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# Community owned fibre optic networks - a sustainable broadband future for rural areas in Croatia?

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# Community owned fibre optic networks – a sustainable broadband future for rural areas in Croatia?

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## Abstract

For a small rural community such as the city of Krk (6.000 inhabitants), the business model for a fibre roll-out is not very promising if it is based on the classical cost-benefit analysis where investments are covered by service revenue generated. The conducted analysis is leading to two main findings – there will be no network operator investing in the roll-out of a fibre access network in the city of Krk and the fibre network has to be rolled out by becoming an integral part of the utility of the city. By utilizing the existing network of empty ducts and the facilities of the city owned cable network, the city of Krk has a better starting position than other comparable cities in Croatia. Public private partnership and open access are highly relevant in future elaborations.

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# 1. INTRODUCTION

Broadband networks can contribute significantly to the economic and social evolution and development of a region. In the competitive environment of the telecommunications sector, investment in future-proof fibre based access networks will only be undertaken, if a positive business case materializes. Traditional telecom providers and other private investors, however, will in their business case calculations not consider external effects for economic development of the region. Municipalities can calculate the business case considering longer payback times and positive external effects. In this respect telecommunications infrastructure can be rather treated like other utilities.

This article investigates the potential for the realization of a fibre network in the city of Krk on the island Krk in Croatia. It covers technical and economic aspects of such a rollout and analyses the costs of network rollouts, achievable revenues, financing, legal and regulatory aspects (national and EU), the business model for the community as well as the rationale for public support for such a project. Thereby, the article follows examples of many other European and Non-European cities and regions to consider an enhancement of local infrastructure for electronic communications but also considers national and regional peculiarities and specificities of Croatia and the island of Krk.

# 2. LOCAL CONDITIONS

The city of Krk covers an area of 40 $km^2$ on the island Krk in the northern part of Croatia and has approximately 6,000 permanent inhabitants and 2,200 buildings. The houses are mainly single family houses but there are also multi dwelling units with up to 25 units resulting in approximately 5,000 households, whereby 45% of the households are used by non permanent residents. The main source of income in Krk is tourism based on 13,000 beds in hotels and private accommodations resulting in 725,000 overnight stays in 2007[2].

[2] Information gathered by the tourist board of the City of Krk (www.tz-krk.hr)

There are currently two fixed network operators (T-HT and Optima Telekom) and three mobile network operators (T-Mobile, Vipnet, Tele2) offering a range of telecommunications services in Krk. The fixed access network used by both operators is owned by the incumbent operator T-HT and consisting of two telephony exchanges. T-HT and Optima own fibre backbone lines connecting the town of Krk with the town of Rijeka where all main national and also some international service providers are present.

Both operators are offering ADSL products with downstream bandwidths of up to 16 Mbit/s, whereby the achieved bandwidth is in any case depending on the distance between subscriber and exchange. By this only a very low number of users will be capable of receiving the maximum bandwidth of 16 Mbit/s. The average fixed access data package taken by private customers is 4 Mbit/s (10 Euro by Optima Telekom[3] and 15 Euro by T-HT[4]) and volume based charging. The flat volume option is charged at a price of 7 Euro by Optima Telekom and 14 Euro by T-HT. Out of this information it is estimated that the average spending of private customers would be around 18 Euro / month.

Concerning the roll-out of a municipality owned fibre network, a special case in Croatia is the open question about the ownership of the conduits (DTK) where telecommunication ducts and cables are located. This will be discussed in the chapter about legal and regulatory aspects.

## 3. CHOOSING THE RIGHT BUSINESS MODEL

The business model is determining how a company is planning to enter the market successfully with a sustainable business and how to achieve profit out of its investment in the long term. According to the fact that the town is planning to invest in an optical network for providing fast Internet access and other IP based services, the starting point of the analysis is the classical telecommunication business model, explaining the three main layers of the business / value chain and analyzing possible business models for the municipality of Krk, from which we will draw recommendations. It needs to be kept in mind that the city's activity is not supposed to replace

[3] http://www.optima.hr/za-po-doma/internet/optidsl, accessed 23rd of July 2010
[4] http://www.t-com.hr/privatni/kzona/cjenici/int_adsl.asp, accessed 23rd of July 2010

private companies' activities and that the city's goal is not to achieve profit by the provision of telecom networks and services. However, also a municipality can only undertake and justify investments if it is in line with public finance and if such a project is solidly financed and does not burden the local inhabitants. Thereby, also issues of securing the availability of public infrastructure can be an important facet of public policy.

The classical telecommunication business model is based on revenues from private or business customers, connected to the telecommunication network which is owned by the telecommunication company (Figure 1).

