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ARCHITECTURE OF EXTRANET SYSTEMS FOR SUPPORT TO ENTERPRISE ELECTRONIC BUSINESS

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***Abstract**: In order to support electronic business (e-business) activities, an increasing number of enterprises develop computer networks that are based on web standards and connected to internet. Usually, first step is building internal computer networks based on web standards, such as intranets that support internal business functions of enterprises (sale and marketing, accounting and finance, procurement and manufacturing etc.). The next step is connecting an enterprise intranet with information systems of its business partners (suppliers, buyers etc.) in order to build extranet supporting B2B relations of the enterprise with the partners. Therefore extranet systems is based on internet technology for support to business-to-business (B2B) electronic commerce of enterprise. The paper is just dedicated to extranet systems, particularly to technological alternatives considering their architectures that enterprises can choose.*

***Keywords:** E-business, intranet, architecture of extranets, B2B electronic commerce*

1. Introduction

In order to support business processes, an increasing number of organizations developed local area networks (LANs) and wide area networks (WANs) and made interconnections between the networks. These networks links the enterprise's organizational units and the enterprise with its business partners around the globe encompassing a range of hardware and software platforms, communication protocols, and network architectures. Global internetworking of enterprises is driven by several technology factors, such as expansion of public network infrastructure, development of web technologies, and evolution of database technology. (Levermore, Babin, Cheng 2010, 367-393)

Business-to-business electronic commerce (B2B e-commerce) refers to transactions between enterprises, taking place electronically through internet, intranet and extranet. Key factors influencing B2B e-commerce expansion are: possibility of secure communication

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through internet infrastructure, emergence of private and public B2B markets, requirement for collaboration between suppliers and buyers and technology improvement for internal and external organization integration. Considering technology improvement, main role plays B2B information systems supporting secure communication between companies and accomplishment of commerce transactions. (Ridings, Wasko 2010, 95-120)

A B2B system is an information and management system that goes beyond organizational boundaries and connects an organization via electronic links with its trading partners to share data, information, and business applications. Also the system provides electronic transactions including buying and selling goods and services, and facilitates communications and decision making for the purpose of increasing efficiency, effectiveness, competitiveness, and profitability for participating organizations. The electronic links are established by internet, extranets, intranets, electronic data interchange (EDI), workflow systems, mobile communication technologies, and the other information and communication technologies.

B2B systems support supply chain management, electronic commerce, mobile commerce, and collaborative commerce activities. Therefore, the systems provide the basic infrastructure to allow suppliers and buyers to interact in an on-line environment. The rapid proliferation of technologies for the systems implementation has caused confusion in understanding various types of these technologies. In that context, an extranet technology for support to B2B systems and e-commerce is explained in the paper. Main aim of the research is to analyse various alternatives considering architecture of extranet supporting B2B e-commerce. Therefore this paper is structured in six parts. After introductory remarks, concept and architecture of intranet is explained. In the third part of paper, definition and classification of extranet systems are given. The fourth part of paper is dedicated to analysis of three types of extranet architectures based on public networks, while the fifth part of paper explains extranet architecture based on virtual private networks. The final part of paper is dedicated to concluding remarks about extranet architectures. (Yoo, Choudhary, Mukhopadhyay 2011, 145-170)

2. Architecture of Intranet Systems

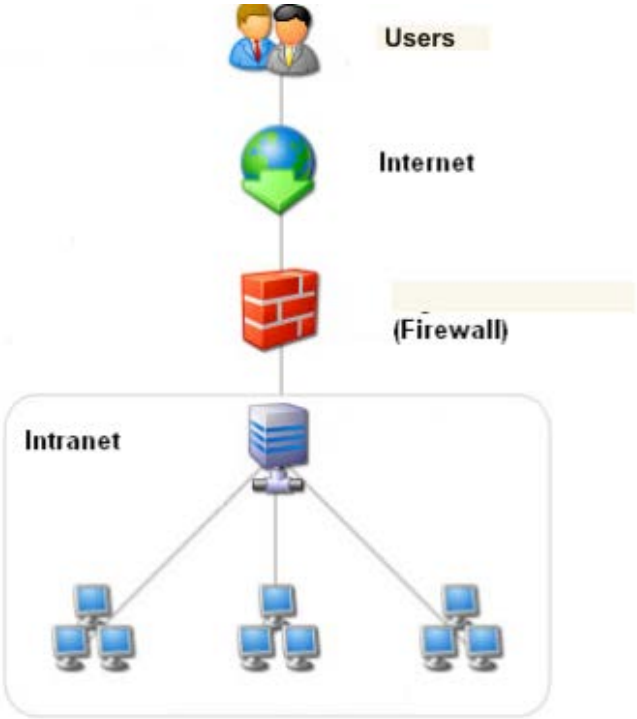
Although organizations have used their internal local area networks for management and coordination of business processes, intranet is becoming basic technology for internal electronic business processes. Organizations can use internet networking standards for developing private networks, called intranets which provide access to data of a whole organization. An intranet uses existing network infrastructure of an organization with internet connectivity standards and software developed for World Wide Web. Networked applications operating on various types of computers including mobile devices across the organization can be used on intranet. (Kim, Olfman 2010, 1-24)

