ISSN 1392 – 1215 ELECTRONICS AND ELECTRICAL ENGINEERING 2010. No. 7(103)
ELEKTRONIKA IR ELEKTROTECHNIKA

T 120 SYSTEM ENGINEERING, COMPUTER TECHNOLOGY
SISTEMŲ INŽINERIJA, KOMPIUTERINĖS TECHNOLOGIJOS

Approach on Applications of Random High Data Flows Concerning the Architecture of Computer Networks

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Introduction

The RFID readers were initially created as simple subordinates connected to the serial port of a PC, offering support to a dedicated application. Such a configuration is named "oriented on application" and it offers an appropriate configuration for developments that imply a modest number of readers, carrying out a specific function.

At the same time with the necessities evolution for production on a large scale, it was developed a new generation of readers.

These network devices contain the software and hardware implementation for the TCP/IP stack and Ethernet wire connections or LAN wireless connections (802.11).

A RFID reader network that supplies with data a variety of RFID client applications using the middleware RFID situated between the readers and the applications, it is named RFID network. We will name these readers configurations "oriented on the network".

The evolution towards such a complex interconnection of the components used by RFID will raise different problems (of scalability, ductility, etc) that must be taken into consideration when design a RFID network.

The problem is much more serious especially when the number of readers reaches a certain level with the purpose to carry out the interrogation requests, or when the resources of the enterprise will be divided by the RFID clients and by other applications of the enterprise.

This situation is real in applications such as the automatic production where hundreds of readers interrogate tens and hundreds of container components from the assembly lines and supply information in real time for system applications with the purpose to carry out the assigning in processes and the routing of the production flow.

As it was mentioned before, the situation resembles to the case of the traders, where all the warehouse tags are constantly monitored by hundreds of readers from the level of sales and from the stocking warehouse with the purpose to bring benefits such as the rapid counting of the stock and the audit, the diminution of the inventory level, a large range of tracking facilities of a product's direction, the administration of products aging, the prevention of theft, the rapid payment at the cash register.

The volume of RFID data generated by these applications can lead to blocking the enterprise network or intranet if they are taken over directly by these networks. In order to avoid these troubles it is inevitable the use of a middleware between readers and the RFID application at the level of the organization.

Solutions of optimizing the communication, so as to transfer high data flows are proposed in this paper. Simultaneously, the functioning in normal conditions of all network applications and stations will also be ensured.

Current architecture

The architecture of a typical enterprise network. Fig.1 illustrates a typical enterprise network that includes the following components:

- Main switches and edge switches (switch placed at the meeting point of two networks) that carries out the chaining of the basic network (backbone);
- Routers that divide the sub-networks and supply commutation services between networks or virtual LANs;
- Routers with firewalls for creating demilitarized zones (DMZ) for securing the local networks, allowing the LANs to access the public networks;
- The data memorization networks (Storage Area Network/Network-Attached Storage - SAN/NAS) for stocking on a high speed network, secure and elastic in the advantage of some large user networks;
- Access mechanisms of virtual private networks type Virtual Private Network (VPN) for the internal guidance and/or partners for accessing the enterprise network.

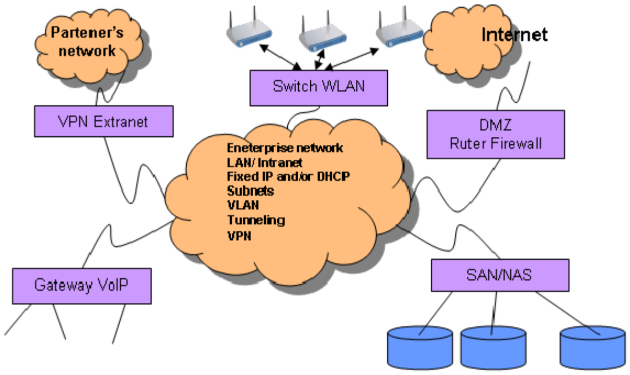

Fig. 1. A typical example of an enterprise network

The network of the enterprise can be administrated by using fix IPs or a DHCP server, or a combination of these two, according to the nature of the requests given by the business of the enterprise.

The performance of the network is determined and measured by the capacity of the network (the maximum value of the transmission band) and by the width of the available band (the maximum value of unused band). The capacity of the 100Mbps or 1Gbps network is a static parameter determined by the commutation possibilities and the type of cable used in the network. The available band width is a dynamic factor determined by different factors, as it is shown in [1].

