
The status of broadband in Western Greece: a study on the supply and the demand of broadband services for e-government promotion

Christos Bouras

Research Academic Computer Technology Institute,
Department of Computer Engineering and Informatics,
University of Patras, 26500 Rio, Patras, Greece
E-mail: bouras@ceid.upatras.gr

John Papagiannopoulos

Department of Information and Communication Systems Engineering,
University of the Aegean, GR 83200 Samos, Greece
E-mail: jpap@aegean.gr

Sokratis K. Katsikas

Department of Technology Education and Digital Systems,
University of Piraeus, 150 Androutsou St., GR 18532 Piraeus, Greece
E-mail: ska@unipi.gr

Stefanos Gritzalis*

Department of Information and Communication Systems Engineering,
University of the Aegean, GR 83200 Samos, Greece
E-mail: sgritz@aegean.gr
*Corresponding author

Abstract: Fast and reliable access technology is necessary for developing efficient and effective e-government services. The existence of a direct relationship between the presence of a broadband network and the availability of e-government services has frequently been debated in the literature. This paper presents the results of a study conducted by the Research Academic Computer Technology Institute (RACTI), which investigates the current status of broadband with regards to the demand for and the supply of broadband services and infrastructures that will support these services, in the Western Greece Region. Broadband promotes open effective governance and improved services to citizens while creating a new economy based on knowledge. Broadband development has a significant impact on e-government support and diffusion.

Keywords: broadband services; e-government; business models.

Reference to this paper should be made as follows: Bouras, C., Papagiannopoulos, J., Katsikas, S.K. and Gritzalis, S. (2008) 'The status of broadband in Western Greece: a study on the supply and the demand of broadband services for e-government promotion', *Int. J. Electronic Governance*, Vol. 1, No. 3, pp.326–344.

Biographical notes: Christos Bouras obtained his Diploma and PhD from the Department of Computer Engineering and Informatics of Patras University (Greece). He is currently an Associate Professor in the above department. Also he is a scientific advisor of Research Unit 6 in Research Academic Computer Technology Institute (CTI), Patras, Greece. He has extensive professional experience in design and analysis of networks, protocols, telematics and new services. He has published 250 papers in various well-known refereed conferences and journals. He is a co-author of eight books in Greek. His research interests include analysis of performance of networking and computer systems, computer networks and protocols, telematics and new services, QoS and pricing for networks and services.

J. Papagiannopoulos holds a BSc in Physics, an MSc in Electronic Automation and an MSc in Electronics and radio-electrology, all from the University of Athens. He is currently a PhD candidate with the Department of Information and Communication System Engineering, University of the Aegean, Greece.

S.K. Katsikas received the Diploma Engineering (Electrical Engineering, University of Patras, 1982), the MSc (Electrical and Computer Engineering, University of Massachusetts at Amherst, USA, 1984), and the PhD (Computer Engineering, University of Patras, Greece, 1987). He is a Professor with the Department of Technology Education and Digital Systems, University of Piraeus, Greece. He has been involved with many CEC funded R&D projects (computer security, robotics, and artificial intelligence). He has authored more than 170 papers and 20 books in his areas of research interest, which include information and communication systems security, estimation theory, adaptive control, and evolutionary programming.

S. Gritzalis holds a BSc in Physics, an MSc in Electronic Automation, and a PhD in Informatics all from the University of Athens, Greece. Currently he is an Associate Professor, Head of the Department of Information and Communication Systems Engineering, University of the Aegean, Greece and Director of the Information and Communication Systems Security (Info-Sec-Lab). His published scientific work includes several books on information and communication technologies topics, and more than 160 journal and national conference papers. His research interests include information and communication systems security (secure e-commerce, e-business, e-government, e-learning services; public-key infrastructure architectures; wireless mobile ad hoc and sensor networks security; privacy enhancing technologies; medical informatics security and privacy.)

1 Introduction

We broadly define as 'broadband' any advanced, feasible and politically, socially, financially and technologically innovative environment that enjoys the following properties:

- Existence of rapid internet connection to as large a part of the population as possible, at competitive prices (in the form of a consumption good), without restrictions as to the transmission systems or the terminal equipment of the communication ends.
- Existence of an appropriate network infrastructure that:
 - allows the development of existing and future network applications and information services
 - provides users with uninterrupted connections
 - meets the application needs in bandwidth and availability
 - is able to continually be upgraded at the lowest additional cost, so as to meet the emerging needs, as they grow and evolve at a pace and cost dictated by the progress of the information and communication technology.
- Ability of the citizens to choose among:
 - alternative connection offers suitable to their equipment
 - various network applications
 - various information and recreation services, with a possibility for the citizen himself or herself to join the supply of context, applications and services.

The existence of an appropriate regulation framework, consisting of policies, measures, initiatives, direct and indirect interventions, that is essential for the strengthening of the innovation and the protection of the competition is also desirable.

In the past few years, various studies have pointed out the important social and financial impacts of broadband (Annis et al., 2005; Lehr et al., 2005). These surveys reveal that most potential benefits are expected in the e-government area, especially for G2B and G2G transactions (Bauer et al., 2002).

