

*INNOV-6:
"RFID Vapor,
Fiction and Truths"*

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June 4 - 7 2005
Las Vegas



Agenda

- Quick Definitions and Level Setting
- How to Read and Write tags?
- Integration with your back end?
- What are the hard parts related to an implementation?

Why RFID is Important?

- RFID will redefine many business processes and how information is shared between “partners”.
- Mandates may force companies to adopt RFID. i.e. Wal-Mart, DoD
- Persistent & Autonomous Data Store

Show Me the Money

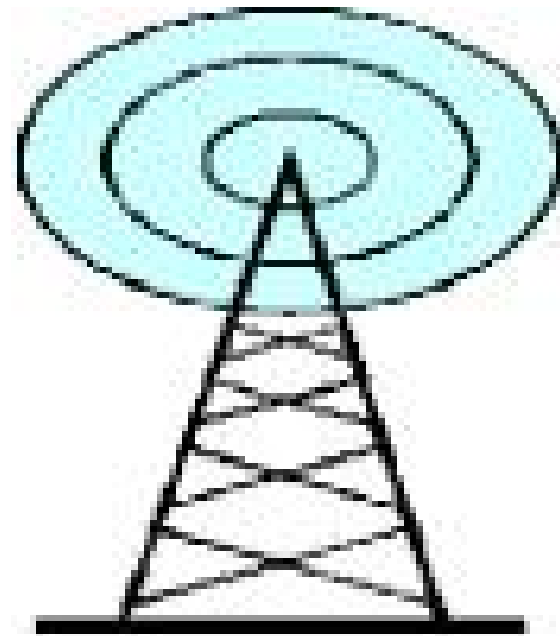
THE BOTTOM LINE

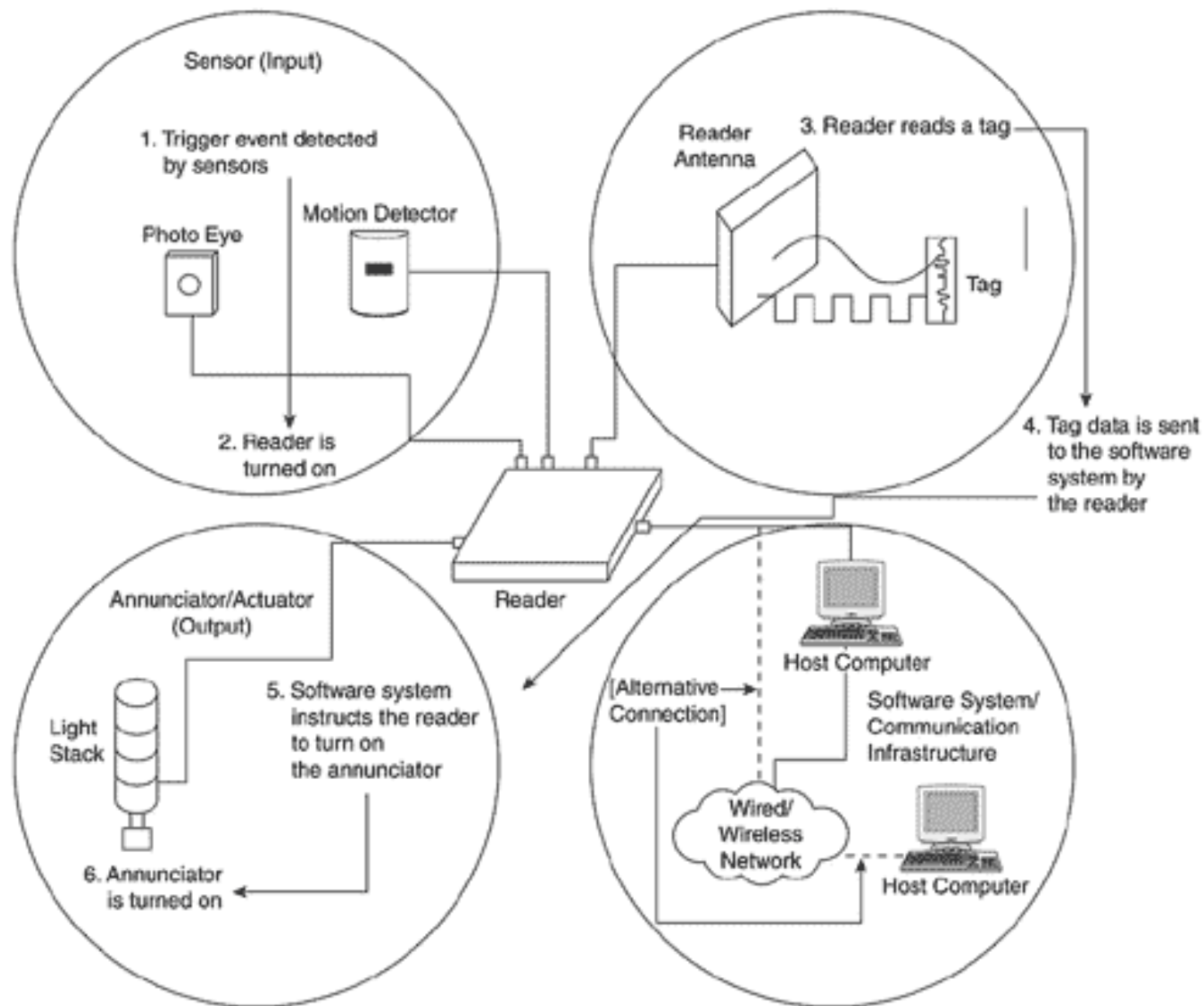
The ability to know where every item is in the supply chain and store could save retailers billions of dollars per year. Here's an estimate of what Wal-Mart might save annually when RFID technology is deployed throughout its operations.

\$6.7 Billion	Eliminate labor costs by 15 percent.	Reduce labor	lets
\$600 Million	Eliminate out-of-stocks using smart shelves to monitor on-shelf availability.	Reduce out-of-stocks	rt by
\$575 Million	Known item automatically reduces administrative error and vendor fraud.	Reduce shrinkage	or ducts
\$300 Million	Be more efficient significant savings.	Increase distribution efficiency	that
\$180 Million	Improve inventory management Wal-Mart reduce its inventory and the annual cost of carrying that inventory.	Reduce inventory carrying cost	in its ; Wal-
\$8.35 Billion	Total pre-tax saving is higher than the total revenue of more than half the companies on the Fortune		

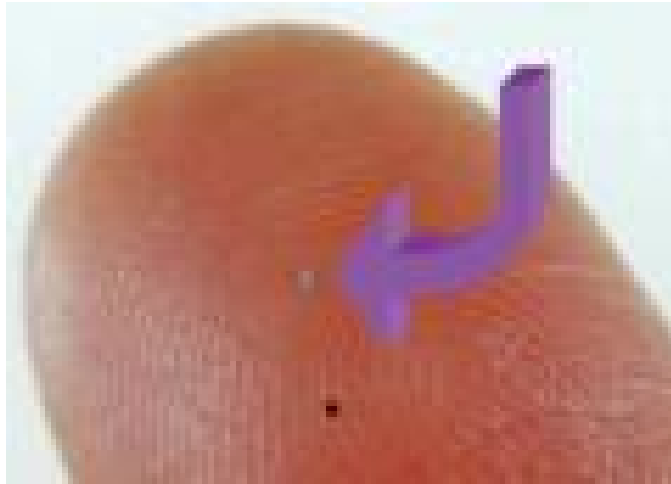
RFID – How?

