Silicon Valley World Internet Center:

Massive Adoption of RFID?

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Topics:

- *The Big Picture*
- *RFID Overview*
- *Why The Supply Chain?*
- *$64,000 Question…when? And With What?*

The Big Picture

Evolving The Real-time Enterprise

- Collins & Porras, Built to Last …

…….. "Genius of the And":

We Can….	AND we can
Reduce errors to almost none..	Get things done faster
Engage people in understanding and improving their processes and procedures…	Maintain control on how works gets done
Measure and analyze what we do….	Apply creative solutions to "Push the envelope"
Make customers extremely happy …	Make a lot of money

The Real-time Enterprise

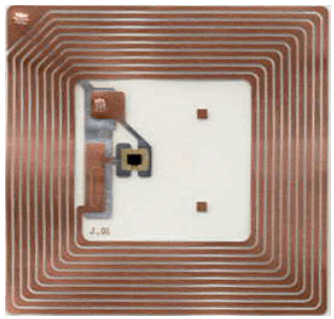
- Pande, Neuman and Cavanah, The Six Sigma Way, "the importance of measurement":
  - "The long term development of measurement "infrastructure"…, is a key building block for a full organizational Six Sigma system. The huge benefit is an ability to monitor and respond to change in a way that few organizations can lay claim to today."

RFID Overview

Some Inductive Tag Anatomies

Traditional 125kHz Inductive RFID

- Antenna typically ~120 turns of copper wire
- Typically use discrete resonant capacitor
- Rigid construction
- Pre-defined form-factor



13.56MHz flexible Inductive RFID

- Planar antenna typically use 7-10 turns
- Wire, etched or stamped coils
- Typically use on-board or laser tuned resonant capacitor
- Resonant tanks sensitive to surroundings – some laser tuned to application
- Requires bridged cross over interconnect
- Limited, pre-defined form-factors

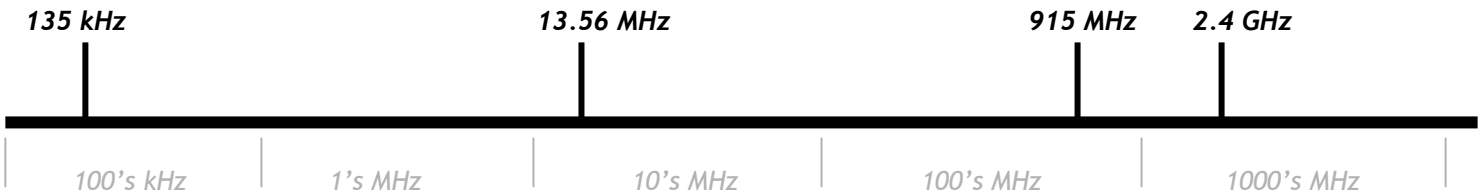
13.56MHz Inductive RFID

- Antenna typically 3-10 turns of copper wire
- Discrete or on-board resonant capacitor
- Rigid construction
- Pre-defined form-factor

915 MHz flexible Inductive RFID

- Planar antenna typically 1 turn
- Etched or printed coils
- Typically use solid state, mask defined resonant capacitor. No tuning required
- Requires advanced assembly processes to adhere very small chips to interconnect
- One Chip, many antenna designs

Frequency Performance Comparison



Performance Comparison			Guide to typcial anticipated performance on various surfaces								
Freqency / Technology	Typical Read Range (meters)	Relative Cost	Effect against Paper / Cardboard	Effect on core of dense Paper Roll	Effect on Clothing (cotton / poly)	Effect against Wood	Effect against Glass	Effect against Rubber	Effect against Plastic	Effect against Liquids	Effect against Human Body
122-135 kHz Inductive	.36 - .77	Highest	√	√	√	√	√	√	√	√	√
13.56 MHz Inductive	0.1-.15	Medium	√	?	√	√	√	√	√	√	√
862-868 MHz UHF	1?	Low	√	√	√	√	√	√	√	?	?
902-928 MHz UHF	3-5	Low	√	√	√	√	√	√	√	?	?
2.45 GHz Microwave	1-1.5	Lowest	√	X	√	√	√	√	√	X	X

