Supply Chain RFID Applications

Radio Frequency Identification (RFID) technology is a growing area of innovation as Wal-Mart and other retailers make a big push to "tag" items on their shelves for easier inventory management and tracking.

This patent landscape covers the patenting activity with respect to the use of RFID in the supply chain in various industries. The patents reviewed are organized by timeline, companies, industries, and applications. The patents are organized by claims, applications, and a detailed SWOT (Strength-Weakness-Opportunity-Threat) analysis is also provided.

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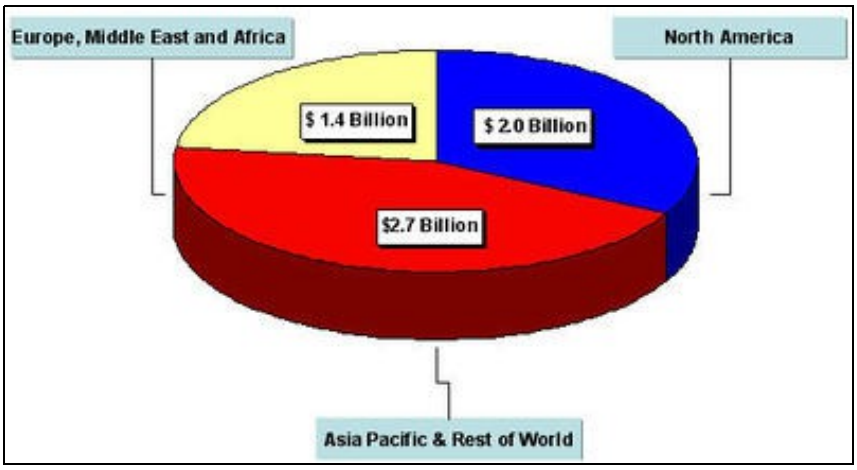
Rationale

- ?A billion people will interact with a million e-businesses via a trillion intelligent interconnected devices? - Louis V Gerstner
- Technological developments in RFID are taking place rapidly - Source
- Innovation is occurring in the RFID market, but it is diffused and application-specific - Paul Faber
- RFID has been spawning a lot of innovation. One of the newest is Jewel (disposable RF-enabled tickets) - Source
- Scientists are developing a system that combines RFID tags and high-definition CCTV cameras to track passenger movements in busy airports
- Wal-Mart Doubling RFID-Enabled Stores - Source
- Oracle and Intel join forces for RFID push - Allyson Fryhoff, vice president of Oracle
- Oracle boosts supply chain management tool - Don Klaiss, Oracle
- U.S. FDA to reduce the counterfeiting of prescription drugs - Source
- Ignorance putting RFID rollouts at risk - ABI Research
- Cash under threat from RFID payments - ABI Research
- ?It?s inappropriate to use RFID technology for tracking and authenticating identities of people? - Pattinson
- CDT Working Group on RFID: Privacy Best Practices for Deployment of RFID Technology - Center For Democracy & Technology

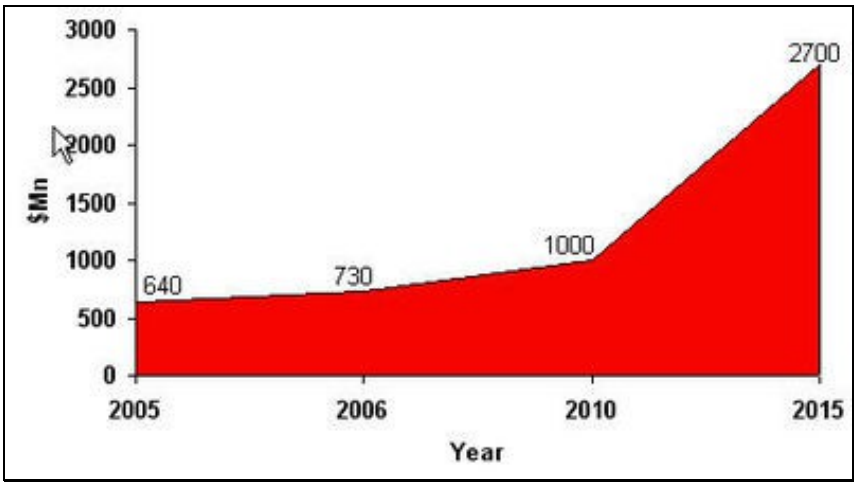
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RFID - Market Potential

