Adoption and Pricing: The Underestimated Elements of a Realistic IPTV Business Case

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ABSTRACT

The adoption of IPTV increases competition for telecom operators. Especially video on demand and the move to HDTV push the bandwidth requirements to the limits. It is very challenging for an operator to construct a successful and sustainable introduction of IPTV over the existing infrastructure. This article gives an overview of a typical business case followed by a detailed discussion of the adoption and evaluation of the outcome. The results of this article indicate the importance of a correct choice of adoption model and related parameters. It illustrates how different IPTV-specific effects on adoption (i.e., competition and analog switchoff) might have a considerable impact on the outcome. After adoption, the article shows how the outcome of the business case can be used within pricing decisions by setting sustainable and competitive boundaries on the tariff. Finally, as pricing will also have an important impact on adoption (e.g., a price reduction could lead to increased adoption), the possible impact of this feedback loop is indicated. In this sense the approach discussed in the article could easily be extended with a highly detailed cost model of the network architecture and technology, leading to a full business case for IPTV introduction by a telecom operator.

INTRODUCTION

Broadband access is gaining widespread adoption on a global scale, and is becoming in most advanced regions more and more of a commodity service on which customers rely constantly. Additionally, broadband access technologies currently offer a bandwidth ranging roughly from 3 up to 100 Mb/s in the access. While the lower boundary of this bandwidth is hardly enough to offer enjoyable video service on top of telephony and Internet access services, the fast evolution to overall higher bandwidths opens up the field for digital television (DTV) offerings.

DTV services are actually a broad realm of

different services (e.g., video on demand [VoD], broadcast, network personal video recorder [NPVR]) and technical platforms (digital video broadcasting terrestrial [DVB-T] or satellite [DVB-S], IPTV, over-the-top video [e.g., YouTube], etc.). We focus on DTV as offered by fixed broadband access networks. In the remainder of the article we refer to this as IPTV.

At the customer premises a setup box is attached to the existing video infrastructure, and it decodes the digital signal into the required television signal. Thus, from a customer point of view there is little change, and the meaningful differences between alternative IPTV offerings are functionality, quality, and tariff.

From an operator point of view, the different possible services and technical platforms will have an important impact on traffic and thus on costs. In order to find the sweet spot for IPTV, an operator should build a business case in which the costs, caused by functionality and quality, and revenues, gained from customer adoption, are in balance with each other. This means selecting the right set of conditions for the IPTV offering and the right implementation over the network.

First, we detail the different building blocks of such a business case. As the focus of this article is on adoption and evaluation, this section indicates how the information of this article should be completed with a detailed cost model to construct a full business case.

Next, we focus on customer adoption for telecom services especially, and in more detail, the intricacies to be expected when offering an IPTV service.

Then we move directly to the evaluation of the outcome, leaving detailed cost modeling to other papers. Especially considering pricing, which has great influence on customer behavior, we indicate the impact the actual tariff has on adoption and how this might influence the overall business case.

Finally, we conclude with an overall view on the business case for IPTV and show how the information in this article can lead, in combina-

■ Figure 1. Methodology for building a business case.

tion with technological modeling of IPTV, to a clearer view of profitability and tariff boundaries for a telecom operator when it plans to introduce an IPTV service.

BUSINESS CASE OVERVIEW

A business case aids managers in making deliberate decisions on when and how to deploy a new service or produce a new product. For the introduction of IPTV, the business case should provide rationales for making decisions on when to deploy which type of IPTV service. In this sense the business case aggregates all information on expected expenses and revenues gained from the rollout of such a service. Figure 1 gives an overview of the methodology used in this article for building a business case.

In the preliminary step of the business case, we gather all input information of importance to the project. This includes customer behavior, equipment prices, existing infrastructure, and so on.

Based on this input we calculate, in the first step, customer adoption. This information will be crucial to the final outcome, and a thorough understanding of the specific details of the considered service — in this case IPTV — is very important.

