African Journal of Business Management Vol. 5(17), pp. 7224-7231, 4 September, 2011
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM10.605
ISSN 1993-8233 ©2011 Academic Journals

Full Length Research Paper

Diffusion of Internet Protocol Television (IPTV) service demands: An empirical study in the Serbian market

Valentina Radojicic*, Bojan Bakmaz and Goran Markovic

Faculty of Transport and Traffic Engineering, University of Belgrade, Vojvode Stepe 305, 11000 Belgrade, Serbia.

Accepted 7 April, 2011

In this paper, we consider diffusion process of new services in the residential market. We described the main influences and decision factors of new telecommunication services adoption. In order to forecast the adoption of new service, diffusion theory is applied. Building upon the Bass diffusion model, we proposed an innovative approach, which encompasses a new model for residential market potential estimation. Based on such analyses, we performed the forecast of Internet Protocol Television (IPTV) demand in the Serbian market until the end of the year 2012. Such forecast are not only important for the providers introducing the innovation service, but also for all others that provide related services that complement or substitute for the innovation.

Key words: Diffusion theory, forecasting, Internet Protocol Television (IPTV), market potential, operator.

INTRODUCTION

Television distribution is one of the largest technology systems deployed after electric power and telephone networks. Digital technologies have completely transformed the telephone and data networks creating much more versatile and dynamic telecommunication infrastructure and services. The television distribution is now undergoing a similar digital evolution. Internet Protocol Television (IPTV) is one of the promising services/ technologies, which takes a step further in distribution of video streams over communications networks.

It is obvious that IPTV will be the killer application for the next-generation Internet and will provide exciting new revenue opportunities for service providers (Xiao et al., 2007). Asia-Pacific region has been at the forefront of IPTV, lunching IPTV service tests in 2002. The worldwide growth of IPTV subscribers during the last years was very dynamic. The new forecast from Multimedia Research Group (MRG) indicates that the number of global IPTV subscribers will grow from 28 million in 2009 to 83 million in 2013, a compound annual growth rate of 31% (Maisonnueve et al., 2009).

The success of the IPTV services is determined by the time and volume of profitable operations. Getting the maximum number of subscribers as soon as possible for IPTV services is clear goal for any service provider. IPTV adoption in Western Europe will continue to enjoy dynamic growth up to the 2014 (19% per year) resulting in 20.3 million IPTV users (IPTV Global Forecast, 2009). However, during that period, the dynamics of the IPTV market will change: The main growth factors that drove the IPTV market during its launch phase (home broadband adoption and the analog TV switch-off process) will gradually fade out, and short-term growth will mainly come from the conversion of secondary TVs to digital TV. The IPTV forecast for the next five years is both conservative and optimistic, based on very detailed semi-annual analysis of individual service providers and on a country-by-country basis. Such a projected growth will have a number of implications for the evolution of IPTV related technologies (Ahmad and Begen, 2009).

The diffusion of IPTV service follows the S-shape curve, similar to the diffusion of technological innovations. The curve rises gradually at first; accelerates after taking off (if the service is successfully adopted); begins to level off following the inflection point, and finally increases slowly to approach saturation.

In this paper, we focused on forecasting the number of IPTV subscribers in Serbian telecommunication market in a case of the main national telecom operator. For this

*Corresponding author. E-mail: valentin@sf.bg.ac.rs. Tel: +381 11 3091 275.

Table 1. Comparison between traditional TV systems and IPTV.

Terrestrial TV	Cable TV	Satellite TV	IPTV
No interactivity	Limited interactivity	No or very limited interactivity	Full interactivity
Service not guaranteed	Service not guaranteed	Service not guaranteed	Guaranteed QoS/QoE
Not user centric	Limited user centric (video on demand)	Not user centric	User centric (personal video recorder, video on demand)
Broadcast all channels all the time	Broadcast all channels all the time	Broadcast all channels all the time	Broadcast only those channels being watched at given time
Limited content	Limited content	Limited content	Unlimited content

purpose, we used the basic Bass diffusion model, which is a very useful tool for forecasting the adoption of a new service (Bass, 1969). A key area of uncertainty in forecasting of a new telecommunication service is the estimation of the overall market potential. A new model for estimating the total market potential which encompasses several parameters of interest for considered marketplace is proposed here. Such forecast are not only important for the company introducing the innovation service, but also for other companies that make related services that complement or substitute for the innovation (Lavrence, 2008; Radojicic, 2003; Vanston and Hodges, 2004).

