

„LAST MILE“ SOLUTION IN LITHUANIA

DEVELOPMENT OF BROADBAND INFRASTRUCTURE IN LAZDIJAI AND ALYTUS MUNICIPALITIES

TECHNICAL AND ECONOMICAL VIEW

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Content

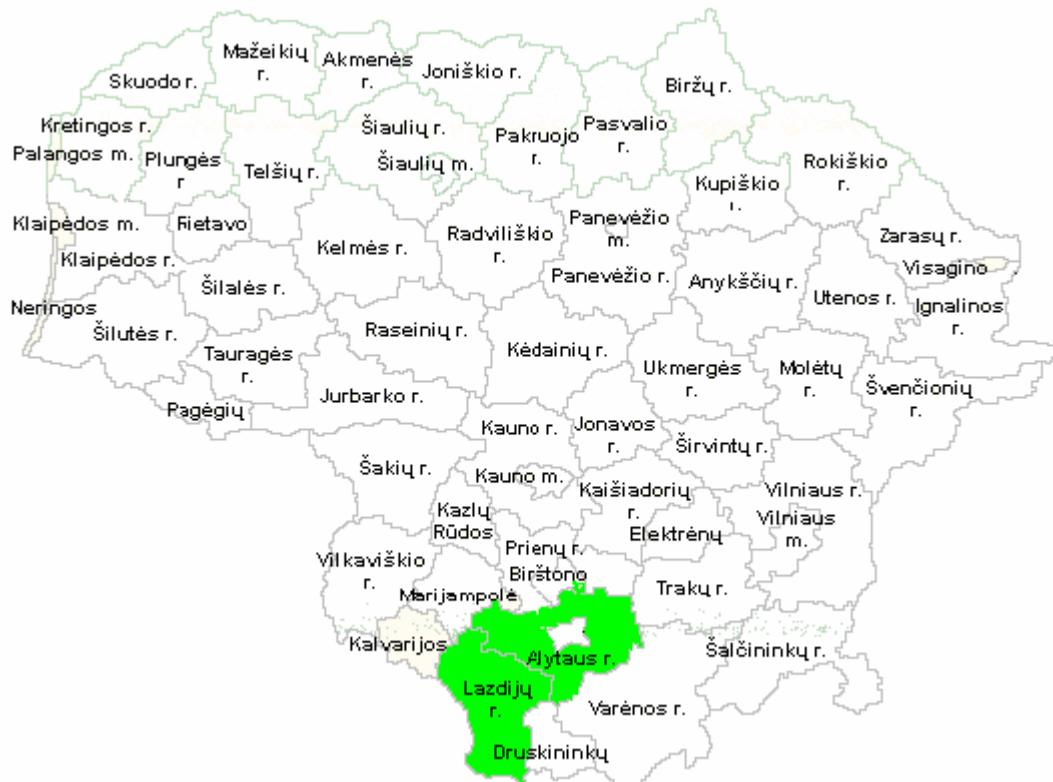
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1. Background/Conditions

Lithuania is divided into 10 counties, which are subdivided into 61 municipalities. This project is implemented by 2 municipalities: of Lazdijai and Alytus regions. Alytus town municipality is not participating in the project.

1.1. Geographic

Alytus and Lazdijai municipalities are located in the south of Lithuania (marked green in the map).



Lazdijai region occupies the territory of 1309 km². Alytus region Municipality occupies 1404 km² (source: Department of Statistics).

According to the information provided by Department of Statistics, at the beginning of 2007 the population of the Lazdijai region was 25.233 people and Alytus region – 31.420 people. So the density of the population is 19.3 persons in km² in Lazdijai region and 22.4 in Alytus region. The total density of Lithuania is 51.8 persons in km².

1.2. Situation before the project

When planning to implement a broadband data transfer network, the present situation was examined and the possibilities to use already built infrastructure and driven broadband network were investigated. Stock company “TEO”(Telecom), as the leader of data transfer market, has the best developed network both in the territory of the whole Lithuania and in the Lazdijai and Alytus municipality regions.

