EPC - Electronic Product Code

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EPC – Electronic Product Code

- Identification code stored on an RFID tag
- Is a unique number that identifies a specific item and allows its tracking along all stages of the supply chain
- Contains a wide range of information unique to that item including the manufacturer, SKU, product information and serial number when applicable

SKU – Stock Keeping Unit

EPC Tag Data Standard (TDS)

- Defines the Electronic Product Code™ (EPC), and also specifies the memory contents of Gen2 RFID Tags.
- TDS covers:
  - The specification of the Electronic Product Code, including its representation at various levels of the EPC global Architecture and it correspondence to GS1 keys and other existing codes.
  - The specification of data that is carried on Gen 2 RFID tags, including the EPC, “user memory” data, control information, and tag manufacture information.

(See slide 12)

Electronic Product Code (EPC)

- Universal identifier for any physical object.
- It is used in information systems that need to track or otherwise refer to physical objects.
- Within computer systems, including electronic documents, databases, and electronic messages, the EPC takes the form of an Internet Uniform Resource Identifier (URI). This is true regardless of whether the EPC was originally read from an RFID tag or some other kind of data carrier. This URI is called the “Pure Identity EPC URI.”
- Example of a Pure Identity EPC URI:

  urn:epc:id:sgtin:0614141.112345.400

(URN = Uniform Resource Name)

Encoding EPCs onto RFID tags

- A very large subset of applications that use the Electronic Product Code also rely upon RFID Tags as a data carrier.
- RFID is often a very appropriate data carrier technology to use for applications involving visibility of physical objects, because RFID permits data to be physically attached to an object such that reading the data is minimally invasive to material handling processes.
- Owing to memory limitations of RFID tags, the EPC is not stored in URI form on the tag, but is instead encoded into a compact binary representation. This is called the "EPC Binary Encoding."

Serialized Global Trade Item Number (SGTIN)

- Assigns a unique identity to an instance of a trade item, such as a specific instance of a product.
- General syntax:
  - urn:epc:id:sgtin:CompanyPrefix.ItemReference.SerialNumber
- Example:
  - urn:epc:id:sgtin:0614141.112345.400

Serial Shipping Container Code (SSCC)

- Assigns a unique identity to a logistics handling unit, such as a the aggregate contents of a shipping container or a pallet load.
- General syntax:
  - urn:epc:id:sscc:CompanyPrefix.SerialReference
- Example:
  - urn:epc:id:sscc:0614141.1234567890

Serialized Global Location Number (SGLN)

- Assigns a unique identity to a physical location, such as a specific building or a specific unit of shelving within a warehouse.
- General syntax:
  - urn:epc:id:sgln:CompanyPrefix.LocationReference.Extension
- Example:
  - urn:epc:id:sgln:0614141.12345.400

Global Returnable Asset Identifier (GRAI)

- Assigns a unique identity to a specific returnable asset, such as a reusable shipping container or a pallet skid.
- General syntax:
  - urn:epc:id:grai:CompanyPrefix.AssetType.SerialNumber
- Example:
  - urn:epc:id:grai:0614141.12345.400

Global Individual Asset Identifier (GIAI)

- Assigns a unique identity to a specific asset, such as a forklift or a computer.
- General syntax:
  - urn:epc:id:giai:CompanyPrefix.IndividulAssetReference
- Example:
  - urn:epc:id:giai:0614141.12345400

more identifiers…

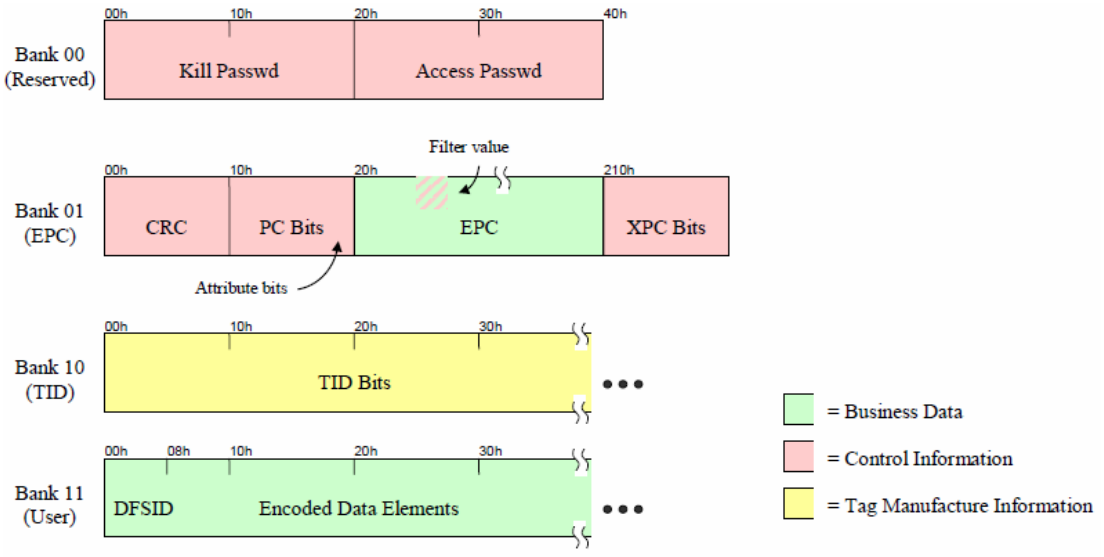
- Global Service Relation Number (GSRN)
- Global Document Type Identifier (GDTI)
- General Identifier (GID)
- US Department of Defense Identifier (DOD)

Memory Organization of Gen 2 RFID Tags

- Types of Tag Data
  - **Business Data Information** - describes the physical object to which the tag is affixed. This information includes the Electronic Product Code (EPC) that uniquely identifies the physical object, and may also include other data elements. This information is what business applications act upon.
  - **Control Information** - Information that is used by data capture applications to help control the process of interacting with tags. Control Information includes data that helps a capturing application filter 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.
    Unlike Business Data, Control Information has no equivalent in bar codes or other data carriers.
  - **Tag Manufacture Information** - Information that 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. It may also include information that describes tag capabilities, as well as a unique serial number assigned at manufacture time.
    Usually, Tag Manufacture Information is like Control Information in that it is used by capture applications but not directly passed to business applications. Like Control Information, Tag Manufacture Information has no equivalent in bar codes or other data carriers.

