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TRACK AND MANAGE **EVERYTHING**

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APR. 3-5, 2012 | WALT DISNEY WORLD SWAN AND DOLPHIN RESORT, ORLANDO, FLA

RFID Tag Data Standards

Kenneth R. Traub, PhD

Ken Traub Consulting LLC

3 April 2012

Outline for Today

- 11:30: RFID Visibility Data for Business Applications
 - What's the important data, and how do you use it?
- 12:15: RFID Data Capture Software
 - How do you collect the important data?
- Lunch
- 1:45: Putting It Together: Architecture, Product Selection and IT Governance
 - How do you build a complete system for the enterprise?
- 2:30 (now): RFID Tag Data Standards
- 3:30: RFID Data-Capture Standards: LLRP and ALE



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About the Speaker

- Independent Consultant
- Specializing in EPC/RFID Standards adoption
 - Software architecture for enterprises and solution providers
 - Educational programs on standards tailored to clients' needs
- Actively involved in GS1/EPC standards development
 - Member, GS1 Architecture Group
 - Editor, GS1 System Architecture
 - Editor, EPCIS and CBV specifications
 - Co-chair, Filtering & Collection (ALE) Working Group
 - Editor, EPC Tag Data Standard
 - Contributor to four other software specifications
- Consulting Instructor for Academia RFID



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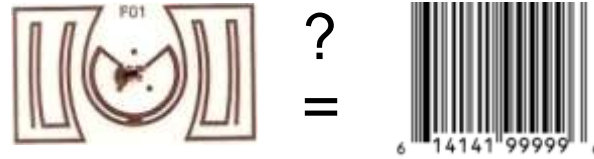
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What's In a Tag?



- More data (up to kilobytes)
- Random access
- Writeable as well as readable
- Fancy features (passwords, access control, crypto, “files”, sensors, ...)
- Info about the tag’s chip itself
- ➔ RFID Tag Data more complex than bar code!



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Types of Tag Data

<p>Identification</p> <p>What's the tag attached to?</p>		
<p>Supplementary data</p> <p>Info about the thing the tag's attached to (height, weight, expiration...)</p>		
<p>Control Data</p> <p>To operate various tag functions (passwords, filter values, ...)</p>		
<p>Tag Manufacture Data</p> <p>Make, model, mfr serial, ...</p>		



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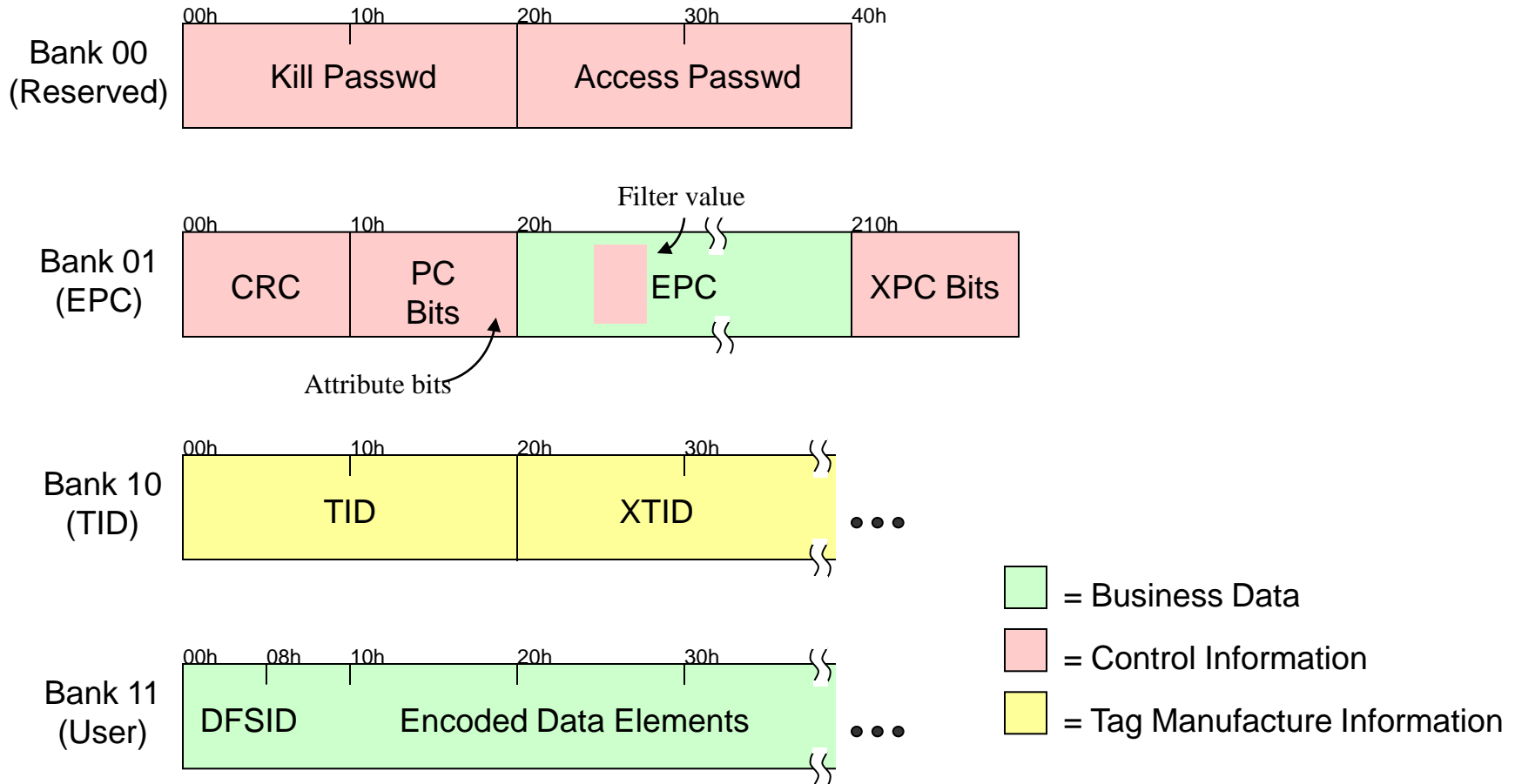
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Gen 2 RFID Memory Map



