# BROADBAND RANKING OF REGIONS AND ITS METHODOLOGICAL BASIS

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***Abstract**: Access networks plays an essential role in some sectors of the economy. Its speed basically defines the utility of the system. In Hungary, in 2009 the average guaranteed download speed was just 1 Mbit/s, and a little more than the tenth part of subscribers had 4 Mbit/s or more data rate. For satisfaction the claims of today and immediate future needs broadband – capacity of at least 50 Mbit/s – infrastructure. To build of such infrastructure in those regions, which less attractive commercially for service providers, state intervention is necessary. The country and EU provide financial sources but is not enough to the necessary developments. Many ICT infrastructure developments has happened on many settlements in Hungary, but not always on the most suitable places. My aim is to rank regions based on the ICT development of them, because it is worthy to focus time and resources, where these will be return as quickly as possible. In my opinion the target of the developments would be worthy to select on the basis of usefulness. Complex regional indicator is necessary to this objective which can be applied on settlements level and on the basis of it these can be ranked. It is important to have regard to such social-economic factors which really correlate with existence of broadband networks. In this article I present the Hungarian regions situation in broadband network respect, and the methodological basis of to construction of a regional network indicator. I sketch scope of possible earmarkable elements – which are accessible statistical indicators in connection with broadband networks – and applicable model for it.*

***KEYWORDS:*** broadband network, regions, rank, investment decision support, efficiency

**JEL CLASSIFICATION CODES: O39, R11, M15**

## 1. INTRODUCTION

The penetration of the broadband internet infrastructure is shaping the nature of traditional ICT sectors and also the society as a whole. The growing availability of high bandwidth is likely to enhance business growth opportunities for service providers (Picot & Wernick, 2007), furthermore it can enhance economic opportunities in rural areas by stimulating the development of home businesses and telecommuting and by facilitating access to education and training. (LaRose et al, 2011). Large-scale NGN (Next Generation Network) infrastructure development is going on worldwide. For EU it is also a priority issue and it has developed different strategies, programs for network development and provide financial support for implementation too. The development ideas are closely interlinked with governmental supports which help to those regions where there is no or not suitable high speed network infrastructure and the return of investment is not provided on market conditions (Commission of the European Communities, 2006).

In the interest of efficient resource allocation can be important to assess the general characteristics of the regions. Obvious methodology and monitoring system for it have not yet been worked out in the Hungarian subsidy practices of broadband developments. In my article I present the theoretical and methodological fundamentals of such indicator which may help network development efficiently and effectively. By the indicator it should be possible to realize ideas of state high speed network infrastructure developments in such a way for they should be targeted and effective.

Furthermore, with realization of investment, development analyses will play an important role. The main goal of these analyses is to answer the question whether or not the investment in chosen broadband access technologies is profitable (Zagar & Krizanovic, 2009). Since it's about investment which cover larger geographical area, can be relevant the measuring and calibrating of efficiency on regional or settlement level, the index may assist in these processes. Although, there is wide range of those composite indexes which related to measure of ICT development, and these indices measure different aspects of the information society (Emrouznejad et al, 2010), but they don't give answer on the question what the standard of ICT developments of a region within a country. But, this would be essential for selecting the regional development way, which is well-established economically.

## 2. BROADBAND INFRASTRUCTURE AS CAUSE AND EFFECT

Figure 1. shows where the conditions was given – which necessary to a profitability service – , the development has happened by investments of service providers, on business basis. But those rural regions which are less attractive in a business point of view, state intervention is necessary to build up a modern hard-infrastructure. But in my opinion about the scarcity of financial resources which available for this aim, it is useful to consider the place of use, build up NGN infrastructure, where bigger efficiency can be reached. If it built up on the not suitable place, people would use only a tiny fraction of the capacity. However, those areas, that have reached a certain level of development, to realize network with public aid, would promote further improvements there.