The network interconnection evolution of the RFID applications. The readers initially operated as subordinates connected in a typical way to a host computer through the serial port and offered support to a dedicated application.

Such a configuration is named oriented on application (according to [1]) and it is illustrated in (Fig. 2).

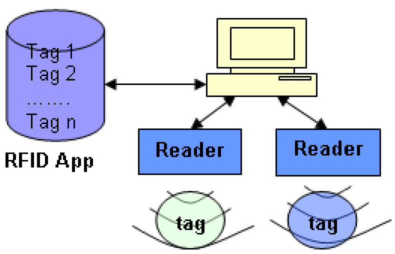

Fig. 2. Implementation oriented on application

For the accommodation to production implementation on a large scale, it was developed a new generation of readers.

These network devices contain the software and hardware implementation for the TCP/IP stack and Ethernet wire connections or LAN wireless connections (802.11).

A RFID network of readers, which provides data to a variety of RFID client applications (App A, App b, etc.), (Fig. 4), using the middleware RFID situated between the readers and the applications, is named RFID network. We will name this readers configuration, illustrated in (Fig.3), as being oriented *on the network.*

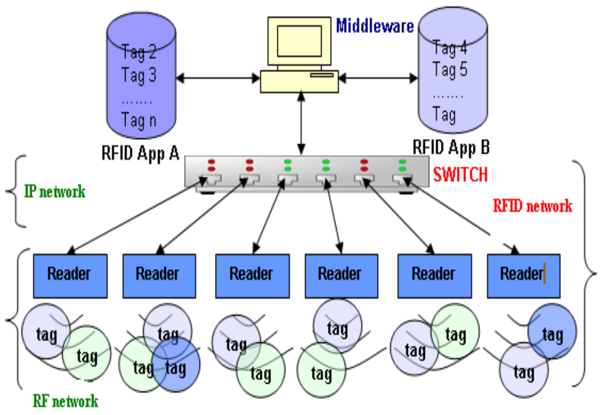

Fig. 3. Implementation oriented on the network

The evolution towards such an interconnection of the components used by RFID will raise different problems that must be taken into consideration when designing a RFID network, especially when the number of readers reaches a certain level with the purpose to carry out the interrogation requests, or when the resources of the company will be divided by the RFID clients and by other applications of the enterprise.

The distributed design of the RFID network

All the objects excepting the RFID App A, App B (Fig. 4) (App A, App B are not illustrated here) applications and the middleware structure represent the major components of an enterprise network that includes servers and clients that run different applications such as those of the ERP type, of inventory administration (Inventory Management System – IMS), systems related to finances, etc.

The band width requested by the applications depends on the nature of the applications, as it is shown in [1]. These ones draw up the nucleus of the network traffic. It is a habit that some ports from the edge switches and/or the basic switches of the existing enterprise network to be retained for extension. There are two options when we want to add an RFID network: piggybacked or dedicated.

Piggybacked network type. If one use the piggybacked type design, (Fig. 4), the addition of an RFID network (the main readers, middleware and the RFID applications) will be made by adding this one to the basic structure of the existing network, for example using the free ports of the basic and edge switches.

Such a design of the RFID network will lead to its mixing with the enterprise network, a fact that will lead to limiting its scalability, as it is proven in [1, 2].

The piggybacked design type has restrictions given by the segmentation.

If the edge switches 1 and 2 from the enterprise network were assigned to the same network, then the connection of the readers to switches will inherit this segmentation, even if the RFID applications may need readers in different sub-networks or VLANs.