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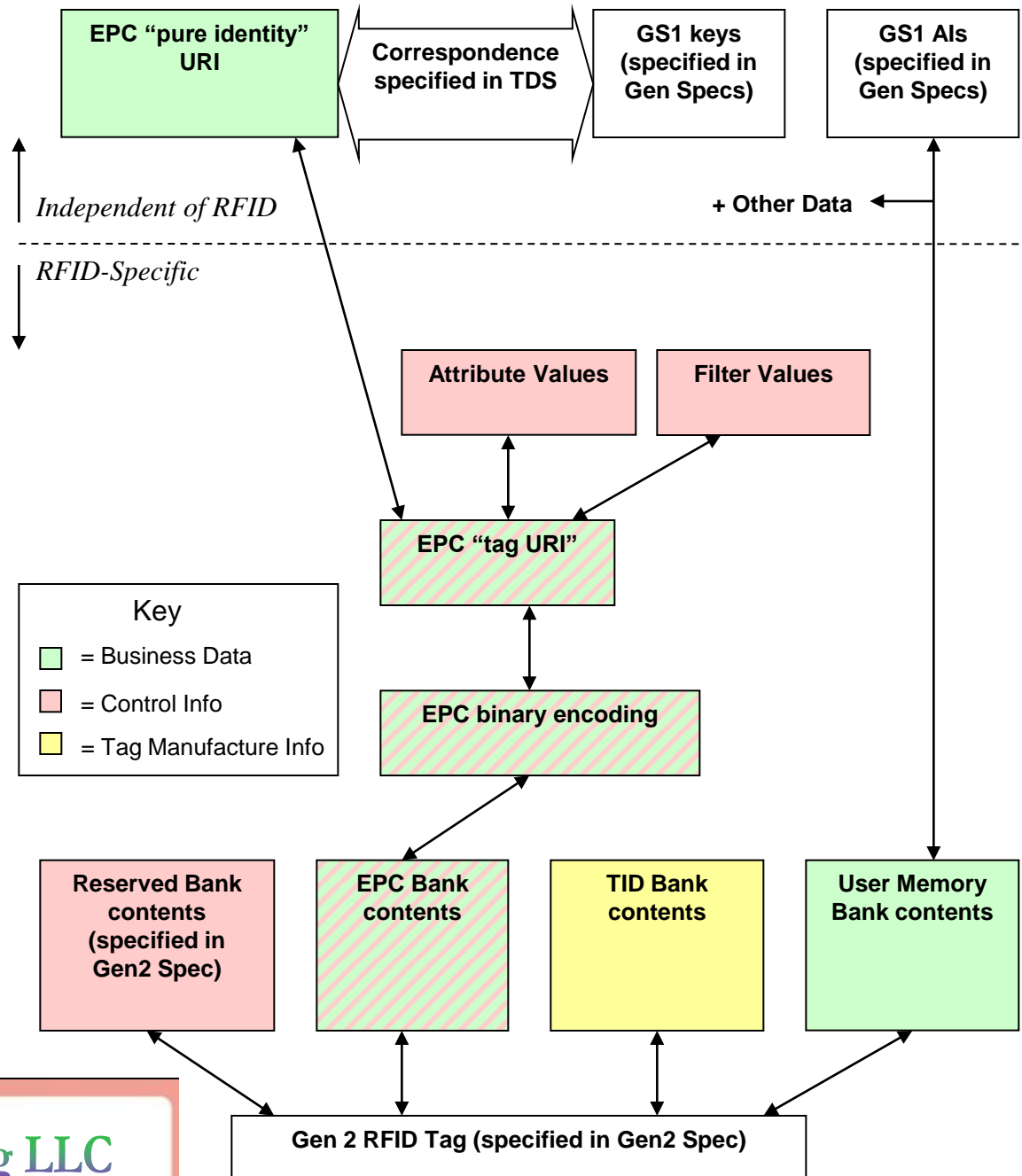
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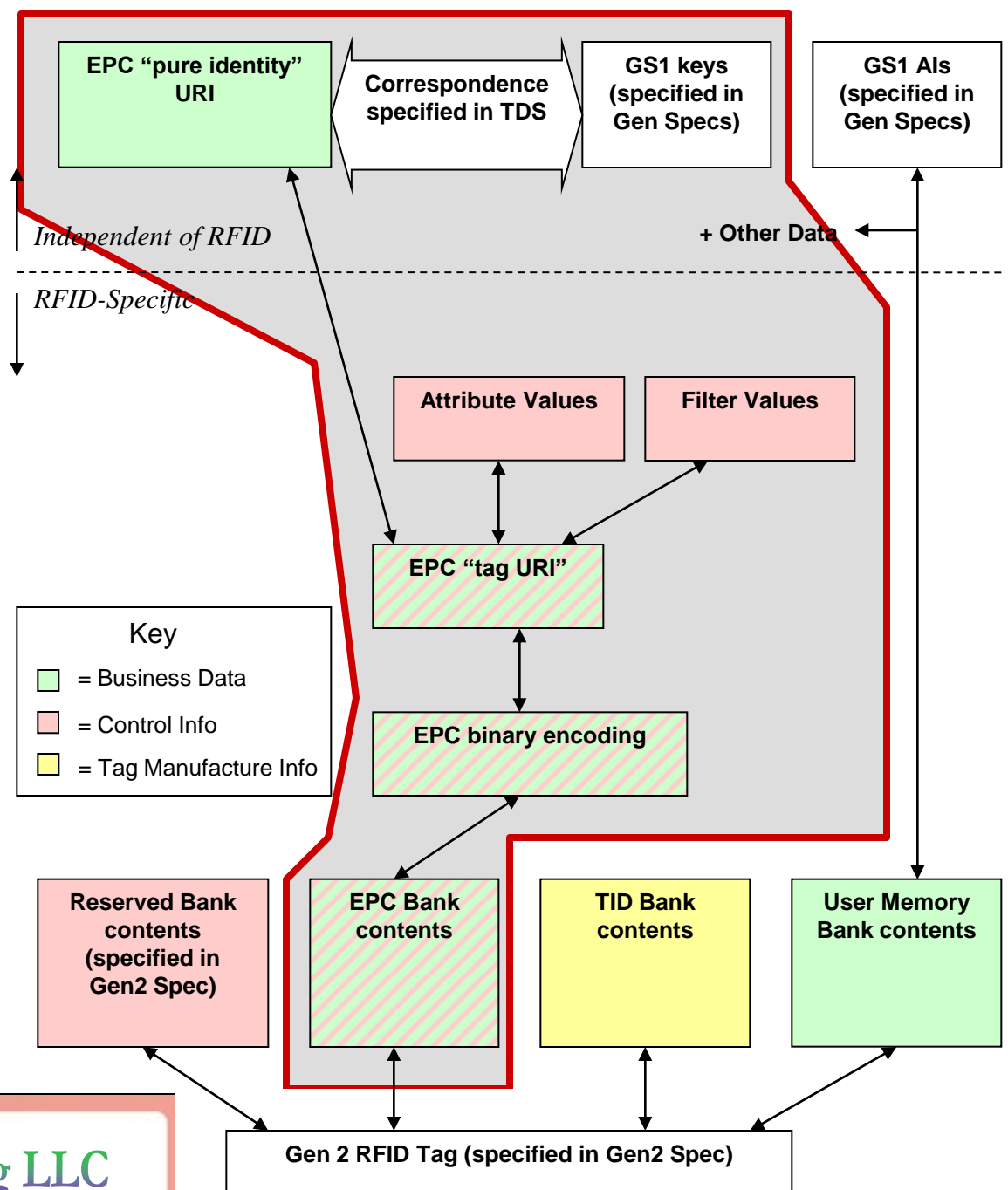
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EPC Tag Data Standard



