

Ubiquitous Computing in Business Processes

Part III

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Outline

1. Recap

The Supply Chain - A complex puzzle!

Where is my product?

How will my partners gain visibility?

How can my supply chain improve?

How can I prove delivery to customer?

Am I compliant to regulations?

How can I manage recall and returns?

Why is there a delay?

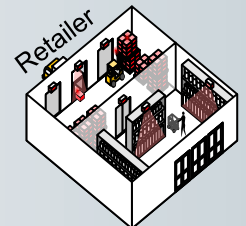
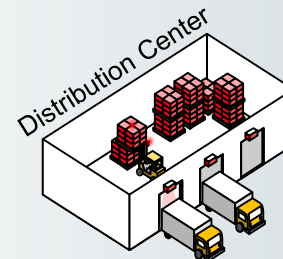
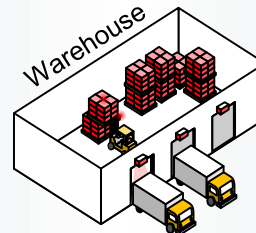
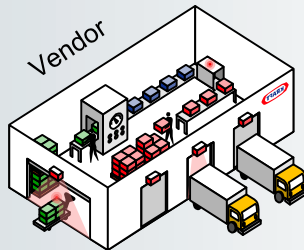
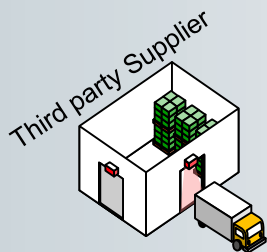
When will my shipment arrive?

Is the product genuine?

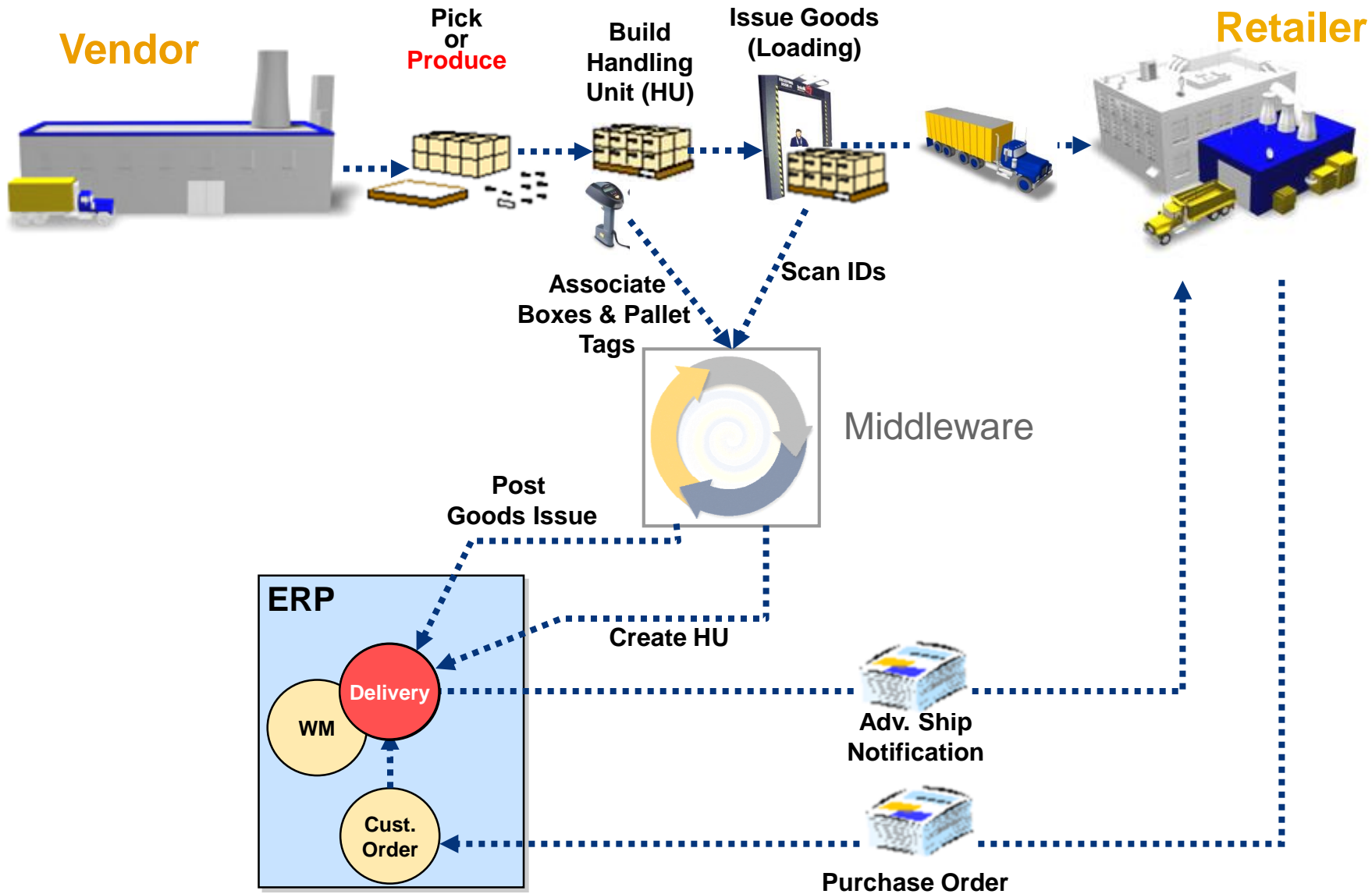
What is causing the bottleneck?

How can I track my assets?