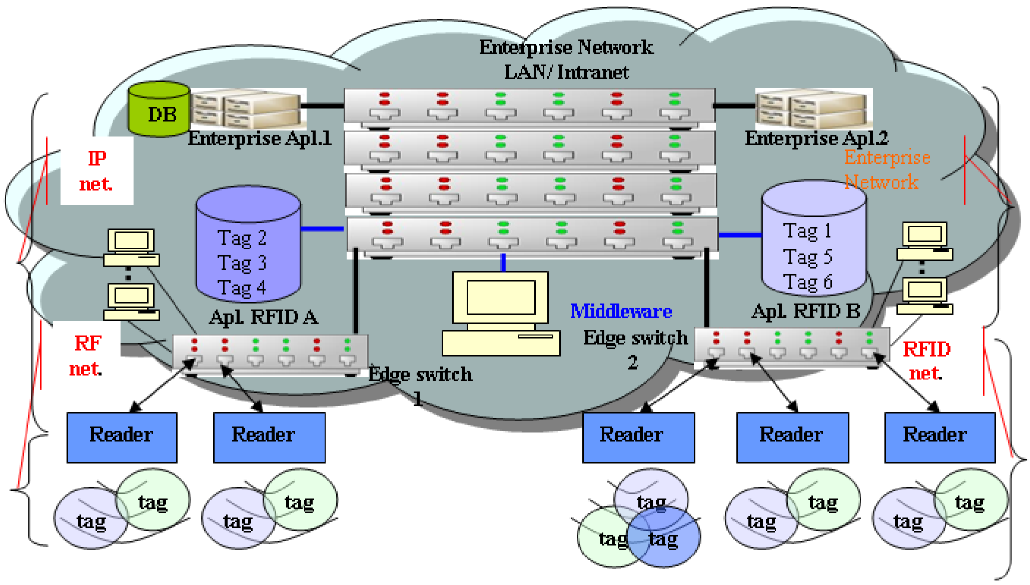

Fig. 4. RFID network – piggybacked design

Dedicated network. If there is used the dedicated design, as in the example from the (Fig. 5), the RFID readers are connected to dedicated switches that will be connected to the switches from the highest level (the basic switches in the RFID network). The RFID middleware, connected to this switch will filter the RFID data and will convert them in information for being used by the RFID applications.

The RFID applications as a type of application at the enterprise level, communicate with the middleware through the router with firewall function that will hide the RFID network for security reasons. Such a design gives to the RFID network more scalability and elasticity in the network administration.

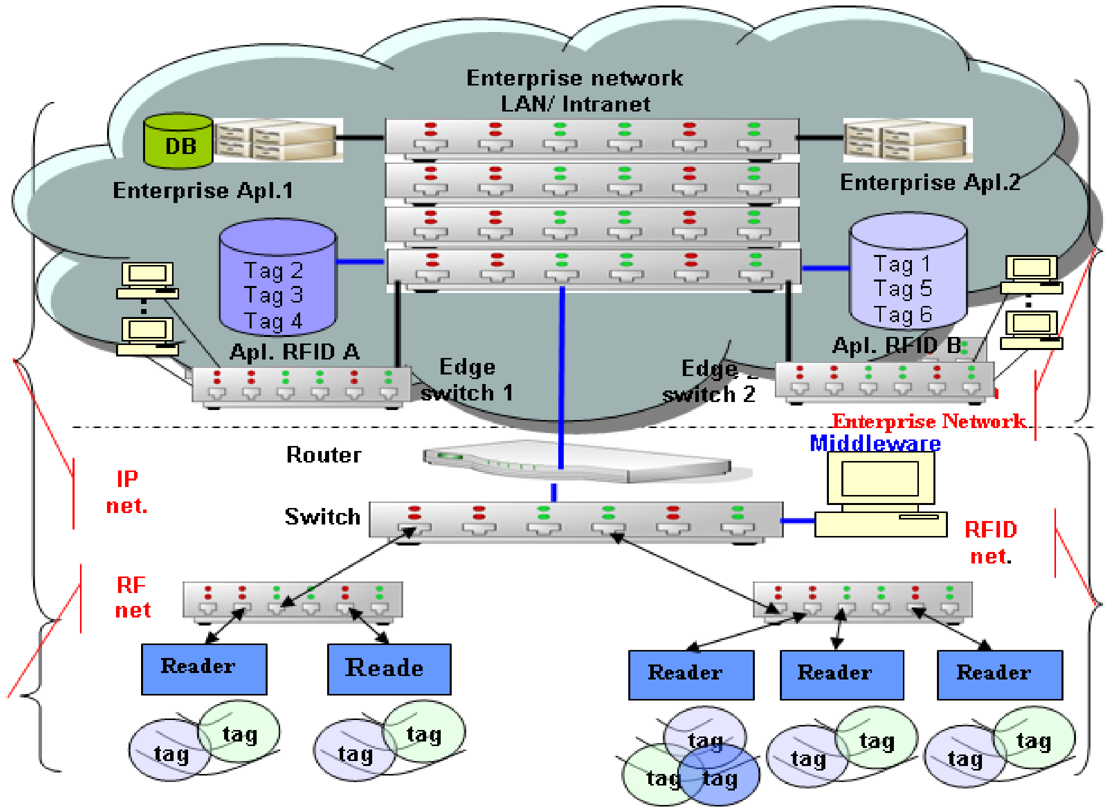

Fig. 5. Dedicated network

The architecture of the proposed system

The Hardware architecture . An original architecture for the management of an infrastructure, provided with high number of RFID labels, is proposed in this section.

