



EPCglobal UHF Gen2 v1.2.0 for ISO/IEC SC31/WG4/SG3

EPCglobal UHFAI 1&2 WG
April 7, 2008



UHF Gen2 v1.2.0 Developers

- The UHF Gen2 v1.2.0 specification was developed by the EPCglobal UHF Air Interface 1&2 Working Group.
- WG co-Chairs
 - Jeff Fischer, Reva Systems
 - Richard Ulrich, Wal*Mart
- WG Members
 - 63 member companies participating
 - 20 of the WG members also participated in WG4/SG3 in 2007
- WG Charter
 - To develop an UHF air interface specification based on the “EPCglobal Item-Level Tagging Requirements” document v1.2.3 and to design a solution that enables forwards compatibility with future functionalities



Part of the Family - UHF Gen2 v1.2.0

Date	Specification	Purpose
2004	UHF Gen2 v1.0.9	Ratified. EPCglobal base standard; this was submitted to ISO
2007	UHF Gen2 v1.1.0	Slight modifications to meet ISO format. Approved by ISO. Ratified
2008	UHF Gen2 v1.2.0	<ul style="list-style-type: none">▪ Expanded functionality for item-level tagging by adding 3 new optional functionalities to support more complex supply chain applications that require higher memory usage▪ Addressed backwards compatibility issues to UHF Gen2 v1.1.0▪ Addressed forwards compatibility to allow future functionality



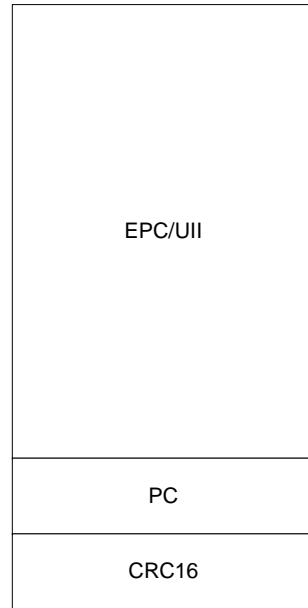
What are the new optional features and definitions?

1. The construction of the PC word
 - PC Bit 15_h (user-memory indicator)
 - PC Bit 16_h (protocol control extension (XPC) indicator)
2. The possibility to expand the PC word by up to two additional XPC words
 - LSByte of the 1st word is reserved for recommissioning function
 - *(Note: MSbyte of the first word is currently not used within Class1 EPC definitions)*
 - 2nd word is reserved for further applications and/or enabling migration paths
 - Defined the PC length to be 5 bits and limited to the EPC/UII structure
3. BlockPermaLocking method
4. Further definitions
 - CRC16 of the inventory stream
 - The length indication during inventory stream