Intranet technology provide rich set of tools for creation of collaboration environment where members of an organization can exchange ideas, share information and work together on projects and tasks regardless of physical location. Business or corporative intranet very rapidly has been becoming replacement for classical modes of communication and networking. The intranet improves internal communication in an organization, facilitates work of employees and makes workflows faster. (Duane, Finnegan 2003, 133–158)

Traditional systems for collaboration and document management are expensive and require licensed client-server networks, special client software and great data storage capacity. On the other hand, intranet technology provides inexpensive and universally available platforms for basic publishing of documents, so that many organizations use this solution. Employees of an organization can publish information by using web authoring tools and send it to intranet web server. In that way, information is becoming shareable resource that can be accessed through whole organization by standard web browser software. Web documents can be multimedia objects that combine text, graphics, audio and video, along with hyperlinks. When a document is sent on server, it can be indexed for fast access and connected to the other documents. (Guah 2006, 8-16)

On the other side, there is extranet (extended intranet) enabling access to authorized users outside the organization such as suppliers, buyers, business partners etc. Intranet applications and information can be accessed only by authorized users or employees inside the organization. Intranet can be connected to public internet, but it is not necessary. An architecture of intranet connected to internet environment is presented on figure 1. (Mahadevan, Kettinger 2011, 28-45)

Figure 1. Architecture of a typical intranet connected to internet



Source: (Turban et al. 2006)

Main problem related to intranet technology is security and protection of data and resources from unauthorized persons who want to access to intranet without permission. Presently, many security methods are used and well known are firewall and IP tunneling.

Firewall is hardware and software security system developed to limit communication between local intranet and internet. Purpose of firewall is prevention of malicious intrusions and stopping intranet users to access to forbidden and dangerous data on internet. It selectively passes packet data sent to some device inside intranet.

3. Definition and Classification of Extranet Systems

Extranets are viewed as business-to-business networks and can be defined in many different ways. For example, one definition (Archer, Gebauer 2002, 22-50) says that an extranet is an intranet that allows controlled access by authenticated outside parties. Typically an extranet will link the intranets of distributed organizations for the purpose of conducting business. This secure electronic consortium usually consists of an enterprise and its key trading partners, customers, dealers, distributors, supplies, and contractors.

In its basic form, an extranet is the interconnection of the two previously separate LANs or WANs with origins from different business entities. (Pavlou, El Sawy 2002, 1-21)

Third definition (Eom 2005, 123) says that an extranet enables integration of internal corporate networks with the internet creating a new network facility that connects many organizations with mature intranets.

In this paper, an extranet is described as a WAN based on web technology that links a enterprise's employees, suppliers, customers, and other business partners in a secure online environment supporting electronic business activities and transactions. An extranet is a computer network based on web standards that links information systems of several business partners. The extranet is an extended corporate intranet using the web technology for support to a numerous software applications in the areas of sales, marketing, finance, accounting, manufacturing, online publishing, procurement, inventory management, supply chain management, etc.

Secured extranets enable trading partners of an enterprise to gain controlled access to the enterprise's intranets. On that manner, all trading partners increase profitability and competitive advantage by managing key business processes through the network environment.