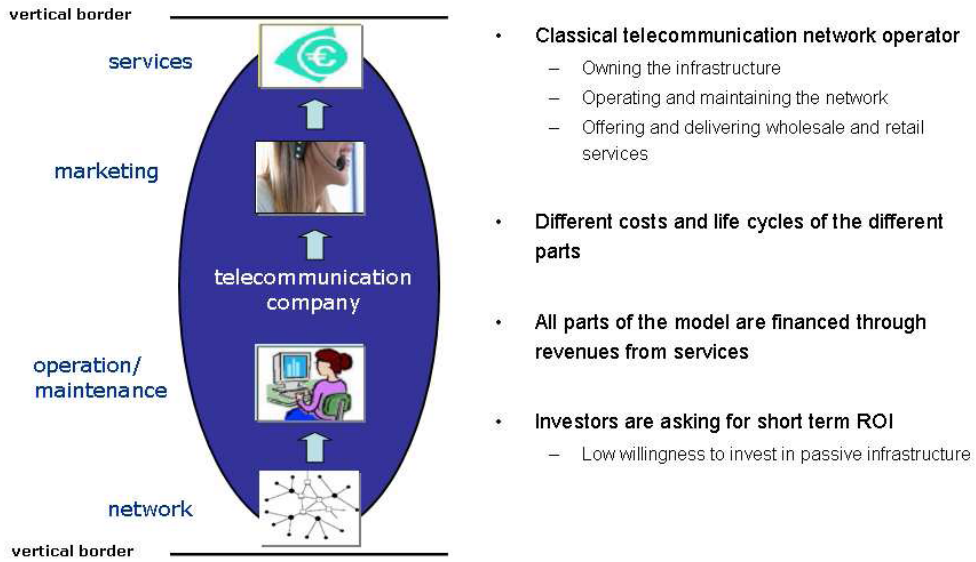


**Figure 1: Classical (vertically integrated) business model**

The commonly offered services offered today are telephony, IPTV and Internet access. The most important fact in running a classical telecommunication business is the usage of **own** infrastructure for providing **own** services to its **own** customers. The investments in infrastructure and operation of the network are paid back mainly by revenues generated through (retail and wholesale) service provisioning. On the other hand, new business models are developing based on the segmentation of the classical model or separation of functions, shown in Figure 2.

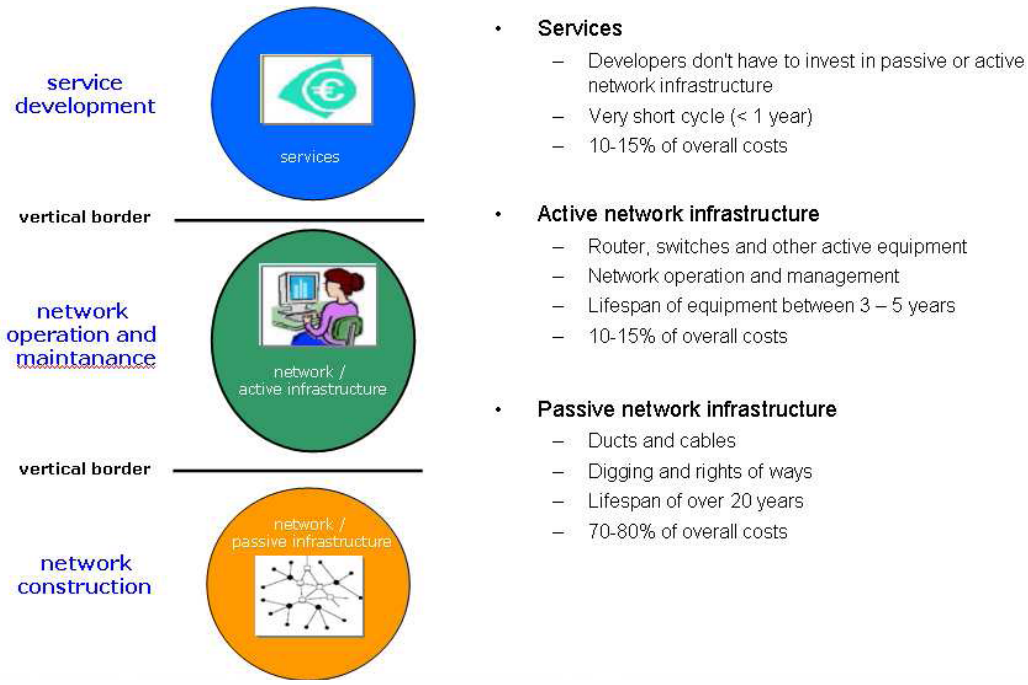


**Figure 2: New (horizontally separated) business models**

In this way we can clearly see the three main layers of which any telecommunication business and by this also an optical network, comprises of:

- Infrastructure consisting of corridors, ducts, cables and buildings commonly denoted as passive infrastructure
- Equipment necessary for conveying data including O&M, commonly denoted as active infrastructure
- Service and application which are what the consumers demand. Typical services are telephony, internet access or IPTV. This part is commonly denoted as service provisioning.

Incumbent network operators, such as the Croatian T-HT, today in its operations are controlling all three parts of the network and all functions which is denoted as vertically integrated business model, being the common practice for the last decades. During the last decade there has been a substantial change in the telecommunication business starting with the liberalization of telecommunication which took place in Western European countries in the mid / late 1990s. The liberalization enabled companies without active and/or passive infrastructure to provide their own services to subscribers by utilizing the infrastructure of the incumbent operators. In this way companies like H1, Optima, Metronet or Iskon entered the Croatian market. The competition on the service layer has led to lower prices for telephony and Internet

access for the customers on the one hand but also decreased the revenues and margins of T-HT on the other hand. Subsequently incumbent operators like T-HT are reluctant to invest in new infrastructure, especially not in the most expensive part, the passive infrastructure in the access part of the network.

This development is calling for a new solution, whereby many European municipality fibre projects are based on open access policies and functional separation. According to the report of the Berkman Center[5], this approach has played a core role in the first generation transition to broadband in most of the high performing countries and is now playing a core role in planning for the next generation transition. The positive impact of such policies is strongly supported by the evidence of the first generation broadband transition.

This is why municipalities like the city of Krk must activate and consider investing in future proof access infrastructure based on optical fibres but also has to decide about the selection of the appropriate business model. There are in principle four major options for municipalities.

The **first option** for the municipality's business model is to copy the vertically integrated business model of traditional / historic telecommunication operators (“Incumbents”) and to be in charge for all three parts of the network (“Full Municipal”). The advantage of this model is the full control over all three layers and a possibly shorter payback time period. The draw back is that the municipality has to run the network and provide the services, i.e. it has to substitute a private run business activity and becomes a “market player” itself.

