Service-Oriented Architecture Concept for Intelligence Information System Development

Jugoslav Achkoski [1], Vladimir Trajkovik [2], Danco Davcev [3]
[1] Military Academy „General Mihailo Apostolski“,
Skopje, Macedonia
[2, 3] Faculty of Electrical Engineering and Information Technologies,
Skopje, Macedonia
jugoslav_ackoski@yahoo.com, trvlado@feit.ukim.edu.mk, etfdav@feit.ukim.edu.mk

***Abstract*—This paper presents an idea for Service Oriented Architecture (SOA) approach in prototype of Intelligence Information System (IIS). IIS prototype, based on SOA, could offer better coordination among institutions involved in intelligence thus providing increase of intelligence effectiveness. This approach can serve as a foundation for the establishment of the Integrated Intelligence System, which is based on services as software components. In this paper, we propose five postulates that can serve as checklist for integration of SOA in IIS.**

Keywords- concept; SOA; intelligence information systems.

I. INTRODUCTION

Intelligence, as a public service, has a great significance for a country [1]. Frequently used information systems, which support intelligence activities, have high influence in the decision making process. Modern information technology considerably contributes to the processes' (activities) improvement by supporting intelligence cycles (planning, collecting data, analyzing data and dissemination). Although, there is constant improvement in the field of information technology, significant advancement in the quality of work in the field of intelligence has not taken place in the last ten years [2].

SOA offers possibilities of making new opportunities for increasing efficiency of IIS. These opportunities could be found in a form of expanded solutions for designing intelligence and information systems [3], [4], and [5]. SOA approach in information systems is a logical solution, not only for temporary and short term exploitation, but also as a perspective solution for general strategy in companies and governmental institutions [6].

Every modern intelligence system is based on some type of information system [7]. Usage of contemporary technology, especially Information Communication Technology (ICT), is giving more efficient execution of all phases of the intelligence service.

This article is divided in several sections. Section III describes the model of Intelligence Information System. Section IV demonstrates functions of the distributed Intelligence Information System. Finally, in the Section V, expected achievements enabled by deploying SOA concept for developing intelligence information system are explained.

II. RELATED WORK

There are numerous IT projects which dedicated their work on designing information systems for military purposes. This paper will give survey on recent projects explaining Macedonian approach related to this problem. In addition, the development of these solutions in SOA based purposes will be discussed.

Within the Macedonian e-Gov project (2004-2011) [8], different services have been developed within different information systems. These solutions have increased efficiency and transparency in specific public sectors, but problems appear when the interoperability of such services has to be established.

The following information systems: Information System Documentum; Information System eParliament; Information Border Management System (IBMS) and Interoperability System, can be considered as related to IIS.

All these Information Systems are SOA-based. As a result, information integration between IIS and selected Information Systems should be simple.

The goal of the **Information System Documentum** is to manage and store documents with different functions in a proper and convenient way. This system's consumers are:the government of the Republic of Macedonia; The Ministries; The General Secretariat; The Parliament; The Justice Secretariat; The Euro-Atlantic Integration Secretariat; The Ohrid Framework Agreement Secretariat; The Administration service.

Information System eParliament solution refers to the interior judicial processes. It is responsible for the daily coordination in decisions making which is derived from the judicial processes in Parliament. At the same time, this Information System integrates the Parliament and different institutions that are involved in the decision making.

The **Integrated Border Management System – IBMS** provides a platform for Information sharing, controlling and monitoring the state border. This system should provide coordinated information sharing between the state authorities that are responsible for the border management and security.

 ISBN: 978-1-61208-152-6

Important information for the IIS contained in the IBMS is:State entry or exit of people, goods and vehicles; Detecting organized crime; Monitoring potential smuggling across the borders; Checking and monitoring the transfer of materials and infectious diseases, etc.

Data sharing between these systems has to be fast and efficient. The **Interoperability System should** help avoiding data duplicates and reduce errors caused by different systems' inconsistencies.

Technologically advanced countries use SOA based information systems in military domain. The main reason for this is increased level of security. Medlow [9] explains the interest about deploying SOA in ICT systems which are part of the military and civilian domains. SOA implementation in military domains of the systems used by land forces, peacekeeping or other kind of operations as a part of multinational contingents (led by NATO, UN or EU) is usually a big challenge.