An extranet is developed if more than two enterprises connect their intranets to each other and create business-to-business network with purpose to improve coordination between these enterprises in many functional fields such as sales, marketing, manufacturing, human resources, finance, procurement etc. The trading partners participating in the business collaboration include enterprises working on a joint business project, distributors, contractors, suppliers of raw materials, vendors, dealers, consultants, etc. An extranet system allows trading partners, including customers, to gain limited access or provides a collaborative environment connecting trading partners to manage key business processes in the most timely and cost-effective manner.

Taking into account many criteria for categorization, extranet systems can be classified in various ways. According to number of participants and forms of participation in B2B e-commerce, extranet systems can be configured and categorized in following ways: one-to-one system (a typical buyer–seller system), one-to-many system (a marketing or purchasing system) and many-to-many system (electronic market system). (Hong 2005, 30-53)

The extranet systems can also be configured according to the type of dependence between the organizations participating in business and commerce transactions. Full interdependency requires a configuration in shape of star where data moves toward the central hub. The second type of extranet systems support sequential interdependency between organizations. In this configuration, nodes of the systems are organized in a straight line, where the output of one node becomes the input of the next. The third type of extranet systems is determined according to reciprocal interdependency between organizations and these systems are very complex. (O'Donnell, Glassberg 2005, 7-29)

Presented extranet system configurations focus on the physical interconnection of participating organizations, apropos data flows between them. However, the configuration of a B2B extranet can be viewed from a different perspective that reflects horizontal or vertical electronic links between organizations. According to the perspective the extranet system configuration can be either horizontal or vertical. The linkage between heterogeneous supply chains from different industries is vertical, whereas the linkage between organizations spanning a single industry is horizontal.

Therefore, type of extranet system configuration depends on purpose or strategy of electronic business. For example, extranet system configured horizontally supports organizations which are horizontally connected for cooperation between competitors. On the other hand, extranet system configured vertically supports organizations seek vertical interconnection with buyers and sellers or with firms that provide complementary products or resources.

In another classification of extranets (Eom 2005, 204) following terms are used: intronets and supranets. As we can see in table 1, main differences between these two types of extranets are related to sponsorship of extranet, nature of access to extranet, relationships between participating organizations, service offered by extranet, etc. Also well known examples of these types of extranets are presented in table 1.

Table 1. Classification of of extranets

Type	**Intronet**	**Supranet**
Sponsorship	Owner sponsored	Consortium sponsored
Gateway access	Proprietary network	Semi open network
Relationships	One-to-many	Many-to-many
Service offered	Information product	Communication/decision tools
Primary justification	Provide unique resources	Efficiency/timeliness
Primary beneficiary	Initiator with information	All consortium members
Long-term objective	Lock-in partner	Consortium competitiveness
Nature of application	Pull application	Push application
Example	Federal Express' Tracking Systems	Automotive Network eXchange (ANX)

Source: (Eom 2005, 204)

The well known example of supranet (Eom 2005, 204) is the Automotive Network Exchange (ANX) in field of auto industry. This extranet is made by three automakers (Chrysler, General Motors, and Ford) and it links the automakers with registered trading partners and sponsored trading partners. ANX has expanded into other areas such as healthcare, retail, and automotive sectors where provides security and connectivity solutions. The healthcare industry has joined and started to use the ANX because the auto industry spends great amount of money to provide health insurance for its employees. It was a logical step for the auto industry to bring insurance companies and hospitals onto the ANX network).

