Invest Today or… Tomorrow?
A Real Option Approach to Strategic Development in the French DSL Market (*)

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Abstract: This paper presents a descriptive case study of the new entrants' strategies on the French DSL market, applying the theoretical framework of real options. It is shown that two main strategies have been built around different analyses of the fixed incumbent operator's wholesale offer. The first is based purely on a classical valuation approach (net present value). The second accounts for an "invest tomorrow" real option included in the incumbent's wholesale offer. The trade-off carried out by new entrants with the second strategy is then analysed and illustrated with a real option valuation based on the binomial tree method. Consequently, wholesale offer prices could include a mark-up to reflect the loss of a real option value by the incumbent in favour of new entrants.
Key words: Broadband, DSL, French communications market, real options, DSL wholesale offers, pricing.

In 2002, at the beginning of the DSL retail market in France, the incumbent fixed operator provided access to its network through two forms of wholesale offers: full unbundled access – providing the service directly to the customer on its own national wide network using unbundled access offering of the incumbent to complete its network – or national bitstream offering – providing the service up to a national point of presence or national main distribution frame (See Figure 1) [1]. The new entrants Internet Services

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1 There are mixed offers between the two offers above that are not discussed here for the purpose of our analysis.

Providers (ISP) deployed their DSL networks based on an analysis of the two possibilities based on the fixed incumbent operator's wholesale offer.

In the first case, a new entrant ISP penetrated the DSL retail market, using the "invest today" strategy. This consisted in rolling out a national network to have access to an unbundled wholesale offer from the incumbent. This strategy, however, required huge network irreversible investments in a context of uncertain demand. These investments could generate considerable losses if a critical mass of subscribers was not reached over the short term, but could also be profitable if the critical mass was reached.

The second case, defined as the "invest tomorrow" strategy, first relied on the wholesale national bitstream offer before migrating subscribers to the wholesale unbundled offer. The national bitstream offer could be seen as a highly valuable option for ISP entrants giving them an opportunity to delay initial network investments and wait until, and if, more favourable market conditions occur in future (for example, a critical mass of ISP subscribers).

This incumbent wholesale offer also provides several interesting implications for regulation analysis. At the present time, the models used by the national regulatory authorities in order to calculate the price of the incuments' wholesale offers do not take into account the risk associated with their important irreversible investments (PINDYCK, 2005, HAUSSMAN, 2000; ALLEMAN & RAPOPPORT, 2006). Should the risk not be properly evaluated, the incumbent may be reluctant to make future investments, which may negatively impact telecommunication developments. The real option analysis provides helpful theoretical tools required to evaluate the levels of access charges that will promote investment incentives in telecommunications (ALLEMAN & RAPOPPORT, 2006; HARMANTZIS & TANGUTURI, 2007; VALLETTI & CAMBINI, 2005).

This article focuses on the case study of new entrants that have adopted the "invest tomorrow" strategy via a simple illustrative [2] model applying the real option approach as in ALLEMAN & RAPPOPORT (2002). The strategy of analysing investment decision with a binomial tree can also be found in MUN (2002), COPELAND & ANTIKAROV (2001), BRANDÃO, DYER & HAHN, (2005).

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[2] For a formal theoretical treatment on this issue, one can consult TRIGEORGIS, HAUSMAN & TARDIFF (2000).

Our paper is organised as follows. In the second section, the economic models of ISP derived from the national bitstream and unbundled access alternatives are introduced. In the third section, the investment criterion motivating new entrants to reject the "invest today" strategy is analysed and illustrated with a numerical example. In the fourth section, an "invest tomorrow" real option is identified within the national bitstream offer. The value of this real option offered to the new entrants is evaluated under the binomial tree method using illustrative data; the investment trade-off yielded by including the real option value is then analysed. In the last section, a discussion is introduced on the inclusion of a real option mark-up in the price of the national bitstream access.