Further, we give a background and main challenges for IPTV service. Then, we describe the basic analytical expression of the Bass diffusion model and a new model for estimation the total market potential. Determining the main Bass parameters is possible by using analogies with other services or analytically. Forecasted results obtained in this paper are based on the collected data of IPTV service sales during the year 2009. A new model for residential market potential is used. In the final section the concluding remarks are given.

BACKGROUND FOR IPTV SERVICE DEPLOYMENT

IPTV is actually a complex interplay of a number of technology areas, drawing from TV broadcast technologies, video coding (for example, MPEG-2 and H.264) and encryption (for example, digital rights management), IP transport networks, heterogeneous access networks (WiFi, WiMAX, LTE), quality of service (QoS), quality of experience (QoE), and so on. Advances in IPTV technology will be based on progress in any one or more of these fields and its relationship with the other components of the overall IPTV system.

Comparing with traditional cable, terrestrial and satellite TV, IPTV distinguishes itself with full interactivity, high personalization and flexibility as shown in Table 1. IPTV has been an initial driver for telecom investments for the last few years. The bandwidth requirements of video transmission make it one of, if not the most, demanding mass-market telecommunication applications to date (Maisonneuve et al., 2009). Transmission of a standard definition (SD) video stream takes several Mbit/s, while high definition (HD) reaches into the tens Mbit/s. This is far more than what is required for voice transmission (typically 32 to 64 kbit/s), or even web browsing. As a result, IPTV has been the best motivation for operators to deploy higher-speed DSL, and to consider deploying fiber technologies (FTTx) and wireless broadband networks (for example, WiMAX). These capacity upgrades also bring much higher communication speed and enable new services such as video telephony or file sharing, but it is not certain that in isolation they would have been a sufficient motivation for operators to invest in massive new infrastructures, or indeed for customers to pay premium subscriptions. IPTV has been the catalyst for a technology leap.

BASS DIFFUSION MODEL PERFORMANCES

The Bass diffusion model has been widely used as forecasting procedure of new services and it was proposed to deal with the problem of initial adopters. This modeling approach assumes that potential adopters become aware of an innovation by means of external events, for instance, marketing efforts. Bass introduced the idea of dividing the innovation adoption rate into two factors, one endogenous, usually called "imitation factor", and the other exogenous, and commonly referred to as the "innovation factor". Figure 1 represents the Bass diffusion adoption process (Radojicic and Markovic, 2009). Figure 2 represents a basic customer choice model, which is used to examine competition between visual services such as cable, terrestrial TV, video-on-demand, video shop rental, satellite or IPTV.