In Greece, the proliferation of the broadband networks and services can lead to the simplification of the procedures and the betterment of the functioning of the public sector, thus raising its productivity and lowering the support costs. The implementation of networks of a national scale, such as Syzefxis (network infrastructure for e-government), Taxisnet (network of Ministry of Economy and Finance) and IKAnet (network of the major social security agency) is a definite challenge for the development of nationwide broadband services. Benefits for the private sector businesses will also appear.

Within the operational programme (Information Society Programme 2005) for the development of the local access network infrastructures, the Research Academic Computer Technology Institute (RACTI) conducted the present study, which intends

- to explore the status of broadband services and the demand for them in the Western Greece Region
- to come up with reliable estimates of the future development of such services
- to propose a number of actions considered as critical for accelerating the spreading of the broadband services in the region
- to underline the positive and intransigent factors for the dispersal of broadband services and consequently the effect on local e-government promotion in the region.

If the market forces were left on their own, all broadband infrastructures and services would exist only in the two largest cities of the country, namely Athens (region of Attica) and Thessaloniki (region of Central Macedonia), as well as along the highway that connects them.

In the Region of Western Greece (RWG), the third largest in population of the country, with 700,000 inhabitants, a good number of scientific and research Institutes with high degree of specialisation exists. These can support the supply of and also create demand for broadband services. Patras, the capital of the region, third largest city in the country, is a major transportation hub and gateway of the country to Western Europe. All three sectors of economic activity in Western Greece contribute importantly to the GNP. The above observations manifest the fact that the Western Greece Region is an interesting case for conducting a study such as the one whose results are presented herein.

It is expected that the work presented herein will have broader impacts, namely impact on local government strategy, which will reduce the effort and time required for action. This work is also expected to provide local government with useful information that can be used to guide local communities and other partners as to what investments in telecommunications infrastructures are needed in order to maximise the benefit from broadband development.

The remaining of the paper is structured as follows. Section 2 describes the methodology that was followed. Section 3 presents the results of the study. Section 4 provides an in-depth analysis of these results. Section 5 discusses recommended future goals and actions. Finally, Section 6 summarises the conclusions.

2 Methodology

We contacted two groups of participants: the providers and the major users of broadband services.

We define as providers all the companies and the organisations that offer broadband services in the region. The major users are the organisations, the public authorities and the citizens that utilise the offered broadband services.

We approached all 13 companies with telecommunication-related activities in the region; 10 of these responded (response rate is 0.76). We also approached all 30 major users of broadband services in the region; 25 of these responded (response rate is 0.83). The major users are 14 municipalities, four hospitals, three chambers of commerce, three public higher education institutions and six research centres.

2.1 Structure and distribution of questionnaires

Two different questionnaires were used.

The first questionnaire was mailed to the providers of broadband services in the RWG. Our target was to give the providers of broadband services the opportunity to share with us their experiences, their needs and their future plans in this field. The questions basically aimed at the broadband services offered by each of these providers. Also, there were questions regarding future plans for the development of the supply of broadband services.

The second questionnaire was mailed to the major users of the broader public sector of the region. Under the term 'major users' one finds the municipalities, the public

organisations, the ministries, the district, the prefectures, the hospitals, the chambers of commerce, the Higher Education Institutions, the research institutes, as well as the major local media. The input of these users was indeed of the utmost importance for the success of the present study.

The users were requested, among others, to state how satisfied they were from the speed of their internet access, as well as in what ways they use the internet. Also, with the help of the appropriate questions, we were able to trace their knowledge of broadband services and the penetration level of such services.

At this point, it is essential to emphasise the fact that both questionnaires were followed by cover letters that explained to the recipients the objectives of the survey and the use that would be made of their responses, as well as the terms of participation to the survey. Also, it pointed out the ways by which the completed questionnaires could be returned to RACTI: The participant could communicate with us either via e-mail or ordinary mail – the former being preferable.

2.2 Communication with participants

In every information collection procedure, it is quite impossible to achieve the immediate response of all those who participate – especially when the information collection depends upon third parties. Such is the case with the questionnaires of the present study, and for many of the participants one or two telephone follow-ups were essential in order for them to complete the questionnaires. The purpose of this telephone communication was for the RACTI to be informed on the reasons why the recipients did not respond, as well as to offer them some assistance, lest they had difficulties with any of the questions. Many of the recipients found it difficult to fill the questionnaire due to either a certain lack of specialisation and information on the matters the questionnaire referred to, or a lack of time available. Furthermore, as an additional action taken to deal with these cases, a team was formed. This team visited the recipients and through a conversational, interviewing procedure filled out the questionnaires on behalf of the participants.

2.3 Processing

When the processes of compiling and distributing the questionnaires as well as the follow-up actions were completed, we proceeded with the processing stage.

The questions were categorised according to the kind of answers that could possibly be given, thus two categories were formed.