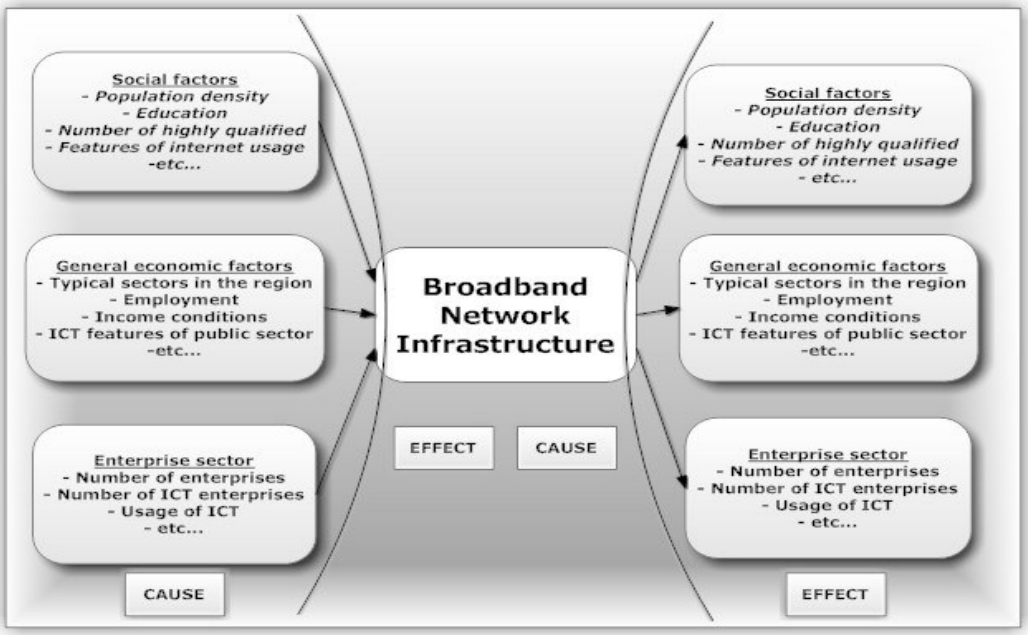


**Figure 1. Broadband network infrastructure as cause and effect**

I classified the factors – which have an effect on return, consequently on investments – in three main factor groups. The first is the set of social factors. This includes, inter alia, the demographic, educational and characteristics of internet use. Fact, that the business-based infrastructure building requires economies of scale.

Key factor in costs is the distance of the customer. Thus, more densely populated areas are far less expensive in terms of investments per customer. (Höffler, 2007). Also important the people's relation with broadband access. Ryszard Struzak lays down as follows: The fact that half of the people surveyed do not need or want high speed access at home may indicate that a significant part of society has another hierarchy of needs and values, and does not know, does not understand, and/or does not appreciate the benefits such access can offer. Bottlenecks are households and small enterprises in rural areas and poor social strata. To change this attitude, additional stimulus programs and resources are required (Struzak, 2010). There is little information about broadband usage and the types of services that customers choose more frequently based on their socio-economic background (Koutroumpis, 2009).

The second factor group the general economic characteristics. Inside this very important thing the economic sector which is typical of given region. Economic performance is lower in those regional economies still highly geared towards agriculture and manufacturing sectors and with relatively low incomes. It results lower ICT spending, fewer investment, infrastructure and service development (Preston et al, 2007). Furthermore ICT characteristics of public sector – which on regional level means local governments and public bodies - have to be considered .

The characteristics of enterprises (penetration, usage, etc.) got in the third group, because in Hungary small and medium sized enterprises mean one of the biggest business sector considering their number. This sector employ 70% of employees of national economy, and their contribution to GDP reaches 50% (Hungarian News Agency, 2008).

If these factors don't reach a sufficient level of development, telecommunication companies are not willing to invest in modern infrastructure development in rural areas because the expected profit is of high uncertainty (Moutafides & Economides, 2011). About it – like USA – in Hungary the large and medium sized cable companies typically operate in both metropolitan and non-metropolitan areas, the small companies almost exclusively operate in rural areas. In contrast to the large cable providers' billion dollar upgrades, the infrastructure of small companies often decades-old, obsolete, and, they often serve only a few thousand, if not a few hundred, households (Wood, 2008). Therefore, state intervention and initiatives are necessary to redress market failure (Moutafides & Economides, 2011), but in this case the efficient allocation of financial resources is also important.