EPC Tag Data Standard



EPC Identification Schemes

EPC Scheme	Related GS1 Identification Key	Use	Tag Encodings
SGTIN	GTIN (with added serial #)	Trade items	SGTIN-96 SGTIN-198
SSCC	SSCC	Pallet or other unitized loads	SSCC-96
SGLN	GLN (with optional extension #)	Locations	SGLN-96 SGLN-195
GRAI	GRAI (serial number mandatory)	Returnable/reusable assets	GRAI-96 GRAI-170
GIAI	GIAI	Fixed assets	GIAI-96 GIAI-202
GDTI	GDTI (serial number mandatory)	Documents	GDTI-96 GDTI-113
GSRN	GSRN	Service relations (e.g., loyalty card)	GSRN-96
GID		Auto-ID Center legacy	GID-96
DoD		US Dept of Defense	DoD-96
ADI		Aerospace and Defense	ADI-var



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Different EPC Forms

- GS1 Element String – as used in bar code

(01) 1 0614141 00743 8 (21) 401

----- *GTIN* ----- *Serial*

- Pure Identity URI – just the EPC – as used in EPCIS

<urn:epc:id:sgtin:0614141.100743.401>

- Tag URI – in software when all tag info needs to be represented – as used in RFID middleware

<urn:epc:tag:sgtin-96:3.0614141.100743.401>

- Binary – on-tag representation

001100000111010000100101011110111110100011000100101111100000000000000000000000000000000000110010001

3074257bf46261c000000191 (*Hexadecimal equivalent*)

Bar Code to EPC URI

(01) 1 0614141 12345 2 (21) 401

*Check digit
not included
in EPC*

urn:epc:id:sgtin:0614141.112345.401



ACADEMIA

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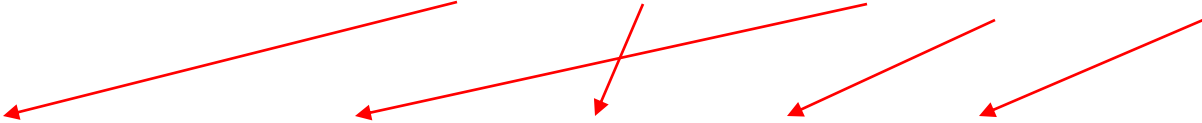
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URI to RFID Tag

- In information systems, an EPC is a URI:
`urn:epc:id:sgtin:0614141.112345.401`
- Too big to encode directly into a 96-bit tag
- So, an equivalent binary form is used:

`urn:epc:id:sgtin:0614141.112345.401`



Header	Filter Value	Partition	Company Prefix	Item Reference	Serial Number
8 bits	3 bits	3 bits	20-40 bits	24-4 bits	38 bits

x30 for SGTIN-96

Additional control info to help isolate tag populations



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Same EPC, different binary forms

- An SGTIN serial number may be up to 20 alphanumeric characters (from GS1 standard)
- Too large for 96-bit tag
- So, two binary variants:
 - SGTIN-96 handles all-numeric serial number whose value is $< 2^{38}$
 - SGTIN-198 handles any serial number, 1–20 alphanumeric characters
 - Latter becoming less rare, as tags with that capacity have now become available



