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***Highlights from NOMS 2008:
Pervasive Management for Ubiquitous Networks and Services***

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The IEEE/IFIP Network Operations and Management Symposium (NOMS 2008), the premier conference in the field of network and services management, was held 7–11 April 2008 in the exciting and lively city of Salvador da Bahia, Brazil. This was the 20th anniversary of this highly successful and well-known international conference, and we believe that NOMS 2008 followed the traditional long-standing strong track record of excellence.

NOMS 2008 focused on the management of the pervasive IT world; this year the theme was “Pervasive Management for Ubiquitous Networks and Services.” There is much interest in this theme, as evidenced by the large number and high quality of the papers submitted.

The organizing committee of NOMS 2008 put together an outstanding program including technical sessions, poster sessions, application sessions, dissertation digest sessions, a software tools session, panels, workshops, and tutorials. The program included three keynote speakers who are well-known leaders in their respective fields. The first keynote speaker was Roberto Saracco, from Future Centre — Telecom Italia Lab (TILAB). His speech was entitled “From Value Chains to Ecosystem: New Opportunities for Telecommunications and New Challenges for Managing Networks and Services.” The second keynote was delivered by Prof. Ian F. Akyildiz of Georgia Tech. He discussed spectrum management issues, and network and operations management in cognitive radio networks. The last keynote was given by Prof. Luiz Fernando Gomes of Catholic University of Rio de Janeiro (PUC-Rio). The title of his talk was “Brazilian Terrestrial Digital TV System.” The program also included a Distinguished Expert Panel who debated real new challenges ahead in managing ubiquitous networks and services.

NOMS 2008 received a total of 220 submissions from 34 countries. After a thorough review process followed by a face-to-face meeting of the Technical Program Committee, 64 papers were accepted. The result of this process was an exceptional technical program consisting of 16 sessions in two tracks presenting the latest research results.

The technical program was complemented by a third track consisting of five panel sessions that provided a broad forum

for attendee participation, and three application sessions that focused on practical lessons learned in the user and vendor communities. In addition to these tracks, there was an impressive selection of technical posters, tutorials, keynotes, software tools, dissertation digest sessions, and workshops on emerging topics in management.

For the first time in NOMS’ history, we had a technical session on the software tools used to manage networks and services. This session was followed by extensive demonstrations of the tools selected for presentations. Another first was the inclusion of dissertation digest sessions where a selected set of recent Ph.D. dissertations on the field of network management and services were presented.

Several meetings were also collocated with NOMS 2008, notably a two-day meeting of the Operations Committee of the IEEE Communications Society (OpCom), chaired by ComSoc President Dr. Douglas Zuckerman, and a two-day meeting of IFIP Technical Committee 6 (TC6, Communications Systems) chaired by its president, Professor Guy Leduc.

About 400 attendees enjoyed the conference as well as the city, Salvador da Bahia, Brazil, the first capital of Brazil developed in the colonial period, and notable for its cuisine, music, and architecture. With a charming Old Town (a World Heritage Site), a vibrant musical scene, and popular Carnival celebrations, it is considered one of the birthplaces of Brazilian culture. It is important to note that, even though NOMS 2008 took place in a very pleasant place by the ocean, with splendid sunny weather, the attendance at the sessions was always high, even on the last day, which demonstrated the attractiveness of the technical program and the quality of the local services provided to the attendees.

The next events following the strong traditional long-standing track record of excellence and coverage will happen at the Integrated Management Symposium 2009 (IM ’09) in New York and NOMS ’10 in Osaka, Japan.

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Regulation of the Telecommunication Market in the Republic of Serbia: Start-up

By Milan Jankovic, Jovan Radunovic
 Republic Telecommunication Agency, Belgrade, Serbia

In the Republic of Serbia, the process of liberalization and elimination of monopoly in the telecom sector, as well as the beginning of harmonization with the EU legislation, began with the adoption of the Telecommunications Law in 2003. The necessary condition for the implementation of this law was the establishment of the Republic Telecommunication Agency. In May 2005, the National Parliament of the Republic of Serbia appointed the Managing Board of the Republic Telecommunication Agency (RATEL), which provided, within the legal timeframe, all necessary conditions for RATEL to become operational and begin its work on 19 December 2005. Having rapidly resolved the initial problems concerning its functioning, RATEL successfully completed the business year of 2007.

