

Intel Factory-to-OEM RFID Tracking Proof-of-Concept

Presentation to the iNEMI RFID Forum

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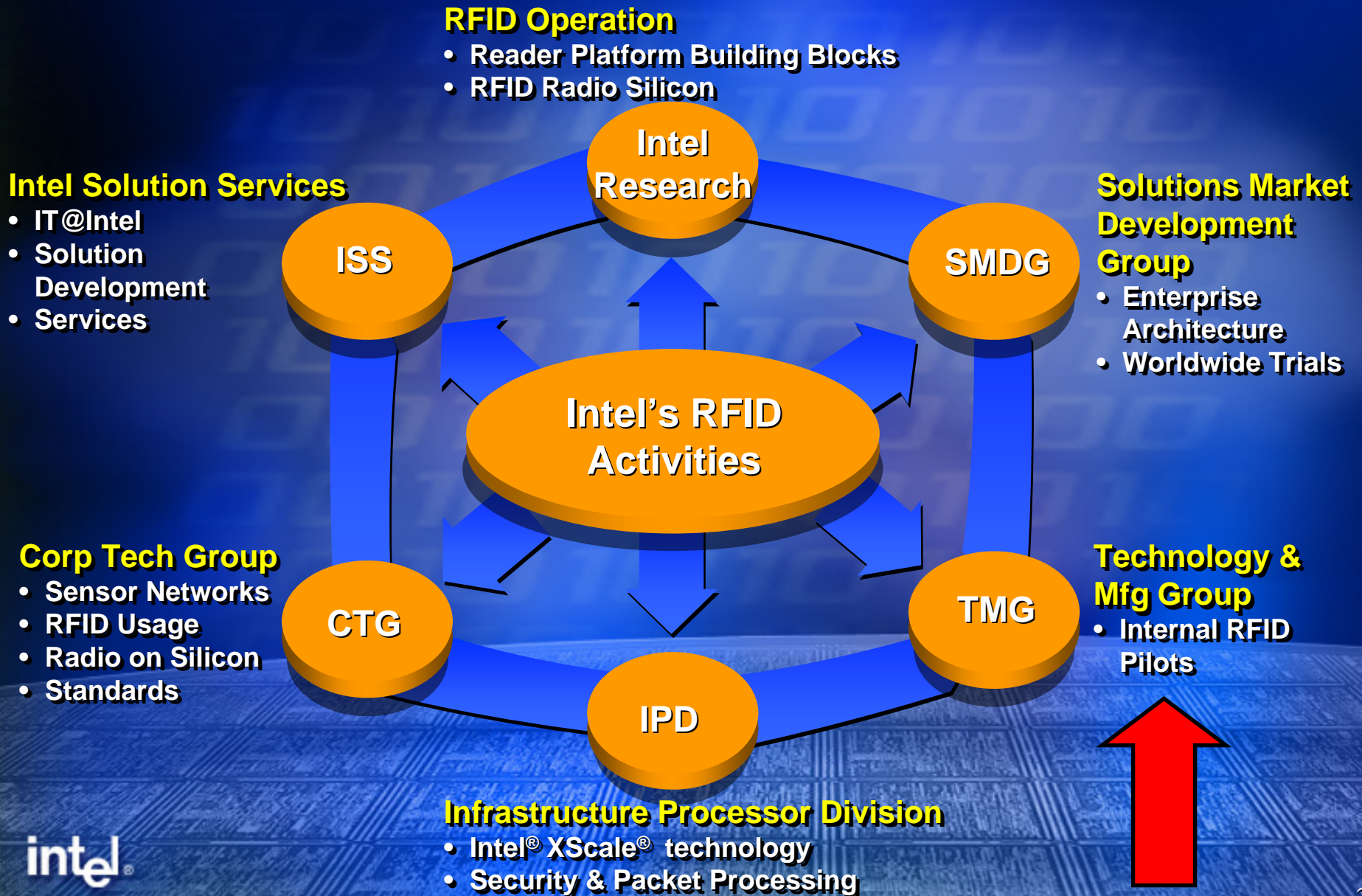
Intel Corporation (USA)

