

RFID & EPC Essentials

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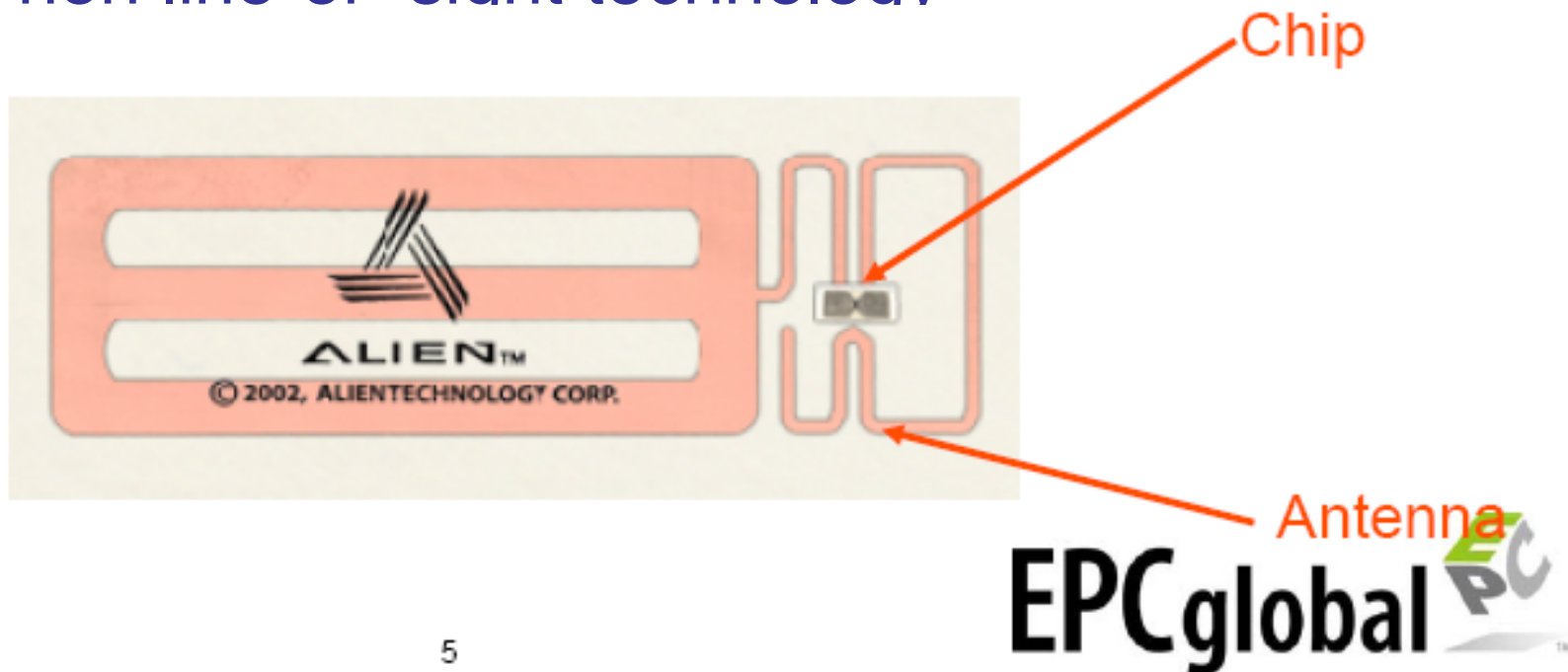
What is EPC?

- The tag, including a chip, an antenna and the packaging substrate
- A numbering scheme that uniquely identifies all objects
- Incorporates existing EAN.UCC keys, and very recently US DoD constructs
- Connects physical objects to computer networks

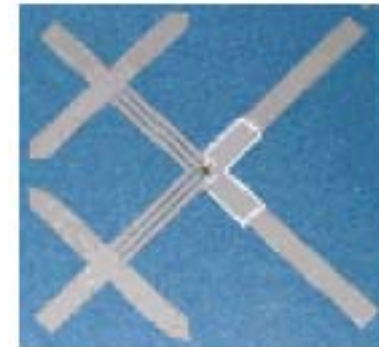


Tags and Readers

- Radio Frequency Identification - RFID
 - Chip + antenna + packaging substrate = Tag
- Readers use radio waves
 - non line-of- sight technology



What do tags look like?



