

RFID@B2B a Powerful Enabler of Business Transformation

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Introduction

Business to business (B2B) applications focus on using the Internet and/or extranet to develop business-to-business partnerships and transform inter-organizational relationships. RFID is relatively low-cost data and wireless transmission technology that helps manufacturers to improve a number of business applications and processes. In this paper we present an RFID_B2B system that brings together the RFID and B2B advantages and which could be a powerful enabler of business transformation in the context of the globalization process. The presented system helps small, medium and enterprise organizations to improve productivity and provide better service to their customers by providing a flexible solution for all of a company's B2B needs.

B2B Concept

Business to business (B2B) is a term commonly used to describe any electronic business transaction occurring between two separate business entities. This includes the exchange of both products and service. Examples of exchanged products and services might include the selling of raw material inputs from one firm to another, the sale of capital equipment, the purchasing of commercial insurance or the contracting of one firm with another for the procurement of accounting services.

The overall goal in B2B content and process integration is to facilitate secure, robust, reliable, automated, and innovative business integration to greatly simplify interaction with customers and other business partners and to enable new ways of doing business 1. Successful content management for B2B electronic commerce has to address various aspects: information extraction from rough sources, information classification to make product data maintainable and accessible, reclassification of product data, information personalization, and mappings between different information presentations 2.

Some of B2B systems benefits are:

- a low total cost of ownership; this is a result of the

easy configuration of always-changing, complex partner networks and relationships;

- a high and secure visibility into partnering activities and performance; this can be reached at all points in the network;
- an increased partner mind-share; this can be obtained through revenue-generating tools providing; this tools can be used independently by a partner or in collaboration with other partners or the vendor;
- a lower cost for marketing and selling;
- a shorter selling cycle;
- just in time delivery; this is one of the most important advantages of B2B and enables the company to have the track of good with the help of electronic commerce.

Automated business-to-business transactions are not an entirely new concept. Large organizations have been using automated systems for a number of years, and some have been programmed to exchange business transactions with other automated systems as far back as the early nineties 3. But, user testing shows that B2B websites have substantially lower usability than mainstream consumer sites. According to Jakob Nielsen 4, the major problems with B2B sites are:

- the fail in supporting customers' decision-making process by preventing them from getting the information they need to research solutions;
- they use segmentation that don't match the way customers think of themselves;
- they lack pricing information (the users in the study prioritized prices as the most critical type of information);
- lack of product availability information (which ranked second).

Our research team developed an RFID_B2B system that consists in a viable and efficient solution to eliminate these problems.

RFID Technology

Radio frequency identification (RFID) is a

technology for the automatic identification by radio of physical entities, such as objects (products, palettes, industrial containers) or people 5. This relatively new automatic identification and data capture (AIDC) technology uses digital data encoded into a radio tag (or “smart label”) located in or on the respective entity. The data stored on the tag is collected by a reader using radio waves. RFID is similar to another AIDC technology, bar code technology, but instead of optically scanning bar coded labels it uses radio waves to capture data from tags and no direct line of sight is required for this data exchanged between the tags and the readers. The RFID tag store much more data than bar coded label and can be read and written with a reader for thousands of times, acting as a portable database.

There are three types of RFID tags: active, passive and semi-passive tags. Passive tags are undoubtedly less expensive than active tags and most companies are focusing on passive tags.

RFID technology is emerging as a powerful and proven tool for streamlining production at manufacturing facilities of all sizes 6. The reason for the recent rapid and escalating use of RFID lies primarily in advanced miniaturisation, maturity as well as in the constant price decline which makes the use of RFID economically viable in ever more areas of application 7-10.

Electronic product code (EPC) standard supports the use of RFID in the consumer goods and retail industries. While the standard continues to be adopted in various markets and employed in a wide range of applications (e.g. the retail supply chain), many RFID users are particularly interested in high-level functionality features to meet their own requirements. Using the EPC number as an identifier certainly provides benefits, but there are many applications that require additional memory on the tag in order to more fully meet the needs of many users. This available memory can be used to customize an application and allows users the flexibility that a standard EPC tag or dedicated applications cannot fulfill.