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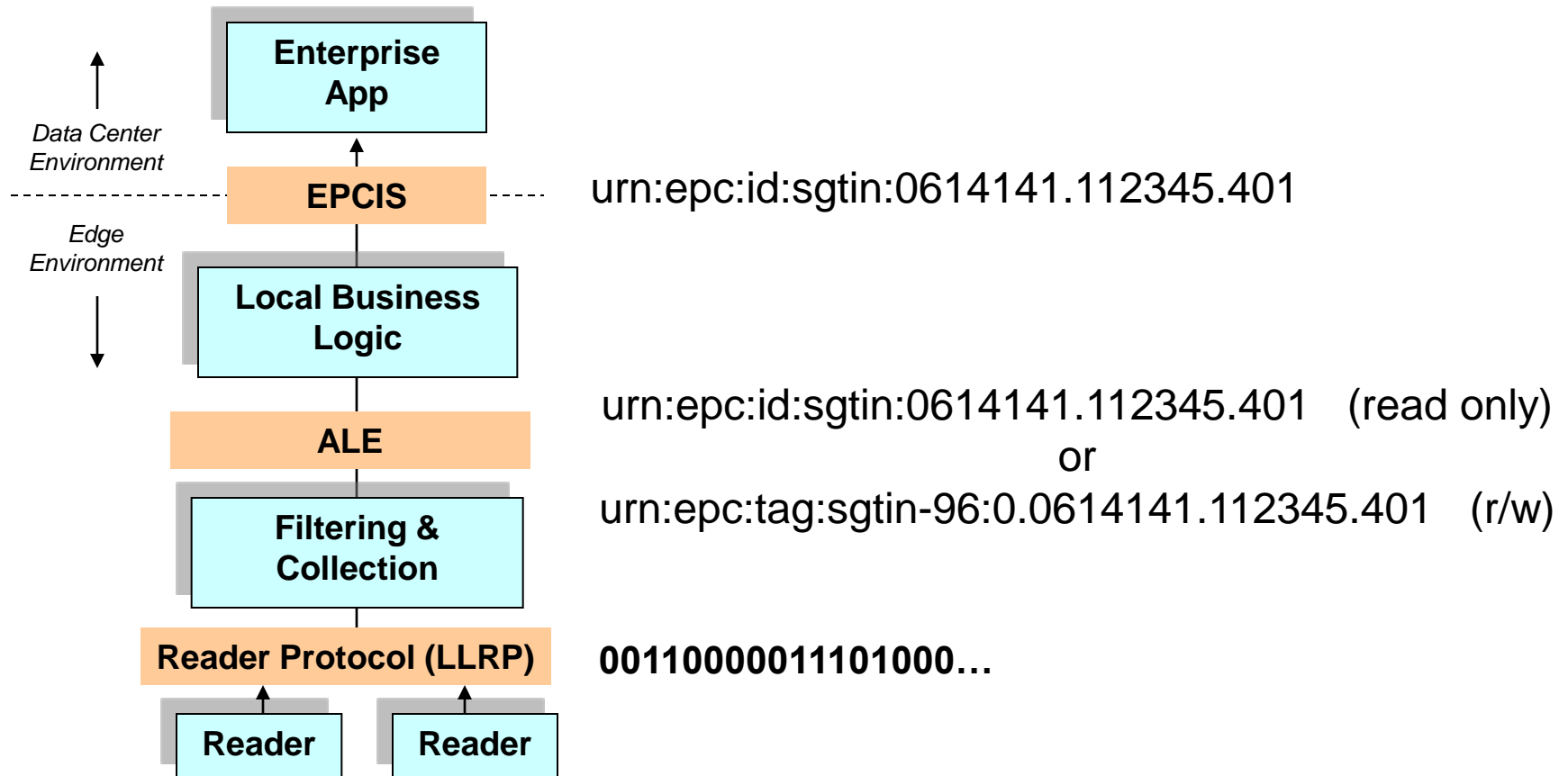
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Where Different Forms are Used



- Moral: Business apps should never use the binary format!



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EPC Translation – Resources

- Free interactive translators
 - www.kentraub.com/aidc
