THE USAGE OF INFORMATION TECHNOLOGY IN THE IMPLEMENTATION OF THE BOLOGNA PRINCIPLE OF THE STUDENT MOBILITY

Gordana Radić
Paneuropean University APEIRON
gordana.r@apeiron-uni.eu

Contribution of state of art
DOI: **10.7251/JIT1101024R** UDC **37:331.55(4)**

Summary: In this paper, student mobility is observed as one of the steps in realization of the Digital Agenda of the European Union. Student mobility, as one of the main principles of the Bologna process, is the means of effectiveness increase and quality of the educational system in European Higher Education Area, EHEA, because it enables better exchange and flow of knowledge and ideas, as well as the adoption of good practices. Management Identity (IdM) system of the Higher Educational institution is a system which supports student mobility by using personal information when accessing data. The basic identity document in this system is a student smart card with the owner's fingerprint. This biometrical data insures high level of data and identity protection. This paper proposes informational system which, in itself, contains standards for student mobility support as one of the modules of the IdM system of the Higher Educational institution.

Keywords: Identity management, student mobility, smart card, biometrics

INTRODUCTION

Our society is, nowadays, also called informational society, in order to emphasize the rising influence of Informational-communicational Technologies (ICT). It refers to society in which cheap information and ICT are widely used, or society of knowledge, in order to emphasize the fact that the largest profit is obtained by investing in non-material, human and social capital, and that the essential factors of society development are knowledge and creativity.

World Summit on the Information Society – WSIS [7] which was held in Geneva in October 2003 provided us with a definition in which it is stated that Information society is society where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life.

Informational society offers great possibilities: new workplaces, new tools for education and training, easier access to public services, more active participation of people with special needs and more effective collaboration between regions.

In a developed Information society, creation, distribution and information manipulation become a significant economic and cultural activity.

The second chapter of this paper examines Digital Agenda as one of the leading initiatives of the EUROPE 2020 and the reform of the Bologna process of the higher education, which promotes student mobility.

The third chapter examines multidisciplinary system of the IdM, and the fourth chapter is dedicated to the biometrics and smart card as the carrier of the identity. The proposal for the informational system for the student mobility sup-

port based on the smart card is given in the fifth chapter.

Digital Agenda And Bologna Proccess

Digital agenda

Digital agenda [1] represents one of the seven leading initiative strategies of the EUROPA 2020, which goal is to provide sustainable economic and social gain of the unique digital market based on fast and ultra-fast internet and interoperable applications by 2020. It defines the key roles of ICT, if Europe wants to succeed in its ambitions for the year 2020. The goal of the Digital agenda is to make the way for maximization of social and economic ICT potentials, and to make Europe a provider of smart, sustainable and inclusive growth on a global level. Internet is the most significant potential for the execution of the tasks, education, communication and freedom of speech.

European Digital agenda relies on seven standards which have international dimension, namely the making of the unique digital market, the improving of the interoperability of the ICT products and services, inciting trust and internet safety, significantly faster internet access, inciting research and development investment, the improvement of digital literacy, skills and the usage of the ICT in solving crucial social challenges (health care, education, climatic changes,…).

Europe has to insure that the new IT equipment, new applications, data repository and services communicate without limit. Digital agenda defines procedures and standards which are improved, and sets interoperability as a key to success. Internet is a good example of the interoperability because many units and applications work together anywhere in the world. Over 50% of Europeans use internet daily, but 30% of them have never used it at all. It is necessary to improve digital skills of individuals, and Digital agenda takes into account this kind of digital division.

Bologna process

Bologna process [6] is the process of the European Higher Education reform which goal is to promote student and professor mobility by establishing the European area of Higher Education by the year 2010. This process is named after Bologna Declaration from June 1999, which was signed by Ministers in charge of Higher Education from 29 European countries, and its official name is the European Higher Education Area – EHEA. This process is characterized as a national-international process and is conducted by national Ministries of education, universities, professors and students which/who present their work to the Council of Europe and European Commission.