- Estimated value share of RFID market in 2010, by region



- The global forecast of RFID hardware, middleware and IT market

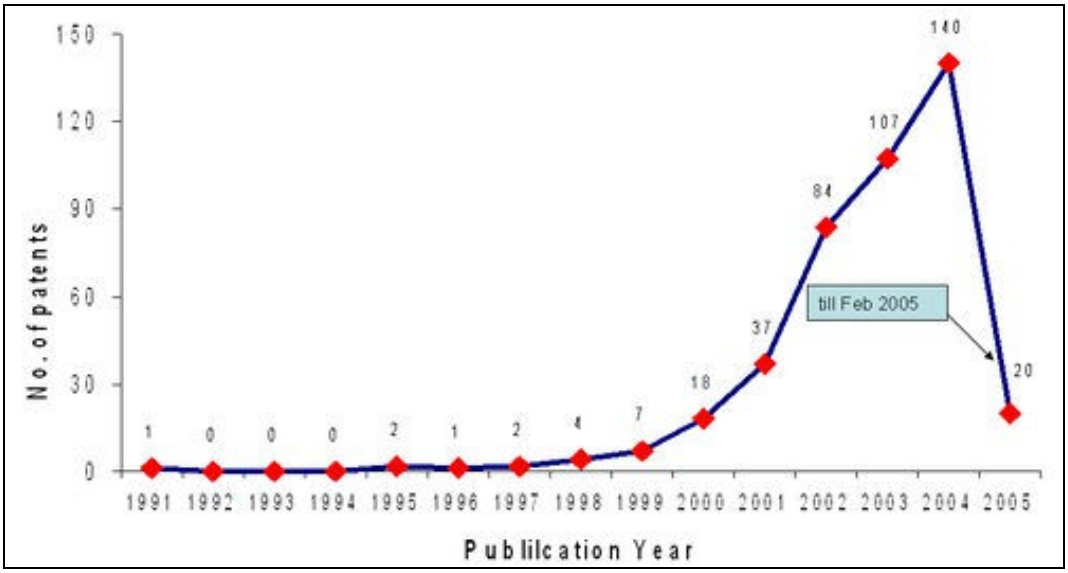


- The RFID market is anticipated to continue to grow rapidly in these and many other market sectors and industries including the food and drug industry, propelled by United States FDA mandates. The technical issues that have made standardization more challenging are heading toward resolution with the emergence of the second-generation of UHF RFID
- Retail RFID is estimated currently at just under 27% of the overall RFID market and supply chain management (SCM) applications, when considered as separate from warehouse and distribution and transportation, represents just over 15% of the overall RFID market. These distributions will undoubtedly change rapidly and should be reconsidered at regular time intervals as the RFID technology and established and emerging markets mature (Source - BCC Research)

Patent - Quantitative Analysis

IP landscape over years

- According to the search data, IP activity in RFID based supply chain applications seems to have started during the year 1991
- The graph shows terrific growth from 2000 onwards and high activity during 2004 with 140 patents alone
- Around 423 patents have been published in a span of 4.2 years from 2000 till date (Feb. 2005) indicating the potential in the field



IP landscape over years: Growth in RFID base supply chain applications

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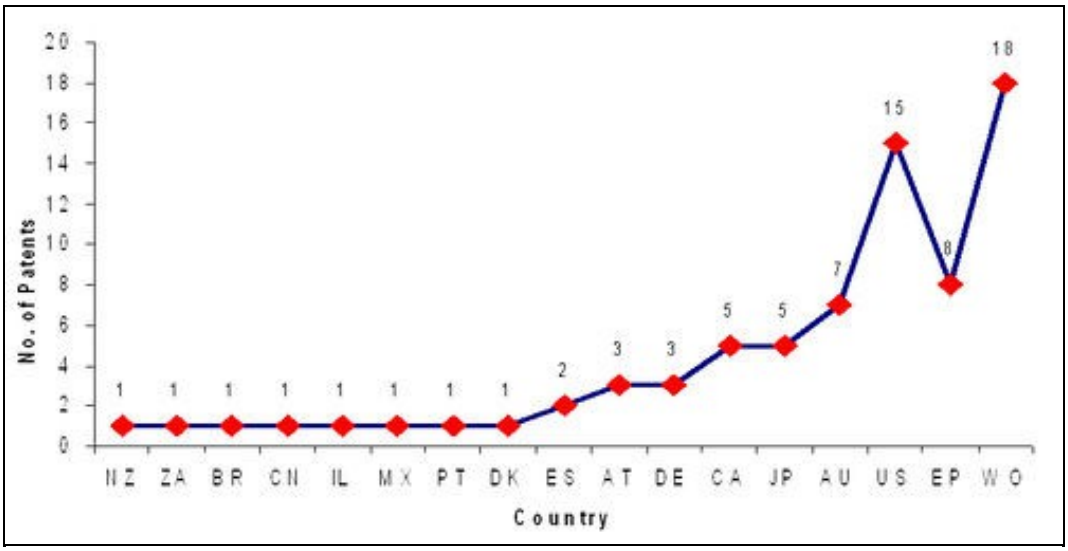
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IP landscape by region