Gen 2 Tag Memory Map

- Four separately addressable banks, numbered 00, 01, 10, and 11.



Reserved Memory
(Bank 00)

- This memory bank stores the kill password and the access password (each are 32 bits).
- The kill password permanently disables the tag (very rarely used).
- The access password is set to lock and unlock the tag's write capabilities.
- This memory bank is only writable if you want to specify a certain password. Most users do not use this memory area unless their applications contain sensitive data. It cannot store information besides the two codes.

EPC Memory
(Bank 01)

- This memory bank stores the Electronic Product Code (EPC).
- It has a minimum of **96 bits** of writable memory.
- The EPC memory is what is typically used in most applications if they only need 96 bits of memory.
- There are some tags that have the capability of allocating more bits to the EPC memory from the user memory.
- This is the first writable memory bank.

TID Memory
(Bank 10)

- Stores the unique Tag ID number (done by the manufacturer when the IC is manufactured)
- Typically, this memory portion cannot be changed.

User Memory
(Bank 11)

- If the user needs more memory than the EPC section has available
- Certain ICs have extended user memory which can store more information
  - There is no standard in how many bits of memory are writable on each tag
  - Typically, the extended memory is no more than 512 bits
  - There are some high memory tags with up to 4K or 8K bytes of memory.
- This is the second writable memory bank for Gen 2 ICs.

Filter Value

- The filter value is additional control information that may be included in the EPC memory bank (01) of a Gen 2 tag.
- Allows an RFID reader to select or deselect the tags corresponding to certain physical objects, to make it easier to read the desired tags in an environment where there may be other tags present.
- **Example**:
  - If the goal is to read the single tag on a pallet, and it is expected that there may be hundreds or thousands of item-level tags present, the performance of the capturing application may be improved by using the Gen 2 air interface to select the pallet tag and deselect the item-level tags.

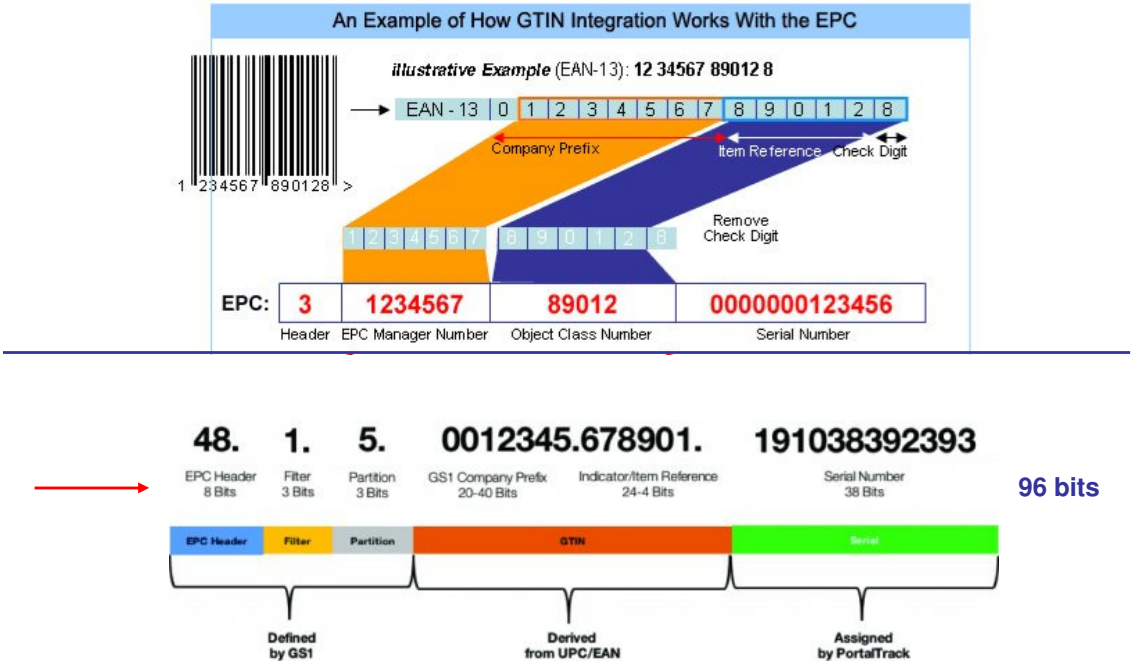
Multiple tags – The "Tag Collision" problem

- When multiple tags are in range of the reader:
  - All the tags will be excited at the same time and the answers will overlap ("collide") making it very difficult or impossible to read their ids.
- Collision avoidance mechanisms
  - Probabilistic
    - Tags generate a random number based on a slot size
    - When the reader broadcasts that number the tag will answer
  - Deterministic
    - Reader searches for specific tags (may use the *Filter Value*)
    - Other algorithms exist

Reader Collision Problem

- Reader-Reader Interference
- Reader-Tag Interference
- Solutions:
  - Only reader to reader interference
    - Assign different operating frequencies
  - Only multiple reader to tag interference
    - Assign different time slots for operation
  - Both types of interference
    - First allot different time slots, then frequencies

Illustration of GTIN integration in EPC



Questions?