## 3. SITUATION OF BROADBAND IN HUNGARY

First of all I present the change of internet usage by the BIX (Budapest Internet Exchange) data traffic statistics. In Hungary BIX is the only one center to handle of the Internet data traffic, so in particular the data traffic is focus there. The statistics is given in Figure 2. Clearly that the data traffic is continuing to grow to 2009, from this year a slight decrease took place. Because the number of subscription have been steadily increasing in these years, the explanation for the decrease probably is that service providers started to optimize the data traffic by proxy servers.

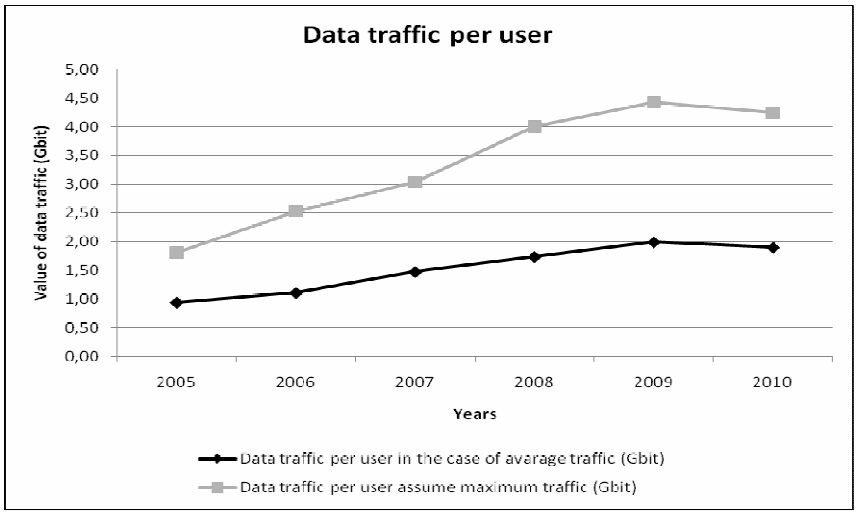


**Figure 2. Data traffic per user in case of average and maximum traffic**

*(Source: Own calculation by data of www.bix.hu)*

Therefore the invisible data traffic for BIX increased, the load of BIX and the quantity of data traffic which flow through on it dropped. Obviously that in spite of traffic optimize, the data traffic per user is growing, just it doesn't reach to BIX. On the basis of data traffic values I made a computation in reference to find out how much data rate belongs to the average and maximum data traffic, the result of which is given in Table 1.

**Table 1. Relation between data traffic and data rate**

*(Source: Own calculation by data of www.ksh.hu and www.bix.hu)*

| Év | Number of internet subscribers | Data traffic per user in the case of average traffic (Gbit/s) | Required data rate for average data traffic (kbit/s) | Data traffic per user assume maximum traffic (Gbit/s) | Required data rate for maximum data traffic (kbit/s) |
|---|---|---|---|---|---|
| **2005** | 1.000.737 | 11 | 94,21 | 21 | 179,87 |
| **2006** | 1.329.625 | 17,2 | 110,88 | 39 | 251,41 |
| **2007** | 1.832.023 | 31,4 | 146,91 | 64,5 | 301,77 |
| **2008** | 2.310.914 | 46,6 | 172,84 | 107 | 396,87 |
| **2009** | 2.803.543 | 64,8 | 198,12 | 143,5 | 438,73 |
| **2010** | 3.340.868 | 73,6 | 188,83 | 164 | 420,76 |

Values are calculated in 2010 the data rate per user must be 190 kbit/s at least, in case of average data traffic. All year assume maximum data traffic of given year this value is greater than 420 kbit/s. Since the subscribers not use the network at the same time, this value is growing. On the basis of it, the broadband penetration may deceptive, because this definition means 128 kbit/s data rate, which no broadband at all at today's requirements. Building up and developing access network infrastructure are well-established in Hungary according to my calculations, every year more and more people subscribe to internet connection and more

and more subscribers will require connection with really high data rate. The average value of it 420kbit/s already, and have to be prepared to further increase.