Three service characteristics (marketing, quality, and

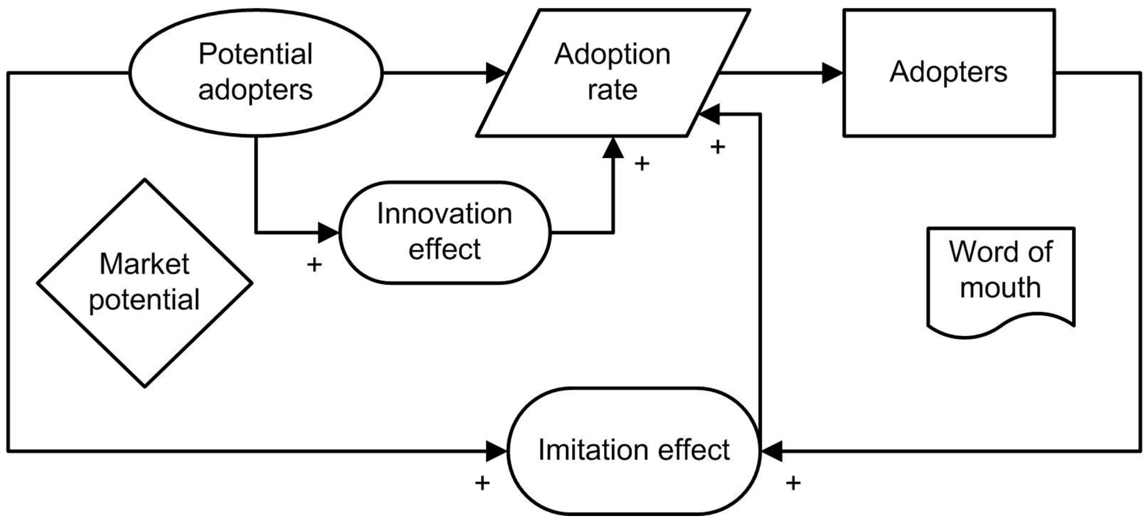

Figure 1. The Bass diffusion adoption process.

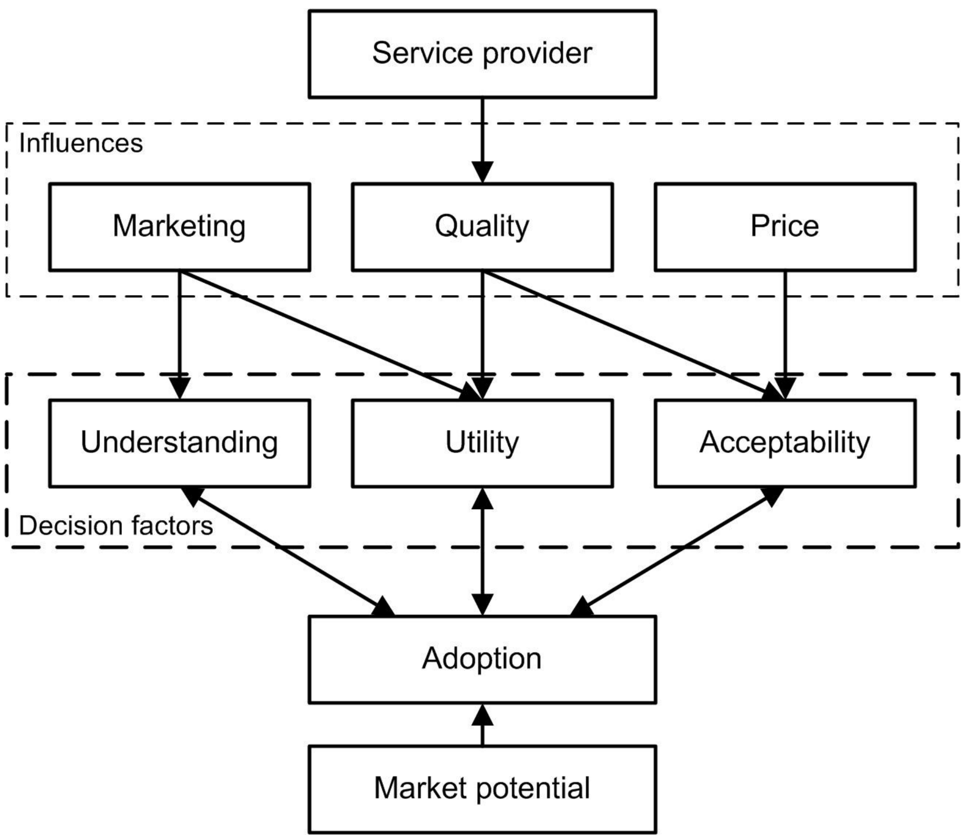

Figure 2. A system dynamics representation of the adoption of new telecoms services.

price) influence the consumer's valuation of the service and these in turn lead to adoption (Fildes, 2002). Despite the focus of these models on policy, they may also be used in forecasting, in part because of the transparent inadequacies of statistical methods. Thus, to model and forecast the demand for new service, awareness is seen as a pre-cursor to possible adoption, but no measurements were available on this variable and its growth was seen as affected by both marketing plans and culture specific preferences. The compound diffusion path resulting from a developing awareness and subsequent adoption is then simulated based on estimated parameters. A key output of this model was a set of forecasts.

Understanding of new service may be affected by changing the actions of marketing. On the other hand, the understanding of the service greatly affect users who have already accepted a new service. Service utilization is a factor that should include the actual need of users for the service, the importance of their work or daily life, the benefits that can be achieved by new service etc. On the utility can be affected by changing the quality and marketing functions controlled by the service provider, and depending on the factors of the final acceptance of services (Lu et al., 2009). The acceptability of the service affects the price and quality, which also controls the service provider. In addition to these, there are a number of external influences such as culture, changes in price and quality equipment, competitive on the market, and so on.