Anschuetz [10] shows that the SOA implementation in the systems can be used as a possible solution for reorganization and optimization of the business processes which affords platform's independent application usage and implementation and its integration into organizational infrastructure. The usage of SOA offers benefits in terms of service interaction with external clients. As an example, the usage of SOA in a chain of supplying partners and other clients can be indicated. New generations of applications joined with integration processes of automation, business analysis and information integration allow the operators to extend the SOA benefits. In addition, recent researches related to this issue show that various information systems are created with emphasis on the evolution of business processes and information toward SOA that can be used to design suitable solutions for unsafe missions and network centric operations.

Bruce [11] explains that authorities responsible for building defense systems recognize the neediness of creating a full service oriented platform which will be used for operational military applications and services. As examples, the concepts for Network Core Services (Department of Defense (DoD)) and Network enabled core services (NATO) can be mentioned. In the same framework, the Australian Department of Defence suggest similar architecture (Single Information Environment Architectural Intent 2010). The IBM SOA Foundation (Triton Core) integrates different software products, best practice and consists of pattern which provides the elements required to implement and integrate SOA [12], [13] in organizational infrastructure [14], without financial implication caused by the coding and modifying processes.

Triton Core System consists of Enterprise Service Bus (ESB) and core for services [15], which is connecting the applications and resources of the other services in order to establish "Net-Centric" solution. Generally, the newly created Triton Core System has decreased the costs of Australian Defense Department and Australian defense industry. This solution raises the efficiency toward Single Information Environment architecture.

Mechling in [16] is describing the usage of the SOA by the Finnish Defense Forces (FDF). FDF are requested to increase their membership in the coalition with various specifics of military and civilian organization. Critical scenario which should be expected during their activities is coordination between Air Force, Navy, Police, Hospitals, and other military and civil groups. Technological incompatibility can cause coordination complications in the moment when groups use different technological architectures and communication protocols. FDF C4 (command, control, communications and computing) systems were created to support military domain, but these systems are „stove-piped" for supporting land forces, Navy and Air Force operations in the same time. In order to avoid this potential obstacle, the Program FINED was developed. The main reason for developing this program is implementation of the SOA for increased efficiency and creating reusable technology.

Radcliffe [17] is explaining that command and control (C2) information systems exploited in headquarters and in an operational level are using SOA. In order to increase capability of information sharing in military environment, the SOA approach allows flexible increase of the capability to share information through integration and systems interoperability based on commercial-off-the shelf (COTS) technology and standards.

This paper will give contribution in usage of SOA for developing prototype of IIS, which fulfills the requirements for intelligence disciplines as an Imagery Intelligence (IMINT), Signals Intelligence (SIGINT), Measurement and Signature Intelligence (MASINT), Electronic Intelligence (ELINT), Open-source Intelligence (OSINT), Human Intelligence (HUMINT) that answer to the requirements for intelligence cycle on which contemporary model of the Macedonian intelligence should be based.