The proposed architecture is from the category of the dedicated architectures because these architectures deal better with intense network traffic specific to the infrastructures with a very large number of RFID labels. The presence of a router with firewall type facilities, isolates the network from the point of view of the data security and gains in this way, on one side, band width that otherwise it would have been busy with different passwords, authentications and other security information and determination time that will be consumed with different methods of encrypting/decrypting, keys generation, etc. The profound distribution of the computation power and of the local databases is another important aspect of the new architecture. The embedded type systems and the working qualities in real time of the WINDOWS CE operating system were the basic attributes that stood at the base of this decision.

We make the observation that the new variants of Windows CE also implement the DCOM middleware from Microsoft, which allows the using of the OPC data servers, alarms and historic events on these systems, a fact that will assure a middleware for the RFID application.

From the analysis of an important number of embedded systems with Windows CE, the best found performance/ cost report was given by the eBox 2300 systems. Thanks to the VGA video output these can also implement local client applications of HMI type (Human Machine Interface), for example for local configurations or local read-out of tags at the level of the gates attached to the dock in warehouses.

In the case of very complex applications, an intermediary level can be added, represented by PCs or working stations, of great computation power and of huge stocking capacity in order to implement servers connected as clients to the servers from the first level that runs on the eBoxes (Fig. 6).

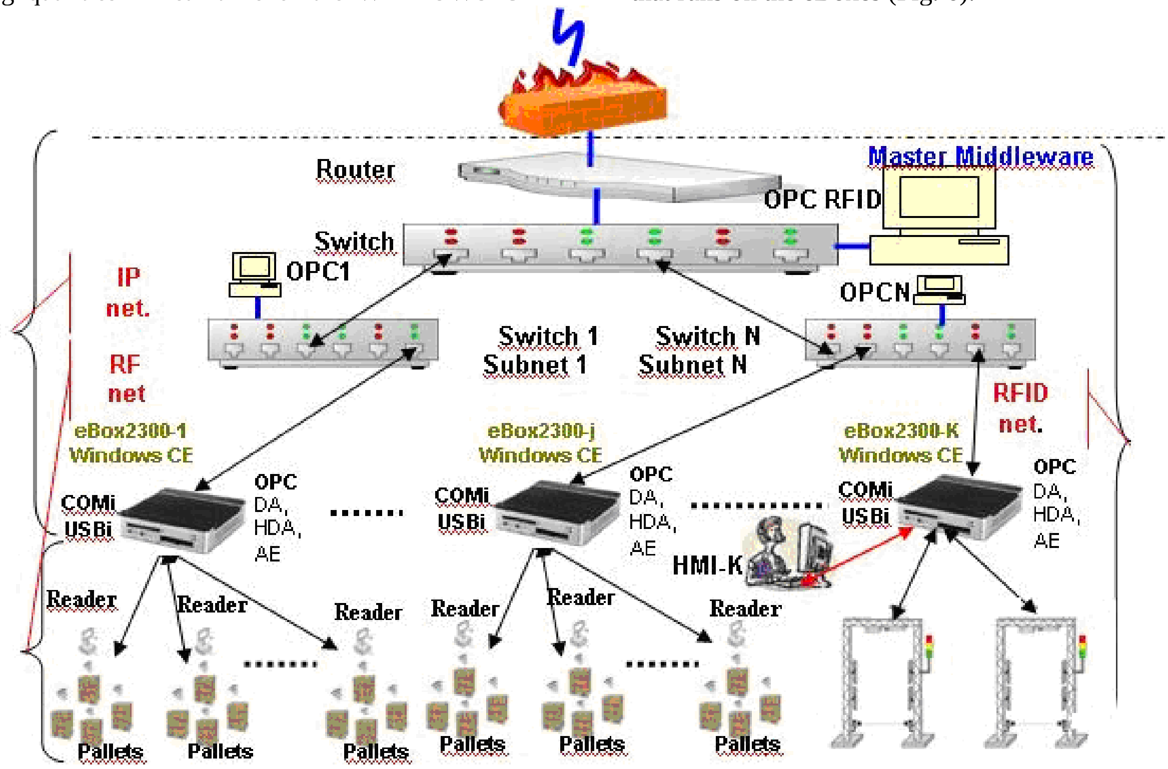

Fig. 6. The hardware architecture of the system proposed for the management of an infrastructure with a very large number of RFID labels

The Software architecture. The OPC servers allow the connection of each server to any client. More clients can be connected to the same server. A client can connect himself to more servers. A server can be the client of another server or the servers can connect themselves directly among themselves. More clients can create groups at the servers' level. It is obtained a special versatility for the application configuration.