Pursuant to the Telecommunications Law, RATEL has been assigned the task of regulating the telecom market in order to provide conditions for creating a free and open market and further development of the telecom sector, along with the fulfilment of the public interest stated in the following documents:

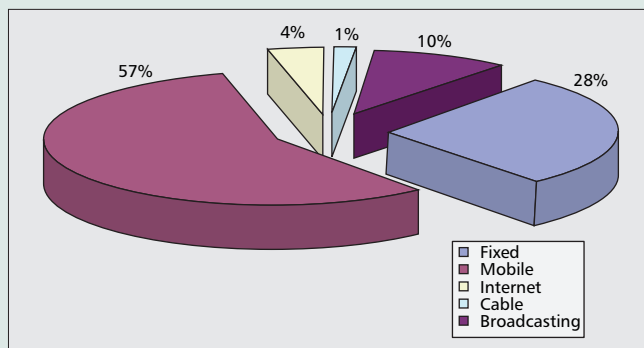
- Telecommunications Law (Official Gazette 44/2003, 36/2006)
- Strategy for the Development of Telecommunications from 2006 to 2010 (Official Gazette 99/2006)
- Strategy for the Development of Information Society in the Republic of Serbia (Official Gazette 87/2006)
- National Strategy for the Economic Development of the Republic of Serbia from 2006 until 2012 (adopted by the Government of the Republic of Serbia)

Guided by the declared principles of lawfulness, competence, impartiality, and transparency, RATEL endeavors to promptly fulfill its role.

Telecom market regulation, with the purpose of its development, which is reflected by the introduction of new technologies, services, and ICTs, may only be achieved by creating the conditions for a free and open market. Indeed, this means prevention of anticompetitive practices by one or more operators in the market. Therefore, it is necessary to provide competition as the only means to guarantee success in achieving the set goal.

This is relevant, on one hand, for the stimulation of competition in the areas of the telecom sector that have been closed until now and, on the other hand, for additional development of competition in areas where it is already present.

Competition can be provided through entry of new operators and introduction of new technologies, whereas in the areas where this is not possible, SMP operators need to be identified in the relevant markets. The prices in such closed markets need to be regulated and formed by applying a cost-



■ **Figure 1.** Distribution of the Serbian telecommunications market. (Source: RATEL—31/12/07)

oriented model. The experience of the developed countries is telling us that successful development of telecoms can only be achieved in this way. Therefore, RATEL has identified market regulation as its principal task.

In 2007 RATEL strongly promoted competition in the telecom sector by drafting regulations and initiating the procedure for the introduction of new technologies and services.

The conditions were created to launch the procedure of public tender for license issuance for FWA and WiMax service provision in order to provide broadband access development, as well as the public tender for license issuance for CDMA-PAMR usage in order to provide public voice and lower-quality Internet service in sparsely inhabited areas. The regulations providing possibility for opening the fixed telephony market (i.e., license issuance to a new fixed operator) was completed.

Competition was brought into the mobile market (RATEL issued three second- and third-generation [2G +3G] licenses). 3G service provision began enabling, among other things, high-rate Internet transmission and TV signal transmission. Along with the introduction of new services, there was also a significant cut in prices for mobile services. Finally, the open mobile market resulted in the conditions needed to introduce a fourth player into the mobile market.

Analysis of the telecom market shows that there was an increase in total revenue of the telecom sector last year, amounting to €1.47 billion, which is 10 percent more than 2006 (see table). It is interesting to see the allocation of revenues and investments in the development of the telecom network and services (Fig. 1).

The revenue from fixed telephony decreased from €426
 (Continued on Newsletter page 6)

	2005		2006		2007	
	Number of subscribers (1000s)	Penetration (%)	Number of subscribers (1000s)	Penetration (%)	Number of subscribers (1000s)	Penetration (%)
Fixed	2527.3	33.7	2719.4	36.3	2854.5	38
Mobile	5510.7	73.5	6643.7	88.6	8452.6	112.7
Internet	756.7	10	1 05	13.4	1268.5	16.9
Cable	530.5	7	541.9	7.2	774.1	10.3
Broadband	40.5	0.54	121.6	1.62	583.1	7.8

