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Adding cost-drivers to the pricing process by using a bottom-up cost-allocation approach

Abstract-Given the growing level of competition in telecom, it has become very difficult to raise prices of service offers in time. As such, it is very important to set the right consumer-price from the start when introducing a new service over an existing network. Setting the initial price too low might jeopardize your profits, while setting the price too high will reduce your competitive advantages over other service-providers. In order to make a well informed decision, several parameters must be taken into account. Some of these parameters are market driven, for instance a demand-curve showing the amount of clients that can be expected for a certain price of the service. While these parameters certainly are very important, the pricing decisions should also depend on the cost of providing the service. We will show the essential role of this cost in the process of price-setting for a new service. However since the new service does not yet exist over the network, this cost cannot be derived from a top-down network cost model reflecting the current situation. Instead, a bottom-up cost-allocation method must be used to calculate this cost. We will describe such an approach and explain why this method should be used as opposed to other methods. We also show the positive effect that the introduction of a new service might have on the profit-margins of other services and how to quantify this effect using the proposed method. Finally we use the proposed method to determine a good pricing scheme in a realistic case where an iDTV service is introduced in a network mainly carrying internet-traffic. *Keywords: pricing, cost-allocation, bottom-up.*

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Introduction

Pricing is the process of determining which tariff to charge for a certain service to the customer. The process of setting a price for a certain service is a difficult problem, especially when considering the introduction of a new service on the market. The price set for the service might have a huge impact on the telecom company, since in the highly competitive telecom-market of today services typically have a low elasticity. This means you should avoid raising your tariff in the future because it would have a significant negative impact on your market share. As such setting an optimal initial price for a new service is crucial yet complex: if it is set too low, this might result in a unsustainable situation, while setting it too high might result in a lower take-up of market share. Given the growing level of competition and the decreasing profits in telecom, pricing becomes essential.

Within the process of pricing the service provider has to make several important decisions. First the service provider can decide which pricing scheme he will use for the considered service. Several pricing schemes and variations are detailed in the literature [1], [2], [3], [4], [5] mostly focused on the effects and variations of the very dynamic auction-pricing. Pricing schemes often used in current-telecom-networks are:

- Flat rate pricing. The tariff charged to the customer is independent of actual resource utilization.
- Usage or content-based pricing. The tariff charged to the customer is proportional to the bandwidth or content provided to the customer.
- Time-based or congestion-based pricing. The tariff charged to the customer is depending on the time of day (peaks) or on the actual congestion measured in the network.
- Auction-based pricing. The available bandwidth is auctioned amongst all customers.

While the pricing scheme is very important for the marketing of the new product, setting the actual tariff charged, regardless of the pricing scheme used is more important from the company's profitability point of view. Making this decision relies on a lot of information in which the company tries to model the reactions of the different players in the field. The following players can be identified (non-exclusive):

The customers will either buy the new service or the competing service depending on the tariff proposed. Their buying behavior is usually retrieved through the use of market research.

The competition is selling similar services. Accurate information about the competition is hard to get and the interpretation of this information involves knowledge of their strategic background.

The regulator tries to maximize customer surplus and might, from this point of view, impose regulations on the considered tariff.

Finally, ***the company*** tries to maximize their profits and turnover, especially in the long run. For doing so, costs and revenues are important as well as the strategy the company pursues.

Before turning to game theory or another method for calculating an optimal solution of the problem, it is possible to use cost-allocation to calculate indicative cost-drivers for a fast identification of the solvability of the pricing problem. The costs calculated using different cost allocation schemes give several different indicative margins on the price. Since all services use the same network, the costs of using this network are not easily retrieved. Depending on the way the costs are calculated, the results obtained might lead to a different decision.

If the calculated cost is higher than the actual cost, it might either lead to an uncompetitive tariff for the new service or to a negative decision on the introduction of this new service. If the calculated cost is lower than the actual cost, it will lead to a non-profitable service or a non-sustainable price, which might impact profits negatively when the number of customers increases. While it might be a strategic decision to take a small loss in order to gain market share very fast, it is still very important to have an idea of a sustainable tariff for the service.

The remainder of this paper is structured as follows. Section II gives a background on cost-calculation and allocation for network-services and shows which pricing-margins can be deduced from these costs. In section III these margins are related to each other in the scope of a realistic use case in which an iDTV service is introduced over an existing network in which a broadband internet access service is already provided. Finally Section IV provides a general conclusion and future work.

Cost-Driven Pricing

Within cost-driven or cost-based pricing, the total revenue of all customers is expected to cover all costs incurred for delivering this service to the customers.