The first category comprises all the questions that had a given, limited number of possible answers and did not appeal to the recipients' own judgment in order to be answered. For example, to the question "In which way do you connect to the internet?" there can only be one of the following answers:

- Dial Up
- Integrated Services Digital Network (ISDN)
- Asymmetric Digital Subscriber Lines (ADSL).

The possible answers to these questions not only are very specific, but also very limited in number.

The second category includes all the remaining questions, the answers to which may vary depending on the recipient and require using their judgment. For example, the question “Can you mention factors that in your opinion could affect positively the development of the broadband services market in the Region of Western Greece?” does not have a specific set of possible answers.

The processing process was rather simple for the first category. We numbered the identical answers given to the same question by different recipients. Following the end of this process, the pertinent percentage was automatically calculated.

For the second category, similar answers were grouped together. By the end of the process, we treated and analysed all answers in groups, once more concluding in percentages, as with the first category.

2.4 Representativeness of the responses

The participants were selected very carefully. We selected the most important representatives from each category and, in many cases, we contacted all the members in a category. For example, all stages of education, all the hospitals and all the municipalities in the region were contacted. Having such a representative sample, it is safe to assume that the conclusions reflect the situation accurately.

3 Results

This section describes the questionnaires that we used. It also presents and discusses the survey results. The discussion is structured following the sample categorisation into providers of broadband services and major users of such services in the public sector.

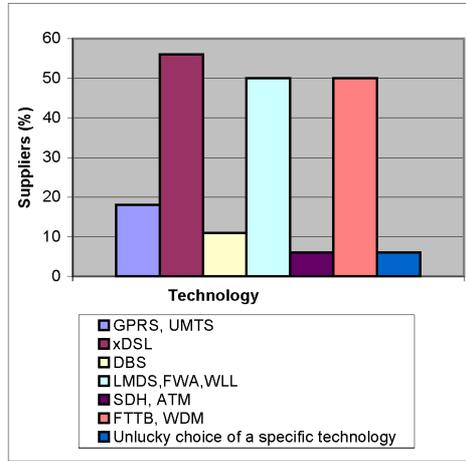
3.1 Providers of broadband services

The questions in the providers’ questionnaire were mostly of a closed form or of a form that led to answers that could be easily grouped. In the sequel, both the questions and the answers are reported and commented upon.

Describe broadband services you intend to develop or offer to your users in the region of Western Greece, as well as the suggested broadband access technologies.

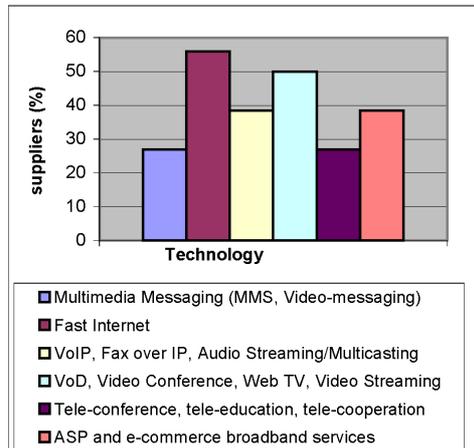
Network access is seen to be through DSL Technologies (XDSL), Local Multipoint Distribution Services (LMDS), Fixed Wireless Access (FWA), Wireless Local Loop (WLL), Fiber to the Building (FTTB). The Network Foundation is based on Asynchronous Transfer Mode (ATM), Internet Protocol (IP), Synchronous Digital Hierarchy (SDH) and Division Wavelength Division Multiplexing (DWDM) Technologies, as depicted in Figure 1.

Figure 1 Broadband access technologies that the providers intend to develop or offer to the users in the Region of Western Greece (RWG) (see online version for colours)



As far as broadband services are concerned, it is easily observed that fast internet remains the basic service to be offered. Other services that providers plan to develop include video and audio communications (e.g., audio streaming, video on demand, video conference, web TV). A rather limited provision of advanced telematic services (tele-education, tele-conference, tele-training etc) is included in their plans, as shown in Figure 2.

Figure 2 Broadband services that the providers would wish to offer in the Region of Western Greece (RWG) should they have at their disposal networks of larger capacity (see online version for colours)

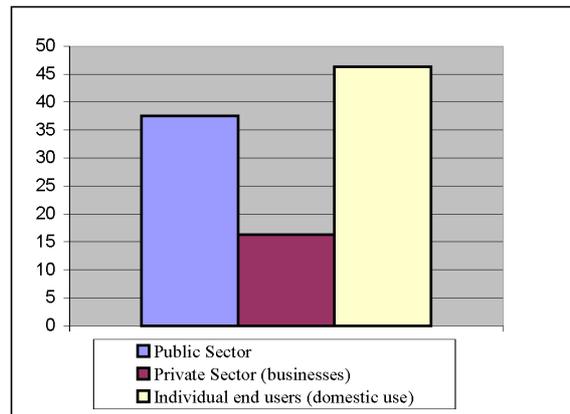


Which category of customers would you think that the development of the broadband services market in the RWG could be based upon?