Mobility, as the principle of the Bologna process, refers to students, teachers, graduates and researchers. Student mobility refers to the period of studies outside Home University, and return back after successful studies at another university in home country or abroad. Mobility can be horizontal, meaning that a student spends certain amount of time at another educational institution whether in his/her home country or abroad, and vertical, when a student finishes his/her complete studies in another country.

Mobility, which is referred to in the Bologna process of Higher Education reform, is not the only goal of the reform. The principle of mobility can be fulfilled if other set principles are fulfilled too, namely if the system of ECTS credits is established, system of quality is insured, study cycles and qualification validation are obtained. All these principles are mutually connected and conditioned by each other.

Mobility is the means of enlargement of effectiveness and the quality of educational system among the European Union members and other European countries, because it enables better exchange and flow of knowledge and ideas, as well as the adoption of good practices.

In the process of making the European area of Higher Education, it is concluded that the unique evaluation of a student's load is necessary, which would be used for defining student's necessary work

in order to successfully overcome a subject, a year, or a whole study program. This measure was introduced at the beginning of the Bologna process in order to accomplish student mobility, and was called the European Credit Transfer System. As the process of the reform was developing, it was concluded that the student's load could be measured by this kind of measure. Through the ECTS system, the institution of the higher education insures autonomy, is more transparent, it can change and adjust its programs and has a simple approach to the international programs. Credit Transfer System is an important instrument of mobility improvement within the Bologna process.

Transparency criteria and procedure of profiling student's value expressed in ECTS credits is gained by insuring additional information about curriculum and its relevancy to the academic level of qualification.

IDENTITY MANAGEMENT

Identity Management (IdM) represents a system which insures the managing of adjustable access to the IT surrounding for every user, which is mostly determined by business function and security requirements. This system improves work processes and mutual use of information, one identity per person. If this system is used and maintained properly, it does not allow unauthorized access. It is necessary to set all authorizations in concordance with the present law regulations, and special attention should be paid to the user's privacy policy, the establishing of central data base for internet maintenance, the managing of access rights of every user and inciting strict policy of the managing of this data.

The consolidation of access control is the most important thing in a successful IdM strategy. The control most often exists on the level of software application. The attempt of the access control for every application represents a problem from the aspect of system's vulnerability and weak spots because of the inability to test them properly. However, a centralized access to the Identity Management allows automation and speeding up of the process. Besides needed technologies, it is necessary to establish required policies which will enable proper use of user's account. A consistent monitoring of resource access can be the only way of detecting improper use.

Typical IdM system of organization includes: repository of personal data which is used by the system in order to define user's identity; set of tools for adding, up-date and deletion of data; system which regulates user's access and system of control and report.

A simple definition of the Identity Management is that it is an informational system or set of technologies which are used for identity management support. It is important to emphasize that every identity has its life cycle which consists of:

- *Account provisioning* – establishing of identity which gives the user an appropriate level of resource access
- *Account maintenance* – insures update on identity information
- *Account de*-provisioning – refers to the deactivation of user's account when the user leaves IdM system

Identity Management automatic solution helps with the consolidation and centralization of the IdM module including it into the IT system.

Identity Management system consists of four modules.

The first module is the establishing of identity by link on the person's name or object and reestablishing of identity, e.g. by link on a new or added name or subject's or object's number.

The second module is the identity description which is done by an arbitrary assignment of one or more attributes which are used for a certain subject or object as an identity, or re-description of the identity (e.g. changing one or more attributes of subject or object identity).

The third module represents activity flow, in which it is necessary to record and/or insure access to the identity activity protocol and optionally analyze the sample of identity behavior.

The fourth module deals with the destruction of identity if the user leaves organization, or identity management system.

The introduction of the biometrical data into the identity management system raises the level of identity data security.