At the moment Stock company “TEO“ has extended the optical connection cables to Lazdijai region, and installed the equipment which can provide DSL connection services (in the towns of Lazdijai, Veisiejai and Sheshtokai)

Just 3 municipalities of 14 in the region of Lazdijai have such equipment. So at this time only 7657 from 27129 residents of Lazdijai region can theoretically use DSL services and this is only 28 percent of Lazdijai region residents. Rest remote municipalities at this time can not use the broadband network service, as Stock company “TEO“ has not installed rearmost equipment needed and optical cables are not extended to the existing telephone stations. Meanwhile in the middle of the year 2004 34 connection stations of Stock company “TEO“ have functioned in the municipality of Alytus region. In four of them it is possible to provide DSL connection services, and in five of them the optics are extended.

In the villages where there is a possibility to use DSL services live 9037 people, or 27.7 percent of all the residents of Alytus region. In the map there are marked black places, where exist DSL connection and marked white places where optical cables exist.



Number of residents in the region of Lazdijai, where broadband connection technologies are installed:

Rate	The municipality of Lazdijai region	The municipality of Alytus region
Total amount of region residents	27 129	32 572
Number of residents where SC 'TEO' stations exist		
In towns and townships	9 978	3 438
In villages	3 570	11 151
Totally:	13 548	14 589
Number of residents where SC 'TEO' DSL units exist		
In towns and townships	7 657	4 564
In villages	0	1 035
Totally:	7 657	5 599
Number of residents where SC 'TEO' optics exist		
In towns and townships	7 657	1 980
In villages	0	1 649
Totally:	7 657	3 629

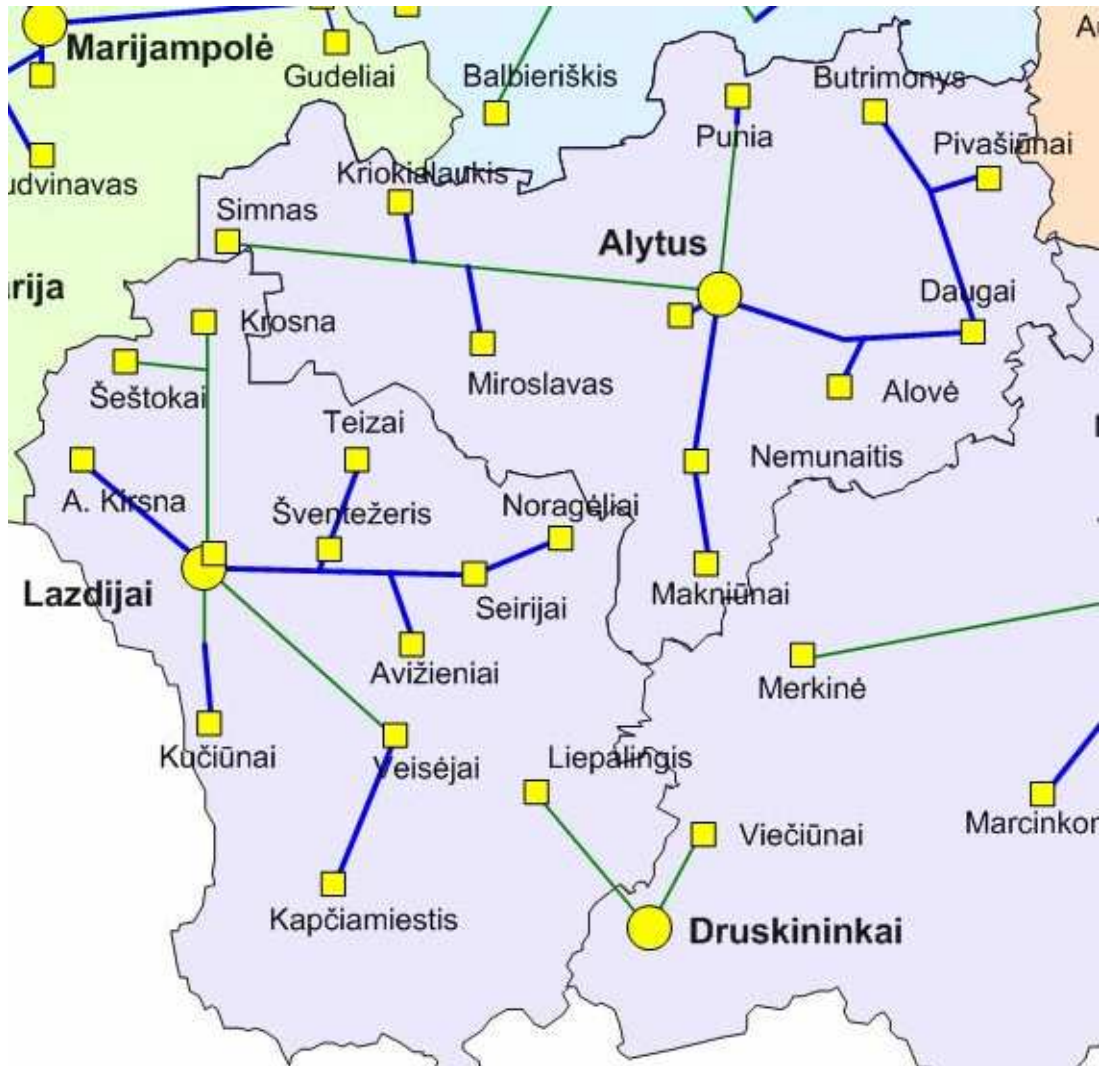
The main service of Stock Company "TEO" used for supplying a broadband network is maintained by DSL device solution. This limits distances between DSL concentrator and the service receiver, as the effective distance of service supply is just 4 km (counting the connection cable distance, it means that real actual distance is much smaller). In that case a big territory of the region, which is far from communication stations will not be able to use DSL services even if the full station modernization will be made. Meanwhile densifying stations because of a small number of users is not effective in the case of services and exploitation. This will determine that part of single farmers and village residents will not have opportunities to connect to the broadband network with the help of simple and cheap solutions. According to above given assumption it is possible to predict, that SC 'TEO' broadband network force in villages and towns of Lazdijai region is very limited and its prospects are very obscure.