■ Economic models of unbundled access and national bitstream access

This preliminary section introduces the basic differences in the economic models of a new entrant ISP in unbundled access and a new entrant ISP in national bitstream (Figure 1):

DSL Network architecture

Briefly, to reach final consumers, the DSL incumbent made investments in four principal following areas:

- Local loops which are the copper pairs between final DSL subscribers and the main distribution frames.
- Main Distribution Frames (MDF) which are the termination points where exchange equipment and terminations of local loops are connected. A new entrant ISP can reach final consumers from this module via the incumbent unbundled offer (unbundled access – invest today strategy).
- A national network which connects the main distribution frames to national access points, entailing substantial investments.
- National access points which are the points of presence of the incumbent where the ISP will have to connect to have access to the wholesale bitstream offer (national bitstream – delay strategy).

ISP new entrants in unbundled access

The ISP network has to be deployed up to the MDF of the incumbent fixed operator. Since MDFs are positioned at a local level [3], the network capital expenses (CAPEX) required to reach the MDF are significant. These CAPEX are covered (including a return on investment) if the ISP reaches a critical mass of subscribers on the MDF. In addition to the CAPEX costs per subscriber, the ISP has to pay a local unbundled access fee to the incumbent, equivalent to renting space on the incumbent's local loop from the MDF to the ISP subscriber, an operating expenditure (OPEX). In this model, the ISP subscriber can be profitable only if the Average Revenue per User (ARPU) covers three costs: (1) Network CAPEX, (2) Wholesale OPEX, and (3) other OPEX per subscriber. In this model, key profitability is reached via a critical mass level of subscribers on the MDF. At the beginning of the digital subscriber line (DSL) market in France, it was not clear that this condition could ever be met, although some ISPs in France started directly with this offering.

ISP new entrants in national bitstream

The ISP new entrant network only needs to reach one national point of presence. As a consequence, network CAPEX costs per subscriber are low compared with those of ISPs using the unbundled access offering. The new entrant ISP, however, has to pay access fees for national bitstream to the incumbent, representing significant OPEX per subscribers. In France, the high level of national bitstream wholesale prices (OPEX) did not leave enough economic space for the ISP to be profitable over the long run.

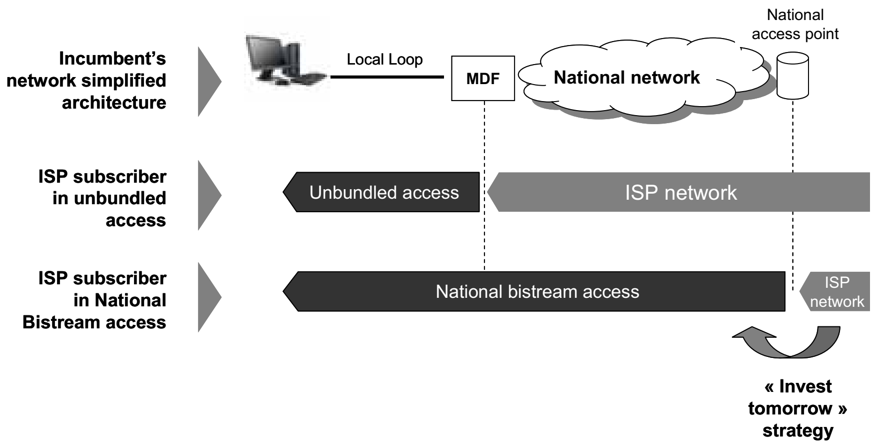
These two economic models raised issues on the French DSL market. On the one hand, rolling out network with unbundled access in an uncertain market ("invest today" strategy) was based on the risky hypothesis that the ISP subscribers would reach a critical mass. On the other hand, rolling out network with national bitstream access made it difficult to be profitable in the long run, since wholesale price left little economic space.

An intermediate "invest tomorrow" strategy proved successful in the French DSL market. This entry strategy combined the two new entrant ISPs economic models introduced above. Precisely, it consisted first in reaching DSL subscribers using the national bitstream wholesale offer (economic

3 There are about 12,000 MDF in France according to the National Regulatory Authority (ARCEP).

model of new entrant ISPs in national bitstream), before upgrading them to unbundled access (economic model of new entrant ISPs in unbundled access).

Figure 1 - ISP subscribers in unbundled access and national bitstream access



Source: TERA Consultants

This "invest tomorrow" strategy implied determining whether delaying investment was worth being temporarily unprofitable with the national bitstream economic model. This trade-off is numerically analysed in the following sections incorporating the real option analysis.

