INTERNATIONAL TELECOMMUNICATIONS SOCIETY
ITS 18TH EUROPEAN REGIONAL CONFERENCE
2-4 SEPTEMBER 2007. ISTAMBUL, TURKEY

Technical and Economic Viability of WiMAX-PLC Network Roll out to Supply Broadband Access in Rural and Exurban Areas

Madrid, 31th March, 2007

AUTHORS:

Mr. Antolín Moral Caballero
Ph. D. Researcher
Polytechnic University of Madrid

Mr. Arturo Vergara Pardillo
Ph. D. Researcher
Polytechnic University of Madrid

Dr. José Manuel Riera Salis
Professor
Polytechnic University of Madrid

Dr. Sergio Ramos Villaverde
Assistant Professor
Polytechnic University of Madrid

Dr. Jorge Pérez Martínez
Professor
Polytechnic University of Madrid

CONTACT:

e-mail: amoral@gtic.ssr.upm.es
www site: www.gtic.ssr.upm.es
Phone and Fax: +34 91 336 73 20
Mobile: +34 605 66 52 61

ADDRESS:

Escuela Técnica Superior de Ingenieros de Telecomunicación
Office C-431
28040 Madrid
Spain

Topics: policy to reduce broadband gap, cost-effective broadband access solutions for rural and isolated areas

ABSTRACT

The new strategic framework for the European Information Society "i2010 – A European Information Society for growth and employment" places particular emphasis on tackling the issues of both geographical coverage of broadband and the social and economic digital divide.

Definitions of broadband have continued to evolve and are changing with time and place. European Commission defined "broadband" in a 2004 Commission Communication[1] as "a wide range of technologies that have been developed to support the delivery of innovative interactive services, equipped with an always-on functionality, providing broad bandwidth capacity that evolves over time and allowing the simultaneous use of both voice and data services". Moreover, the concept of "digital divide" in developed countries usually refers to the gap between "have" and "have-not" in terms of broadband access.

Broadband allows households to access advanced e-government, e-health and e-learning services, improving their quality of life and their participation into the social and democratic life. Moreover, it enables businesses to communicate with clients and suppliers and limits business migration to urban areas. By its own nature, broadband bridges distances and is particularly beneficial to the development and attractiveness of remote and rural areas.

Broadband access, in other words, has become a prerequisite for everything from economic growth to social inclusion. A concerted effort has seen broadband fast growth over the past few years. But this progress is uneven. Several Commission Communications[2] underlined the persistence of a *broadband digital divide* in terms of geographical coverage. In 2005, broadband access was available to only about 60% of businesses and households in the remote and rural areas of the EU15, compared to over 90% in the urban areas. In the new Member States, the gap is even greater. Where it is available, moreover, broadband access quality is often lower in rural areas, constraining the potential availability of audiovisual and multimedia services.

Market dynamics suggest that commercial forces will drive further deployment, although some areas of the EU will suffer delayed coverage or will be excluded altogether from broadband rollout. In fact, a study[3] of PriceWaterhouse Coopers concludes that broadband will be available to more than 95% of urban population in the EU25 by 2010 although coverage in rural areas will be much lower (achieving 75% by 2013 in the wealthier countries but no more than 35% in most of the recent accession countries). And the same study estimates the net present value of benefits to be 69% larger than costs. Under these circumstances, public intervention may be considered desirable or necessary.

The scope for public intervention in under-developed areas was emphasized in *e*Europe 2005. In the eEurope 2005 Action Plan (IP/04/626) set 'widespread availability and use' as its

[1] COM(2004) 369: "Connecting Europe at High Speed: National Broadband Strategies"
[2] COM(2003) 65, COM(2003)673, COM(2004) 61, COM(2004) 369, COM(2004) 380.
[3] Price Waterhouse Coopers (2004), "Technical assistance in bridging the digital divide - A Cost Benefit Analysis for broadband connectivity in Europe".

broadband objective and set that Structural Funds can be used to increase broadband coverage in under-served areas if the use is based on competition rules and on the regulatory framework for electronic communications. It aims at minimizing competition distortions due to public support on the basis of a technology-neutral approach. These objectives are shared by the i2010 Initiative.

While implementing *e*Europe 2005, Member States were committed to put in place national broadband strategies. In Spain, the Ministry of Industry, Tourism and Trade launched the "National program for the roll-out of broadband in rural and remote areas" in 2005. With this program co-financed by EU funds (IP/05/398), the Spanish authorities have earmarked a total of €26.4m in direct grants and €111.9m in interest-free loans for the period from 2005 to 2008. Under the program, providers of electronic communications services may submit proposals for providing broadband in specific areas where such services are currently not available. The Commission concluded that the aid was not likely to cause undue distortion of competition within the Single Market and was therefore compatible with EC Treaty state aid rules (Article 87).

In addition to traditional xDSL and cable operator, new agents could be motivated by this program to roll out new networks in areas without a broadband supply. Among these agents, utilities that own a widespread optic fiber network have some important competitive advantages. They could roll out an access network just where they have fiber optic cable with less cost. Moreover, the possibility of bundle their present services with their new telecommunication services and the fact that most costumers have a reasonable expectation of quality and reliability from their power provider could help them to capture customers faster and easier than other new operators. Finally, it is their financial and sale strength. So as to make a cost-effective broadband network, the more properly technologies are those that reuse wire previously existing or wireless technologies. So the emergent WiMAX and PLC represent a great opportunity for these agents. WiMAX could extend the connectivity with a low cost and PLC could exploit the electricity grid that reaches almost 100% of population and the possibility of in-home distribution.