Mobile connection operators also have enough explicated infrastructure, but the technologies (GPRS, EDGE, HSCSD) used at present time do not give opportunity to reach induced requirements for broadband networks (technological channel permeability restriction).

In bigger towns of Lazdijai and Alytus regions smaller internet service conveyors present, but their services spread is not marked and their infrastructure according to territorial aspects is not explicated.

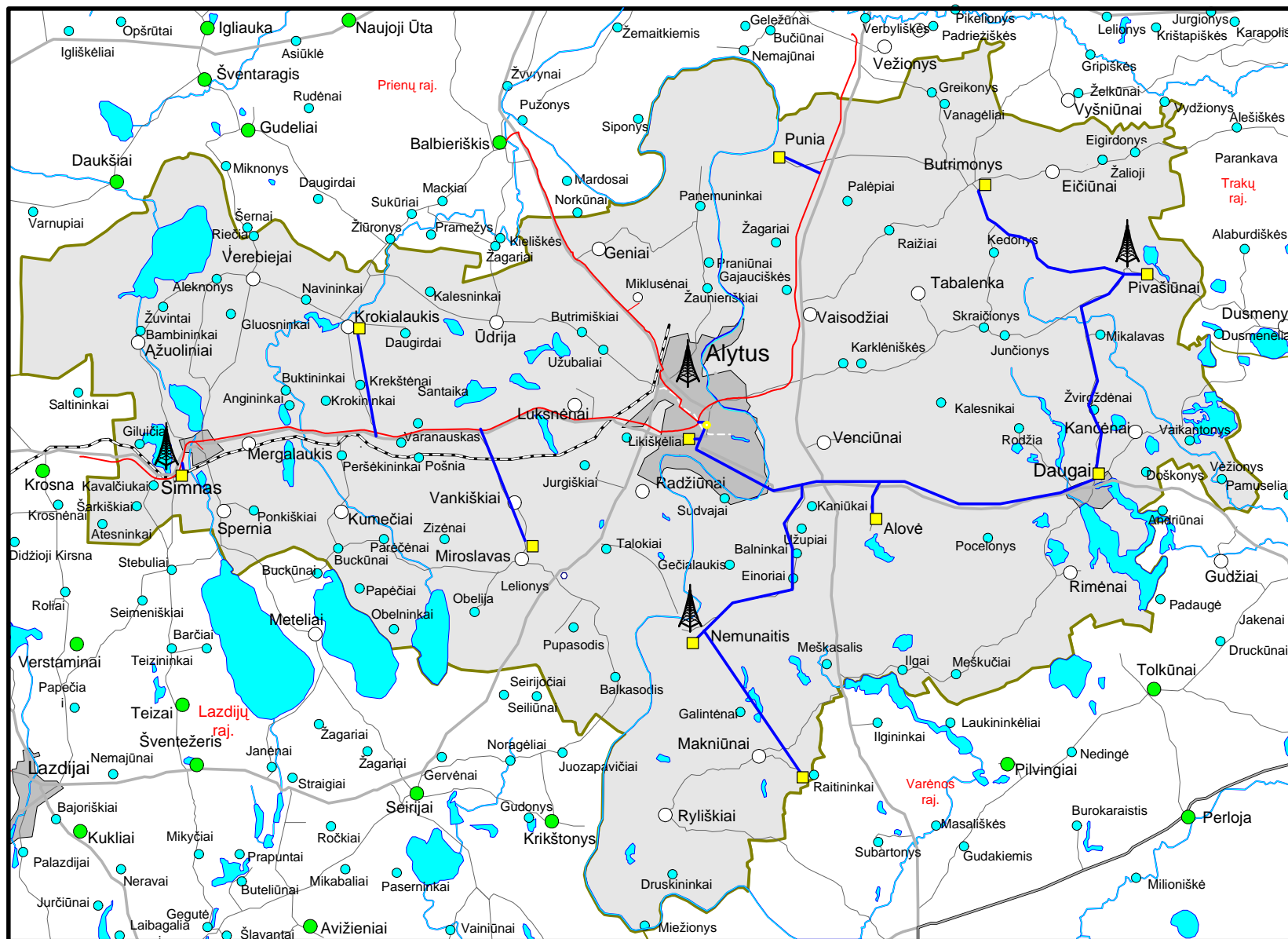
National RAIN project anticipates the connection of municipalities with monitories with the help of optical fiber cables. Here it is shown the topological scheme of Lazdijai and Alytus regions.

