Tracking of products
- Access control

## Architecture

Basic architecture of an RFID system includes transponder or tag, antenna, reader, and data processing station (Figure 1).

**Figure 1.** How RFID System Works




## Transponder or Tag

The transponder or tag is the main part that needs to be on the object. A transponder or tag comes in three different types: passive, active, and semi-active. Each type has its own characteristics from the point of view of power source (Table 1).

**Table 1.** Transponder (Tag) Types

| Passive | Active | Semi-active (Battery-Assisted Passive) |
|---|---|---|
| Powered by RFID reader (no internal battery)<br>Least expensive but short range (up to 10m)<br>Small, light, unlimited life | On-board transmitter and has power source<br>Higher cost but greater range (100m or more)<br>Finite life | On-board battery power source but no on-board transmitter<br>Greater range (up to 100m) than pure passive<br>Higher cost than passive but less than active<br>Finite life |

RFID transponder or tag can also be delivered with the following data-handling capabilities:

- Read Only: Data is written into the tag at time of production and cannot be changed thereafter.
- User Programmable: Data can be written multiple times with or without access control after the production cycle.
- Read/Write: Data can be read from or written to the transponder when the transponder is in range of a reader/writer. The amount of memory available to write the data can vary depending on the type of transponders or tags.

## Antenna, Reader, and Data Processing

A reader is basically a radio frequency (RF) transmitter and receiver, controlled by a microprocessor. The reader captures data from transponders or tags by using an attached antenna and then passes the data to a computer for processing.

As with tags, readers come in a wide range of sizes and offer different features. Readers can be affixed in a stationary position, portable, or even embedded in electronic equipment such as a small chip on the circuit board. The reader and antenna can also be integrated in a handheld device (Figure 2).

**Figure 2.** RFID Readers


## Frequencies

RFID technology can be used in different frequency ranges depending on the distance, type of tags, and type of usage (Table 2). With lower frequency (LF), the signal will travel only a few centimeters, but the cost of ownership is lower. With high frequency (HF), the signal can travel up to 1m but will cost more than LF. Among those frequency types, passive UHF has gained popularity because of its low cost, good read range, and adopted standards.

**Table 2.** RFID Frequency Ranges

| | Frequency | Distance | Sample Application |
|---|---|---|---|
| **LF** | 125 kHz | Few cm | Auto immobilizer |
| **HF** | 13.56 MHz | 1m | Building access |
| **UHF** | 860-960 MHz | 2-10m | Supply chain |
| **µWave** | 2.4 GHz | > 10m | Traffic toll |

## RFID on Cisco Catalyst Switches

To respond to the growing use of Automatic Identification and Data Capture (AIDC) and sensor technologies for asset management, location, and tracking, Cisco is adding RFID technology to select products, including the Cisco® Catalyst® 6800 Series chassis and line cards with front-facing passive UHF RFID technology, providing the latest auto-ID capabilities for asset management (Table 3).

**Table 3.** RFID-Enabled Cisco Catalyst 6800 Series Chassis and Line Cards

| Cisco Catalyst 6800 Series | Product ID |
|---|---|
| **Cisco Catalyst 6800 line card** | C6800-48P-SFP<br>C6800-48P-SFP-XL<br>C6800-48P-TX<br>C6800-48P-TX-XL<br>C6800-8P10G<br>C6800-8P10G-XL<br>C6800-16P10G<br>C6800-16P10G-XL<br>C6800-32P10G<br>C6800-32P10G-XL |
| **Cisco Catalyst 6800 chassis** | C6880-X-LE<br>C6880-X<br>C6807-XL<br>C6816-X-LE<br>C6832-X-LE<br>C6824-X-LE-40G<br>C6840-X-LE-40G |

The RFID tag is on the lower left side of your new chassis and on the left side of the line-card faceplate.
The RFID tag on new versions of Cisco Catalyst 6800 line cards will be on the ejector arm handle (Figure 3).

**Figure 3.** RFID-Enabled Cisco Catalyst 6800 Series Products

## Type of RFID Tag on Cisco Catalyst Switches

The RFID passive tags on Cisco Catalyst 6800 Series products are compatible with the Generation 2 GS1 EPC Global Standard (as well as being ISO 18000-6C compliant), operating in the 860-960 MHz UHF band.

Each RFID tag on the Cisco Catalyst 6K Series has an Alien Higgs 3 memory chip (or equivalent) that can allocate 208 bits to Electronic Physical Code (EPC) and 384 bits to user memory with built-in 96 bits tag ID (TID) information. Cisco has chosen the Alien Higgs 3 for the extra EPC memory capacity available to encode in EPC Serialized Global Trade Item Number (SGTIN)-198 format.

## EPC Partition

EPC is used as a universal identifier for physical objects and uses a specific encoding format that includes serial number, vendor ID (company prefix), and reference number (item number of product) (Table 4).

**Table 4.** EPC Partition Format

| SGTIN-198 EPC Partition (Access Locked) | | | | | | |
|---|---|---|---|---|---|---|
| **Logical segment** | EPC header | Filter | Partition | GS1 company prefix | Indicator/item reference | Serial number |
| **(bit count)** | 8 | 3 | 3 | (20-40) | (24-4) | 140 |

**Note:** The EPC header identifies the length, type, structure, and generation of EPC. The hex value for SGTIN-198 EPC is 36. The decimal value range of the company prefix (20-40) and individual item reference (24-4) fields varies according to the contents of the partition field to make sure of global compatibility with preexisting numbering standards. The combined sum of bits is always 44 (Table 5).