RFID@ B2B

Our research team implements an RFID_B2B system that brings together the B2B and RFID advantages and which in the near future could be a viable solution for the potential problems created due to the globalization process. Thus, the RFID_B2B system refers to the business relations in large enterprises, corporations and groups, as regards the control of the materials along their entire supply chain. The system can enable the real-time and multidimensional coordination for all players in the B2B process. The RFID_B2B system suggests applying the RFID technology by using RFID 13.56 MHz High Frequency (HF) passive tags to identify materials and assemblies. Thus, based on the ID codes of the materials and assemblies, it is possible to control the content and the origin of any finite product, the content of assemblies and the origin of any constituent component. By extending the system to the entire supply-chain - final producer, supplier, the manufacturer’s suppliers, etc. – it can be implemented a comprehensive trace and track functionality, from product origin, throughout the lifetime of processes and

products. In order to accomplish this, all the necessary tracking information will be comprised in the tags attached to the materials, sub assemblies, assemblies and finite products. There is considered a broader data model, called nesting, that is used for multi-dimensional businesses- in fact, for effective global logistics and customer care in any industry. Nesting is the ability to identify and aggregate product data from the item up to through all the packing and shipping units (pallets, containers etc.) to the transportation mode. Nesting supports the entire complex views in the chain – horizontally and vertically – reflecting all key product, conveyance and logistic structures 9.

General Presentation

The research team chooses to design a scalable architecture to meet the growing needs of enterprise deployments. Thus we consider a layered architecture arranged in such a way that the lower layers support and enable the upper layers. This architecture has some advantages: divide the complex system into several more manageable components, allow different groups to work on different layers concurrently etc. The RFID_B2B system is structured on three levels: the corporation level, the local level and data collection level at the material control departments (Fig. 1).

At the platform’s *corporation level*, the following achievements have been made:

- services are offered to ensure the support for concluding contracts, along with the agreements, the conventions at the board level of the corporations, the firm groups or the representatives of the firm groups;
- informational management of the group/corporation enterprises, ensuring supervision of the material flows (with effects on the establishing of supply and sales strategies), as well as of the good functioning of the internal network of the group/ corporation;
- supply of reports regarding the current activities within the group/ corporation, including alarm in case of generation of specified events.

The following are provided at the *local level* or at the enterprise level:

- proper administration of the received, sent, defective, repaired, returned entities at the enterprise level;
- access to the company servers network, as well as communication management along the supply- sales main chain, providing the opportunity to manage and access the information referring to the route followed by materials, assemblies and finite products;
- coordination of the materials/ assemblies flow in order to ensure adequate distribution to corresponding departments, as well as to deliver the order to the gates in departments;
- documents delivery for controlling the production, materials, finite products, assemblies, including those in the service department.

Different applications of RFID are implemented in the *data collection level* in order to write and read the data from the tags attached to the materials, assemblies and finite products. These integrated local applications are highly dynamic and have a large task to perform, such as

data capture and filtering, data and user authentication, identifying and updating data. At this level, the communication is wired or wireless.

The tags having over 128-bits of dedicated user memory allow the storage of additional item information and the development of new applications. Thus, this available memory can be used to customize an application, allowing the user the flexibility that a dedicated application

cannot fulfil. We propose the defining of the data type that will be used when storing the information. Thus, our system considers the use of some fundamental data along with some data type defined by the user. The defined data types and a proposed script language allow data and commands to be specified on a tag in a uniform way, independent of the particular application.