■ Why "invest tomorrow" is preferred over "invest today"

This section describes the financial reasoning used by French ISPs who did not adopt the "invest today" analysis. The following set of simplifying assumptions were used:

- Given the current DSL subscriber number on each MDF, an ISP would incur a sunk CAPEX cost of 200€ per subscriber to roll-out its network up to the MDF.
- The investment horizon of the business is at year 3. Year 0 only includes the network CAPEX of 200€.
- Given the market forecasts at year 0, cash flow per subscriber at year 1, 2 and 3 respectively are 42€, 84€, and 126€.

- The annual market cost of capital (WACC) is 20%.

On the basis of these assumptions, the net present value per subscriber is negative namely -34 € (Table 1). Accordingly, the ISP would stay out of an "invest today" strategy and explore other alternatives.

Table 1 - Discounted cash flow of an ISP in unbundled access at year 0

Year	0	1	2	3
Cash Flows per subscriber	-200 €	42 €	84 €	126 €
Discount factor	1.00	0.83	0.69	0.58
Discounted cash flows per subscriber	-200 €	35 €	58 €	73 €
WACC	20%			
NPV	**-34 €**			

Source: TERA Consultants

■ Adopting the "invest tomorrow" strategy

In this section, the "invest tomorrow" strategy is analysed in terms of real options. First, the real option "invest tomorrow" included in the national bitstream offer is defined. Then, the value of this option is calculated using successively a two-period (one year) binomial tree and a ten-period (still one year) binomial tree.

As explained in the first section, the roll-out of national bitstream gives the ISP the opportunity to delay its network investment while still participating in the market. This opportunity is considered as a real option, with the following characteristics:

- The cost of this real option corresponds to the net present value of the first year's cost of connecting national bitstream subscribers. This requires drawing up a business plan of an ISP national bitstream subscriber, which is not the purpose of this paper.

- The value of this real option can be derived by following a simple set of assumptions:
  - the real option to "invest tomorrow" in the ISP network is bought in year 0;
  - the option can be exercised in year 1, one year later. By definition, the ISP has no obligation to exercise the option. If the number of subscribers

on the MDF does not reach the critical mass at year 1, the ISP will not exercise the option;

- the underlying asset considered is the net present value of the expected discounted cash flow from year 1 to 3 with a risk free rate (r) of 5%. Based on cash flows introduced in the previous section, the value of the underlying asset (S0) at year 0 is 225€ per subscriber (cash flows of 42€ at year 1, 84€ at year 2, and 126€ at year 3 with a risk free rate of 5%). Contrary to the previous section, cash flows are discounted with a risk free rate, in line with an assumption of a risk neutral environment considered in option valuations;
- the exercise price of the real option corresponds to the cost of rolling out the network up to the MDF, which is 200€ (1 + .20) = 240€ per subscriber (assumption from the previous section). If at year 1 (in twelve months), the underlying asset is above 240€, then the option is exercised. In this case, the net present value of the project is positive;
- the annual volatility of the underlying asset (δ) is assumed to be 40%.

For further simplification, we first assume that there are only two possible market states at year 1: "good" and "bad". We can thus calculate the real option based on a two-period binomial tree (Table 2) [4].

In the case of a "good" state, the underling asset in year 1 (i.e. Discounted cash flow of unbundled access excluding the 240€ investment) increases with the multiplicative upward movement in the underlying asset u:

$$S_1^{Good} = u \times S_0$$

With

$$u = e^{\delta\sqrt{T}}$$

Where T is the incremental time unit.

With model specifications, $S_1^{Good} = 336€$. In this case, the option should be exercised, as the value of the underlying asset (336€) is above the exercised price (240€).

However, in the case of the "bad" state, the underlying asset in year 1 decreases to:

[4] Readers may consult MUN (2002) as a standard book relating to our calculating methodology.

$$S_1^{Bad} = d \times S_0$$

With the multiplicative downward movement in the underlying asset d, which is computed as:

$$d = \frac{1}{u}$$

We can thus derive $S_1^{Bad} = 151€$ In this case, the option should not be exercised, as the value of the underlying asset (151€) is below the exercise price (240€).