October 4, 2005

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Intel's RFID Activities



Internal Proof-of-Concept Approach



Conduct *in situ* studies and experiments to examine:

- Material flows
- Information flows
- Capabilities & Impacts



Understand & use to best advantage the interplay between:

- people
- product
- tools/technology
- environment



To learn the true implications of “end-to-end”

Find the “threads”

RFID
Ethnography
Studies

RFID for Mfg

RFID for
Logistics
Mgmt

RFID for
Supply Chain
Integration

RFID for
Enterprise
Infrastructure
(Data Center)

Influence corporate strategies

Logistics RFID Pilot

- A series of internal pilots utilizing different RFID and smart object technologies have been and are being performed at Intel
- The research project featured today is a logistics RFID proof-of-concept that demonstrated product visibility from manufacturing to OEM
 - Added UHF tags to cases of silicon microchips as they were packaged at an Intel plant in Malaysia and shipped to the manufacturing plant of an OEM.
 - Tracked more than 80,000 Intel processors
 - Used UHF RFID readers made by Tyco Fire & Security's Sensormatic* division
 - Implemented using 96-bit passive tags

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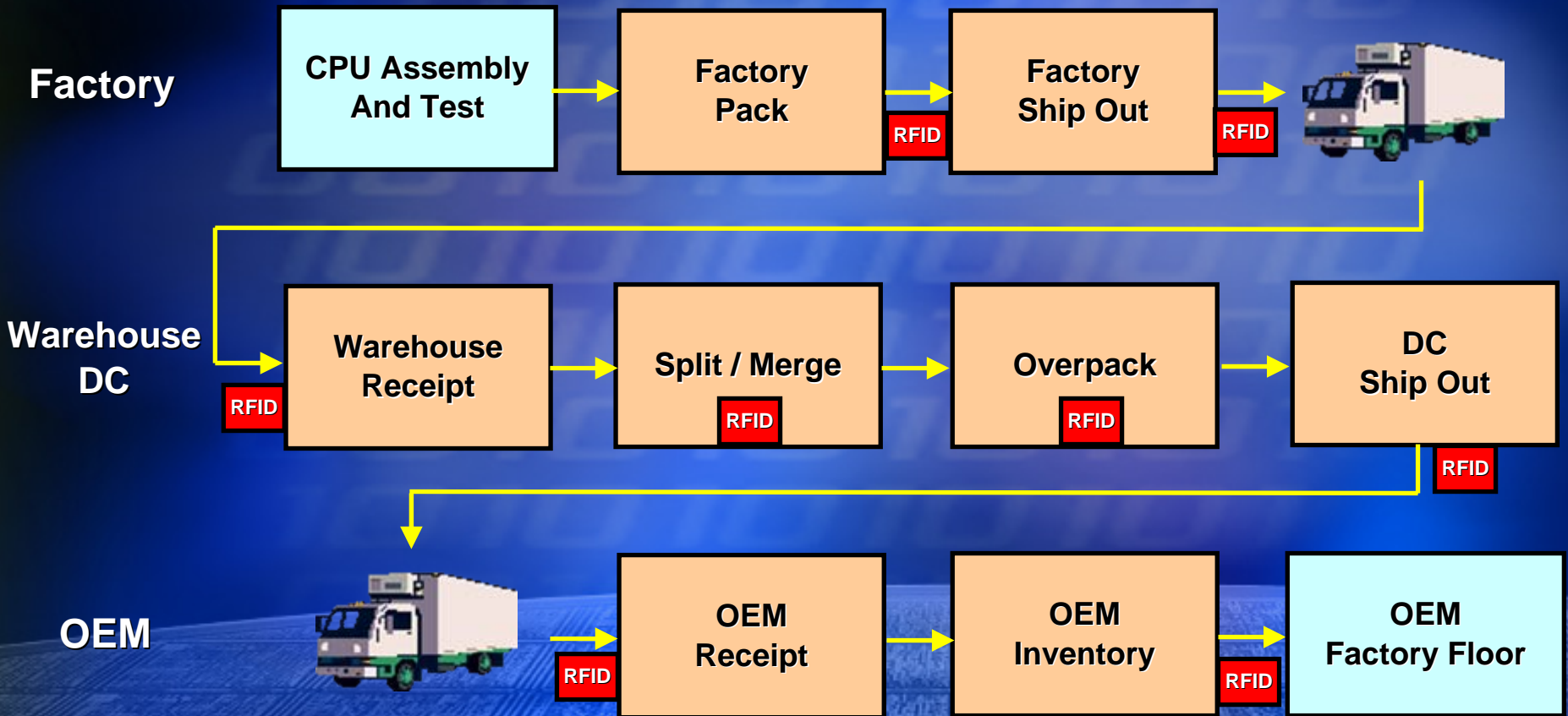
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Logistics RFID Pilot