- Usually included in commercial “RFID Middleware” software
 - Always present in an ALE implementation
- Translator-only software libraries
 - FossTrak TDT (free)
 - www.kentraub.com/aidc (see the FAQ)



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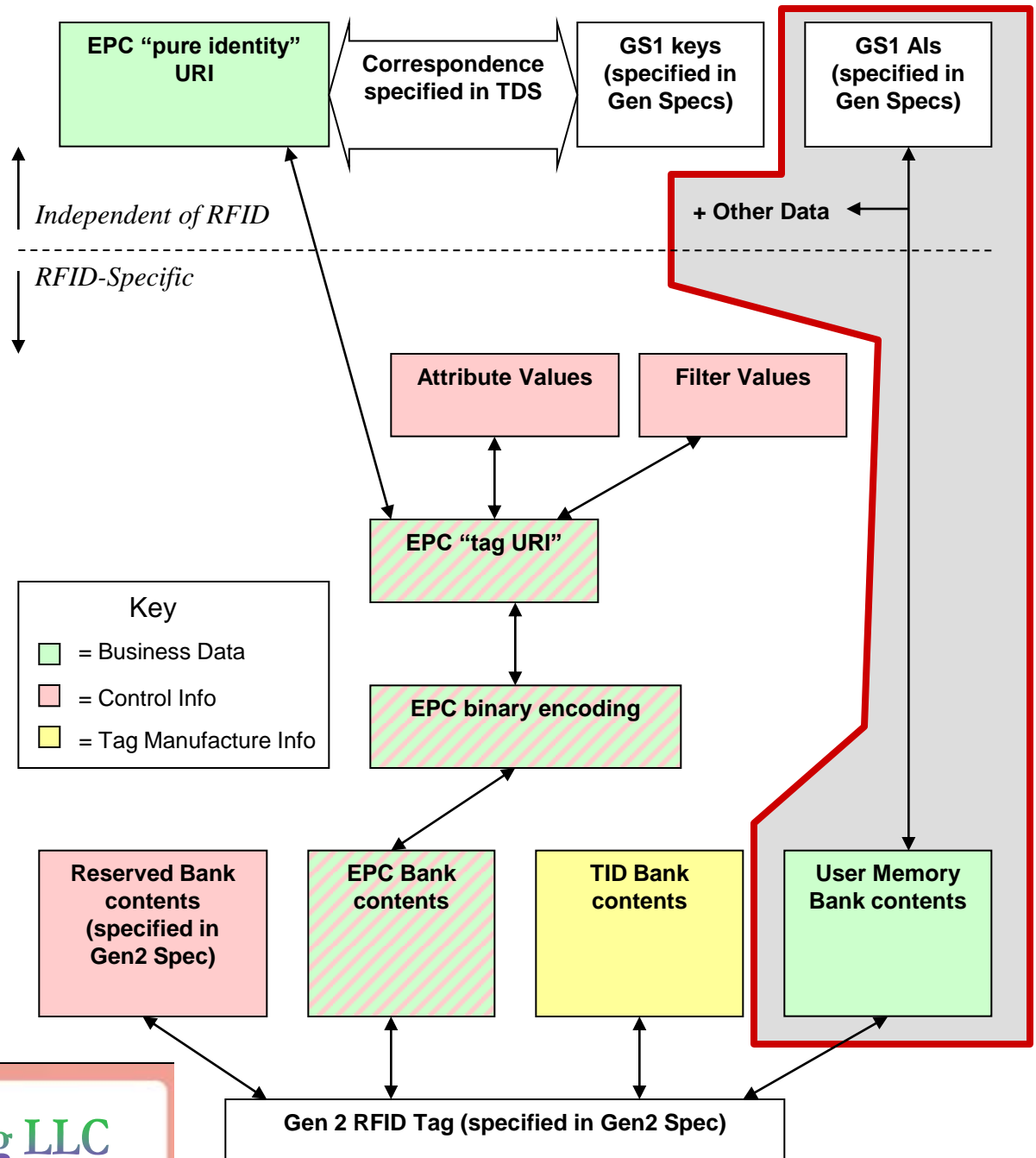
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EPC Tag Data Standard