Supply Chain

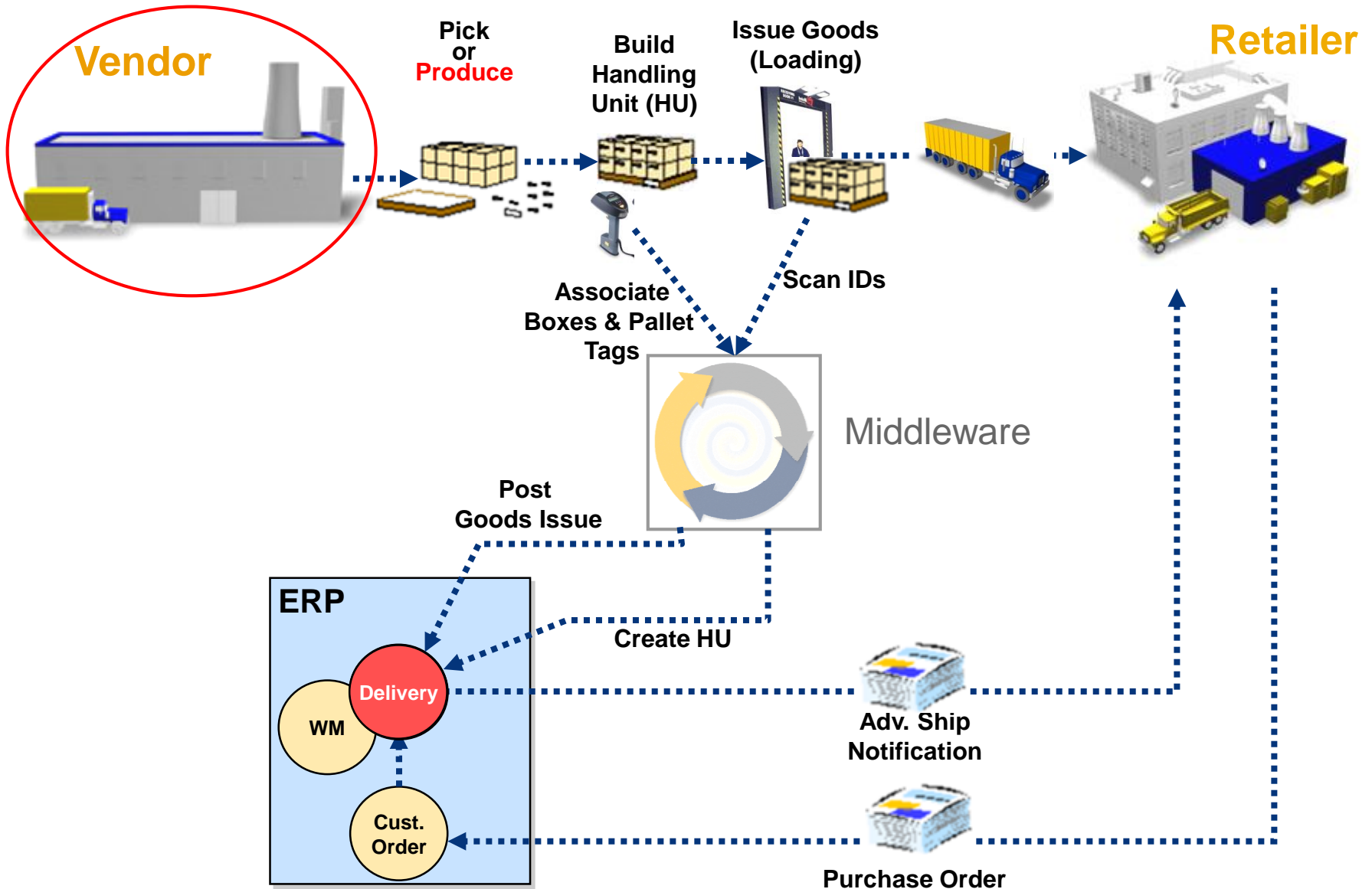


RFID in Order Fulfillment Process

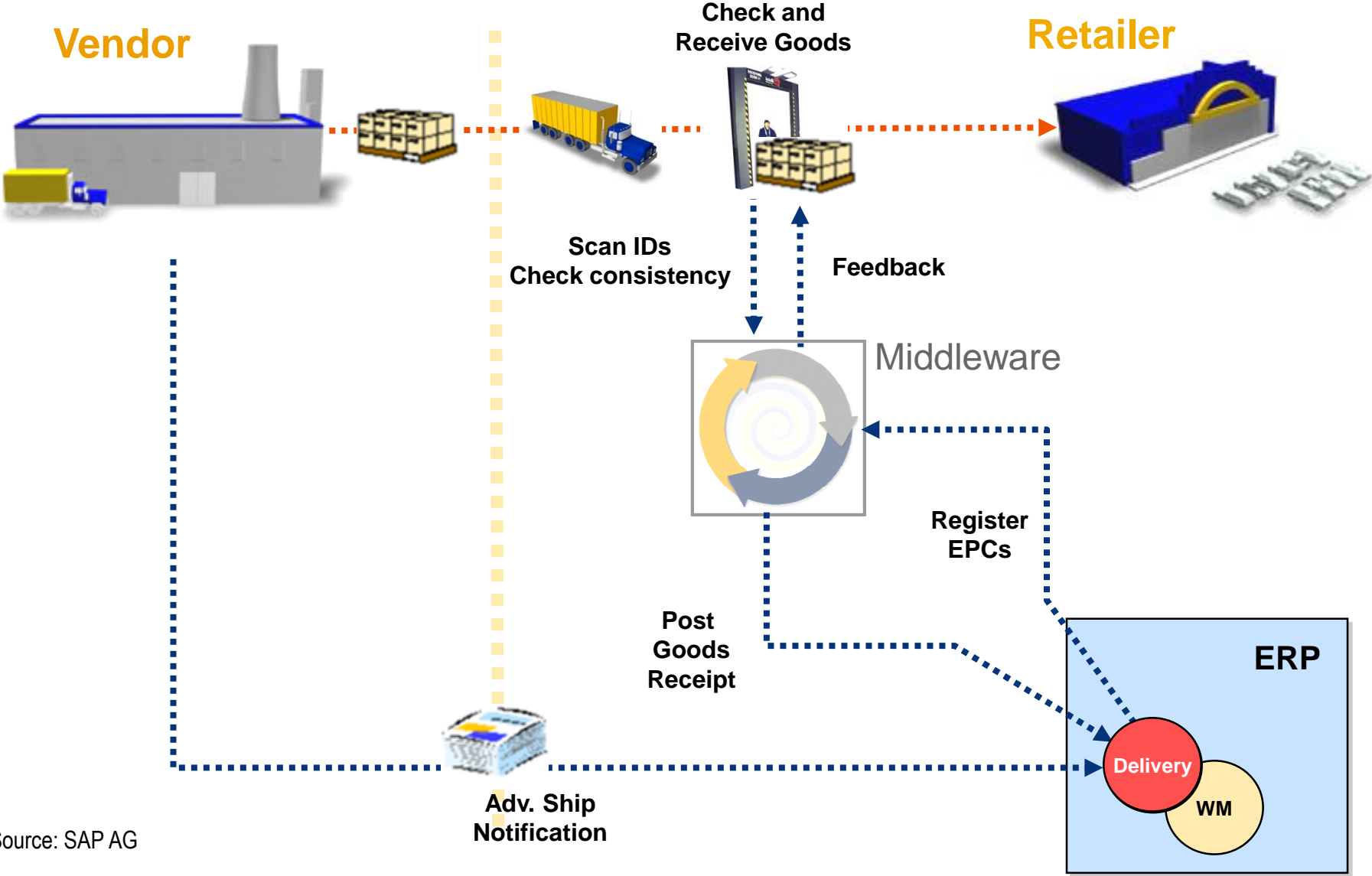


Let's have a look into the Factory!