A great number of European universities have their IdM systems. It is necessary to determine data standards which determine subject's identity and unique identity for the EHEA. This data should be accepted by the EUA (European University Association) and thus setting the basis for the managing of student's smart card with the goal of student mobility support.

Biometric and Smart Card

From the beginning of civilization, the identification of a human body was crucial in the creation of human society [5]. Hence, the identification of the person is an integral part of infrastructure which supports financial business, care for human health, distance learning, communication, judiciary, border services and many other areas.

As society becomes more electronically connected and represents a large global community, it is necessary to enable a reliable identification of a distant person by method of automatic identification. Representatives of such kind of surrogate identification are passwords, which are mostly used as an electronic access control, and cards mostly used in bank and administration applications. Cards and passwords can be used by other persons besides those to whom they are assigned by which unique person identification is not insured.

Biometrics which refers to the automatic person identification, based on its distinctive anatomic and behavior characteristics can become an essential component of the effective person identification. Biometric components of an effective solution in person identification cannot be mutually used by several persons, cannot be shared or lost. Essentially, they represent physical identity of the person. Biometrics represents automatic methods of the person identification based on physical characteristics or behavior. It represents a simple relationship human – machine, insuring three basic functionalities: positive identification, wide range identification and authentication.

Biometrics is regarded as an essential technology in defining secure identification system because it insures the highest level of privacy in identity verification.

Wide rage system of identification and system of triage cannot be implemented without the support of various biometrical methods.

In order to make a complex biometrical system, three basic requirements must be fulfilled: accuracy, data base capacity and utilization.

Any reliable system of the person identification must include biometrical components. Biometrics has an important role in applications used for sample recognition [2]. Precondition for biometrical recognition is to create data base with samples, which will serve as a comparative tool, and finally for recognition.

It is necessary to emphasize that the biometrical characteristic of a person, besides its advantages, has some disadvantages too. It is difficult to predict a biometrical data without any disadvantages, which would be perfect in any given conditions. If we take a fingerprint [4] [3], into account, then these disadvantages are related to the cases when fingers are, for example somehow tainted or when the skin is damaged. In cases of sample damage, it is necessary to up-date biometrical identification of the person, and this is done in the repository of biometrical data.

Smart card is a card of standard dimensions with an integrated chip, and integral circuits, which can process information. A great amount of information can be uploaded onto the smart card. This card is accepted as one of the safest and most familiar form of electronic identification. The identification security is increased by adding biometrical data onto the smart card [5].

EHEA AND STUDENT MOBILITY

As mentioned before, mobility is the means of enlargement of effectiveness and the quality of educational system among European Union members and other European countries, because it enables better exchange and flow of knowledge and ideas, as well as adoption of good practices.

The idea of necessity of international cooperation and mobility within and outside of the system of higher education came from Europe itself. The establishment of student and teacher mobility in the Bologna process had the biggest support among European countries. For accomplishing this goal, EU has promoted programs such as Socrates/Erasmus/Phare, which supported the efforts of contracting parties of the Bologna Declaration to establish conditions for the accomplishment of mobility. Mobility of highly educated people has often been regarded as a "Brain drain" from underdeveloped countries or countries which are members of the EU. This emigration of educated people to Europe and developed countries was not parallel with the influx of highly educated people to the underdeveloped countries. Mobility existed, but was directed one-way.

European programs for student exchange have insured international cooperation between different universities.

The most common problems that students encounter when they want to study outside their Home Universities are the recognition and verification of exams with which they proceed to study in another country. The verification is usually characterized as being international or widely institutional. We can differentiate two kinds of verification; one is the verification for academic and professional purposes, and the other is the verification of a program which refers to the verification of a specific study program of one higher education institution by another. This mutual verification is conducted by colleague professors and its goal is to enable the continuation of studies at another institution or to vindicate a student from a repeated study of a certain subject or material which does not differ significantly from one institution to another. In terms of institutions, the verification refers to the verification of agencies which are considered responsible and trustworthy, and which guarantee prescribed quality.