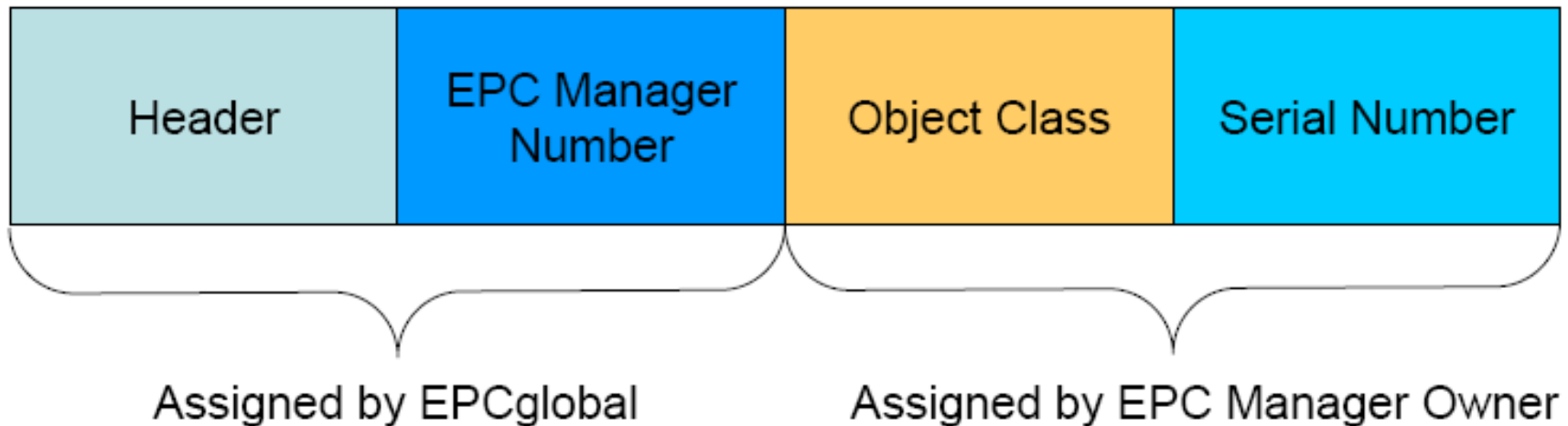
Tags and Readers

- The reader ‘zaps’ the chip with a radio wave, the chip replies with its EPC
 - EPC is the only thing stored on the chip
 - The chip is passive (no power)



Basic Format

- Header: Identifies the length, type, structure, version, and generation of the EPC
- EPC Manager Number: Entity responsible for maintaining the subsequent partitions
- Object Class: Identifies a class of objects
- Serial Number: Identifies the instance



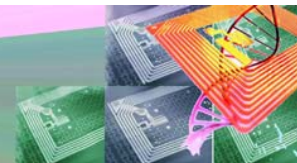
EPC Structure

- Encoded on radio frequency tags in bits
 - 0's and 1's
- Provides multiple formats for:
 - Various bit length tags (64 and 96)
 - Accommodates existing identifiers
 - All formats support unique EPCs



Schemes Defined (v1.1)

- General Identifier (GID) GID-96 a serialized version of the GS1 Global Trade Item Number (GTIN) SGTIN-96 SGTIN-198
- GS1 Serial Shipping Container Code (SSCC) SSCC-96
- GS1 Global Location Number (GLN), SGLN-96 SGLN-195
- GS1 Global Returnable Asset Identifier (GRAI) GRAI-96 GRAI-170
- GS1 Global Individual Asset Identifier (GIAI) GIAI-96 GIAI-202 and
- DOD Construct DoD-96 96-bit format for
- General Identifier (GID)
- GID is not an EAN.UCC format



64-bit Tags

- Widely available today
- Being used in pilots
- A temporary measure for immediate and cost-effective implementation
- Forward compatible with 96 bit chips
- Has some constraints

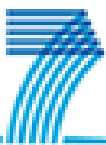




General Identification Number (GID)

- The *General Identifier (GID-96)* is independent of any known, existing specifications or identity schemes.
- The General Identifier is composed of three fields, namely:
 - The *General Manager Number*,
 - The *Object Class*, and
 - *Serial Number*
- Encodings of the GID include a fourth field, the header, to guarantee uniqueness in the EPC namespace.

