

Broadband business opportunities for utility based firms in the new era: modeling the competition

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Abstract - After the deregulation of the telecommunications market, municipalities and utility-based firms which own physical resources are capable of entering in this market. This study focuses on the broadband business field and provides a model for analyzing the new perspectives for new investors in the field. It integrates real options and game theory and considers price and quantity competition for various stages of the business game in order to find the optimal business strategy. Both techniques are based on quantitative analysis, while the complicated broadband business field requires a multi-criteria analysis including also qualitative thinking. The various business factors are integrated into a single utility function using the Analytic Hierarch Process. Finally, we discuss a real world case study in the specific business field.

Keywords-component; Broadband business, Real options, Game theory, Decision analysis, Investment analysis

I. INTRODUCTION

In the new era of the telecommunications business field with a high number of potential investors, the Information and Communication Technologies (ICT) service providers should seek access network solutions with even more bandwidth. However, communication solutions like xDSL (x Digital Subscriber Loop) and WiMAX in fixed wireless communications experience recognizable limits of their capabilities mainly because of limited bandwidth. So far, the most viable solution for high bandwidth provision, especially in access networks, is the optical fibers technology. Hence, the installation of the optical fibers and their commercial exploitation is a very challenging business activity. Authorities that own physical infrastructure such as service utility companies experience competitive advantage against typical telecommunications operators. These advantages are mainly coming from the lower installation and implementation costs of the optical fibers networks. Such kinds of initiatives are already taken place also in Greece. These infrastructures will be based on local municipalities and service utility companies and should be operated in an effective way. Therefore, effective business modeling should be applied. In the telecommunications business field, market deregulation and technological innovations have made it possible for the so-called “facility-based” or “utility-based” firms to roll out proprietary networks and to rely mainly on their own infrastructures in

order to provide services to end-customers. Contrary to the facility-based firms and local municipalities, “service-based” firms do not invest in facilities but lease access to the networks of facility-based firms in order to offer services on retail markets. The potential business investors in the broadband technology field face the dilemma of selecting the time entry into the market and the type of the business activity to be involved. In addition, facility-based firms experience lack of specific business experience and because of this they should look for possible joint ventures with telecommunication companies and set up specific subsidiaries for this purpose. In this paper, we treat broadband business opportunities using real option thinking and apply game theory to model competition for the aforementioned business stages. However, real options and game theory analysis are strictly quantitative decision analysis theories, while the overall business complexity requires higher flexibility in overall problem modeling. Quantitative real options thinking has been already applied in the ICT field [3][4][13]. Also, options analysis in broadband business field and especially concerning broadband technologies upgrade from ADSL (Asymmetric Digital Subscriber Loop) to VDSL (Very High Data Rate Subscriber Loop) has been examined in [6][7][8][16]. For a survey of options theory applications in the ICT field, the interest reader is referred to [5]. We consider quantity and price competition for the available business stages according to their specific business characteristics. The main aim is to provide a decision making model in the specific business field, where initial investment owns future opportunities treated as real options. The interest investor faces one dilemma: “should he wait for understanding even better the overall business and control some of its uncertainties, such as customers demand and business experience or he should act rapidly and preempt possible competitors, which are also owning the specific business opportunity?” The paper is organized as follows. Section 2 proposes a background of the broadband industry, which motivates our modeling and analysis. Section 3 describes the model and the proposed analysis. Section 4 discusses a real world case study. Section 5 provides a discussion and suggestions for future research. Finally, section 6 concludes.

II. INDUSTRY BACKGROUND

A. The Broadband Market

Broadband services enable consumers to access the Internet at high-speed rates. In most industrialized countries, broadband is developing fast. For instance, there were 37.9 million broadband lines in the United States (US) and 33.4 million lines in the European Union (EU) in 2004, compared to 28.2 million lines and 19.4 million lines, respectively, one year earlier [9][11]. Broadband business opportunities further to the previous decade deregulation of the telecommunications markets are supported by the state authorities who recognize that broadband technology can improve citizens' quality of life. Although the cost of broadband infrastructures has decreased, the required investments remain an obstacle for private sector [14]. Facility-based companies experience significant competitive advantages since they own a number of physical resources or installation rights that in overall decrease the optical fibers implementation cost. Nowadays, Greece holds one of the lowest positions in the EU with respect to the broadband penetration. Broadband in the country is still at the early stages of growth with a penetration rate of 7% in 2007 [6]. However, the Greek stage will fund organizations to deploy and operate broadband networks and services.