4. The Architecture of Extranet Based on Public Network

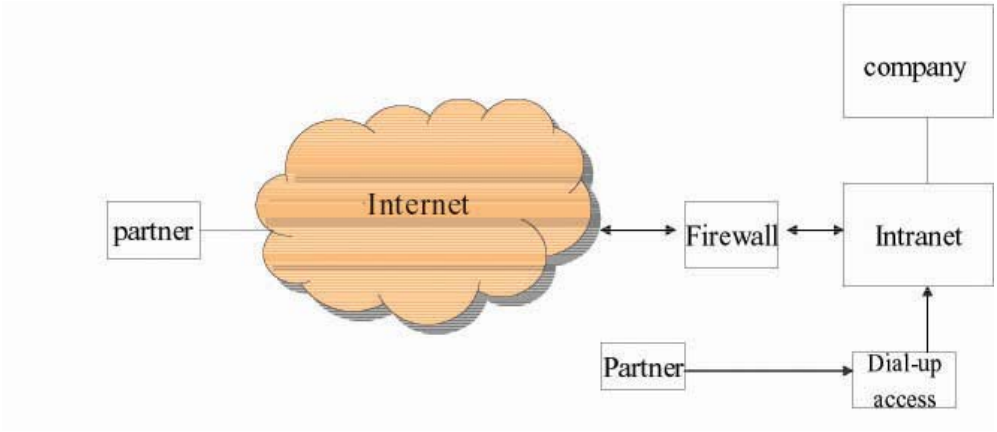
There are three different types of extranets: private network, public network, and virtual private network (VPN) extranets (O'Donnell, Glassberg 2005, 7-29). In private extranet a private, leased line is used for linking the intranets of several organizations. The main and significant advantage of this type of extranet is its high security level. However high cost of private phone lines is the most significant disadvantage of private extranet. Because of the high cost of private phone lines, public network extranets and VPN extranets are the most appropriate alternatives for many enterprises.

The all types of extranets as the business-to-business networks are built on the client/server architecture. Understanding the architecture of extranets requires explanation of basic concepts such as the technology of client/server systems. The client/server architecture of information systems consists of client devices, server computers, and computer networks. The client devices are personal computers (PC) and many other portable and mobile devices such as notebooks, tablets, smart phones etc. The users of these devices send requests for service via client software that passes them to the network software. The software sends the requests to the server and receives the answers to the requests from the server and passes the results back to the client software. The server can be any type of computer such as a microcomputer, a minicomputer or a mainframe computer. The server software contains operating systems, database management software and part of the network management software.

Public network extranets can be designed on different ways depending on used hardware, software and network technologies. As we can see on figures 1, 2 and 3 there are three types of architecture for extranet system considering the ways of using internet for connection of an enterprise intranet with its business partners. These architectures are: architecture of extranet based on secured intranet, architecture of extranet based on specialized application and architecture of extranet based on e-commerce model.

The architecture of extranet based on access through secured intranet (figure 2) enables business partners of some enterprise to access to internal network of the enterprise. In order to implement this network architecture, it is necessary to consider the network security issue and high level of trust in business partners is needed.

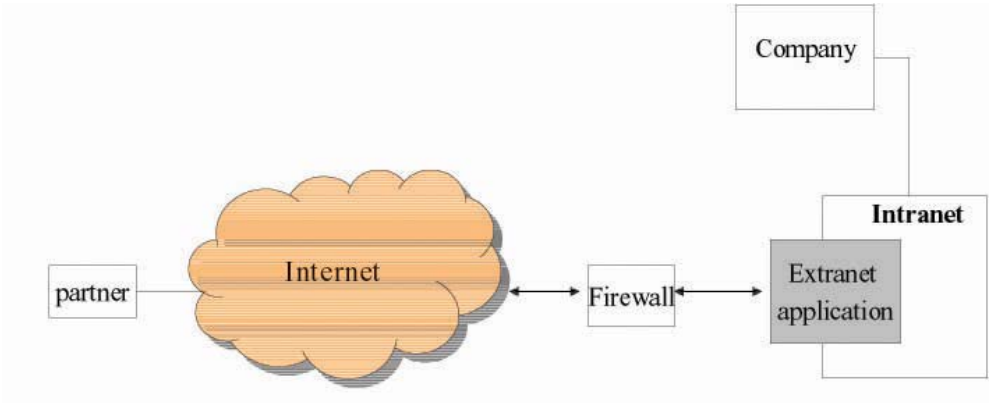
Figure 2. The architecture of extranet based on secured intranet



Source: (O'Donnell, Glassberg 2005, 7-29)

The architecture of extranet based on access through specialized application (figure 3) allows business partners of some company limited access to its internal network through extranet web site. Wide range of extranet applications such as commercial ones and developed for special purposes as well are accessible through extranet including order processing, data base access, customer support, e-mail and the other tools for communication.