	Header	General Manager Number	Object Class	Serial Number
GID-96	8	28	24	36
	0011 0101 (Binary value)	268,435,455 (Max. decimal value)	16,777,215 (Max. decimal value)	68,719,476,735 (Max. decimal value)



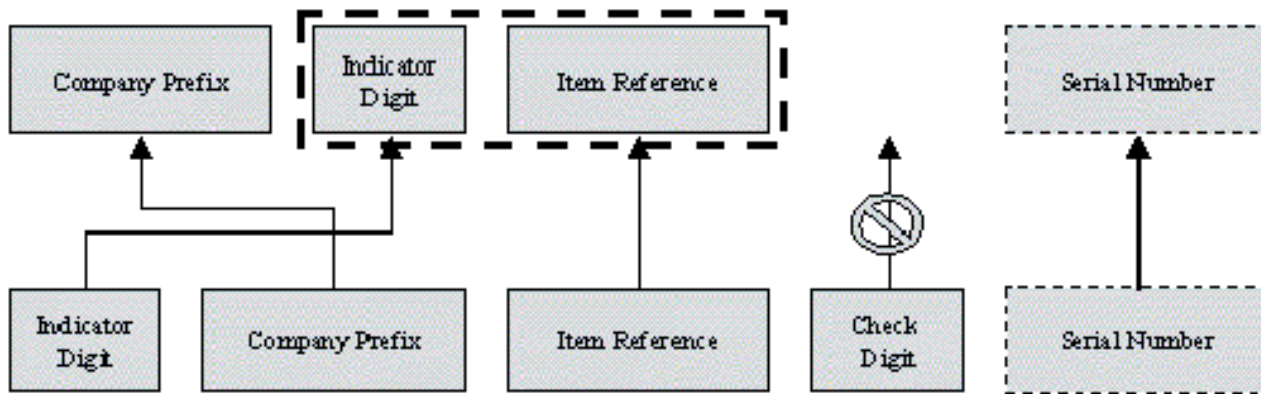
Serialized Global Trade Item Number (SGTIN)

- Derived from EAN.UCC GTIN (EAN.UCC Barcode-128)
- The *Company Prefix* is assigned by GS1 to a managing entity
- The *Item Reference* is assigned by the managing entity to a particular object class.
 - For the purposes of EPC Tag Encoding it is derived from the GTIN by concatenating the Indicator Digit of the GTIN and the Item Reference digits, and treating the result as a single integer
- The *Serial Number* is assigned by the managing entity to an individual object.
 - It is not part of the GTIN code, but is formally a part of the SGTIN.
 - **SGTIN-96** against **SGTIN-198**



Serialized Global Trade Item Number (SGTIN)