In the second step all this information is combined with the expected revenues, and a technical model leading to an estimation of the capital (CapEx) and operational (OpEx) expenses. Considering the cost modeling, there is plenty of literature available. For instance, [1] contains a clear overview of an approach to calculate the expenses for IPTV, with a main focus on CapEx. Fewer articles elaborate on OpEx as these are typically much harder to model, require deep introspection of the telecom operator, and might involve confidential information on operational processes, costs of manpower, and tooling. For an operator itself, however, confidentiality and introspection will not pose any problems, and OpEx can be calculated by basing them on activity based costing as is done in [2, 3]. As already mentioned, this article will not treat the construction of a cost and revenue model. To elaborate a full business case, however, it should be

completed with detailed information about both costs and revenues.

The final step of the business case relates the different cash flows generated by the revenues and expenses for deploying IPTV over the network. In order to evaluate the project, we can calculate important economical indicators, like return on investment (ROI), net present value (NPV), or payback period. Furthermore, in a valid business case we expect all expenses to be at least covered by all revenues over the given period of the project. Bottom prices for the service can then be calculated from the expected costs and expenses.

It should be noted that the proposed business case focuses on adoption and pricing, and does not contain all possible intricacies of the parameters of such problem, but only a subset of the interactions between the different elements. Considering the high number of technological, strategic, and business parameters, constructing a fully detailed model is a very complex task.

ADOPTION OF IPTV

The purpose of a good adoption model is to forecast in a reliable manner the number of customers and their behavior as a function of time. In this way it fits within the first step of the business case overview as proposed before. Different models exist and will not all lead to the same reliability in the case of IPTV. Therefore, we first select the most reliable adoption model for IPTV. We complement this with a view of the expected evolution of customer usage of the different IPTV services. In addition, the possible impact of two important effects for IPTV — competition and analog switchoff — is described.

CUSTOMER ADOPTION

Different models can be used for modeling the adoption of a new technology or service. These models typically resemble an S-shaped curve for presenting the adoption as a function of the time. Different mathematical formulations can be used for these S-curves, leading to slight variations in the adoption models. Often used models within literature, both in telecom and more in general, are Rogers, Bass, Fisher-Pry, and

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Gompertz. Roughly speaking, information used for properly estimating the parameter values of these models can be gained from two sources:

- 1 Fitting of the mathematical adoption models to existing adoption data available. This requires sufficient data to be available and thus requires an existing customer base. For IPTV this might not always be the case.
- 2 Extrapolation from existing comparable technologies. In the case of IPTV we could make an extrapolation based on telecom broadband adoption on one hand and broadcast television (color or black and white) on the other. For television as well as broadband adoption, there is a lot of information available.

When considering the different mathematical formulations for modeling the adoption, it is clear that not all fittings will be as close to the actual data. However, the reliability of the forecasted adoption is of huge importance. Intrinsically IPTV is built on both broadband and television. As broadband access (and its adoption) is more novel than broadcast television, we have used the broadband data to select the most reliable model for forecasting IPTV adoption. To make a well considered selection, we have fitted the adoption models to existing data in two different ways. First, we have investigated the reliability of the models in the range of the data. Therefore, we have fitted each model to all available data and have calculated the difference between the fitted and exact data. The more reliable a model, the more closely it will follow the exact data. Second, we have investigated the reliability of the model for forecasts beyond existing data. Therefore, we have fitted the model to the first available data points (e.g., the first 50 percent) and then calculated the difference between the fitted (forecast) values and the exact values for the remaining data points. The more reliable a model, the less difference there will be between the forecast and exact data for this remaining part.

Different fittings made on existing telecom data for the adoption of broadband in Belgium show that both the existing and forecast data are most reliably modeled using a Gompertz adoption model.

SERVICE ADOPTION

In addition to the size of the customer base, the operator should also estimate how often customers will use the functionality and different services of IPTV. From a cost point of view, the expected uptake of VoD and more personalized content (e.g., commercials, NPVR) is especially important. Since the increased functionality and freedom of choice offered by the above services allows exploiting the long tail of video content, a gradual shift to more unicast instead of broadcast and multicast traffic can be expected. In combination with a growing number of TV sets per household, this could (in the end) lead to a (far) future scenario with a dedicated video stream per person.

The future will most probably also bring an increase in quality that currently started with a move from standard definition television (SDTV) toward HDTV. Typically this will

increase the bandwidth required per stream, somewhat tempered by continuous advances in video codecs.