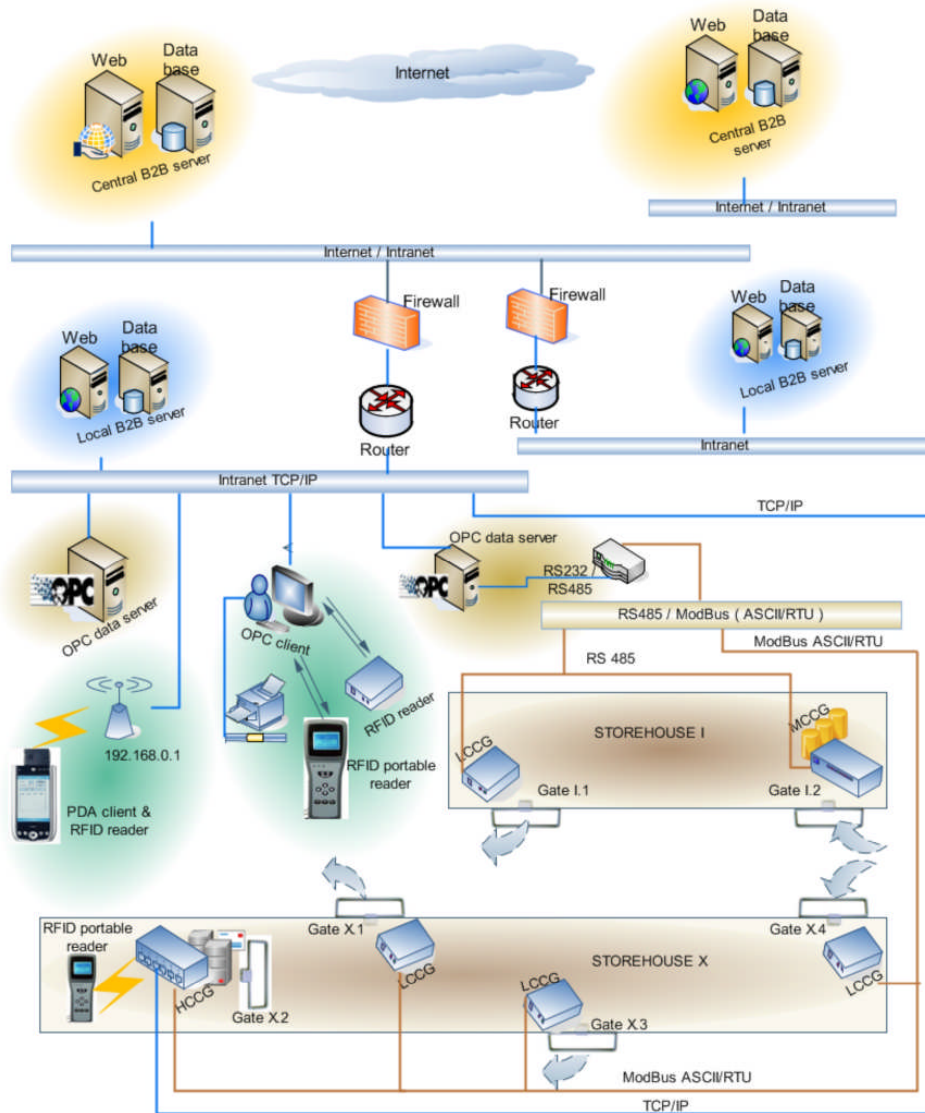


Fig. 1. The system architecture

The system architecture permits to add different modules after installation, e.g. additional automation systems such as automatic storage and retrieval systems, conveyor systems etc.

As for the development environments and the database management systems employed to create the components and the application, we chose Microsoft Visual Studio 2005, Sybase SQL Anywhere 10 for the PDA devices and Microsoft SQL Server 2005 for the PC database server.