- Radio Technology – Think AM Radio
- Issues
 - Wave lengths
 - Attenuation
 - Absorption
 - Reflection
 - Interference

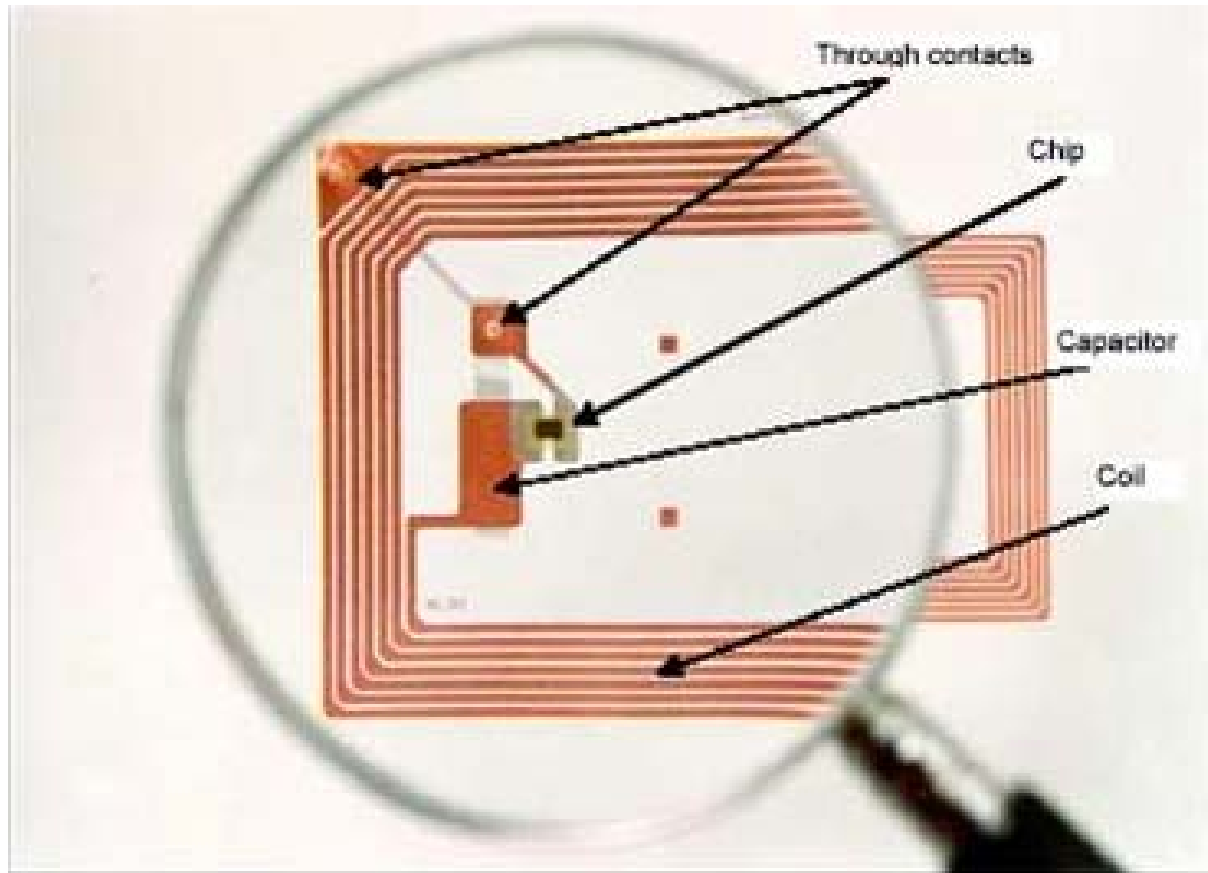




Anatomy of a Tag : Chip



Anatomy of a Tag : Inlay



Anatomy of a Tag : Package



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Tag Types

	Active Tag	Passive Tag
Power Source	Internal Power	None
Tag Battery	Yes	No
When Powered	Constant On or Reader Tripped	Only in field of a reader
Signal Needed	Low	High
R/W Distance	Far	Much Closer
Cost Scale	\$25.00 - \$100.00	\$.25 to \$2.00
Form Factor	Hardened Package	Many

Standards Organizations



International
Organization for
Standardization

“ISO (International Organization for Standardization) is the world's largest developer of standards. Although ISO's principal activity is the development of technical standards, ISO standards also have important economic and social repercussions. ISO standards make a positive difference, not just to engineers and manufacturers for whom they solve basic problems in production and distribution, but to society as a whole. ”

ISO RFID Standards

- ISO 15693—Smart Labels
- ISO 14443—Contact-less payments
- ISO 11784—Livestock
- ISO 18000 - Air interface protocol.
 - The ISO 18000 series covers the air interface protocol for systems likely to be used to track goods in the supply chain.



Standards Organizations



Powered by GS1

EPCglobal is leading the development of industry-driven standards for the Electronic Product Code™ (EPC) to support the use of Radio Frequency Identification (RFID) in today's fast-moving, information rich, trading networks.

EPC Global's Mission

Track goods through the international supply chain.

Develop a low-cost RFID system using disposable Tags

The Auto-ID Center developed its own protocol and licensed it to EPCglobal on the condition that it would be made available royalty-free to manufacturers and end users.