 ISBN: 978-1-61208-152-6

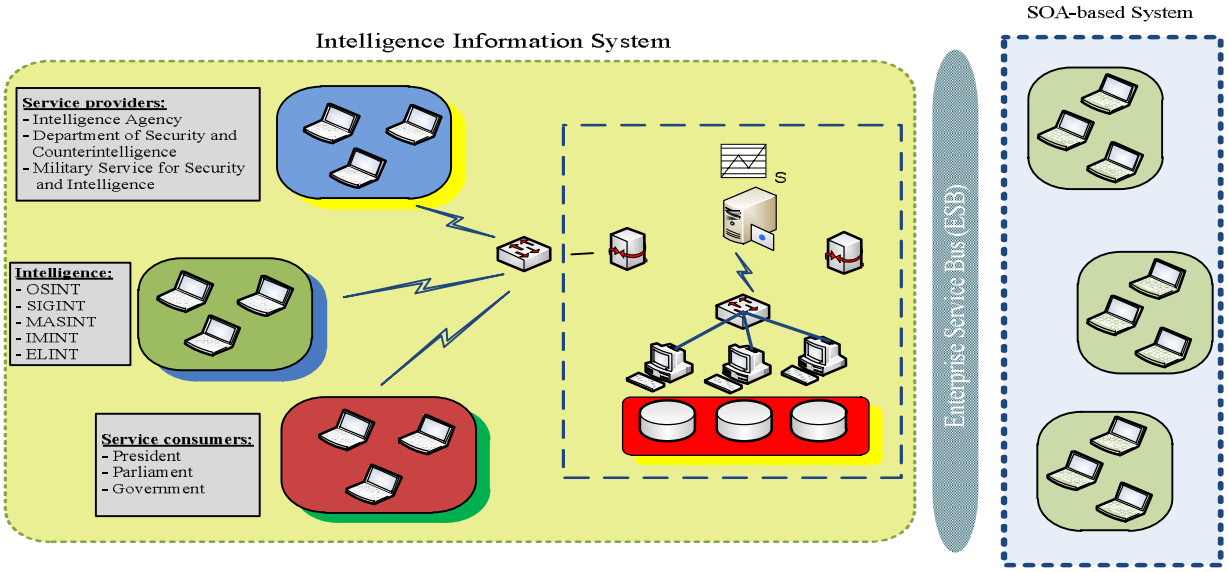

Figure 1. Model of SOA-based Intelligence Information System

III. IIS MODEL

The Model of SOA-based Intelligence Information System shown on Figure 1 should completely fulfill the intelligence role and assignments and its connection to the information systems of similar institutions.

Presented IIS model shows three types of users: service providers, service consumers and Intelligence. Service consumers are institutions (Crisis Management Center, MOI, Intelligence Agency or others) that have the need to get information from IIS or to give information as a notification.

According to security procedures service providers provide the consumers with required information.

Intelligence is based on several intelligence disciplines: IMINT, SIGINT, MASINT, OSINT, etc. In order to fulfill the requirements of intelligence disciplines, several tasks should be completed; gathering information (assessments, analyses, generating reports, etc.), then its verification and notification (e.g., political and security situation in foreign countries related to security of investments), etc.

All services are getting information from appropriate service providers through Information systems of the government institutions or the agencies which are included in Intelligence cycle. In addition, it is possible other Information systems to be service provider for inter-institutional governance. Service providers among system support for workflow processes define web services which are exploited from the users with appropriate security level to service registers.

Our methodology of developing SOA-based Intelligence Information System consists of several postulates. Experiences from recent researches which refers to SOA show that agencies, departments, institutions and other stakeholders can push and pull data on a standardized and flexible manner through communication interfaces using XML schema and web services.

The first postulate defines data exchanging methodology within SOA. It should be compatible with publicly described solutions for information systems which are supporting intelligence functions.

The second postulate focuses on the usage of SOA for information systems design, with the intention of finding relevance for developing Intelligence IIS. SOA should be treated as a standard for reusing information that is loosely coupled. This postulate enables independency of the implementation platform provided that hardware and software replacement without negative implications toward other components of a system as far as communication interface of service is not changed.

The third postulate describes functionalities for system end users of the IIS. According to user's division, user's functionalities of IIS can be explored from different aspects. Intelligence, as a system end user of IIS, is based on intelligence disciplines that are divided on sub-intelligence disciplines. These disciplines have different implementation as services within different government institutions, departments or military force units as a component of national security systems (Intelligence Agency, Ministry of Interior (MOI), Ministry of Defense (MOD), Ministry for Foreign Affairs and others). Intelligence services can be divided in three categories: data entering, data verification and notification (assessment of services for certain country could vary depending of security policies of the country).

