ICT Standards in South Eastern Europe (SEE) Education: Macedonian Case

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Abstract

The Standards Education (SE) in the field of ICT gains increasing momentum worldwide. The strategic value of the ICT standards and their influence on the economy proves essential towards countries' development and their economic growth. This paper overviews the relevant current SE initiatives with a special emphasis on the South Eastern Europe (SEE) case and Macedonia. It discusses the level of ICT penetration, the recognition of the SE importance and the involvement of the relevant stakeholders in the SE curricula design on various education levels in Macedonia. Finally, the paper pinpoints the future directions towards transparent and harmonized SE.

Keywords: ICT, Standards Education (SE), South Eastern Europe (SEE), SE initiatives, ICT standardization, Macedonia's case.

1 Introduction

The Information and Communications Technology (ICT) represents a seamless convergence among the technologies dealing with information handling, software and communications, thus enabling the end-users with ubiquitous access, storage and manipulation of relevant information. The importance of ICT is rapidly increasing in the last decade promoting them into a pillar of the modern and well-developed societies. The ICT development is strongly affected and boosted by the *international standardization* that fosters harmonization on a worldwide level. Therefore, the **ICT standardization process**

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provides essential conditions and components for **transparent development of the overall society**.

The International Telecommunication Union (ITU) highlighted the importance of the ICT standardization through its Broadband Commission [1]. Its first country case studies published in 2012 showcase the links between the broadband connectivity and the UN Millennium Development Goals [2] in partnership with ITU. Figure 1 depicts the envisioned growth of the Internet penetration in developing and the Least Developed Countries (LDCs) worldwide. It is evident that the ambitious target of the ITU-UN partnership is to have 60% of the worldwide population online by 2015. The process of ICT standards harmonization proves to be crucial towards achieving this goal.

The rise of the ICT and its standardization is inevitably intertwined with the necessity for **Standards Education (SE)** in the field. The crucial point within is to understand the strategic value of the standards, the levers how this value is created and the effects in economic and public life. Therefore, a unified and harmonized worldwide SE can guarantee long-term ICT sustainability and its application in practice. It is of upmost importance that countries and universities work in this area providing transparent SE curricula ensuring education of new engineers and policy makers that can efficiently cope with future ICT challenges.

The Asian countries (e.g. Korea, Japan, China etc.) are currently leading the ICT SE process in the world [3]. They have established national bodies and action plans that treat the topic in a systematic manner starting from curricula development on all education levels (evenat primary school) through development of teaching materials and organization of conferences. This **top-down approach** proves to be the most effective one in terms of

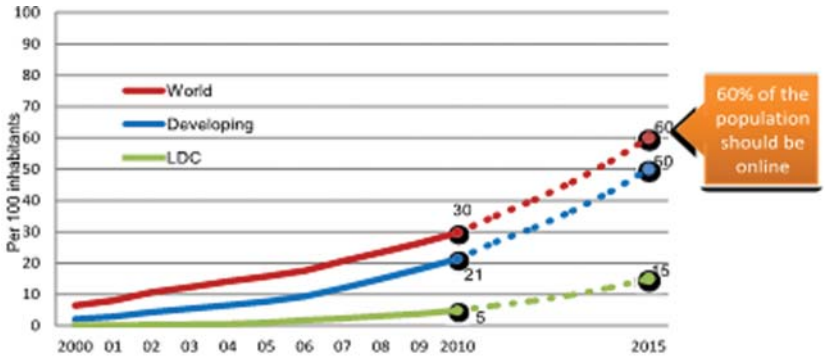

Figure 1 Broadband target 2015 (ITU-UN) [1].

market and industry needs for standards-literate professionals. Moreover, the Asian approach targets top students for SE education as the field is foreseen as a frontrunner for understanding the future ICT ecosystem, the interoperability of systems and the possible inconsistencies raising from disharmonized standards worldwide. Effectively, this ensures that the countries focusing on SE at this moment invest in their *future worldwide influence* and this must be embraced as a *roadmap by the developing countries as well*.