Although the impact of both the move to personalization and higher quality is hard to estimate, an increase in both is very likely, and their evolution could be fitted to existing trends to get a clearer view. As both could be seen as additional services (e.g., VoD service, HDTV service), they can be modeled by adoption curves as well, albeit in competition with other IPTV services (e.g., SDTV service). The issue of competition is tackled below.

COMPETITION

Within a highly competitive market, as is the case for telecom services and especially for an IPTV service where different players (e.g., content providers, telecom operators) offer comparable services, competition will have a direct impact on adoption. Also, the competition with other DTV offerings (not over fixed broadband access) such as DVB-T or DVB-S will be very important for the success of IPTV.

Game theory is a very complete approach to modeling the effect of competition. It involves the construction of a detailed business model of all players and their possible actions. Additionally, all the different business cases should interact with each other to reflect the impact of the actions of all players. It thus involves a lot of work on the integrated models and a lot of input data that might not be available.

On the other hand, it might suffice to use a combination of an adoption and substitution model as proposed by Norton and Bass [4]. In such a model different generations of the same or comparable technology or service (e.g., SDTV vs. HDTV, or more generally a notion of the perceived quality) will interact with each other and with the initial customer adoption. A generation with superior technology, quality, or service will take over the adoption of the other generations. It is fairly straightforward to extend the best fitting — here Gompertz — adoption models with an identical substitution model.

ANALOG SWITCHOFF

Regulation might also have considerable influence on final adoption. In the case of DTV, a strong impact will probably be caused by the transition to digital TV, commissioned by the Federal Communications Commission (FCC) to take place on February 17, 2009 in America and scheduled from now until 2012 in several European countries.

When the analog signal is switched off, most (if not all) viewers will switch to DTV. In countries with high coverage of broadband access networks, this could lead to high adoption of IPTV. It could also lead to more intense competition with other DTV offerings.

In the battle for customers, IPTV providers will prepare the network for this event to offer customers the best possible service. They could persuade customers to follow this move by means of specific incentives and packaging. If customers follow this reasoning and subscribe to the newest generation, as mentioned in the competition model, this can lead to a boost in adop-

tion of this generation. Given the incentive of this newest generation, the impact of analog switchoff can be split between the different services according to customer willingness to pay and preferences.

Note that broadcast television has already reached full market potential, typically at least at 98.2 percent, while broadband is expected to reach a market potential of 80 percent but is not yet at this point in most countries.

Figure 2 shows an illustrative example of an adoption according to a Gompertz model extended with competition between two generations. Typically, the first generation is broadband not optimally suited for IPTV, and the second generation is broadband better suited for IPTV. It also includes the impact of analog switchoff (taking place in 2011). We assumed that all customers choose IPTV, and 80 percent of the new customers choose the newest generation. This means we assumed that the total adoption of IPTV jumps up to 98.2 percent at this point. This could, for instance, be the case in a country like Belgium with a high penetration of fixed access networks.

WHAT TO DO WITH THE COSTS

IPTV requires huge bandwidths over the network. It will most probably require upgrades of the network equipment. The size of the upgrades will depend on customer base and their usage pattern (e.g., VoD vs. broadcast) and might affect access and backhaul in a different manner. In order to find a viable business case, the operator has to cover at least all costs by the revenues. This means the operator can calculate a minimal required average return per user (ARPU). These calculations are part of the last step in the business case overview as proposed before (Fig. 1).

We first focus on how important it is to isolate the cost incurred for IPTV services from the total cost of all services. Next we investigate the trade-offs between different schemes for billing the customer. Finally, we show how the price charged for the service might influence the adoption and hence change the whole business case.

It should be noted that there are a multitude of other parameters and decisions to make in the evaluation of a business case. For instance, packaging (triple or quadruple play) and content portfolio will be very important. Considering the revenues, marketing and advertising will also play an important role. Estimating the influence of these parameters on the business case requires dedicated market research, which is outside the scope of this article.

ALLOCATING COSTS

With the current move to an all-IP network carrying data, voice (VoIP), and video (IPTV) over the same network, it is clear that such integration leads to important savings due to effects of economy of scale and scope (larger volumes allow price reductions and specialization). There is also a trend to introduce more services over the existing network infrastructure. For instance, considering IPTV, there are a lot of new services

■ Figure 2. Adoption for broadband access with the impact of competition and analog switchoff.

that can be deployed, such as VoD, NPVR, telebanking, and video telephony.

