WIK-Consult • Report

Study for Iliad and Bouygues Telecom, France

Copper ULL pricing in front of decreasing demand and migration to NGA

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Management Summary

1. The French Government follows the ambitious plan to achieve national coverage of superfast broadband access mainly based on fibre by 2025. Operators and public authorities have already made strong efforts to achieve this target. Currently about 18% of all households have already access to the fibre network. This is less than the EU average of 24% (in 2014), but significantly more than the fibre coverage achieved in countries like Germany, Italy and the UK. Significant further investment efforts are needed to achieve universal fibre coverage. However, only 25% of all households, which have already the opportunity to subscribe to fibre access, actually make use of that opportunity. This is a challenge for the Government's targets as well as for the business case of investing operators.

2. Against this background the French regulatory authority ARCEP intends to use a further uplift of copper ULL wholesale prices from the current price level as a regulatory tool to motivate users to migrate from copper to fibre access and to further incentivize fibre deployment investment. In this study we show that such a pricing approach is not economically efficient, will harm French users, will distort and restrict competition and is not compatible with relevant European regulations. Furthermore and even more important is that such a regulatory policy approach is counterproductive in achieving and supporting the goal of a nationwide fibre coverage in a few years' time.

3. The current costing methodology and pricing approach applied by ARCEP leads to over-recovery of the relevant cost for (at least) four reasons: Firstly, the approach recovers the incumbent's actual investment at current cost. These are higher than efficiently incurred investments. Secondly, when ARCEP changed its valuation approach, it was applied to gross and not to net book values, which generated significant windfall profits given the age structure of the assets. As depreciation methods have different annuities profiles, when adopting a new method, the last net book value should be taken into account. Thirdly, because of the non-replicability of ducts, a CCA evaluation leads to cost over-recovery. Fourthly, the cost allocation of ducts according to actual connections results in a cross-subsidization of fibre at the expense of copper ULL.

4. The pricing approach does not properly deal with the shrinking demand for copper loops. Pricing for an old technology in a competitive market does not lead to increasing prices for the old technology which is being substituted by a superior new technology. Furthermore, the reference model of a copper access network is neither in line with the technological development nor with market development and the market behaviour of incumbent and competitors in France. Regulators have to take a long-term perspective for pricing decisions and not a backwards oriented view if efficient investment should be incentivized by the outcome of their decisions.

5. Further uplifting the copper access charges will not incentivize further fibre investment of the incumbent operator. Instead, it will increase the opportunity cost of such investment by cannibalizing raising copper profits and therefore disincentivize its fibre investment. This holds in particular if the uplift is exercised on a nationwide basis. The argument also holds if uplifting is focussed on fibre areas only, but quantitatively to a lower degree.

6. Further uplifting copper access charges will reduce the ability of altnets to finance fibre investments. These charges represent about 50% of the cost in an unbundling business model. Therefore altnets are quite vulnerable even to small changes of the wholesale charge. This holds in particular, since copper access will remain the dominant broadband access mode in any relevant scenario in the next years. If altnets would have to reduce their fibre investment, this will further reduce the incumbent’s incentives to invest in fibre. Copper price uplifting therefore generates a negative cycle in the deployment of fibre.

7. If altnets lose their ability to invest in fibre, not only the speed of fibre coverage will be slowed down in France but the competitive model of infrastructure-based competition becomes (also) endangered. The French regulatory model relies on altnets to duplicate the incumbent’s investment path to some degree by co-investment and own network deployment. Altnets do not get unbundled access to fibre or bitstream access. Instead, they get duct access for their own fibre investment and can engage in co-investment arrangements with the incumbent. Thus, they also take a fibre investment risk. If they become unable to invest in fibre, there will be no competitive choice of superfast broadband for users.

8. With regard to users, further uplifting copper access charges is like introducing a migration tax. Many studies show that the price only is one factor which influences the switch or the migration of customers from DSL to fibre products. Fibre inhouse cabling seems to be a much more important impediment to migration than fibre prices in France. Given the sunk cost nature of their fibre investment, French operators have any motivation and incentive to motivate users to migrate to fibre. Uplifting copper access charges will not generate additional incentives. Therefore, it is realistic to assume that not only copper but also fibre retail prices will be increased as a result of a copper access price increase.

9. Uplifting copper access charges will harm economic efficiency and broadband users. The inefficiency of the migration tax approach becomes even more obvious in case end-users do not even have the option to migrate to fibre. This is currently the vast majority of users. In a nationwide uniform wholesale price approach also these users are paying the migration tax without having the option to avoid it by migrating to fibre. Such price increases will generate significant welfare losses and cause a digital divide without any impact on migration.

10. The study shows that the implementation of the EU costing Recommendation of 2013 has not led to an increase of ULL charges in Europe. The EU average price level on the contrary has remained rather stable at a level of € 8. Some more detailed case studies show a reduction of the ULL charges due to the implementation of the Recommendation. The comparison also shows that countries with a significant higher level of fibre coverage and fibre take-up like Sweden, Finland and the Netherlands did not use ULL charges as a regulatory tool to achieve their significant fibre performance both in coverage and in take-up.

11. The study presents, discusses and assesses several pricing options to change and to reform the current ULL pricing methodology. The various options are assessed according to the criteria cost recovery/over-recovery, incentives to invest, level playing field of competition, migration to fibre, predictability of outcome and overall efficiency.

12. If ARCEP would not change its costing and pricing methodology, ULL charges would accelerate to increase. This outcome generates welfare losses and harm to customers and would generate the opposite result of what would be happening in a competitive market. The incumbent would lose incentives to invest and altnets their ability to invest.

13. As a second major option, ARCEP may keep in principle its current calculation method. Partial changes may, however, be introduced to correct for critical assumptions in its current approach. ARCEP may compensate for decreasing demand, move to a HCA valuation of ducts, conduct efficiency corrections in OPEX or may base the capital cost calculation on net book values. ARCEP may also fix current or previous ULL charges at that level for the next five years.

14. All individual proposals for partial changes generate a superior outcome compared to following the option of no change. The most significant impact would follow from a move to a HCA valuation of ducts and the net book value determination of capital cost. All partial changes would reduce ULL charges and therefore improve investment conditions. Partial changes do not lead to compatibility with the EU costing Recommendation, but bring the outcome closer to the intentions of the Recommendation and are more or less supporting the exemption criteria.

15. ARCEP could also choose to directly and fully implement the concept of the European costing Recommendation. We discuss two different options: ARCEP could base its ULL pricing decision on an overlay model which models explicitly the migration from copper to fibre. As a second option, ARCEP could directly take FTTH as the modern equivalent asset network for access. In this case, the copper price is derived from a fibre network cost model. The model's outcome would be reduced by the performance delta between copper and fibre access. This pricing approach has been introduced in Switzerland on the basis of a governmental

decree. We show that retail price differences can consistently inform the determination of the performance delta.

16. From our point of view, the FTTH MEA approach is the most convincing one. It fits perfectly with the policy intention in France to achieve a universal fibre network soon. Nevertheless, our proposals for partial changes are also pertinent, because they imply that the resulting ULL prices meet the European price range of 8 – 10 Euros.

17. Instead of uplifting the ULL charges on a nationwide basis, ARCEP may also choose a more targeted migration tax approach. Under this approach, ULL charges would be deaveraged. Only in areas where fibre effectively is available the ULL wholesale charge would be uplifted to incentivising users to migrate from DSL to fibre. In the rest of the country a more traditional cost-based pricing approach would be pursuit. To achieve effective competition the relevant fibre area cannot only be defined by the availability of fibre to end-users. The approach only makes sense (if at all) if it is applied where there also is effective competition in the fibre market by three or more operators.

18. The deaveraging pricing approach of uplifting ULL charges is a more targeted approach compared to a nationwide uplift approach. Therefore the associated welfare losses and burden to users is lower. Structurally the inefficiencies of the concept remain in the areas where the concept would be applied. The effects on migration would remain limited if observable at all given the fact that the take-up rate for fibre is around 25%, for Orange even lower at about 20%. On the other hand, competition would be significantly distorted and altnets would be harmed in their competitive and investing capabilities.

19. The current ULL pricing approach as applied by ARCEP as well as some of the options for change presented here lead to excessive profits for the owner of the legacy copper access network. If there is a rationale for a migration tax, it would be the intention to incentivize access seekers (and indirectly the incumbent) to increase retail prices of copper-based services to motivate users to migrate from copper to fibre. The intention cannot be to generate windfall profits to the incumbent.

20. If the proceeds of a migration tax flow to the incumbent, the infrastructure competition between the incumbent and the access seekers will be significantly distorted. Only if broadband access demand is elastic, access seekers can increase prices. If they cannot increase prices correspondingly, the migration tax also becomes a transfer of profits from access seekers to the incumbent. Thereby, the investment capabilities of access seekers will be reduced. Their ability to invest in fibre will be reduced and infrastructure competition will be hampered in France. Nevertheless, if ARCEP still favours that approach for the future, there is no reason

why the proceeds of the (implicit) tax should be transferred to the incumbent. This generates additional distortive effects on competition. If the approach still will be applied despite its distortive implications, the proceeds of the (implicit) tax should be used either to foster migration in a less distortive way, e.g. by directly subsidising users for migration. Or, the proceeds may be used to support fibre investment in a competitively neutral way. In this case all potential investors should have non-discriminatory access to such a fund and not only the incumbents in its role as access provider.