Unfortunately, Europe lags behind Asia in the SE field. The general consensus is that the SE at the academic level in Europe is inadequately based on the outcome of scientific research [3]. It means that Europe is very active in the area of *standardization research*, but *lacks effective SE*. Therefore, the European Academy for Standardization (EURAS) [4] was formed in order to stimulate the SE and promote the inclusion of education in standardization policies at national and European levels. At the same time, the South-Eastern Europe (SEE) countries are also vigorously trying to follow the European and the world trend in SE. Most of them realized the potentials of the ICT for the developing societies and focus on SE. In this manner, the **INA Academy** [5] tries to act as a catalyst for ICT development in SEE promoting diffusion of ICT services and SE in the field.

Republic of Macedonia is a developing SEE country that **already recognized ICT as a strategic area towards its future growth**. Relevant national bodies and universities have started a dialog on creation of SE curricula, which would fit the needs of modern ICT and will ensure that Macedonia keeps the momentum in the area with the developed countries.Also, the country participates in numerous international standardization bodies that foster the process of ICT SE initialization and harmonization.

This paper discusses the SE status worldwide, with a particular emphasis on the SEE case and Macedonia. Its focus is on the level of ICT penetration in the Macedonian society and the corresponding SE efforts and their harmonization. The paper is organized as follows. Section 2 provides general overview on the SE worldwide. Section 3 focuses on the Macedonian case elaborating the ICT status and standardization as well as the participation towards SE activities. Section 4 briefly describes the current university experiences and practices in Macedonia regarding the SE. Finally, section 5 concludes the paper.

2 Relevant International SE Initiatives

The importance of the ICT SE area emphasizes the potential negative consequences if SE is neglected. This can lead to serious setbacks and loss of market

influence by the involved stakeholders. Therefore, the SE area is gaining momentum by a plethora of international organizations such as the ITU [1, 5], International Standards Organization (ISO) [6], International Electrotechnical Commission (IEC) [7], International Cooperation for Education about Standardization (ICES) [8], Institute of Electrical and Electronics Engineers (IEEE) [9] etc. Their SE related initiatives range from harmonization of the ICT standards to raising SE awareness via public events (e.g. workshops, seminars etc.) and creation of standard related curricula. This will ensure the leading strategic role of the ICT in the 21^{st} century.

The pioneering steps towards transparent SE worldwide were established in 2001 when IEC, ISO and ITU jointly established the **World Standards Cooperation (WSC)** [10]. The main idea behind was to strengthen and advance the voluntary consensus-based international standards systems of IEC, ISO and ITU. WSC also promotes the adoption and implementation of international consensus-based standards worldwide and resolves any outstanding issues regarding cooperation in the technical work of the three organizations. The WSC initiatives comprise public events, education and training.

On an international level, ICES is also strongly committed to facilitating SE by providing guidelines for curricula development and creation of education materials. ICES is a network of individuals and organizations whose mission is topromote education about standardization and improve its quality and attractiveness for all stakeholders.

The Asian countries, i.e. South Korea, Japan and China, currently hold the primate in SE worldwide. Korean Standards Association (KSA) [11] body ensures supply of adequate expertise and coordination of the university curricula on SE. The university SE curricula are broadly present in the countries academic education system with multidisciplinary one-semester courses accompanied by relevant materials supplied from Korean standards experts. Korea initiated University Education Promotion on Standardization (UEPS) program in 2004 establishing itself at the forerunning place in SE worldwide. Japan takes a similar and well-devised approach to SE investing 1M US dollars in the period 2005-2010 for identification and addressing of all SE-related issues [12]. Moreover, the focus of the Japanese SE is on the strategic aspects of standardization (e.g. business strategies, intellectual property rights, strategic management etc.) rather than on the technological ones. Indonesia also follows the Asian trend hosting a WSC Academic Day in 2012 where 28 universities participated in discussions on SE. Finally, China provides several curricula on SE on more than 30 universities targeting hands-on experience in standardization, e.g. industry internships. The Chinese National Institute

for Standards (CNIS) [13] is monitoring the SE process in the country paying serious attention to research and development for its own business of standardization.