RFID in Discrete Manufacturing Process



RFID in Goods Receipt Process



Source: SAP AG

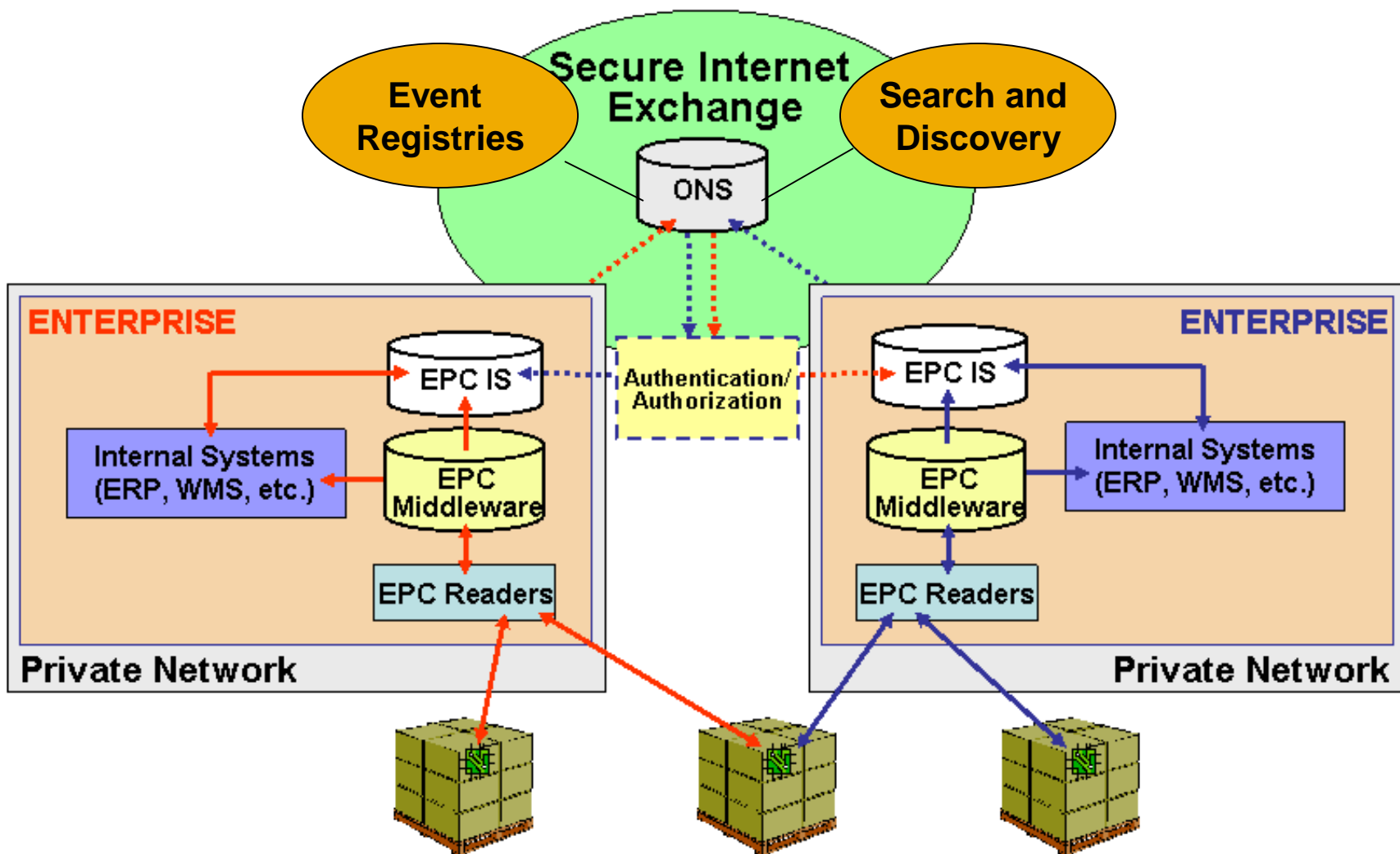
Outline

2. RFID Information Exchange between Enterprises in Supply Chains

RFID in Supply Chains: The Need for Standardization

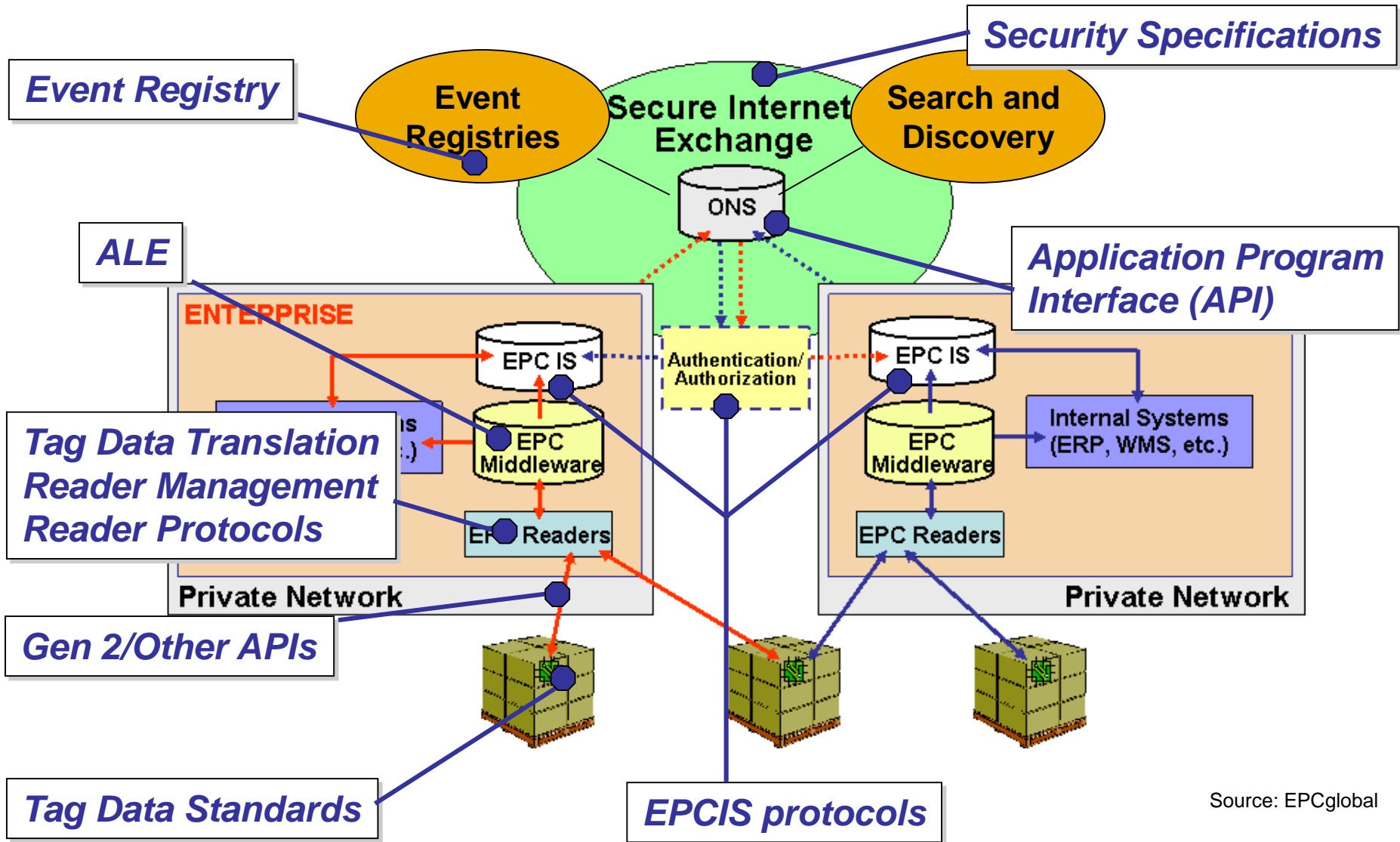
- In order to ensure **supply chain visibility**, the exchange of data between companies along the entire supply chain is required
- Inter-company business processes can profit from RFID as an **automated identification and data collection technology**
- In order to leverage the full potential of RFID, **standardization at multiple levels** is required. Most importantly:
 - RFID tag data: syntax and semantics
 - Communication btw. tags and readers: hardware characteristics
 - RFID related data exchange: interfaces and data formats
- **GS1/EPCglobal** is one out of many organizations that drive the standardization of RFID and the underlying data management infrastructure

The 'Internet of Things' - EPCglobal Network Architecture



Source: EPCglobal

EPCglobal Network & Standards Overview



Source: EPCglobal

EPCglobal Network Standards' Scope

Tag Data Standards	Encoding EPC tags information based on various numbering system standards
UHF Gen2 Air Interface Protocol	Reader – Tag communication
Reader Protocol	Reader – Middleware / applications communication
Reader Management	Multiple EPC reader environment management
Tag Data Translation	Converting tag data standards to Internet compatible formats (at reader level)
Application Level Eventing (ALE)	Multiple EPC handling seen by multiple readers based on filtering criteria/rules
Object Naming Service (ONS)	Find information source to given EPC
EPCIS Protocols	Storage and retrieval of information about EPC
Security Specification	Secure EPC information handling and exchange

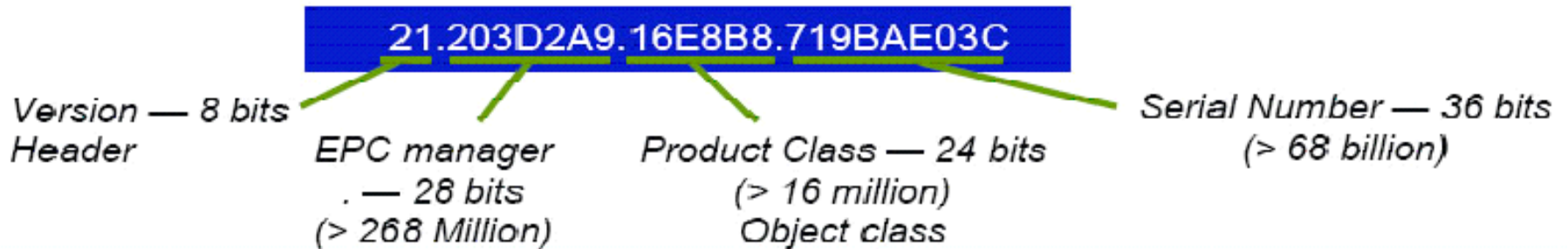
EPCglobal/GS1 Tag Data Standard

Main goal: Migration of existing serialized and non-serialized numbering schemas for RFID-enabled applications