Highlights from the Workshop

Pervasive Broadband Wireless Access – Toward Long-Term Evolution

By Fernando Velez, Orlando Cabral, Valdemar Monteiro, Jonathan Rodriguez, Alberto Nascimento, Atalio Gameiro, and Joel Rodrigues, Portugal

The Final Workshop of the CROSSNET (Cross-Layer Design and Network Planning for B3G Systems, <http://www.e-projects.ubi.pt/crossnet/>) project took place on February 19, 2008, at Instituto de Telecomunicações, Portugal. There were 133 participants, 31 percent from academia, 22 percent from R&D laboratories, 15 percent from telecommunication services and maintenance, 11 percent from manufacturers, 11 percent from regulators, 7 percent from operators, and 3 percent from public bodies and safety services. From the feedback received from participants, the adherence to the event was justified by their need to access discussion fora on technology trends and challenges in the telecommunications sector, and research on deployment strategies for pervasive broadband wireless access was faced as an endeavor.

The keynote speakers were Prof. Elvino de Sousa, University of Toronto; Dr. Tom Rondeau, Trinity College Dublin; Prof. Loutfi Nuaymi, Telecom Bretagne; and Prof. Javier Gozalvez, Uwicore, University Miguel Hernandez, Spain, covering the topics of 4G visions, broadband wireless access, cognitive radio, and dynamic spectrum access. Presentations also covered opportunities, challenges, and visions for long-term evolution, vehicular communications, and future spectrum management. One of the proposals is to deploy base stations (or access points) organically building autonomous infrastructure wireless networks.

The Workshop was sponsored by Ordem dos Engenheiros (Colégio de Engenharia Electrotécnica and Especialização de Telecomunicações), IEEE (Portugal Section and VTS Portugal Chapter), Academia de Ciências — Instituto de Altos Estudos, Academia de Engenharia, Advanced Resources, Alcatel-Lucent, ANACOM, Ericsson, FCT, Instituto Superior Técnico, Microsoft, POSC, PT Inovação, Rhode & Schwarz, University of Aveiro, and University of Beira Interior, Portugal.

A copy of abstracts and the majority of presentations are available for download at <http://www.e-projects.ubi.pt/crossnet/workshop.html>

The coexistence scenario across heterogeneous networks should be seen by the end user as the ability to attain a plethora of multimedia services under a single platform in a ubiquitous and transparent fashion, providing the impetus for system solutions addressing network discovery, selection, connection, and reselection as the terminal equipment migrates between collocated networks.

In the scope of CROSSNET, interoperability among B3G, IEEE 802.11, and IEEE 802.16 is investigated, since these technologies are widely seen as the enablers for converging the wireless and mobile worlds. By using the existing simulation platforms for different systems such as high-speed downlink packet access (HSDPA) and WiFi, a common radio resource management (RRM) module is being developed in order to provide a step toward network convergence to hide the heterogeneity between operators and technologies.

CROSSNET has implemented an HSDPA system-level evaluation tool for evaluating RRM protocol performance.

Furthermore, cross-layer scheduling and link adaptation provide key output to enhance the effective capacity and coverage in a more cost-effective way.

The IEEE 802.11 WLAN (also known as WiFi) technology has seen high penetration in the broadband fixed wireless access (BFWA) market to provide data services to hotspot areas, mainly due to ease of network deployment and low cost. However, with the quality of service (QoS) constraints becoming evermore stringent, the IEEE opted to evolve the 802.11 standard to 802.11e, a WLAN technology for QoS support. The key enhancement in this evolved standard can be found in the MAC layer, which now provides support for differentiated service classes and proposes techniques to enhance the ability of the physical (PHY) layer to deliver time-critical multimedia traffic. CROSSNET is addressing innovative enhancement to IEEE 802.11e by pursuing research studies on the application of cross-layer signaling to improve QoS delivery, and provide more efficient usage of radio resources by adapting such parameters as arbitrary interframe spacing, a differentiated backoff procedure, and transmission opportunities, as well as acknowledgment policies. A key output from this work is also the development of an event-driven system-level simulator for IEEE 802.11e.