Europe recently started to promote initiatives in the SE area [14]. The most important aspect is the need for a coherent approach towards SE on a continental level. Europe acknowledges that the possible consequences of neglecting SE in Europe can be summarized as [14]:

- Reduction of the European influence in international standardization;
- Domination of non-European agents in international standardization and
- Europe becomes a follower rather than a leader in standardization issues.

As a result, every EU country must closely follow the SE initiatives in order to guarantee the SE transparency.Currently, European leader in SE is Britain [15] closely followed by Germany and France.

European efforts towards SE and harmonization are best reflected in the joint initiative of the European Committee for Standardization (CEN) [16], the European Committee for Electrotechnical Standardization (CENELEC) [17] and the European Telecommunications Standards Institute (ETSI), which formed a **Joint Working Group – Education about Standardization (JWG-EaS)** [18] with hopes to professionalize education in standardization and increase the number of people who have a fair and positive knowledge of standardization, its characteristics and its added value. This initiative is very important for SEE countries (including Macedonia), as most of them are ETSI and ITU members.The focus of JWG-EaS is aimed at [18]:

- Creation of a network of national members interested in education about standardization;
- Provisioning of a concerted policy on education about standardization in order to maximize the benefits amongst the National Standards Bodies in Europe and abroad;
- Gathering of best practice to convince governments and regions, academia, companies etc. of the value of education about standardization and propose appropriate actions;
- Establishing and maintenance of appropriate contact with other activities relevant to education about standards, for example EURAS [4] and ICES and
- Setting up a repository of tools and materials concerning education about standards and standardization.

As already mentioned, **EURAS** also governs relevant SE activities. EURAS is a German-based society that promotes research, education and publication in the field of standardization through organization of various dissemination events. The most prominent one is the annual EURAS Conference that gathers researchers, policy makers and company representatives interested in the field of SE.EURAS is devoted to stimulating SE on a European level in a more systematic and coherent manner. In practice, many European researchers weakly correlate their work with educational activities leaving Europe behind Asia in the field of SE. Therefore, EURAS is strongly committed to mapping the standardization research into relevant SE and corresponding possible academic contributions to standardization as well.

The SEE countries are trying to follow the European current trend on SE by promoting various initiatives mostly in the form of public dissemination (e.g. conferences, workshops etc.). The most serious organized contribution to SE in SEE is done by the INA Academy [5], which closely monitors the ICT developments and enables informational update in the areas of regulatory management, customized research, business modeling/forecasting and technology strategy. However, the SE is generally targeted towards senior managers from ministries, regulators and operators through various forms of trainings. Figure 2 shows the geographical focus of the INA Academy. It is evident that the Academy covers EU and non-EU members from SEE building an extensive network of high-profile contacts in national bodies and operators resulting in brainstorm meetings, intensifying of the ICT involvements, assistance in finding funding mechanisms, harmonizing the EC guidelines and standards and providing (partial form of) SE in the region.

The relevant SE activities on an international level must be carefully scrutinized and applied in a harmonized manner locally. This will ensure that the targets are met and that the SE truly serves its purpose towards transparent development of the overall society. The following section will provide a case study on ICT penetration, standardization and SE in Macedonia.

3 Case Study: Macedonia

As mentioned in the introduction, Republic of Macedonia is a developing SEE country recognized as a nation with strong commitment to connectivity as a driver of national growth [19]. Macedonia boasts an impressive broadband penetration rate of 32% on a national level with 100% company Internet connectivity. Moreover, the Internet access in schools and WiFi-based public Internet access is already rolled out with very high percentage of national

Figure 2 Geographic focus of the INA Academy (red colour indicates associated EU country, yellow colour indicates EU country member) [5].

coverage including remote areas. Macedonian schools offer one web-enabled computer for every 1.45 children. University students and academics can freely access knowledge and research resources via the academic network MARnet.