Have you developed network services (bundles), which are fully orientated towards specific professional groups (e.g., physicians, lawyers, students, the public sector etc.)? If yes, please name them.

The dominant opinion is that the public sector and the individual (domestic) users with a percentage of 37.5 and 46.3 respectively are the customer categories on which the development of the broadband services market in the RWG can be based. On the contrary, only 16.3 % believe that the development of the broadband services market in the RWG can be based on the private sector (Figure 3).

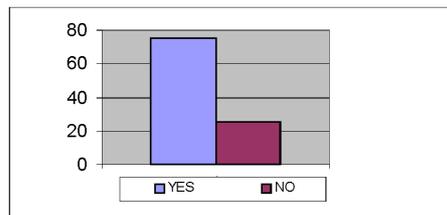
Figure 3 The client categories on which the development of the broadband services market in the Region of Western Greece (RWG) can rely (see online version for colours)



Seventy five percent of the providers have developed applications especially designed for specific professional groups (Figure 4). Indicative responses were:

- exclusive services of internet connection
- tele-cooperation
- tele-conference
- live broadcast of events.

Figure 4 The development of network bundles, fully orientated toward specific professional groups (see online version for colours)



3.2 Major users of the broader public sector

In the following, the notation A/B denotes

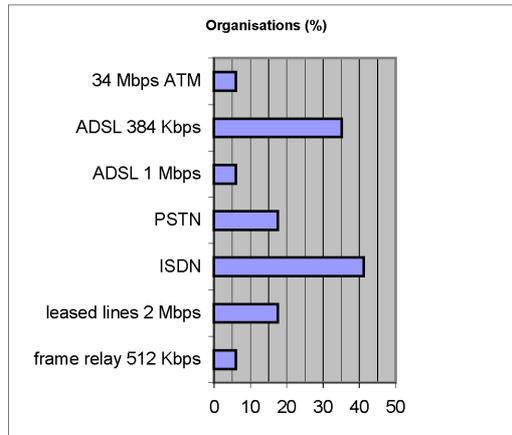
- A: the number of major users sharing the same opinion on the specific question
- B: the number of major users that answered the specific question.

Report the kind of access that your organisation has to the internet and the technologies you use for the internet connection within your organisation.

What are the basic internet applications used by the personnel and to what extent do the present infrastructures cover your needs?

Figure 5 depicts the technologies used for internet connection. In total, 17/25 organisations indicated the technologies they use; note that an organisation can use more than one access technology at the same time.

Figure 5 Technological solutions and infrastructures that the major users have developed and use up to the present for the supply of internet services (see online version for colours)



The use of internet applications per organisation is shown in Figure 6.

Figure 6 Percentage of the major users per internet service (see online version for colours)

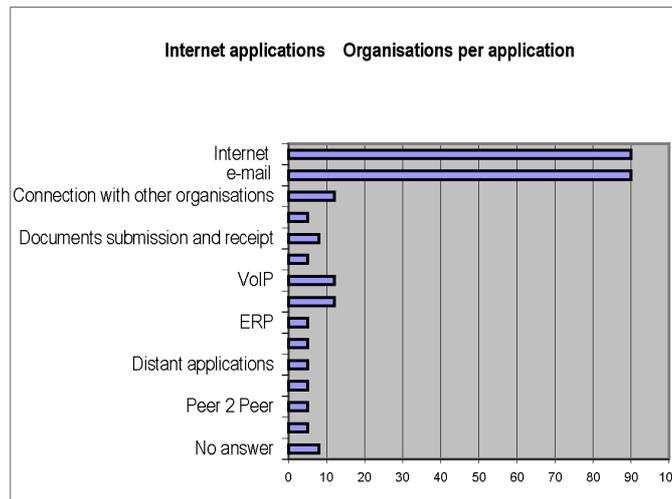
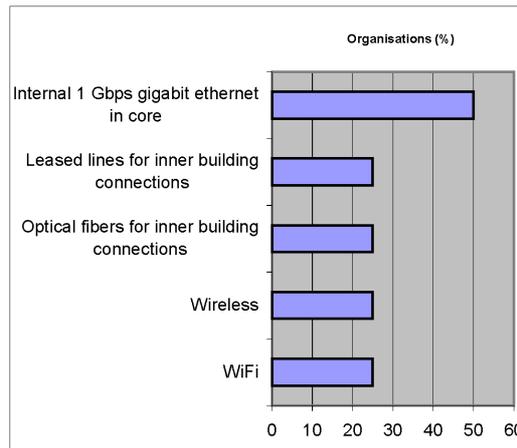


Figure 5 also manifests the lack of ‘serious’ broadband infrastructures, since the largest part of the organisations (41%) use ISDN for their access to the internet.