- **Implementation topics:**
  - Product material
  - Wireless spectrum (ie..Europe and Asia)
  - Operational scenario (ie.. location of tag, location of reader)

Tag Memory

- Read Only Memory (ROM):
  - Data is burned into IC at the factory (License Plate)
  - Can never be changed
  - Virtually no control or alignment of data content with respect to enterprise needs
- Write Once, Read Many (WORM)
  - Data generally written into the IC at factory and locked
  - When locked can not be reprogrammed
- Read/Write
  - Some data may be programmed at the factory and locked
  - Other data may be written, erased and rewritten into memory in the field
    - By customer individually
    - During operation

Tag Power

- Beam Powered
  - Generally referred to as “Passive”
  - Converts RF energy into DC power to operate
  - Uses reader RF carrier as source of “Clock” to Synchronize with Tag Signal
  - Very Long Life products
  - Range is dependent on several factors:
    - Reader Transmit Power
    - Reader Receive Sensitivity
    - Tag Modulation Depth
    - Integrated circuit efficiency/power consumption
    - Environmental/ambient tag/reader conditions

- Battery Powered
  - Generally referred to as “active”
  - Generally operate asynchronously (Tags have their own tag source)
  - Battery boosts range and tag sensitivity
  - Battery powers onboard functions when away from reader

Anti-Collision & Read Rate

Anti-collision

- Ability to address a number of tags simultaneously in a given read zone

Read rate

- The speed at which the reader can process tag data
  - Readers multiplex amongst their antenna ports
  - 1 port ~ 200 reads/sec
  - 2 ports ~ 100 reads/sec per port

Electronic Product Code (EPC)

Acronyms Soup:

- Global Item Trade Number (GITN)
- Uniform Product Code (UPC)
- Japan Article Numbering Code (JAN)
- European Article Numbering (EAN)

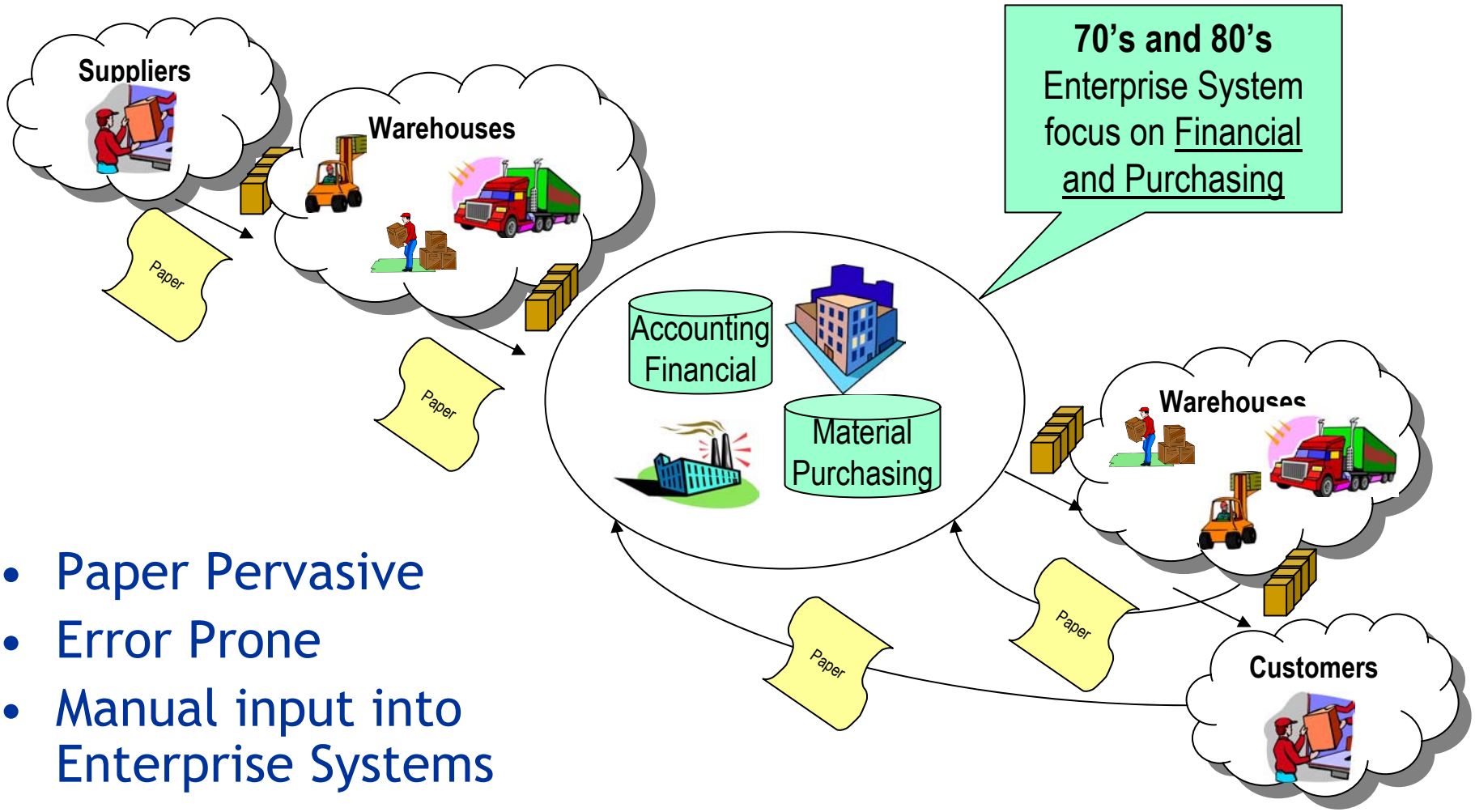
- EPC Example (96 bit), 1.1×10^{18} unique item numbers