In addition to this, the "good" and "bad" state occurs with probability p and $(1-p)$ respectively, where p is defined as:

$$p = \frac{r \times T - d}{u - d}$$

This model indicates that $p = 0.46$

Table 2 - Two-period binomial tree

T	0	1
	225	336
		151

Source: TERA Consultants

Once the binomial tree of the underlying asset is calculated, the option value is calculated, with the risk free discounted rate e^{-rT}, as follows:

$$ROV = e^{-rT}\left[p \times (S_1^{Good} - S_0) + (1-p) \times (S_1^{Bad} - S_0)\right]$$

Or, 42€ by solving the binominal recursively (Table 3).

Table 3 - Valuation of the real option by solving the two-period binominal recursively

T	0	1
	42	96
		-

Source: TERA Consultants

To increase model accuracy, the calculation is performed with the same assumptions as for a ten-period tree (Tables 4 and 5). To be concrete, we still consider the same binomial tree with above illustrated parameters, with, however, the incremental time unit $T_{ten\_period} = 1/9$. Using this approach, the real option is valued at 35€.

Table 4 - Ten-period binomial tree

T	0	1	2	3	4	5	6	7	8	9
	225	257	294	336	384	438	501	572	654	747
		197	225	257	294	336	384	438	501	572
			172	197	225	257	294	336	384	438
				151	172	197	225	257	294	336
					132	151	172	197	225	257
						116	132	151	172	197
							101	116	132	151
								88	101	116
									77	88
										68

Source: TERA Consultants

Table 5 - Valuation of the real option by solving the ten-period binominal recursively

T	0	1	2	3	4	5	6	7	8	9
	35	52	77	109	152	204	265	335	415	507
		19	30	46	70	104	148	201	262	332
			8	14	24	39	63	98	145	198
				3	5	9	17	31	55	96
					0	1	2	4	8	17
						-	-	-	-	-
							-	-	-	-
								-	-	-
									-	-
										-

Source: TERA Consultants

A more appropriate value may be obtained when the number of incremental time units tends to infinity or when their lengths tend to zero, when the discrete model becomes a continuous model, providing the option value coinciding with the Black-Scholes value. With these illustrative parameters, the Black-Scholes option value can be obtained without difficulty, which is also around 34€.

To conclude this section, with the assumptions, the "invest tomorrow" strategy should be adopted if the estimated net present value of the ISP in national bitstream (i.e. the cost of the real option) is inferior to 34€ per subscriber (the value of the real option).

■ Discussion on the introduction of a real option mark-up in the price of national bitstream access and concluding remarks

This case study demonstrates that a real option value was included in the national bitstream wholesale offer provided by the French incumbent fixed operator. This real option facilitated the entry of alternative operators in the

French DSL market's since it gave them the opportunity to invest in rolling-out the network tomorrow instead of today. In order to promote competition and investments from the incumbent, the optimal tarification of the national bistream wholesale price should therefore have integrated the real option value. Assuming a constant real option monthly fee P from year 0 to year 1, the real option value can be expressed on a monthly basis as follows:

$$ROV = \sum_{k=0}^{3} \frac{P}{(1 + WACC/12)^{12 \times k}}$$

Hence,

$$P = \frac{ROV}{\sum_{k=0}^{3} \frac{1}{(1 + WACC/12)^{12 \times k}}} = 0.9€$$

In other words, with illustrative data and assumptions considered in this paper, a 0.9€ mark-up should be added to the price of the national bitstream wholesale offer reflecting the value of the "invest tomorrow" real option. The monthly economic space left by national bitstream would then be much higher than it appears without accounting for the real option value. (See HAUSMAN, 1999, ALLEMAN & RAPPOPORT 2006 and PINDYCK 2004 and 2005 for similar conclusions with alternative, but similar, models).

To conclude, the case study of the French DSL market illustrates a common regulatory failure in setting wholesale tariff on a cost basis. Indeed, purely cost oriented wholesale tariffs may in some cases disregard asymmetric risks borne only by the incumbents, and hence reduce their incentive for further investments. The real option framework, as implemented in this paper, is an appropriate tool in order to calculate a mark-up over the costs of providing wholesale services. A reasonable real option mark-up may in some cases provide more incentives for the incumbents to invest in their networks, without preventing market entry.

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