- **EAN.UCC standards** define numbering schemas for different application cases
 - EAN: European Article Number (a.k.a. International Article Number, IAN)
 - UCC: Uniform Code Council
- **Global Trade Item Number (GTIN)**
 - Identifier for any kind of products or services, incl. books (ISBN is a GTIN variant)
 - Item level enhancement: SGTIN
- **Serial Shipping Container Code (SSCC)**
 - Identifier for packaging units, such as boxes or pallets, rather than contained products
- **Global Location Number (GLN)**
 - Identifier for functional and physical entities participating in processes
 - Functional entity: company name, head quarters address, comp. division name, etc.
 - Physical entity: warehouse loading dock, building, room, retail shop, etc.

Electronic Product Code (EPC)

- 96 bit General Identifier (GID-96) without specific EAN.UCC semantics:



- **EPC Manager:** Uniquely identifies the EPC issuing company, typically the manufacturer of the tagged product in question
- **Product/Object Class:** Uniquely identifies the product type, a.k.a. “Stock Keeping Unit” (SKU)
- **Serial Number:** Unique identifier of the given item of type *Product Class*

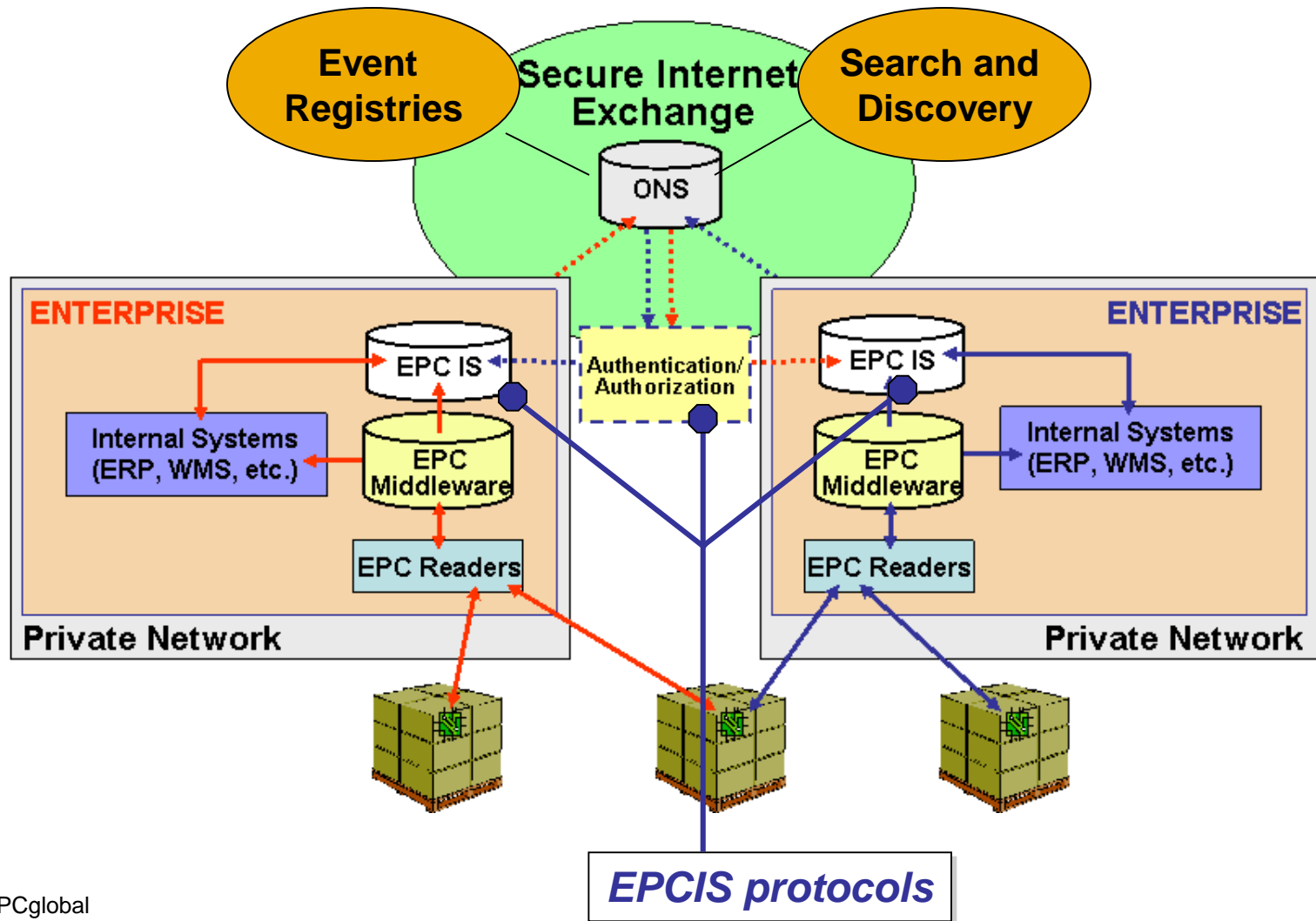
Electronic Product Code (EPC) Encoding SGTIN-96

- 96 bit EPC with SGTIN specific semantics:

Header	Filter Value	Partition	Company Prefix	Item Reference	Serial Number
00110000	3	3	20 - 40	24 - 4	38

- Filter Value: Allows fast definition of, e.g.
 - Retail Consumer Trade Item
 - Standard Trade Item Grouping
- Partition: Indicates length of both Company Prefix and Item Reference fields
 - In total 44 bits
- Item Reference: Unique identifier of product type (SKU)
- Serial Number: Unique identifier of the given item of type *Item Reference*

EPCglobal Network Architecture



Source: EPCglobal

EPC Information Services (EPCIS)

Goal: Provide data sharing between companies based on EPC

EPCIS standard specifies **service interfaces** to

- capture and query EPC-related data in an interoperable way
- it does not specify how to manage and use EPC data