Academic verification represents the recognition of studies, qualifications or national or international university degree. It is necessary for forming an academic career at another educational institution or for professional needs and competition at the work market.

National ENIC/NARIC centre is the reporting centre of academic student mobility for students with national and international qualifications.

In the context of the EHEA, we can differentiate between three basic levels of verification:

- The recognition and verification of qualifications, including previous studies and professional experience for the purpose of acceptance or re-acceptance to higher education
- The recognition and verification of short study periods connected to the student mobility, wherein ECTS credits are used as the basic instrument of verification
- The recognition and verification of fully completed academic degrees, wherein a Diploma Supplement, which will be discussed later, is used as the basic instrument of verification

ECTS system is based on three basic elements, namely information about the study programs and achievements, agreement between partner institutions and the usage of ECTS credits. These three elements are effective if the three crucial documents are set, namely

- informational package
- study agreement
- transcript of records

The goal of the **Informational package** is to objectively present, to the students and their mentors, the study program of the educational institution, the assessment of the student's load, the module of examination, which is, assumingly, sufficient for the proper choice of the study program in inter-university exchange.

Study agreement is signed by a student, Home Institution and the institution which is the host after achieving mutual agreement prior to student's return to his/her studies. By signing this agreement, student accepts studies abroad as an integral part of his/her studies according to the coordinated part of the study program of the Host Institution and this agreement has to be accepted by all three parties, namely a student, Home Institution and Host Institution [5]. Home institution guarantees to the student that it will fully verify all completed courses stated in the agreement. By the agreement, the Host Institution confirms that the study program is acceptable and that it is not in collision with its study regulation. There is a possibility of a change in the agreed study program for justifiable reasons about which all three parties have to make statements.

Transcript of records is a document which is issued in order to demonstrate student's load in overcoming certain study program and achieved success prior to student's transfer to another studies and after his/her return from another university. This document is important for the verification of achieved ECTS credits for the student exchange, namely mobility support.

The fourth document which supports student mobility is the **Diploma Supplement** (DS), and it is submitted with a certain degree providing more detailed insight into the content, system and study regulations, especially concerning achieved results of an individual to whom this document is issued. The goal of the DS introduction is to improve transparency and facilitate academic and professional verification and the assessment of the achieved qualification in the last study program. Information, which is part of the DS, enables various academic institutions, in the country and abroad, to independently assess acquired skills and knowledge of a graduate. DS contributes to the affirmation of the higher educational institution itself on the international level and the verification of various universities. The content of the Diploma Supplement is acquired through the process of the implementation and creation of EHEA. This document is complementary to the degree issued to the individual, and it contains short biographical data of a student providing more detailed insight into the content, system and study regulations, especially concerning achieved results of the individual to whom this document is issued. DS is an official document, attached to the main degree and written in at least two languages, national and international, and is issued by the higher educational institution. This attached document enables the comparison of the degrees and qualifications acquired by them in various systems of the higher education, which enables their easier verification abroad.

University Information System - The Recommendation of the Information System For Student Mobility Based on the Smart Card

Student mobility supported by the smart card

As already mentioned, the most common problems that students encounter when they want to study outside their Home Universities are the recognition and verification of exams with which they proceed to study in another country. Student who wishes to continue his/her studies at another higher educational institution by module of exchange, has to fill in the application in which he/she states at which higher educational institution he/she wants to study and which study program he/she has chosen. Documents which student "carries" with him are: Study agreement, Transcript of records, DS optionally, and Informational package. These documents are uploaded onto the student smart card which is issued by the Home higher educational institution.