Introduction

In many countries worldwide access networks are in the transition from copper to fibre access. There is either a partial upgrade in the form of fibre to the cabinet (FTTC) which entails a substitution of the feeder part of the network through fibre or a full substitution of the copper access network by means of a fibre to the home (FTTH) architecture as in France. The transition process occurs gradually and will take more than a decade to be completed. The tendency that fibre goes deeper into the access network seems to be irreversible. The physical limits of transmission capacity of copper access pairs are approached. In any case, during the transition phase copper and fibre networks are operated in parallel.

All regulators facing this situation of technological change and transition have to answer the question how to price unbundled access to the copper loop in this transition phase. Should they keep the usual forward looking long-run incremental cost standard based on the current cost of replacing the copper access network for determining the copper access charge? Or should they move to an approach where fibre access is regarded as a modern equivalent asset (MEA) to copper access and the wholesale price for copper access is determined on the basis of the forward-looking long-run average incremental costs (FL-LRIC or simply LRIC)[1] of fibre access or should they develop a totally new pricing approach?

This decision has to be taken in order to facilitate the deployment of next generation access networks (NGA), to encourage market investment in open and competitive networks and at the same time to meet the welfare targets such that the outcome is in the long term interest of users. Furthermore, ARCEP’s objectives have to be fully met.

This study reflects the ULL pricing issue for the specific market and regulatory situation in France. In Section 1 of the study we will present and analyse ARCEP’s current pricing and costing approach as represented in the latest ULL pricing decision. Section 2 will analyse the network and market environment in France. We will present and interpret the current status of NGA deployment and the operators' plans for the future. This is done to get a view on the relative importance of ULL today and tomorrow.

Section 3 presents our more theoretical regulatory economics analysis of the appropriate costing standard to be applied for wholesale access pricing. We will show the strength of LRIC as a cost standard as well as its pitfalls and limitations in a situation of demand and technological change. We will show what potential alternatives to LRIC in the case of transition might be and/or how to adopt the LRIC methodology. Particular emphasis will be given to the approach as recommended by the EU Commission in its recent costing methodology Recommendation of 2013.

1 The abbreviation LRAIC would be correct, but LRIC is the more familiar usage.

Section 4 then in more detail develops an implementation approach for the Recommendation's proposals. We will make suggestions how to implement the Recommendation in the specific French environment. We will also make proposals how to solve some open issues and inherent problems of implementation. These are related to the inconsistencies of using on the one hand side a bottom-up costing model and on the other hand side the incumbent’s accounts to determine the regulatory asset base. We propose a pragmatic approach to determine the current asset value to overcome inconsistencies and problems in applying the indexation method. We will then provide some qualitative assessment what the impact of the implementation might be in France.

These implementation proposals will be reflected before the background of the implementation of the Recommendation in other Member States in Section 4. For four countries (Italy, Germany, Denmark and Spain) we will provide some more detailed case studies.

In our final Sections 6 and 7 we will present various regulatory pricing options for ULL in France and their assessment. We discuss various options of partial changes and the option of a direct and full implementation of the costing Recommendation. We also discuss the idea of a geographical deaveraging of ULL charges depending on the fibre take-up and the aspect of a competitively neutral use of the excessive ULL profits. These options, including the option of “no change”, will be assessed on the basis of common assessment criteria in regulatory policy.

1 ARCEP's pricing and costing approach for ULL

1.1 ARCEP's pricing approach

1.1.1 The development of ULL pricing principles over time

Backed by corresponding European regulation, the French regulator ARCEP applies a price regulation remedy on copper ULL according to cost based pricing. The basic principles of the cost standard and cost calculation approach date back to an ARCEP decision of 2005.[2] Based on a cost model ARCEP simulates the so called "coûts courants économiques" (CCE) to determine ULL cost.

In its Decision No. 2012-0007 of 17 January 2012, ARCEP amended its Decision No. 05-0834 of 15 December 2005, changing the cost valuation method to be used for the copper pair, by progressively shortening the amortization period of copper cables from 25 to 13 years[3] while at the same time progressively increasing the amortization period of civil engineering assets from 40 to 50 years between now and 2021. This scheduled increase should result in a decrease in France Télécom's full unbundling tariffs after 2012.

In November 2010 ARCEP published a decision regarding the economic conditions that would give access to ducts in France Télécom's access network.[4] The decision in particular determines how the relevant cost of ducts is to be shared by the copper and fibre loops. The relevant cost is determined from the normal regulatory accounts as it relates to the local loop. It apparently excludes costs that are explicitly incurred to enable roll-out of FTTx that would not have been necessary if one had used a less volume consuming technology.[5]

2 ARCEP Decision No. 05-0834.
3 Because the French government is striving for 100% coverage with high speed broadband by the year 2025, ARCEP decided to "send a strong signal" and assumed that all copper cables currently in use should be fully amortized by 2025. Hence the (remaining) lifetime was set at 13 years. See Decision 2012-0007, p. 5.
4 See ARCEP decision 2010-1211 of 9 November 2010.
5 See p. 8 of the decision.

Table 1-1: Monthly LLU prices in France from 2000 to 2017

Date	11-2000	07-2001	06-2002	06-2005	01-2006	01-2009	01-2011	01-2012	01-2013	01-2014	01-2015	03-2016	01-2017
LLU price	**17.10€**	**14.48€**	**10.50€**	**9.50€**	**9.29€**	**9.00€**	**9.00€**	**8.80€**	**8.90€**	**9.02€**[1)]	**9.05€**	**9.10€**	**9.45€**
Cost base	LRAIC				FAC			New allocation of ducts					
Asset valuation	Successive replacement cost (les Coûts de Remplacement en Filière (CRF))				Current cost with economic amortisation (~tilted annuity)								
Basis of cost calculation	100% of lines		~70% of lines		~95% of lines								
WACC	>12.1%	12.1%	10.4%	?	?	10.7%	10.4%[6]	8.9%[7]				8,7%	8.7%

1) This price was retroactively reduced to 8,78 Euro because the proven OPEX by Orange was much lower than originally forecasted for the pricing decision.
Source: Bouygues, WIK

6 ARCEP Decision 2010-0001.
7 Consulted in November 2011. http://www.arcep.fr/uploads/tx_gspublication/consult-projdec-taux-remu-fixe-mobile-151111.pdf ARCEP states that the decrease of the WACC results from revision of market risk premium, coefficient of specific market risks and ratio of debt to equity, all of which have now been evaluated in a long-term view.

These three decisions are still the basis for ULL price regulation of the last years and those for 2016 and 2017.

In its 2005 Decision ARCEP decided to use the Fully Allocated Cost Standard to determine ULL charges. In its former pricing decisions ARCEP had used the LRIC cost standard. At that time ARCEP had used a bottom-up cost model to determine the relevant cost. Table 1-1 provides an overview of methodological aspects and the outcome of ULL price determination in France. The ULL price was steadily reduced starting from a high level of 17.10 Euro in 2000. The turning point is marked in 2014 when the upwards pricing trend started.

The most prominent price change is the one related to the 2002 decision[8] which reduced the number of lines taken into account for determining the cost of unbundling (see below) and reduced the WACC from 12.1% to 10.4%. Since 2005 ARCEP has not determined the LLU prices ex ante, but has verified ex post that France Télécom complies with its obligation to set “non-excessive” tariffs. France Télécom dropped the price from 9.50€ in 2005 to 9.29€ in 2006. France Télécom explained that productivity gains allowed it to reduce the wholesale price from 9.29€ to 9.00€ in January 2009.

In France copper access line costs were initially determined on the basis of all lines. In 2002 ARCEP took note[9] that alternative operators tended to apply for unbundled lines primarily in denser populated areas and that the average copper local loop costs depend on the density of the area. ARCEP decided to distinguish two areas: (1) one densely populated area where it is likely that alternative operators will invest in unbundling within two years; and (2) a lower density area where it is highly unlikely that such investment will occur. At that time ARCEP considered about 70% of total lines for determining the LLU cost. Therefore the cost of LLU was predominantly derived from the average copper cost in denser populated areas (about 21 million lines of a total of 34 million).[10]

In 2005 ARCEP noted[11] that the footprint of unbundling had enlarged significantly (also due to activities of local authorities) bringing the average cost of unbundled lines closer to the average cost of all lines. However, ARCEP also noted that the existence of the compensation fund for Universal Services was likely to conflict with a LLU price based on all lines. It was decided that the LLU cost should not consider the cost of the (relatively long) lines in those unprofitable areas with low population density for which France Télécom is compensated for by a Universal Service fund. This Universal Service regime compensates France Télécom for a part of the cost of lines in remote and therefore otherwise unprofitable areas, so that the operator can offer users there also a subscriber line at an affordable price. If we then assume the cost of the LLU was based

8 ARCEP Decision 02-0323.
9 ARCEP Decision 02-0323, p. 15/16.
10 In the 2005 Decision 05-834 ARCEP quantified this share still as 70% of all lines.
11 ARCEP Decision 05-834, p. 31/32.

on the average cost of lines - that also include the lines in these remote areas - this cost estimate would turn out to be unduly high and the corresponding price for the LLU might disadvantage alternative operators in their competitive position. These areas make up 5% of all lines so that the new regime extends its copper pair average cost base to 95% of all lines.