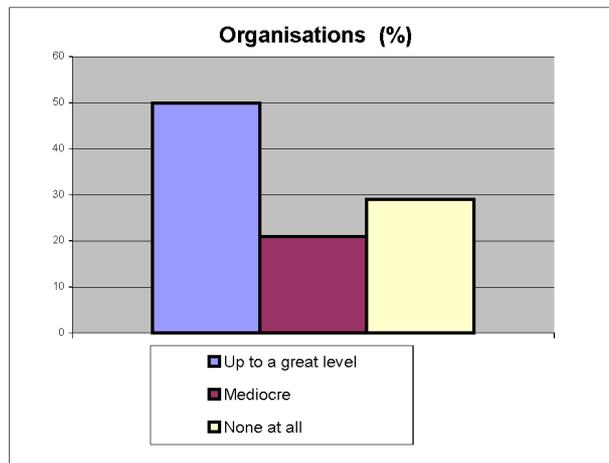
Regarding the technologies used for the intranet connection within the organisation, 8/25 organisations in total were able to name them specifically (in more detail than merely using the general term ‘local network’). The results are shown in Figure 7. An organisation can use more than one technology simultaneously.

Figure 7 Technologies for the internet connection within the organisation (see online version for colours)



Finally, regarding the extent to which the present infrastructures cover the needs of the organisation, 14/25 organisations responded. The results can be seen in Figure 8.

Figure 8 Extent to which the present infrastructures cover the needs of the organisation (see online version for colours)



Considering the relatively old-fashioned access technologies that are widely used, together with the lack of utilisation of ‘real’ broadband services, the fact that 50% of the organisations state that the present infrastructures cover their needs reveals the extent to which they are clung on the current use of the internet.

Report the kind of broadband services available in your organisation. Which technological solutions or infrastructures do you intend to develop in the immediate future (until the end of 2007) for covering your needs?

Figure 9 depicts the percentage of the organisations that acquire broadband services. One may observe that a striking 76% does not use such services.

Figure 9 Percentage of the organisations using broadband services (see online version for colours)

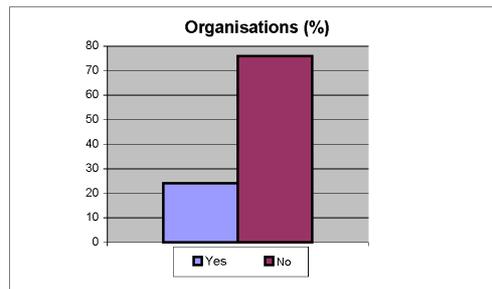
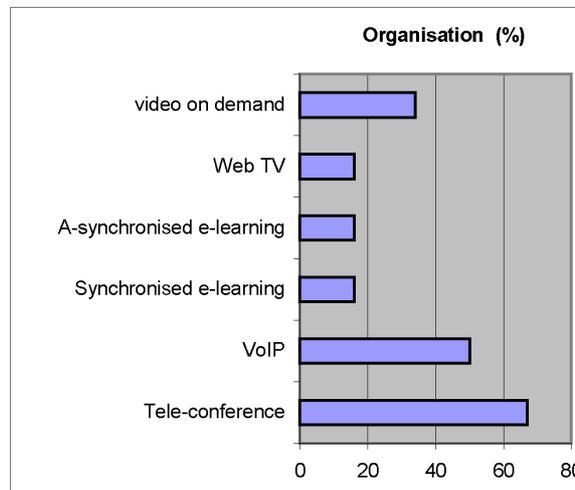


Figure 10 depicts the percentage of the organisations already using broadband services (up to 24% of the total), per specific service. ADSL broadband access services have been excluded.

Figure 10 Types of broadband services that the organisations use (see online version for colours)