In a converged network, the available bandwidth is shared amongst all different services over this network and several different services might require a bandwidth increment at the same time. This allows major savings due to economy of scale, but requires a cost-allocation process to determine the cost attributed to each of the different services.

From these costs, pricing-margins can be calculated which give an indication of how low a tariff can be set and whether the tariff set is sustainable.

A. Cost calculation and allocation

Depending on the different cost bases, different costs per service can be revealed. Two approaches can be followed for allocating costs to the different services, dependent on the considered starting point of the network modeling process, top-down versus bottom-up cost modeling.

Top-down versus Bottom-up Cost Calculation

The first approach, the top-down method, starts from the existing network infrastructure. In this case, the actual network dimensioning is a result from fluctuations in historic and current demand, e.g. a growing number of customers and increasing traffic volume for several services, but also a declining service demand for other. The network is therefore less efficient than a new network. The cost of existing equipment is then allocated to the services, through the use of allocation keys [6]. Therefore, an accurate identification of real cost drivers is required. In practice, it might be difficult to select the correct driver, leading to less efficient and less fair allocations. Two important cost bases can be distinguished for the top-down valuation of equipment.

Historical Cost Accounting (HCA) uses the asset purchase costs as book value, taking depreciation into account.

Current Cost Accounting (CCA) values assets at the current market price. This cost base represents the replacement cost of an asset, using Modern Equivalent Asset (MEA) cost base, where the cost of equipment is valued using the cost of a new technology offering the same (or more) functionality as the one that is currently installed.

The second approach, the bottom-up method, requires as starting point the demand for the services. Both a forecasted demand for new services as for existing services can be used here. The network is dimensioned in such way that it is optimal for the current situation: it can serve all customers with the requested services at the proposed quality of service. Service costs are allocated according to their required network equipment and usage.

In the bottom-up method, the company's properties and goods will be evaluated following the forward looking cost (FLC), which means that only new and efficient technology will be used. This implies that an existing network must be reconsidered and remodeled. There are three approaches for doing so, the scorched earth (green field), scorched node (path dependent) or incremental node approach. In scorched earth, the network is redesigned with as few constraints as possible: a different number of nodes, a changed topology and other technological solutions can be taken into account. Both other possibilities make a more fair compromise between efficiency of new technologies and networks and the existing network structure. The nodes stay at their original positions. In scorched node all equipment in the node can be changed, whereas in incremental node the existing equipment in the node is kept and expanded [7].

With the introduction of a new service in the network only bottom-up cost-allocation can be used and any existing resources used in the network should at least be allocated using current cost (MEA) or FLC. With an incremental design of an existing network as in case of the introduction of a new service, scorched node or incremental node will reflect the actual situation best.

Cost-allocation

The calculated costs can further be divided in direct costs, shared costs, joint costs and common costs. [1]

[1] Note that there is no consensus in literature concerning the precise definition of shared and joint costs [6], [7]. We adopt the definitions given in [8].

Once all costs have been calculated and categorized, different types of costs per service can be calculated through different methodologies.

The first method is the Stand Alone Cost (SAC). It considers the cost per service as if there was only one service offered. All shared/joint costs and common costs are added to the direct costs of the considered service and are allocated to that service. The SAC is the highest cost level the service can reach. This method is only used in a top-down approach to determine an upper bound for the cost of a service.

The Fully Allocated Cost (FAC) method allocates all costs to all services. Direct costs are directly attributed to each cost consuming service, shared/joint and common costs are attributed through the use of allocation keys. The hardest part when using this cost-base is to find the right allocation key for all costs. An algorithm that could be used in this context is described in [8].

The (Long Run) Incremental Cost ((LR)IC) method only measures the change in total costs when a substantial and discrete increment or decrement in output is generated. This increment can be a newly offered service, but also an increase in output of one service. Economies of scale will be playing an important role in the allocation of shared/joint cost, resulting in a smaller part of attributed costs than in FAC. The LRIC method is mainly used in the bottom-up approach[2].

B. Unitary cost-margins and effects on existing services

Fig. 1 gives an overview of the different margins which can be identified according to the cost-information available. The refined margins calculated through the use of cost-allocation will be important in case other parameters such as customer demand or competition pricing force the price between the break-even price and the stand alone cost.

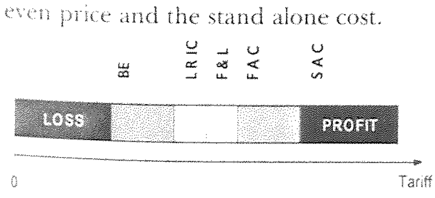

Figure 1 Overview of different cost-margins

[2] There also exist applications of LRIC in a top-down approach.