About it, another issue, the quality divide has become more and more important. Only some years ago the analysis of penetration was focused on who had an internet connection and who did not. Now, the relevant questions are: how good is it? How fast? And, how fast is fast? Thus, the broadband gap can no longer be seen as a penetration divide. It is becoming more and more a quality and capacity divide, and therefore, a divide in the range of services people can access and use. (Vicente & Bernabé, 2010)

In addition the investments of business (service providers), the state and EU investments also contribute significantly for the developments. Similarly to the other Member States, Hungary also spent considerable amounts for network development. From 2004 to 2006, the two most significant infrastructure related tender were the ECOP (Economic Competitiveness Operational Program)-4.4.2 (for local governments) and ECOP-4.4.1 (for small and medium sized enterprises). This theme is being continued under eEurope's successor initiative, i2010, where inclusion is one of three main pillars. Making ICT products and services more accessible, including in Europe's less-developed regions, is an economic, social, ethical and political imperative (Herdon & Houseman, 2007). After these projects the developing will continue (partly EU sources), because one of the strategic objectives of EU and Hungary also to increase broadband penetration (e.g. Digital Renewal Action Program, EU 2020 strategy).

Fact, that rural areas are in most cases not served at all with high speed access and even when served, the supply is inadequate and consists of lower quality and higher prices (Moutafides & Economides, 2011). Figure 3. shows that faster than 1 Mbit/s guaranteed data rate available on a little more than one-third of Hungarian settlements.

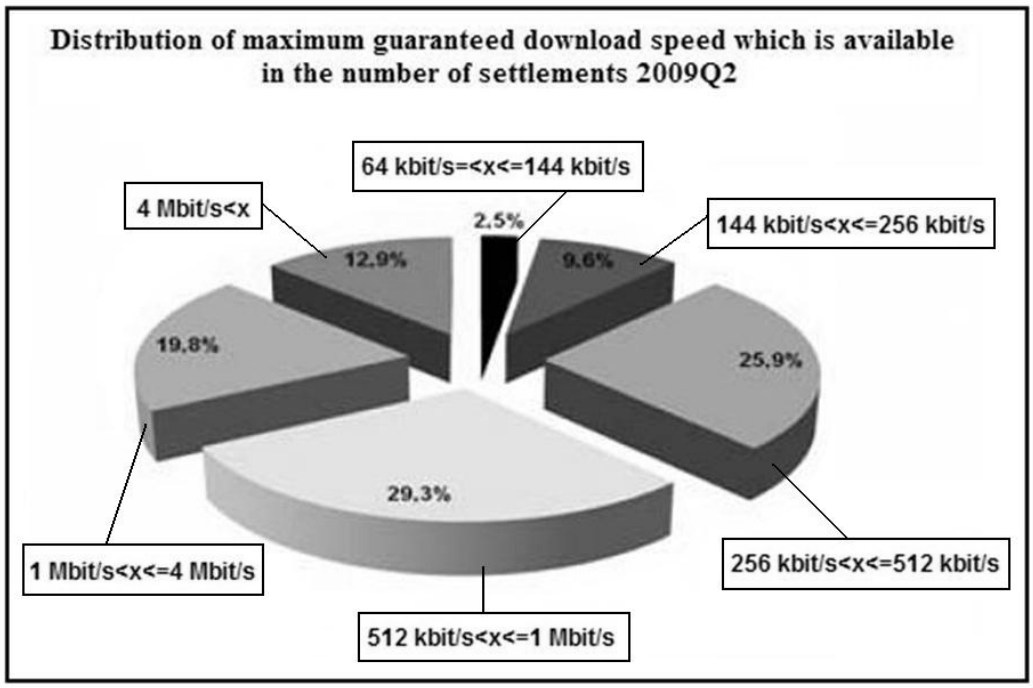


**Figure 3. Distribution of maximum guaranteed download speed which is available in the number of settlements in 2009**

*(Source: Horváth, 2009)*

So developments are required, but the efficiency of use of financial resources is also important, therefore developments are worth to implement where the return and the positive

socioeconomic impacts expected as soon as possible. My aim is to prepare an index for supporting the selection of targets (the field of use of financial resources), which can be applied on regional and settlement level.