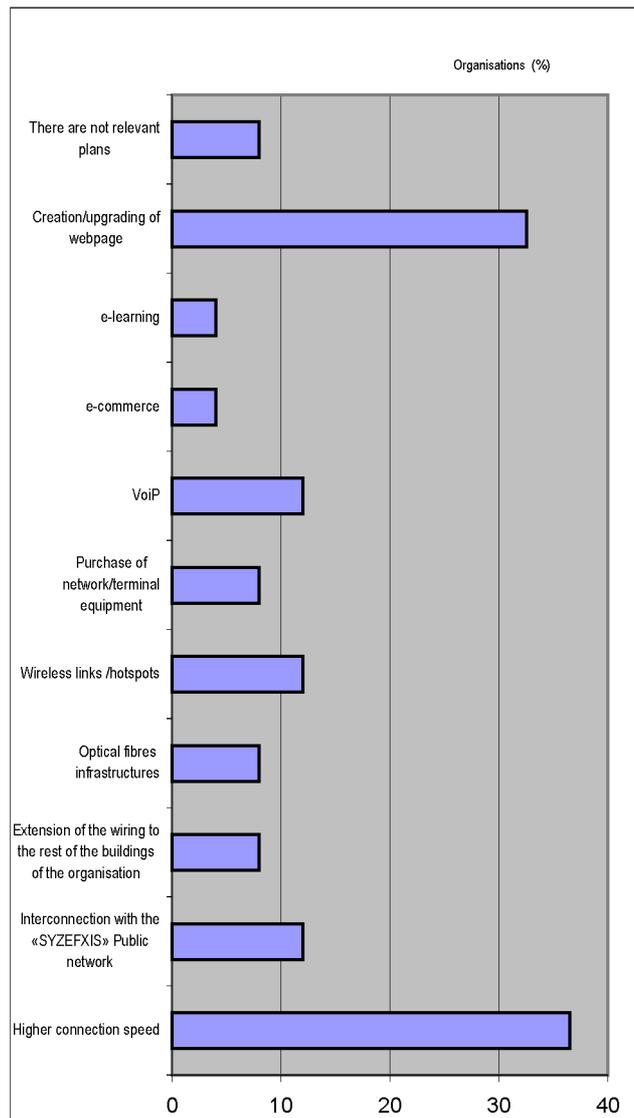


As far as the technological solutions or infrastructures are concerned, 25/25 organisations answered. An organisation may intend to develop more than one technological solution or infrastructure (Figure 11).

Figure 11 reveals that most of the organisations plan – as future solutions or infrastructures – actions that will enhance the internet access speed (36%) and the creation or the upgrading of their organisation website (32%). This fact implies the

basic lack of access services, when such services could as well lead to the demand for broadband services.

Figure 11 Technological solutions or infrastructures that the major users plan to develop in the immediate future (until the end of 2007) (see online version for colours)



Positive and negative factors for the proliferation of broadband services in the RWG.

This section presents the positive and intransigent factors for the proliferation of broadband services as presented through the processing of the questionnaires, for both the providers and major users of the broader public sector (Bouras et al., 2005a). These are:

- The usefulness of the services that will be developed in the fields of e-learning, e-health, e-government and e-entertainment
- The low cost on the user for both the connections and the development of services
- The existence of government intervention and incentives for the development of broadband services in remote areas, mostly due to high infrastructure costs and low user demand. Another form of incentives can be directed towards the subsidy of the user (i.e., tax cuts, student grants etc.).

Many businesses feel that there are serious deficiencies as to the regulatory framework of broadband services. Specifically, it is felt that there is a need for legislative intervention in matters concerning the security of financial exchanges, intellectual property rights and protection of personal data. These are related to the configuration of the final demand thus determining the final price for available broadband services.

A large number of businesses consider as an intransigent factor to the development of broadband services the issues concerning network access. Specifically, the manner in which incumbent operator plans to introduce ADSL with a high access cost (non-value based prices), zero resale profits for the ISPs and the non-commitment form urge the organisation to provide a Service Level Agreement for the above mentioned service (Melody, 2001). Until today, only the incumbent has the appropriate infrastructure from access to backbone network to provide broadband access at a country level.

A regulatory framework particularly organised legislatively is required in order to encompass the entire chain of production all the way from the content provider, to the infrastructure owner, and finally to the consumer (Economides, 2004; Zhang, 2002).

The guidelines stated by the European Union have not been sufficiently followed and for that reason it is deemed necessary to activate a system that will monitor and control the e-commerce process in Greece.

4 Result analysis

The study provided a number of useful results, which are summarised in this section.

4.1 Concerning the providers of broadband services

- All the providers included in the survey are active in the RWG.
- The main technological fields that the Broadband Services providers choose to develop in the RWG are the following:
 - DSL Technologies (XDSL)
 - Local Multipoint Distribution Services (LMDS)
 - Fixed Wireless Access (FWA)
 - Wireless Local Loop (WLL)
 - Fiber to the Building (FTTB)
 - Wavelength Division Multiplexing (WDM).

- One generally observes a growing demand among the users for faster internet connections.
- Should the providers have at their disposal networks of larger capacity, they would choose to invest in multimedia and tele-services.
- All the providers believe that there is room for great development of the broadband services market. This fact indeed stresses out the public need for the use of such services in combination with the characteristic absence of those in the market.
- Most of the providers suggest that the financial motives would be one of the basic factors to positively affect the development of the broadband services market.
- Almost 50% of the providers state that the future growth of the broadband services market can rely exclusively on the simple domestic users. A large percentage (37.5%) believes that this attempt for development should rely more on the public sector.
- Seventy five percent of the providers have developed services aiming to specific professional groups. Some of these are:
 - exclusive services for interconnection in the internet.
 - a-synchronised and synchronised tele-education.
 - tele-cooperation
 - tele-conference
 - live broadcast of events and happenings.
- The same percentage (75%) state that the services they provide are accepted by all the professional groups.
- The services that have stronger requirements in broadband are those related with video reproduction and transmission.

4.2 Concerning the major users of the Broader Public Sector

Up to 90% of the major users in the broader Public Sector report the electronic mail and the internet browsing as their basic internet applications. Following up closely in percentage are the applications of VoIP, tele-conference and the communication with similar organisations, used in percentage that rises up to only 10% on the total of the major users. Therefore, we come to the conclusion that the percentage of the penetration of the broadband services is still very low.