Topological scheme of RAIN network in Lazdijai and Alytus regions.



Optical fiber cables of Alytus region:

— AB „Lietuvos telekomas“ ŠKL
— RAIN ŠKL



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1.3. The needs of target groups

Organizations and companies of region municipalities

According to the present situation in companies it is possible to segregate the most important needs of companies of region municipalities:

- Possibility to exchange information between the institutions and companies of the region much faster and operative;
- To reduce information exchange costs and outlays for ITT;
- To increase work efficiency of employees in administrative institutions of public sector;
- To increase the confidentiality of information exchange;
- To improve quality of public services offered;
- To establish the infrastructure for implementation of public electronic services.

Households and business companies of the region

75 percent of Lazdijai and 89 percent of the region residents live in villages. The biggest part of the residents live in small townships, where there are no possibilities to use broadband internet connection. Present infrastructure development of data transfer, limited competitive surroundings and financially weak market of users do not compound presumptions for further development of broadband network infrastructure. One of the greatest needs of users (household and business companies) is a possibility to use broadband connections (mostly in villages).

The most needed types of services:

1. Home use – possibilities to use broadband connections for teleconferences, to warrant safety (possibilities to connect video cameras), to exchange huge data flows (video information, pictures, etc.);
2. Workplace use – possibility to work in any place – unnecessary to drive to a workplace. A possibility is compounded to use present appliquéés from home or clients office. A possibility to collaborate with associates by conferences and in video mode;
3. Health protection - Patients and treatment specialists can use this type of service. Video conferences in real mode could allow patients to communicate with doctors with the help of video conference, it is possible to look after elder people with expedition;
4. Purchases. Allows to search, review, and order and also pay for purchases by internet. With help of broadband connection part of the products (music, videos, movies, etc.) could be delivered by the internet;
5. Public dominance. Due to broadband connections residents are allowed to use electronic services. In future the possibility to prosecute political debates and discussions of public groups with help of video conference would appear;
6. The study. Broadband connection allows to study at the distance;

7. Culture. Allows held aloof users to be informed about future/past events;
8. Transport. With the help of broadband connection, users can get more information by the internet. Therefore, transportation expenses decrease and traffic jams on the roads as well.



2. Project description

2.1. Project goals

The goals of the project - to allow residents, companies, institutions of Lazdijai and Alytus region municipalities to use broadband data exchange network, to improve public institutions management of the region and quality of extended services.