It is evident that Republic of Macedonia is a representative example of an ICT embracer. This section will provide details on the current ICT status in general in the country as well as on the ICT standardization and SE related activities.

3.1 ICT Status

The ICT sector is a very vibrant one in the country. It is **strategically led and backed by the Government** through two distinguished documents:

- Information Society Strategy [20] and
- National Broadband Strategy [21]

The *Information Society Strategy* defines the economic, social and political vision of the knowledge based society through ICT development and application in all spheres of life. Its aim is to foster creation of modern and efficient services for the citizens and the business community. The adoption of the ideas in the strategy by all relevant national stakeholders resulted in:

- Entirely liberalized market for electronic-communication services;
- Significant number of Internet users and
- Establishment of electronic public services.

The *National Broadband Strategy* is aimed at bridging the digital divide and providing broadband penetration comparable to the one in the developed European countries. The document complements the Government efforts to promote the ICT as a cornerstone of the Macedonian society reconstruction and development.

The adoption of the national strategies led to an increase in the Internet penetration in the country promoting the usage of ICT on a wider scale. Figure 3 depicts the Internet penetration in SEE [22] whereit is obvious that Macedonia represents a regional leader in the area.

The ICT responsibilities in the country were centralized through the creation of a Ministry for Information Society and Administration (MIOA) [23] that closely monitors all ICT related developments including the standardization and the SE. Also, MIOA is responsible for implementation of governmental ICT politics, thus contributing to the achievement of all objectives in the

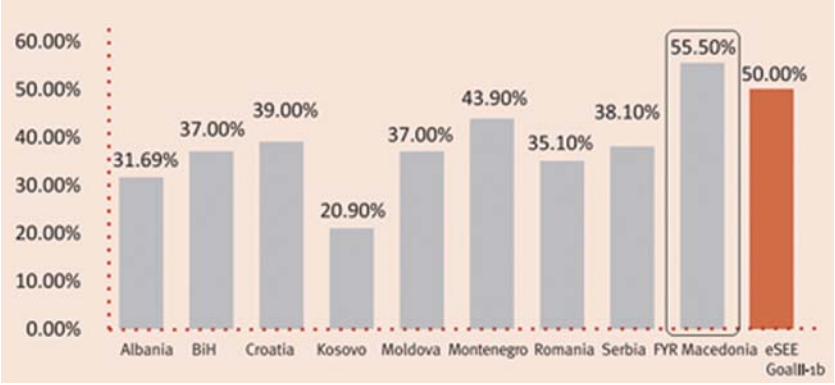

Figure 3 Internet penetration in SEE [22].

previously mentioned strategies. MIOA is in close cooperation with several national institutions such as the Agency for Electronic Communications (AEC) [24], the Standardization Institute of the Republic of Macedonia (ISRM) [25] and the Ministry of Transport and Communications (MTC) [26].

As a result of the joint, systematic and coherent approach by all ICT stakeholders, this area emerges as a strategic one in education and in the Macedonian society in general.

3.2 ICT Standardization

Republic of Macedonia participates in numerous international organizations targeting (or making use of) ICT standardization:

- International Telecommunication Union (ITU);
- European Telecommunication Network Operators' Association (ETNO);
- European Telecommunications Standardization Institute (ETSI);
- International Satellite Communications Organization (INTELSAT);
- European Satellite Communications Organization (EUTELSAT);
- International Satellite Organization (INMARSAT);
- European Broadcasting Union (EBU);
- European Conference of Postal and Telecommunications Administrations (CEPT) and
- World Trade Organization (WTO).