- EPC is technology independent

Ref:Auto-ID White Paper: Integrating the EPC and the GTIN

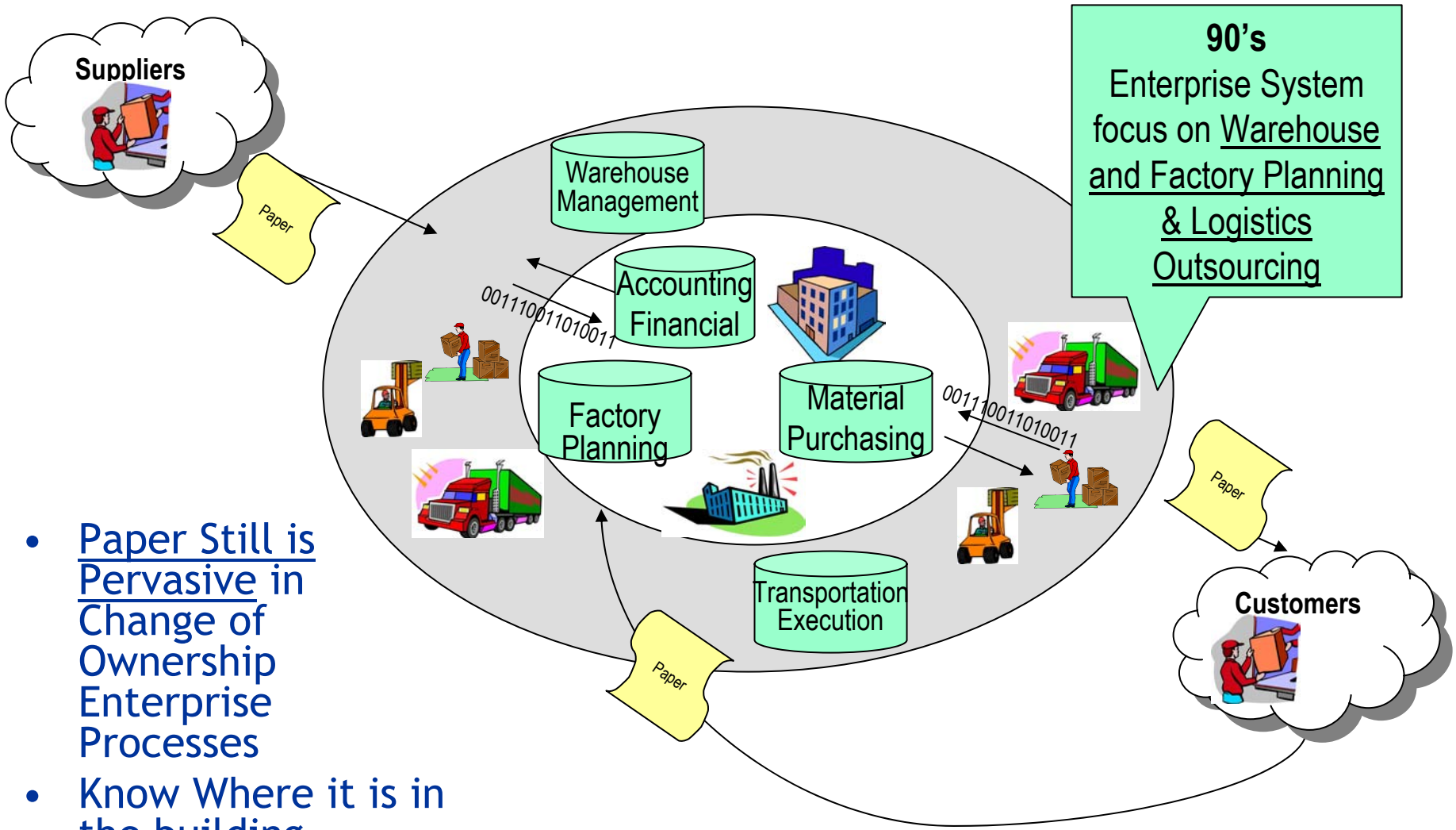
Why Will Supply Chain Applications Drive Massive Adoption?