Radio access technology (RAT) selection algorithms have been studied in the literature, and nowadays equipment with several RATs incorporated is already common. Results on the gains obtained by using WiFi as a backup network for HSDPA have been obtained. The coexistence of the two standards allows prevention of QoS deterioration when in a low mobility scenario. The proposed RAT selection algorithm is based on the load of each system, and the results show a gain of 60 percent on supported network load with the implementation of this QoS procedure over the HSDPA-alone system. As a consequence, when there is heavy load on the IEEE 802.11e network, acceptance of high-priority services will affect the delay in low-priority services like FTP.

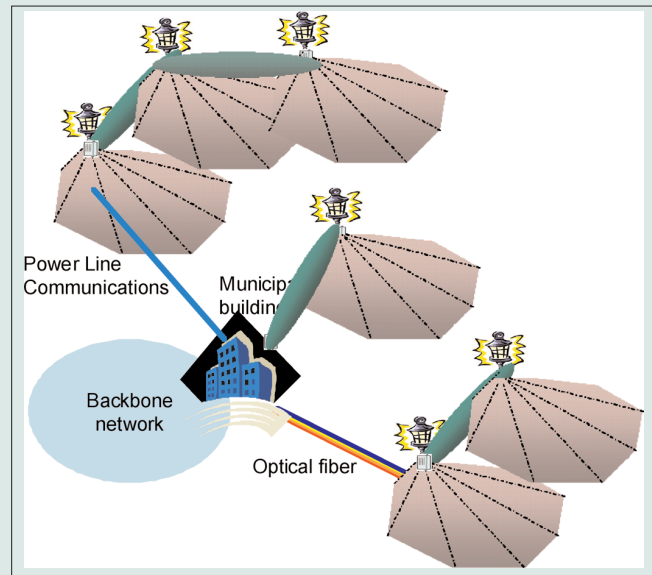
Worldwide Interoperability for Microwave Access (WiMAX) is the commonly used name for broadband wireless access based on the IEEE 802.16 family of standards. WiMAX provides full QoS constrained service types with provisioning for high-data-rate applications targeted toward wide area coverage, and is widely considered to be a strong competitor in the mobile world. Following wireless trends toward ever more efficient networks, CROSSNET designed, implemented, and validated advanced scheduling algorithms based on a cross-layer framework architecture, exploiting information between the PHY and MAC layers. The scheduling policy, considered pivotal in controlling the trade-off between maximizing capacity and QoS delivery, uses cross-layer information to provide preferential treatment to mobile users according to QoS profile, channel conditions, and service classes. A key achievement from CROSSNET is the development of a C++ based mobile WiMAX system simulator that is being used to pursue this line of study.

Milano Digital City: Design of the Municipal Wireless Network of Milano and Trials of Community Services

By Maurizio Dècina and Paolo Giacomazzi, Politecnico di Milano, Italy

Fifteen percent of Italian information and communication technology companies are concentrated in Milano, as well as 40 percent of national research, 37 percent of patents, and 54 percent of the national revenues of the design industry. Moreover, 70 percent of streets in the metropolitan area are cabled with optical fibers, as well as 60 percent of buildings. In 2007, when Milano was a candidate for the 2015 Expo (assigned to Milano in March 2008), the local authority for Research and Innovation started the design of a municipal wireless network based on exploitation of the extensive optical fiber assets of the city and wireless access technologies. This project, named Milano Città Digitale (Milano Digital City), is developed in cooperation with the Department of Electronics and Information of the Politecnico di Milano, one of the leading Italian universities in the field of telecommunication networks.

The objective of the Milano Città Digitale project is to define the architectural, functional, and service components of the municipal network infrastructure. The municipal network must be robust, scalable, and durable. In particular, it must be able to support new technologies, spanning from the current WiFi and 3G HSDPA to 4G systems such as WiMAX and long-term evolution (LTE). The municipal infrastructure will be the basic platform for the provisioning of a rich set of value added services for the citizen, including video surveillance, infomobility, environmental control, telemedicine, tourism, and services for students and aged/disabled persons.



■ **Figure 1.** Example of interconnection of wireless access points to the backbone network: a municipal building terminates connections based on optical fibers, power line communications, and wireless mesh. Connections can be shared among access points through wireless meshing.



■ **Figure 2.** Planning of the radio coverage and backhauling of the central area of Milan (about 5 km²).

These services require independence from the network platform and the possibility of guaranteeing diverse performance and quality levels in different zones of the city. In conclusion, the services provided by the Milano Città Digitale platform are the main objective of the current activity in the modernization of the city, and the Department of Information Systems of the municipality contributes to the definition of the technological platform for service provisioning.