The Bass model is a very useful tool for forecasting the adoption of an innovation. A key feature of the model is that it embeds a contagion process to characterize the spread of word-of-mouth between those who have adopted the innovation and those who have not yet adopted innovation.

The mathematical interpretation of the Bass model is derived from a hazard function corresponding to the conditional probability that an adoption will occur at time t given that it has not yet occurred (Bass, 1969; Bass et al., 1994; Meade and Islam, 2006). If $f(t)$ is the density function of time to adoption and $F(t)$ is the cumulative fraction of adopters at time t, the basic hazard function underlying the Bass model is given by following equation (Bass, 1969):

$$\frac{f(t)}{1-F(t)} = p + q \cdot F(t) \cdot \qquad (1)$$

Parameter q reflects the influence of those consumers who have already adopted the product/service (that is, word-of-mouth communication from previous adopters), while p captures the influence that is independent from the number of adopters (that is, external communication). The solution of equation (1) is given by following equation:

$$F(t) = \frac{1-e^{-(p+q)t}}{1+\frac{q}{p}e^{-(p+q)t}} \cdot \qquad (2)$$

If m denotes the market potential for the new product/service, then the cumulative number of adoptions, $Y(t)$, at time t is given by:

$$Y(t) = mF(t)\,. \qquad (3)$$

The current (non-cumulative) service sale at time t, $S(t)$, is given by:

$$s(t) = mf(t) = pm + (q-p)mF(t) - qmF^2(t) = pm + (q-p)Y(t) - \frac{q}{m}Y^2(t) \qquad (4)$$

For estimation the parameters p, q and m from discrete time series data the following analogue can be used:

$$s(t) = a + bY_{t-1} - cY_{t-1}^2 \qquad (5)$$

where a, b and c are the coefficients that have to be calculated based on the regression analysis. For estimated the value of market potential, m:

$$m = \frac{-b-\sqrt{b^2-4ac}}{2c}\,, \qquad (6)$$

the Bass model parameters of innovation p and imitation q, could be obtained by following equations:

$$p = \frac{a}{m} \qquad (7)$$

and

$$q = -mc\,. \qquad (8)$$

Based on these parameters, the new service adoption could be calculated. The model can forecast the long-term sales pattern of new services and technologies under two types of conditions (Bass et al., 1994):

i. The company has recently introduced the service or technology and has observed its sales for a few time periods;
ii. The company has not yet introduced the service or technology, but its market behavior is likely to be similar to some existing services or technologies whose adoption pattern is known.

One of the most uncertain issues concerned with application of the Bass diffusion model is correct estimation of the market potential. This value has direct impact on diffusion process profile of new service, in other words on parameters p and q. In order to estimate the market potential for IPTV, we have to forecast the total number of residential customers (households) in the area of interest. We could increase the accuracy of the forecast by sub-dividing the total number of households into different economic levels. If we distinguish between four classes of household economic levels HE = (1, 2, 3, 4), we proposed the new model for residential market potential estimation, m:

$$m = k \cdot s \cdot \sum_{HE=1}^{4} HH_{HE} \cdot HP_{HE} \cdot \qquad (9)$$

Table 2. Number of IPTV subscribers (in thousands).

Month	Monthly # of IPTV subscribers *s*(*t*)	Cumulative # of IPTV subscribers *Y*(*t*)
September, 2008.	146	146
October	331	477
November	836	1,313
December	1,793	3,106
January, 2009.	1,849	4,955
February	1,594	6,549
March	1,427	7,976
April	1,154	913
May	1,932	11,062
June	3,412	14,474
July	3,419	17,893
August	264	20,533
September	1,679	22,212
October	1,509	23,721
November	1,509	2,523
December	1,704	26,934
January, 2010.	1,579	28,513
February	1,053	29,566

Table 3. Parameters obtained by regression analysis.