“Entirely Contained” Enterprise



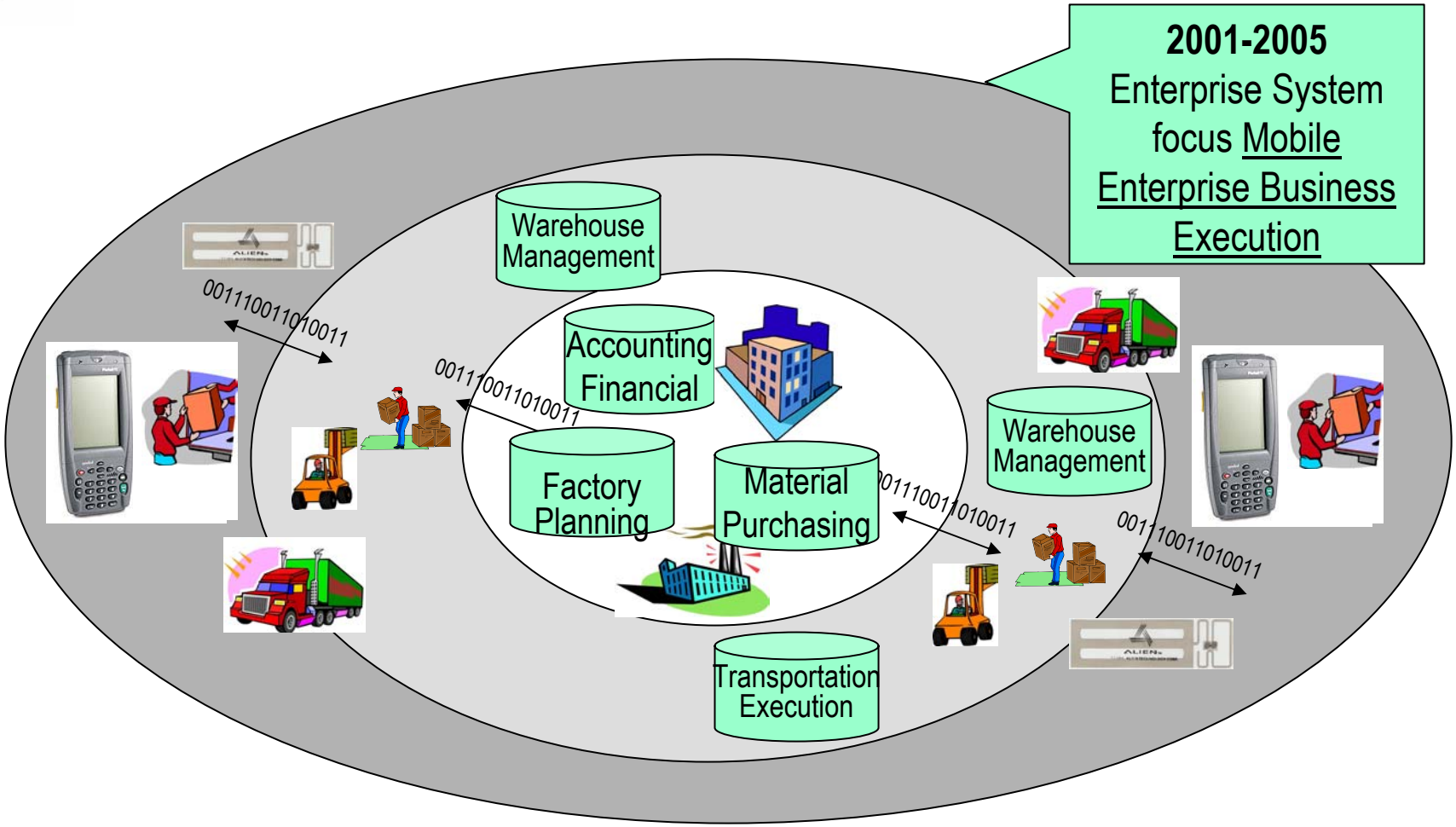
- Paper Pervasive
- Error Prone
- Manual input into Enterprise Systems