Up to 2005 the cost of unbundled local loops in France was based on a Long-Run Average Incremental Cost methodology[12] with asset valuation using "Successive Replacement Cost" ("les Coûts de Remplacement en Filière"). This approach was originally proposed by France Télécom and supposed to emulate a "make or buy" decision of either renewing or maintaining an asset.[13]

1.1.2 The pricing and costing principles of Decision No. 05-0834

In 2005 ARCEP launched a “consultation on copper local-loop costing methods” which was followed by Decision 05-0834. In its consultation, ARCEP proposed four possible cost methodologies for the local loop: 1) Historic Cost Accounting - HCA, 2) Current Cost Accounting - CCA, 3) an economic amortization method and 4) the successive replacement cost method.[14] Actually, ARCEP decided to use current cost accounting with economic amortization in the form of applying a tilted annuity. According to ARCEP, this methodology has three main advantages[15]: non-discrimination (in particular between the different offers of France Télécom), creation of an incentive for FT to invest efficiently in the copper local loop, and an incentive for alternative operators to invest efficiently in unbundling.

ARCEP pointed out that it envisaged that its cost accounting methodology used for the provision of ULL still is in line with the same guiding principles as the LRAIC standard it applied before. The choice of this methodology implies that the only cost taken into account are the ones directly linked to the activity, including costs of future investment and taking into account the evolution of prices.

The other options were discarded; the reasons for deciding against historic cost accounting were primarily that it does not take the evolution of prices into account. In addition ARCEP stated that historic cost accounting does not allow moderating the impact on LLU prices from changes in the annual investment rate of France Télécom. ARCEP states that successive replacement cost does not encourage efficient

12 EU Commission, Case FR/2005/0174.

13 Successive Replacement Cost determines the asset value as the difference between 1) the cost of renewing the asset immediately at its market value and 2) the cost of maintaining the asset until the end of its lifetime. See ARCEP Decision 05-0834, p.8.

14 During the consultation process stakeholders also proposed a price-cap approach and the Infrastructure Renewal Accounting method. Both were discarded by ARCEP for being a mechanism for tariff control rather than asset valuation (price-cap) and too theoretic (Infrastructure Renewal Accounting).

15 EU Commission, Case FR/2005/0301.

investments by France Télécom and would lead to high LLU prices.[16] To put it in our words, the amortization of assets is carried out using a tilted annuity formula applied to the historical investment path.

1.1.3 Amendment of Decision No. 05-0834 in 2012

In this Decision[17] ARCEP changed the lifetime of copper cables and ducts (civil engineering) in its cost model.

In the first half of 2011, ARCEP carried out a public consultation on annualized investment cost methodologies for France Télécom's copper local loop and on changes resulting from the switch from copper to fibre. In the wake of this consultation, ARCEP considered that its method, which is based on economic amortisation of the incumbent carrier's actual costs, does not induce either excessive compensation or provision for replacement of fixed assets, and appears to comply with the ruling from the Court of Justice of the European Union against ARCOR (Germany) and with European Commission recommendations. ARCEP nevertheless believed it necessary to take into account, first, the increased longevity of the civil engineering assets, which is an essential infrastructure that can be reused for the deployment of optical fibre networks, and second, on the contrary, the accelerated obsolescence of copper cables which are due to be replaced by fibre optic cables.

In its Decision No. 2012-0007 of 17 January 2012, ARCEP amended its Decision No. 05-0834 of 15 December 2005, changing the cost assessment method to be used for the copper pair, by progressively shortening the amortization period of copper cables from 25 to 13 years[18] while at the same time progressively increasing the amortization period of civil engineering assets from 40 to 50 years between 2012 and 2021. This scheduled increase should in ARCEP's expectations result in a decrease in France Télécom's full unbundling tariffs after 2012.

Pursuant to the publication of this decision, and in accordance with its regulatory obligations, France Telecom amended the tariffs subject to cost-oriented pricing obligations imposed by market analysis decisions and the price of full unbundling has decreased from €9.00 to €8.80.

Accordingly, there has been a regime change: The previous regime[19] used a lifetime of 40 years for civil works (manholes, ducts, cable tunnels) and 25 years for copper cables

16 ARCEP Decision 05-0834.
17 Decision No. 2012-0007 of 17 January 2012.
18 Because the French government is striving for 100% coverage with high speed broadband by the year 2025, ARCEP decided to "send a strong signal" and assume that all copper cables currently in use should be fully amortized by 2025. Hence the (remaining) lifetime should be 13 years. See decision 2012-0007, p.5.
19 Decision 2005-0834

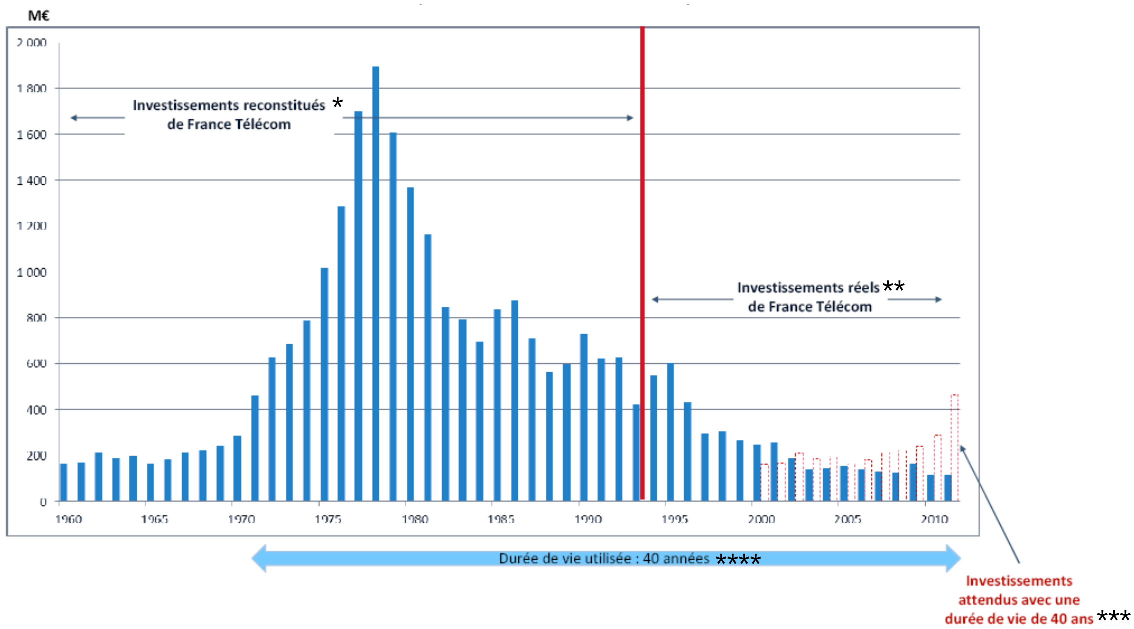
and poles. The new decision[20] increased the lifetime of civil works by 1 year, every year from 2012 to 2021, that means 41 years in 2012, 42 years in 2013, etc., till reaching 50 years in 2021. The lifetime of poles will remain 25 years. The lifetime of copper cables is reduced to 13 years.

From our point of view it is useful and important to shed some light on the considerations which led ARCEP to its final conclusion in the decision. The authority launched a public consultation on 29 March 2011 on the criteria for choosing a method of annualized capital costs and the transition from copper to fibre. The results of this consultation were published on 7 September 2011.[21] They were followed up by a deeper analysis by ARCEP published in November and the decision itself in January 2012[22].

Among the most relevant comments on the initial consultation, according to our opinion, is the view that copper cable lifetime should be shorter than 25 years and that the 40 years lifetime of civil engineering was underestimated in the relevant baseline decision of 2005. Competitors argued that France Télécom's current investments are at a significantly lower level than those 40 years ago and hence no corresponding reinvestment of these original investments can be observed. This observation is shared by ARCEP and visualized in Figure 1-1.

20 Decision 2012-0007
21 http://www.arcep.fr/uploads/tx_gspublication/consult_cout_invest_sept2011.pdf
22 ARCEP Decision 2012-0007

Figure 1-1: France Télécom's annual investments in civil engineering (in Euro at the end of 2010)



* Approximated investments of FT
** Actual investments of FT
*** Investments expected with a lifetime of 40 years
**** Considered lifetime: 40 years

Source: ARCEP consultation "Les critères de choix d'une method d'annualisation des coûts d'investissement et la transition du cuivre vers la fibre. Synthèse, analyse et suites de la consultation publique

Furthermore, because of the ongoing fibre deployment all stakeholders agreed that copper will become obsolete eventually and hence will not be considered an essential facility sometime in the future. Even though this conclusion is shared by practically all players the responses are diverse. One suggestion is to differentiate by geographical area since in high density areas an FTTH roll-out is likely to replace copper at a quicker pace than in low density areas where it might remain the only sustainable landline infrastructure.