The results of the project – broadband data exchange network infrastructure is established, including “last mile” solutions, which marks 95 percent of the territory of the municipality. 227 public administrative, educational and other institutions are connected to seamless computer network and conditions are compounded for effective information exchange between these institutions.

The most part of the residents in municipalities of Alytus and Lazdijai region live in villages. There are 74.6 percent of the village residents in Lazdijai region municipality and 89.4 percent of all the residents of Alytus region live in villages. Small and markedly scattered townships dominate on the territory. Present IT infrastructure is weakly developed, and broadband connection services are possible only in biggest townships. Households and business company’s Opportunities of households and business companies to use internet services in small village vicinities are limited. Not enough developed infrastructure is one of the reasons which determines low rate of internet usage in the households of both regions.

In order to solve present problems it is intended to create broadband data transfer network in municipalities of Lazdijai and Alytus regions. Broadband data transfer network establishment using wireless technologies was chosen for effectuation of the project because of bad regional informational infrastructure and a great amount of scattered town ships on the territory.

During the project broadband data exchange network infrastructure will be established in the territories of Lazdijai and Alytus region municipalities, counting “last mile” solutions and public, administrative, education, etc. institutions will be connected to seamless computer network of Alytus and Lazdijai regions.

The project will be effectuated in two stages. On the first stage the infrastructure is being established. The propriety of infrastructure will belong to municipalities of Lazdijai and Alytus regions. On the second stage the established infrastructure will be given to the operator to maintain, that is for private juridical entity, which will be chosen in public contest in the way of competitive dialogue. An operating contract will be signed with this operator. The contract with network operators will strictly regulate retention of infrastructure, the pricing aspects of services and will secure speedy broadband connection development in regions.

2.2. Project alternatives and technical solution

At the moment all set of technological solutions is being used, which can extend broadband data transfer services:

- Cable modem. This solution is very beneficial when cable teleoperator network is developed on the territory but the prospect of technology and its development is obscure, as the equipment used is expensive, and more modern and more improvable solutions appear on the market.
- ADSL – asynchronous data transfer digital line. At its time it was one of the modern technologies, which formatted possibilities to extend broadband data transfer network for less expenses. But at the present time the imperfect speed is noticed when sending data, and the further edification of this technology created WDSL technology.
- WDSL technology is distinguished by very high permeability and has the prospect of development. One of the main defects is a very small effective distance from a connection commutation unit to the ultimate user, just 1.2 km. This doesn't pander demands of a village territory, as residents are scattered on the big territory.
- FTTH is the most modern technology which gives opportunity to transfer big amounts of information on the big distances. But infrastructure on village territories is not developed, and its expansion is very expensive.
- Wireless technologies. These technologies started to develop apace and improve together with GSM network development. These technologies capacitate to extend broadband network service on the big territory for small expenses. Because of standard solutions the installation and coordination of this equipment at last days is very simplified. One of the main defects is possible mistake generation while transferring data, but modern devices already have mistake correction solutions and mistakes display fractionally in modern devices. Perfection/modernization of created networks is very simple with these technologies and is not expensive (actually only small units are changed).

Four project effectuation alternatives were separated:

1. Broadband satellite data transfer network;
2. Broadband wireless WLAN data transfer network (802.3 (CSMA/CD), 802.11B);
3. Broadband wireless WeMAX data transfer network (802.16 standard);
4. Optics and wireless connection technology network (optics + wireless connection).

After application for financing from EU Structural funds was submitted the project had to be integrated with RAIN project.

The result is such:

RAIN project included additional nodes and installed additional fiber-optical cables to the wireless towers. Alytus/Lazdijai project uses this infrastructure to get broadband to the towers. Alytus/Lazdijai project has chosen to use WiMAX technology to cover the whole region area.

Currently Municipality of Lazdijai has announced a public tender for installation of infrastructure and the tender is not over yet. Major technical specifications are published in annex 1.



3. How are decisions taken?

The municipalities of Alytus and Lazdijai regions have initiated the project. A feasibility study (investment project) was prepared by Lazdijai municipality. Later this feasibility study together with the application was submitted to Information Society Development subprogram (priority) under EU Structural Funds (priority No 3.3). The application was submitted to Central Project Management Agency (CPMA) and was successfully selected for financing.