In this document, we analyze the technical and economic viability of an access network roll-out based on WiMAX 802.16-2004 and PLC by an utility that own a widespread optic fiber network to supply broadband access in rural and exurban areas. This analysis is part of a project made for Iberdrola (one of the biggest utilities in Spain) and Polytechnic University of Madrid.

The technical viability was carried out by the roll-out of a pre-sale test in "Las Camaretas" urbanization, near to a small town called Soria. The network consists of Iberdola's fiber optic core network, a WiMAX link to take the connectivity from the core network up to a distribution "step-down" transformer inside the urbanization and a last medium and low voltage PLC link to reach the end-users. The test provided a broadband access to Internet and voice over IP (VoIP) service to twenty customers in the urbanization with an integrated end to end quality of service management. Moreover, the high bit rates supported by WiMAX and PLC technologies could provide television broadcasting besides VoIP and broadband. However, the lack of available spectrum in bands that can be used to NLOS broadband communications converts

the WiMAX link into the system bottleneck keeping the WiMAX-PLC network from offering a real triple play service.

Moreover, we analyze the business case that let to this WiMAX-PLC operator to make a profit. We count with Iberdrola's experience and our own experience acquired with the test to cost and network roll-out estimation. The financial analysis was carried out for a period of 5 years. This was undertaken on the basis of market forecasts (of potential clients and penetration rates) in these rural and exurban areas. A network planning model is used to establish how the resulting target clients are served and finally, investment and operating costs are calculated. Earnings come from sales of broadband and voice over IP services. Finally, we do emphasis in the study of the sensibility of the model to those factors that are more difficultly predictable like market forecasts. The objective is to determine conditions needed to ensure the economic viability of this WiMAX-PLC solution.

BIBLIOGRAFICAL NOTES

[1] European Commission (2004): *Connecting Europe at High Speed: National Broadband Strategies*. COM(2004) 369. May 2004.

[2] European Commission (2006): *Bridging the Broadband Gap*. COM(2006) 129. March 2006.

[3] Price Waterhouse Coopers et al, "Technical assistance in bridging the digital divide – A Cost Benefit Analysis for broadband connectivity in Europe", October 2004.

[4] European Commission Press Release: *State aid: Commission endorses public funding for broadband communications in rural and remote areas of Spain*. IP/06/284. 7th April 2005.

[5] Ministerio de Industria, Turismo y Comercio: *Programa de extensión de la banda ancha en zonas rurales y aisladas*. ORDEN ITC/701/2005 (BOE 22-03-2005). March 2005.

[6] WiMAX Forum: *Fixed, nomadic, portable and mobile applications for 802.16-2004 and 802.16e WiMAX networks*. White Paper. November 2005.

[7] Electric Power Research Institute: *Broadband over Power Line 2004: Technology and Prospects*. White Paper. October 2004.

ABOUT THE AUTHORS

Mr. Antolín Moral gained his BSc degree and his MSc degree in Telecommunication Engineering both form the Universidad Politécnica de Madrid and he is currently working on his Ph. D. His research interests are focused on the development of New Generation Network (NGN) and the new advanced telecommunications services from a technical, economic and regulatory point of view and on telecommunications policy and regulation.

Mr. Arturo Vergara gained his Telecommunications Engineering Master degree in 2006 from the Universidad Politécnica de Madrid. Since 2007 he has a scholarship from the Universidad Politécnica de Madrid to develop his Ph.D activities in the Research Group of Communications and Information Technologies. His research interests are focused on technological, economic and regulatory aspects of NGN development and new advanced telecommunications services.

Dr. José Manuel Riera received his MSc degree in Telecommunication Engineering in 1987, and his PhD in 1991, both from the Universidad Politécnica de Madrid. Since 1993 he has been an Assistant Professor of radio communications at this University. His research interests are in the areas of radiowave propagation and wireless communication systems. He has directed research projects in these fields with private and public funds. He is the author of more than 30 technical papers, published in international journals and conference proceedings or as book chapters.

Dr. Sergio Ramos gained his Ph.D. in Telecommunications Engineering from the Universidad Politécnica de Madrid, and he has an MBA from the Stockholm School of Economics. He worked for the European Commission as Resident Twinning Adviser of a PHARE Twinning Project for the Public Utilities Commission of Latvia, to design and monitor the transposition process of EU framework into Latvian legislation. Sergio is an expert on mobile and wireless communications, his research interests being the technological, economic, regulatory and social aspects of 3G and Beyond communications systems and mobile Internet. He is currently Deputy Coordinator of the Telecom Operators Group at the Spanish ICT Industry Association (AETIC) and Associate Professor at the Universidad Politécnica de Madrid.

Dr. Jorge Pérez gained his Ph.D. in Telecommunication Engineering from the Universidad Politécnica de Madrid, and his Master in Social and Political Science from the Universidad Complutense de Madrid. He is a professor in the Signals, Systems and Radiocommunications Department of the E.T.S.I. de Telecomunicación. Dr. Jorge Pérez leads the Research Group in Communications and Information Technologies (GTIC-SSR-UPM). His research interests are focused on new advanced telecommunications services and telecommunications policy and regulation. From 1990 to 1999, Dr. Pérez was President of the Spanish Professional Association of Telecommunications Engineers and Dean of Spanish Telecommunications Engineers. He currently holds the Chair on Information Society Development of Red.es, where he coordinates the Spanish Experts Group on Analysis and Prospective on Telecommunications. In addition, he is adviser on Industrial Policy on Telecommunications and Sector Regulation for the State Secretary of Telecommunications at the Spanish Ministry of Industry, Tourism and Commerce.