The **second option** is to invest and take care of the passive and active infrastructure (passive AND active part) and to leave only the service provisioning to other providers (“Integrated Open Access”). Regarding the source of financing, the infrastructure can also be constructed together with a private company (PPP – private public partnerships). The model is denoted as “integrated” because passive and active infrastructures are provided by the same entity. In this business model it is important to establish an open access policy for service providers, whereby the network operator

[5] Berkman Center: Next Generation Connectivity - A review of broadband Internet transition and policy from around the world, Final Report, February 2010

is not discriminating between any of the service providers, allowing access under the same condition for each of them. If more than one service provider is providing a specific service, there will be competition and therefore a better quality of the specific service and a lower price. The advantage for the municipality of this
model is not to have to take care of service provisioning. The disadvantage can be found in reduced revenues (but also lower investments than in the previous model) and longer pay-back time. The problem is that in this approach usually the reduction in revenues is bigger than the reduction in investment compared to the first option.

The **third option** is building only the passive part of the infrastructure (ducts and cables) and leaving the active part and the services to other providers ("Passive Open Access"). Also in this model a PPP approach can be realised for building the passive infrastructure. This model is known as provision of "dark fibre" whereby the passive infrastructure is rented to other network operators in a non-discriminatory way. The operators who are renting the fibres need their own active equipment for providing services. The advantage of the passive open access model for the municipality is to concentrate only on building the network and leaving the operation of the network and the service provisioning to other companies.

The **fourth option** for the municipality is to build the passive part of the infrastructure (ducts and cable) and leaving the active part to exactly one network operator ("Municipal Open Access"). The difference to the previous model is that the operator of the network can not be a service provider – he is only operating the network in a non-discriminatory manner for each of the service providers on top of it. Also in this model the PPP model for financing the passive infrastructure is an option worth considering. The advantage of this model is again that the only part the municipality is in charge of is the roll-out of the passive network. By leaving the management to only one company which must not provide end-user services the municipality is ensuring non-discrimination towards service providers. This model is also more attractive for service providers because they do not have to care about running a network.

Our **recommendation** in this specific case was to adopt the fourth option as a long term goal. By using the municipal open access business model the municipality of Krk will take care of the development of the passive fibre infrastructure in the same

way as it is now taking care of roads, schools, the harbour and other utilities. The active part of the network management is in the hand of a professional company or highly educated staff whose only task is to operate and manage the infrastructure by providing highest availability and transmission quality on the network layer (Layer 2). The provisioning of the end user services is in the obligation of the service providers who are connected to the network in the same way as any other user. Investments in building and operating the network are financed only by monthly access charges. For reaching the necessary amount of customers for the municipal open access business model, we recommend a step-by-step approach implemented in rollout phases. Intermediate steps will partly be based on other business models than the municipal open access model. The recommended rollout phases and the marketing strategy will be described in one of the following chapters.

# 4. COST AND REVENUE ESTIMATION

The estimations have been undertaken by looking at the specific situation in the city of Krk and then calculating the cash flows and the profitability based on cost estimates derived from other projects conducted by SBR Juconomy Consulting AG and other consultancy firms around the world as well as local information. The cost and revenue estimation has been calculated as an investment calculation, i.e. based on cash flows and the net present value in the same way as it would be done for any other private investor. In this calculation the external value is not taken into account.

The elements considered in the calculation are investments in the access networks (ducts, fibre cables, buildings, installation costs etc.), active network elements (hardware, software and customer premises equipment), backhaul and the termination of traffic into the Internet. The CAPEX for the access network are mainly determined by the deployment cost of rolling out the optical fibre, whereby the most expensive part is civil work (digging and excavation works)[6]. There are a few alternative methods for preventing civil work like micro-trenching and lying optic cables inside the canal of the sewage systems, but also using existing poles and ducts.

[6] EU Commission, Explanatory note to the Recommendation on regulated access to NGA, 2008 (see: http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/nga/expl_note_nga.pdf, accessed 23rd of July 2010); Office of Communications of the United Kingdom, Next Generation New Build, 2008 (see: http://stakeholders.ofcom.org.uk/binaries/consultations/newbuild/statement/new_build_statement.pdf, accessed 23rd of July 2010).

In the case of the city of Krk there are over 11 km of empty ducts in the area of the town and over 1.000 households attached to the local cable-TV network, both owned by the municipality and therefore used for reducing the investments in the access network. The network deployment will first cover the main businesses and neighbouring private households, starting to connect the majority of private users after year 5 of a calculation period of 10 years. The accumulated number of business customers is 100 and the number of residential users is 2570. As the architecture of choice we recommend a Point-to-Point architecture whereby each customer/household is connected by a dedicated fibre to the main distribution point, located in the existing premises of the municipality owned utility provider. In the calculation we considered Ethernet based active components. The following table shows the input values used for the calculations and the related sources:

| Input parameter | Value | Source |
|---|---|---|
| CAPEX per meter in the access network | Existing ducts: 14.5 €/m (best case), 20 €/m (base case) and 28.5 €/m (worst case)<br>Digging: 39.5 €/m (best case), 45 €/m (base case) and 53.5 €/m (worst case)<br>Poles: 22 €/m (best case), 35 €/m (base case) and 48 €/m (worst case) | Various benchmarks and cost studies |
| Number of meters of ducts | Total: 41.225 m (digging: 9.775 m; existing ducts: 13.950 m; alternative: 17.500 m) | Market projection by SBR |
| Number of homes connected | 2.700 (best case), 2.570 (base case) and 1.300 (worst case) | Market projection by SBR |
| Market share | Starting by 100% in year one, then falling by 2% for each year until year 10, thereafter constant at 80 % | Market projection by SBR |
| Cost of Peering/IP-Upstream | Starting at 50 Cent per user per month falling by 10% per year | SBR experiences from cost gathering from small ISPs (Austria and Germany) – adjusted due to high bandwidths per user and general cost reduction in peering and IP-Upstream wholesale costs. |
| Cost of leased line from Krk to Zagreb | Installation: 36,000 in year 1, approximately 9,800 in year 8, 2,700 in year 16 and 730 € in year 24 | Official offers, research and SBR experience |