Product Flow



Typical RFID Portal



- Each typical portal included:
 - Controller PC running Microsoft WindowsXP* operating system
 - Connected to ethernet network
 - Communicating with RFID database server
 - Running custom middleware designed to capture research data
 - One Tyco Agile 2* RFID reader
 - Two Tyco Omniwave* antennas
 - Optionally, a modified Omniwave* antenna used for writing tags
 - Optionally, a standard linear barcode reader, if required at the operation

Factory Pack



- Trays holding multiple CPU chips were bundled and strapped before being placed in a shipping box
- Shipping box was taped shut and labeled normally

- Existing label requirements on boxes were maintained
- No changes made to existing information systems
 - Parallel “drop-in” PoC implementation reduced integration time

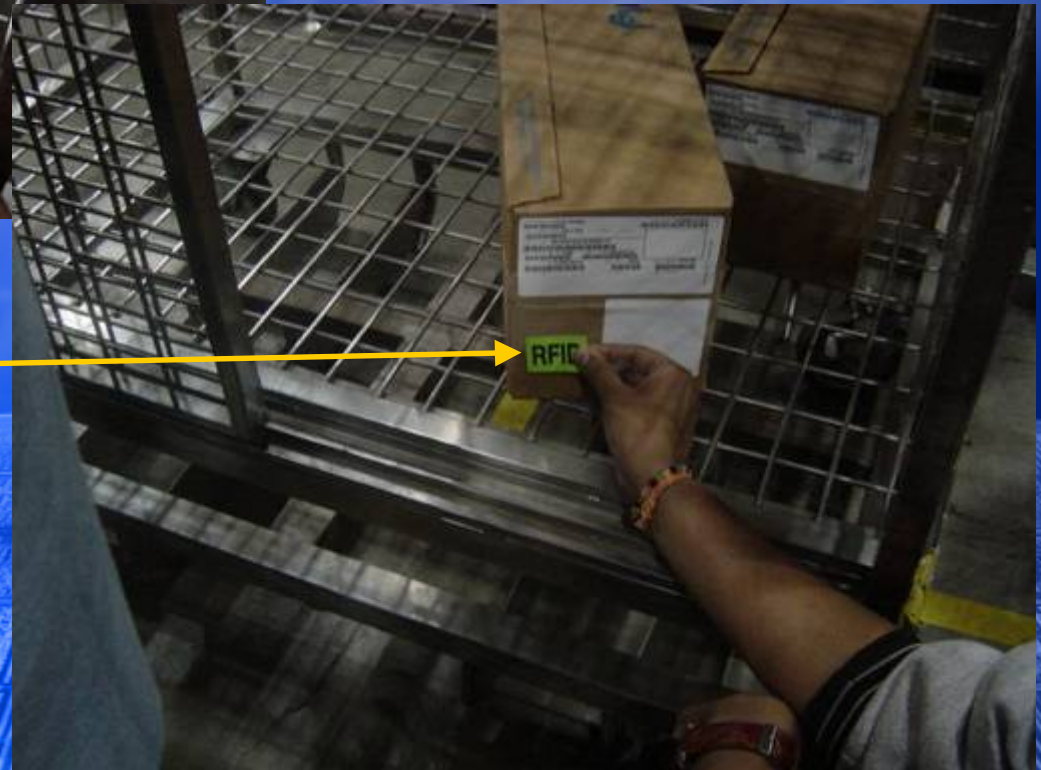


Factory Pack



- RFID tags were written with unique identifiers and hand-placed on the shipping boxes.