 ISBN: 978-1-61208-152-6

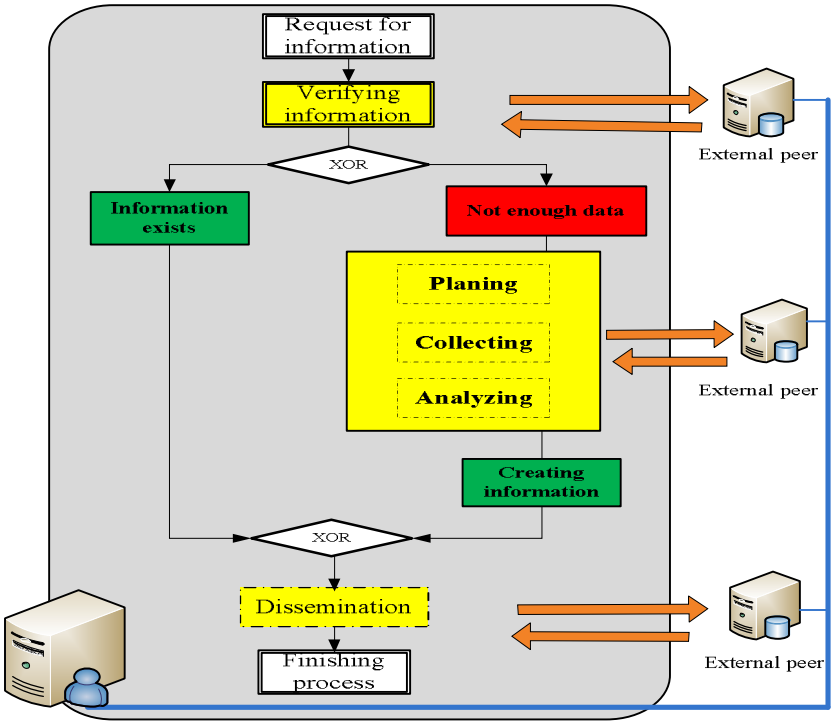

Figure 2. Example process of IIS [18]

The fourth postulate provides means that enable the future development of the IIS. In order to meet its future requirements, information infrastructure should be adoptable and flexible, and thus it needs to fully support information sharing process. The information sharing should be the basis for system development. It can help the authorities in decision making process, enabling them to plan actions in a convenient way. In order to accomplish this, one should define the model of information system integration which is undependable of the unique technologies and integration platforms.

The fifth postulate suggests that security standards needed to be implemented in order to achieve certain level of security. SOA-based information systems must be protected from intrusions and other vulnerabilities. Term security in these circumstances indicates establishing mechanisms which have system protection functions. In the phase of system designing, possible attacks and threats should be explored and according to them system protection mechanism should be designed. Usual vulnerabilities related to information system security refer to message interception, changing the context of message, denial of service, access denied, etc.

These five postulates can be used as the basis for SOA system deployment on the top of appropriate IT infrastructure. Such IIS achieves minimum requirements for designing services that are needed to be implemented in intelligence process with internal functions which can be processed from external IIS peer [18].

IV. EXAMPLE PROCESS WITH INTELLIGENCE INFORMATION SYSTEM

In this chapter we will demonstrate the function of distributed IIS that follows suggested postulates. Figure 2 presents typical example process of request for intelligence information that should be established in intelligence sectors departments or agencies. This process has three functions which should be performed from external nodes in the network [18].

Function 1: As the client issues requests for certain information, this request ought to be accepted without exception if there is information available. In the case when there is no available information the request should be treated as request for creation of such information by certain agency that will be delegated to be information provider. The necessary inputs of data that have to be sent to external peer include the form request for information. According to this, this function executes computation steps in order to check whether information can be sent directly to the client who requested the information or additional data would be needed for creation of the information related to request. At the end, external functions send information messages back for local process.

Function 2: If there is not sufficient data for creation of intelligence information, a second function is started and its basic role is to decide which data is necessary or critical for creating intelligence information. Input values for this function is data from received request for

 ISBN: 978-1-61208-152-6

intelligence information, followed by the information of intelligence disciplines which should be used for collecting information about which department, agency or sector is responsible for every part of process. In that manner this function is starting information planning, then collection and later analyses of collected information. In order to simplify this process, one can suppose that an agency which is responsible for producing intelligence information should deliver information in time. The value of the function in this case is a complex object and it consists of data related to intelligence information and expired date for their usage.

Function 3: When there is enough data related to Intelligence in a database of stakeholders, information creation can be started. The third function creates data records to whom intelligence information are sent explaining how long the information is valuable, etc. All data is wrapped as a complex object and it is sent to node of IIS which is the requestor for intelligence information.

Local peer in this example wraps requested data as objects in which the remote function calls are. Local database of intelligence stakeholder receives complex return objects and record them as a second master data.

This example shows how single functions of a process for requesting intelligence information is done on external IIS peers and how a local IIS system benefits from using external business logic, e.g., by using optimization functions.

V. EXPECTED ACHIEVMENTS

Expected achievements that refer to SOA concept for developing intelligence information system are the following [19]:

1. Proposed model of IIS fulfills requirements for intelligence disciplines, and answers to requirements for intelligence cycle on which the contemporary model of Macedonian intelligence should be based.
2. Proposed approach for application integration which shows how selected information systems from Macedonian e-Gov project should exchange information.
3. Proposed approach describes which describes how to avoid technology dependence for the creation of information systems completely based on SOA.
4. Proposed approach which suggests that SOA security standards should be used in order to achieve appropriate level of access control and authentication.
5. Proposed model which integrates protocol for the information's distributed searching (online or near-line) depending on situation's importance in order to make the senior decision-makers an appropriate decisions.