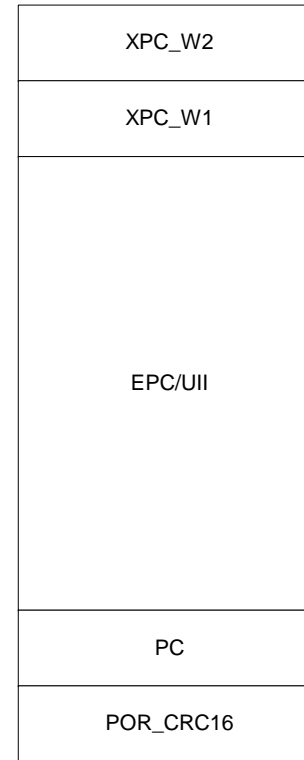
Construction of EPC/UII page

was



is

22h



21h

20h



to



02h

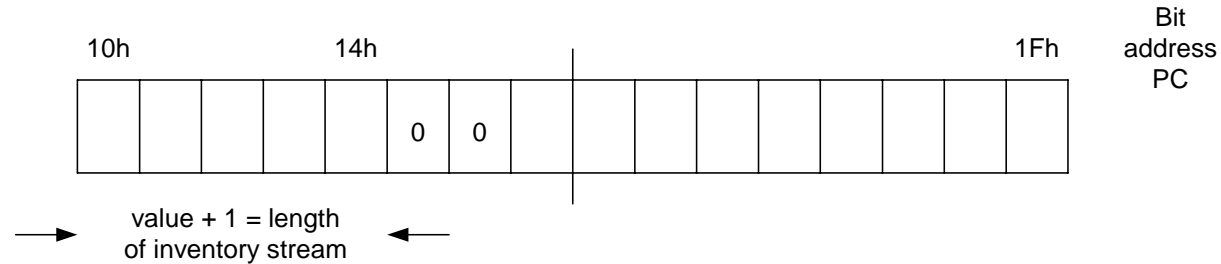
01h

00h

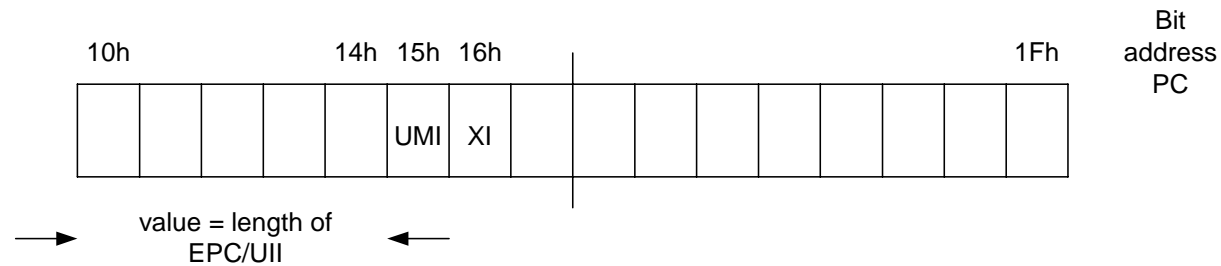


Construction of PC word

WAS



IS



<15h> : emulated bit if set to 1 then it is indicating that there is a formatted user memory on chip

<16h> : emulated bit, if set to 1 then it indicates that a XPC is part of the inventory stream

Note1: The length indication backscattered during the inventory stream is the length of the inventory stream + 1

Note2: the CRC16 backscattered during the inventory stream is the CRC16 of the entire inventory stream including XPC settings



PC Bit 15_h (User Memory Indicator)

- PC bit 15_h indicates whether a Tag contains information in User memory
 - Bit 15_h = 0: No information in User memory, or User memory does not exist
 - Bit 15_h = 1: Information in User memory
- Allows for 2 methods of implementation
 - #1 Tag computes the value of the User memory indicator (UMI).
 - #2 An Interrogator writes the UMI for legacy tags.
- PC Bit 15h Memorandum of Understanding (MOU)
 - *Method 2, in which a reader writes PC bit 15_h, is only allowed for Class-1 Tags that do not implement block permalocking or recommissioning (this allowance permits compatibility with existing Tag silicon). Method 2 will not be included in the Class-2 protocol; instead, Class-2 Tags must use Method 1. Acceptance of this MOU is fundamental to accepting Method 2 for Class-1 Tags.*
 - *Method 2 shall not be used for new tag developments from now on.*



The XPC in General

- XPC is expanded control information for the inventory stream.
- XPC has a length of 0 or 16 or 32 bits.
 - Usage of XPC is indicated in PC
- Defined 3 bits of the XPC for recommissioning. Several additional bits have been proposed for 180006-C by the BAP/sensors *ad hoc*.
- The second XPC word is currently not used but can be used for further applications in future.
- Consequences
 - The length of the inventory stream can change. Therefore the length information backscattered within inventory stream is the length of the entire stream.
 - The length stored in the PC is the length of the EPC/UII
 - The CRC backscattered within inventory stream is the CRC16 of the entire stream.
- EPC and ISO reader systems are not able to command tags that are using bits other than those already defined.