- As part of the temporary labeling requirements, human-readable labels were also placed to help identify the presence of RFID



Factory Pack



- Loaded carts were scanned at the Pack portal to generate a stored list of cart content.
- The loaded carts were then set to the factory ship out area.



Factory Ship Out



- At factory ship out, the fully-loaded carts were once again scanned just before exiting the factory on their way to the warehouse.

Warehouse Receipt, Inventory, Split and Merge



- Similarly at warehouse receipt, the carts were scanned again upon arrival
 - Verified that all boxes sent were received
- As usual, boxes were unloaded from carts and placed in inventory for later picking.
- After being picked out of inventory for an order, the boxes went through split and merge operations to obtain the correct number of units for the order.
 - This required additional in-process reading and writing of RFID tags

Overpack, Warehouse Ship Out



- The individual boxes of CPUs were then put into overpack boxes, which in turn received their own RFID tags.
- The completed overpack boxes were then placed on pallets for shipment.
- Each pallet in a shipment also received an RFID tag.
- The portal at ship out had to be able to read all of the stacked overpack box tags and the pallet tag to allow the shipment to go.

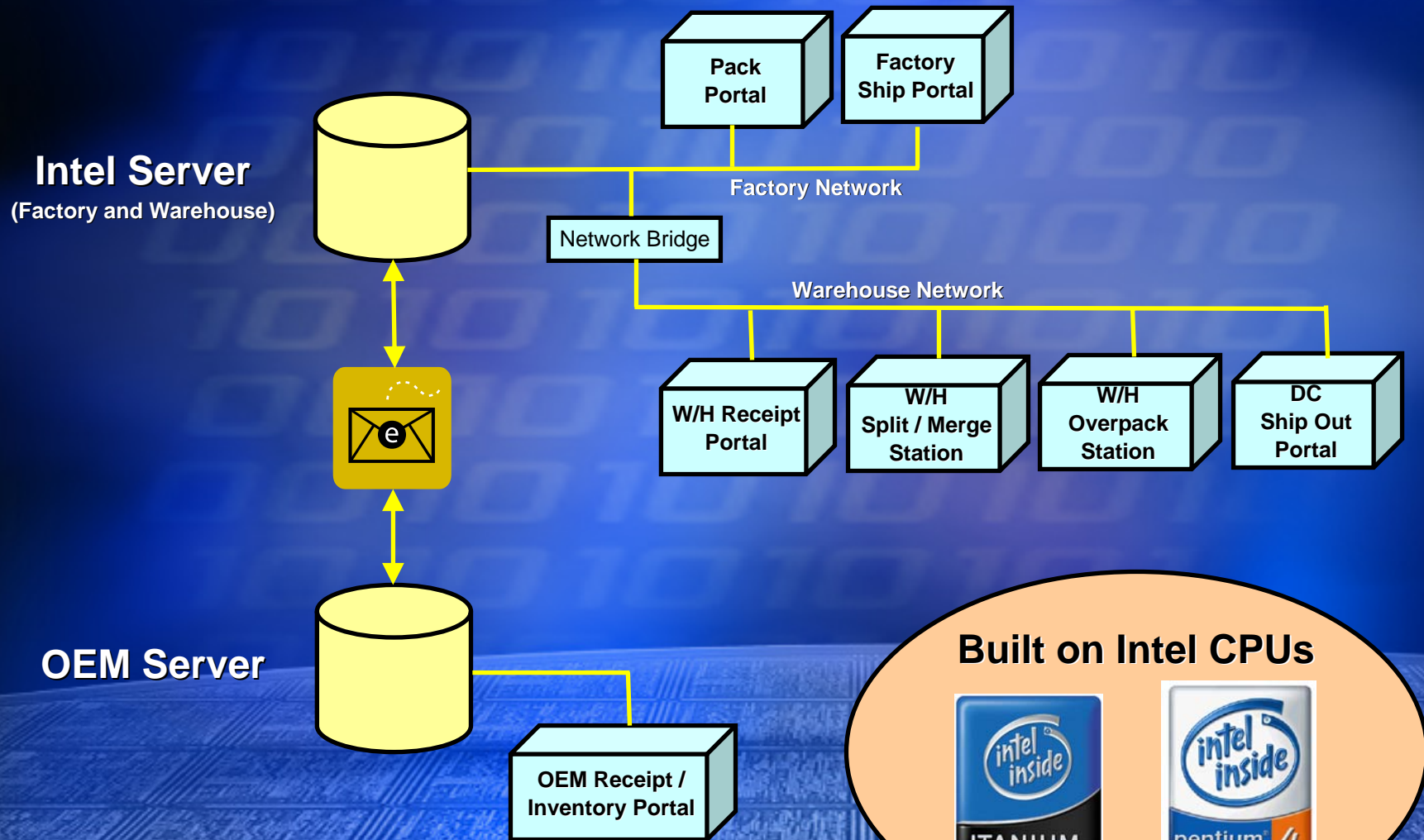


OEM Receipt & Storage



- Similarly, loaded pallets of product were scanned at the OEM upon receipt and placed in the OEM's inventory
- The individual boxes were scanned for the last time when pulled from inventory for consumption on the OEM's factory floor
- Throughout the entire process chain, all transactions were recorded to databases for later analysis

PoC Logical Infrastructure



Built on Intel CPUs



Technology



Cell phones

RFID Reader

- Performed extensive RF environmental scans to determine possible interference issues first
- Obtained site licenses from the Malaysian MCMC to operate RFID in the 917.5-922.5 MHz region
- Tyco provided customized firmware to run Tyco Agile 2* readers in this band
- Performed laboratory and in-situ spectral emissions testing
- Field-tested this configuration in active DC in US first