## 4. METHODOLOGICAL BASIS OF CONSTRUCTION A REGIONAL NETWORK DEVELOPMENT INDEX

### 4.1 Process of the index construction

Figure 4. shows the process of constructing a complex index.

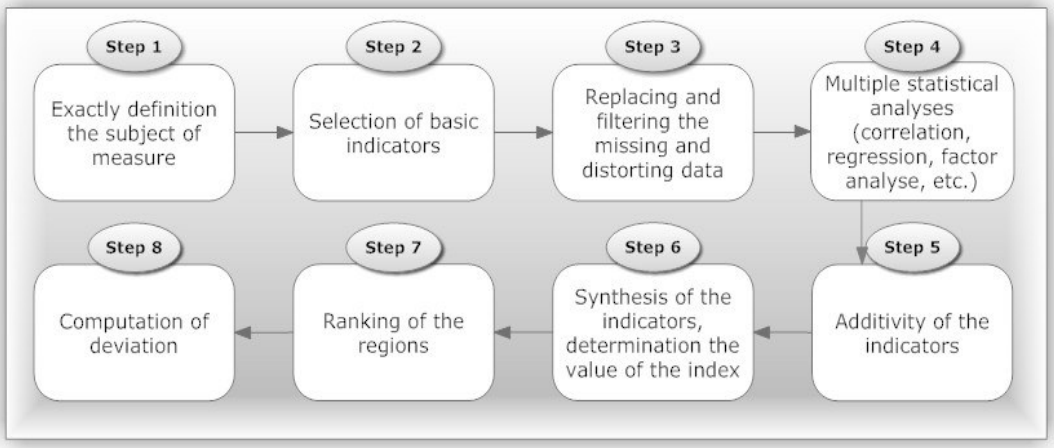


**Figure 4. Process of the index construction**

*(Source: Own editing by Hanafizadeh et al, 2009)*

My aim is to measure the development related to network infrastructure on regional and settlement level. Since this won't be a general ICT index, such data are required which correlate to high speed network, like usage and access attributes. After filling the important data gaps and removing the distorting data In the next step the correctness of data set and methodology chosen must be checked with multiple statistical analysis.
For additivity the distinct units of measurement should be eliminated. It may given by the formula, which shows figure 5.

$$6 \times \left( \frac{\text{data of a given region - value of sample minimum}}{\text{value of sample maximum - value of sample minimum}} \right)$$

**Figure 5. Formula for converting hard data for additivity**

The basis of it, the standard formula of NRI (Networked Readiness Index) for converting hard data, adapted for regional level. In step six it come the synthesis of the indicators, finally the value of the index should be determine for each region, and the degree of deviation will give the level of backward.

### 4.2 Factors which can be involved in the index

The factors, which important to determination of differences in cross-country broadband penetration, also can explain regional differences within a country (Bouckaert et al, 2010). Because of this I determined the three main group and the scope of factors for certain groups

on the basis of NRI components, that there are three important stakeholders to consider in the development and use of ICT: individuals, businesses, and governments. (Dutta et al, 2004) I chose NRI because I make an index for decision support of NGN investments, and NRI contains such social, economical and technological components which are related to broadband network. There is a general macroeconomic and regulatory environment for ICT in which the stakeholders play out their respective roles. Furthermore, the three stakeholder's degree of usage, and readiness to use and benefit from ICT (Dutta et al, 2004). Since the index prepares for regional comparison, of course, the groups contains different components from the NRI. Necessary such data, which are available on regional level, or may be calculated from existing data. On regional level table 2 contains those factors which presumed are in directly or indirectly connection with existence of network infrastructure. In the table show those data which may be involved in the index.