With this increasing number of services all running over the same network infrastructure, it becomes very difficult to estimate for each service how it will contribute to the overall network infrastructure cost. A clear indication of the costs contributed by each service is very important to get an idea of the profitability of each service. Additionally, when determining the bottom tariff to charge for a service (either at introduction or at a later point in time), the cost will be the main input. Different allocation schemes exist for splitting the total cost of a network operator between the different services it provides. More information on the different types of costs and the rationale behind their allocation can be found in [5, 6].

Figure 3 shows the difference between the bottom prices calculated according to different allocation schemes. The allocation scheme used in the calculations of the costs will have an important influence on the bottom price calculated for the service. Additionally, the figure shows the results for four different planning periods (A = 15 years, B = 10 years, C = 8 years, D = 5 years), indicating that the length of the business case and especially the way the costs are allocated during the first years of deployment have a very important influence on the calculated bottom price. The following allocation schemes were used:

- The standalone cost (SAC) allocation scheme calculates the costs for the deployment of a new IPTV service as if it is the only service over the network. This leads to an overestimation of the cost and thus to a certainly safe, but probably noncompetitive price. It is the highest price boundary found (on the right side) with all higher prices leading to guaranteed profits.

- The break even cost method calculates the costs for the new IPTV service as if all existing services together with the new service should break even. Break even is the lowest boundary on price. Due to cross-subsidization from all existing (profitable) services to the new IPTV service, this situation might become unsustainable as the customer base for IPTV raises beyond the expected sales. The results in Fig. 3 (D) clearly show that this cross-subsidization has an

■ Figure 3. Price boundaries depending on the cost-allocation scheme used (normalized to max. SAC (C)).

important impact in the first years of the project.

- Fully allocated cost (FAC) is the allocation scheme in which all costs are split according to the actual resources being used. Such fully allocated cost calculation is based on an allocation key, such as bandwidth overall or peak usage, calculated in advance for all services. FAC results in both a competitive and sustainable price towards the customer, on condition that a correct allocation key is used. Different functionalities and requirements of data transport (e.g., bandwidth, quality of service, relation to peak bandwidth) could be taken into account (e.g., VoD will require much higher [dedicated] bandwidth than broadcasted video and should contribute a larger cost, unless if some technologies are used to reduce this bandwidth at the peak moment).

- Long run incremental cost (LRIC) scheme allocates only the incremental cost for the upgrade of the network attributable to the IPTV service. This way the new service profits more from economy of scale for its cost which results in a lower boundary.

- Finally, we propose to make a trade-off between LRIC and FAC in which only incremental costs are allocated to the new IPTV service in case it consumes a relatively low share of network resources. Once the service matures and consumes considerable network resources, the costs are allocated according to the FAC scheme.

PRICING

There are different pricing schemes that could be used for billing the customer (see also [7]). Considering broadcast content over IPTV, there will be no difference between customers. All customers located behind the same switching hub (e.g., local exchange or head-end) can choose from the same stream of channels at the same time, and are charged the same whether they watch or not (in some cases there is an additional charge for extra channels with specific content).

When VoD is considered, the situation is different. Providing VoD to many customers requires large amounts of bandwidth and could lead to congestion. In such a situation it makes more sense to use advanced pricing schemes. The revenue effect of using a specific pricing scheme can be found through simulations, in which the tariff the customer is charged is calculated according to the specific pricing scheme used. The reaction (renting a video or not) of each customer is simulated consistent with probability, the tariff, and their willingness to pay. The final outcome is a simulated list of films rented along with the tariff charged. It is easy to calculate the revenues for the different pricing schemes.

Figure 4 shows the profit per movie as a function of the traffic congestion in the network for the following pricing schemes:

- Flat rate or content-based — Charging a fixed tariff per movie, possibly depending on the movie's content, quality, or length.
- Time-of-day-based — Charging a tariff depending on the time of day the movie is rented. A higher tariff is charged for movies rented during peak periods.
- Congestion-based — The tariff charged depends on the level of congestion in the network. In our implementation the tariff is linearly increased once more than 70 percent of the bandwidth is consumed at peak.
- Auction-based — The tariff charged is deduced from a (agent-based) Vickrey auction. In this the customers indicate the price they are willing to pay, from which a market clearing price is deduced. This market clearing price will be the tariff charged to all customers who bid at least this price.