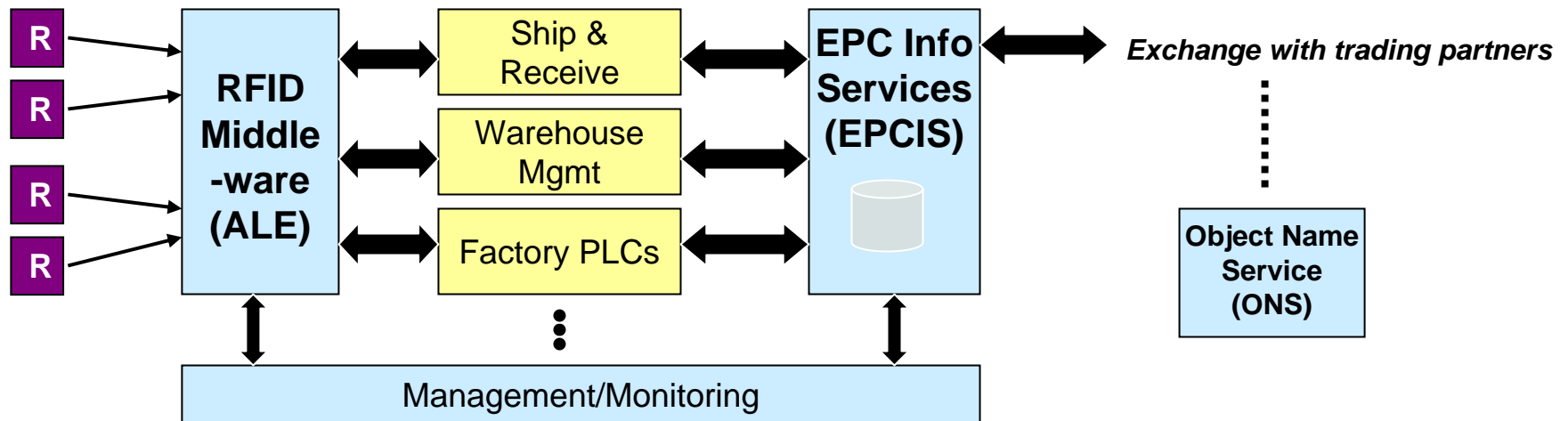
Also charged with developing a network architecture—a layer integrated with the Internet—that would enable anyone to look up information associated with a serial number stored on a tag. The network, too, needed to be based on open standards used on the Internet, so companies could share information easily and at low cost.

EPC Global System Goals

1. Uniquely identifying items (Electronic Product Code)
2. Detecting the presence and identity of items (RFID)
3. Passing the information across the network (EPC middleware)
4. EPC Backbone
 - a. Finding information on the network (Object Name Service)
 - b. Track item characteristics and movement (EPC Info. Service)
 - c. Representing item characteristics and movements (PML)

Complete EPC Architecture

Infrastructure-centric



EPC Tag Level Standards

Globally unique object identifier = A 96 bit License Plate

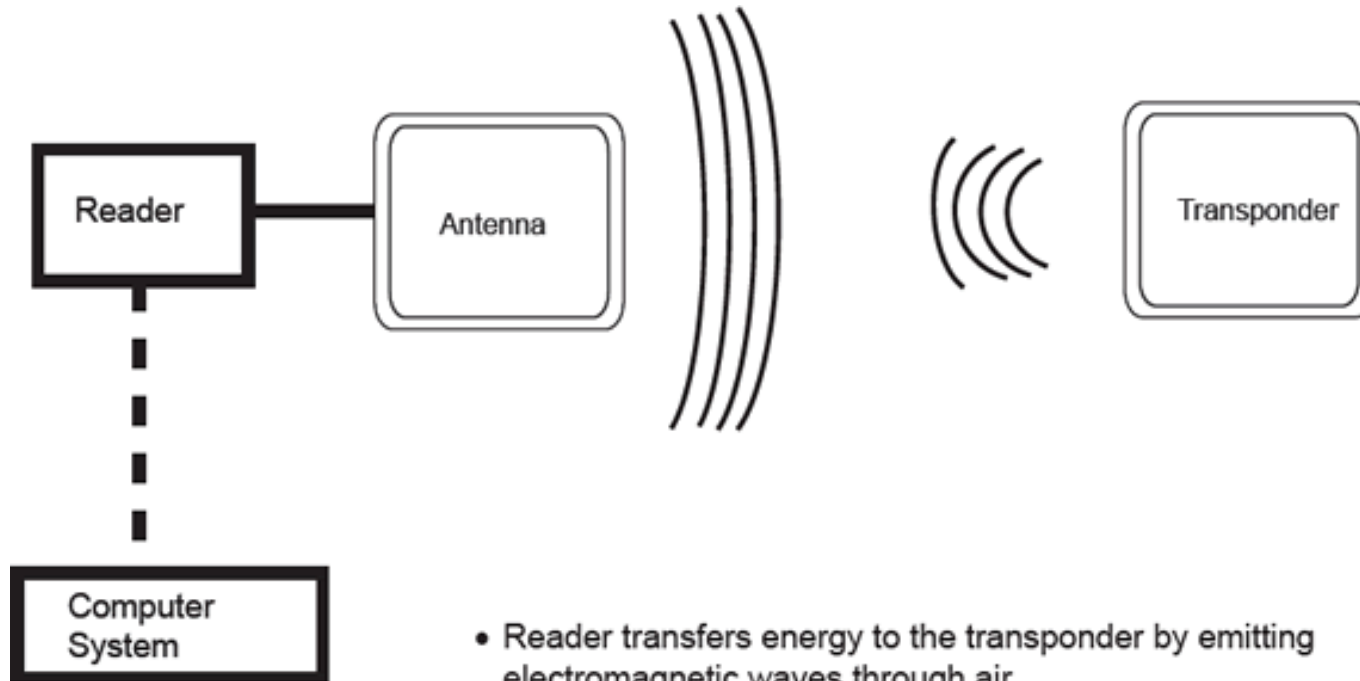
Currently supports the following keys:

GTIN	Global Trade Item Number
GIAI	Global Individual Asset Identifier
SSCC	Serial Shipping Container Code
GRAI	Global Returnable Asset Identifier
GLN	Global Location Number
NDC	National Drug Code

Designed to accommodate other keys such as:

UID	Unique Identifier)
VIN	Vehicle Identification Number

Air Interface Protocols



- Reader transfers energy to the transponder by emitting electromagnetic waves through air.
- Transponder uses RF energy to charge up.
- Transponder receives command/data signal and responds accordingly
- Reader receives transponder response and process accordingly
ie. sent to a host computer or external devices through its control lines.