CONCLUSION

Intelligence Information System Model gives contribution in Homeland Security and Civil Military Emerging Risks assessment through the possibility of providing information in the appropriate way by implementing pushing and pulling mechanisms into information systems, then by selection of data and creation of information from raw data, that can be used in creating intelligence products and dissemination reports to the authorities. In our case, this is done by IIS based on SOA which follows the five postulates that enables flexible and secure design of IIS.

REFERENCES

[1] Air Combat Command, - Version 2, CONOPS UAV, Section 6 - Communication Integration and Interoperability, http://www.fas.org/irp/doddir/usaf, US Air Force; 3 Dec 1996

[2] P. Baglietto , M. Maresca, et al.. "Stepwise deployment methodology of a service oriented architecture for business communities." Journal: Information and Software Technology 47(6), pp. 427-436. 2005

[3] R. R Burk.. "Enabling Citizen-Centered Electronic Government" 2005-2006 Action Plan. USA. Office of EGovernment and Information Technology. 2005

[4] M. H. Burstein "Dynamic Invocation of Semantic Web Services That Use Unfamiliar Ontologies." IEEE INTELLIGENT SYSTEMS (JULY/AUGUST). (vol. 19 no. 4) pp. 67-73. 2004

[5] M. Castellano "An e-Government Cooperative Framework for Government Agencies". 38th Hawaii International Conference on System Sciences. Hawaii, IEEE. pp. 121c-121c. 2005

[6] T. Erl, Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services, Published by Prentice Hall. 2004

[7] "Exploring New Command and Control Concepts and Capabilities Final Report", NATO SAS-050, January 2006

[8] e-Gov Project - Paves the way for modern Macedonia, http://www.egov.org.mk, consulted of January 2011

[9] D. MedlowSaab Systems, "Extending Service Orientated Architectures to the Deployed Land Environment", Military Communications and Information Systems Conference (MilCis) Australia, http://www.milcis.com.au/, 2009

[10] B. Anschuetz, *Director*, SOA WW Business Development & Client Engagement Management, IBM Software Group, "Service Benefits – Life Beyond SOA", Military Communications and Information Systems Conference(MilCis) Australia, http://www.milcis.com.au/, 2009

[11] M. Bruce and A. Heys, IBM, "Introducing the Triton SOA Foundation for Military Systems Integrators and Developers", Military Communications and Information Systems Conference(MilCis) Australia, http://www.milcis.com.au/, 2010

[12] M.P. Papazoglou. "Extending the Service Oriented Architecture". Business Integration Journal, pp. 18-21. February 2005

[13] S. Kumar and R. Rana. "Service on demand portals: A primer on federated portals". Web Logic Developers Journal:WLDJ, pp. 22-24. September/October 2004

 ISBN: 978-1-61208-152-6

[14] D. Krafzig, K. Banke, and D. Slama. “Enterprise SOA:Service Oriented Architecture Best Practices”. Prentice Hall, 2005

[15] A. Anagol-Subbaro. “J2EE Web Services on BEA WebLogic.” Prentice Hall, Upper Saddle River, Newy Jersey, 2005

[16] J. Mechling, Lecturer in Public Policy,”Finnish Defense Forces – Network-Centric Operations”, John F. Kennedy School of Governance, Harvard University, 2007

[17] S. Radcliffe, L. Trotman, and H. Duncan “Supporting Capability Evolution Using a Service Oriented Architecture Approach in a Military Command and Control Information System”,
http://nectise.com/pdfs/2_Stewart%20Radcliffe.pdf

[18] N. Brehm , J.M. Gómez,: Secure Web Service-based resource sharing in ERP networks. International Journal on Information Privacy and Security (JIPS) 1 pp. 29-48, 2005

[19] J. Achkoski, V. Trajkovik , and M. Dojcinovski “SOA Approach in Prototype of Intelligence Information System” ICT Innovations 2010, Web Proceedings, ISSN 1857-7288 pp. 149-160. 2010

 ISBN: 978-1-61208-152-6