EPCIS offers interfaces to a EPCIS Repository

EPCIS Repositories store

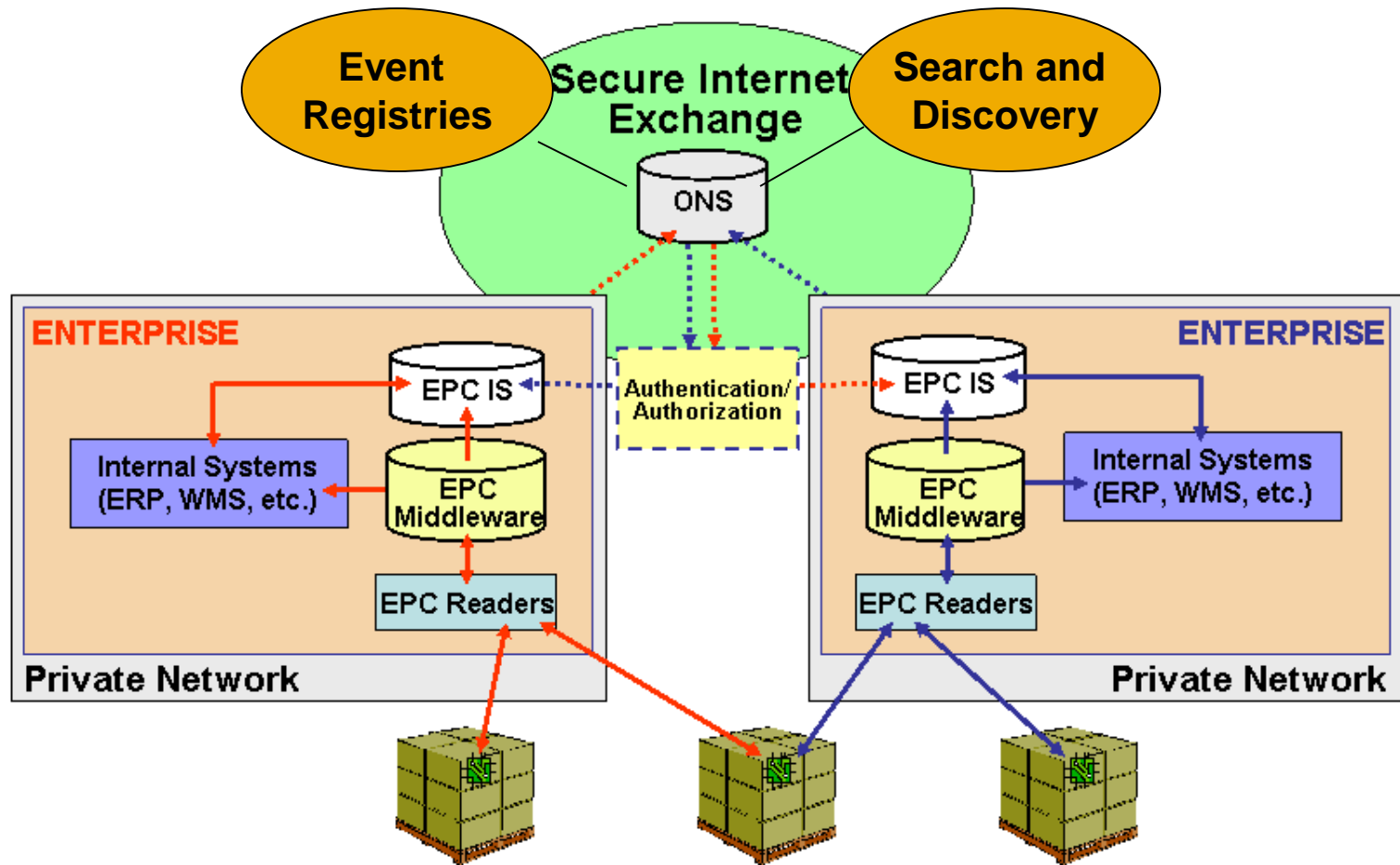
- **historical event data** with business relevance, e.g.

“The pallet with EPC E containing the list L of EPC has left the warehouse W at location L on date D.”

Business applications generate, maintain and utilize EPCIS data, e.g.:

- when sending a shipping notification or goods receipt
- when items of a production batch have to be recalled
- when a ‘drug pedigree’ has to be generated, etc.

EPCglobal Network Architecture



Source: EPCglobal

Object Name Service (ONS) in Overview

ONS returns Unified Resource Identifiers (URI) to a requested EPC

ONS supports only GTIN based lookups

ONS standard does not support item-level information

- URI points to product-level data rather than item-level data

ONS entirely **relies on DNS** architecture and protocols

- conforms to existing Internet name services
- utilizes Naming Authority PoinTeR (NAPTR) to return one or more URI on the same host

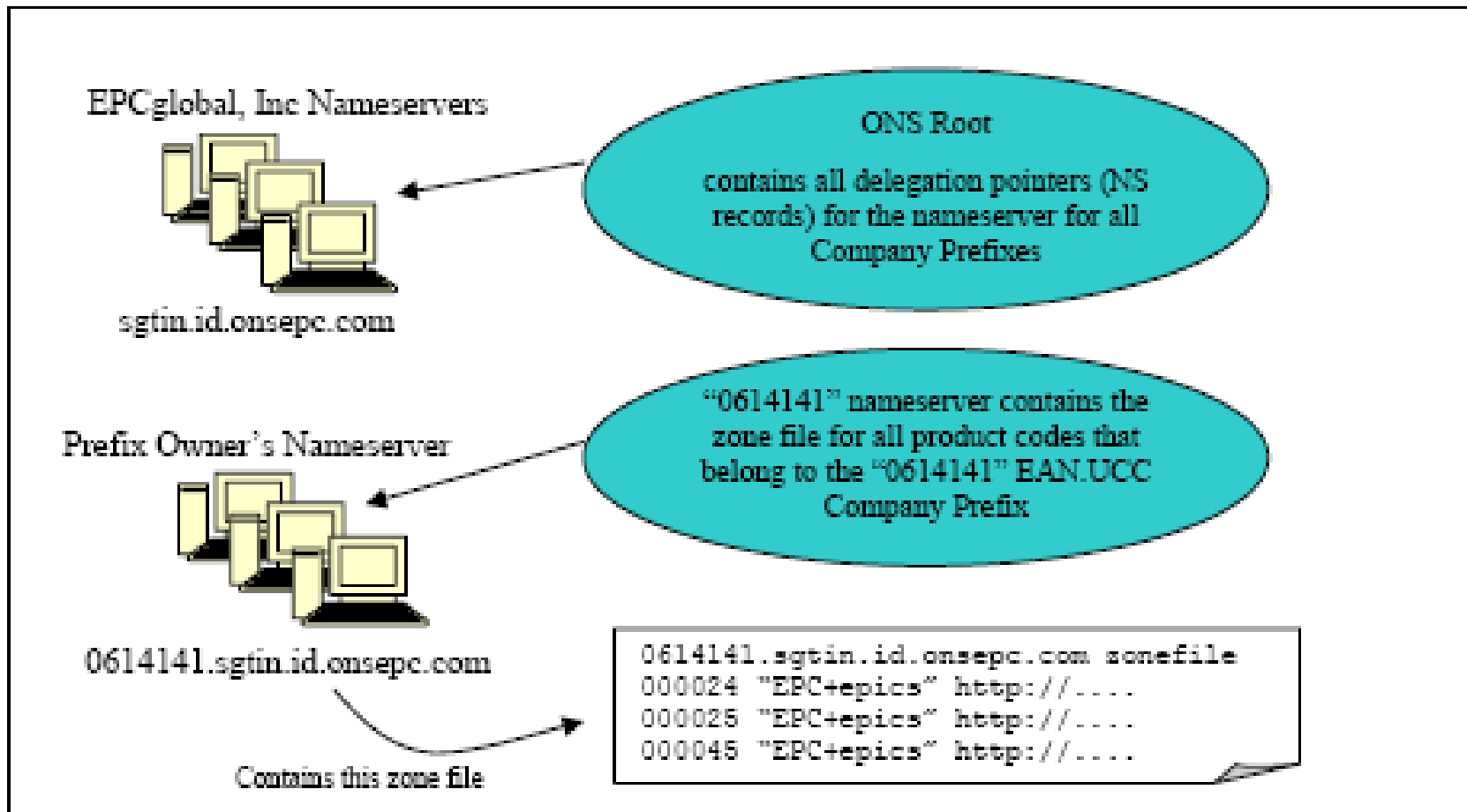
Each URI found points to a server containing product level information or services

- product name, manufacturer name, advertisement, ...
- EPCIS Query Interface to find out more about the tagged product