ARCEP concluded that as long as the copper network is still in use the declining demand for copper would lead to constantly rising access charges and therefore a mechanism needed to be put in place to ensure relative pricing stability for products based on copper during the transition period to fibre.

ARCEP published a follow-up report with a more thorough analysis of the issues of this consultation in November 2011.[23] In this report ARCEP decided to gradually extend the civil works lifetime by one additional year every year from 2012 to 2021 (hence extending the lifetime from 40 to 50 years at the end of this period).

Regarding copper cables ARCEP decided to reduce the lifetime in order to accelerate the repayment of copper network cost while there are still large numbers of users utilising the copper network. This is based on the assumption that by 2025 almost all French users will be served by very high speed broadband (i.e. fibre). ARCEP wished to "send a strong signal to the market" and permit a full amortisation of copper cables by the year 2025. Lifetime of copper cables was therefore reduced from 25 to 13 years.

ARCEP described in detail how the changes to lifetime should be implemented in the calculation of annuities by increasing the remaining lifetime by the difference of the previous lifetime and the new lengthened lifetime. For example, an asset invested in 1990 with an amortisation period of 40 years, would have a residual life of 18 years in 2012. Increasing the duration for amortization by one year in 2012 means that for the calculation of the annuity in 2012 a remaining lifetime of 19 years would be used for that asset.

ARCEP provided tables for both copper cables (with shortened lifetime) and civil works (with increased lifetime). Each line of those tables indicates investment of a given year; each column indicates the remaining lifetime for this investment the future (2011 and beyond).[24]

Regarding the decrease in amortisation time for copper cables ARCEP decided to apply the following rules:

- For assets whose residual life is less than 12 years, the remaining life is unchanged;
- For assets whose residual life is greater than or equal to 13 years, the remaining life time is equal to 13 years in 2012;
- New assets acquired after 2012 are amortized over a lifetime of 13 years.

23 "Les critères de choix d'une method d'annualisation des coûts d'investissement et la transition du cuivre vers la fibre. Synthèse, analyse et suites de la consultation publique" http://arcep.fr/uploads/tx_gspublication/consult-projdec-amorti-boucle-cuivre-151111.pdf

24 See Decision No. 2012-0007.

1.1.4 Allocation of duct cost between copper and fibre

In November 2010 ARCEP published a decision regarding the economic conditions that would give access to ducts in France Telecom's access network.[25] The decision in particular determines how the relevant cost of duct is to be shared by the copper and fibre loops. The relevant cost is determined from the normal regulatory accounts as it relates to the local loop. It apparently excludes costs that are explicitly incurred to enable roll-out of FTTx that would not have been necessary if one had used a less volume consuming technology.[26]

ARCEP considered four indicators that could be used for determining the shares of the costs of the duct network to be allocated to copper and fibre. These were:

1. The relative lengths of copper and fibre cables,
2. the relative volumes that copper and fibre cables occupy in the ducts,
3. the relative volumes of cables effectively in use, and
4. the relative number of customers that obtain access over copper or fibre.

ARCEP decided to use the last of these approaches reasoning that allocating the cost according to the number of customers using either technology would better reflect the needs of long-term transition from copper to fibre. It would allow a progressively increasing share of the relevant duct network cost to be charged to fibre as it would be proportional to the corresponding revenues. It would also not disturb the equilibrium of current services using copper as a technology.[27]

The approach towards duct costs has the effect of allocating these costs from copper to fibre in a dynamic manner over time, which reflects the state of maturity of fibre uptake. Three stages are involved in the costing process:

1. Civil engineering costs are allocated between local loops installed in ducts and local loops which are directly buried.
2. Costs are allocated between local loop access and core network according to the lengths of cable infrastructures deployed in these segments.
3. The costs of local loops installed in ducts are allocated between copper and fibre according to the number of retail access lines based on copper and fibre (i.e. the respective take-up) using the duct network. Such retail access lines include

25 See ARCEP Decision 2010-1211 of 9 November 2010.
26 See p. 8 of the Decision.
27 Decision 2010-1211, p. 10f.

those used for residential and business purposes as well as other types of access such as mobile base stations.

ARCEP reports that all respondents in the public consultation expressed themselves in favour of this approach.[28] ARCEP's approach does in our view not reflect any cost-based pricing rule but represents a "value of service" pricing. Over time the cost allocation approach brings the allocation of costs closer to the actual capacity used by each technology. In the first years when the penetration of fibre still is low, fibre will be allocated a (much) lower share of duct space than a capacity based approach (based on the duct space required for deployed fibres) would dictate. In this way ARCEP's allocation approach lightens fibre from costs and reduces the risk of fibre investment to some degree. This method of allocation, however, also implies a cross-subsidization of fibre by copper compared to a capacity based allocation approach, as the share of the actual use of duct space by fibre presumably is larger than the share of customers currently getting access over fibre.

1.2 ARCEP's modelling approach

Since 2005 ARCEP basically applies a top-down cost modelling approach based on France Télécom's accounts. ARCEP choose separate costing methodologies to determine

- Capital cost,
- OPEX,
- Services related to local loop provisioning, and
- Common cost,

which we will describe briefly in the following paragraphs.

Capital cost

The asset base is in principle based on Orange's account. Historic asset values are indexed to current values (for 2004). ARCEP applies different methods for different periods.

(1) **1950-1992:** For this period, ARCEP found the accounting data on the annual investment not reliable and build a simulated accounting database for that period itself by reconstructing France Télécom's local loop investment history.

(2) **1992-2004:** For this period, ARCEP relied on France Télécom's accounting data.

28 Decision 2010-1211, p. 10.

(3) **2005-2008:** For this period, ARCEP used France Télécom's investment projections which were adapted to investment cycles in the past.

ARCEP allocated 72% of the total civil engineering expenditure to the local loop network. This allocation factor was applied for the whole investment history. The factor is based on France Télécom's calculations for the reference year.

The split between ducted and buried cables was assumed to be 90% vs. 10% for the whole period. This split is based on France Télécom's actual numbers of 2005. ARCEP deducted 22% of the capital cost for civil engineering for which France Télécom got local or other public subsidies for deploying the network in the first decades of network infrastructure development.

Besides the asset value, the annuity formula needs the economic lifetime of the relevant assets to calculate capital costs. ARCEP relied on the economic and not the technical lifetime of the assets and generally increased the lifetime as shown in Table 1-2.

Table 1-2: Asset lifetime before and after 2005

Type of asset	Lifetime before 2005	Lifetime after 2005
Civil engineering for ducted cable	30 years	40 years
Civil engineering for buried cable	20 years	25 years
Cable (depending on type)	15 - 20 years	25 years
Other passive elements		25 years

Source: ARCEP, Decision No. 05-0834, p. 6f.

For the tilt of the annuity formula which represents a technical progress component, ARCEP used the following values:

- Civil engineering for ducted cable: -0,23%
- Civil engineering for buried cable: -0,23%
- Cables: 1,80%
- Other passive elements: 1,80%

To index the historic asset values ARCEP used a consumer price index. To determine the capital cost per line, ARCEP divided the capital cost per year by the number of active lines, which were 30,4 million in 2005. This number was assumed to be constant for the following two years.

<u>OPEX</u>

OPEX for maintaining the copper access infrastructure were calculated by France Télécom at a level of 2,10 € per line for 2005, 2006 and 2007. This amount was accepted by ARCEP. OPEX includes indirect costs for procurement, logistics and indirect assets as buildings, IT and vehicles.

<u>Services related to the local loop</u>

For these services which include wholesale commercial costs, fault repair and billing, ARCEP accepted a total of 1,52 € per line including:

• Provisioning:	0,24 €
• Fault repair:	1,08 €
• Billing:	0,20 €
Total	1,52 €

<u>Common cost</u>

For common cost ARCEP accepted a mark-up of 5,78% on attributable cost. Costs for redundant personnel, redundant real estate and buildings are not allowed as relevant common costs.

France Télécom receives universal service payments in areas where it is uneconomic to provide access services. Furthermore, in previous decisions ARCEP took into consideration that altnets could only provide economically viable services on the basis of unbundling for 70% of all access lines (≙ 21 million lines). This commercially viable area has significantly expanded over the last years according to ARCEP. Activities of local entities and private stakeholders led ARCEP to the assumption that the deployment of unbundling continues at the same pace in the next years. They state furthermore, that the conjecture that there is no deployment outside the dense areas is outdated and it is difficult to determine areas in which the prospect of unbundling is insignificant. Furthermore, they assume that the deployment of unbundling becomes more homogenous and therefore, the average cost of unbundled lines will converge to the average cost of all lines, even so most operators still only utilize unbundled access in the denser areas. In light of this reasoning ARCEP tended to consider the maximal area for the cost calculation. They only excluded the costs for the longest lines covered by the universal service fund from the calculation, which are 5% of the access lines.