Milano Città Digitale differs from other national municipal wireless projects in its particular focus on institutional services for security, road traffic control, environmental, and social services such as communications for students and underprivileged citizens, and assistance to the aged. Institutional community services on the Internet will become one distinctive feature of a municipality.

The technical project is based on the concept of exploiting to the utmost the large variety of assets of Milano's municipality in the metropolitan area: the poles of the public illumination systems, streetlights, the network for the monitoring of the metropolitan area, the control network of ATM (the public transportation company), the Campus II optical fiber network connecting around 800 municipal buildings, the optical fiber network of the Direction of Transportation and Mobility, the large optical fiber network of Metroweb, and the electric grid of A2A (the

Milano Digital City/*continued*

public utility) that can be used to support power line communications.

The poles of the public illumination system and streetlights can be used to place wireless access points, and backhauling (i.e., connecting the radio access network to the fixed backbone network) can be obtained with radio mesh networks, optical fibers, and power line communications. In this complex framework, the Dipartimento di Elettronica e Informazione of the Politecnico di Milano has developed MUWI, a software tool for the optimal cost-oriented design of a municipal wireless network infrastructure. MUWI optimizes both radio coverage with diverse bandwidth requirements and wired backhauling, in very large metropolitan areas with extensions on the order of hundreds of square kilometers. MUWI minimizes the cost of the entire infrastructure, and provides a detailed design and budget of the infrastructure. In the next phase of the project MUWI will be used to assess the relevance and utility of the available

assets as well as the sensitivity of costs to system parameters. In the next phase the Milano Città Digitale project will focus specifically on services for the city and the community by providing a detailed analysis of the portfolio of priorities and needs, and defining the requirements of the platform for the provisioning and management of services. By the end of 2008, two demonstrators will be deployed in two significant areas of the city in order to experiment with some sample services. In the selected trial areas the municipality is completing the deployment of a significant asset: a fiber optic network and infrastructure for public video surveillance. In the San Siro (the soccer stadium) area, the fiber-wireless infrastructure will be used to experiment with control services such as surveillance on public transportation vehicles and car parking management. In the central Duomo area, advanced services for tourism will be tested (virtual guide, interactive video maps, context-aware services in transportation, parking, restaurants, etc.).

Highlights from the 3rd IEEE Broadband Wireless Access Workshop, Collocated with ICC 2008, Beijing, China

By Thomas Michael Bohnert, Siemens CT, Germany, and Dmitri Moltchanov, Tampere University of Technology, Finland, General Chairs

Dirk Staehle, University of Wuerzburg, Germany, and Gabor Fodor, Ericsson Research, Sweden, TPC Co-Chairs

This year the IEEE International Conference on Communications (IEEE ICC 2008) not only received a record number of technical paper submissions, but also attracted 15 workshop proposals. After a careful review process, three full-day and five half-day workshops were included in the overall conference program.

The purpose of these workshops is to provide a platform for presenting the latest scientific achievements in response to current and future challenges. From a technical or business perspective, or even both perspectives, topics and novel ideas in communications and networking, focused on a specific research area, are presented in a less formal, more interactive way than in the main conference.

The Third IEEE Broadband Wireless Access Workshop (BWA) (<http://www.bwaws.org>) was selected as one of the full-day workshops. After being collocated with NGMAST '07 in Cardiff, United Kingdom, and IEEE CCNC '08 in Las Vegas, Nevada, this achievement renders a significant step forward in manifesting the workshop's overall objective: to become and remain the number one workshop in the area of BWA.

The response to the call for papers from the international research community was extremely positive: a record number of more than 70 papers were submitted from 26 countries. The Technical Program Committee (TPC) selected 15 papers for publication and inclusion in IEEE Xplore. After acceptance ratios of 32 and 28 percent for the first and second event, this edition's 22 percent marked a new record. In addition, the three best papers, ranked based on reviewers comments and workshop presentations, will be published in a special issue of the renowned Elsevier *Computer Communications* journal.