ONS servers do not store product or item specific information

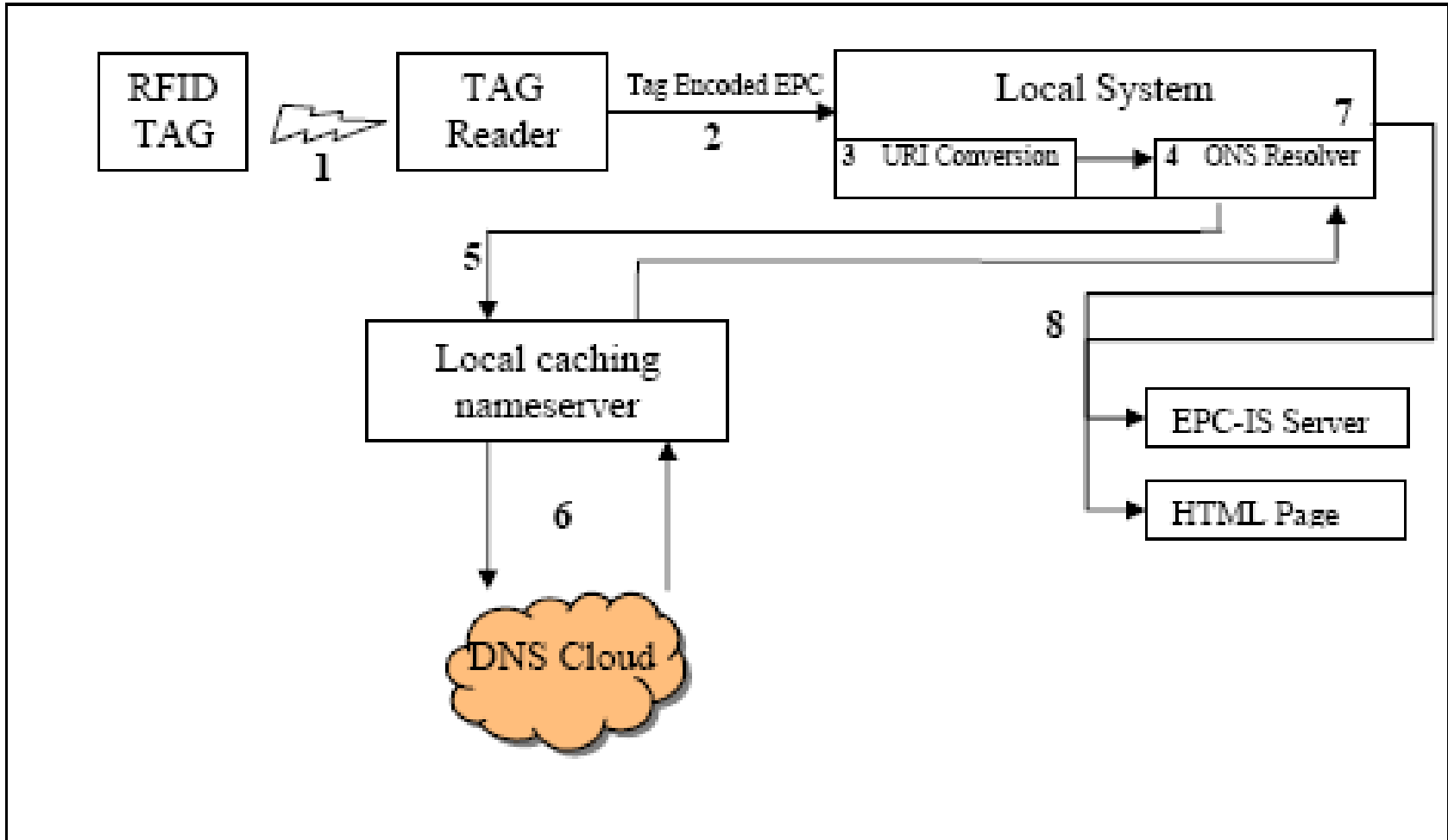
ONS – Distributed Resolution Example

Company Prefix: 0614141, Products by Item Reference: 000024, 000025, etc.