IP landscape of RFID based supply chain - Based on selected 30 records

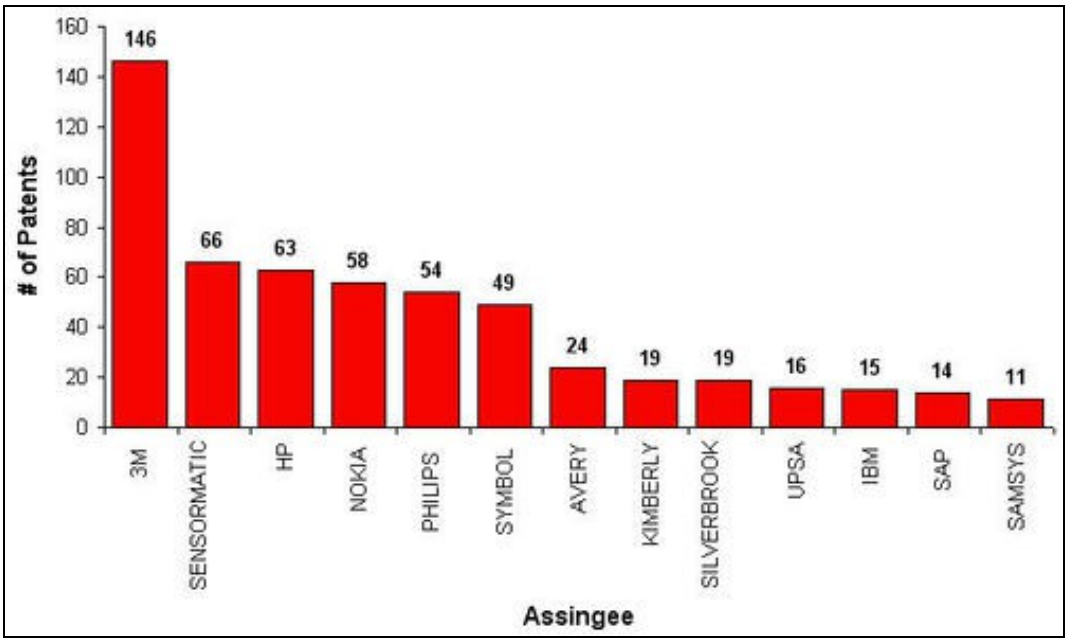
- The graph reveals that the growth in RFID based supply chain applications patenting has been across all the regions. United States is more active than Europe, Japan and Australia



IP landscape by region: RFID base supply chain

Competitor landscape

Top players

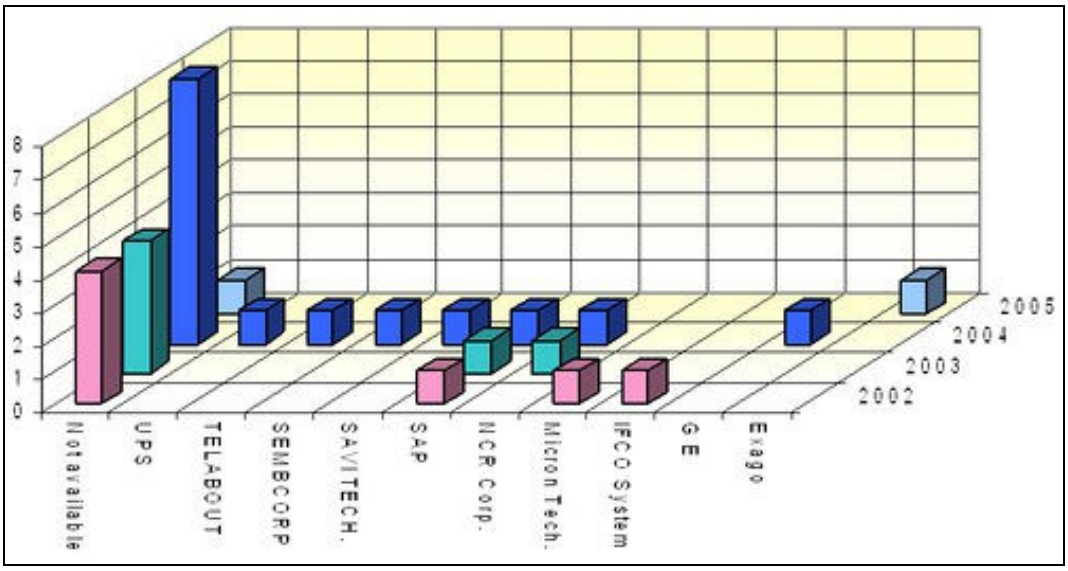


Top players

Competitor Analysis

Growth in RFID based supply chain - The present graph and interpretation is based on selected 30 records

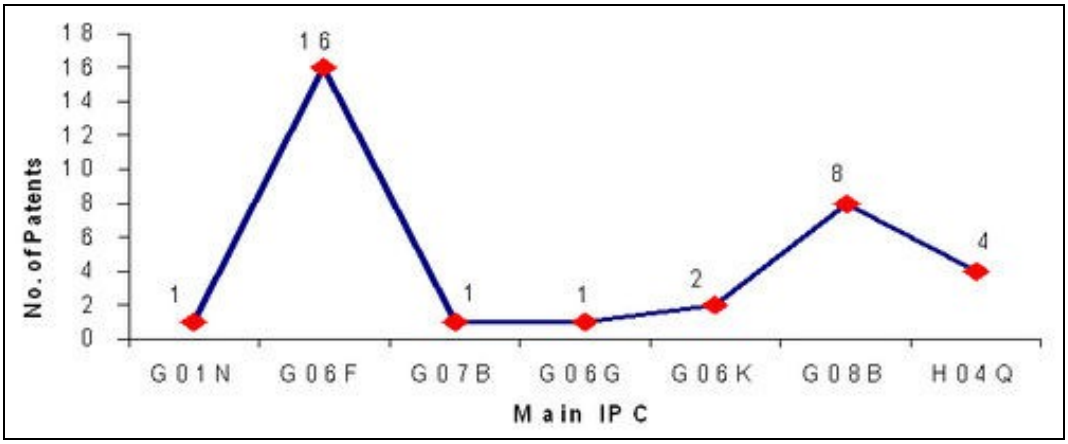
- The graph indicates SAP as leading and consistent player with 3 patent records
- EXAGO seems to be the new entrant in 2005
- It is interesting to note that the competitors in 2004 have not shown any activity in the beginning of 2005