Outer margins

The two outer margins on the tariff of the new service can be easily defined using only the forecasts and simple economic calculations. These two margins will only give a clear indication whether the proposed business scenario will result in a certain profit or in a certain loss evolution.

Break-even

The break-even calculation (BE) of the services over the existing network gives a minimum-margin on the tariff to charge to the customers of the new service. This should be interpreted as the tariff under which losses are sure. In this calculation the minimum expected revenue is calculated as the difference between the summation of the costs of all services over the network and the (forecasted) revenue of the existing services as shown in (1).

It is clear that this is not a sustainable cost and will result in loss when the amount of customers is higher than forecasted. This margin should therefore be used as an absolute minimum margin; beneath this margin the service cannot be provided.

$$margin_{BE} = \frac{cost_{tot} - \sum_{s \in Existing\ Services} revenue_s}{\#customers_{forecast\ new}} \qquad (1)$$

Stand-alone

The stand-alone calculation (SAC) for the new service over the existing network gives an upper margin, which should be interpreted as the tariff above which profits are sure (in case the forecasts are correct). In the stand-alone calculation the tariff is set at such level that all costs made for introducing the new service are covered, when these costs are calculated stand alone (as if no other investments in network-architecture happen at the same time).

$$margin_{SAC} = \frac{cost_{new\ without\ existing}}{\#customers_{forecast\ new}} \qquad (2)$$

Narrowing down

Working between the two previously defined margins requires a closer knowledge of the actual costs for providing this new service to the customers.

Within a converged network all services are using the same equipment of the network, which allows large cost-reductions due to economy of scale and scope. The cost should here be calculated using two different cost-allocation methods. A combination of both can be used for narrowing down even further.

Margin based on FAC

The FAC-margin reflects the situation in which each service is paying the amount of resources it uses, regardless of the fact that it might actually be filling spare capacity of other services. All investment costs are allocated using a fair cost-allocation scheme which reflects the actual usage of the resources available in the network.

Margin based on (LR)IC

The LRIC-margin reflects the situation in which the new service is at each moment seen as an additional service on top of the main service(s). The costs allocated to the new service are equal to the additional investment-costs necessary to provide the service when the cost for providing the increment for all existing services is already committed.

Margin based on combination of LRIC and FAC

Considering the adoption curve of a new service, it is clear that in an early stage it resembles most closely the LRIC situation of a very small service using mainly spare capacity of the existing services. In a later stage of its adoption it will possibly grow at a size justifying the use of FAC. A margin can be calculated using a combination of both (referenced by F&L), by setting a threshold level on the capacity and using LRIC as long as capacity-requirements for the new service stay beneath this level and FAC when the capacity requirements are above this level. Using such method might also give the new service a more competitive edge without pushing the existing services in a non-profitable situation.

Case-Study – Introductiom of IDTV

In order to get an idea of the relative difference of these considered margins, we've calculated all considered margins for a realistic case. In this case we consider the introduction of a new iDTV-service over an existing network with an existing internet broadband access service (referred to as BB in the remainder of this paper). The iDTV-service considered will offer at least digital channel broadcasting and VoD.

A. Forecast

Making a good forecast for introducing a new service over a network and for the existing services over this same network lies outside the scope of this paper. Since such figures have a high strategic value for a telecom company, it is nearly impossible to acquire accurate and consolidated forecasts for such case. In spite of this, it is still possible to acquire some data and by making grounded assumptions retrieve a more or less realistic forecast.

Since all costs of capacity are directly driven by the customers, this is also used as the starting point for the forecast. We made use of the adoption curve as defined by Rogers for modeling the evolution of both customer-bases. Historical data for the existing BB service could be easily retrieved from the annual reports from the considered telecom-company [9]. For iDTV, we started from a market analysis, conducted by the Ghent University, concerning this matter [10] and [11]. This growth is similar to the one found in [12] considering a smaller customer base. We estimated that the adoption of iDTV will be faster than the adoption of BB, due to the existing high penetration of TV, the easy conversion and the use of triple play as a marketing strategy for introducing the digital television to the existing BB customers and new customers. We expect both adoption curves to merge in the future (2015). Following this assumption we constructed the likely adoption curves for both BB and iDTV.

We also expect the maximum bandwidth available per user to change in time as well. Historical figures of this bandwidth for BB can be found in the same annual reports as before [9]. Illustrative figures of this bandwidth-evolution for iDTV were found in [13]. We extrapolated these numbers assuming that the total bandwidth requirements for iDTV equal those of BB in 2009 and that both will not divert from each other afterwards.