Source: EPCglobal

ONS Query Processing Overview

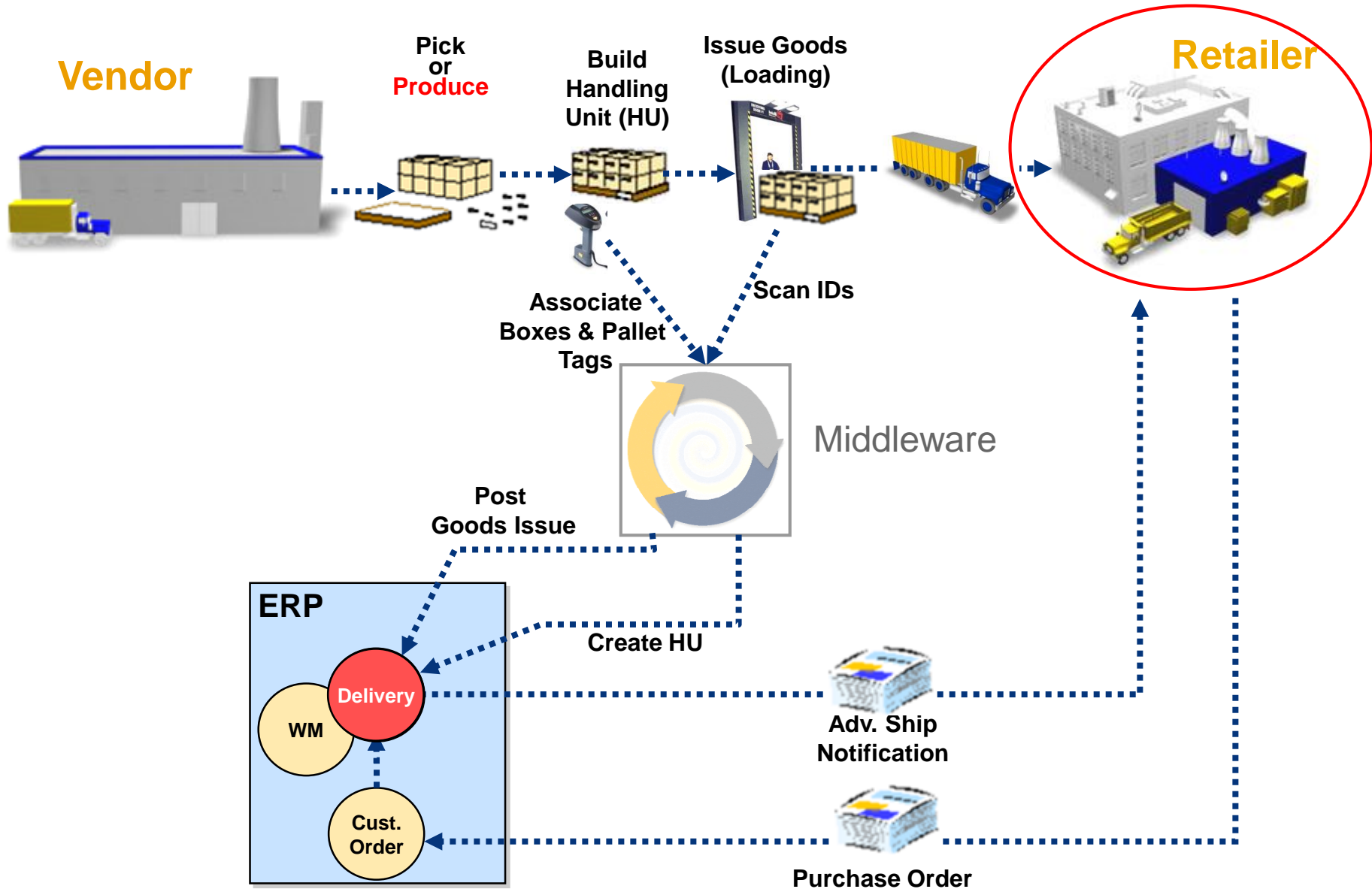


Source: EPCglobal

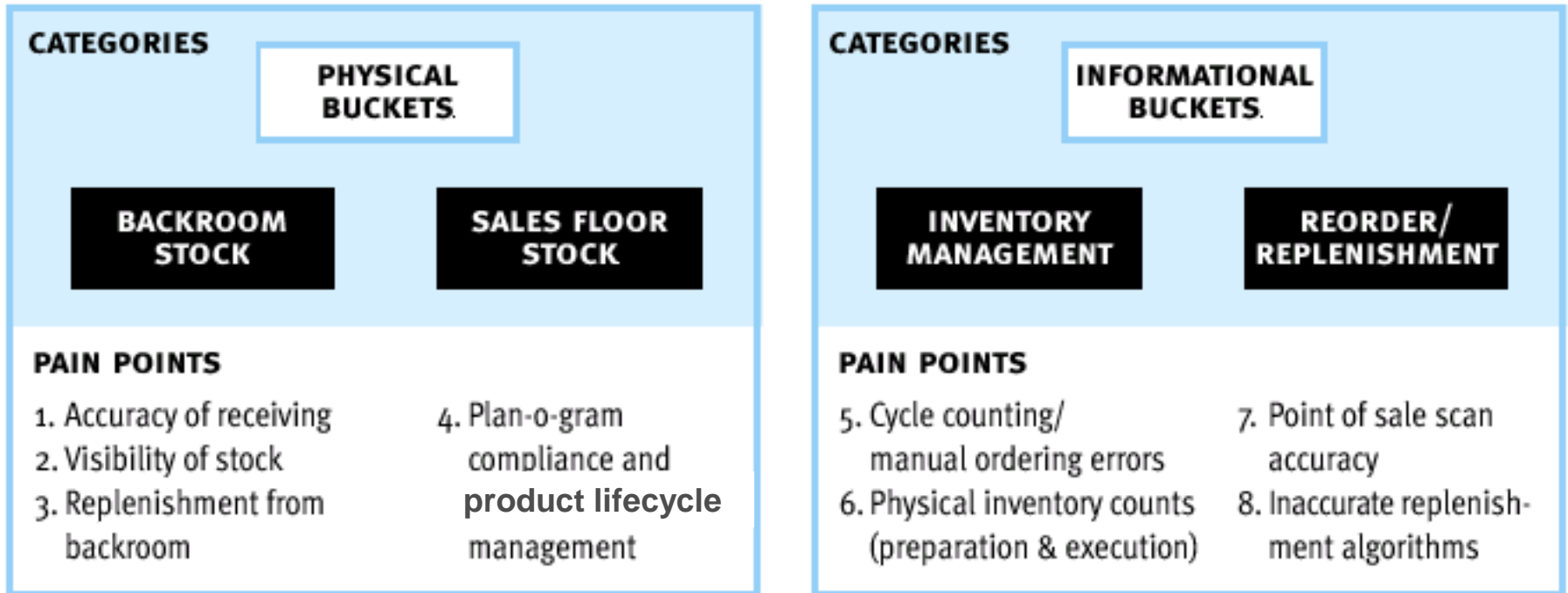
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3. RFID in Retail Processes

RFID in Retail Processes



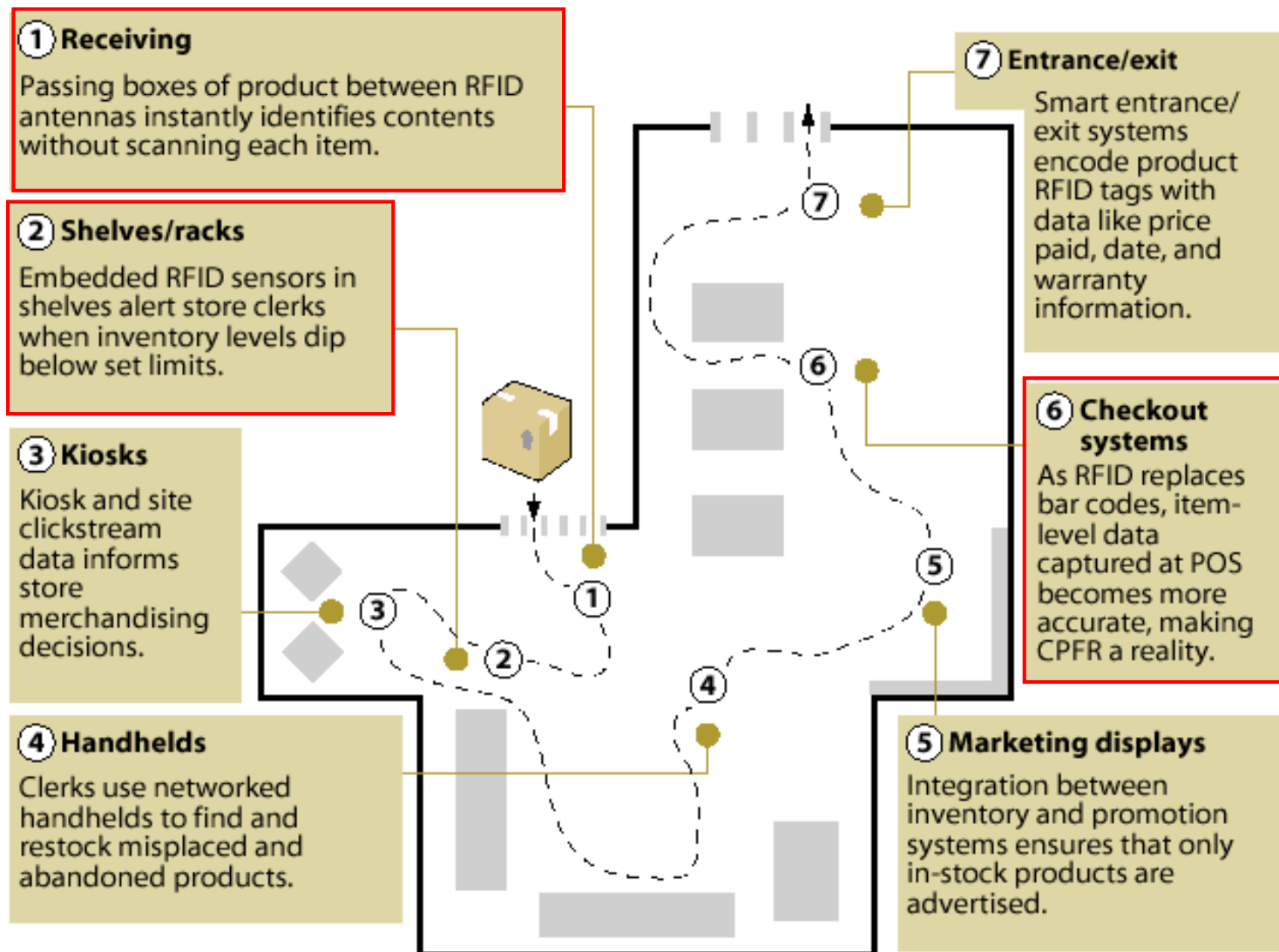
Retail Management: Overview Pain Point Categories



← Labor Allocation Inventory Management →

Source: PWC Consulting

Potential Retail Store Operations supported by RFID



Source: Forrester Research, Inc.

