Understanding the Control Information On EPC Gen 2 Tags

This article briefly discuss about the Control information on EPC gen 2 Tags

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1. Introduction

Generation 2 RFID Tags has three different kinds of data in it

1.1.Business Information

This information includes the Electronic Product Code (EPC) that uniquely identifies the physical object and describes the physical object. This information is captured by data capture level and passed to business application level.

1.2.Control Information

This Control Information includes data that helps in filtering out tags from large populations to increase read efficiency, special handling information that affects the behavior of capturing application, information that controls tag security features, and so on.

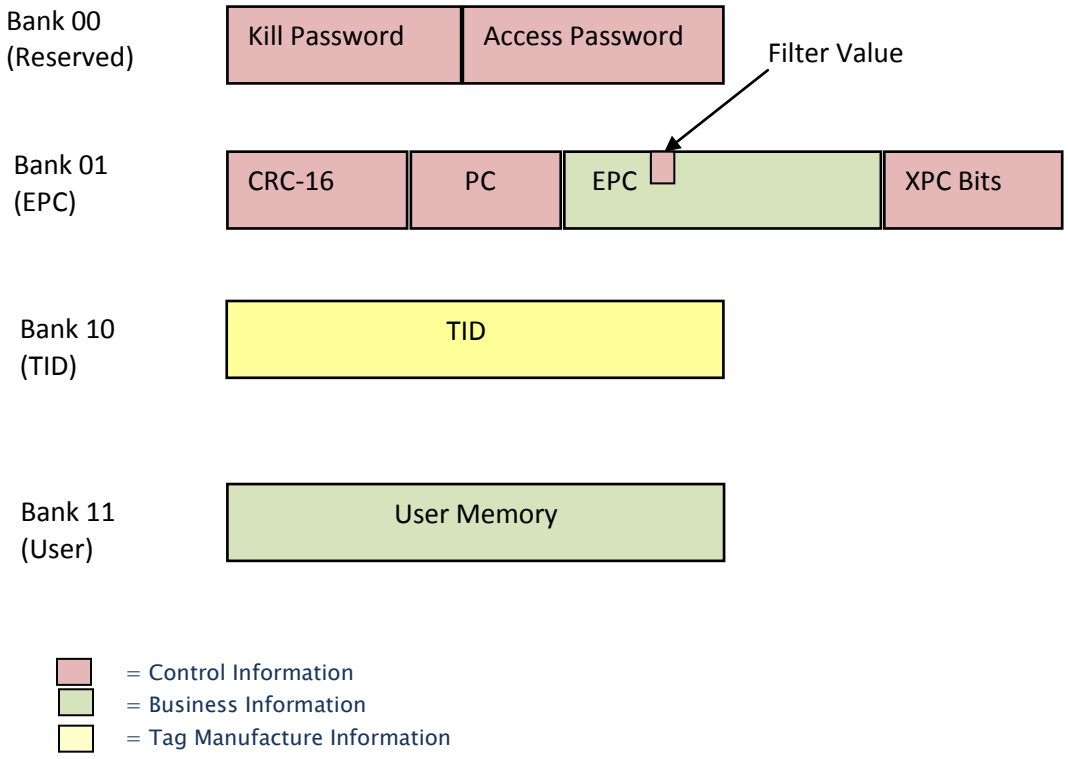
1.3. Tag Manufacture Information

This describes the Tag itself, as opposed to the physical object to which the tag is affixed. Tag Manufacture information includes a manufacturer ID and a code that indicates the tag model.

In this document, we focus on control information as it plays the major part in communicating with data capture applications. This will help us in control the process of interacting with tags. Control Information does not have any influence on business applications level but it can represent how a data capturing application presents business data to the business application level.

2. Control Information

The Following Diagram shows the fields of control information in EPC Gen 2 memory