There can also be created clients at the level of eBoxes with the purpose of configuration and local tracking, for example when forming the boxes, paddles or the loading/unloading docks. The proposed architecture of the OPC servers and also the connection with the superior levels is presented in (Fig. 7).The DCOM middleware has problems with the firewall and it cannot pass it. As a consequence, the server on which it is the so called MASTER Middleware must implement the OPC DA XML data server, described in the OPC specifications. Using the WEB services and SOAP, from here there can be implemented other levels of security. If the servers from other levels are the clients of other servers, the servers from the last level are the clients of the readers. The diversity and complexity of the readers must be hidden form these servers. As a consequence, they will implement a level of software often called (especially in the operating systems) HAL (Hardware Abstraction Level), meaning an abstracting level of the hardware.

The HAL architecture includes:

- An interface, with very well defined methods, that hides the particularities of the readers from the point of view of the OPC servers.
- An interface that standardizes the access to the drivers supplied by the readers' producers. Adding a new driver will only need the writing of a wrapper for the adaptation to the methods from the standard interface.
- A hierarchically organized tags dictionary that will be a cache memory for the server and at the same time a virtual memory for the tags.
- The structure of the tags dictionary is defined for each reader and XML tag folders or EDS (Electronic Data Sheet).
- Software that allows the local administration of the tags for the initial tests or for maintenance.
- A software, most of the times supplied by the reader producer in order to configure and maintain the reader.
- The drivers supplied by the reader producer.

The filtering, aggregation, and grouping operations can be carried out for the first level of OPC servers at the HAL sublevel and for others, at the level of the OPC clients.

The OPC clients can implement the producer/ consumer model of communication, by subscribing to the OPC, DA, XML or AE servers.

These servers can produce events when it takes place an RFID transaction, meaning a reading or writing from/in tag.

The event easily spreads from bottom to top through the OPC client/server hierarchy.

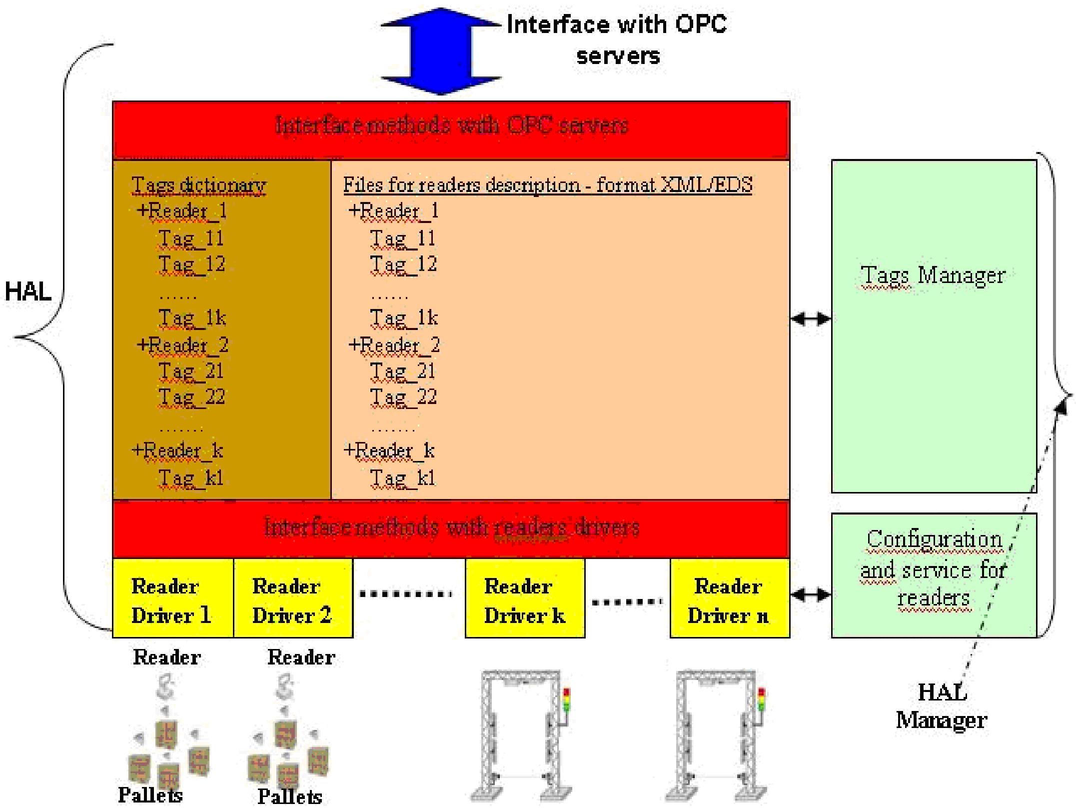

Fig. 7. The architecture proposed for the HAL level at the OPC servers connected directly to the reader

In order to design a cheap and safe RFID network, it is necessary to make a quantitative analysis of the band width necessary for the RFID traffic.