The international activity of the country in these organizations fosters the ICT standardization process ensuring accurate and up-to-date ICT development. The international ICT standardization efforts are channelized through the most important national ICT pillars, i.e.:

- MASIT - ICT Chamber of Commerce;
- Economic Chamber of Macedonia / IT Association - Macedonian Association of the IT Companies;
- Macedonian Chambers of Commerce / ICT Chamber;
- Macedonian Academy of Sciences and Arts;
- Macedonian e-Society Association (MESA);
- e-Gov Project and
- Foundation for sustainable ICT solutions "Metamorphosis".

The focal Macedonian standardization body is the **Standardization Institute of the Republic of Macedonia (ISRM)** [25]. As of June 2012, ISRM is a full-fledged member of CEN and CENELEC, thus closely monitoring the international ICT standardization and its application on a national Macedonian

level. The accession of ISRM in CEN and CENELEC is viewed as a very positive development, not only for the European standardization system, but also for the economy of the Balkan region and the whole of SEE. It means that the Republic of Macedonia can become fully integrated into the European single market.

ISRM's ongoing activities target active participation in relevant ICT entities such as the EC COST [27], the EC FP7 [28] programme, the NATO SfP programme [29]etc. promoting ISRM into a contributor to international ICT standardization. Moreover, ISRM's activities also focus on cooperation and facilitation of transition processes towards European initiatives (e.g. transition to digital terrestrial television etc.). Finally, ISRM is responsible for improvement of knowledge and awareness on ICT standards among industry, SMEs and consumers paving the way for SE curricula development in the country.

3.3 Participation in SE Activities

Republic of Macedonia acknowledges the importance of SE and its potential impact towards future ICT-oriented developed societies. The most important lessons to be learned and applied from the worldwide experiences can be summarized as:

- Introduction of SE on all educational levels in a systematic, top-down, approach, i.e. providing teaching materials and repositories;
- Selection of high-quality students for SE;
- Organization of public dissemination events on ICT standards and their importance in the developing societies and
- Active participation in national and international standardization organizations.

Currently, the participation in SE activities in Macedonia is organized on educational (secondary and higher education) level and national regulatory level.This subsection will provide more details on the ongoing initiatives.

3.3.1 SE in High Schools and Universities

The SE in high schools and universities is mostly channelized through the ICT curricula on secondary and higher levels. There are numerous ICT educational centres scattered throughout the country, Figure 4, offering education in various ICT areas. Even though the SE is inherently present in every ICT curricula as a fundamental part, the number of dedicated ICT SE programmes, especially in the universities, is quite low.

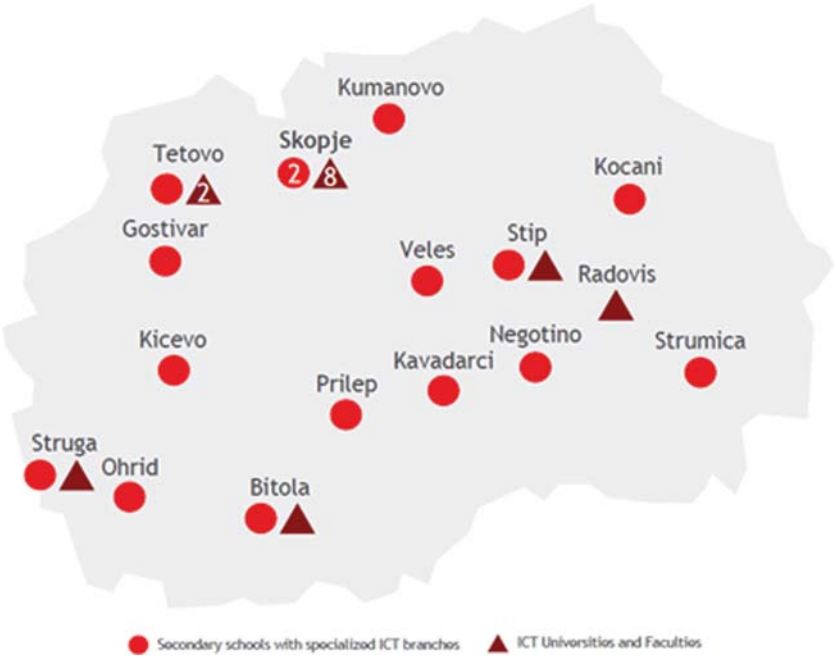

Figure 4 Distribution of ICT educational centres in Macedonia [31].