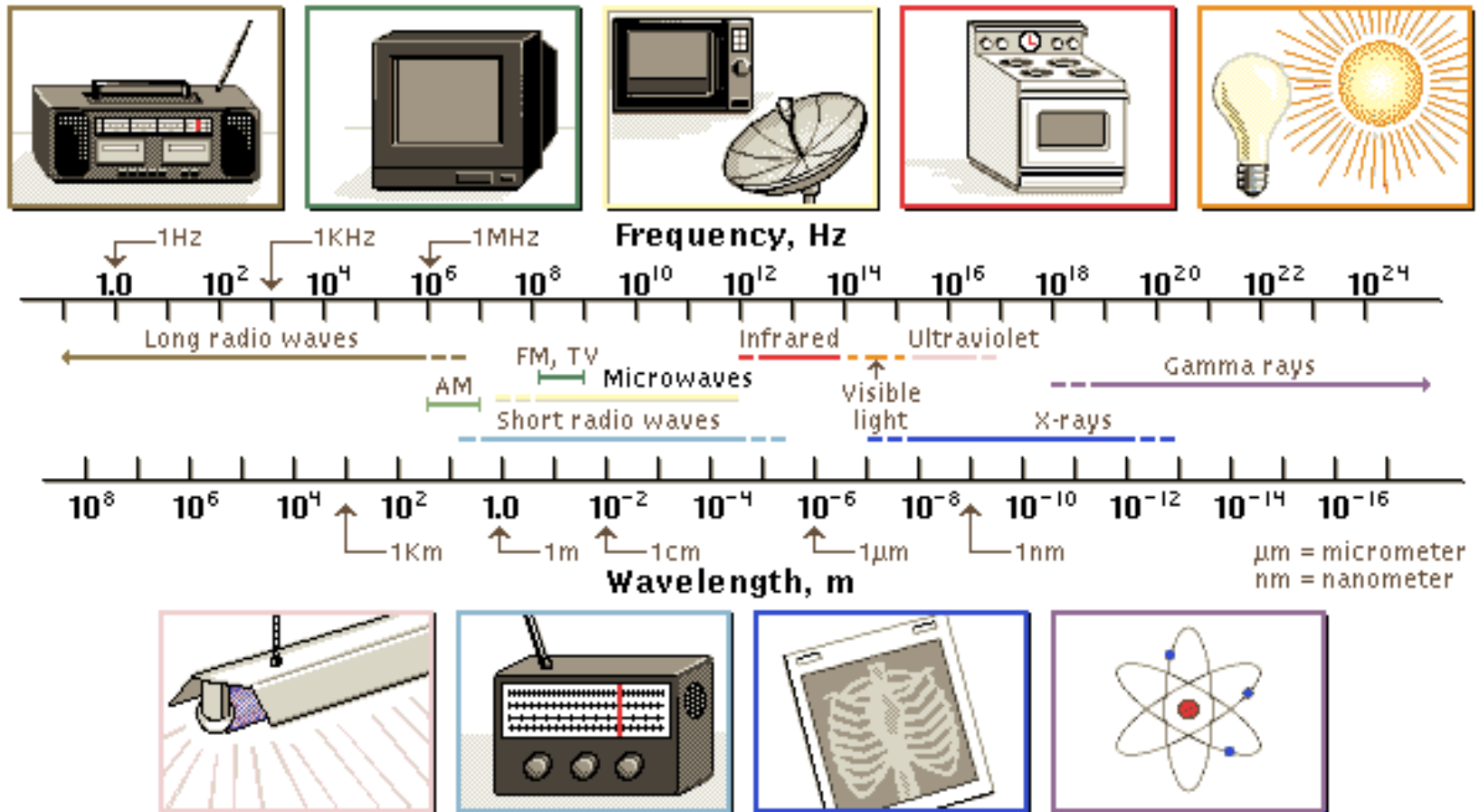
ISO Air Interface Protocols

- 18000—1: Generic parameters
- 18000—2: 135 KHz
- 18000—3: 13.56 MHz
- 18000—4: 2.45 GHz
- 18000—5: 5.8 GHz
- 18000—6: 860 MHz to 930 MHz
- 18000—7: 433.92 MHz

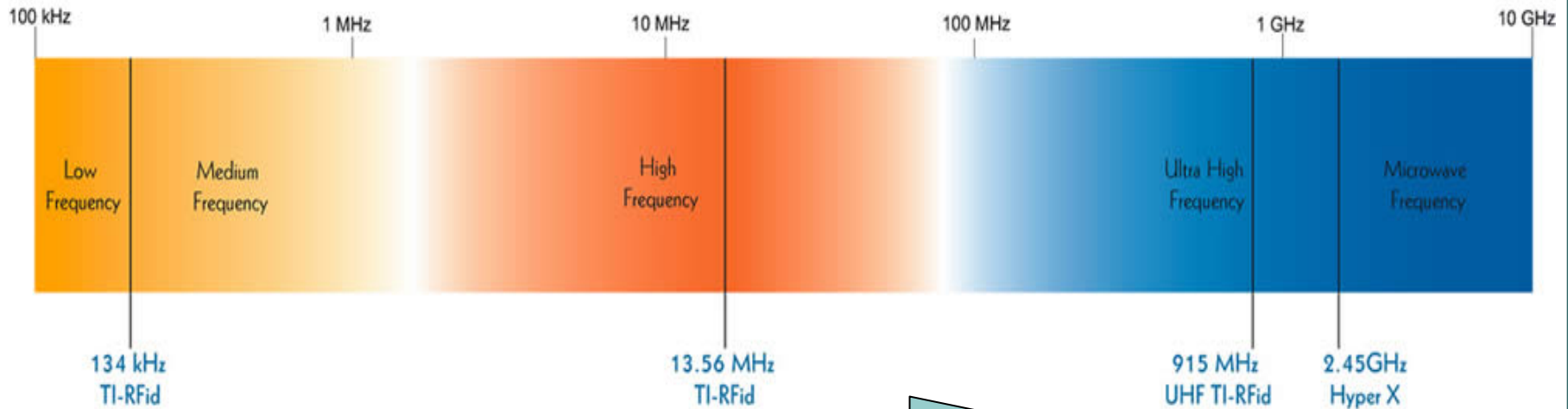
EPC Air Interface Protocol

- UHF Band {860Mhz to 930 MHz Only}
- Read Range for Logistic Type Apps.
- Global Applicability

Electro-Magnetic Spectrum



RFID Standard Frequencies



Antenna Gets Smaller

Faster Speed, Bigger Data Payload

Good Around Metal

Vapor and Fiction Alert

- IBM “Boxes told me so...”
- Privacy and Security Concerns.



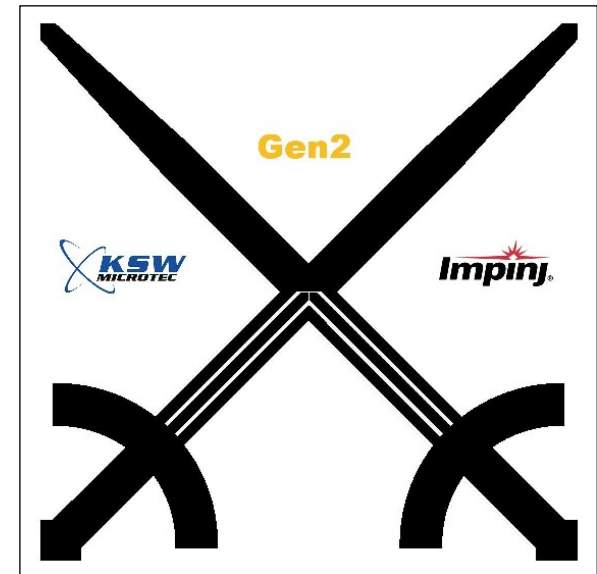
Satellites tracking
your purchase or
you

Agenda

- Quick Definitions and Level Setting
- How to Read and Write tags?
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Re-Cap

- Pick a Frequency
 - 915MHz
- Pick an Air Interface Protocol
 - EPC Gen2 Class 1
- Pick a Tag Type
 - Passive Tag
- Pick a Tag Form Factor
 - Label Inlay