The EPC [2, 3, 4] is a standardization of the identification number of the objects for the EPCglobal networks.

The EPCglobal network offers a flexible frame for the EPC data structures that support numerous numbering schemes (such as GTIN, SSCC, GLN, GRAI, GIAI, GID, EAN.UCC, VIN, etc.).

Conclusions

The way in which it is organized the network that supports a chain of RFID applications has a very important role in their good functioning, and also of the rest of the applications from the enterprise. It is important to use a design on more levels that can offer a correct and fair division of the resources, aspect that will allow a data traffic at the highest parameters. At the same time with the growth of the application complexity that uses RFID, this one becomes oriented on the network:

- Design of the RFID network plays an important role in the performances of an RFID application.
- The method used is important for the readers assigning and grouping;
- For a correct design, an analysis on three levels has to be carried out;
- The middleware design can also be an important factor for a successful RFID application.

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Received 2010 02 15

A. M. Gaitan, V. Popa, V. G. Gaitan, F. A. Hrebenciuc. Approach on Applications of Random High Data Flows Concerning the Architecture of Computer Networks // Electronics and Electrical Engineering. – Kaunas: Technologija, 2010. – No. 7(103). – P. 61–66.

The Radio Frequency Identification (RFID) technology has reached our lives during the last years, by means of providing new alternatives as comparing to other identification methods, such as bar codes. In order to transmit the information stored on tags, the RFID technology uses wireless communication. It also creates flexible and scalable identification systems. The RFID technology has started to be used to various fields, such as supply chain management, track and trace of animals and many other applications, in a contactless manner of tracking the entities. This paper proposes a revolutionary identification system. By the help of connecting the RFID devices within high complex networks, this system will offer flexibility and scalability as concerns the management of random high data flows. Ill. 7, bibl. 6 (in English; abstracts in English, Russian and Lithuanian).

А. М. Гайтан, В. Попа, В. Г. Гайтан, Ф. А. Хребенциуц. Подходы к приложениям с большими потоками случайных данных, посвященный архитектуре компьютерной сети // Электроника и электротехника. – Каунас: Технология, 2010. – № 7(103). – С. 61–66.

Технология радиочастотной идентификации (RFID) начала войти в нашу жизнь в последние годы, засчет предоставления новых альтернатив, в отличие от других методов идентификации, таких как штрих-кодов. Для передачи информации, которая хранится в память, RFID технология использует беспроводную связь. Она создает гибкие и масштабируемые системы идентификации. RFID технологии стали постепенно использоваться в различных областях, таких как управление цепочками поставок, обнаружение и отслеживание животных, и многие другие приложения без необходимости линии для обнаружения. В этом документе предлагается революционная система идентификации. При подключении двух RFID устройств в сети высокой сложности, предлагаемая система позволит обеспечить гибкость и масштабируемость, удельная управлению с большими потоками случайных данных. Ил. 7, библ. 6 (на английском языке; рефераты на английском, русском и литовском яз.).

A. M. Gaitan, V. Popa, V. G. Gaitan, F. A. Hrebenciuc. Atsitiktinių didelių duomenų srautų kompiuterių tinkluose architektūros tyrimas // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2010. – Nr. 7(103). – P. 61–66.

Vartotojams identifikuoti vis plačiau taikoma RFID technologija. Svarbi koduota informacija taikant RFID technologiją, perduodama bevieliu ryšiu. Taip sukuriama lanksti sistema. RFID sistema gali būti taikoma įvairioms grandinėms valdyti, stebėti ir sekti gyvūnams bei daugelyje kitų sričių. Aprašomas siūlomas naujas identifikacijos metodas paremtas atsitiktinių didelių duomenų srautų valdymu. Il. 7, bibl. 6 (anglų kalba; santraukos anglų, rusų ir lietuvių k.).

DOI: 10.5755/j02.eie.9277