Almost all higher education institutions and universities in the country offer an ICT curriculum. The most versatile programme along with dedicated ICT SE initiatives is being offered on the largest and oldest university in the country, i.e. **Ss. Cyril and Methodius University in Skopje (UKIM)** [30]. More details on the university practices in ICT SE in Macedonia are given in section 4.

3.3.2 National SE Efforts

According to Article 73 of the Stabilization and Association Agreement (SAA) between the Republic of Macedonia and the European community and its countries (April 2004), Republic of Macedonia undertakes all necessary measures in order to speed up the development of the standardization as one of the pillars in the quality infrastructure, to support the participation in the work of the European standardization bodies (e.g. CEN, CENELEC, ETSI etc.) as well as to encourage the use of Community technical regulations and European procedures for standards, testing and conformity assessment [25]. The *Law on Standardization* ("Official Gazette of the Republic of Macedonia",

No. 54/02) regulates national standardization efforts. Republic of Macedonia acknowledges the importance of ICT, clean energy, energy efficiency and robotics as the most important areas towards standards harmonization [20, 25].

The main Macedonian national body dealing with the standardization in general (and therefore with ICT standardization also) is the ISRM [25]. The main strategic goal of ISRM is the harmonization of international standards locally, thus ensuring the fulfillment of the necessary prerequisites in the standardization area for Macedonia's European Union membership. ISRM actively participates in the work of European standardization bodies, provides ICT resources, adopts European and withdraws conflicting national standards, implements notification and standstill procedures and guarantees for protecting the rights of CEN and CENELEC publications. It also aims to develop a **standardization strategy** to ensure and encourage the involvement of all relevant stakeholders.

ISRM's SE efforts are disseminated through various public events such as workshops and seminars. There was a joint ISO/ISRM Awareness-Raising Seminar in 2009 [32] that gathered 29 participants from production, **educational institutions** and governmental bodies to discuss the need and the benefits of harmonized standardization and SE. Also, ISRM organizes workshops on its participation in the CEN/CENELEC technical committees in order to promote the SE work in the area.

Besides ISRM, there are also numerous national SE efforts lately. The national regulatory body AEC is raising awareness on broadband and ICT standardizationthrough organizing IRC conferences [33]. The IRC conferences serve as a platform for exchange of ideas among regulators, operators and vendors in SEE emphasizing the importance of standards literacy for future interoperability and society development. It presents and highlights the latest standards such as LTE-Advanced, spectrum regulation future strategies, broadband and multimedia protocols and standards. Also,ITU is locally present through its *Centre of Excellence (CoE)* at the Faculty of Electrical Engineering and Information Technologies (FEEIT), Ss. Cyril and Methodius University in Skopje (UKIM) that regularly offers e-learning courses to interested parties, e.g. regulators and vendors. These courses target the latest ICT technologies and their standardization on a global scale. *FEEIT/UKIM* additionally offers various SE related courses in its curricula for the undergraduate and the graduate students. Furthermore, FEEIT/UKIM regularly gives courses to broad professional auditorium (form of continued education) on new and evolving technologies and standards such as UMTS, LTE, IPv6, VoIP etc. Moreover, various vendors present in the country offer the possibility to

ICT professionals to obtain a standard-based certificate for proficiency in a certain ICT technology, e.g. *Cisco academia* on networking etc.Finally, many universities and companies regularly take part in FP7 related activities on research, development and harmonization in the SE field.