Supplementary Data – GS1 AIs

AI	Description	Format	Label
10	Batch or Lot Number	an..20	BATCH/LOT
11	Production Date (YYMMDD)	n6	PROD DATE
12	Due Date (YYMMDD)	n6	DUE DATE
13	Packaging Date (YYMMDD)	n6	PACK DATE
15	Best Before Date (YYMMDD)	n6	BEST BEFORE or SELL BY
17	Expiration Date (YYMMDD)	n6	USE BY OR EXPIRY

- Plus dozens more...



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User Memory Outline

- Conceptually, the contents of user memory is a collection of many data elements (name/value pairs)
- Challenges:
 - Efficient data compression / limited memory
 - Random access
 - Selection based on tag contents
 - Adding/updating/deleting data elements
 - Selective locking



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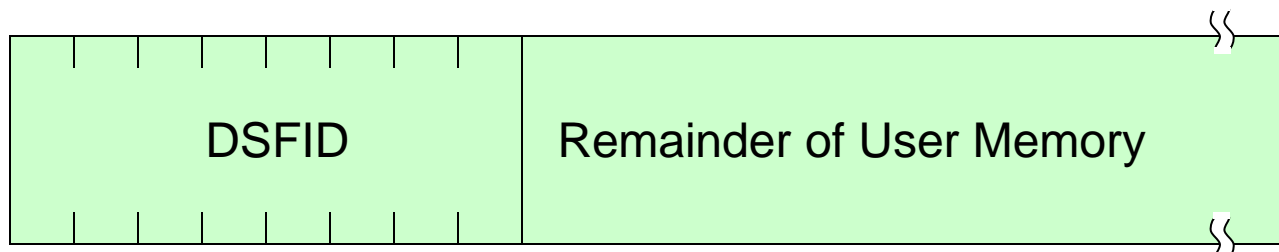
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User Memory Encoding

- All encoding schemes share a common format for the first eight bits of user memory, called the “Data Storage Format Identifier (DSFID)”:



Access Method
Identifies the encoding scheme used
00 = no-directory
01 = directory
10 = packed objects

Data Format
Identifies which data system predominates (all encoding schemes allow escape to other data systems)
00000 = uninitialized tag
01001 = GS1 AIs