The papers were organized in three sessions, including the performance evaluation and planning of cellular and multihop networks, physical layer issues, and signal processing and radio resource management. The topics of these technical sessions covered theoretical as well as practical deployment

aspects of various broadband wireless access technologies, including the following subjects:

- Performance analysis and deployment issues of multihop multiple input multiple output (MIMO) relay networks
- Capacity and coverage analysis of Third Generation Partnership Project (3GPP) LTE multihop deployment scenarios and the issue of self-organization in LTE
- Co-channel interference cancellation in multihop relay networks
- Signal processing aspects of MIMO-orthogonal frequency-division multiplexing (OFDM) systems
- Radio resource allocation, fairness issues, and TCP-friendly congestion control in modern wireless access networks

Underlining the workshop's close relation with industry, it was opened by the keynote speech of Dr. Asimakis Kokkos, head of China Industry Environment at Nokia Siemens Networks (NSN). Dr. Kokkos has more than 15 years of industrial experience in the telecommunication sector, and has held managerial positions at NEC, Nokia, and now NSN. He has also contributed to the standardization of 3G and WiMAX in the European Telecommunications Standards Institute (ETSI), International Telecommunication Union (ITU), and WiMAX Forum.

Dr. Kokkos addressed the industrial as well as the academic perspective of mobile broadband in his talk, "Broadband: Does One Size Fit All?" He provided valuable insight in operator revenue-and-cost models, their causes and resulting trends. He summarized the evolution of radio access and projected its development over the next 10 years. He then continued with some arguments in favor of LTE, but also stressed the importance of multiradio-capable devices. IMT-Advanced is considered the next major step forward. As a final piece of advice to the present scientific community, he put forward the importance of dynamic spectrum management.

It is the hope of the organizers that this edition of the BWA workshop series has fulfilled the expectations of the authors and workshop attendees, as well as the conference

Highlights from the 3rd IEEE Broadband Wireless Access Workshop Continued

host, IEEE ICC 2008. From our point of view, scientifically and organizationally, it was very successful, and we would like to express our sincere gratitude to all people involved, in particular for the outstanding performance of the Technical Program Committee. In addition, we would like to thank the IEEE ICC 2008 workshop chairs for their support and constructive cooperation.

We are delighted to announce that the 4th IEEE Broadband Wireless Access Workshop will be held in conjunction with IEEE GLOBECOM '08 in New Orleans, Louisiana, in November. The keynote for this event will be delivered by Prof. Dr. Edward W. Knightly from Rice University, Houston, Texas. This achievement underlines the workshop's strategy of maintaining its excellence, and it would be our great pleasure to welcome you in New Orleans, as either an author presenting your latest scientific disclosing or an attendee in similarly warm and lively interactive discussions as were found in Beijing. For more information on the upcoming event, please visit our website: <http://www.bwaws.org>

Before closing, we would like to use this address to remind all of us of the devastating earthquake in Sichuan, only a few days before and overshadowing our event. Culture, belief, rule, and policy might divide nations, yet sincere humanity does not know frontiers but cares for those in despair. Our sincere condolences to all victims.

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TELECOM REGULATION IN SERBIA/continued

million to €414 million, whereas investments increased significantly, from €62 million to €166 million. The revenue from mobile telephony showed a significant increase, from €581 million to €839 million, and there is a sharp rise in investments as well, from €103 million to €210 million. The revenue from Internet service rose from €26 million to €59 million; however, the revenue from cable distribution service decreased from €22 million to €20 million.

Such increases in revenues and significant investments resulted in increased numbers of users of all telecom networks and services. The considerable increase in investments also brought about the introduction of new technologies and services, and better quality of service. Fixed penetration increased from 36 to 38 percent, and digitalization rose from 88.6 to 93.3 percent. There was a considerable increase in mobile penetration amounting to 112.7 percent, corresponding to over 8.4 million users. There is also an increase in Internet penetration amounting to almost 17 percent, with around 1.27 million, whereas the number of users is certainly two to times that. The fact that broadband penetration grew from 1.6 to 7.8 percent is of particular importance. This applies to access via ADSL and mobile Internet (3G).

In 2008 RATEL's principal task is the implementation of a cost-oriented model for market regulation in order to prevent anticompetitive behavior in closed markets and create conditions for an open market.

In addition to this primary task, RATEL is paying particular attention to the enhancement of telecom infrastructure and stimulation of new services. The focus is also on the development of broadband networks. One of the main tasks is the creation of conditions for the application of new technologies and services: VoIP, triple play, IPTV, DTV, and e-government.

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