It is evident that the SE efforts are gaining momentum and that all relevant stakeholders (academia, vendors, regulators) are actively participating. However, all these efforts are sporadic and isolated and there is a clear need for systematic approach towards SE. A possible solution is to embrace the SE concept on a university level and offer specially created programs for SE on all academic levels. The following section will discuss in more details the current status of the SE university practices in the Republic of Macedonia.

4 University Practices in ICT SE in Macedonia

The initial efforts to provide relevant SE in the field of modern ICT emerged in 2004 at FEEIT/UKIM for the students majoring "Telecommunications" on undergraduate level and "Wireless and mobile communications" and "Communications and Information Technology" on graduate level. In 2011, the undergraduate curriculum was upgraded and enhanced to better suit the latest ICT initiatives, thus there was a change of the name into "Telecommunications and Information Engineering". Students study a handful of courses based on relevant ICT standards such as the IEEE 802 family of standards, 3GPP, optical networks, DOCSIS, multimedia etc. There are also **specific ICT SE related courses** such as "*Standardization and regulations in telecommunications*" (offered on a Dipl.-Ing. level) and "*Business management in telecommunications*" (offered on a MSc level).

They introduce the students to the activity domains of the most important standardization bodies (e.g ETIS, ITU, 3GPP, IEEE) and the most relevant standards, highlighting the importance of standards towards shaping and boosting the ICT developments and competitiveness.

Additionally, the curricula are continuously updated to accommodate the new technologies, e.g. LTE, LTE-Advanced, DVB-T etc. As a result, students majoring telecommunications on undergraduate and graduate level are trained to understand the ICT standardization process are familiarized with practically all relevant ICT standards today and are well aware of the benefits of harmonized SE on a national and international level.

In order to further extend its involvement in SE and be in line with the international corresponding efforts, FEEIT/UKIM created a specific curriculum

termed "**Regulation in energetics, electronic communications and traffic**" on a graduate level in February 2013. This is the **first organized effort** to provide a completely *SE devoted curriculum on an academic level*. The choice of the courses and their contents was carefully designed in accordance with the latest industry developments and industry needs for harmonized SE. The curriculum caters for all relevant ICT standards for electronic communications, both fixed and wireless.

Additionally, there is an effort between the national AEC and UKIM to jointly develop an *ICT SE curriculum for the domain of spectrum usage and novel wireless services and initiatives*. This is still an ongoing issue.

It is clear that the Macedonian academic efforts to provide SE are following the international trends showcasing the benefits of harmonized SE for the overall development of the modern day ICT-based society in general.

5 Conclusions

The ICT in general is widely recognized as a driver towards modern society development. ICT is emerging as an inevitable part of all aspects of modern living, thus there is a clear need of understanding and embracing the ICT concept in order to fully use its potential. This is where the SE paradigm raises emphasizing the potential gap between the ICT developments and the society's potential to transparently follow them. Therefore, there must be a **focused and harmonized SE effort on international and national levels** enabling the bridging of the digital divide and creating an ICT literate future society.

There are several opportunities for provisioning SE towards fulfilling its goals. All relevant stakeholders (i.e. academia, vendors and regulators) from the public and the private sector should be involved in the process by organizing dissemination events, raising awareness through seminars and workshops etc. This would ensure that a systematic and coherent approach is held guaranteeing successful SE.

It is clear that the **academia can play a key role in the SE process** by introducing relevant curricula on all levels of studies. However, the academia must work in close cooperation with other interested parties, specially the standardization responsible bodies in order to create the most suitable market compatible curricula. These *synergies* will faster the developments towards a comprehensive ICT-based society.

This paper focused on the SEE initiatives for SE and especially on the case study of the Republic of Macedonia. Evidently, the region undertakes a

number of actions towards SE awareness and active participation in the ICT standardization harmonization area. It should be noted that the ICT area is very vibrant and needs a pro-active approach for efficient SE and ICT incorporation in all areas of modern day living.

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Biography

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