Traffic used for the simulation has peaks between 18 and 22 h. At 0 percent traffic congestion, the highest peak consumes all available bandwidth without any blocking. The situation below 0 percent traffic congestion is left out of the figure as the advanced pricing schemes lead to profits per movie that are lower than those of flat fee. Finally, the parameters for the different pricing schemes were initialized to give the same results at 0 percent traffic congestion.

Going from flat rate to auction-based, there is increasing incentive for the customer to avoid congested periods. On the other hand, the transparency of the tariff charged to the customer will decrease; and for auction-based, it is even questionable whether customers would accept such a pricing scheme. However, auction-based will clearly give the best results, followed by congestion-based. Flat rate and time of day have lower profits per movie. It is important to note the result of the time-of-day pricing scheme. This pricing scheme will result in a decrease of profit per movie for increasing traffic congestion when the parameters of the pricing scheme are not continuously adapted to this change (Note that a continuously adapted time-of-day scheme is equal to the congestion-based scheme). This is caused by an increasing chance of movies being rented just before the penalized period, running over part of the penalized period (without extra charge) and leading to a decrease in profit. Practically speaking, this means that probably flat

rate is the most obvious choice as it is most transparent and has a more or less constant profit per movie. Congestion-based and especially auction-based pricing could prove very profitable in those cases where considerable congestion is (and will remain) present in the network. If strong adoption of VoD is expected and network bandwidth is not (or cannot) be adapted adequately, this could be the case in the future.

INFLUENCE OF PRICING ON ADOPTION

Finally, all decisions made in the previous steps will also influence the adoption of customers. The forecast of customer adoption used at the initial stage of a business case is derived from market research analysis. Such market study is based on an implicit price that is expected to be both attainable considering the technical implementation as well as reasonable for customers. If first calculations prove that this price is not attainable and a (slightly) higher price should be set for IPTV service, probably fewer customers will subscribe to this service. In other words, charging a higher price than initially anticipated will lead to a reduction of customer adoption, and might lead to a smaller upgrade of the network infrastructure and thus to lower CapEx in the first years of deployment.

In an IPTV environment there might be considerable investments at the start of deployment for installing content servers, acquiring the right content, and upgrading the bandwidth in the access network where necessary. Thus, for IPTV the loss of revenues caused by the reduction of the customer base could impact the business case more substantially than the reduction (postponing) of CapEx. In such a case this leads to a further increase in price.

Results from such an iterative calculation have been indicated in [6] and show that, depending on the expected impact of the price-change on the customer adoption model, either a slight relaxation or reinforcement can be found. We considered two different impacts of the tariff on the adoption model. In a best case scenario we considered a limited (linear) customer response to the change in tariff. In the worst case scenario we considered a much higher customer response (quadratic).

In greater detail, the results show that a 10 percent difference from the implicit (market research) price might lead to a difference of slightly less than 10 percent (best case) up to 25 percent (worst case). Clearly this risk cannot be discarded and should be taken into consideration.

CONCLUSION

When building a business case for the deployment of IPTV service, there are more than just technical issues (comparing technologies, optimizing traffic, etc.) to take into account. This article shows where the more technical papers can be extended to a full business case. First adoption, in both customer base and usage, will play an important role. Therefore, the article contains an overview of the customer adop-

Figure 4. Profit per movie as traffic congestion increases.

tion models and different parameters that influence this adoption for IPTV. The most important parameters here are the choice of adoption model (Gompertz is found to be the best), the extension toward modeling competition, and the effect of analog switchoff. Second, the evaluation of costs and especially pricing will have an important influence on the business case. By allocating costs fairly to IPTV and all other services, more competitive yet still sustainable lower boundaries on pricing can be calculated. The second pricing parameter is the pricing scheme to use, for which flat rate pricing is optimal in a low congestion situation and congestion- or auction-based are promising for situations with higher congestion in the network. Finally, as pricing will also influence customer adoption, the outcome of the business case might change its inputs. This effect should not be neglected as it might lead to important differences and coupled risks or opportunities.

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