"Contained" Enterprise



- Paper Still is Pervasive in Change of Ownership Enterprise Processes
- Know Where it is in the building

"Extended/External Enterprise"



- Digital Real-time Enterprise… Extended To Farthest Reaches Of Enterprise

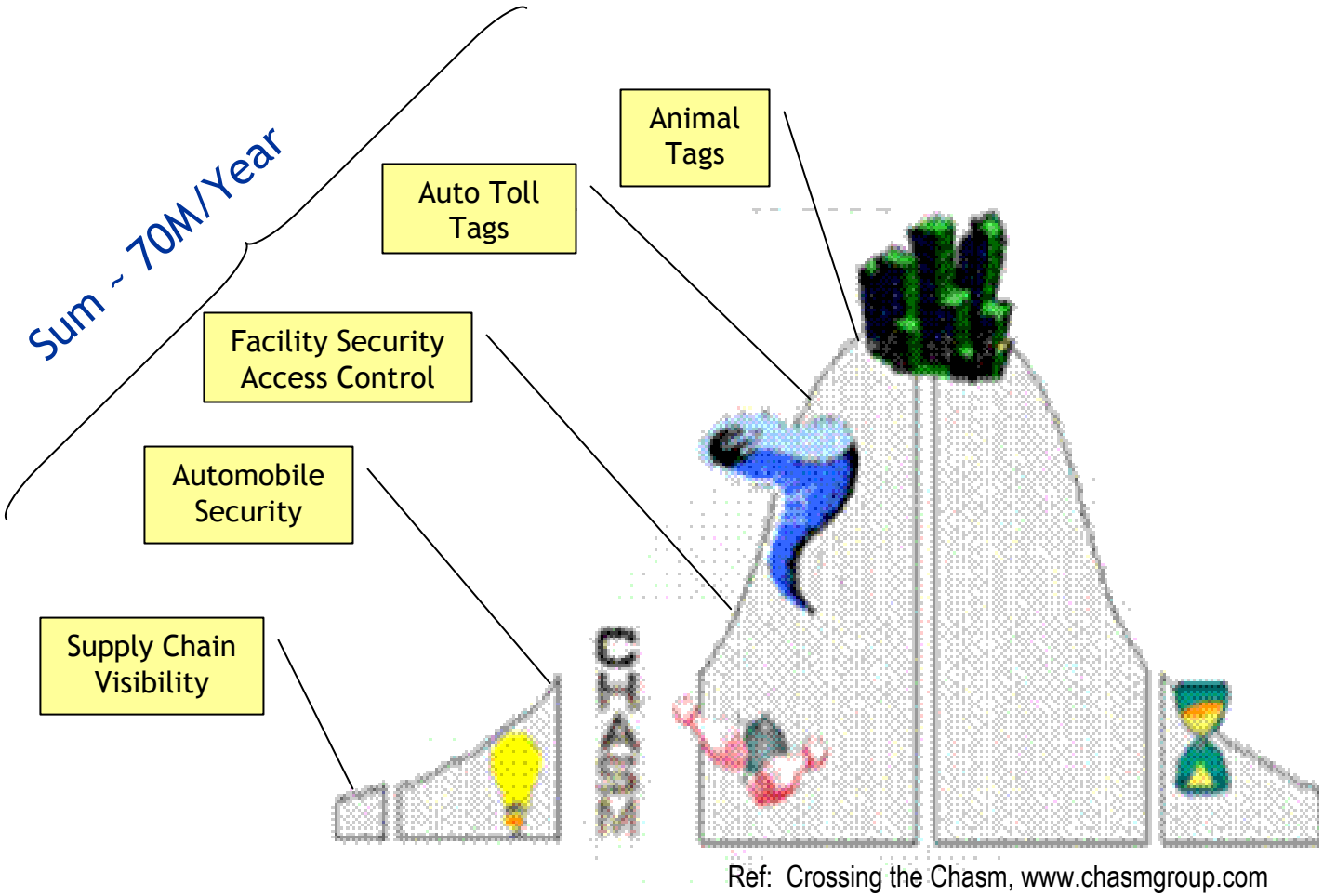
Global Supply Chain Needs

- Increased focus on inventory visibility (1)
  - Importance: 1.63 on a 1 to 7 scale (1 = very important) on shipping giants
  - Current information visibility: 2.39 on a 1 to 7 scale (1= very visible)
- Increased pace of inventory turns
- Increasing need for absolute quality of data down to S/N
- Reduced accounts receivable back log day sales outstanding (DSO)
- Anti-counterfeiting and anti-theft is emerging as high on for visibility solutions

1. (From Giants Of Shipping Study, Logistic Management Magazine, Et. Al, September 2002)

Where is RFID in Adoption?