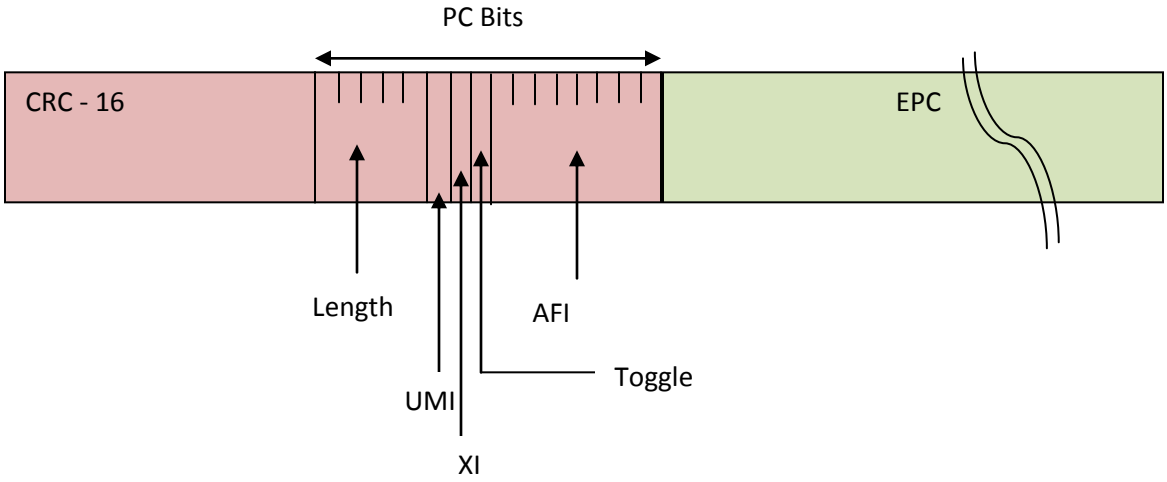


The following table describes the control fields in the memory map above

Bank	Bits	Fields	Description
Bank 00 (Reserved)	00_h – $1F_h$	Kill Password	A 32-bit password that must be presented to the tag in order to Complete the Gen 2 "kill" command.
	20_h – $2F_h$	Access Password	A 32-bit password that must be presented to the tag in order to perform privileged operations
Bank 01 (EPC)	00_h – $0F_h$	CRC	A 16-bit Cyclic Redundancy Check computed over the contents of the EPC bank.
	10_h – $1F_h$	PC	The Most Important Part in EPC Bank is PC. The PC controls the backscattering of tag data. Detailed Explanation is given below
	20_h – End	EPC	Electronic Product Code, plus filter value. The filter value provides a means to improve tag read efficiency by selecting a subset of tags of interest
	210_h – $21F_h$	XPC	Extended Protocol Control bits. If bit 16h of the EPC bank is set to one, then bits 210h – 21Fh (inclusive) contain additional Protocol control bits as specified.

2.1.Protocol Control

The following diagram illustrates in greater detail the first few bits of the EPC Bank (Bank 01), and in particular shows the various fields within the Protocol Control bits (bits 10_h – $1F_h$, inclusive).



The following table specifies the meaning of the PC bits:

Bits	Field	Description
10_h – 14_h	Length	Represents the number of words comprising the EPC field
15_h	User Memory Indicator (UMI)	Indicates whether the user memory bank has data or not. By default the bit will be 0b
16_h	XPC Indicator	Indicates whether XPC is present or not
17_h	Toggle	If zero, indicates an EPC global application If one, indicates a non-EPC global application
18_h – $1F_h$	AFI	An Application Family Identifier that specifies a non-EPC global application for which the remainder of the EPC bank is encoded

Till now we had define the five controlling parameters in the EPC memory and in next sections we will briefly describes the effect of each controlling parameters.

2.1.1 Length

Generally the protocol control for EPC – 96 tags will be 3000. After Converting the PC 30 00 into binary you will get the following binary string

00 11 0	0	0	0	0000 0000
Length of the String In words	UMI	XI	Toggle	Reserved for future purpose

First 5 bits in the protocol control describes the number of words in EPC. As per the example SGTIN- 96 we will have 6 words of Tag id.

The Maximum length for EPC will be 31words (11111) only if the XI indicator is zero, and XI=1 the maximum length will be 29 words (11101)

These can write by an Interrogator to the Stored PC and if its exceeds the Specified limit then the reader will shows and error message.

Below table provides the PC for different type of EPC tags.

Tag	Bits	PC (Hex)	EPC Words
SGTIN-64	00100	2000	4
SGTIn – 96	00110	3000	6
SGTIN – 128	01000	4000	8
SGTIN – 496	11111	F800	31

2.1.2 User Memory Indicator

This is 15_h in the Protocol control which indicates whether the tag has user memory or not. By default the value will be 0b and 1b if the User memory contains data.

This can be Read/Write with interrogator, when you write the data to user memory the tag automatically computes the data and map the corresponding value to the 15_h or it can be fixed by the Tag Manufacturer.

As per our example if the UMI indicator is 1 then the Protocol control will be 3400.

00 11 0	1	0	0	0000 0000
Length of the String In words	UMI	XI	Toggle	Reserved for future purpose

2.1.3 Extended Protocol Control

If bit 16_h of the EPC bank is set to one, then bits 210_h – $21F_h$ (inclusive) contain additional protocol control bits. It comes with the This Data can be writable with an interrogator.