Competitor landscape - Growth in RFID base supply chain

Technology trend

Technology Trend (Main IPC) - Based on selected 30 records



Technology Trend (Main IPC)

The above graph indicates technology focus by various assignees

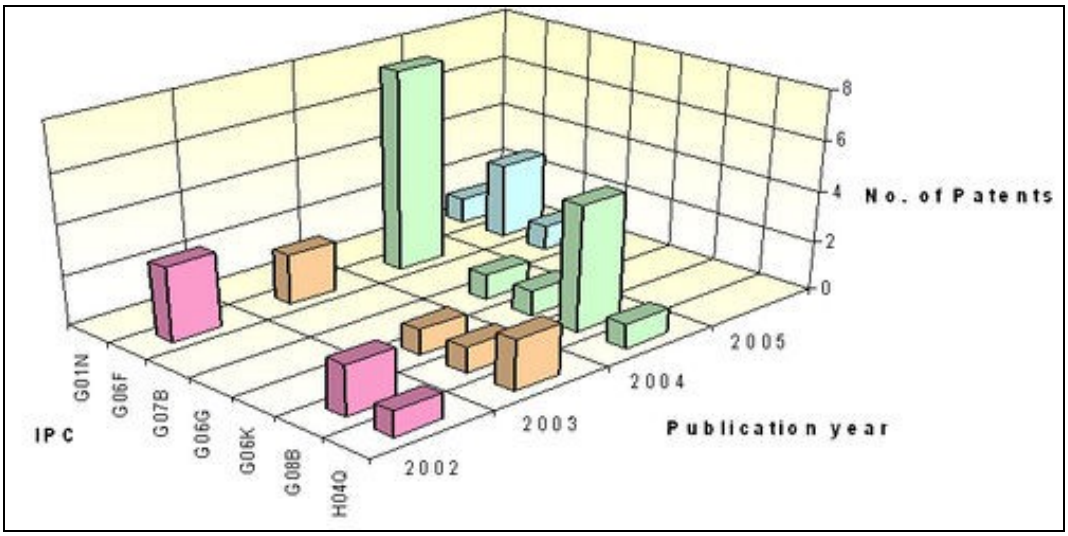
- G06F - Computing, calculating, counting - Electric Digital Data Processing
- G08B - Signaling - Signaling Or Calling Systems; Order Telegraphs; Alarm Systems
- H04Q - Electric Communication Technique ? Selecting (Switches, relays etc.)

IPC code and Description table

Technology landscape (Main IPC)

The present graph and interpretation is based on selected 30 records

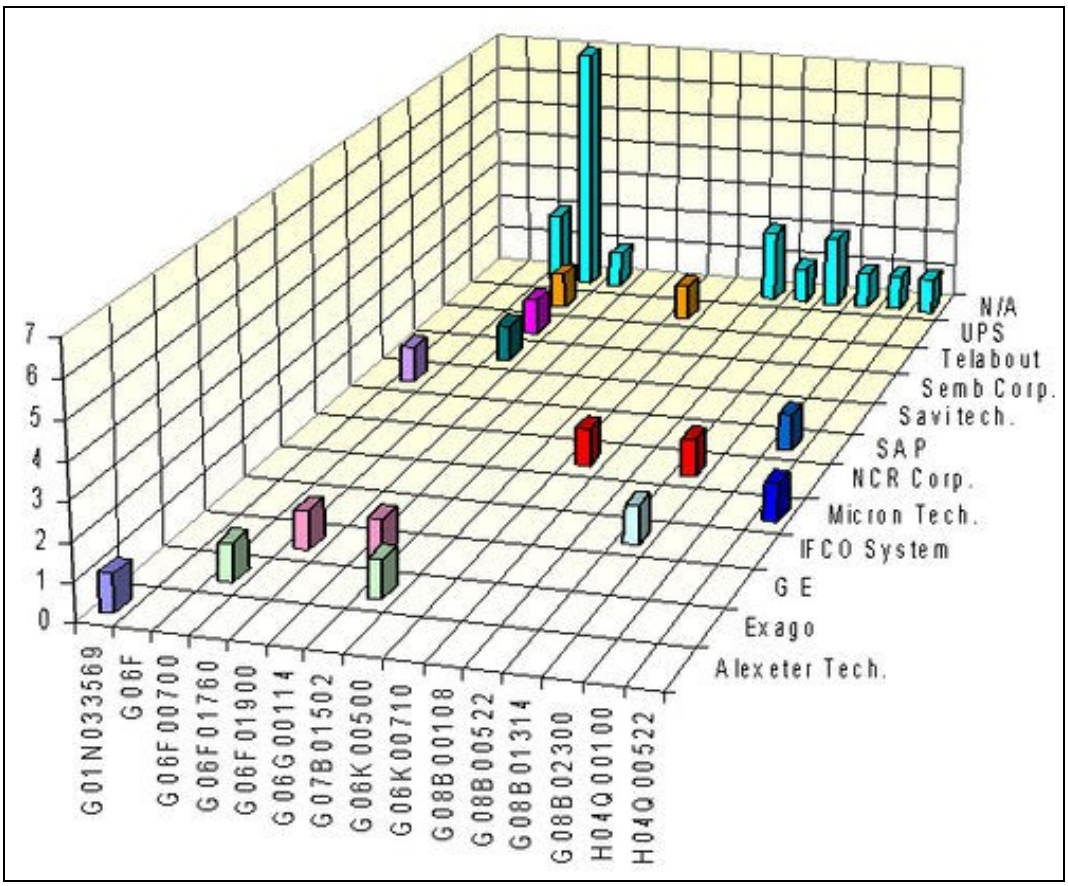
- It is evident from graph that **G06F** (Electric Digital Data Processing) technology is widely used in RFID based supply chain applications showing continuous progress throughout
- The progress indicates key technology area targeted by many players and having market potential
- Followed by **G08B** (Signaling), **H04Q** (Electric Communication Technique) and **G06K** (Recognition of data; Presentation of data; Record carriers; Handling record carriers)