1.3 Characteristics of ARCEP's latest ULL pricing decision

In February 2016 ARCEP decided on new ULL charges to be valid for 2016 and 2017.[29] In applying the same cost model as in previous decisions, ARCEP determined an ULL cost and corresponding price of 9,10 Euro for 2016 which was a modest price increase of about 1% compared to the ULL charge prevailing in 2014. For 2017 ARCEP calculated a more significant increase of cost and the ULL charge by 4% to 9,45 Euro.

The cost determination methodology used for the 2016 and 2017 decision rests on the approach developed in Decision No. 05-0834 in 2005 which has been amended in 2012.[30] The basic procedure of determining costs relies on audited input values provided by Orange and on budget forecasts of the following year. This methodology implied that access seekers did not know the relevant wholesale price for the current year at the beginning of the year. Thus, they had to make their retail pricing decision without knowing the (exact) corresponding wholesale price. By also determining the 2017 price, ARCEP adopted and changed this, in our opinion, unsatisfactory practice which was a source for inefficient retail price decisions. ARCEP assumes that the approach developed in its decision in 2005 and which is still applied now is coherent with No. 40 of the EU costing Recommendation.

In the costing approach applied by ARCEP five major parameters have to be determined:

(1) <u>The real WACC to determine the capital cost</u>
In a separate regulatory procedure and decision[31] ARCEP has determined a nominal WACC of 8,7%. The relevant inflation rate was fixed on the basis of the French government’s projections to 1% in 2016 and 1,4% in 2017. Thus, the resulting real WACC amounts to 7,7% for 2016 and 7,3% in 2017. This is a rather high value if for instance compared to the recent WACC determination of the German NRA in its latest ULL pricing decision.[32] In this decision BNetzA calculated a nominal WACC of 6,44% and a real WACC of 5,2%.[33]

(2) <u>Evolution of the relevant number of access lines</u>
For determining the relevant number of copper access lines, ARCEP considered the evolution of access over the different technologies. For forecasting fibre access, ARCEP relied on the objectives of the Plan France Très Haut Débit and for the regional distribution on the SDTAN.[34] Furthermore, ARCEP took into consideration the deployment plans of operators and the market demand

29 ARCEP Decision No. 2016-0206 from 16 February 2016.
30 By ARCEP Decision No. 2012-0007 of 17 January 2012.
31 ARCEP Decision No. 2015-1369.
32 See Section 5.2.2 of this study.
33 The effective real WACC was uplifted to 5,9% because BNetzA applies an exponential smoothening of the recently calculated WACC with the calculated WACC over the last ten year.
34 Schémes directeurs territoriaux d'aménagement numérique.

dynamics. As a result, ARCEP calculated a reduction of copper access lines in 2016 by 1 million lines and in 2017 by 1,25 million lines. These reductions of copper access lines appear to be rather high in our view. They correspond to the achievement of fibre connections from 2008 to 2015. It would require an increase of fibre connections by more than 70% in 2016. That seems to be rather optimistic, when compared to a growth rate of 14% from Q3 2015 to Q4 2015.

(3) Investment

Investment has been rather stable in the last few years. Investments in copper cables are considered to be proportional to the number of active copper lines. Re-usable passive infrastructure has been distributed between copper and fibre access according to active copper and fibre connections. This ratio has been assumed to be constant over the last years. ARCEP takes into consideration Orange's investment plans as incorporated in its strategic plan. Furthermore, investment into improved service quality is included in the cost base. This investment will be monitored. ULL charges will be adopted retrospectively if it is not conducted as planned. It is unusual that incumbents in this network development scenario are still investing in copper cables. Without knowing the relevant modelling parameters, it is not possible to assess this point convincingly. We understand from Decision 2010-1211 that the cost of ducts will be allocated between copper and fibre according to the respective number of retail connections. This rule does not seem to be consistently applied by using a constant allocation share when the number of fibre connections grows.

(4) Operating expenditure

OPEX determination is based on Orange's accounts and anticipates efficiency improvements. Because of the limited transition to fibre over the next two years, ARCEP ignores negative scale effects due to transition. ARCEP's efficiency assumptions are not transparent and can therefore not be assessed.

(5) Taxes

The telecommunications tax is an exogenous factor for the cost calculation and a relevant source of price increase. From 2015 to 2017 the tax increases by 66% on a per line basis. In 2017 the tax amounts to 12,65 Euro per line and year and 1,05 Euro per month in 2017, which represents a share of 11% of the ULL price.

ARCEP has reduced the charges for non-recurring services related to ULL like customer service, connection and termination to a level below the relevant costs of those services. In particular the reduction of the termination charge shall reduce the barrier to migrate to fibre. The balance of costs of non-recurring services and their price is transferred to monthly ULL rental costs such that there is overall cost recovery of the ULL service as a whole.

1.4 Reasoning of ARCEP's ULL pricing and future plans

In several public statements ARCEP and its President have reasoned their ULL pricing decision and provided some indication on the future ULL price path.

In an interview with Le Figaro at 6 April 2016[35] Chairman Soriano highlighted that regulation cannot accept a market outcome of a network duopoly, “the worst of all systems”, between the incumbent Orange and the cable operator Numericable/SFR. It is essential in his view that the other two operators heavily invest in fibre, too. The increase of ULL charges shall motivate these altnets to invest in their own fibre network instead of further using Orange's copper access network via unbundling. The regulatory emphasis is to incentivise further investment instead of getting lower retail prices.[36] The level of prices is acceptable. There is no need for further downward pressure.

Before the latest ULL pricing decision Chairman Soriano pointed out that the upcoming price decision shall provide a strong and precise signal to the market that the copper access charges shall support the migration to fibre.[37] Therefore, ARCEP intends to progressively increasing the copper ULL charge. Instead of lowering the recurring monthly copper ULL charges, ARCEP will reduce the non-recurring charges, in particular the termination charge to make the migration from fast to superfast broadband easier.

In its detailed roadmap of the “revue stratégique” ARCEP announced, that it will formulate an ULL pricing strategy still in 2016 which will cover the period 2018 – 2020.[38] This strategy will formulate economic conditions for a further migration to fibre and provide security for the investors, especially for the operators using ULL access.

1.5 Current cost of a copper network as reference point not appropriate

1.5.1 Copper access as the reference network architecture

ARCEP determines the ULL cost based on an end-to-end copper access network from the end-user premise to the MDF. Due to the CCA valuation of the network assets this approach represents the cost of a new copper network. Users pay at the retail and at the wholesale level the price of a new copper network.

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35 Interview of M. Soriano (Chairman) by Le Figaro: "C'est la fin de la régulation pro-low-cost", April 6th 2016.
36 Interview of M. Soriano by Europe 1, April the 4th 2016.
37 Interview of Soriano, NetInpact, November 2015: www.nextinpact.com/news/97302-interview-sebastian-soriano-si-arcep-etait-inventee-aujourdhui-que-devrait-elle-faire.htm
38 www.arcep.fr/uploads/tx_gspublication/feuille-de-route-detaillee-janv2016.pdf, p. 5 et 6

This reference point entails two major implicit assumptions:

(1) The copper access network represents the actual technological frontier of a telecommunications access network; it is the Modern Equivalent Asset (MEA) of an access network today.

(2) Following the competition standard, any new entrant investing in a new access network today would invest in such a reference architecture and technology.

Both implicit assumptions obviously are not valid in France for years. Technologically, an end-to-end FTTH network without any doubt represents the technological frontier of an access network. FTTH networks deliver bandwidth without restrictions which exceed those of a copper network by far. They provide additional quality advantages (like symmetrical bandwidth, energy efficiency etc.) which cannot be produced in a copper network. In a comparative Greenfield consideration the investment cost of a fibre network are not higher than those of a copper network. This is proven by the first cost modelling approaches of NRAs.[39] Since fibre networks require lower operating expenses and lower fault repair costs than copper networks[40], they might even cause lower total costs per line compared to a copper access network.

Given this broad set of advantages of a fibre network, no new entrant in the market would invest in copper access anymore. It would directly build a fibre network. This is perfectly and impressively demonstrated by the investment activities of altnets in France. In a competitively structured access market, the superior MEA technology will drive the existing technology out of the market. This is to be expected in France within the next decade (at least for relevant parts of the local access networks).

The MEA consideration for the whole access network is independent of the fact that deployment and migration takes time and will only be conducted gradually. This might even include intermediate steps like FTTC. Gradual migration follows from the fact that the decision relevant cost for the continued use of the copper network are not the long-run replacement cost but the short-term cost consisting of operating expenditure and the opportunity cost of the old assets. These are much lower than the replacement cost.

The long-term considerations, nevertheless, remain relevant for regulatory authorities. This forward looking perspective should be related to new technology as the relevant MEA. In case of technological progress old production assets in a competitive market have to be depreciated such that they can compete against the old technology (at least in sub-segments of the market) until the new technology is finally dominating. This depreciation requirement holds independent of the actual usage pattern of the old technology. What is needed for efficiency is a MEA valuation of the old technology

39 For example in Sweden, Denmark and New Zealand.
40 Fibre cables are insensitive to humidity and electromagnetic interference; the fibre strand connections are less fault prone because of fixed splicing or exact connectors.

relative to the cost of the new technology. We will further elaborate on this point in Section 3.3.4.