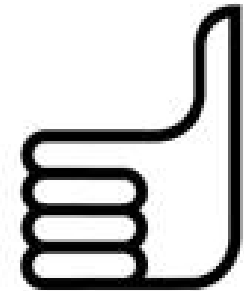


Current Tag

- ISO Tags have both a fixed size payload for the serial number as well as some degree of user memory.
- EPC tags are 96 bit tags with no user memory yet but it is in the spec.
- EPC GEN2 Class 1

What's so good about GEN2

- It is a world wide UHF standard
- Multi Vendor Choices
- Lower costs as we move to a commodity
- Lots of needed internal capabilities like
 - Tag Kill
 - Write Passwords
 - Tag to Interrogator Encryption
 - Bandwidth & Channel Utilization



What's not so good EPC Gen2

- No User Memory

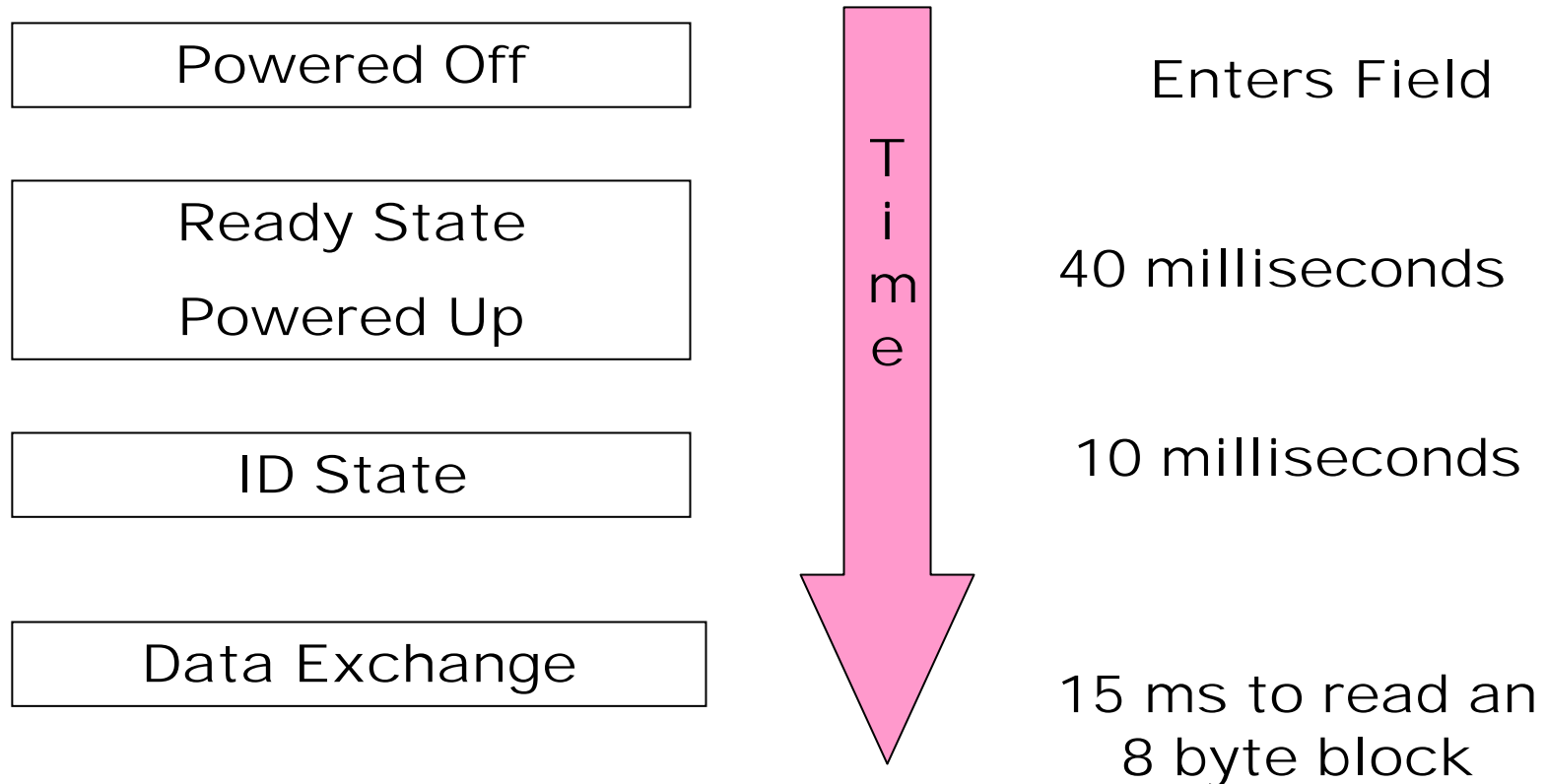


- ISO tags are better for non-standard uses of the technology.
- ISO tags are slowly going away in favor of EPC. We are currently in between the adoption of one and the fade of the other