Especially, focusing on Greece water supply and sewerage network operator in the second largest city of Greece, Thessaloniki, has been announced its intention for entering in broadband business field by installing optical fibers in the existing sewerage network [21]. Also, the city of Patras, which is the biggest municipality in the Region of Western Greece, and the third biggest city of Greece owns a Metropolitan Area Network connecting a large number local authorities such as universities, hospitals and schools. Similar broadband metropolitan networks have been developed in various parts in all around the world; indicatively, we mention, Sweden (Stockholm), Austria (Vienna), Spain (Catalonia), New Zealand (the city of Wellington), Netherlands (Amsterdam), USA (a group of cities in Utah) and Australia [18][19]. Particularly, for Europe 96 out of the 139 FTTx projects (FFTH, FTTB) 66% of them involve municipalities and utility companies [21]. For an overview of an overview of Fiber, European (Muni and other) Fiber to the Home and Fiber backbone projects the interest reader is referred to [12].

B. Description of the overall business opportunity

We focus on facility-based firms, normally utility companies that own a number of physical resources. Such resources may be transportation networks, sewerage and water pipes and electrical wires poles and pylons. Based on this infrastructure the legal owner of it may install dark optical fiber for implementing a passive optical network. The activation of passive network, light the fiber, will be the next business stage initiated by the utility firm itself or by a telecommunications company that posses the required amount of experience. Finally, after the activation of the optical fibers network the specific services provision is the

third stage of the overall business stage. The overall broadband business opportunities for transportation utility-based firms which are willing to act in this field were discussed in [13], while [4] applied options thinking for staged broadband investments under exogenous competition modeling. We consider the present study as an extension of that work focusing more on endogenous competition modeling and introducing a multicriteria perspective. The proposed analysis aims at finding answers to the following questions: *which are the layers or stages of the specific business that are available to utility firms? what kind of competition is experienced by the interest investor at each layer? what is the optimum time and scale to implement each stage of the overall broadband business?* Let call NewTelCo, the interest investor. NewTelCo faces competition at various stages of its future business activity. NewTelCo normally is a subsidiary of the parent utility company. In the following, we examine the various types of competition for each of the business stages. We provide arguments for considering various types of competition for each business stage (layer).

C. Competition modeling for these opportunities – Price or quantity competition?

The industrial organization literature has investigated circumstances under which each type of competition is more likely to occur. In the aircraft case, where fixed costs are all paid before sales take place and the firms have capacity to fill many more orders than they may get, price competition is likely. In other cases, where the production process takes a long time, firms may commit themselves to some level of output, and then sell it for what they can get. In this case, competition is in quantities. Such case might be the dark fiber infrastructure installation at distribution and especially access network layer, while the quantity might correspond to the geographical coverage.

III. ANALYSIS AND MODEL PRESENTATION

A. The business case - the game to be solved

A number of identical firms may enter the broadband business field in the deregulated telecommunications market. We consider a staged business game where in each stage the optimum investment decision in terms of time, quantity and price is estimated according to competition conditions. Our target is to find the overall business equilibrium for all the players in the specific game. We start our analysis with two firms to be involved in the specific under investigation business entry. We may easily extent this assumption by considering more firms to compete.

B. Analysis presentation

We consider three layers of analysis: 1) the passive network layer, 2) the active network layer and 3) the service layer [13]. For each layer we may consider different type and severity of competition. In the following we discuss for each business layer the types of competitions and provide arguments for these considerations. Passive layer includes dark fiber, ducts and microducts. Active network includes all

these equipment that lights the fiber and provides capability for bandwidth dealing on the physical transmission mean. The active optical fiber network will provide wholesale access for Service Providers (telcos, ISPs, video providers etc.) or any third party which will want to lease a part of the funded infrastructure. The supported services will be triple-play (Voice, Data and Video) and in the near future quad play (Plus Video, Mobile).

1) *Dark fiber installation - Infrastructure decision-Passive Network.* In the first stage, identical firms decide whether and where to build a passive optical fiber network. It is the decision to invest the basic infrastructure, which is the dark fiber installation. That decision may be related to dark fiber installation for backbone and/or distribution, access network. In this stage, firms choose the geographical area (coverage) of the dark fiber deployment. We consider it as quantity competition, because such investment takes a long time and so firms prefer to commit themselves with a specific quantity (here, the geographical coverage or the number of the FFTH connections in a specific area).