- the largest part of the major users (41%) uses ISDN lines for their internet connection, an old-fashioned access technology, which under no circumstances favours the Broadband Services
- most of the major users (36%) include the upgrading of their internet access speed in their future plans
- 76% of the major users do not use Broadband Services

- given the opportunity, the majority of the major users would be interested in adopting broadband services such as:
 - exchange or transfer of massive archives
 - tele-education
 - tele-conference
 - customer service via the internet
 - remote access to medical files (for major users in healthcare)
 - real time remote monitoring of events
 - tele-labour (naturally regarding only those of the users for which such a service could be applied)
 - webpage upgrading.

Therefore, the response of the major users of the broader Public Sector towards Broadband Services appears positive, given the fact that there will be the relevant access services to support those. The state should cater in order to ensure the supply of Broadband infrastructures and services to these organisations, thus contributing, directly or indirectly, facilitating their operations and, consequently, to the betterment of the living standards of the citizens.

5 Recommendations: future work

The state usually becomes involved in broadband matters in three different ways:

- by creating policies, setting the appropriate regulatory and legislative frames
- by using network products and services
- by starting and administrating direct and indirect interventions through programs, which aim at managing market failures.

Most of the times, the first of the aforementioned categories provides the State with the most active and effective tool for the formation of the telecommunication sector, in order for the general political goals to be achieved. Carefully designed legislative and regulatory frameworks can predict, administrate and cover the possible ‘failures’ of the free market, without introducing elements of ineffectiveness or even alter its function.

As a major client and a user of broadband services, the state may have an all-important effect on the development of broadband services. The aggregation demand of the needs of the Public Sector has the greatest effect in agricultural, remote regions, where the Public Sector can literally be the only customer interested in broadband infrastructures, regardless of the high cost. As a result, a well-designed policy of aggregation demand of the needs of the public sector may enhance the coverage of the distant, agricultural regions without bringing alterations to the market (as those can be observed through subsidies of the demand and the offer programs) (Clark et al., 2003; Gillet et al., 2003).

The third category of energetic involvement of the State in network matters is characterised by immediate interventions. Speaking of smoothly functioning markets, such interventions should take place only when the two aforementioned categories of intervention cannot successfully deal with market failures. Well-structured interventions of this sort can help avoid even market alterations – although that is a peril not to be taken lightly. Such interventions should include both encouraging actions on behalf of the providers, and taking measures for the toning of demand, while, in most cases, positive results should be expected mainly from the part of the demand and less from that of the supply. These measures are of exceptional importance especially in areas already altered or deformed, where, for example, the provision of extended broadband services from a sole organisation leads to a halting of the competition – and, consequently, of the services reaching the major user.

The result analysis for the evolution of supply and demand for broadband infrastructures and services leads to the following fields of action in order of priority, which we believe can speed up the spreading of the broadband services in Greece, and therefore in the RWG.

- *Reduction of the dependence on the single main network infrastructure.*

Unlike the rest of Europe, where an important structure of advanced network infrastructures was attained between 1998 and 2003 (often from alternative telecommunication providers), in Greece there seems to be a continuous, exclusive relationship of dependence from the main network infrastructure of Incumbent Local Exchange Carrier (ILEC). The new companies in the telecommunication field have only recently taken their first steps investing in fibre networks capable of supporting broadband services (Bouras et al., 2005b).

- *The solution to the interconnection problems.*

The creation of competition regarding the supply of broadband services should be a primary concern, so as to lead to low prices and high quality (Economides and Lawrence, 2002). This would take the creation of local network infrastructures that would interconnect nationwide.

- *The application of flexible supply procedures regarding network services and infrastructures.*

As clarified above, the State will be called upon to play an all-important role of client/supplier in the broadband services market, in order to nurture and strengthen it at birth. There will be a need for studying the present legal status carefully, to avoid possible obstacles to the creation and development of mixed business models involving both State and the private sector, according to the international manner (OECD, 2003). In these business models the percentage of the state participation will balance the lack of private motives due to limited demand or high realisation cost (Bouras et al., 2007).

- *Exploitation of the aggregated demand of the Public Sector for the strengthening of demand.*

We have already pointed out that the part the Public Sector is called to play, as a major client, is avoiding failures in the broadband services market, especially in the areas of reduced demand. Summing up the demands of the public sectors services such as healthcare, education etc, as far as their needs are concerned, we create true broadband

demand. In this way, we justify the development of infrastructures that may later be used to provide the population with relevant services at low prices.

- *Ensuring the services' low distribution cost.*

The general conclusion is that the 'distribution cost' factor is the greatest obstacle when it comes to the development of broadband networks and services. Low prices are achieved if there is competition in the access network, or if the client-owner creates the access infrastructure (Alexiou et al., 2007).

6 Conclusions

Full-scale implementation of e-government raises difficult issues. These include safeguarding trust and confidence in online interaction with the government, as well as widespread broadband access to online broadband services so that no digital divide is created. In the RWG, the absence of services that will create demand for broadband services, services of broad acceptance and interest, does not allow the creation of a critical mass demand for development. However, the development of broadband infrastructure and services is of strategic importance for the region, since it can significantly stimulate economic activities, and contribute to a great extent to the improvement of the e-government services. In order to achieve development of broadband infrastructure and services, we make some specific recommendations and propose actions that should be undertaken.