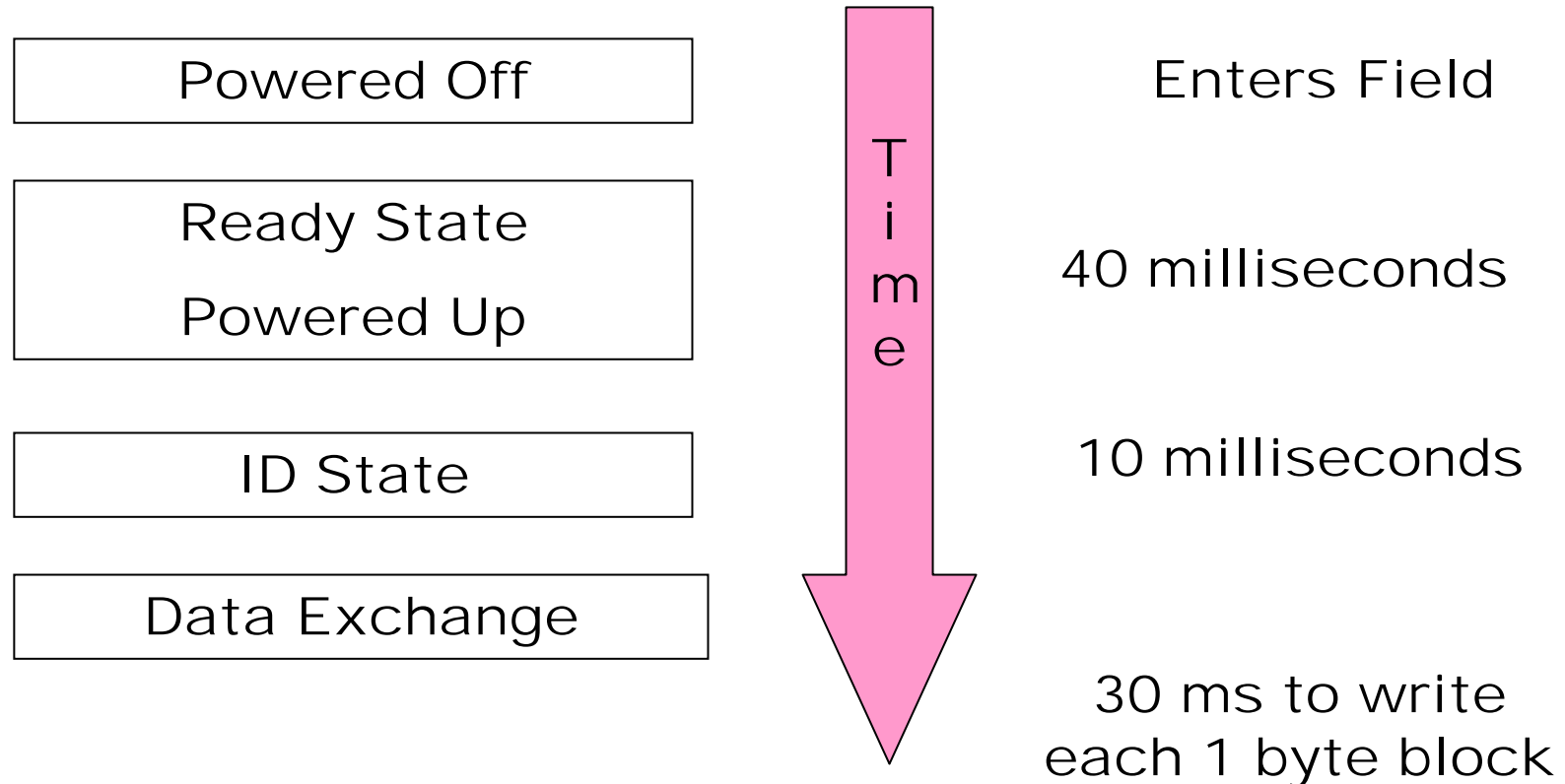
Don't Lose Focus

- The ISO B2B standards still exist but can not be implemented just yet with EPC Gen2 tags
- EPC is about serializing every widget
- ISO is much more than just serialization.

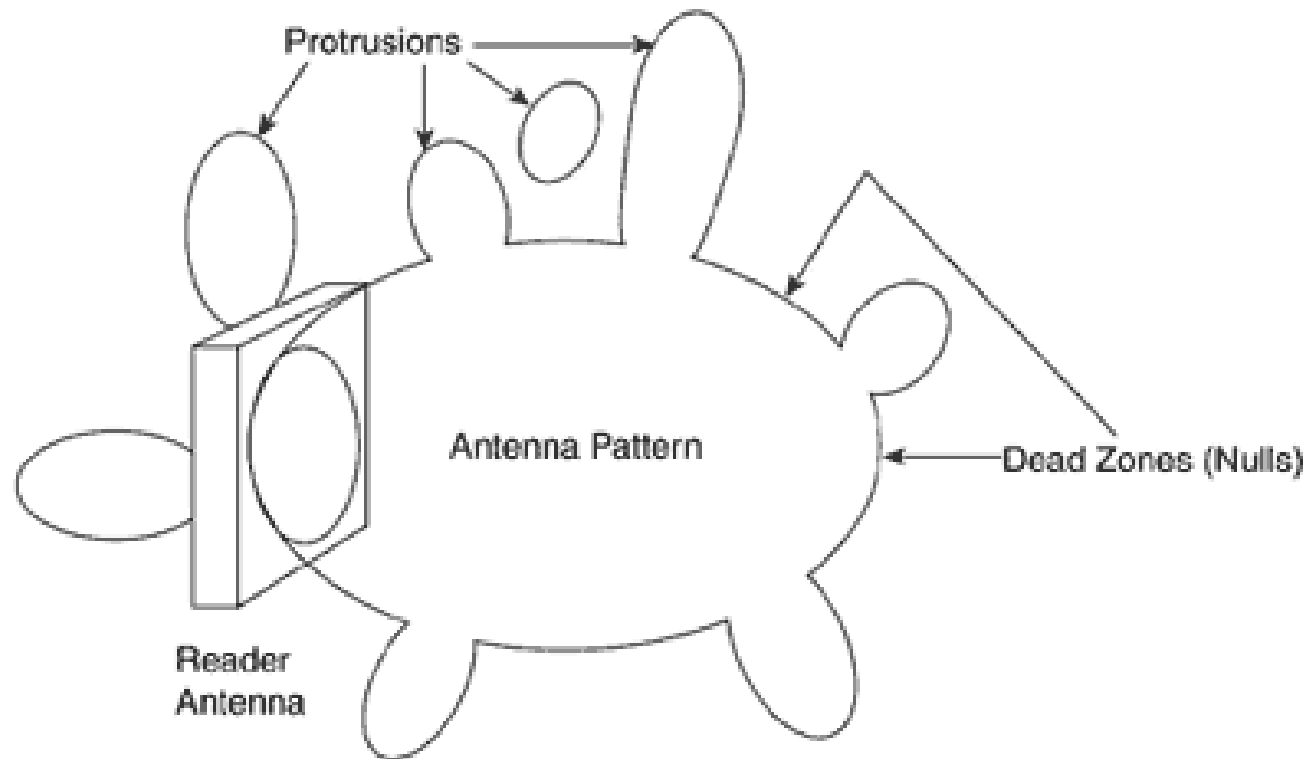
Reading Physics 65 ms



Writing Physics 80 ms

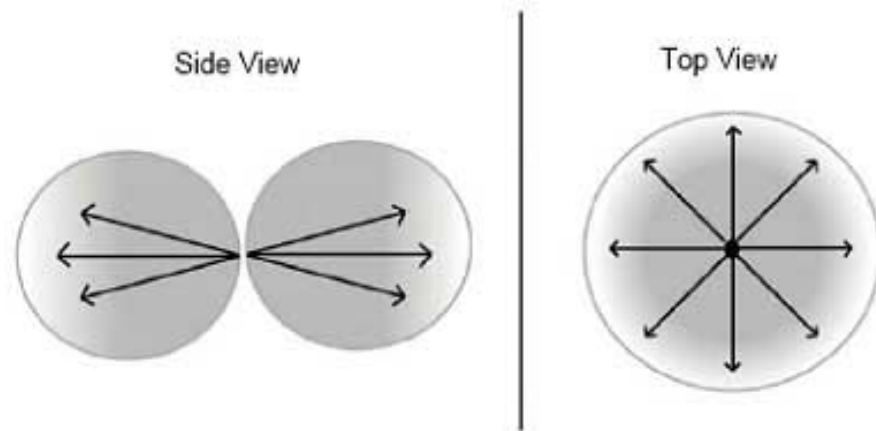
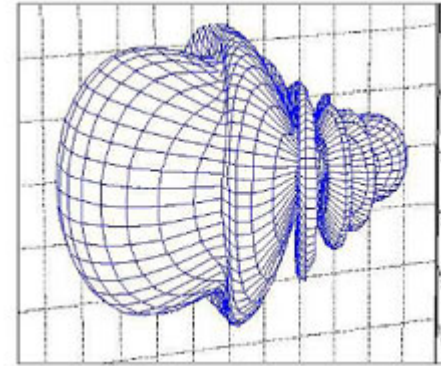


Sample Antenna Pattern



Antenna Physics

- Polarity
- Circular vs. Directional Patterns
- Shielding



What is Gain?