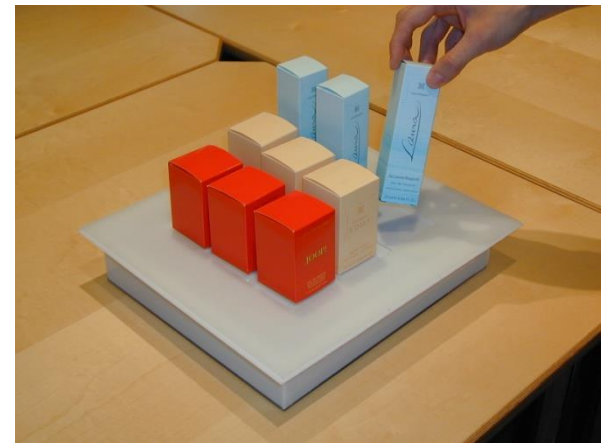
RFID Smart Shelves in Retail Stores: Overview

Smart Shelf with RFID technology

- Recognizes position of tagged products
- Sends state of shelf to back-end system

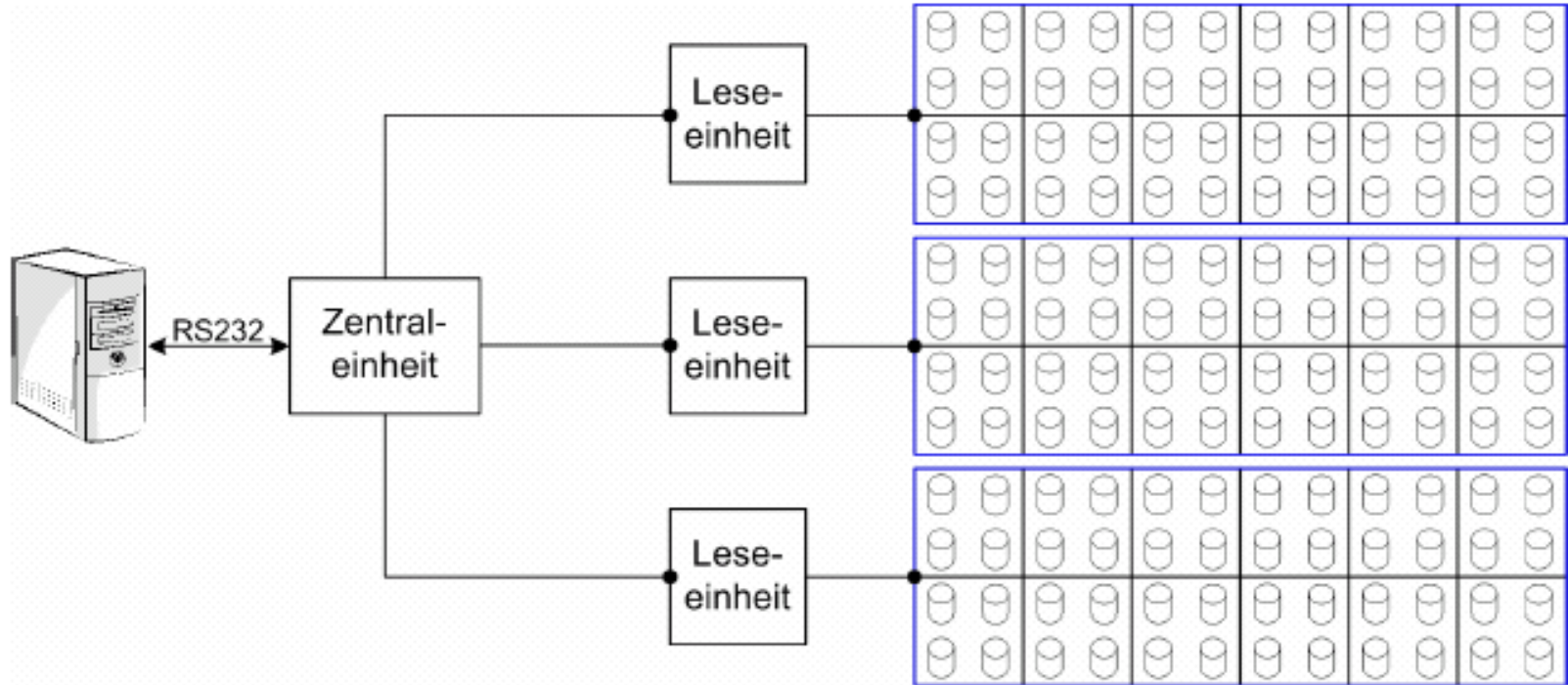
Back-end System

- Monitors state of shelf
- Recognizes
 - Misplacement
 - Expiration date
 - Out-of-Stock situation
 - Plan-o-gram compliance
- Triggers countermeasures
 - Sends orders to vendors
- Sends alerts to store staffs' mobile devices



Source: SAP AG

Example Smart Shelf – Hardware Architecture

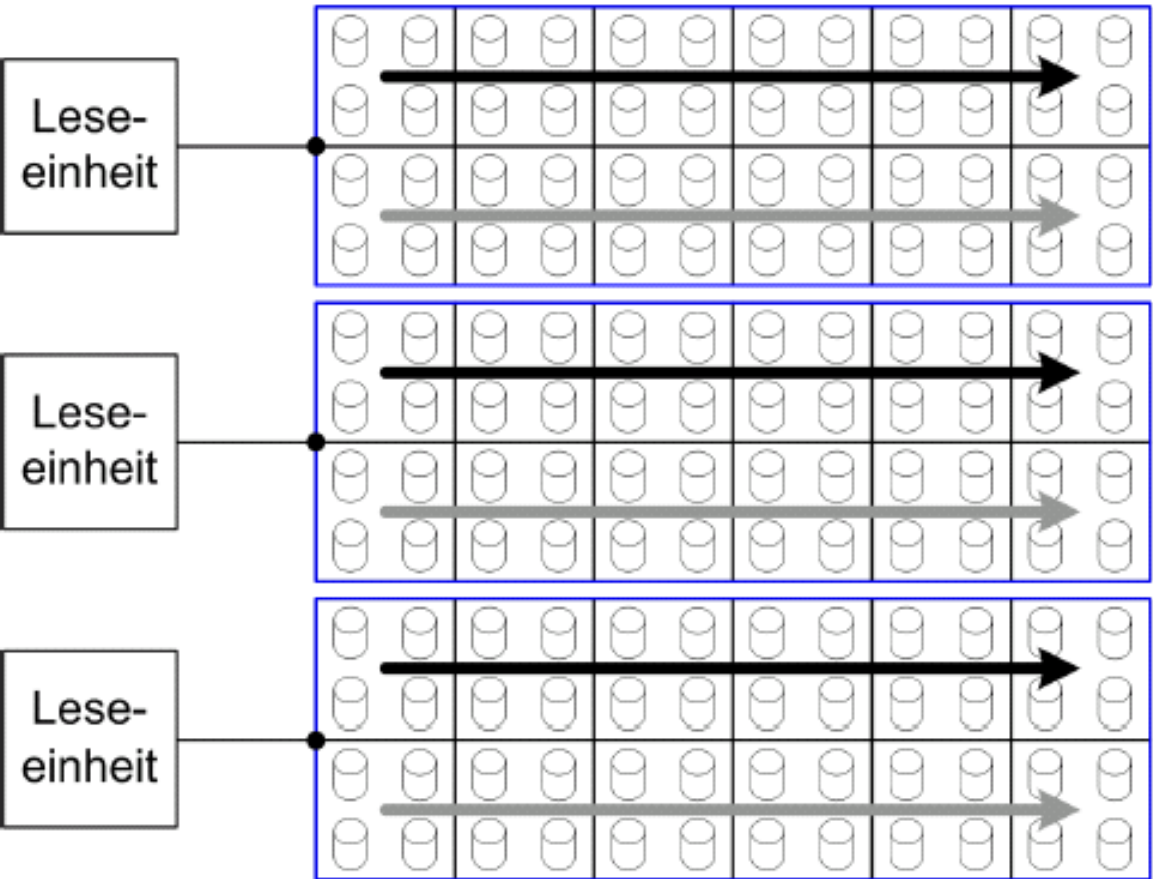


Spule

4 Spulen bilden
eine Antenne

Ausgelesenes Antennen-
feld durch eine Lese-einheit

Example Smart Shelf – Interleaved Reading



Source: SAP AG

Example Smart Shelf – Some Technical Details

- Items equipped with RFID transponders
- 125kHz EM Marin system
- 6x6 RFID antenna grid
- 12 antennas multiplexed in 1 reading unit – overall 3 units
- 3 antennas are read in parallel (130ms per successful read)
- 9 items can be detected
- Read miss rate: 0.3 %
- Average response: 1.5 s