PC Applications

All PC applications present a high degree of generality that permits a simple implementation in various

activity fields without any modifications in the structural level of software applications. Thus, the user can define a template that describes the data format to be used for writing data into tags. Through an advanced template editor the user can establish necessary fields (e.g. product authentication features, expiration date for perishable goods, shipping information, along with other data that is pertinent to the user) and their type (character, string, integer, real). Also, the user can reserve memory for data fields that can be defined and written later. Developments in RFID technology continue to yield larger memory capacities and the templates will allow the increasing of the total data size on the tag as and when required, without changing the application. When a B2B client orders a particular item from a supplier, that supplier sends an order

confirmation and template information back to the client. The client company stores that information in its system locally. Thus, at time of purchase or issuance the client company is informed of what data type is stored on the RFID tag on the desired item. This feature enables reading of the tag content for authorized user only. Hence, it is impossible to identify the contents of the tag without the corresponding template. Through this solution, a highly secured data exchange is used by all B2B members.

All templates are created at the PC level and then transferred to the PDA through specialized web services. An important aspect is related to the visual organization of the fields on a tag so that they can be read on the PDA display. The visual space on the PDA touch screen is far too small and it is rather difficult to create/update a tag that has too many fields; the low display resolution and small display screen inhibit information to be displayed completely and clearly. That is why, users can define at the PC their own visual areas according to their needs and then group all tag fields. In general, each group will consist of several fields with the same purpose. All visual areas created at the PC level are then transferred to the PDA.

PC applications from the data collection level enable RFID data capture, filtering, correlation and database update. Also, the PC-control gates communication is enabled for sending the commands to the control gates, respectively for PC database updating with control gates read information.

The PC applications installed at local and corporation level provide a service-oriented architecture (SOA) platform consisting on distributed application server, secure reliable messaging, local database, systems management. Thus, the RFID_B2B system can be the service provider by enabling some functions as web services, which can be accessed by external systems. By delivering B2B functionality as a web services, partners and customers can interact in different ways as business needs evolve. Also, the RFID_B2B is a service requester by enabling it to invoke web services hosted by external systems (e.g. currency converter). The RFID_B2B system implements security and authentication facilities, easy trading community management (such as, partner profiles and settings), data integrity and transaction management etc.

Mobile Applications

The implemented RFID_B2B system also handles multiple PDA devices and PC servers and facilitates data sharing among these devices. Thus, mobile application performs the following functions 11:

- integrate and exchange information with complex RFID_B2B systems and other PDA mobile devices, enabling intelligent updating of PC and PDA databases;
- enable the management of the database, which stores information related to tags and templates;
- work in stand-alone mode (independently of the main servers);
- read RFID tags and automatically update the PDA database as necessary;

- write RFID tag or update the information stored on the tag without recourse at that time to a central database;
- support multi-user configuration to meet the requirements and in accordance with circumstances;
- assure the information security through system access control, as well as data encrypting from the database;
- enable the management of system registered users;
- enable the communication with other systems and allow the connection to higher level enterprise networks;
- employ a multi-user and user-friendly interface.

RFID-Based Control Gates

Because RFID tags can be read automatically without any user intervention, we proposed some RFID-based control gates to provide unsupervised, constant tracking. Thus, all item movements can be automatically recorded as they pass by control gates, the tag script code can be interpreted and unauthorized movements can trigger an alarm or event notification according to the user's settings. Our system permits the use of three types of RFID-based control gates, which vary both in price and the package of features that are being offered. The three types are: Low Complexity Control Gates (LCCGs), described in 12, Medium Complexity Control Gates (MCCGs), described in 13, and High Complexity Control Gates (HCCGs), described in 14. All three types of control gates have the ability:

- to read fields from RFID tags and save them into a non-volatile history memory using a file system;
- to send stored data to a PC (only at request);
- to modify fields on RFID tags as a result of a command from a PC or as the result of an internal script execution;
- to fire alarms as the consequence of some actions and events that occurred;
- to control relays and read data using digital inputs and outputs.

But they vary both in price and the package of features that are being offered. Thus the MCCG offers the same features as the LCCG type, adding to that new features like: an extended support for storing history data on a Flash memory card (an xD-Picture Card) that allows superior storage capacity (up to 128MB for the given file system), more computational power, the ability to connect two RFID readers at the same time, the remote access via a web interface. HCCG adds more advanced features like, high performance hardware architecture based on an ARM9 microcontroller, a multi-tasking embedded Arm-Linux operating system and extended web features like an Apache web server optimized for embedded systems and able to run CGI applications.