Technology landscape (Main IPC) - Growth in RFID base supply chain

Technology landscape ? Assignee wise

According to the present data, most of the leading players have focused on building sound: Administration, commerce, management, supervision and forecasting (electronic cash registers other than digital data processing) aspects for RFID-based supply chain applications

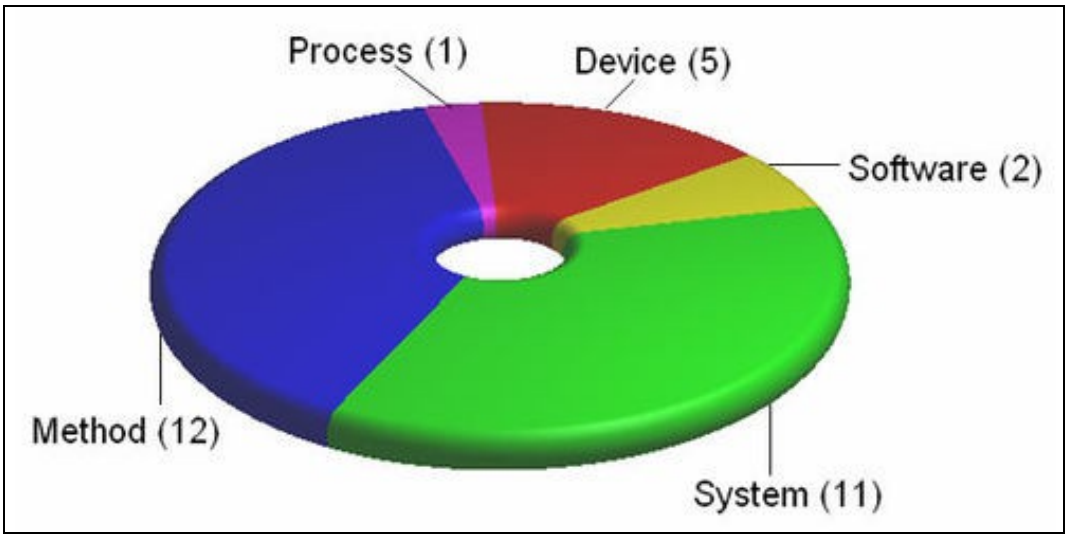


Technology landscape ? Assignee wise

Qualitative Analysis

Classification of patents based on main claims

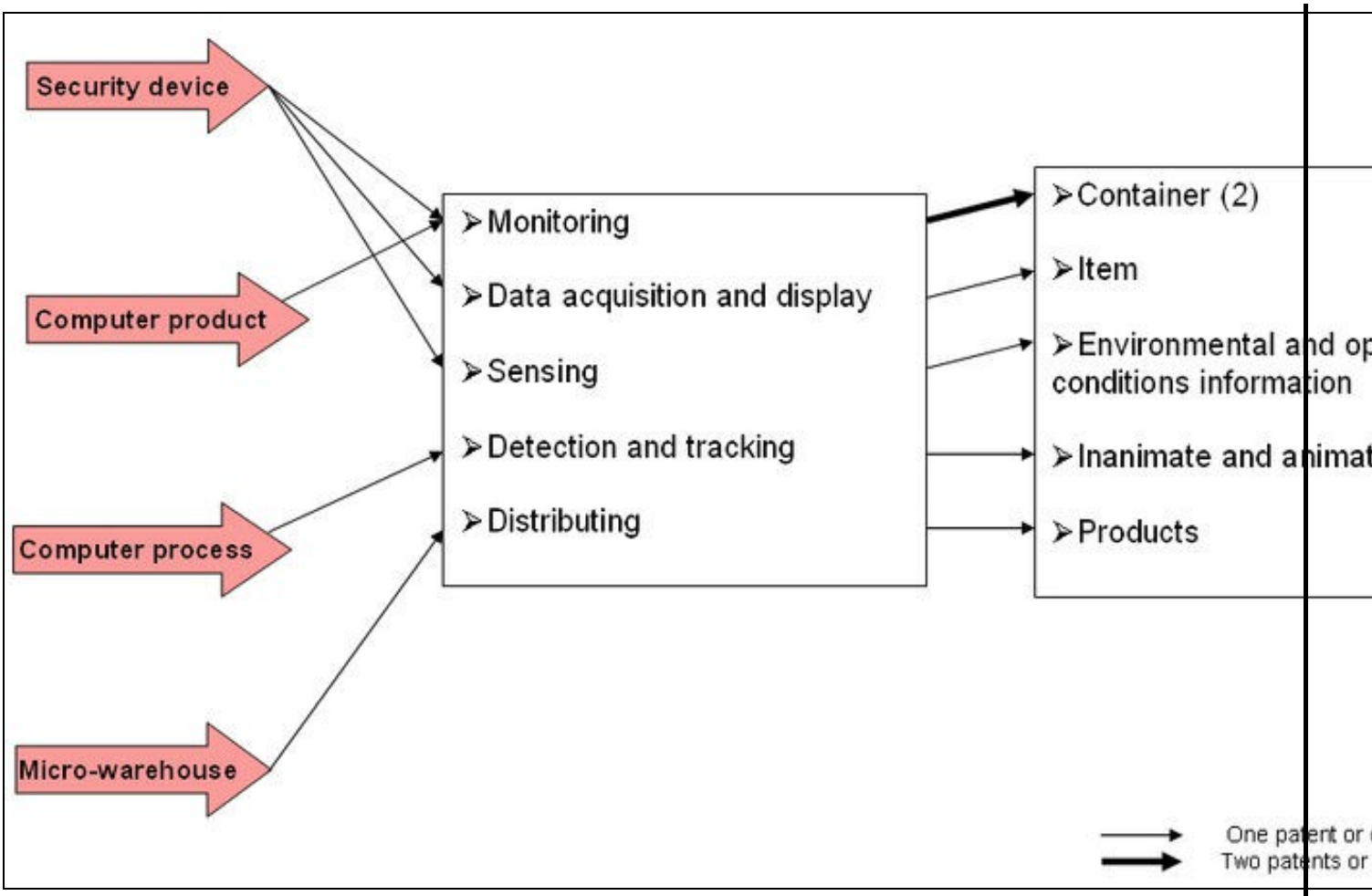
The following graph indicates various subjects that have been covered by various assignees in the area of RFID based supply chain applications. The various subjects are the result of SAO analysis. More granularity on subjects is presented in the table below and clusters