2.1.4 Toggle

If Toggle = 0 (17_h), indicates an EPC global application; in particular, indicates that bits 18_h – $1F_h$ contain the Attribute Bits.

If one, indicates a non-EPC global application; in particular, indicates that bits 18_h – $1F_h$ contain the Application Family Identifier (AFI).

Bits 17_h – $1F_h$ (inclusive) are collectively known as the Numbering System Identifier (NSI). It should be noted, however, that when the toggle bit (bit 17_h) is zero, the numbering system is always the Electronic Product Code, and bits 18_h – $1F_h$ contain the Attribute Bits whose purpose is completely unrelated to identifying the numbering system being used.

2.1.4.1 Attribute Bits

The Attribute Bits (18_h – $1F_h$) are eight bits of "control information" that may be used by capturing applications to guide the capture process. Attribute Bits may be used to determine whether the physical object to which a tag is affixed requires special handling of any kind. Attribute bits are available for all EPC types. It is essential to understand that attribute bits are additional "control information" that is not part of the Electronic Product Code. Capturing applications may, however, read the attribute bits and pass them upwards to business applications in some data field other than the EPC. It should be recognized, however, that the purpose of the attribute bits is to assist in the data capture and physical handling process.

2.1.4.2 Application Family Identifier

This indicates the remainder of the EPC bank contains a Unique Item Identifier (UII) appropriate for that AFI.

2.1.5 Protocol Control Matrix for SGTIN- 96

Sno	Length	UMI	XI	Toggle	Attribute Bits	Protocol Control
1	00110					3000
2	00110	1				3400
3	00110		1			3200
4	00110			1		3100
5	00110				1	3001
6	00110	1	1			3600
7	00110	1		1		3500
8	00110	1			1	3401
9	00110	1	1	1		3700
10	00110	1	1		1	3601
11	00110	1		1	1	3500
12	00110	1	1	1	1	3701
13	00110		1	1		3300
14	00110		1		1	3201
15	00110		1	1	1	3301
16	00110			1	1	3300

2.2.Filter Value:

The filter value is extra information that is encoded into the RFID tag to assist RFID readers when confronted with a large number of tags. For example, suppose you have a warehouse application in which you want to read an RFID tag on a pallet, but each pallet contains 100 tagged cases and each case contains 24 tagged items. The reader sees a total of 2401 tags, even though you just want to read only one! This can make reading performance very slow. By programming a different filter value onto the pallet tag, it is possible for the reader to broadcast a "select" command instructing only the pallet tag to respond.

The filter value is *not* part of the EPC, or we can say it is not part of the identification of the object to which the RFID tag is attached. The filter value is just extra information that is there to help RFID readers do their job better. It normally only plays a role in data capture, and is not communicated to business applications. Because the filter value is not part of the EPC, it does not contribute to the uniqueness of the EPC. Therefore, two EPC Tag URI that only differ in their filter value cannot be applied to two different objects, because the corresponding pure identity URI would be the same for both.

Following Tables gives us the Types of Filters which are in SGTIN – 96 EPC Tags

Filter value Description	Binary Value	Filter Value
All Other	000	0
Retail Consumer trade Item	001	1
Standard Trade Item Grouping	010	2
Single Shipping/Consumer Trade Item	011	3
Reserved Item	100	4
Reserved Item	101	5
Reserved Item	110	6
Reserved Item	111	7

2.3.Reserved Memory

An EPC GEN 2 tag has two separate passwords, an access password and a kill password, each are 32 bits and are stored in the reserved bank (bank 00) of the tag memory.

When a tag is singulated, it enters one of two states:

- Secured (if access password is all zeros, which is the factory default)
- Open (if non-zero access password has been programmed to the tag)

A tag in the open state can be moved to secure by providing a non-zero access password. The key thing to remember is that assigning a non-zero access password does not, in itself, prevent anyone with a GEN 2 reader from reading or changing data on the tag. It only requires that any future users must provide the access Password in order to change the lock state and is simply one step in effectively locking tag memory.

Following Tables provided the Read/Write Lock status on memory banks

Sno	Memory	Read Locked	Write Locked
1	Reserved Bank (00)	Yes	Yes
2	EPC Bank (01)	No	Yes
3	TID memory (10)	No	Yes (Locked by Tag manufacturer)
4	User Memory (11)	No	Yes

3. References

[1] "EPC Tag data Standard" version 1.8 Jan 2014 Released by GS1

[2] "EPC™ Radio-Frequency Identity Protocols Generation-2 UHF RFID ", Specification for RFID air Interface , Version 2.0.0 Ratified, Protocols for communications at 860 Mhz to 960 Mhz,