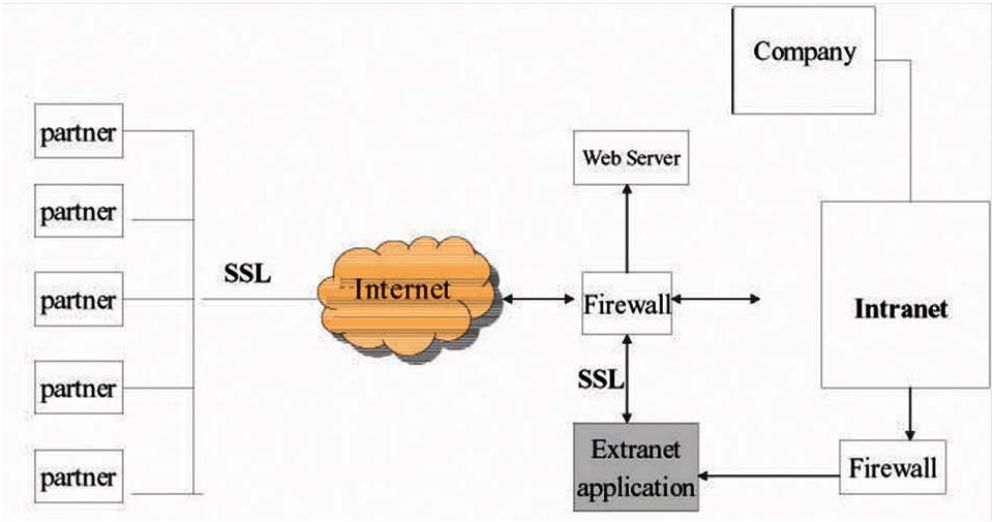
Figure 3. Architecture of extranet based on specialized application



Source: (O'Donnell, Glassberg 2005, 7-29)

The architecture of extranet based on e-commerce model (figure 4) is suitable for collaboration with great number of business partners where technics of providing data security and transaction processing are used. The technics are appropriate to e-commerce transactions between many partners.

Figure 4. E-commerce model of extranet system



Source: (Hong 2005, 30-53)

5. The Architecture of Extranet Based on Virtual Private Network

A VPN extranet is a type of business-to-business network that in comparison with a private extranet obtain connection between organizations with lower costs. The type of extranet also accomplishes security and confidentiality of information by encryption technics. By using the technics, data is protected and safe from being intercepted and accessed by unauthorized users. (Molly et al. 2011, 645-652)

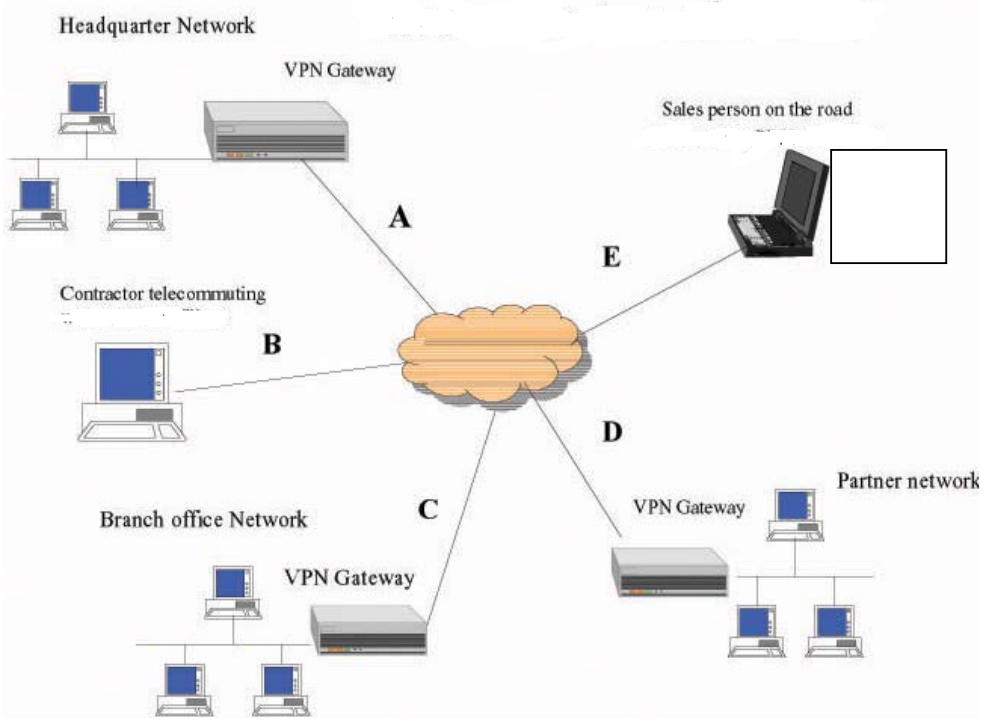
Virtual private network extranet simulates a private network where a set of nodes is configured on a public network such as internet. Connection between the nodes is on a short-term temporary basis among cooperating companies.