ARCEP's costing methodology only partially addresses the MEA requirements, if at all, e.g. by shortening the (remaining) lifetime of copper assets and the allocation of duct cost between copper and fibre access.

1.5.2 Decreasing demand and increasing cost

Baseline of ARCEP's cost determination is the installed base of ducts and copper cables. This costing baseline does in the first place not respond to a decreasing demand for copper lines. The relevant network therefore is not dimensioned for current demand but for demand in the past. ARCEP itself assumes a decline for 2016 by 1 million lines and for 2017 by even 1,25 million lines. In ARCEP's model the size of the (duct) network may even and actually is growing due to capacity requirements of the fibre network.

In ARCEP's costing methodology, the allocated cost of ducts (and civil engineering) for ULL reacts to decreasing demand while the cost for copper cables and civil engineering related to buried cables does not respond to the decreasing demand.

The allocation of duct cost (including the respective civil engineering cost) responds to a declining demand insofar as it is caused by a migration of customers from copper to fibre. Duct costs are allocated between copper and fibre according to actual connections. We have shown in Section 1.1.4 that this allocation is not capacity-based and therefore not cost-based. Nevertheless, the allocated duct cost decreases in case of migration in absolute terms. In relative terms they might, nevertheless, increase on a per line basis depending on the duct investment incremental to and caused by fibre. Insofar and to the extent that the declining demand for copper lines is caused by other factors than the migration to fibre (e.g. migration to cable or to mobile, reduced number of households), the allocated duct cost per line increases.

About 10% of all access network cables are not ducted but directly buried in the ground. Those costs do not respond to a declining demand and increase ceteris paribus on a per line basis in case of declining demand.

The installed base of copper cables and other passive network elements allocated to the access network (like manholes, street cabinets and distribution frames) does not respond to a declining demand.

If the copper network was dimensioned in the past for 100% of lines (e.g. 30 million lines) and the actual number of active lines amounts to 80%, then the remaining lines have to bear the cost of the former 100% of lines.

All the factors mentioned above generate the costing dynamic in ARCEP's costing methodology that ULL cost progressively increases on a per line basis with a decreasing number of active copper lines.

1.5.3 OPEX of the old network

Operating costs are derived from Orange's accounts. Therefore they represent the actual cost of an "old" copper network. This costing approach leads to excessive cost in two respects. First, the cost of a new network is derived from the actual cost of an old network without conducting systematic efficiency corrections. Secondly, the approach does not take into consideration that the operating expenditures of the relevant FTTH MEA are significantly lower than those of a (new) copper network.

In particular with regard to operation, maintenance and fault repair an old network causes higher costs than a new network. Components of an old network often face limited availability. This makes it more costly to replace them. The probability of faults increases in an old network. Corrosion of copper connectors, aging of cable insulation, sensitivity to humidity, change of transmission characteristic and impact on increasing cross talk and attenuation are aging effects of copper cables, which increase OPEX of an old copper network compared to a new one.

One of the many advantages of an FTTH network are lower operating expenditures. This holds for building capacity, electricity cost, fault repair and maintenance expenditure etc. According to most recent operators' estimates,[41] OPEX of a fibre network could be half of those of a copper network.

In a recent ULL pricing decision the New Zealand regulatory authority Commerce Commission also determined the copper ULL cost on the basis of a fibre MEA approach.[42] The relevant OPEX were as in the French case derived from the accounts of the incumbent operator. The old copper network's OPEX were then reduced by an efficiency factor of 40% representing the difference between the relevant cost of a copper and a fibre network. This calculation results in the efficient OPEX of the MEA technology. ARCEP does not conduct such MEA efficiency adoptions.

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41 E.g. Verizon which has a large fibre footprint in the US report cost savings of building capacity of 60%-80% and of 40%-60% for energy. Reliability increases by 70%-80% and generates corresponding savings of maintenance and fault repair:
(see
http://www.theregister.co.uk/2015/05/20/verizon_fibre_is_so_much_cheaper_than_copper_were_goin
g_allfttp/)

42 See Commerce Commission (2015).

1.5.4 Cost over-recovery

In the previous Section we have shown that ARCEP's costing approach is not efficient because it relies on an inappropriate modern equivalent asset approach, it does not properly deal with decreasing demand and it overestimates OPEX. In this Section we will show that ARCEP's approach also leads to (further) over-recovery of cost.

Firstly, it has to be noted that ARCEP's top down costing approach guarantees Orange (at least) a recovery of its actual investment at current cost. Economic theory asks for the recovery of efficient costs incurred by the incumbent operator, including the capital and operating cost. Recovery of efficiently incurred cost requires that only those assets which are needed for an efficient network and an efficient network structure are part of the relevant cost base. Only those assets are relevant for cost calculation which are required to meet capacity for current demand. Spare redundant ducts or trenches, unused floor space and overdimensioned Main Distribution Frames could be typical examples of inefficiency in the access network. Since all actually invested copper access network assets are part of the cost base in the cost model, ARCEP assumes that asset quantities, asset structure and network structure are those of an efficient network and represent efficiently incurred cost. ARCEP's cost methodology does not envisage efficiency corrections on the identified asset volumes.

NRAs which apply bottom-up cost models to calculate LRIC of ULL usually identify significant deviations of the efficient asset structure and quantities as calculated by the model and the assets identified in the cost accounting system of the incumbent. In Germany, for instance, where the NRA calculates the current cost of the local loop on the basis of a bottom-up model it has identified the following deviations:[43]

- Number of manholes,
- Number of street cabinets,
- Deployment techniques and deployment costs,
- Length of trenches and cables,
- Number of copper pairs and reserve capacity,
- Degree of outsourcing,
- Sharing of trenches between network layers and external users,
- OPEX
- Building rentals.

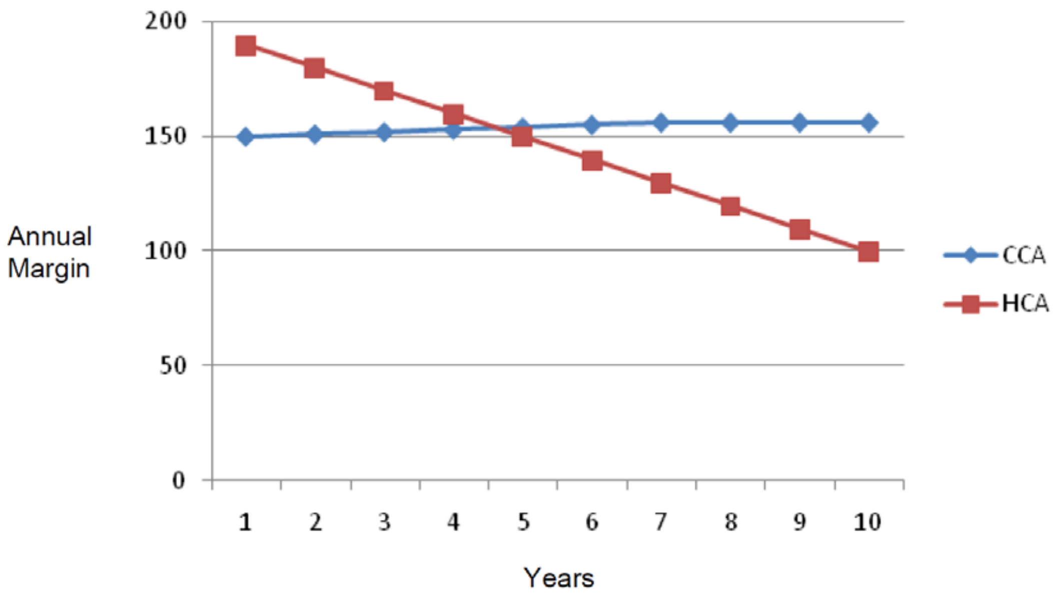
43 See the latest ULL decision of BNetzA, BK 3c-16/005, Consultation draft of April 2016.

From these observations one can conclude that the calculated ULL prices compensate Orange for more than the efficiently incurred costs.

The way in which ARCEP calculates capital cost and applies the annuity approach is another source for over-recovery. The use of a consistent depreciation method throughout the life of an asset is essential for achieving economic cost recovery and to avoid over-recovery and under-recovery. This holds in particular if the lifetime of assets is rather long as it is in the case of the access network. Different depreciation methods have different annuity profiles. Changes in the asset valuation regime can therefore generate windfall losses or windfall gains.

Figure 1-2 describes the windfall profits emerging from a change from HCA to CCA which may lead to a higher margin being earned over the lifetime of the asset.