- It Depends on the Definition of RFID….. & Perspective



Expectations
= X,000 M/Year

Ref: Crossing the Chasm, www.chasmgroup.com

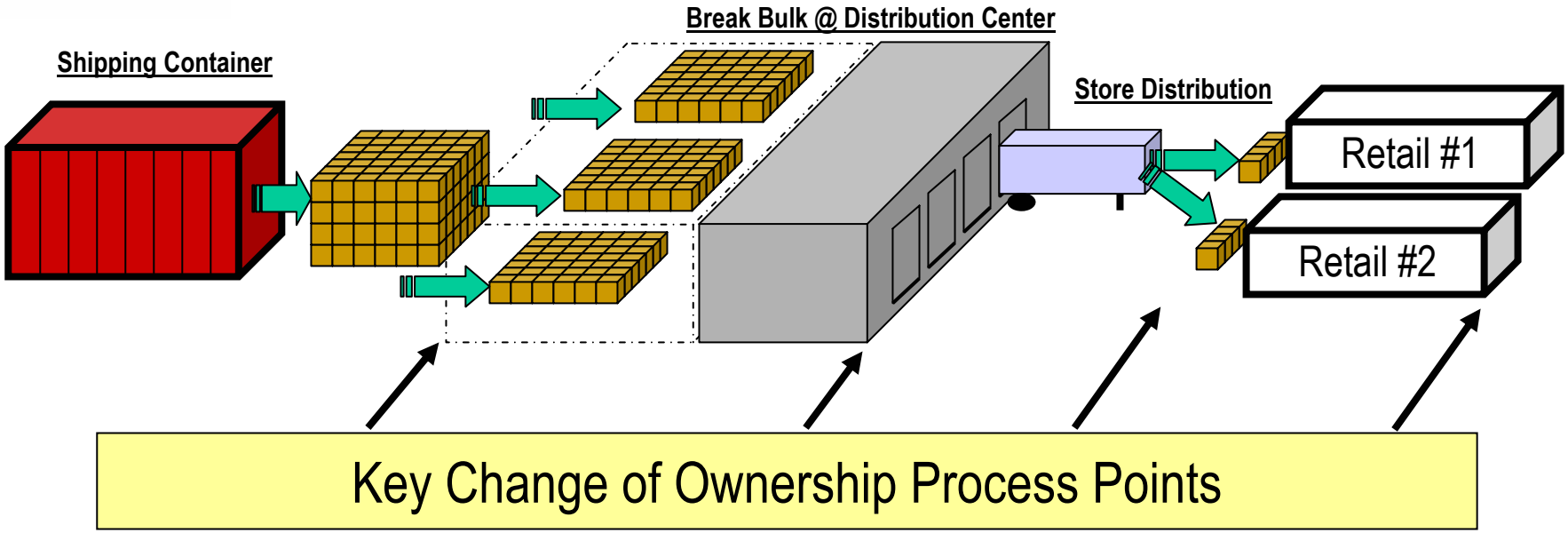
Specific “Pain Points” In Supply Chains Addressable by RFID…..

- It’s the accuracy and accountability of inventory at change of ownership points
- In the Warehouse
  - Automating Receiving and/or Shipping
  - Pick, Pack and Ship visibility
- In the retail location
  - Automating receiving into the store room
  - Shelves… when readers come way down in price