References

- Alexiou, A., Bouras, C., Primpas, D. and Papagiannopoulos, J. (2007) 'Metropolitan broadband networks: design and implantation aspects and business models', in the forthcoming book on *Global Diffusion of Broadband Data transmission: Factors Affecting the Adoption, Usage and Economics of Broadband*, July, IDEA Group Publishing, 2008, pp.196–210.
- Annis, R., McNiven, J. and Curri, M. (2005) *Industry Canada Broadband Economic Impact Study*, Rural Development Institute, Brandon, Manitoba, 31 August, pp.1–51.
- Bauer, J.M., Gai, P., Kim, J., Muth, T.A. and Wildman, S.S. (2002) 'Broadband: benefits and policy challenges', in James, H. and Mary, B. (Eds.): *Quello Center for Telecommunication Management and Law*, Michigan State University, East Lansing, MI, pp.1–103.
- Bouras, C., Alexiou, A., Igglesis, V., Kapoulas, V., Paraskevas, M., Tsiatsos T. and Papagiannopoulos, J. (2005a) 'The broadband' status in the region of western Greece: overview and recommendations', Paper presented at *Proceedings of the Broadband Europe 2005*, Bordeaux, France, 12–14 December.
- Bouras, C., Alexiou, A., Igglesis, V., Kapoulas, V., Paraskevas, M., Scopoulis, I. and Papagiannopoulos, J. (2005b) 'Deployment of broadband infrastructure in the region of western Greece', Paper presented at *2nd IEEE /Great e-net International Workshop on Deployment Models and First/Last Mile Networking Boston*, MA, USA, 7–8 October, pp.588–593.
- Bouras, C., Gkamas, A., Papagiannopoulos, J., Theophilopoulos, G. and Tsiatsos, Thr. (2007) 'Business models for broadband municipal optical networks: a proposed model for the Greek case', Paper presented at *12th IEEE Symposium on Computers and Communications*, Aveiro, Portugal, July.

- Clark, D., Gillett, S., Lehr, W., Sirbu, M. and Fountain, J. (2003) *Local Government Stimulation of Broadband: Effectiveness, E-Government, and Economic Development*, National Center for Digital Government, John F., Kennedy School of Government, January, MIT Press.
- Economides, N. (2004) *Telecommunication Regulation: An Introduction*, Working Paper EC-03-22, Stern School of Business, N.Y.U.
- Economides, N. and Lawrence, J. (2002) 'Access and interconnection pricing', *The Antitrust Bulletin*, Vol. XL, No.3, pp.557–579.
- Gillett, S., Lehr, W. and Osorio, C. (2003) 'Local government broadband initiatives', *31st Research Conference on Communication, Information and Internet Policy (TPRC)*, Arlington, VA, pp.537–558.
- Lehr, W.H., Osorio, C.A., Gillet, S.E. and Sirbu, M.A. (2005) 'Measuring broadband's economic impact', *31st Research Conference on Communication, Information and Internet Policy (TPRC)*, Arlington, VA.
- Melody, W. (2001) *Telecom Reform: Principles, Policies and Regulatory Practices*, Technical University of Denmark, Lyngby.
- OECD (2003) 'Policies for broadband development: recent oecd work on broadband committee for information', *Computer and Communications Policy*, Directorate for Science, Technology and Industry [DSTI/ICCP (2003)3].
- Zhang, B. (2002) 'Understanding the impact of convergence on broadband industry regulation: a case study of the United States', *Telematics and Informatics*, Elsevier Science Ltd., Vol. 19, No. 1, pp.37–59.

Websites

- Broadband, [http:// www.broad-band.gr](http://www.broad-band.gr)
 IKAnet, <http://www.ikanet.gr>
 RACTI, <http://www.cti.gr>
 Syzefxis, [http:// www.syzefxis.gov.gr](http://www.syzefxis.gov.gr)
 Taxisnet, [http:// www.taxisnet.gr](http://www.taxisnet.gr)

Acronyms

ADSL	Asymmetric Digital Subscriber Lines
ASP	Application Service Provider
ATM	Asynchronous Transfer Model
DBS	Direct Broadcasting Satellite
DSL	Digital Subscriber Lines
DWDM	Dense Wavelength Division Multiplexing
ERP	Enterprise Resource Planning
FTP	File Transfer Protocol
FTTB	Fiber to the Home
FWA	Fixed Wireless Access
GPRS	General Packet Radio Service
IP	Internet Protocol
ISDN	Integrated Services Digital Network

ISP	Internet Service Provider
LMDS	Local Multipoint Distribution Services
PSTN	Public Switched Telephone Network
SDH	Synchronous Digital Hierarchy
UMTS	Universal Mobile Telecommunications System
VoIP	Voice over IP
WiFi	Wireless Fidelity
WLL	Wireless Local Loop
XDSL	DSL Technologies