Classification of patents based on main claims

SAO analysis clustering

Subject	Action	Object
Method	* Delivering * Monitoring (3) * Processing * Detecting (2) & tracking (6) * Displaying information * Computing the orientation and position of a wearer * Unattended distribution or retrieval of returned * Return of a return * Retrieving ordered (2) * Receiving * Wirelessly exchanging * Enabling enhanced * Facilitating an interaction * Distributing (3) * Collecting * Entering event data common to a group of individual animals	* Between a consignor and a consignee * Container * inanimate and animate objects * Items (2) * Data acquisition and display device * Calibrating a fixed camera * Assets (2) * Unattended facilities * Item to an unattended facility * Items that have been delivered to an unattended facility * Environmental condition associated with an item of inventory * Shipment record from the intelligent asset management and sensing device * Information * Asset management and tracking capabilities * Between a user and a product item * Products from a micro-warehouse * Products from an access restricted area * Products from a restricted access area having an entry point * Number of mail units (2) * Livestock information (2) * Database
System	* Detecting & tracking (5) * Processing(2) * Unattended distribution or retrieval of returned * Inventory management * Monitoring (2) * Networking * Enabling enhanced * Facilitating an interaction * Distributing (3)	* Inanimate and animate objects * Item (6) * Time * Environmental condition * Unattended facilities * Sensing device * Asset management and tracking * Container * Number of mail units * Articles through customs



Note: Number in ( ) indicates occurrence in more that one patent or main claims

Problem vs Solutions

Prior art Problems	Solutions	Patent number
1. A central system has limited visibility of containers in the global supply chain **2.** Drawback of the central system is the delay in alerts concerning the container **3.** Typical central systems have difficulty in collecting reliable information across heterogeneous systems	A decentralized state system comprising containers to automatically provide continuous and uniform monitoring of a container state is needed. A container should be robustly configured with localized logic capable of determining a state in response to real-time events experienced by the container relative to dynamic and static event information concerning expected events State determinations made through local information are more reliable to typical prior art systems that use central systems to make inferences about the security state	US20040246130
1. A major disadvantage of all transponder based tag designs is the special anti-collision method used **2.** A short range reader must be used to individually address each tag within the larger field **3.** A second major disadvantage is that to obtain long ranges (100-1,000 feet), higher frequencies are required and these lead to high power consumption	**1. & 2.** By using lower frequencies (not exceeding 1 MHz and typically under 300 KHz) and a base station design that uses large loop antennas (such as 10.times.10 feet to 500.times.500 feet) and by transmitting a digital ID to selectively activate a selected client tag, rather than a non-selective signal which would activate many tags simultaneously **3.** Networked RF Tags (NRF Tags) have significantly reduced power consumption and long range (1000 sq feet to 10,000 sq feet per antenna), have the power capacity to add displays (e.g. LCD) and light emitting diodes (LED?s) and detectors and buttons so they may become fully interactive "tag clients" (this is not possible with transponder)	US20040201454
1. One drawback of these systems is that they require the goods to be passed through designated gateway areas, typically causing great inconvenience **2.** Another drawback is that it is not possible to track the location of the goods within the warehouse	**1.** Each ID tag is coupled to an asset and is configured to wirelessly communicate with other ID tags in the network within a predetermined proximity **2.** Each tag is also configured to relay communications from other ID tags so that a communication path is established between the RMS and any ID tag in the network, either directly or via other ID tags	US20040174260