SGTIN Bit-level Encoding



GTIN plus Serial Number Identity Structure



Tag Encoding: SGTIN – 96 and SGTIN - 198

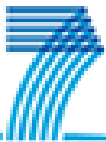
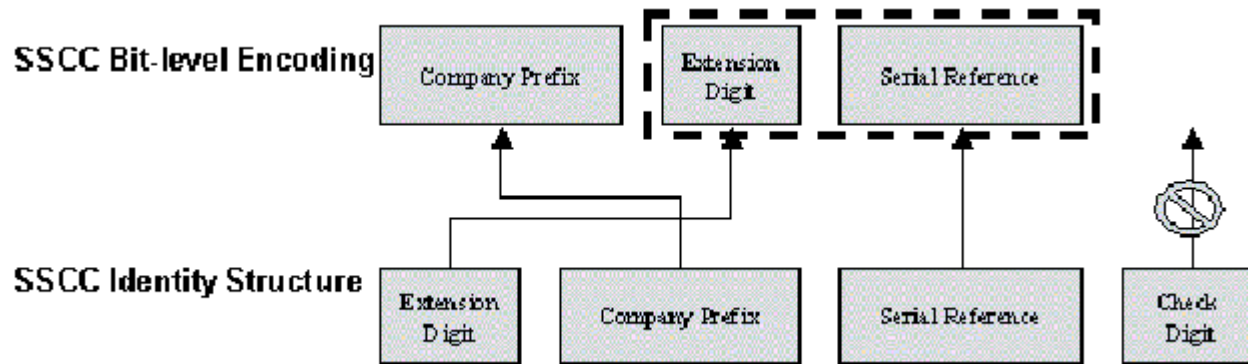
	Header	Filter Value	Partition	Company Prefix	Item Reference	Serial Number
SGTIN-96	8	3	3	20-40	24-4	38
	0011 0000 (Binary value)	(Refer to Table 5 for values)	(Refer to Table 6 for values)	999,999 – 999,999,999,999 (Max. decimal range*)	9,999,999 – 9 (Max. decimal range*)	274,877,906,943 (Max. decimal value)

	Header	Filter Value	Partition	Company Prefix	Item Reference	Serial Number
SGTIN-198	8	3	3	20-40	24-4	140
	0011 0110 (Binary value)	(Refer to Table 5 for values)	(Refer to Table 6 for values)	999,999 – 999,999,999,999 (Max. decimal range*)	9,999,999 – 9 (Max. decimal range*)	Up to 20 alphanumeric characters



Serial Shipping Container Code (SSCC)

- SSCC Pure Identity scheme is defined by EAN.UCC
 - Unlike the GTIN, the SSCC is intended for assignment to individual objects and therefore does not require any additional fields to serve as an EPC pure identity
 - Though it does not hold any class identification
 - As in SGTIN, a fixed digit count for *Company Prefix* is used to allow for ONS services and filtering



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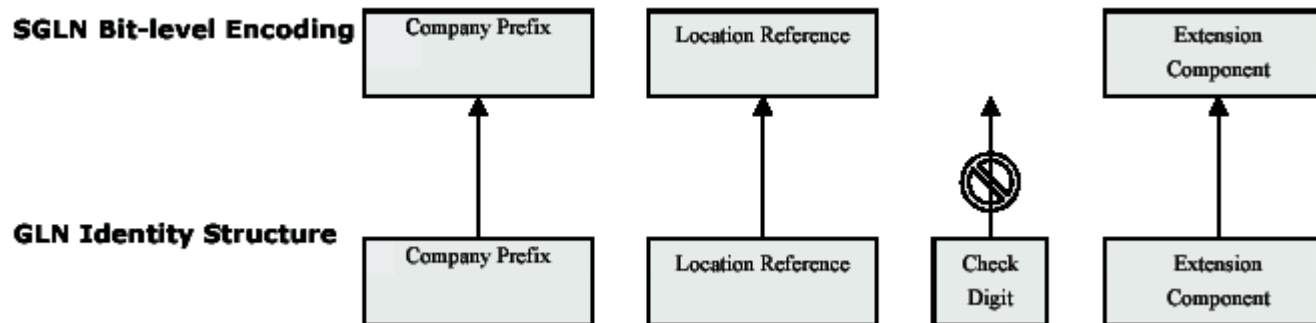
Tag Encoding: SSCC - 96

	Header	Filter Value	Partition	Company Prefix	Serial Reference	Unallocated
SSCC-96	8	3	3	20-40	38-18	24
	0011 0001 (Binary value)	(Refer to Table 9 for values)	(Refer to Table 10 for values)	999,999 – 999,999,999,999 (Max. decimal range*)	99,999,999,999 – 99,999 (Max. decimal range*)	[Not Used]



Serialized Global Location Number (SGLN)