VPN utilizes an encrypted communication process that transfers data from one node to another node securely. The secured data transfers are assured by efficient encryption technology, and the data passes through open, unsecured, routed networks. Encryption and IP tunneling obtains secure point-to-point network connections across the public internet.

Some VPNs are set up with a network architecture similar to an extranet using a leased line. Many virtual private network extranets have a VPN gateway in front of the firewall. A gateway is a device that links two networks with different protocols. If two networks have incompatible protocols, a gateway converts the data from a sending network with its protocol to a format compatible with the protocol of a receiving network.

There are many IT firms that provide secure VPN solutions for corporate intranets, extranets, and internet remote access. Leading vendors of VPN products obtain different network configurations, architectures, and security for VPNs. A VPN can be built with or without the firewall. One of possible VPN solution for extranet system is illustrated in figure 5.

Figure 5. The architecture of a VPN extranet



Source: (Molly et al. 2011, 645-652)

The VPN extranet provides connection and communication with business partners (link AD), connection and communication with branch office (link AC) and secure remote LAN access through public internet. These network architecture allows telecommuters and mobile employees to communicate with a enterprise network over the internet. For example, a telecommuter dials into a service provider's point of presence, establishes a tunnel (link AB) to headquarter over internet, and make authentication to gain access to the enterprise network.

6. Conclusion

An extranet is a computer network based on web standards that links information systems of several business partners. The extranet is an extended corporate intranet supporting a numerous software applications in the areas of sales, marketing, finance, accounting, manufacturing, procurement, inventory management, supply chain management, etc. There are three different types of extranets: private network, public network, and virtual private network (VPN) extranets. Because of the high cost of private phone lines, public network extranets and VPN extranets are the most appropriate alternatives for many enterprises. Extranet systems can be designed on different ways depending on used hardware, software and network technologies. As we can see in this research the architectures that one enterprise can choose for its extranet are: architecture of

extranet based on secured intranet, architecture of extranet based on specialized application and architecture of extranet based on e-commerce model. The secured intranet access architecture allows the business partner to log directly onto a enterprise's intranet for access. Network security must be on the highest level if the enterprise wants to implement this network architecture. Also, high level of trust in the partners must be built. Architecture of extranet based on specialized application allows the partners to gain limited access to the intranet of enterprise through the extranet web site. Numerous extranet applications, both packaged and custom built, is available over an extranet, including order processing, procurement, customer service and support, groupware and workflow, e-mail, and other communication tools. The electronic commerce model is the best appropriate to deal with a large number of partners using e-commerce security and transaction-processing techniques.

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ARHITEKTURA EKSTRANET SISTEMA ZA PODRŠKU ELEKTRONSKOM POSLOVANJU PREDUZEĆA

Rezime: Sve veći broj preduzeća razvija računarske mreže koje su zasnovane na veb standardima i povezane sa internetom radi podrške aktivnostima elektronskog poslovanja. Obično je prvi korak izgradnja internih računarskih mreža baziranih na veb standardima kao što su intranet mreže koje podržavaju interne poslovne funkcije preduzeća (prodaja i marketing, računovodstvo i finansije, nabavka i proizvodnja itd.). Sledeći korak je povezivanje intranet mreže preduzeća sa informacionim sistemima njegovih poslovnih partnera (dobavljača, kupaca itd.) da bi se izgradio ekstranet sistem koji podržava odnose preduzeća sa svojim partnerima. Prema tome, ekstranet sistem je zasnovan na internet tehnologiji i pruža podršku B2B (business-to-business) elektronskom poslovanju preduzeća. Ovaj rad je upravo posvećen ekstranet sistemima, pre svega tehnološkim alternativama kad su u pitanju arhitekture ovih sistema koje preduzeće može da izabere.

Ključne reči: Elektronsko poslovanje, intranet, arhitektura ekstranet sistema, B2B elektronska trgovina