| Input parameter | Value | Source |
|---|---|---|
| | Yearly rental of dark fiber: 107,520 € | |
| Investments in active network elements per user | 173 € per customer plus set-up costs of 10.000 € in year 1. | Our figures are resulting in 173 € per customer for CPE, and router plus 10,000 € set-up costs in year 1. |
| Direct equipment O&M | 9.70% | SBR Benchmark |
| Indirect equipment investment | 4.00% | SBR Benchmark |
| Indirect OPEX | 4.20% | SBR Benchmark |
| Indirect operations costs (EP-MU) | 12.60% | SBR Benchmark |
| Minimum EPMU | 75,000 € | Based on the mark-ups for OPEX and Indirect operations costs, the absolute costs for OPEX are underestimated in case of a small size of the operations. Therefore, a minimum for indirect operations costs of 75,000 € per year equal to one full-time-employee has been budgeted. |
| WACC (cost of capital) | 15% | The EU Commission has proposed 15% for NGA investments in order to incentivize investors. The average value in EU is around 10-14% for fixed and mobile networks. It is expected that the risks are higher for a completely new network and therefore we assume 15%.[7] |
| ARPU, Class 1<br>(Partner customers) | Base case: 36 € per Month for the bitpipe service<br>Best case: starting at 50 € per month<br>Worst case: starting at 24 € per month | SBR assumption |
| ARPU, Class 2<br>(other customers) | Base case: 18 € per Month for the bitpipe service<br>Best case: 25 € per month<br>Worst case: 12 € per month | SBR assumption |

Based on the described methodology and inputs, a high level cost and revenue estimation can be made for a base case, a best case and a worst case. Due to the inaccuracy of a high level estimation, the range of possible results is accordingly large, but due to the specific results and the profitability considerations, this is not to be regarded as a problem as the results are definite.

[7] ERG Report, Regulatory Accounting in Practice 2008, September 2008. p.26

In the base case, the net present value (NPV) is negative with a value of 1,3 Million € at a WACC of 15%. The break-even is reached from year 11 an onwards. The following graph shows the expected cash flow for the next coming 30 years:

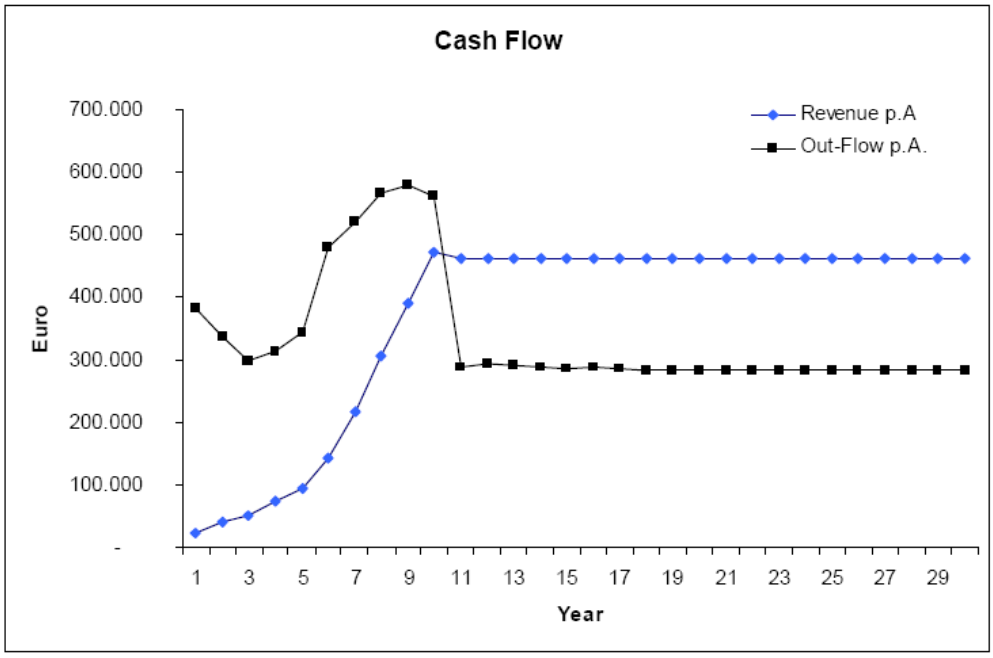


**Figure 3: Cash flow for 30 years**

If these values are cumulated and discounted to present values (i.e. regarding the cost of capital of 15%), the following picture is given:

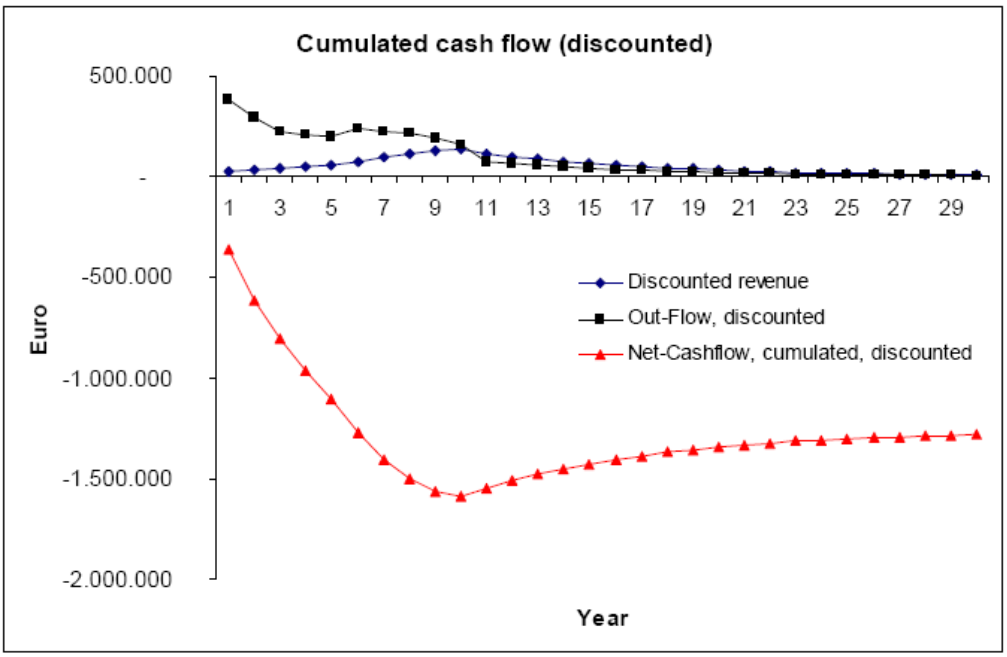


**Figure 4: Cumulated cash flow (discounted)**

As can be seen in Figure 4, the discounted cumulated cash flow (whereas the red line is equal to the NPV) is -1,3 million € after 30 years of operations. It is interesting to look at the distribution of costs in Figure 5. These are shown as undiscounted values for the 30 years calculated in the following graph. As can be seen, the cost for deploying the physical access network is only representing 15 % of total costs. A large part of the costs are derived from the transport from Krk to Zagreb. For these costs, optimization possibilities exist. If the town of Krk for instance cooperates with a national ISP, the ISP is expected to be able to realise this connection at much lower costs. Further, the indirect OPEX (overhead costs) are making up 22 % of total costs. This is due to the fact that we calculate with a minimum of one full time employee at a cost of 75.000 € per year. We regard this to be necessary, inter alia, to provide the necessary support for the business customers (hotels and partner customers).

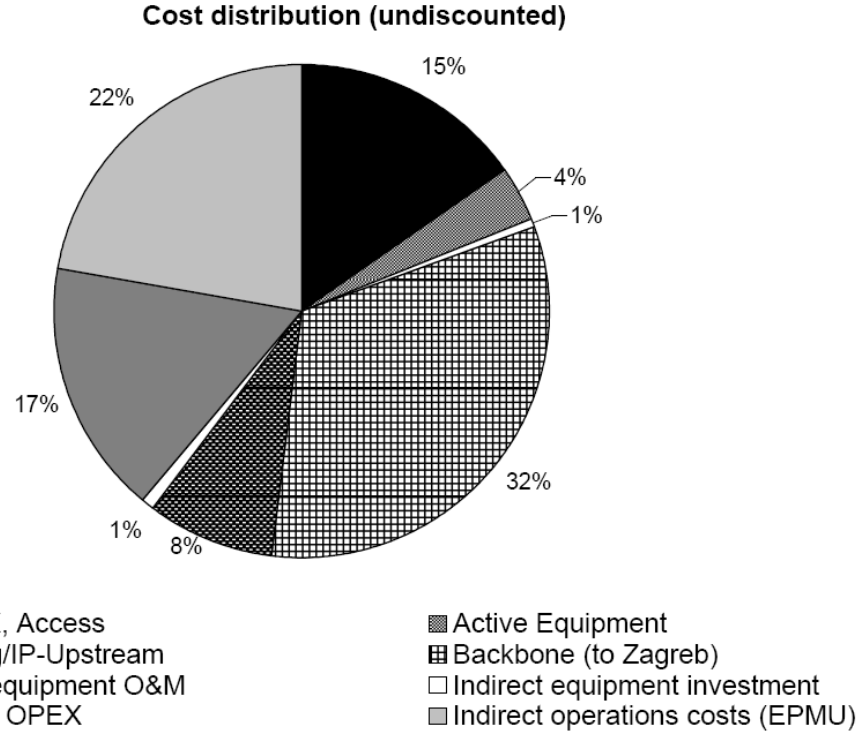


**Figure 5: Cost distribution**

As stated previously for some input values, there is a range and not a fix value determined. The most positive values are used to calculate a best case scenario and the most negative values for the worst case scenario. The different input values are listed in the following table:

| Input parameter | Best Case | Base Case | Worst Case |
|---|---|---|---|
| CAPEX per Meter, type 1 | 39.50 € | 45 € | 53.50 € |
| CAPEX per Meter, type 2 | 14.50 € | 20 € | 28.50 € |
| CAPEX per Meter, type 3 | 22 € | 35 € | 48 € |
| Revenue (partner customers), p.A. | 600 € | 432 € | 288 € |
| Revenue (other customers), p.A. | 300 € | 216 € | 144 € |
| Number of homes connected | Starting with 65 in year one increas-ing to 2,700 in year 8 | Starting with 65 in year one increasing to 2,570 in year 10 | Starting with 10 in year one, in-creasing to 1,300 in year 15 |

As a result, the following cumulated and discounted cash flows are derived for the three cases:

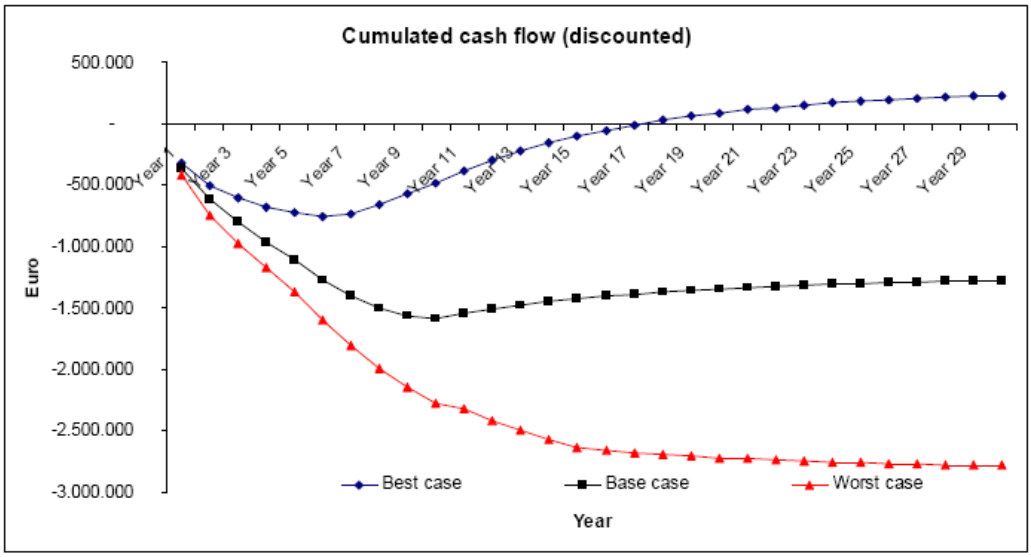


**Figure 6: Cumulated cash flow for different scenarios**

The calculations have been made with a WACC (cost of capital) at 15 %. For some projects, the municipalities have the opportunity to finance investments at a much lower rate. By assuming a rate of 6% instead of 15%, the outcome of the calculations for the net present value is -880,000 € for the base case, -4.8 million € for the worst case, while the best case becomes much more positive with a positive present value of 2.4 million €:

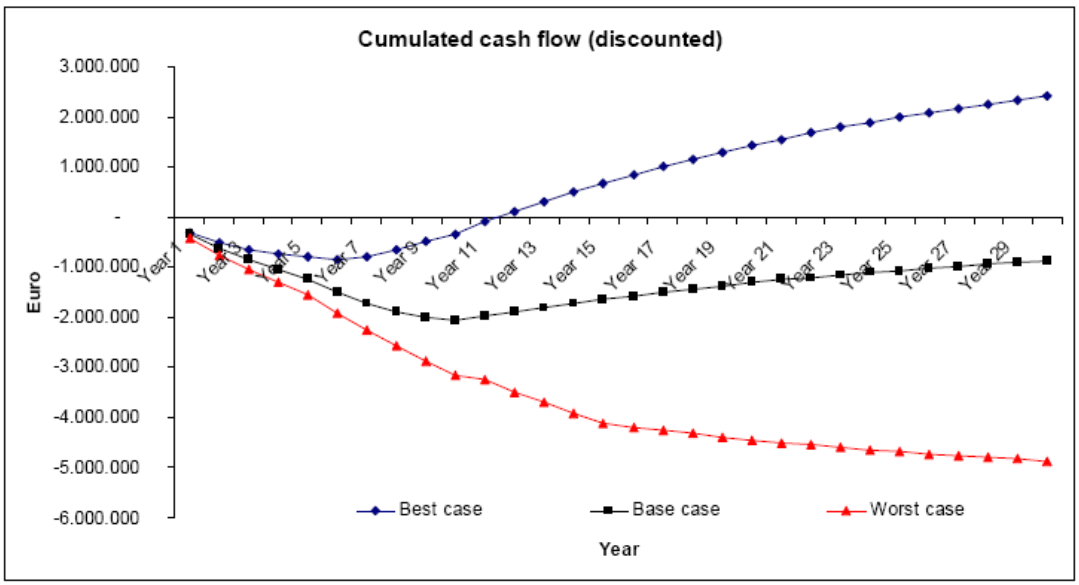


**Figure 7: Cumulated cash flow assuming a WACC of 6%**

The high level cost and revenue estimates provided clearly show that the investment can only be made with public support or by applying another business model. The contribution margins won't be able to cover the CAPEX of 1.5 million € in fibre local loops. In total, a result of between -2.8 million € (net present value) for the worst case and 230,000 € (net present value) for the best case, with a most likely result of approximately -1.5 million € (present value) is to be expected.

These calculations are only high level, but clearly show that another concept is advisable. Based on an optimization of the business model, as for instance a close cooperation or joint venture with an ISP in combination with innovative models of financing, the investment in a fibre network in the town of Krk has the chance of being profitable. A crucial factor thereby is to reduce the costs for the backhaul connection and for costs of management and operations.

## 5. FINANCING

From the decision regarding the business model, it seems to be quite clear that the city of Krk is moving towards the municipal network and this may also to the larger extent involve financing by the city. Thus, the city can choose between various options:

- It could enter into a PPP model looking for an additional private investor who supports the project, especially undertakes the financing.
- The city could look for external financing through the Banks for Reconstruction and Development (EBRD) or the European Investment Bank (EIB) where telecommunications projects are generally something that is supported by the means available to these institutions.
- The city of Krk may also be forced to provide some of the money for the investment locally.

In the last option one could consider to which degree certain local taxes and fees may be used in order to foster such networks. For example one could consider to which degree house owners could be asked to contribute to the financing of such a network. This could either be done via an obligation to participate in the financing or it could be done by issuing bonds by the city of Krk for such projects where the investors later on have the possibility to receive a payback from such investment. However, this would require that the city outsources the activity in separate units which is then directed according to commercial criteria.

Although international experience shows that PPP models are difficult to implement, we believe that a PPP model would be the best solution for the city of Krk in financing the network. The reason for this is that the economic viability of the activity is uncertain and therefore, project financing oriented towards long term goals seem to be an attractive approach. The PPP is a model which also has gained some importance through successful implementation in Croatia and experience in this area is available. The risk of an alternative infrastructure to be deployed in Krk by private investors is low – and once the municipal network is in place, it is even lower. The network is being developed to support the social and economic development of Krk. These goals are related to public functions. However, operational know how is important to be added – something that can be organized in a PPP project[8].