**Table 5.** Headers and Partitions

| Header Value (binary) | Header Value (hexadecimal) | Encoding Length (bits) | Coding Scheme |
|---|---|---|---|
| 101100 | 2C | 96 | GDTI-96 |
| 101101 | 2D | 96 | GSRN-96 |
| 101110 | 2E | NA | Reserved for Future Use |
| 101111 | 2F | 96 | USDoD-96 |
| 110000 | 30 | 96 | SGTIN-96 |
| 110001 | 31 | 96 | SSCC-96 |
| 110010 | 32 | 96 | SGLN-96 |
| 110011 | 33 | 96 | GRAI-96 |
| 110100 | 34 | 96 | GIAI-96 |
| 110101 | 35 | 96 | GID-96 |
| 110110 | 36 | 198 | SGTIN-198 |
| 110111 | 37 | 170 | GRAI-170 |
| 111000 | 38 | 202 | GIAI-202 |
| 111001 | 39 | 195 | SGLN-195 |
| 111010 | 3A | 113 | GDTI-113 |

| Partition Value (P) | GSI Company Prefix | | Indicator/Pad Digit and Item Reference | |
|---|---|---|---|---|
| | Bits (M) | Digits (L) | Bits (N) | Digits |
| 0 | 40 | 12 | 4 | 1 |
| 1 | 37 | 11 | 7 | 2 |
| 2 | 34 | 10 | 10 | 3 |
| 3 | 30 | 9 | 14 | 4 |
| 4 | 27 | 8 | 17 | 5 |
| 5 | 24 | 7 | 20 | 6 |
| 6 | 20 | 6 | 24 | 7 |

Access to the EPC partition is locked; end users cannot access the EPC partition. Cisco pre-encodes the tag's EPC memory with the following data per global SGTIN-198 format (Table 6).

**Table 6.** Cisco EPC Memory SGTIN-198 (208 Bits)

| | |
|---|---|
| EPC SGTIN-198 header | 36 (hex) |
| Filter | 0-7 |
| Partition | 5 |
| EPC global assigned Global Company Prefix (GCP) | 0746320 (alternate GCP: 0764494 and 0882658) |
| Item reference | 000000 |
| Serial number | The Cisco alphanumeric serial number in the format AAA######AA |
| Example:<br>EPC SGTIN-198 header = 36<br>Filter = 3<br>Partition = 5<br>GCP = 0746320<br>Item Reference = 000000 (TBD)<br>Serial = SAL11221234 | |

Encoding output will be as follows, and reader will read this information for data processing.

EPC tag URI: urn:epc:tag:sgtin-198:3.0746320.000000.SAL11221234

EPC memory encoding (hexadecimal, 7-bit ASCII encoding):
36742D8D40000029C198C58B264C59336800000000000000000000

## User Memory Partition

The user memory partition has Cisco product ID, version ID, and other information. End users can be replaced or add the contents with custom information. This partition is also password protected and can be unlocked by using the passcode (that is, 6789ABCD) (Table 7).

**Table 7.** User Memory Partition Format

| | |
|---|---|
| **User memory partition (access unlocked)** | ≥ 240 bits |
| **Cisco encoding data (7 bit encoding)** | Cisco PID, Cisco VID |

| | |
|---|---|
| **User memory (384 bits)** | ASCII encoding |
| **Cisco product ID** | For example, C6800-32P10G= |
| **Cisco version ID** | For example, A01 |
| **Cisco top assembly number (TAN).TAN revision.date of ship** | For example, 800-12345-01.00.2015-01-29 |
| Sample Encode Data: C6800-32P10G= A01 800-12345-01.00.2015-01-29 | |

## TID Partition

TID is a unique 96-bit field that is programmed prior to placement on the product, and TID information is permanently locked. TID has specific product information from manufacturing (Table 8).

**Table 8.** Tag Identifier Format

| 32 Bits | | 64 Bits |
|---|---|---|
| IC Manufacture | Chip Version | Factory Programmed Unique ID |
| Sample Data: | | |
| E2003412 | | 0614 14110073 4886 |
| | | |
| E2 --- Common | | |
| 003 --- Indicates the tag is built with memory chip (H3) | | |
| 0614-4886 --- Immutable tag serial number | | |

## How End Users Access Tag Data

Tag contents are accessed by using EPC Global Class 1, Generation 2, ISO 18000-6C-compliant fixed or mobile readers (Figure 4). Any RFID system that supports EPC Generation 2 is able to access data from Cisco Catalyst 6800 Series RFID-enabled products for asset tracking and asset management.

**Figure 4.** Sample EPC Generation 2 RFID Reader


End users are also able to access a tag's data by using Telnet, a web browser, serial communications to the reader, third-party middleware applications, and so on.

## Conclusion

RFID technology can increase the efficiency of processes and cost savings by providing improved visibility, less monitoring, less human intervention for asset management with less errors, and higher reliability. Cisco Catalyst 6800 Series chassis and line cards are also the first Cisco products to launch with front-facing passive UHF RFID technology, providing the latest auto-ID capabilities for asset management.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Printed in USA C11-735013-00 07/15