Figure 1. The block diagram of the study agreement

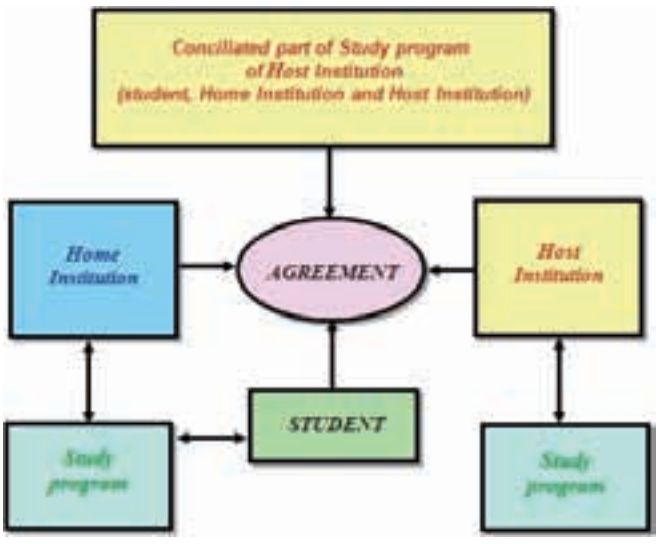


Figure 1 shows the block diagram of the study agreement [5]. By signing study agreement, student accepts studies abroad as an integral part of his/her studies according to the coordinated part of the study program of the Host Institution and this agreement has to be accepted by all three parties, namely a student, Home Institution and Host Institution [5].

Student smart card is designed in a way to protect data which contains. The biometrical data of the card's owner insure the highest level of protection. In this case, I recommend a fingerprint as an identification data which raises the level of protection of the smart card system and represents very reliable solution from the aspect of privacy. All data concerning the card's owner is uploaded onto the card's computer chip. The computer chip requires a smart card reader, thus enabling a successful communication with a computer platform.

Each university has its own system of IdM which contains all necessary data which has to be uploaded onto the smart card. Data which is necessary for the student mobility support is uploaded onto the smart card. University IdM system must have a biometrical system.

Module of the system of personal identity verification

Which data is necessary for the student mobility support?

Following data is necessary: student personal data and fingerprint, student's home institution data, student's host (abroad) institution data, and regulated subjects which student has to pass at host institution.

Personal data:
- First and last name
- Date of birth
- Permanent address
- National Unique ID

Fingerprint:
- Right hand thumb
- Right hand index finger

Study Agreement:
- Student data
- Home institution basic data
- Home institution study program
- Host institution basic data
- Host institution study program
- Regulated (coordinated) part of the study program, accepted by Home institution, Host Institution and student
- Time period of the Agreement Validity

Transcript of Records of the smart card owner:
- Date of the exam
- Subject name
- Letter and numerical grade
- Allocated number of ECTS credits

In order to accomplish this kind of concept of the horizontal mobility support, each Higher Educational Institution, besides standard ICT equipment and applications, needs to have:

a. Smart card read/write device
b. Fingerprint read/write device, as a part of the biometrical IS and
c. Standard application to support process of the smart card content for the identification of the card's bearer, incorporated into the IdMS of the institution.

In order for a biometrical data to be a unique student identification data, it is necessary for a biometrical system, together with an accompanying hardware support, to be a subsystem of the IdMS. It is important to emphasize that the identity biometrical data, by means of biometrical informational system, which operates as a subsystem of the IdMS, is loaded into the data base, and together with the personal data on the smart card represents a unique ID of the card owner (carrier).

Figure 2 shows a simplified block diagram of the biometrical IS which collects and verifies biometrical data in the sensor module and in the module for input and verification of the fingerprint characteristics. Then, it loads the data into the data base. The module for pairing of the loaded data and the data from the data base provides information about verified or declined identification.