The combination of both the bandwidth- and customer-increase results in an increasing bandwidth requirement in the network which is shown in Fig. 2.

Finally we will calculate the costs, assuming that the initial costs are proportional to the amount of bandwidth that is additionally installed in the network. Since realistic cost-figures could not be found we set the cost of incremental investment for the period 2008-2009 equal to 10000 units. These initial costs are further adjusted to reflect the effects of economy of scale (EOS), cost-erosion of the considered material and rate of return of the investment. The factor used for EOS is taken from traditional SDH-networks where a quadrupling of the required capacity results in a cost which is 2.5 times higher [14]. This corresponds to a cost-increase of approximately 8 for a capacity-increase of 25 which lies between the cost-increase of 6 and 10 as mentioned in [16] and deduced from [15]. Cost-erosion is assumed to be an exponentially decreasing function in which costs decrease with 10% every year. This resembles closely the cost-erosion model proposed in [17] and [18]. Finally the interest rate of return for calculating NPV is set to 10% as well.

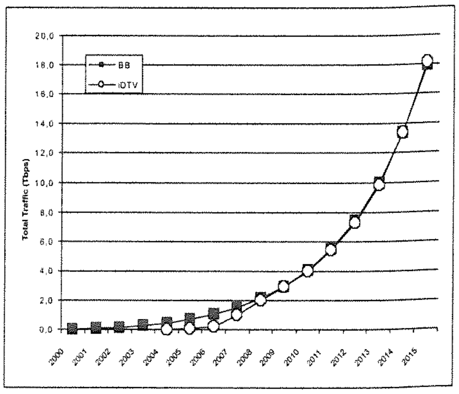

Figure 2 forecasted capacity-evolution for iDTV and BB

B. Pricing and effects on existing services

From the forecasted cost-evolution, as discussed above, the different cost-margins can be calculated. Since, in the forecasts of this case only the costs of the installed and shared network-capacity are calculated, the cost-allocation only takes these costs into account.

Outer margins

In case of the stand-alone cost only the cost of the iDTV should be calculated as if it were the only service over the network using the same effects as described above. It is clear that, due to the effect of EOS, the sum of the costs of BB and iDTV both calculated as stand-alone will be larger than the cost of providing both over the same network. In case of the break-even cost, the revenue of BB should be known. Two different methods for calculating this value are considered:

1. The yearly revenue for BB is set at a value which guarantees a predefined profitability (expected profit (EP)) of the service (as stand-alone (SAC)).

$$Revenue_{tot} = \sum_{years} SAC_{year} \cdot (1+EP) \quad (3)$$

2. The tariff charged to the customers (C) of BB is set at a constant value which guarantees a predefined profitability in a predefined year (y).

$$Revenue_{tot} = \sum_{years} Tariff \cdot Users$$

$$Tariff = \frac{SAC_y \cdot (1+EP)}{Users_y} \quad (4)$$

The break-even margins based on these are called respectively BE cost and BE cust.

Narrowing down

As described above, the margins calculated in the previous section can be narrowed down by using different cost-allocation schemes. In the following calculations the combination of FAC and LRIC makes use of a threshold value of 20% which means that all costs are allocated using the LRIC allocation scheme as long as the bandwidth-requirements for iDTV stay below 20% of the total bandwidth requirements.

C. Results

The resulting pricing margins, as calculated for the considered interval up to 2015, are shown in Fig. 3. As the pricing margins calculated using the LRIC cost-allocation scheme and the FAC cost-allocation scheme are sustainable pricing margins, the different figures show a large difference with the BE-margin in which the sustainability is not guaranteed. On the other hand the figures also show that these pricing margins give more competitive margins than the stand-alone cost.

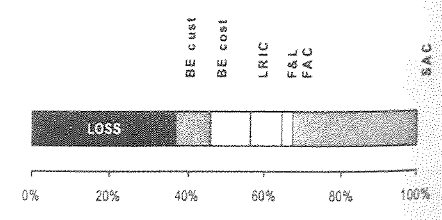

Figure 3 Pricing margins (in unitary cost) calculated using the proposed allocation methods

Fig. 4 shows that the narrowed down margins are between 60% and 70% of the stand-alone cost margin, and are at least 10% above the highest BE-margin and up to 50% above the lowest BE-margin.