Isotropic



Directional

“Rules”

- The Reader can only ‘talk’ to one tag at a time.
- Qty addressed is a function of enough time, signal availability, strength & interference
- Timing and Speed are linked
- Tags can interfere with each other

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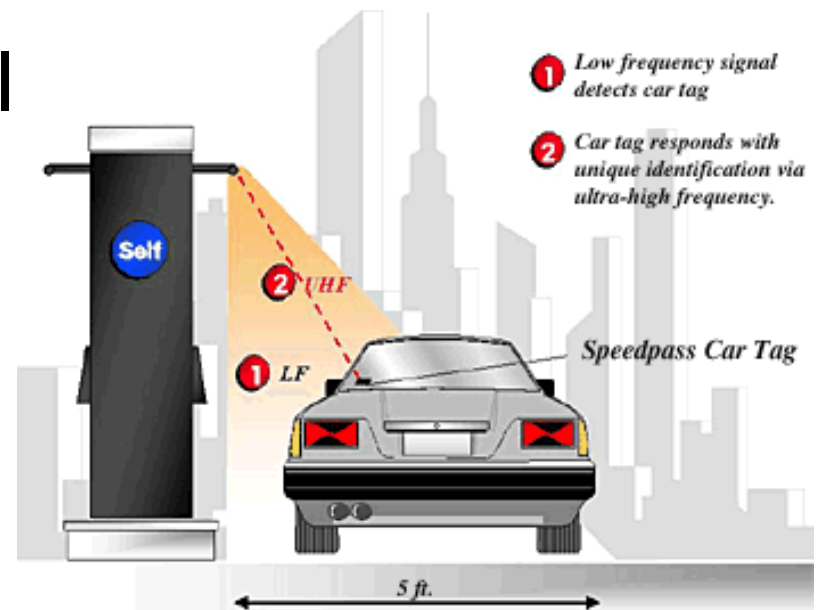
Integration

- EPC is just a Serial Number
 - We need to associate that with the specific instance of the widget.
 - We need to publish the relationship
 - We need to make that available to the “world”



Database Ties – Simple Case

- Read a Tag
- Forward that to the business system
- Cross reference that to the database
- Do something useful
 - Validation
 - Additional Data
 - Point In Time
 - Trip some sensor



EPC

Hdr . EPCMgr . ObjCls . Serial
013 . 0614932 . 123456 . 1000000000

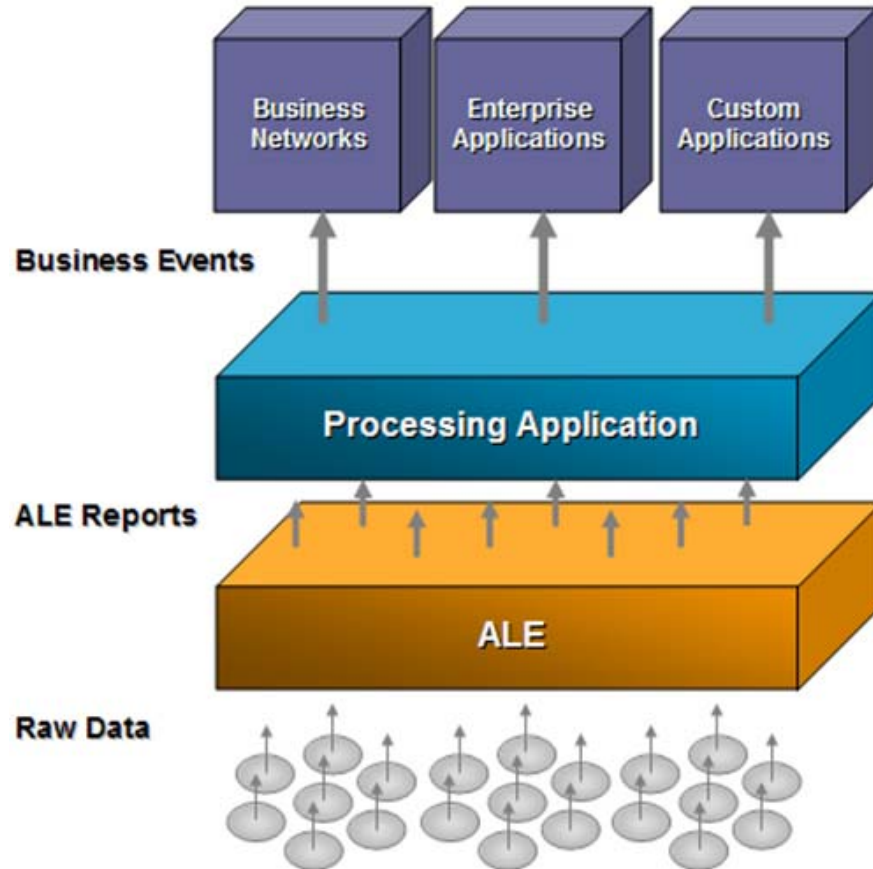
HEADER identifies the type of EPC number

The OBJECT CLASS is the class of the product, usually the stock-keeping unit or other object-grouping schema

EPC MANAGER, is the company responsible for maintaining the Object Class and Serial Number

The SERIAL NUMBER is the unique object identifier

EPC - ALE Layer



Event Stream Processing

“The capability of continuously analyzing, evaluating and responding to real-time streaming event data”