All three kinds of control gates are able to use a RS485 serial connection to communicate with a PC through ModBus communication protocol and a RS232 connection to communicate with the RFID reader. OLE for Process Control (OPC) which stands for Object Linking and Embedding (OLE) for Process Control, defines a standard interface that allows applications to access data

from a variety of devices. Our OPC server is responsible for acquiring the data requested by a client from different RFID-based control gates.

As this solution proposes the implementation of processing logic on RFID tags, there is no need to modify the software of the embedded system to allow the same device to be used in different applications (security, parking, supply chain, etc.).

System Benefits

The presented system offers a high degree of flexibility and helps companies of all sizes enable their customers to do business on demand — when they want, where they want and how they want. Other system benefits are 20:

- Assures realtime inventories so the users can always receive accurate, up-to-date inventory information;
- Permits strengthening customer and partner relationships with collaboration;
- Speeds and simplifies the deployment and management of e-commerce sites;
- Maximizes performance, scalability and adaptability of partners systems;
- Provides rich, ready capabilities for products catalog and content management. Thus, permits a greater visibility through realtime product updates, availability, pricing information and new data types acquisition;
- Offers personalization capabilities.

These benefits aim to win customer loyalty by satisfying the consumer needs related to low waiting time and improved system security.

Further developments

The following aspects might be taken into account as future directions for development:

- integration of intelligent agent technology, through the development of some intelligent agents, which allow the defining of the user's profile, the collecting of information and its filtering (considering the criteria chosen by users), etc;
- application development for mobile wireless equipments (m-commerce);
- on-line processing of transactions (banking-financial-accounting) involved in B2B exchanges;
- applying AI planning methods to search for a plan, to solve a certain goal (e.g., a customer receiving a product) 151617;
- semantic-based transformation by adding semantics to the individual layers 18;
- transition to B4B (Business for Business) – next evolution in B2B communication 19-21.

Conclusion

RFID is relatively low-cost data and wireless transmission technology that can help companies to improve the business to business processes. The presented system helps small, medium and enterprise organizations

to improve productivity and provide better service to their customers by providing a flexible solution for all of a company's B2B needs. The system is so adaptable that many types of businesses can use it and allows enabling new business opportunities and growth. Using the developed system may help customers sharpen data accuracy, process supply chain transactions faster, and improve supply chain and inventory management. Given slim profit margins, companies are looking for ways to save on costs while remaining globally competitive. RFID@B2B may be their answer.

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An RFID_B2B system that brings together the RFID and B2B advantages and which could be a powerful enabler of business transformation in the context of the globalization process is presented. The presented system helps small, medium and enterprise organizations to improve productivity and provide better service to their customers by providing a flexible solution for all of a company's B2B needs. Ill. 1, bibl. 21 (in English; summaries in English, Russian and Lithuanian).

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Анализируется RFID@B2B система, объединяющая RFID и B2B преимущества и способная в контексте процесса глобализации стать мощным инструментом, стимулирующим трансформации предпринимательства. Предложенная система помогает маленьким, средним и большим организациям улучшить продуктивность и поставлять более качественные услуги своим клиентам. Это осуществляется обеспечивая гибкое управление потребностей B2B компании. Илл. 1, библи. 21 (на английском языке; рефераты на английском, русском и литовском яз.).

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Analizuojama RFID_B2B sistema, jungianti RFID ir B2B pranašumus ir globalizacijos proceso kontekste potencialiai galinti tapti galinga verslo transformacijų skatinimo priemone. Pateikta sistema padeda mažoms, vidutinėms ir didelėms organizacijoms padidinti produktyvumą ir teikti geresnes paslaugas savo klientams. Tai leidžia lanksčiai tenkinti kompanijos B2B poreikius. Il. 1, bibl. 21 (anglų kalba; santraukos anglų, rusų ir lietuvių k.).

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