2) *Active equipment installation.* In the second stage, firms choose capacity (size of routers, switches, portion of fiber to “light”, etc.) for each market segment; this capacity choice determines the maximum percentage of telecommunications providers as well as households and business customers in the firm’s market segment that can be served in the final stage. Firms may install different capacities in different segments.

3) *Service and application provision - Products/Service attributes decision.* In this stage, firms choose products and services with specific attributes to offer to the customers. Such services might be double or triple play ICT services with specific bandwidth values as specific service attributes. We consider price competition. Particularly, competitors choose price and offer service to consumers who choose whether or not to buy service based on these prices; consumption takes place and profits are realized. Hence, the firms choose the price of the products/services offered and the customers choose quantities. In conclusion, we consider that physical infrastructure competition (dark fiber) is related to quantity competition, while bandwidth, broadband access services is related to price competition. Similarly, services provision competition will concern price competition. In this work we focus on the business layer analysis and model the competition for dark fiber and active equipment business involvement. Table 1 summarizes the aforementioned discussion and the business roles and business layers, which are available to the utility companies. Also, we present the critical success factors, some comments for each business role as well as the proposed type of competition for each stage. Due to space limitations, quantity competition equilibrium are not given here, rather the interest reader is referred to [1][17][20][23]. The overall quantitative business utility (OBU_{qn}) function including all stages of the business opportunity is given by the following:

$$OBU_{qn} = \sum \pi_j (+\pi_{j-1} (+\pi_{j-2} (\dots (+\pi_{j-j})))) \quad (1)$$

where π is business profit for business stage j , and J is the total number of business stages. In the general case, a compound analysis should be considered since the profit value of the earlier stages depends and contains the values of the future ones. In case we consider no dependency between business stages the quantitative overall business utility is given by the sum of each business stage profit:

$$OBU_{qn} = \pi_{DF} + \pi_{AF} + \pi_{BS} \quad (2)$$

where the business profit indexes indicate dark fiber (DF), active fiber (AF) and broadband services (BS).

TABLE I. BUSINESS ROLES AND TYPE COMPETITION

Role	Description	Critical Success Factors	Comment	Type of Competition
Service Provider	Internet, TV, Telephony, & other services	Customer base, brand, services platforms, marketing know-how	It requires a joint venture with an IT company, since utility companies present poor IT business culture.	Price Competition
ActNet	operates the active network and provides equal access to service providers	Network operations know-how	It normally requires the involvement of Telecommunication experienced people. This can be realised provided the right people are attracted to the new company.	Price Competition
PasNet	builds and owns the passive network	Funding for investment in passive network infrastructure	Normally, utility company may ensure funds by national or European Union sources for a passive network deployment	Quantity Competition

Stage one and quantity competition analysis indicates that the firms should be first movers (FMs), since they will experience higher profits [1] [23]. However, since both competitors recognize it, under symmetrical conditions they will normally move simultaneously and so gaining less. In addition, in price competition, the competitor with the best quality attribute (here bandwidth or number of optical fibers per connection) is able to charge higher prices and so experiencing higher revenues.

C. Qualitative Analysis presentation

Broadband business activity contains a number of critical factors/criteria that should be treated in a qualitative way. We briefly present qualitative criteria that can be integrated with the quantity competition modeling as presented before.

1) *Strategic Intangible Factors (SIF).* Typical measures of strategic perspective for a potential ICT provider are the following: shareholders and senior management commitment and funding handling (SMC), strategy entry intensity in the telecommunication market (SEI), and structure complexity of the new telecom provider-need for alliances (SCA). Shareholders and senior management may not be fully committed to the investment providing full management support, and especially funding. Also, alliances with other competitors in the field may be required,

especially for investors such as utility firms having no specific business experience.

2) *Tactical and Operation Intangible Factors (TOIF)*. Factors related to the Tactical and Operational perspectives are identified. These factors should be business specific, and are requirements that must be fulfilled by isolating detailed tasks, processes and resources, in order to ensure medium/short-term tactical and operational success. If these factors are not considered, they will become an obstacle to corporate progress, and may ultimately result in a loss of business, and failure in the achievement of the specific business deliverables. Such factors can be the following: internal resources-expertise availability (IREA), competition advantage –innovative telecom services provision (CAIS), internal competition – cannibalization of future investments – securing investment benefits (ICSI). The firm can gain competitive advantage by implementing the project, which can be translated to an increase of the market share. In addition, by investing and exploiting a specific business opportunity another existing or future business opportunity may be influenced negatively. Analytically, an investment opportunity treated as prerequisite of a future growth option may influence negatively or positively the future growth option if it is or it is not commercially exploited. In this sense, a new business activity may cannibalize existing business opportunities [4].