Features cited in analyzed 15 patent records

1. The container can be reprogrammed to include updated logic, updated states, and/or updated expected event information (US20040246130)

2. The system comprises a truck server and an optional in-truck data communications means, which comprise a digital cell phone or satellite link (US20040201454)

3. A local computer communicates with the see-through display, information gathering devices and orientation sensors, optical tracking system and business applications over one or more networks (US20040182925)

4. OmniTRACS.RTM., which is a two-way satellite communication system that allows trucks to be monitored and tracked and to allow data communication with dispatchers (US20040174260)

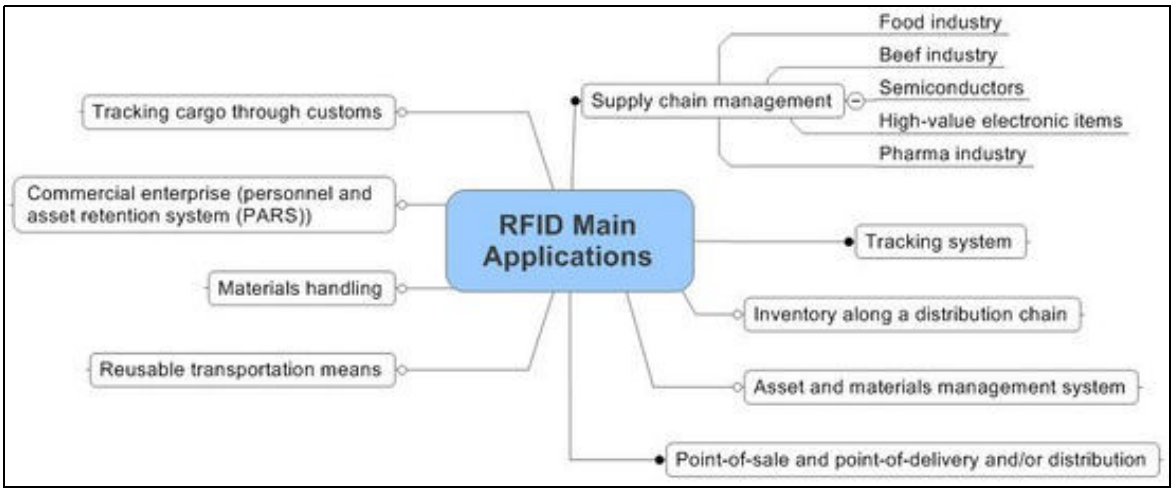
5. The data report from the reporting software can alert the user as to when the detrimental event occurred and identify the custodian who caused the detrimental event (US20040049428)

6. Web-based information system for a beef marketing alliance; value-based procurement and supply chain management (US20020158765)

7. The software contains a component for determining the best time for an animal to go to slaughter based on a target weight (US20020158765)

RFID - Main Applications

Applications which appeared in analyzed patent records have been mapped

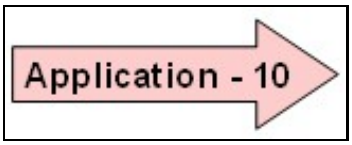
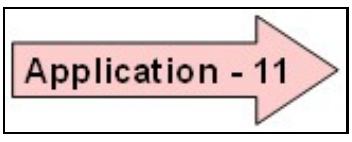


The product moves through the global supply chain which involves various stages (places and processes). The table below indicates the details about the various stages involved in supply chain applications, software applications and hardware used.

Main applications of RFID: Analysis

Application- 1	LOGISTICS CHAIN MANAGEMENT SYSTEM IN FOOD AND PHARMA INDUSTRY.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Airlines and shipping companies **2.** Ancillary Suppliers, **3.** Cargo Community Networks [CCN] which are made up of some of the other participants, **4.** Customs and Quarantine authorities, **5.** Freight forwarders, **6.** Fresh produce exporters, **7.** Fresh produce importers, **8.** Government agencies such as freight export information providers, **9.** Packer/cool store, **10.** Transporters including road haulers and carriers in the importing country.	**1.** Consignment **2.** Supplier **3.** Transport and **4.** Storage	**1.** Central database **2.** A communication secured network **3.** Internet with three interactive databases. **4.** Database and applications (data in a range of formats (maxima, minima, averages, graphical etc) **5.** Passive tag - RW
Application - 2	GLOBAL SUPPLY CHAIN OF SEMICONDUCTORS.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. International suppliers **2.** Airport **3.** Customs agency **4.** Distributors **5.** Shipping dock **6.** Manufacturers	**1.** Transport **2.** Inventory **3.** Shipping **4.** Origin of port **5.** Transshipment port **6.** Destination port and **7.** A consignee	**1.** Program instructions can be in any appropriate form, such as source code, object code, or scripting code. **2.** Computing device: Enterprise servers, Application servers, point of sale terminal etc.. **3.** Passive tag - RW
Application - 3	SUPPLY CHAIN MANAGEMENT OF HIGH-VALUE ELECTRONIC ITEMS & PHARMACEUTICALS.	
Place of events	**Process involved**	**Type of S/W & Hardware**