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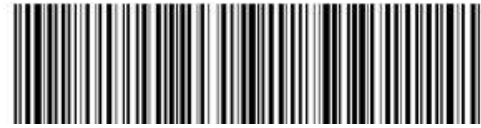
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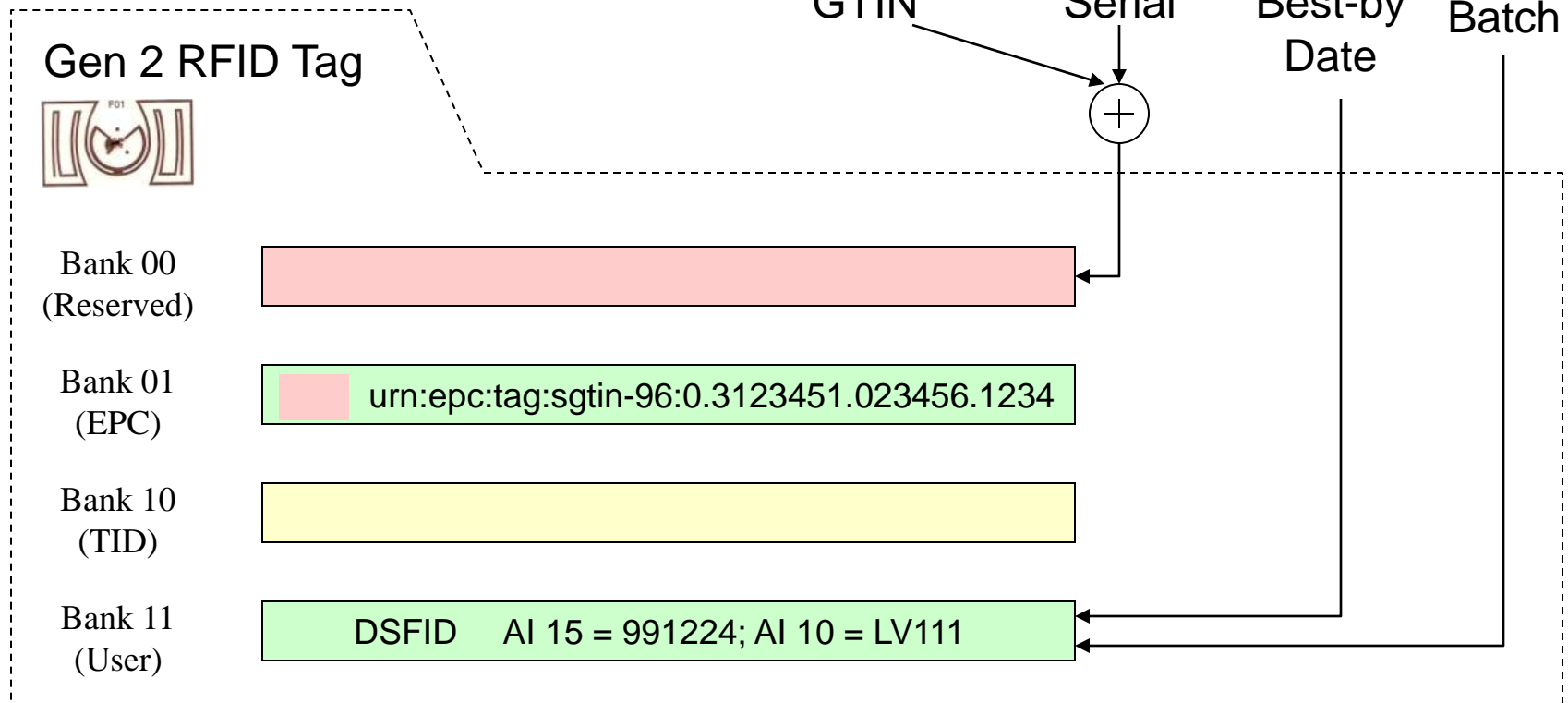
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Example



(01)03123451234569 (21)1234 (15)991224 (10)LV111

GTIN Serial Best-by Date Batch



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User Memory Encoding/Decoding

- Quite complex:
 - Efficient compaction for numeric, alpha data
 - Gen 2 “select” command support
 - Random vs sequential access, “directories”
 - Incremental add/update/delete
 - Selective locking
 - Multiple data systems
- Don't try this at home! Use a commercial software package:
 - www.kentraub.com/aidc