3) *Risk Mitigation Intangible Factors (RMIF)*. Broadband investments experience a number of risks, which are coming from the internal and external environment of the firm. The uncertainty control or “clearness” achieved by the ROs is quantified by the volatility of the stochastic parameters such as investment revenues and investment cost [17][20]. However, the overall uncertainty of an investment opportunity cannot, at least easily, be quantified. Qualitative modeling would help in this. This uncertainty clearness, treated in qualitative way, may concern the following: Firm’s financial Exposure Capability to afford business (FEC) and Regulatory and Environmental issues uncertainty clearness (RE).

D. A multi-criteria hierarchy structure

In the following, we propose an AHP-based structure in order to combine all the aforementioned factors in a single utility function. We call it overall business utility (OBU). The proposed dynamic AHP hierarchy for the aforementioned criteria is illustrated in Figure 1. Each player constructs its hierarchy and runs pair wise comparisons for each investment alternative. The investment alternatives for each player, concerning a full scale game, are invest stage 2 (IS2) when defer stage 1 (DS1), IS2 when IS1, DS2 when DS1, DS2 when IS1. Particularly, full scale game means that both players finally proceed in the investment implementation either by investing at the time where each stage is for the first time available or by deferring for a period of time. Each player estimates its OBU and each of them estimates its pay off function for himself but also for his competitors. We consider that our game is played once

and if a player does not invest (enter the market) then it loses its business opportunity.

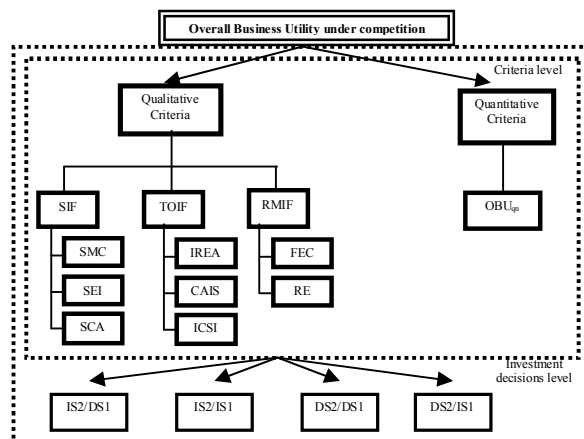


Figure 1. A dynamic AHP hierarchy to business analysis

In case of considering multistage game performance, the proposed analysis provides the framework for a series of iteration between the competitors hierarchy. It involves role-playing the competitors’ likely actions and reactions concerning the sequential or simultaneous actions. Analytically, there is a parallel hierarchy for the competitors. Each player constructs its hierarchy and performs pair-wise comparisons for each of the available investment decisions with respect to the afore-mentioned criteria [3]. Hence, each player estimates its OBU for each investment decision. The series of iterations can continue in each decision node (time instance at which the iteration is executed) up to the moment where the investment opportunity is still available. Hence, the equilibrium point is estimated as the combination of strategies that maximize the OBU of each player with respect to the corresponding OBU of its competitor.

IV. A REAL CASE STUDY ANALYSIS

A. Business case description

To illustrate the proposed analysis we apply it for a growing Water Supply & Sewerage Company, which we refer to as WSSC to protect its identity and its projects. WSSC is interested in entering in broadband business field and exploiting its physical infrastructure (water and sewerage pipes). The company examines the possibility of setting up a subsidiary company named NewTelco Services and entering the telecommunications business as a wholesale infrastructure provider and in parallel developing retail fiber access-based telecommunications services. NewTelco Services may undertake the roles a.) NetCo where it builds and owns the telecommunications access infrastructure which includes passive connection – supply and install ducts, conduits & fibre to the building and b.) OpCo where it activates and operates the active network which includes

active connection providing equal access to Service Providers to enable them to deliver telecommunications services to their customers (Figure 2).