a	*b*	*c*	*p*	*q*	*m*
0.621	0.257	- 0.0087	0.0195	0.277	31.84

Where: *HH* is the number of households; it could be estimated as the ratio of the total population and mean number of households' members; *HP* is household penetration of the considered area (numerical value from 0 to 1 or even above 1); *HE* could be high income families (*HE* = 1), middle income families (*HE* = 2), lower income families (*HE* = 3) and poor families (*HE* = 4); *k* is a parameter of technological availability of network infrastructure; *s* is a service substitution parameter. Before a decision is made about the implementation of IPTV as a new service, it is necessary to test the entire network infrastructure in order to qualify the copper pairs, ready to support this service. The parameter of technological availability, *k*, has to be calculated based on the results of such testing in the Telecom Serbia network. Substitution parameter, (*s*) is estimated based on forecasted share of competing services (terrestrial TV, cable TV, satellite TV and IPTV) in the Serbian market.

IPTV SUBSCRIBERS FORECASTING MODEL EVALUATION

Bass parameters, *p* and *q*, can usually be evaluated in two manners. One way is to use analogies with other similar services or diffusion process. As we have shown, the second is analytical, using equations (5) to (8).

Based on the data of actual and forecasted total IPTV subscribers in the world, it was shown that the estimated Bass parameters *p* and *q* are not directly applicable to the Serbian telecommunication market. Namely, if we use the same values for *p* and *q* (calculated based on the relevant historical data), we obtained the great disproportion between the actual and forecasted results for the IPTV users in Serbia. Therefore, we try to estimate the valid values of parameters *p*, *q* and *m* based on the Equations (6) to (8) and the actual statistics from the Serbian IPTV market during the previous year. Table 2 gives the actual statistics of IPTV service from service introduction in the Serbian market.

We performed the linear regression analysis using equation (5) to calculate the unknown parameters *a*, *b*, *c* and corresponding parameters *m*, *p*, *q* by equations (6) to (8), respectively. Table 3 gives the results of the regression analysis. Thus, the forecasted values of non-cumulative sales at time *t*, obtained by the Bass diffusion model could be calculated using the expression (4). Calculated number of IPTV users obtained by the Bass model is given in Table 4. Figure 3 illustrates the comparative results for actual and calculated cumulative number of IPTV subscribers in a case of regression parameters values $p = 0.0195$, $q = 0.277$ and $m = 31.84$. Authors believe that the obtained estimated value for market

Table 4. Calculated number of IPTV subscribers (p = 0.0195, q = 0.277, m = 31.84).

Month	Monthly # of IPTV subscribers $s(t)$	Cumulative # of IPTV subscribers $Y(t)$
September, 2008.	707	707
October	0.902	1.609
November	1.135	2.744
December	1.398	4.142
January, 2009.	1.682	5.824
February	1.965	7.789
March	2.217	10.006
April	2.41	12.416
May	2.51	14.926
June	2.505	17.431
July	2.394	19.825
August	2.195	22.020
September	1.936	23.956
October	1.653	25.609
November	1.371	26.980
December	1.11	28.090
January, 2010.	0.881	28.971
February	0.689	29.660