**Table 2. Factors which can be taken into account for the calculation of the index**

| **Factors linked to network infrastructure** | **Individual characteristics** | **Enterprise characteristics** | **Public sector characteristics** |
|---|---|---|---|
| Number of internet subscribers | Employment | Number and size of enterprises | Territorial characteristics |
| Characteristics of access network | Unemployment | Number of IT enterprises | Number of settlements with local e-government |
| Number of settlements and households with optical access | Average income | Website of enterprises | Local e-government services |
| | Communications characteristics | Assets | Population and population density |
| use of e-business and degree of internet use | Number of persons with higher qualification | IT investment and R&D | Settlement composition of region (number of cities and municipalities) |

To check that socioeconomic data and factors of three stakeholders really correlate with the network I make correlation tests. I have made calculations on county level, with 19 elements. About its distortion impact, the capital didn't get into the elements. First I examined the correlation between the number of internet subscriptions and eleven variables. Table 3 shows the result of the calculation.

Certain data max be excluded from components because there is not or there is not significant correlation between two variables. So the unemployment (V3), the average income (V5), the number of municipalities (V8) and the area of the county (V10) won't be included into the index.

**Table 3. Result of the correlation calculation**

*(Source: Own calculation by data of www.ksh.hu)*

| | | V2 | V3 | V4 | V5 | V6 | V7 | V8 | V9 | V10 | V11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| V1 | Pearson Correlation | 0,979 | 0,236 | 0,878 | 0,328 | 0,794 | 0,832 | 0,051 | 0,953 | 0,439 | 0,931 |
| | Sig. (2-tailed) | 0,000 | 0,331 | 0,000 | 0,170 | 0,000 | 0,000 | 0,834 | 0,000 | 0,060 | 0,000 |
| | N (number of counties) | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |

Between number of internet subscriptions (V1) and the number of persons with higher qualification (V2), the number of enterprises (V4), the population density (V6), the number of cities (V7), the population (V9) and the number of households (V11) the calculation shows significant correlation.

Correlation test have to make with each factor which related to the existence of network infrastructure. Since among the variables there are which have an effect on each other also, multi-colinearity analysis should be made. Finally scope of data and factors which may be included into the index actually, can be determined with factor analysis.

After the data analyses, and verification of applicability, the next step is the weighting, namely, should be determine the proportion of three component in the indicator. My preliminary choice is the contribution of business, public and household sector to macro-economic performance as a percentage. Since this value is different regionally, the base is the total national economy contribution. Accordingly in the main index the share of the enterprise sector would be 60% (about it important role in employment and contribution of GDP), and the share of the public and private sector would be equally 20%. These proportions are preliminaries, in the final period – if necessary – this factor variable easily

## 5. CONCLUSION: USABILITY OF REGIONAL RANK

In my opinion a rank can be defined among regions or settlements by on the basis of the indicator, in respect of factors related to network infrastructure. The rank can help to realize targeted developing and improving of infrastructure, furthermore this enables to intervene on that place which is bottleneck.

For calculating the index I wouldn't use only those data which measuring directly (e.g. number of accesses and their speed), but I also take account of actually use, capacity utilization, readiness of people, penetration of different e-services. And the characterizations of SMEs also can involved to the calculation

The final result probably a regional indicator, the methodology of which I described in my article. By it determining of broadband situation of regions and settlements would be easier. Furthermore, we can be identified those areas which show gaps before the building up of infrastructure.

About the structure of the index the backwardness can be identified in two ways. On the one hand, which the stakeholder group (households, enterprises of public sector) shows the largest gap, can be exactly determined. On the basis of it the selection of target groups will be easier. On the other hand the objective areas also can be determined, namely, infrastructure, information technology assets or human resource development is necessary.

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