- Deployed smoothly and successfully to proof-of-concept system in Malaysia without interference issues.

- Note the close proximity of cell phone signals in the Malaysian GSM band (which ends at 915 MHz).

Technology



- Experimental lab setup in an active Distribution Center (in Arizona)
- Many experiments were run to determine best configurations to read through closed, locked metal cage trollies

- RF anechoic backdrop used to avoid interference with existing wireless barcode readers in the Distribution Center



Technology

- A custom portal was designed and built
- Portable, low-cost, easy setup and tear-down for temporary use

- Stacked Tyco Omniwave* antennas

- Tyco Agile 2* reader with Intel® XScale™ IXP420 processor



Technology



- Many different 64-bit and 96-bit tags were tested with the portal
- The portal design was tested in many configurations, including the 4-antenna configuration shown below.



Key Considerations

- RFID regulatory standards and compliance
- Technical standards and compliance
- Business process and layout implications
- Reader adaptability, scalability, upgradeability, and management
- RFID component vendor relationships
- Portal design (and tag writing)
- Evolution of tag technology
- Reliability of tags
- Tag placement
- Making RFID work in the field (not just the lab)
- Software/middleware and data
- Data and information infrastructure
- Extracting value from visibility – ROI and business value
- Working beyond the “four walls of the enterprise”
- What’s coming next:
 - EPCIS
 - Gen 2
 - ETSI EN 302-208
 - And of course, the Intel components to enable it!



Edge Devices

- Silicon Building Blocks
- Readers and Sensors

Middleware Layer

- Compute - Data Acquisition Management and Filtering

EPC Application Layer

- Compute - Business Logic & Integration Services

EPC Discovery Layer

- Compute - EPCIS Services Data Warehouse and Analytics

Security Services

- Compute - Authentication Access Control

Air Interface



Reader Protocol

ALE interface

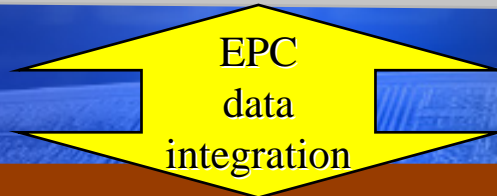


Discovery Services

ONS API

Event Services

EPC Architecture Standards



Enterprise Application Services



Questions?



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