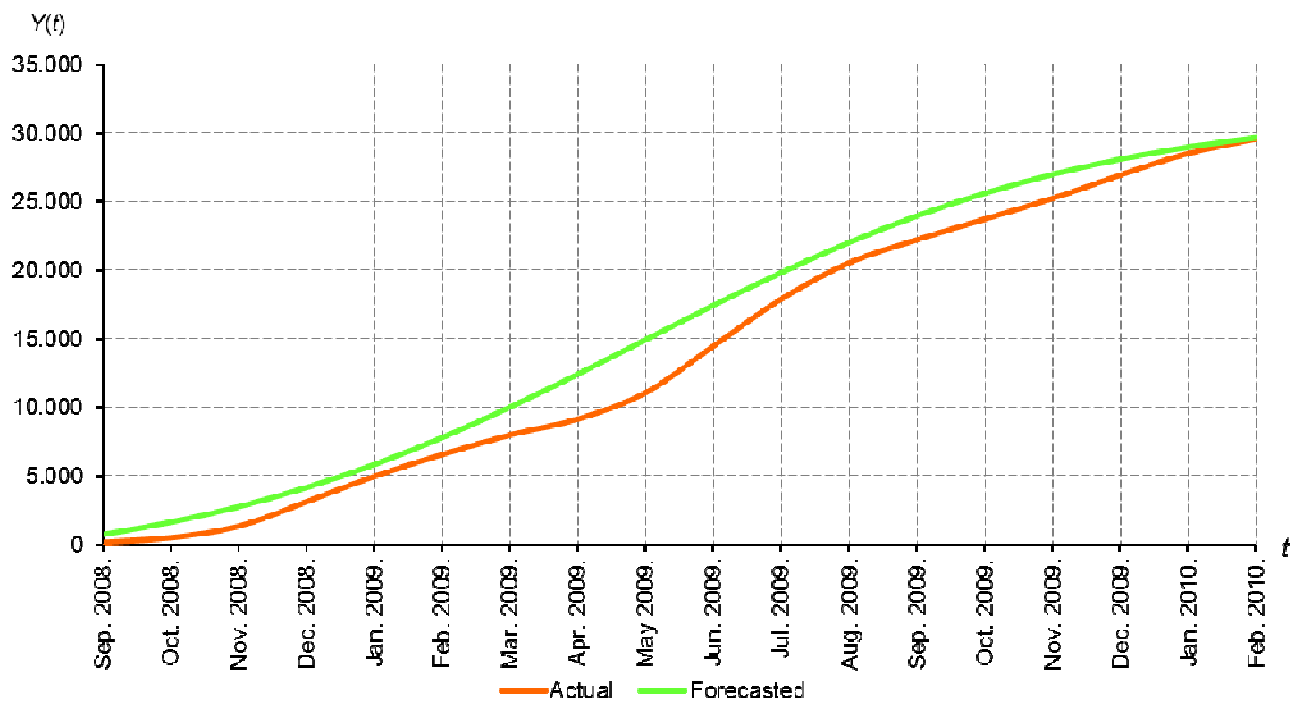

Figure 3. Cumulative number of IPTV subscribers

potential, m, is considerably less than it is expected to be. Therefore, the total market potential for IPTV service in Serbia market has to be estimated based on new model as proposed by equation (9). The major advantage of this model is that it takes into account the main relevant influence parameters of market potential. The corresponding parameters values are: the total population of Serbia is 7.5 millions; the mean number of household members is 3.1; parameter of technological availability of network infrastructure is 0.8. The number of households

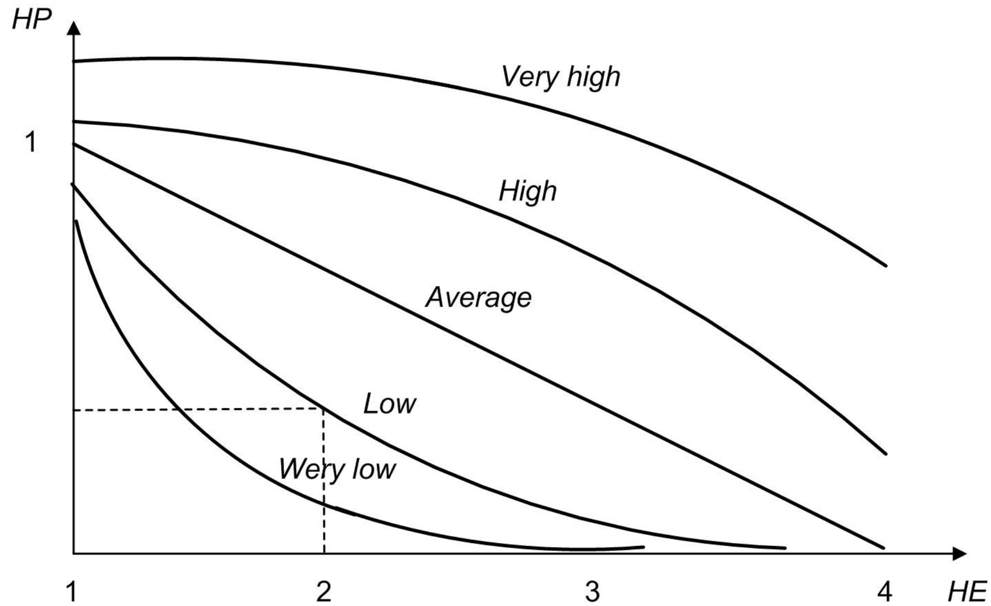

Figure 4. Graphs for household penetration determination

that could potentially become IPTV service users entering households with high-income households (HE = 1) and middle-income households (HE = 2). Household penetration of the Serbia is determined according to the available statistical data and graphs depicted in Figure 4 (Leiijon, 1996) and service substitution parameter is estimated to be 0.6. We performed the necessary calculations based on the statistical data from National Telecommunication Agency (RATEL, 2009).