- Sales teams wanting to up sell on serial number traceability
- Pallets now … Box level soon … Individual Items after that

System Considerations

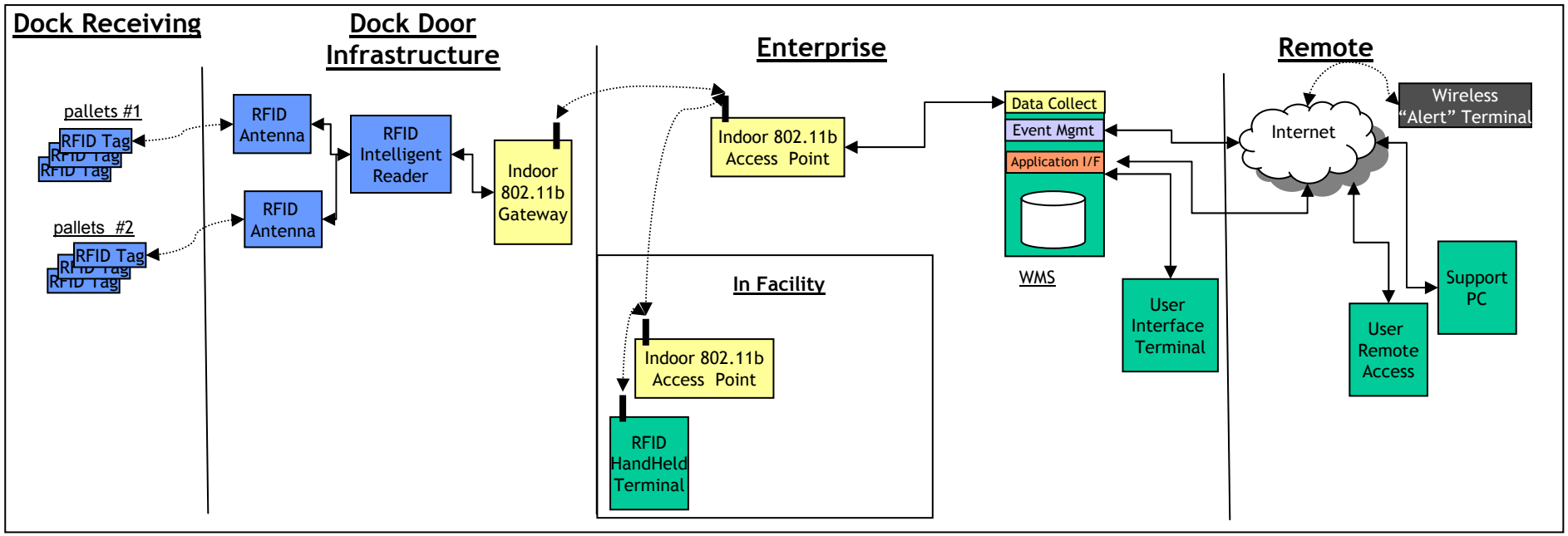
- Read Reliability 99.99%
- Process Margins ..... Wide, can not be restrictive
- Managing Exceptions .... Murphy's Law
- Data Model ..... What do you want to track?
- Product Distribution models and networks
  ..... Practicality of outfitting network
- Value Added Applications
  ..... Decision Support
- Interfaces ..... Use Standards, low volume in distributed transaction model