PC bit 16_h (XPC indicator)

- PC bit 16_h indicates whether the XPC bits have been set. The XPC bits can be set for specific purposes, e.g. recommissioning.
- EPC/UII memory space for XPC bits is expanded to reserve 2 words (32 bits). The MSB of the first XPC word is designated as an XPC extension bit (XEB). A tag shall backscatter the following XPC information as a function of the XI and XEB:

XI	XEB	Backscatter
--	-----	-----
0	0	PC, EPC, CRC
0	1	invalid (XI is the logical OR of the first XPC word so if XEB=1 then XI=1))
1	0	PC, 16-bit XPC, EPC, CRC
1	1	PC, 32-bit XPC, EPC, CRC

- The first XPC word is designated as XPC_W1, and the second as XPC_W2.
 - The 3 LSBs of XPC_W1 are dedicated to recommissioning.
 - All other XPC bits are RFU and shall be zero valued for Class1 tags.



Block Permalocking

- Block Permalocking (BPL) provides data protection by preventing overwrites of memory blocks in User memory (UM). One can only append new information.
 - The command code for BlockPermalock is 11001001.
 - A single command can permalock between 0 and 4080 blocks of user memory.
 - Block size is vendor-defined
 - The memory blocks, which may be blockpermalocked, do not have to be contiguous.
- Interrogators may...
 - permalock one or more blocks in UM.
 - read the permalock status of the memory blocks in UM.
- BPL vs. Lock
 - BPL permanently locks a portion of the bank (blocks) of UM in an unwriteable state. This is independent from the bank lock protection.
 - Lock reversibly or permanently locks a password or an entire memory bank in a writeable or unwriteable state



How BPL Works in Principle

- A Tag can receive a Lock command before or after a BPL command. Here is how the Tag will respond to the second command:

First Command	Second Command	Tag Action
Lock permanently writeable	BlockPerm alock	Backscatter error code
Lock permanently unwriteable	BlockPerm alock	Backscatter success code
BlockPerm alock	Lock permanently writeable	Backscatter error code
BlockPerm alock	Lock permanently unwriteable	Backscatter success code

- A Reader indicates which block to permalock using Mask. The BlockPtr and BlockRange fields indicate the starting location and range for Mask respectively.



Recommissioning Feature

- Recommissioning enables a tag, containing information, to be reused, e.g. recycling, maintenance, warranty tracking, return management,.....
 - Use of 3 RFU bits (3SBs) in the current *Kill* command to allow for recommissioning a Tag. The three bits are related to recommission of
 - user memory, or
 - the lock information (See Comment Flag)
 - Recommissioning status is stored in XPC_W1.
- Killing and recommissioning
 - Identical procedures, EXCEPT
 - Recommissioning bits in the 2nd *Kill* command are zero when killing a Tag dead, and non-zero when recommissioning a Tag
 - A Tag without recommissioning shall ignore recommissioning bits, treat them as zero, and kill itself dead if it has implemented a kill password.
- Recommissioned Tags shall not truncate their replies. A recommissioned Tag that receives a *Select* with Truncate=1 shall evaluate the *Select* normally, but its reply to a subsequent *ACK* shall include its packetPC, XPC, an EPC whose length is as specified in the storedPC length field, and a packetCRC.
- A tag may only be recommissioned once.



Changes Made to Ensure Backwards and Forwards Compatibility

- **Backwards Compatibility Fixes**
 - Length of Tag response to *ACK* command capped at 528 bits
 - Defined ***PacketPC***, ***StoredCRC***, and ***PacketCRC*** to ensure backwards compatibility for v1.2.0 tags
 - v1.2.0 Recommissioned tag may not truncate its reply to a *Select* command
- **Forwards Compatibility Fixes**
 - Defined ***StoredPC*** to ensure forwards compatibility for v1.1.0 tags
 - Reserved for XPC 2 words of EPC memory (32 bits)
 - Defined ***XEB*** (XPC Extension bit) to indicate when Word 2 is used
 - Defined ***Recommissioning*** to be 3 LSBs of Word 1
 - Defined ***Bit E_h*** of XPC Word 1 to be available as a toggle switch for EPCglobal if needed



In Conclusion

- Three options have been added to UHF Gen2 in v1.2.0 to provide advanced capabilities for item-level tagging. These options include PC bits 15_h and 16_h , and BPL. The options enable use of UHF Gen 2 tags now for recommissioning.
- Solutions were added to address backwards for UHF Gen2 v1.1.0 and forwards compatibility for UHF Gen2 v1.2.0.



END