The major problems in initiation phase:

- The project had to be matched/integrated with national RAIN project,
- The technical solution had to be modified as some time after preparation of feasibility study has passed and the solutions became old,
- Infrastructure management model had to be selected,
- State aid rules had to be analyzed and carefully interpreted,
- Land ownership and projection must be done very carefully.

After the project was integrated with RAIN project and technical solution has been updated, the topological scheme looks like this:



The project is building 8 towers (instead of 9 as proposed in the investment project) for WiMAX transmission (marked as red transmission powers on the map above). The project is also installing end node equipment, joining the

networks of Alytus and Lazdijai region municipalities (RAIN1 project is not covering this aspect).

The main impact to the region cannot easily be measured as the project is not over yet.

The major problem is the selection of network Management Company. Currently the tender is announced to select a company for renting the whole network and no decision has been made yet. The management company will have to offer wholesale services to any company at the same price.

The other major problem is state aid.

State aid

State aid – is any of implements, which suits EU contract in 87 article 1 part designated criterions. In EU law it is intended common state aid insurance principle. In the contract of EU article 87 part 1 main provisions are set which are align for state aid:

“Except those cases, when this Contract does not estimate otherwise, state members or the aid rendered in any form from state resources which espousing particular companies or the production of particular items deforms competition or can deform it is inconsistent with common market, when it influences the trade of integrated state members ”. Financial support means for farm individual extended by the state are understood as state aid, for which the requirements of EU contract article 87 are implied and the main insurance principle of it is:

1. Rendered from state resources (states municipalities budget or purse) or under the auspices of state.
2. Extends for farm individuals exclusive economical benefit, which they won't receive in market conditions.
3. Intended for production of some items or services to extend, or for some farm individuals.
4. Deforms or can deform strife and influences trading among EU countries.

According to tentative assessments, sponsorship in case of Lazdijai and Alytus broadband network project confirms state aid criterions. But in the EU contract exceptions are intended, according to which state aid, though it conforms state aid features, can be allowed:

1. Exceptions, when aid is held as not contradictory to common market.
2. Exceptions, when particular aid could be held as not contradictory to common market. (EK decides about this).

In contract article 87 part 2 exceptions for common insurance to extend state aid are anticipated (first of above named cases):

- the aid of social character for individual users, if it is extended without discrimination of appropriate products because of their origin;
- aid to renew damages caused by elemental disasters or other specific events;
- Aid is rendered to particular regions of German Federal Republic, where the damage was caused because of Germany separation, for farms if such aid is needed to compensate the economical lag caused by the separation.

Apparently, that the case of Lazdijai and Alytus network project is not in EU contract article 87 part 2 list of mentioned exceptions.

EU contract article 87 part 3 anticipates possible exceptions (second from above mentions two cases) for common insurance to extend state aid (EK decides about this). According to this part, not contradictory to common market could be held:

- a) Aid, intended for regions, with very low living standard or high unemployment to stimulate economical development;
- b) Aid, rendered for common interests of the Europe, to stimulate project implementation or to rectify huge economical disarray of any member of the state;
- c) Aid rendered to stimulate particular types of economical activity or development of particular economical fields, if it does not disorganize marketing conditions so, that it will remonstrate common interests;
- d) Aid, rendered to support culture and to retain the heritage if this aid does not have influence on marketing conditions and competition in community so, that it will remonstrate common interests.;
- e) Other types of aid, which can be indicated in verdicts of councils, accepted by qualified vote majority, according to the suggestion of Committee.

Leaned on EB institution contract article 87 part 3 c-item EK took decisions in cases of Scotland, Wales, Ireland and UK.

According to above collocated, having expectation, that the project can be accredited for state aid, Alytus and Lazdijai municipalities decided to organize appropriate announcement for EK about state aid.

Land ownership and projection problem

The projection phase must be done very carefully, as land owners are not willed to accept changes in their property. Even if land intended to build infrastructure belongs to municipality, a lot of efforts to convince surrounding land owners to change their plots is needed in order to get power supply. Land owners are not willed to accept power lines go through their land, as it decreases land price and usable land area.

In order to bridge this problem land for building towers must be selected very carefully, taking into account:

- land ownership,
- availability of electricity,
- Suitability for the tower to serve wide reception area (the higher stands the tower, the wider reception area is served) – the land must be on higher grounds.