- The Global Location Number (GLN) is defined by the EAN.UCC as an identifier of physical, logical, and legal entities.
- SGLN-96 against SGLN-195



Tag Encoding: SGLN – 96

	Header	Filter Value	Partition	Company Prefix	Location Reference	Extension Component
SGLN-96	8	3	3	20-40	21-1	41
	0011 0010 (Binary value)	(Refer to Table 12 for values)	(Refer to Table 13 for values)	999,999 – 999,999,999,999 (Max. decimal range*)	999,999 – 0 (Max. decimal range*)	999,999,999,999(Max Decimal Value allowed) Minimum Decimal value=1 Reserved=0 All bits shall be set to 0 when an Extension Component is not encoded signifying GLN only.



...and SGLN - 195

	Header	Filter Value	Partition	Company Prefix	Location Reference	Extension Component
SGLN-195	8	3	3	20-40	21-1	140
	0011 1001 (Binary value)	(Refer to Table 12 for values)	(Refer to Table 13 for values)	999,999 – 999,999,999,999 (Max. decimal range*)	999,999 – 0 (Max. decimal range*)	Up to 20 alphanumeric characters If the Extension Component is not used this value must be set to 0110000 followed by 133 binary 0 bits.



GTIN-to-EPC Mapping

- In 96-bit, variable length company prefix supported by a flexible partition
- In 64-bit, translation table required for company prefix
- In addition to GTIN:
 - Serial number
 - Filter value



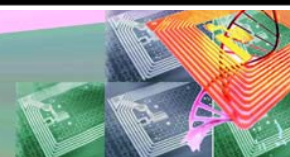
64 bits SGTIN format

	Header	Filter Value	Company Prefix <i>Index</i>	Item Reference	Serial Number
64-bit GTIN	2 bits	3 bits	14 bits	20 bits	25 bits
		8 (decimal capacity)	16,383 (decimal capacity)	9-1,048,575 (decimal capacity)	33,554,431 (decimal capacity)



96 bits SGTIN format

	Header	Filter Value	Partition	Company Prefix	Item Reference	Serial
96-bit GTIN	8 bits	3 bits	3 bits	20-40 bits	24-4 bits	38 bits
		8 (decimal capacity)	8 (decimal capacity)	999,999 - 999,999,99 9,999 (decimal capacity)	9,999,999- 9 (decimal capacity)	274,877,906 ,943 (decimal capacity)



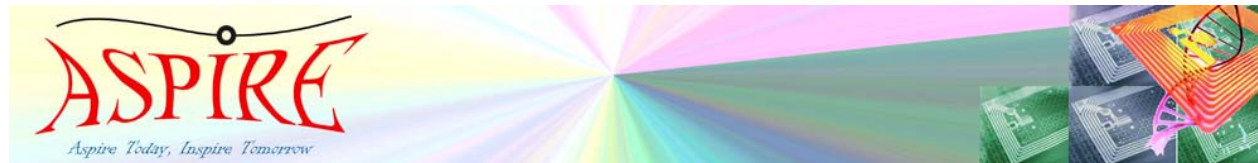
Example

- Start with a UPC:
 - 614141 is the UPC Company Prefix
 - 00734 is the Item Reference
 - 9 is the Check Digit
 - 614141 00734 9
- Turn it into a Global Trade Item Number (GTIN):
 - Add “0” indicator and “0” number system carrier to build out full 14 digit format
 - 614141 00734 9
 - 0 0614141 00734 9



Example

- Prepare for EPC™ encoding
 - Move indicator to first digit of Item Reference
 - Drop Check Digit
 - 0 06 14141 00734 9
 - 0614141 000734