1. Warehouse 2. Truck 3. Freight container 4. Sea vessel 5. Distribution center	1. Shipping 2. Recipient	1. Central data processor is operable for communication with an internet router. 2. Low frequency tag ? 300 KHz
	TRACKING SYSTEM	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Assembly line 2. Warehouse	1. Package handling 2. Baggage handling 3. Parts assembly 4. Navigation through marked waypoints 5. Item retrieval and packaging 6. Inventory control	1. Business applications (cause sorting and loading instructions to appear on the items so that wearer?s of the data acquisition and display device do not have to read each item?s label.) 2. Passive tag
	SUPPLY CHAIN MANAGEMENT.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Storage facility 2. Shipping container 3. Shipping vessel 4. Airport 5. Shipyard 6. Military heavy assets 7. Warehouse 8. Factory	1. Shipping goods 2. Transportation (truck) 3. Retail or wholesale locations 4. Train depot 5. Inventory 6. Delivery 7. Outbound transit 8. Inbound transit 9. Advanced shipping notification	1. Firmware and software to modulate and demodulate the data for the particular protocol 2. Various communication algorithms and command response algorithms 3. UPS Supply Chain Solutions 4. Passive tag ? RW ? Low freq. or 900 MGz
	INVENTORY ALONG A DISTRIBUTION CHAIN	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Distribution 2. Storing 3. Manufacturer (warehouse)	1. Inventory 2. Monitoring 3. Transportation 4. Tracking 5. Retailer or consumer 6. Wholesaler	1. Anti-collision software 2. Program for correlating the environmental condition data with the location data. 3. The data reporting medium is a computer display, a LAN, or a web page. 4. Active or passive tag- RW
	ASSET AND MATERIALS MANAGEMENT SYSTEM.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Lay down yard 2. Warehouse 3. Asset storage	1. Inventory 2. Shipping 3. Asset management 4. Tracking asset material a. Material identification information b. Description of the	1. Software applications (Web application" TagDetect") files may be in HTML format, XML or other formats. 2. Software applications supporting a client-server system or n-tiered computer system. 3. Internet and Central data repository 4. Active or passive tag - RW

	material c. Purchasing details d. Storage and maintenance details e. Material location and f. Destination information. 5. Receiving	
	POINT-OF-SALE AND POINT-OF-DELIVERY AND/OR DISTRIBUTION.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Distribution 2. Micro-warehouse 3. Manufacturing 4. Marketing 5. Customer relation management	1. Point of sale 2. Delivery 3. Inventory 4. Billing	1. MW (Micro-warehouse) enterprise application 2. XML middleware such as Biz Talk.RTM. software. 3. ERP system, web ordering system 4. Passive tag ? RW - freq. - 2.45 GHz
	REUSABLE TRANSPORTATION MEANS.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Distribution	1. Tracking: a. Receptacle or b. Container or c. Packing or d. Pallet or e. Trolley car. 2. Wholesale distributor 3. Chain sales store	1. No Software application 2. Passive tag - RW
	MATERIALS HANDLING	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Express mail 2. Storage	1. Transport 2. Tracking 3. Delivery	Software modules may include: 1. A database module configured to store data on the storage medium. 2. A decision module configured to determine the presence or absence of stale mail based on information provided by the database module.3. 3. Passive or active tag ? read only
	COMMERCIAL ENTERPRISE (PERSONNEL AND ASSET RETENTION SYSTEM (PARS))	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Industrial sites 2. Power plants 3. Refineries and 4. Ports of entry	1. Tracking 2. Monitoring 3. Inventory 4. Security	1. Company databases are: a. Material management systems b. Procurement systems and c. Time and attendance systems. 2. Applications programming 3. Information access through standard formats such as XML and HTML. 4. Passive tag - RW

Application - 12	TRACKING CARGO THROUGH CUSTOMS.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Airlines 2. Distributor	1. Shipping 2. Receiving 3. Tracking	1. Central server runs a program which acts as a central host for processing the information communicated between the different computers. 2. Passive tag - RW
Application - 13	SUPPLY CHAIN MANAGEMENT IN BEEF INDUSTRY.	
Place of events	**Process involved**	**Type of S/W & Hardware**
1. Factory	1. Identifying 2. Tracking 3. Monitoring 4. Livestock production and processing cycle 5. Inventory	1. BeefLink.TM. Software (is a collection of components written primarily in VISUAL BASIC® 6.0 programming language and ACTIVE X® programming methodologies.) 2. Inventory-type report can easily be generated. 3. MicroSoft Excel 4.Passive tag- read only

Sample Landscape View - RFID Warehouse Application

This is supposed to be a flash animation. You'll need the flash plugin and a browser that supports it to view it.

Sample Landscape View - RFID Application - Company XYZ

This is supposed to be a flash animation. You'll need the flash plugin and a browser that supports it to view it.

SWOT analysis

STRENGTHS	**WEAKNESSES**
• Advanced technology • Easy to use • High memory capacity • Small size	• Lack of industry and application standards • High cost per unit and high RFID system costs • Weak market understanding of the benefits of RFID technology
OPPORTUNITIES	**THREATS**
• Could replace the bar code • End-user demand for RFID systems is increasing • Huge market potential in many businesses • Need for standardization	• Ethical threats concerning private life • Highly fragmented competitive environment

Conclusion

It has been observed that selection of RFID tag depends upon the frequency desirable in supply chain application. Industrial focus is on passive RFID technology. The integration of software technology with electronic identification system will definitely give new dimensions to the supply chain management

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