4. Model of financing

The project is financed exclusively by public sector. No private sector financing was used. Lazdijai and Alytus region municipalities have applied to get financing from EU Structural funds, 3.3 measure „Information society development“. Total project size is 6,676 Mio Lt. 4,874 Mio Lt is funded from EU SF and the rest is funded from Municipalities' budget. The budget is with VAT.

Investments of the project consist of 4 main parts:

- Network equipment
- Central units (server) equipment;
- Computer Equipment;
- Consultative expenses

Approximately 90% of the budget is dedicated to infrastructure development, and the rest of the budget is used for administrative purposes (audit, administration services, technical supervision, feasibility study and etc.). The biggest part of the project investment will cost equipment purchase – 56 percent of all projects budget. Construction works in project structure will take 34 percent. The interesting point is that feasibility study was prepared before the application, but it was financed as services were procured under National public procurement rules.

Operational model

Operational model is based on renting the infrastructure to operator. Currently the tender to rent the infrastructure is announced, but later stopped in order to analyze state aid problems.

As infrastructure is based on WiMAX technology, the operator must process WiMAX license. Currently 2 companies in Lithuania process such licenses. The tender participants will have to give a proposal only for wholesale prices (different prices for different bandwidth). The operator will have a right to offer retail services, but wholesale price will have to be the same equal to all market participants. The contract is intended to be signed for 5+2 years. The retail price will not be regulated.



5. Project results, subsequences and effects

The results of the project

- Appointed broadband data transfer network infrastructure in villages, where there is no beneficial electronic infrastructure development possibilities in the conditions of free market. The “last mile” infrastructure is established in the municipalities of Lazdijai and Alytus regions. Data transfer network will cover 95 percent of Lazdijai and Alytus municipality territory.
- Signed contract with network operator, who maintains established broadband data transfer network.
- After implementing the project 123 of Lazdijai and 154 of Alytus region institutions will be connected in data transfer network (totally 227 institutions)

Number of institutions connected in data transfer network:

Type of institution	Institutions of Lazdijai region	Institutions of Alytus region
Municipality's administration	1	1
Monitories	14	11
Educational inst.	37	45
Health care inst.	27	33
Libraries	29	34
Culture inst.	1	15
Other institutions.	7	8
Firefighter inst.	7	7
TOTAL:	123	154

- 227 institutions will be connected into inside network and will be able to use internet connection. That way internet usage in Lazdijai region municipality institutions will increase from 18 % to 86%, And in Alytus region municipality institutions from 34% to 100%. Internet will give conditions to increase wide information spread and employees' competition.

Subsequences of the project.

- It is planned that established broadband connection infrastructure given to possess it by private operators will decrease the price for internet services in villages. This will institute conditions for internet permeability to upsurge rapidly in Lazdijai and Alytus region municipalities. Presumptive that during 2-3 years network operators will extend broadband internet services to 35% households at least, where it is impossible to use broadband internet at this time. In 2 years network operators will have at least 2 400 new clients (households, business companies and institutions) in Lazdijai region

municipality and 300 in Alytus region municipality. In this case internet plough in regions will raise more than 25%.

- During 3 years about 300 new work places are created in the sphere of services.
- Created broadband data transfer network of municipality institutions will institute conditions for rapid information exchange among institutions. More rapid information exchange will mean:
 - Closer intercommunication between institutions;
 - More effective public possession and control of public institutions ;
 - Better quality of extended public services;
- Signally improved the work efficiency of the public institutions in Lazdijai and Alytus regions and according to it, the gratification of the residents and companies' of extended public services is expected to increase.

Expenses for data/information exchange of municipality institutions decrease;

- The major confidentiality of exchanged information is warranted;
- Conditions are intended for educational institutions to use remote education programs;
- The infrastructure is being established, and for this reason public electronic services will be extended for the residents of the region and business companies;
- After the implementation of the project the computer literacy of the employees in municipality institutions will improve.
- Internet consumption in the households of Lazdijai and Alytus regions is increasing the established infrastructure will institute conditions for fast new user subordination to the data transfer network.

The effect of the project:

- The regional investment climate is improving;
- Broadband data transfer network will institute conditions for extension of more different services in regions (slow connection was not able to warrant it).
- The residents of regions will have better access to the resource information. Village residents will be more informed and involved in social and economical activity of the region. Residents (their communities) will be able to involve themselves into remote studies, use e-business and e-medicine services.
- Project implementation will institute conditions to decrease social-economical gap between villages and biggest country towns.
- Conditions are instituted for residents, institutions, companies of the regions to present e-services. The use of electronic services will determine hyper work efficiency and reduced transportation expenses.