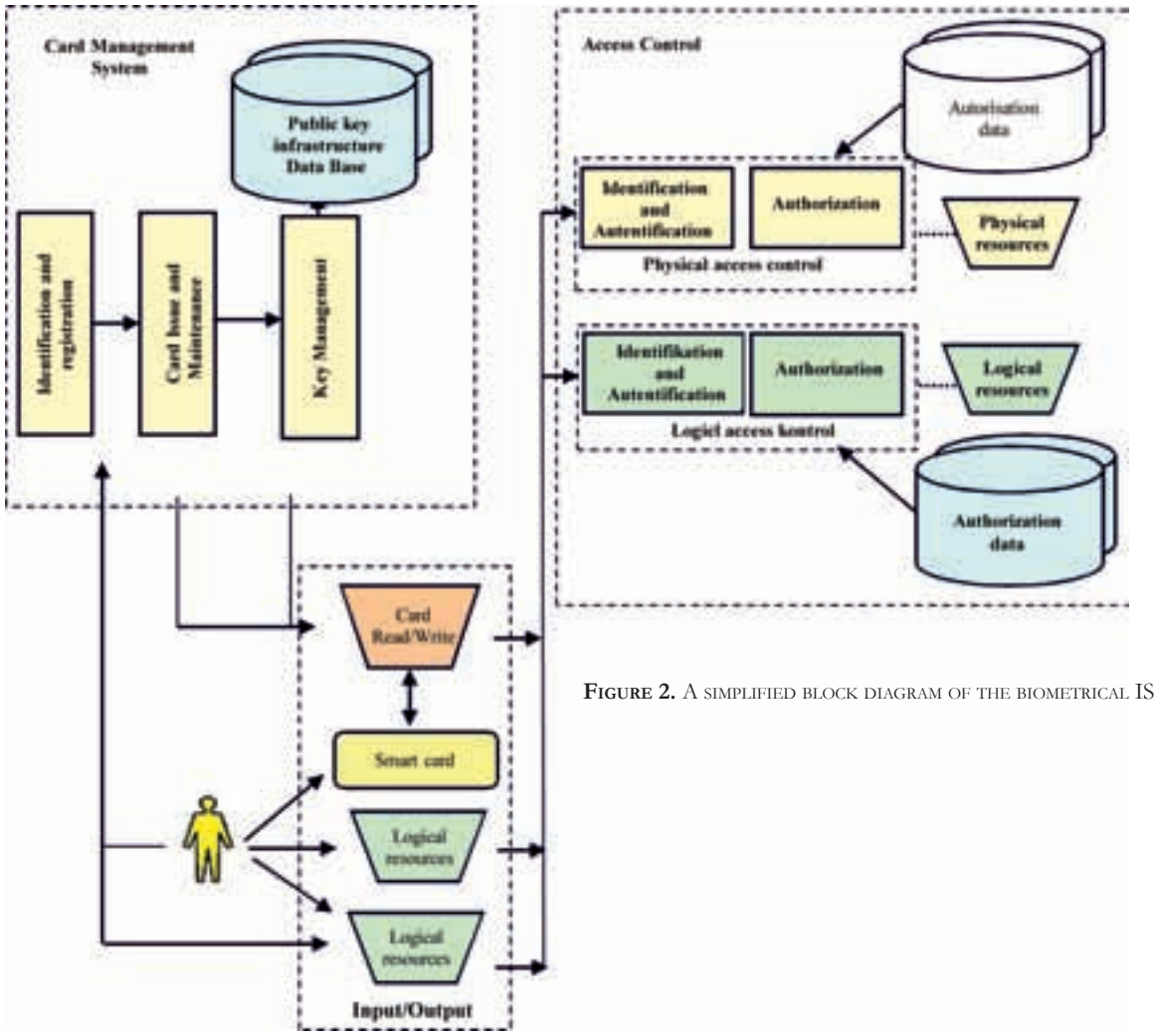
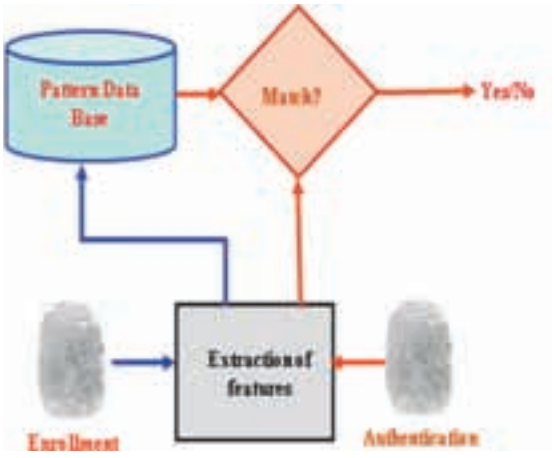