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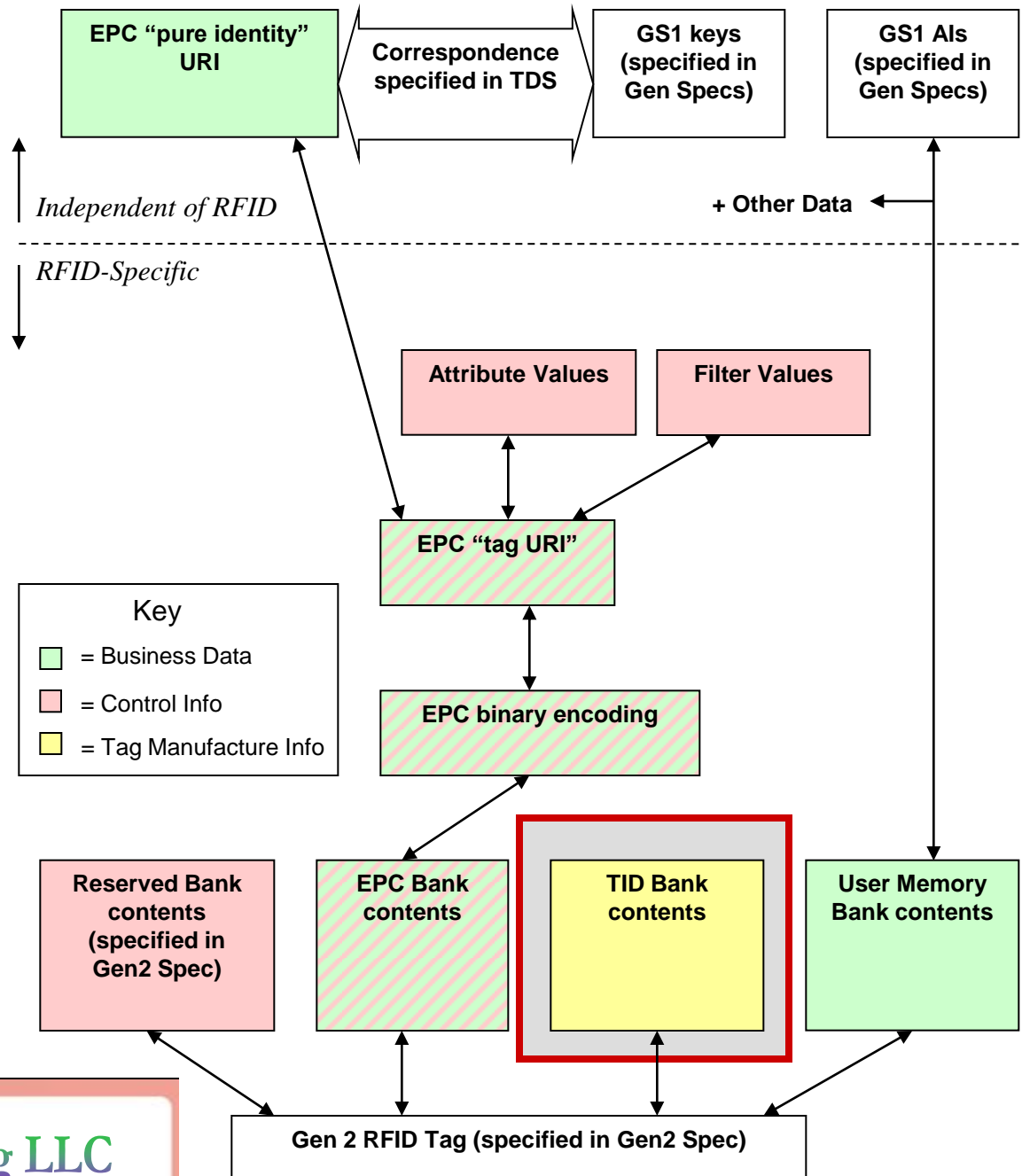
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EPC Tag Data Standard



TID Memory Bank

- TID includes three things:
 - 12-bit numbers identifying the make and model of the tag (not the product to which the tag is attached)
 - (Optional) a serial number assigned at tag manufacture time, unique within the tag make/model
 - (Optional) flags that indicate which optional features the tag supports
 - Latter two are called the “Extended TID” (XTID)
- The TID serial number is *not* the same as the SGTIN
 - Not useful as the serialized identifier of the product:
 - Too RFID specific
 - Doesn't identify product SKU
 - Different than existing product identification
 - Has applications for anti-counterfeiting



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Other Data Systems – Identification

- Bit 17h of EPC memory is the “toggle”
 - If zero, remainder of EPC memory follows EPC standards (as previously discussed)
 - If one, remainder of EPC memory contains:
 - An “**Application Family Identifier**” (AFI) allocated by ISO for a specific purpose; e.g.:
 - C1 = IATA Baggage Identifier
 - C2 = Library loan item
 - Etc...
 - An **application-specific identifier** defined by some standard as indicated by the AFI



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Other Data Systems – Supplementary Data

- Several different supplementary data systems exist:
 - GS1 Application Identifiers (AIs)
 - ANSI MH-10 Data Identifiers (DIs)
 - ATA Text Element Identifiers (TEIs)
- Each originated in a separate bar code world
- Rather similar in content
- In user memory,
 - The DSFID indicates which system predominates
 - All compaction schemes permit inclusion of elements from system other than what DSFID indicates



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Summary

- Four types of Tag Data:
 - Identification
 - Supplementary data
 - RFID Control data (RFID-specific)
 - Tag Manufacture data (RFID-specific)
- Identification and Supplementary Data are defined by carrier-independent standards
 - Carrier-independent forms should be used in business applications,
 - ...*not* the RFID-specific binary/hexadecimal forms
- Tag Data Standards give encoding/ decoding rules for use in RFID
- Multiple standards exist, but tag data indicates which is used



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