Example

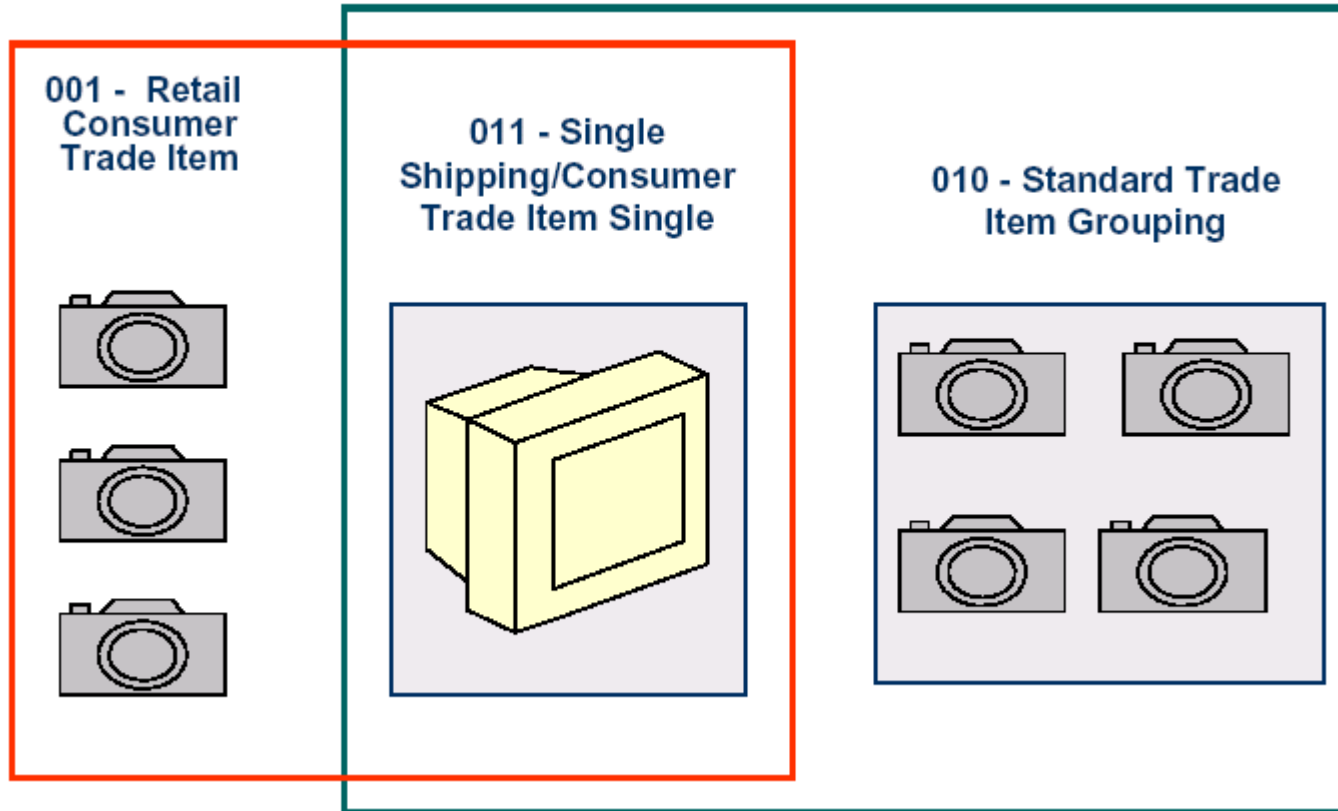
- Encode into 96-bit EPC Tag
 - Select header for SGTIN-96 (48)
 - Filter Value (3 – shipping unit)
 - Partition is determined by the length of the EAN.UCC Company Prefix (0614141 is seven digits, so the Partition Value is 5)
 - Item Reference Number (000734)
 - Add the Serial Number (203886)
- Decimal representation:

– 48 3 5 0614141 000734 203886



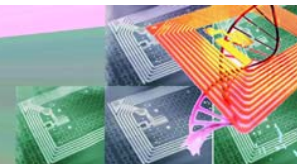
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Using filter values...



Filter Value

- Not part of the EPC identifier
- Used during RF reads to select or mask out types of EPC
- Screen out items not needed in distribution applications to improve RF reads
- Different for GTIN, SSCC, GLN formats
- Validated by GSMP early in 2005



Other Keys

- Other keys will be accommodated by EPC in additional formats
- US Department of Defense constructs
- Any other industry with unique numbering systems
- The formats must always result in unique EPCs

