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

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Intel’s RFID Activities

RFID Operation
- Reader Platform Building Blocks
- RFID Radio Silicon

Intel Research

Intel Solution Services
- IT@Intel
- Solution Development
- Services

Solutions Market Development Group
- Enterprise Architecture
- Worldwide Trials

SMDG

Corp Tech Group
- Sensor Networks
- RFID Usage
- Radio on Silicon
- Standards

Technology & Mfg Group
- Internal RFID Pilots

CTG

Intel’s RFID Activities

Infrastrucure Processor Division
- Intel® XScale® technology
- Security & Packet Processing

ISS

IPD

TMG
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)
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.
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

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

Intel Server
(Factory and Warehouse)

OEM Server

Pack Portal
Factory Ship Portal

Network Bridge

Warehouse Network

W/H Receipt Portal
W/H Split / Merge Station
W/H Overpack Station
DC Ship Out Portal

Built on Intel CPUs

Built on Intel CPUs

OEM Receipt / Inventory Portal
Technology

- 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).

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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
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

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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!
Questions?
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