Retail Distribution Process



- Highly Manual
- Lack of accurate and complete inventory measurements at each change of ownership "point" …… Leads to inventory shrink.

RFID Supply Chain Implementation



- *Increased read range enables many processes to now be automated*
- *No middleware required*
- *Most WMS systems have handheld (human interaction element) in place*

Editorial Comments…..

Customer's View Of What Flavors Of RFID in The Supply Chain Will Be Successful And Where?

- Pragmatic ….
  - Solve my "Today" problems without huge enterprise investment and disruptive process changes
  - No "Anti Gravity Machines" … bought too much "shelfware" last go around
  - Bring solutions that can start small and scale throughout the enterprise

Value Description Matrix

Characteristics	Yesterday	Today	Future
1) Reader : Tag Ratio	**1:1**	**1:100**	**1:1000**
2) Read Range Process Window	**1'**	**6'**	**12'**
3) Value Proposition/ Function	**Data Collection**	**Data Collection + Process Automation+ Event Triggering**	**Closed Loop Control**
4) Host Unit	**Pallet**	**Box & Item**	**Item**

- ***Value propositions are directly applicable to items 1) and 2)***

Ranked Supply Chain Market Verticals… Each Have Unique Opportunities & Challenges

1) Consumer Electronics
   - 100's of Millions of units, high value and moderately verticalized supply networks… but many system units are metal and thus might not applicable to RFID

2) Pharmaceuticals:
   - 100's of Millions of units, high value, packaging host is largely plastic and security and serial number traceability is important… but supply chains are moderately fragmented

3) Consumer Goods
   - Billions of units, moderately valued products, cloth and leather based, moderately verticalized distribution networks, smart labels … but very fragmented supply base

4) Automobile Parts
   - 100's of Millions of units, high value and highly verticalized supply networks… but many are metal and thus not applicable to RFID

5) Consumer Packaged Goods
   - Billions of units, smart packages … but lowest cost products, most fragmented supply chains/distribution networks, many are liquid and foil based

How And When Will We Reach a High Point In Adoption of RFID in Supply Chain Applications?

- When...
  - RFID is not a technology issue any longer
  - RFID Successes are well documented and replicatable across customers
  - Supply Chain Enterprise S/W providers embrace this natural extension of their systems
  - Open Standards for:
    - Air Interface
    - Tag Payload Format
  - Tag payloads are able to be adapted to match existing enterprise system product numbering schemes

  ……. We are getting closer

  - *It will be a "Spock's New World" vs. a "Big Bang"*

RFID Value Chain Questions That Still Remain Open?

- How will closed loop systems really work? (1).
- Is a "middleware" needed?
- Can we get to a $.05 tag? Does it Matter?
- How will the Smart packaging movement impact RFID?
- How will RFID system elements be distributed into solutions? Where is the money to be made?
- How much data will be required to be transmitted outside the enterprise?

(1). Ref: www.autoidcenter.org

Thank You

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