Considering the external financing through the Banks for Reconstruction and Development (EBRD), the financing for private sector projects generally ranges from EUR

[8] Ehrler/Ruhle/Brusic/Reichl (2009), Deployment of fibre optic networks within the framework of public-private partnerships projects, in: International Journal of Management and Network Economics, vol. 1, no. 3, pp 308 - 336

5 million to EUR 250 million, in the form of loans or equity. The average EBRD investment is EUR 25 million. Smaller projects may be financed through financial intermediaries or through special programmes for smaller direct investments in the less advanced countries.

## 6. LEGAL AND REGULATORY ASPECTS

According to the Electronic Communications Act (NN 73/08 – "Zakon o elektroničkim komunikacijama (ZEK)") there are no objections for a municipality to build and operate a fibre optical network in Croatia. Thereby, ZEK is not regulating the ownership of the network, which is regulated by national law regulating ownership in general. According to the Croatian regulatory agency (HAKOM) municipality and towns should build out their own infrastructure, calling this approach "integrated infrastructure" by which the roll-out of telecommunication infrastructure would be in parallel with existing work the community facilities and infrastructure[9]. In this sense the regulator is supporting the investments in infrastructure, whereby the HAKOM is aware of the fact, that a classical network operator is not going to invest in building new infrastructure in rural areas. The ordinances[10] of HAKOM are therefore relating on civil works, whereby the direction is to fill up the ducts with pipes if there is additional space in the ducts and the pipes have additionally been equipped with microducts. The effect of this direction is not only the faster roll-out of new infrastructure but also environmental effects by preventing additional digging and reducing CO2 emission. For the small towns and villages on the island of Krk there is also to consider the general problem connected with digging in narrow streets and the occupancy of limited street areas, which is reduced by applying the ordinance about common use of infrastructure.

A specialty in Croatia is the open question about the ownership of the conduits (DTK) where telecommunication ducts and cables are located. The incumbent operator T-HT was in 1999 sold to Deutsche Telekom. According to a confidential supplementary agreement between the Croatian government and Deutsche Telekom, T-HT is claiming that the conduits have been part of the contract and are now owned by T-

[9] V. Zuti and M. Weber (HAKOM), Electronic Communications Infrastructure Embedded in Other Infrastructures, Fiber Week 2010 (Split/Croatia), 2010
[10] NN 73/08: Electronic Communications Act (ZEK); NN 154/08: Ordinance about common use of infrastructure

HT. On the other side, conduits buried in the streets are part of the street and thereby part of the communal infrastructure if there is no registered right of way or servitude. In European cities this fundament is used for the development of community broadband network based on fibre optics.

Taking into account the European context with regards to public funding and state aid, respectively a municipality needs to consider the following issues and regulative provisions[11]:

- the compatibility of state aid with Article 87 of the EC Treaty in general;
- the general funding programs of the EU to obtain state aid;
- and the Community guidelines for the application of state aid rules regarding the deployment of broadband networks.

These provisions are mentioned here as Croatia is in the accession process to the European Union and the provisions of EU law could become relevant in a foreseeable period. With respect to the role of a municipality/community that is running a business or wants to focus on it, e.g. the operation of a network or the provision of telecommunications services with the aim to make profit, one has to consider that on the general European level there are no specific legal provisions in place focussing on such economic activities. Thus, usually the subsidiary principle has to be applied. This means in the first step the application of national law and by-laws and afterwards the law of the European Union. The latter in general is on a more abstract level.

## 7. SOCIAL AND ECONOMICAL ASPECTS

A city-wide optical network presents an opportunities within the city of Krk for job growth, economic development, transportation and energy savings, health care improvements, community development and tourism.
In a status report on broadband internet access in the Republic of Croatia published in February 2009, the status of broadband access at the end of 2008 is compared to

[11] EU Commission: Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks, 2008

international benchmarks[12]. The following graph shows the broadband penetration rate in EU27 and the Republic of Croatia.

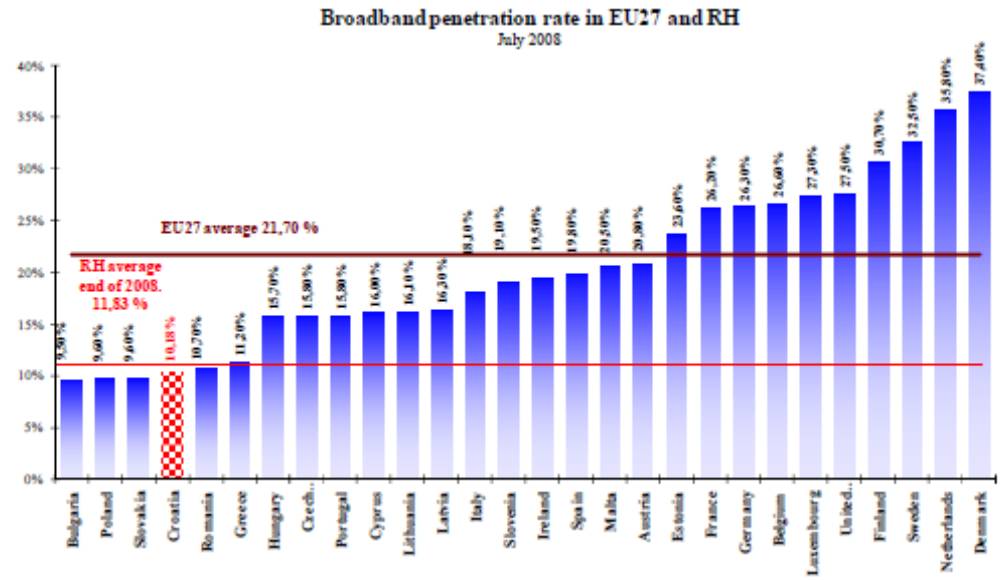


**Figure 8: Broadband penetration rate in EU27 and the Republic of Croatia**

Compared to the EU average of 21.7% Croatia has reached a penetration of 10.18% mid 2008 and ranks between Romania and Slovakia in the lower ranks of European penetration. Considering the late start of broadband development in the Republic of Croatia[13] the last years showed a huge improvement and growth rates well above the average growth rates in the European Union. The government of the Republic of Croatia has recognised a significance of broadband for growth and development of knowledge and economy in general.