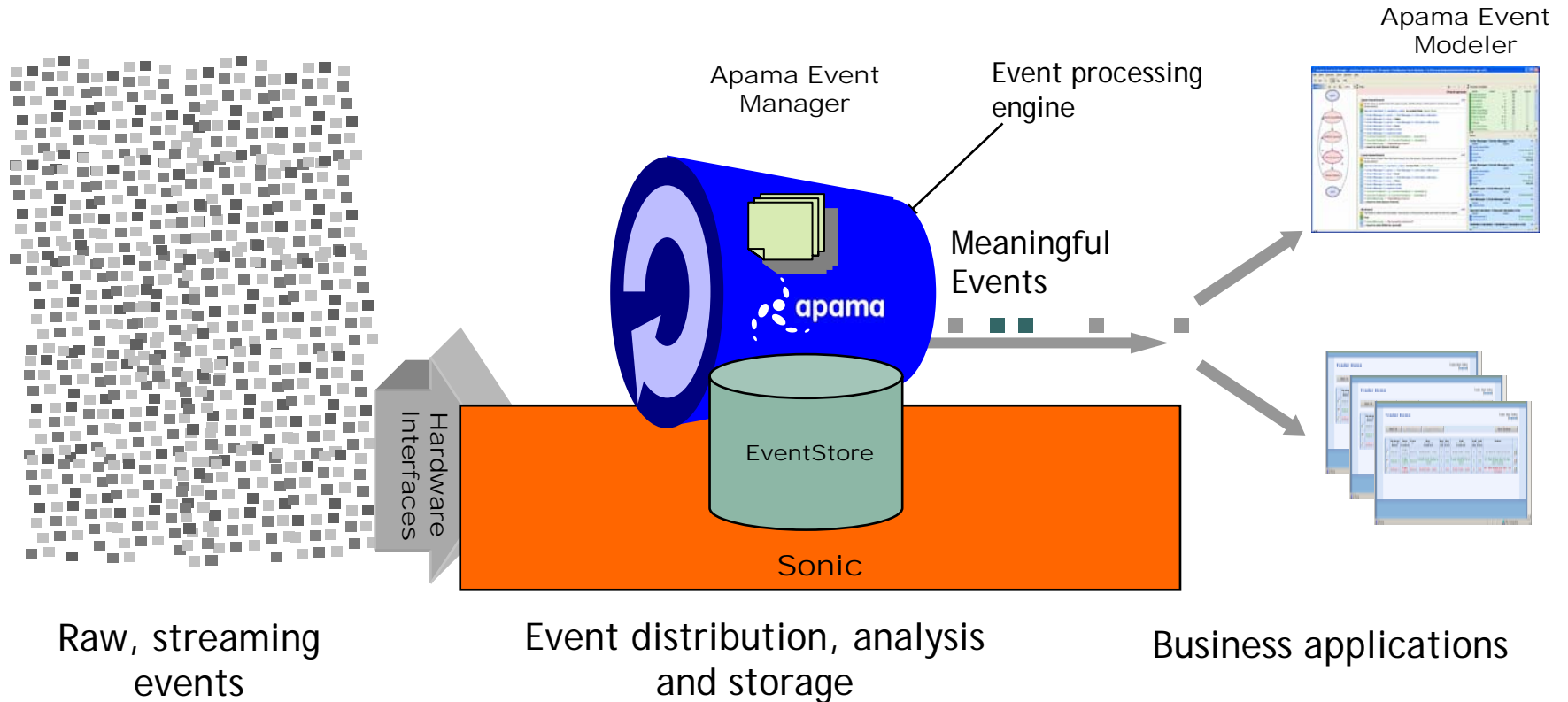
RFID Event Processing

- Insulate applications from high volume, “noisy” RFID event streams.
- Insulate applications from specifics of readers to allow reader replacement
- Process events on the edge to minimize load on back-end systems
- Automate generation of business events from low level events
- Store events to allow audit and analysis of performance of business processes

Data Management Challenges

- **RFID data lifetime is short**
 - You need to respond *now* to opportunities or threats, otherwise the chance has gone
- **Simple RFID events need composition into events of higher-value for business consumption**
- **Increasing data quantities will mean that traditional data management systems just won't be able to cope**

Supporting RFID Apps



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Hard Stuff - Physics

- Coding is Easy
- Industrial Engineering Is Hard
- Testing only valid in ‘Real World’
- Everything Keeps Changing

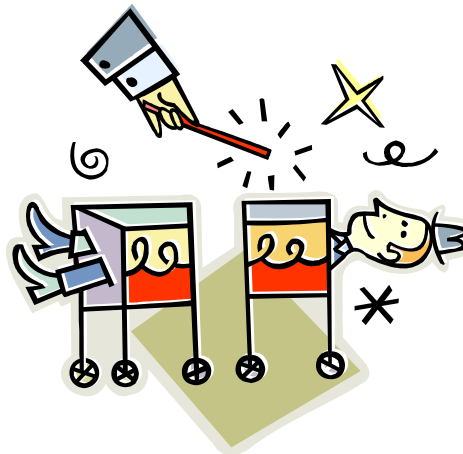
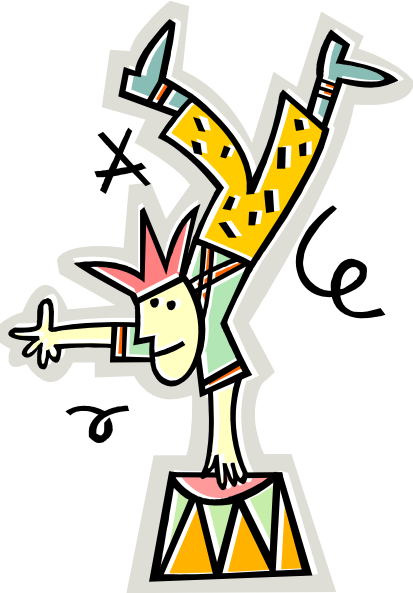
RFID Truth

- Watch the Demo and you can decide the accuracy of the privacy issue.
- ISO and EPC are each still Work-In-Process
- Expect Continuous Change

Industry Observations

- Compliance Tagging is hard and expensive with modest ROI
- WIP Automations hold great promise
- No EPC 'Killer Application' yet
- Extension of Bar Coding, Not a Replacement

Demo



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Questions/Comments/Discussion

Thank You for Attending

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Appendix Slides Follow

- The rest of the slide deck is left as an appendix to the actual talk.

135 KHz

{Range ~.7meter}

- Mostly Used To Track Livestock
- Band is mostly free from regulation
- Works well around wood, tissue & H2O
- Poor with metal, low speed, small data
- Huge Antenna

13.56 MHz {Range ~.7meter}

- Smart Cards, Tap-To-Pay, Bldg. Access
- World Wide Regulated Band
- Works well around tissue and H2O
- Poor w/ Metal, slow speed and small Data Payload

2.45 GHz

{Range ~ 1meter}

- Industrial, was popular but now fading
- Modestly regulated band worldwide but shares bandwidth with WLANS, Microwave ovens, Cordless Phones...
- Good around Metal, with proper tuning
- Bad around tissue, H2O, High Carbon Contents
- Small antenna, small tags

860 MHz to 930 MHz {5 Meters}

- Industrial, This is the only one we care about
- World wide range that works everywhere. May be licensed for added power and range.
- Good around Metal, with proper tuning. Not line-of sight
- Bad around tissue, H2O, High Carbon Contents
- Small antenna, small tags, bigger data payloads, faster

Tag Classes

Class		Power	Details
4	EPC	Active	Long Range, User Memory, R/W
3	EPC	Active	Med.Range, User Memory,
2	BOTH	Passive	Short Range, R/W, User Memory
1	EPC	Passive	WORM, 96 Bit, May extend to R/W
1 v1		Passive	WORM, 96Bit
0		Passive	Read-Only, 64 bit