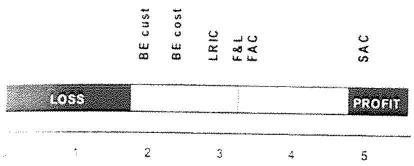

Figure 4 Pricing margins relative to the SAC margin

Setting a tariff for a new service over an existing network is a difficult problem, in which information of the investment cost can be used as valuable input. The outer margins, calculated using break-even or stand-alone cost-allocation give an indication whether a tariff will result in sure loss or sure profit.

Between these two margins a grey zone exists. In this paper we presented how an approach based on bottom-up cost-allocation can be used for narrowing down this zone and gathering additional information in this zone.

We also performed a realistic case study in which the impact of this approach was studied. By using cost-allocation on this case, the upper margin could be refined to 70% of the original margin (FAC) and the lower margin indicating a sustainable price was found about 50% above the lowest original margin.

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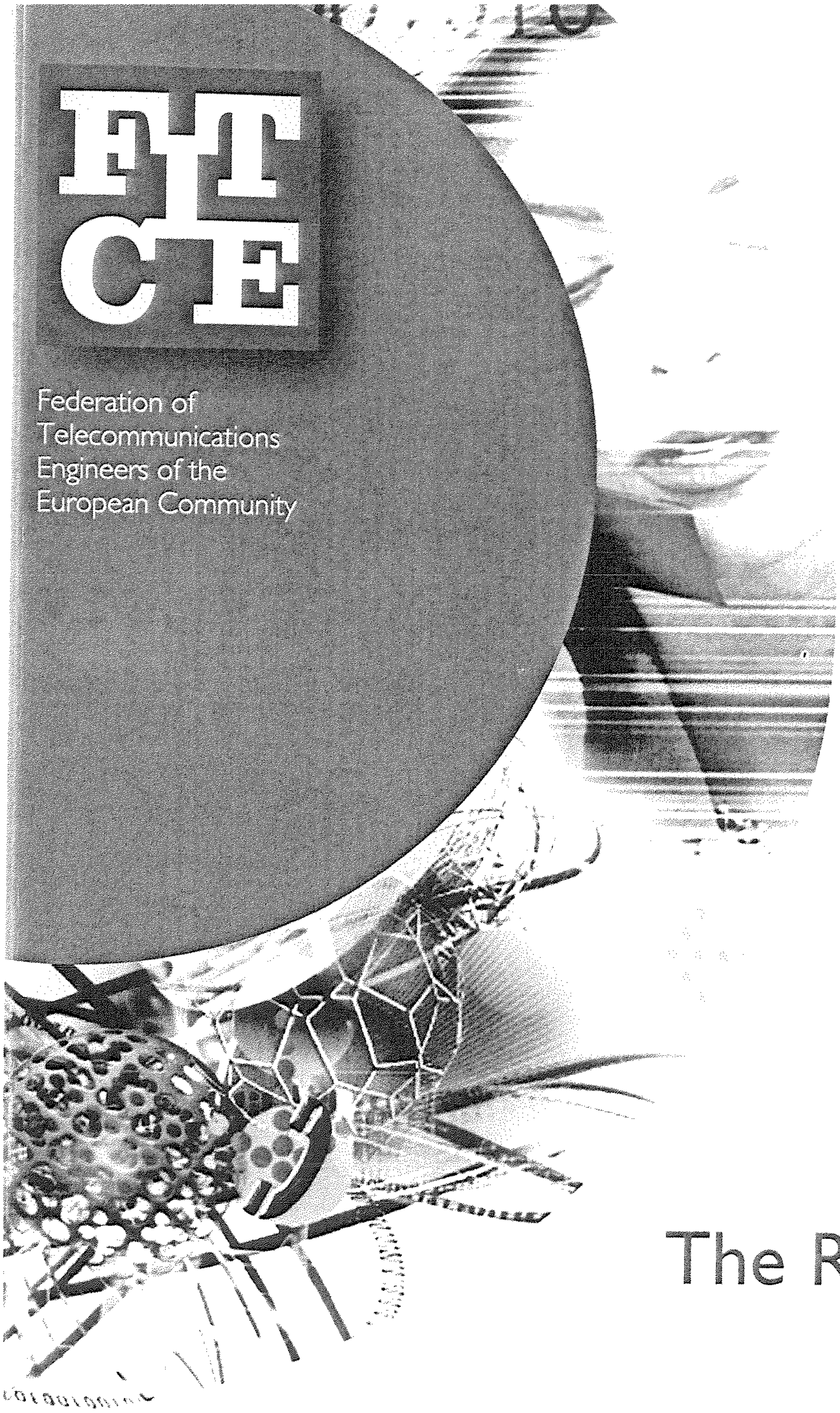

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