Figure 1-2: Illustration of potential windfall gains



Source: Ofcom (2012), Annex 1, p. 13

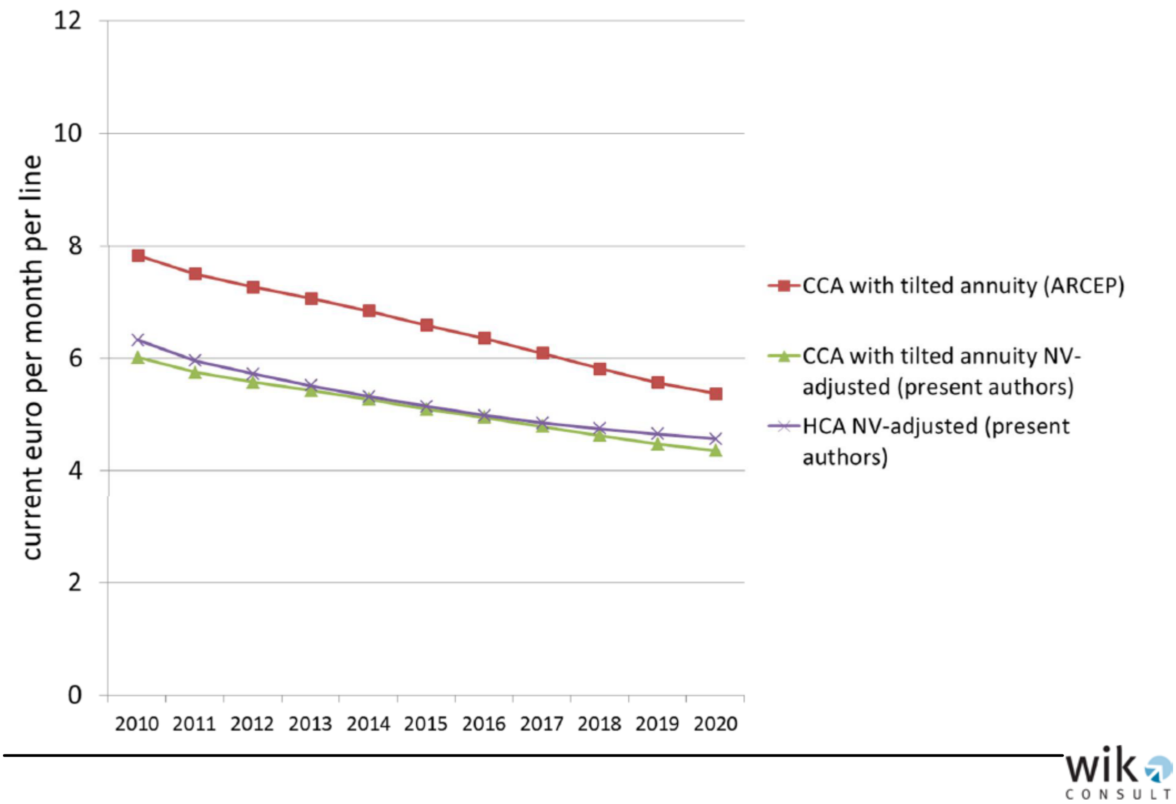
In order to correct for such windfall gains or losses the adjustment of the valuation should not be conducted for the whole (gross) asset value but only for the last net value, that part of the assets which has not been depreciated when changing the valuation method. By not making this correction, ARCEP generated an over-recovery situation. ARCEP could have avoided over-recovery to some extent if the net book value was taken in 2005 as the relevant asset base and the further CCA annuities were calculated from this value and not from the (full) replacement cost value.

In a paper published by Cave et al. in 2012 the authors have calculated the quantitative amount of this over-recovery. The quantification is based on a simulation model which makes extensive use of the data on investment by France Telecom on local loop investment made over a thirty year period as computed by ARCEP in 2005 and published in the corresponding decision. The modelling is based on a set of assumptions.[44] The number of copper lines is assumed to linearly decrease starting from 2010 and falling to zero in 2030. This decrease impacts only the copper cable assets. This assumption is in line with the duct allocation approach ARCEP introduced in 2010.[45] Therefore, it is assumed that the number of users relying on the civil works assets is stable and includes both fibre and copper users. Ducts are used by both technologies. The calculated ULL cost includes both CAPEX and OPEX.[46]

Cave et al. made simulations in order to show how a net value adjustment can prevent over-recovery. In the French case the depreciation method used before 2000 was HCA and between 2000 and 2010 it was CCA with a tilted annuity. Figure 1-3 demonstrates the impact of different methodologies on ULL costs. A CCA methodology with tilted annuity adjusted for the net value generates much lower cost than a CCA approach with tilted annuity as applied by ARCEP. The CCA value, net-value adjusted, with tilted annuity is close to the HCA net-value adjusted valuation. The adjustment for net value has a greater impact on the resulting cost than the choice of CCA versus HCA.

44 See Cave et al. (2012), p. 152.
45 ARCEP Decision No. 2010-1211.
46 We assume that also ULL service related cost and common cost as referred to in Section 1.2 are including in the calculation.

Figure 1-3: Simulation of local loop unbundling cost based on French data: CCA with tilted annuity vs. HCA methodology



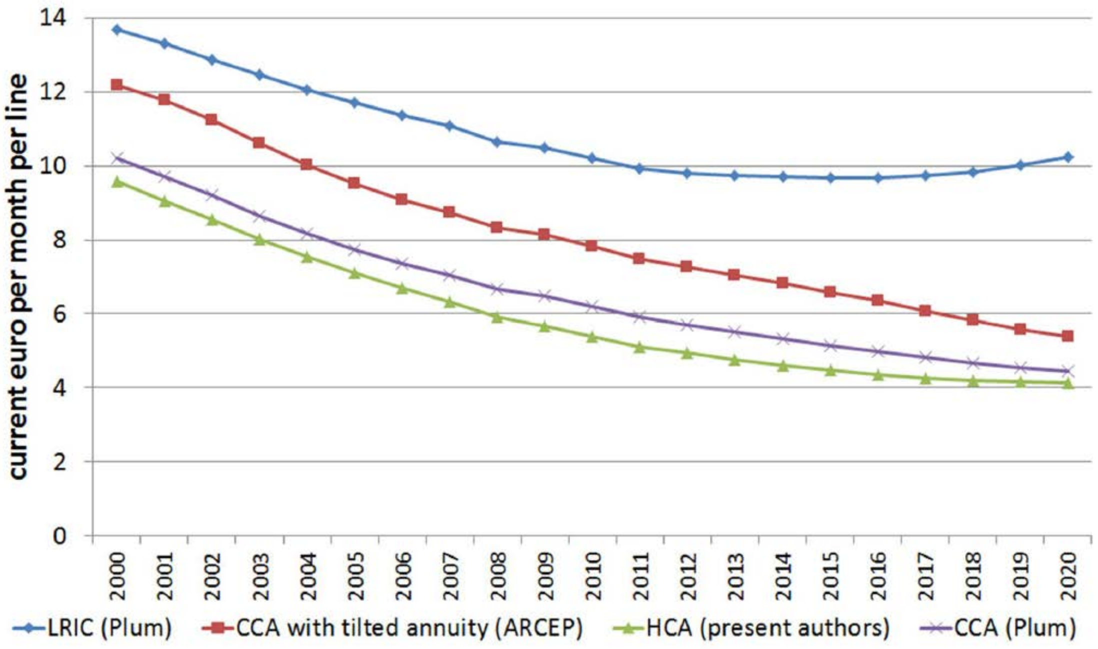
Source: Cave et al. (2012), p. 156

Ofcom addressed the same over-recovery problem when it implemented a new asset valuation method in 2005.[47] Assets created before 1997 were revalued based on a regulatory asset value equal to the net book value. This method is called abated CCA fully distributed cost. It distinguishes between two groups of assets. The post-1997 assets are depreciated on a standard CCA basis. For the pre-1997 assets, their net book value is the relevant asset value and the further CCA annuities are calculated from this value and not from the replacement cost value.

Cave et al., furthermore, argued that a CCA valuation of ducts as such already leads to cost-over-recovery.[48] They argued that the pricing of duct access is neutral with respect to the transition from copper to fibre because ducts are used by both technologies. The useful live of ducts is threatened neither by foreseeable technological obsolescence, nor by competition – ducts are not replicable. Therefore it is possible and appropriate to value ducts at HCA to ensure full recovery of costs on an ex ante basis.