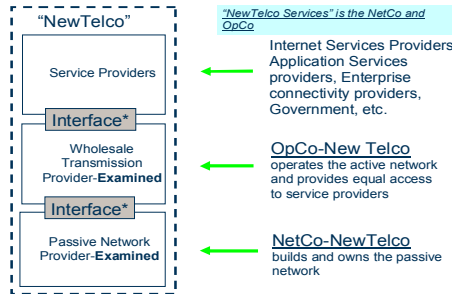


Figure 2. Business model for NewTelco Services

B. Market Status – Business Conditions

The new national Strategy on Telecommunications and New Technologies in Greece 2008-2013 provides a lot of opportunities for new business activities in the broadband field. The overall competition of the WSSC in the area of interest plans to deploy its own fibre network. Hence, WSSC with its subsidiary NewTelco Services needs to be the first to the market with a fiber network in the area. Concerning regulation, which pushed for open access networks, the new network should be promoted as an open access network. Also, local authorities have a time consuming licensing processes. Particularly, it is difficult to obtain permission for installation (digging etc.) of fiber optics. All these give a business advantage to the companies that have the capability to overcome these problems, or have already installed fiber cables, for the next 5 years. WSSC may gain by all these since no permission for digging is needed for its case since the optical fiber can be installed through its sewerage pipes. However, WSSC does not have enough experience for such type of business activities, while the new subsidiary will require some time to be activated and efficiently organized. This fact promotes a required time of delay for clarifying some organizational issues in the new subsidiary. Thus, from WSSC's perspective a decision to enter the broadband business can be a matter of timing. It is examined whether WSSC can afford to wait or should move really rapidly sacrificing uncertainties clearness in order not lose its competitive advantage and even more the overall business value. By waiting, WSSC expects that uncertainties, related to the acceptance of broadband services in the region, and the organizational capabilities of it, would be resolved. By waiting, WSSC could learn more about the potential returns on such investments. For example, the acceptance rate for such services might increase as customers become more aware of these services. In parallel, WSSC could take actions to lower its market entry risk (eg. by seeking corporate alliances for common exploitation of the specific regional market). With these concerns in mind WSSC is addressed to the question: how long should WSSC wait to enter the

broadband market? A two players game is considered where one player is WSSC and the other player is OTE, the national incumbent operator. The content and business characteristics of the specific case study, though no specific financial figures are given, are based on extensive discussions between the authors and WSSC ICT management. The decision making process has to find the balance between investing now or wait till the moment where the business value is higher than its expected value in the future up to the time moment where the investment is still available to the WSSC. During the waiting period, some of the decision factors may change and even if some of them are perfectly predictable the decision maker has to estimate the pros and cons of an early or late decision. Our analysis takes into account the first mover and second mover perspectives. The quantities, prices and revenues for business are derived in [1][2][20]. Concerning the analysis parameters for stage 1, dark fiber installation and quantity competition concerns the coverage of dark fiber in the area of interest (e.g. FTTH connections of dark fibers). Also, fiber activation and price competition refers to bandwidth or number of fibers per home/block, while price parameters concerns price per unit bandwidth and length of the fiber. As mentioned before, for NewTelCo Services it is more profitable to offer higher level of bandwidth, being capable to charge it with higher price than its competitor. Moreover, the overall business initialization and DF installation is more profitable for NewTelCo Services by acting as first mover against its competitor.

V. DISCUSSION AND FUTURE WORK

This paper proposes a framework to model different stages of the competition in the broadband industry. There are some potentially interesting regulatory and economic aspects in our analysis, concerning the nature of competition and the resulting equilibrium in the market. The quantitative game theoretic analysis is already well known for single business, and extended analysis of basic price and quantity competition games is already present in the basic industrial organization literature [20]. However, this paper adds in the overall competition modeling dimension beyond that by introducing compound competition perspective. In addition, we integrate quantitative and qualitative analysis in one business utility function since various business aspects can be more effectively modeled in a qualitative way. In [2] qualitative and quantitative analysis is used showing that qualitative factors may change the typical game theory equilibrium given by the single quantitative analysis. We extend this work by adopting a compound competition analysis. We examine the two players' game (duopoly case). Duopoly provides a starting point for research investigating strategic impacts of ICT investments. Particularly, in telecommunication markets there are normally two-three strong players and a number of weaker players that normally follow the strong ones. One perspective of our analysis could be the case where the game concerns two parties, one is the

firm of interest and the other is the rest of the competition as one entity. Finally, in this work we discuss a three stage broadband business opportunity. Our intention is to show the compound business game in broadband business field, and we could easily adopt a more stages opportunity as given by [13] in the specific field.

VI. CONCLUSION

In this work we examine business activities for utility companies in the broadband business field. We model competition and provide an overall analysis for the whole business, which can be divided in stages. We adopt different competition type for each stage. We include in our analysis qualitative factors coming from the specific business field in order to enhance decision making process. Finally, we discuss a real case study.

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