We assumed that 10% of total Serbian population is classified as high-income households and 35% as middle-income households. Depending on household penetration, global trend and local economy relative to global economy, *low* household penetration curve type seams to be appropriate for Serbian market.

Assuming that HE_1=1 (household economy for high income families), we estimated that the HP_1 = 0.9 (household penetration for high income families), assuming that HE_2 =2 (household economy for middle income families) we estimated that the HP_2 = 0.35 (household penetration for middle income families), based on Figure 4. Based on such given parameters, we estimated the total residential market potential as the results of the expression (10):

$$m = k \cdot s \cdot \sum_{HE=1}^{2} HH_{HE} \cdot HP_{HE} = 0.8 \cdot 0.6 \cdot \left(0.1 \cdot 7500/3.1 \cdot 0.9 + 0.35 \cdot 7500/3.1 \cdot 0.35\right) = 247 \quad (10)$$

For modified value of the residential market potential (m), it is necessary to adjust the Bass diffusion parameters p and q. By using the data curve fit creator, we obtained the following modified values for p = 0.002, q = 0.14. For these values, the best matching between actual and forecasted data are obtained, as shown in Figure 5. In addition, Figure 5 illustrates the cumulative forecasted number of IPTV user for Serbian residential market up to the end of 2012.

The preliminary Serbian Telecom expectations about the adoption rate of the IPTV service were not achieved at the present time. It was about 50% less than previously planed. The main reasons could be found in facts that the time of the service launched was delayed, also due to relatively high service implementation costs for residential subscribers. Such situation indicates that the potential market was not considered adequately. We took into account that circumstances in our forecasting procedure and tried to determine the future IPTV service demands more precisely.

CONCLUSION

The IPTV might become the leading broadband application in the near future. Both, telecom as well as cable operators are highly interested in offering the IPTV service to their customers, mainly due to increase their profits and also to achieve the greater satisfaction of the end users. There were many research studies concerned