Figure 2. A simplified block diagram of the biometrical IS

Figure 3 shows the model of the personal identity verification [5].

We could say that this kind of system implementation is conducted in three steps.

Figure 3. The model of the personal identity verification



The **first** step is to regulate standard, on the EUA level, which will support this kind of system.

The **second** step is the implementation of these IdM systems at Higher Educational Institutions which are willing to support this kind of concept of the horizontal student mobility.

The **third** step would be the networking of these Higher Educational Institutions, as a part of the strategy of the Digital Agenda, Europe 2020.

Conclusion

This paper emphasizes the importance of student and teacher mobility concept as one of the binding components of the unique European Higher Education Area, which is insured by previous implementation of ECTS credits, European Credit Transfer

System, and standardized cycles of academic education lasting eight years in total. Within the mobility concept, the relationship between documents which support mobility concept is emphasized. These documents are: Agreement, Transcript of Records, Informational Package and Diploma Supplement.

A recommended integral informational system of the higher educational institution especially represents the possibility of the implementation of new technological solutions, smart card, which makes use of biometrical data in realization of the system of the student mobility concept, as well as of distance learning.

This kind of system would be a starting point of a full scale system of the student, graduate, teacher and scientist mobility support within the EHEA and ERA (European Research Area). It is also necessary that the European University Association (EUA) defines standards for the smart card content, which will support student mobility, data and the form in which it is used. The development and implementation of this kind of system is based upon regulated standards of European University Association (EUA), which would support the mobility of students, graduates, researchers and scientists.

The important document which supports graduate mobility is the Diploma Supplement (DS), which insures transparency, facilitates academic and professional recognition and the assessment of achieved qualifications within the last study program. Data, which is part of the DS, enables various academic institutions to independently assess graduates' acquired skills and knowledge. It is important to emphasize that the DS contributes to the affirmation of the High Educational Institution itself, on the international level and to the evaluation of various universities. Job market has to recognize regulated qualifications of graduates.

The networking of the High Educational Institutions with an implemented and recommended IdMS, will support the strategy of the Digital Agenda, Europe 2020.

REFERENCES:

[1] A Digital Agenda for Europe, (2010). COM245, Brussels

[2] Jain, A. K. Ross, A. and Prabhakar, S.. (2004). "An Introduction to Biometric Recognition", IEEE Trans. on Circuits and Systems for Video Technology, Special Issue on Image and Video Based Biometrics, Vol. 14, No. 1, pp. 4–20.

[3] Maltoni,D., Maio, D., Jain,A. K. and Prabhakar, S. (2003). „Handbook of Finger-print Recognition", New-York: Springer-Verlag.

[4] Pankanti,S., Prabhakar, S. and Jain,A.K. (2002). "On the infi viduality of fi ngerprints", IEEE Trans. on Pattern Analisys and Machine Intelegence, Vol. 24 No.8, pp 1010-1025.

[5] Radić G. (2008). „Computing Study in EHEA", Paneuropean University APEIRON, Banja Luka.

[6] The Bologna Declaration on the European space for higher education. (1998). Bologna.

[7] WSIS, (2003). Declaration of Principles and Plan of Action, Geneva.

Submitted: February 13, 2011
Accepted: June 02, 2011