Over the last decade several studies have proved the economy benefits of enhanced information technology infrastructure investment and usage. Röller and Waverman[14], found that about one third of the per capita GDP growth could be attributed to telecommunications infrastructure investments. The OECD study "Broadband and the economy (DSTI/ICCP/IE(2007)3/final)" issued May 2008, emphasises that the impacts of broadband on the economy are more significant than the impact of electricity, steam engines and information technology in the past. At the third international

[12] Broadband Internet Access in the Republic of Croatia, 2008 (see: http://www.e-hrvatska.hr/sdu/en/e-hrv/contentParagraph/01111111111111/document1/Broadband_internet_access_Croatia_2008.pdf, accessed 23rd of July 2010)
[13] In 2003 there were only 4.400 broadband internet connections and a density of only 0.01%.
[14] Roeller Lars-Hendrik, Waverman Leonard, “Telecommunications Infrastructure and Economic Development: A SimultaneousApproach”, The American Economic Review, Vol. 91, No. 4. (Sep., 2001)

IT-Summit of BMWi (Federal Ministry of Economics and Technology in Germany) in November 2008 the strategy paper "Broadband of the future" described broadband as engine of the transformation of economy and society. The Connected Nation report “The Economic Impact of Stimulating Broadband Nationally” from February 2008, shows the advantages of the rollout of broadband in rural areas and states that an increase of broadband penetration in the U.S. of only 7% would result in 2.4 million new jobs. Applying the results of the Connected Nation report would mean that for every percentage point increase in broadband penetration employment is projected to increase by 0.2 to 0.3%. This implies that such rollout also can contribute positively to employment in Krk.

Beside employment there is also very high potential in telework and e-government opportunities, because the city of Krk is currently very dependent on workplaces and administration in the nearby city of Rijeka which is 55 km away. In the analysis of a similar project in Portland, Oregon, USA uptown services described that over 13% of the work force were working from home more often if FTTP would be deployed. E-government has already been part of the strategy of the Republic Croatia about IT and communication technology development for the 21st century[15].

Besides being used by citizens or business partners, the optical network will also be used and appreciated by tourists, therefore leading to a higher number of overnight stays in the post-season. By this the season will be spread over the usual summer season and significantly contribute to the overall income of the town of Krk. The optical network will also improve the image of the town of Krk and the installation of definition web-cams on some of the nicest spots in town could attract additional number of tourists.

## 8. CONCLUSION

There are several possible business models for the city of Krk, ranging from vertical integration to concentrating on the infrastructure aspects. We recommend choosing the option of “municipal open access”, which means the involvement of the municipality only on the level of physical infrastructure and thus allows the city of Krk to

[15] Ured za strategiju razvitka Hrvatske: Hrvatska u 21. stoljecu – informacijska i komunikacijska tehnologija, 2007

concentrate on the utility aspects of telecommunications networks. However, the backhaul to the Internet exchange (e.g. in Zagreb) has been identified as one of the main bottlenecks because of the high prices for the backbone connectivity (resulting from low competition) and low end-user service income (resulting from limited number of business and private customers and low Internet awareness of private user). In order to gets the project going we have included the cost for backhaul in the cost/benefit analysis. This allows the city of Krk to independently offer a basic internet access service and connect service providers locally or in Zagreb. In the long run the business model should be restricted to providing passive infrastructure (municipal open access).

We believe that several factors favour the involvement of the city of Krk in rolling out a fibre based optical network:

- The current financial crisis has led to national and EU-wide programmes to foster infrastructure investment. It should be possible to leverage these sources.
- Croatia is on the path to membership of the European Union and has committed itself to become a preferred location for businesses and tourism.
- The city of Krk has access to a duct network, which allows avoiding digging where ducts are available. Synergies can be found with other city owned utilities.

The main challenges for the city of Krk in the realisation of a municipality owned fibre network are:

- The backhaul as a main cost driver and critical point for the business case. Further investigations are necessary to bring down the price for the backhaul. Using dark fibre would allow to profit from falling prices for transmission equipment.
- The costs of civil works. The city of Krk can utilize existing ducts. Other alternative methods like micro-trenching should be investigated.
- The revenue side. Although it is recommended to concentrate on business customers first, it is important to increase the customer base as quickly as possible in order to generate the cash flow for the investments. Options which

should be investigated are the deployment of public hot spots and marketing campaigns for residential customers.

- The financing. It is recommended to analyze options for a PPP-model in order to generate the financial means.

The deployment of a municipal optical fibre network in the city of Krk is a challenging project. A cost/revenue analysis without evaluating the value for the economic development of the region will only have a positive outcome if several critical input factors can be optimized. The best case in the following graph is characterized by prices of civil works at the lower boundary of the estimated price interval and by assuming a cost of capital (WACC) of only 6%. However, the city of Krk is in a better position as traditional network operators. A municipal optical fibre network as a political decision for improvement of infrastructure is a reasonable way forward. As many examples in the world show, investment in basic infrastructure will increase the value of the region as destinations for tourism and settlement of companies. The cumulated cash flow chart also shows that private investors most likely will not deploy such a network in Krk due to lack of density effects and usually, such companies also calculate with a substantially higher WACC. The municipality has the possibility to take a broader view and to also consider (at least qualitatively) where such a network will bring benefit to the local community in other areas.