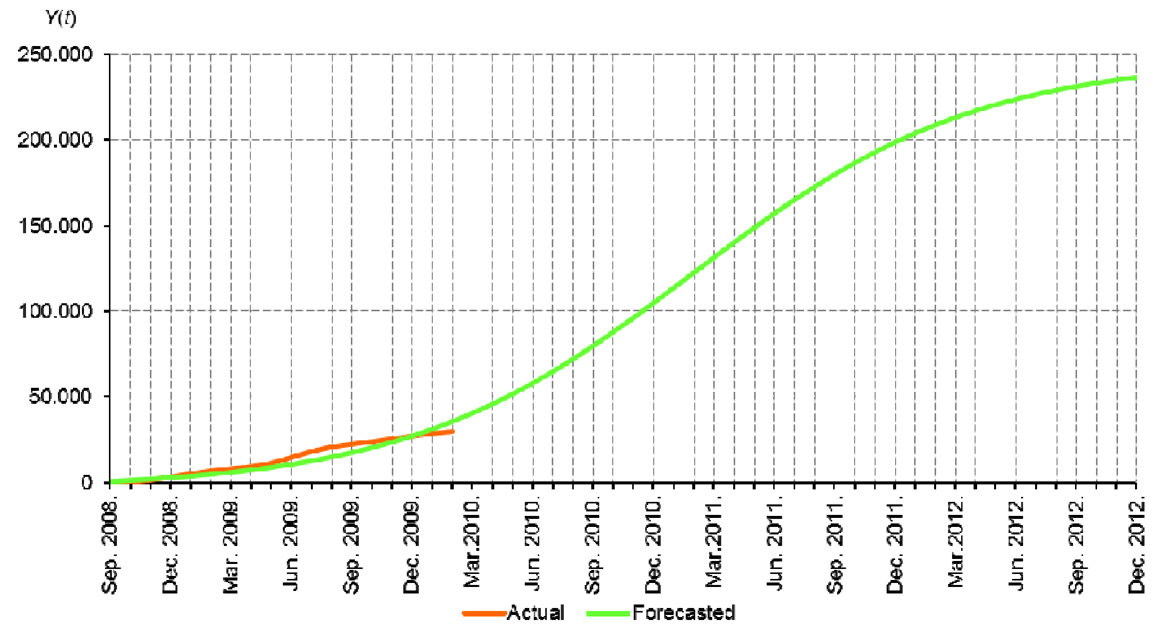

Figure 5: Forecasted and actual cumulative number of IPTV subscribers (p = 0.002, q = 0.14, m = 247)

with forecasting the number of IPTV subscribers in different part of the world. However, a particular and precise forecast has to be done for each country as well as for each operator in the considered country.

In this paper, we presented the results of the forecasted number of IPTV subscribers in Serbia until the end of 2012. The forecasting procedure was performed based on the diffusion theory. We made a modification of the main Bass diffusion model in order to estimate the residential potential market. The new model takes into account the availability of network technology capable to support a new service. The authors believe that the infrastructure network in the case of broadband applications may be a limiting factor in the provision of new services. This factor could be decisive in comparison with some other factors such as marketing, quality and price that may contribute to the adoption of services. In addition, the presence of substitution services has to be taken into account.

It is obvious that the future IPTV demands will significantly depend on various influence factors, primary economic, technological, marketing, etc. Additionally, the IPTV operators have to be ready to take part in highly competitive market circumstances. The actual IPTV demands will depend largely on operator’s ability to promptly and effectively respond to user requests. Consequently, our further research could encompass the concurrent perspective of the future IPTV market in Serbia.

REFERENCES

Ahmad K, Begen AC (2009). "IPTV and Video Networks in the 2015 Timeframe: The Evolution to Medianets". IEEE Comm. Manage., 47(12): 68-74.

Bass FM (1969). "New Product Growth Model for Consumer Durables". Manage. Sci., 15(5): 215-227.

Bass FM, Krishnan TV, Trichy V, Jain DC (1994). "Why the Bass Model Fits Without Decision Variables". Mark. Sci., 13(3): 204-223.

Fildes R (2002). "Telecommunications demand – a review of forecasting issues". Lancaster University. Available: http://www.itu.int/ITU-D/finance/work-cost-tariffs/events/expert-dialogues/forecasting/fildes-presentation.pdf.

IPTV Global Forecast – 2009 to 2013 (2009). Semi-annual IPTV Global Forecast Report - Edition 1. Available: http://www.mrgco.com.

Lawrence VK (2008). "Practical Tips for Forecasting New Technology Adoption". Telektronikk, 104(3/4): 179-189.

Leijon H (1996). "Forecast of Residential Main Lines". ITU docs 74E

Lu IY, Yang CY, Tseng CJ (2009). "Push-Pull interactive model of service innovation cycle-under the service encounter framework". Afr. J. Bus. Manage., 3(9): 433-442.

Maisonnueve J, Deschanel M, Heiles J, Li W, Liu H, Sharpe R, Wu Y (2009). "An Overview of IPTV Standards Development". IEEE Trans. Broadcast., 55(2): 315-328.

Meade N and Islam T (2006). "Modelling and Forecasting the Diffusion of Innovation – A 25-Year Review". Int. J. Forecast., 22(3): 519-545.

Radojicic V (2003). Forecasting in telecommunications. Faculty of Traffic and Transport Engineering. Belgrade (origin in Serbian).

Radojicic V, Markovic G (2009). "New Technology Forecasting using the Bass Model", Proc of the TELSIKS 2009 Conference. Nis. Serbia. 1: 277-280.

RATEL (2009). "An Overview of Telecom Market in the Republic of Serbia in (2009)". available at http://www.ratel.rs/market/overviews_of_telecom_market.129.html.

Vanston LK, Hodges RL (2004). "Technology forecasting for telecommunications". Telektronikk, 100(4): 32-42.

Xiao Y, Du X, Zhang Y, Hu F, Guizani S (2007). "Internet Protocol Television (IPTV): The Killer Application for the Next-Generation Internet". IEEE Comm. Manage., 45(11): 126-134.