- Conditions are instituted for region residents to obtain ITT skills and this will enable them to adjust it to professional activity, proximately increasing labor remit of the region, and instituting conditions for less unemployment in the region.

Potential market

The establishment of infrastructure by municipality resources will institute conditions for operators to decrease investment needs for infrastructure establishment in commercially off-putting territories.

Less private operator investments will institute assumptions to cut prices for extended services and to inscribe major resources for popularizing new products, which will proximately increase permeability of internet consumption in Lazdijai and Alytus regions. With reference to present information almost 50% of Lazdijai and 55% of Alytus region municipality residents at this time do not have opportunity to use broadband data transfer networks. In this case potential market of broadband data transfer network in Lazdijai region is at least 5.4 thousand households, and in Alytus region – 7.2 thousand households.

Potential market:

	Lazdijai region municipality	Alytus region municipality
Total number of residents	27129	32572
Residents without opportunity to use broadband networks	13581	17983
Households without opportunity to use broadband networks	5432	7193
Companies without opportunity to use broadband networks	200	174
Municipality companies and institutions	148	154

Educing pessimistic presumption, that network operators will reach only 40% of internet consumption work, and broadband internet connection price for residents will reach 40 Lt per month, and for companies 70 Lt per month, then credible income of operators in Lazdijai region municipality would be about 1.2 million Lt, and in Alytus region municipality 1.5 million Lt.

6. Recommendations

Technology

Technologies are developing very fast, so the latest technologies must be used. This is why investment project must be not older than 1 year old, otherwise investment project must be updated.

It seems, that the best solution is to utilize RAIN fiber optic cable infrastructure together with wireless technology for last mile in under populated areas.

Financing

Alytus/Lazdijai last mile case was financed from EU Structural funds. There is no chance for such projects to be financed from EU SF from 2007-2013 financing period. The overall budget for broadband networks is 150 million Lt, and the whole amount is already rededicated to RAIN2 project.

So the only financing solution is national/municipality budget or public-private partnership. The later model is needed only if public sector intends to finance further infrastructure development after RAIN2 project is implemented. If not, RAIN2 project has its own strategy how to foster „last mile“ supply in rural areas.

Problems during initiation and implementation

Major problems address during project initiation and implementation:

- The project had to be matched/integrated with national RAIN project,
- Infrastructure management model has to be carefully selected,
- State aid rules have to be addressed while selecting infrastructure management model and must be addressed before project implementation,
- Land ownership and projection phase must be done very carefully (especially power supply problem).

7. Annex 1: Major technical characteristics of Alytus/Lazdijai WiMAX network

The type of radio signal

The environment of spread flow under IEEE802.16-2004, OFDM 256 FFT
Duplex - TDD or FDD
Minimal RF channel size – 1.75 MHz,
Easily configurative RF channel size – 3.5÷14 MHz, 250 KHz step
OFDM sub channel opportunity (OFDM sub channeling)

Base stations transceiver

Ultimate signal capacity in the aerial connector ≥ 35 dBm
Automatic power control (ATPC)
Recipient sensibility (3.5MHz, BER= 10^{-6}), BPSK modulation -97 dBm
Recipient sensibility (3.5MHz, BER= 10^{-6}), 64QAM modulation -79 dBm

Data network conjunction

Network interface - through 10/100/1000 BaseT

Data flow dispensation

Layer2 by IEEE802.1p
Layer3 by IP DSCP
VLAN tagging/untagging by IEEE802.1q

Safety of Users accession

- Base station should maintain users' selection by MAC addresses
- Base station should maintain users' authentication by UAM (Universal Access method) and by PPPoE (PPP over Ethernet)
- Base station should maintain X.509 certificate consumption

User subjection terminal

RF channel size by choice 1.75; 3.5; 7 MHz
Ultimate signal capacity in the aerial connector ≥ 27 dBm
Recipient sensibility (3.5MHz, BER= 10^{-6}), BPSK modulation -95 dBm
Recipient sensibility (3.5MHz, BER= 10^{-6}), 64QAM modulation -77 dBm

Keywords