47 See Ofcom (2012).
48 See Cave et al. (2012), p. 152ff.

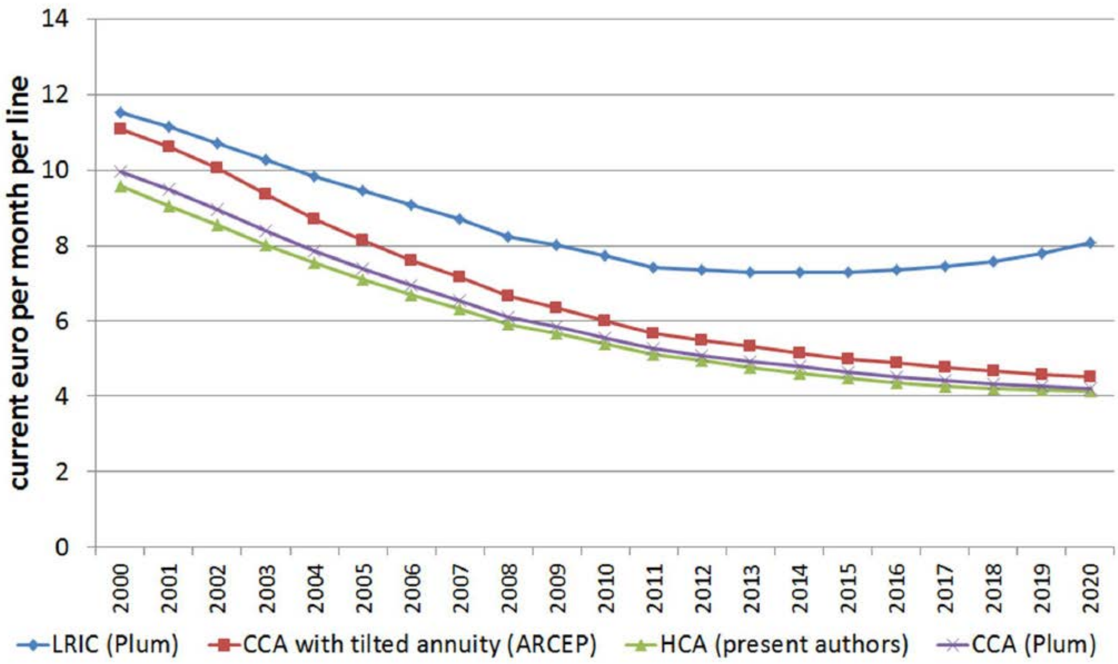
Figure 1-4: Simulation of local loop unbundling cost based on French data



Source: Cave et al. (2012), p. 153

The authors used the same simulation model based on the investment data published by ARCEP. Figure 1-4 shows that the top-down LRIC estimate is very high compared to HCA estimates. The current cost valuations fall in between the two. Figure 1-5 represents the LLU costs when civil works are estimated according to a HCA methodology, while the copper cable valuation method varies. Compared to Figure 1-4, the overall cost is quite similar for all costing methodologies indicating the relative small cost share of copper cables in total ULL cost.

Figure 1-5: Simulation of local loop unbundling cost based on French data when civil works is valued by HCA method and the copper valuation method varies



Source: Cave et al. (2012), p. 153

Also the cost allocation approach for ducts applied by ARCEPs leads to distortions as costs which are not incremental to copper access are allocated to ULL. France Télécom can to a significant degree rely on its existing duct system to deploy fibre cables for its fibre access networks. In most cases the capacity of the duct system is sufficient to host the additional fibre cables. In some cases, however, Orange has to install new ducts, or has to rearrange the cables in the duct system to make it capable of hosting (more) fibre cables or the duct system has to be upgraded to be capable of hosting (more) fibre cables. All these investment activities are not needed for the purpose of providing capacity for the copper access network or to keep it properly maintained. These investments are incremental to the fibre access network. ARCEP's allocation mechanism attributes such investments to the general duct access asset base and cost pool which then is allocated to copper and fibre according to actual connections. This means in practice that today 95% of the costs associated with an asset which is 100% incremental to fibre access is allocated to copper access.

ARCEP's current costing methodology leads to over-recovery of relevant cost for (at least) four reasons: Firstly, the approach recovers the incumbent's actual investment at current cost. These are higher than efficiently incurred investments. Secondly, when ARCEP changed its valuation approach, it was applied to gross and not to the last net book values, which generated significant windfall profits given the age structure of the assets. As depreciation methods have different annuities profiles, when adopting a new method, the last net book value should be taken into account. Thirdly, because of the non-replicability of ducts, a CCA evaluation leads to cost over-recovery. Fourthly, the cost allocation of ducts according to actual connections results in a cross-subsidization of fibre at the expense of copper ULL.

1.5.5 Reference model for cost determination not coherent with behaviour of market participants

The reference model of a copper access network is neither in line with the technological development nor with market development and the market behaviour of incumbent and competitors. For (at least) 10 years a copper access network does not represent the relevant technological edge. Different to many other countries in Europe fibre deployment started about that time in France clearly demonstrating that the copper network no longer can be the relevant MEA.

Regulators have to take a long-term perspective for pricing decisions which should incentivize efficient investment. Therefore the proper MEA reference architecture is crucial even when the actual (and full) migration to the new network infrastructure still takes several years. This is the essence of a forward looking decision oriented perspective which holds even when the transition to the MEA technology occurs gradually. In any case a copper access network which still is the baseline of ARCEP’s cost determination only represents the relevant technological edge in a rather backwards oriented consideration.

2 Fibre deployment, competition and fibre migration in France

2.1 The long-term targets

French regulation on (superfast) broadband access has focussed on fostering the deployment of FTTH with specific attention to promoting infrastructure-based competition on FTTH to the extent economically viable. Furthermore, an enabling lighter asymmetric regulatory regime is going forward to support this target.

Fibre deployment started already in 2006 when Iliad announced a massive fibre investment program. At that time France Télécom was still reluctant to fibre. In 2007 Iliad filed a complaint against France Télécom for abuse of its dominant position. Namely, FT refused to give its competitors access to its civil engineering assets they needed to roll-out their own fibre. In 2008 ARCEP regulated access to FT's ducts. At the same time the LME bill introduced symmetric access obligations for the FTTH terminal segment. In 2010/2011 ARCEP made several decisions on technical and economic rules for FTTH roll-out and symmetric access including co-investment offers.

ARCEP has described that its regulatory approach is intended to ensure

- Operators to limit overall roll-out costs;
- Only a single installation in buildings, instead of multiple ones by different operators;
- The prevention of local monopolies;
- Customers have a choice of ISPs for their very high-speed services.[49]

The preference for FTTH is supported by the French national broadband strategy. In early 2013, the French government set up the "Plan Très Haut Débit" which promotes the deployment of high-speed fibre based broadband networks throughout the country. A major target of the plan is to reduce the digital divide between rural and urban areas by providing equal broadband connectivity to the whole population. The Plan aims to connect 100% of households to high-speed broadband by 2022. Technologically, the Plan aims to achieve FTTH as far as possible. In areas where this is not economically viable, technologies like FTTC or radio technologies should be deployed.

The Plan has calculated a 20 billion Euro investment requirement to meet its targets over a ten year period. The Plan furthermore calculates the need of 3 billion Euro state

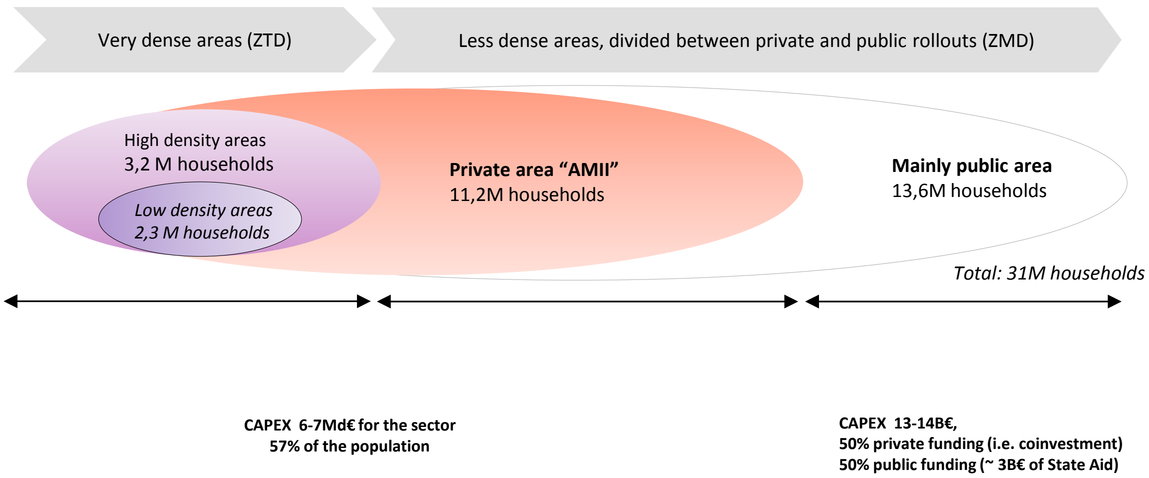
49 ARCEP 2009, Toward FTTH, presentation by Joelle Toledano, ARCEP Commissioner, at DigiWorld Summit, available at http://www.arcep.fr/fileadmin/reprise/communiques/discours/2009/slides-j-toledano-idate09.pdf

subsidies to support rural broadband initiatives where private operators will not deploy their own network without it.

The Plan divides the French territory into subsidized and non-subsidized areas. Non-subsidized areas are those where FTTH has already been deployed and those for which operators have already committed to develop ultra-fast broadband. In these high- and medium density zones public funds and financing will not be granted to private initiatives because fibre deployment is regarded as profitable in those areas. The non-subsidised areas cover 57% of the population. A CAPEX requirement of 6 to 7 billion Euro is calculated for this area. Subsidised areas comprise of those parts of the country with lower population density where operators and other private actors did not show any investment initiative and interest. The Plan assumes that this area which represents 43% of population absorbs an investment requirement of 13 to 14 billion Euro.

Such areas are the scope of subsidised investments which can be pure public initiatives or joint public private partnerships. Figure 2-1 provides an overview on the structure of areas according to these dimensions.

Figure 2-1: Organisation of the FTTH roll-out and regulation



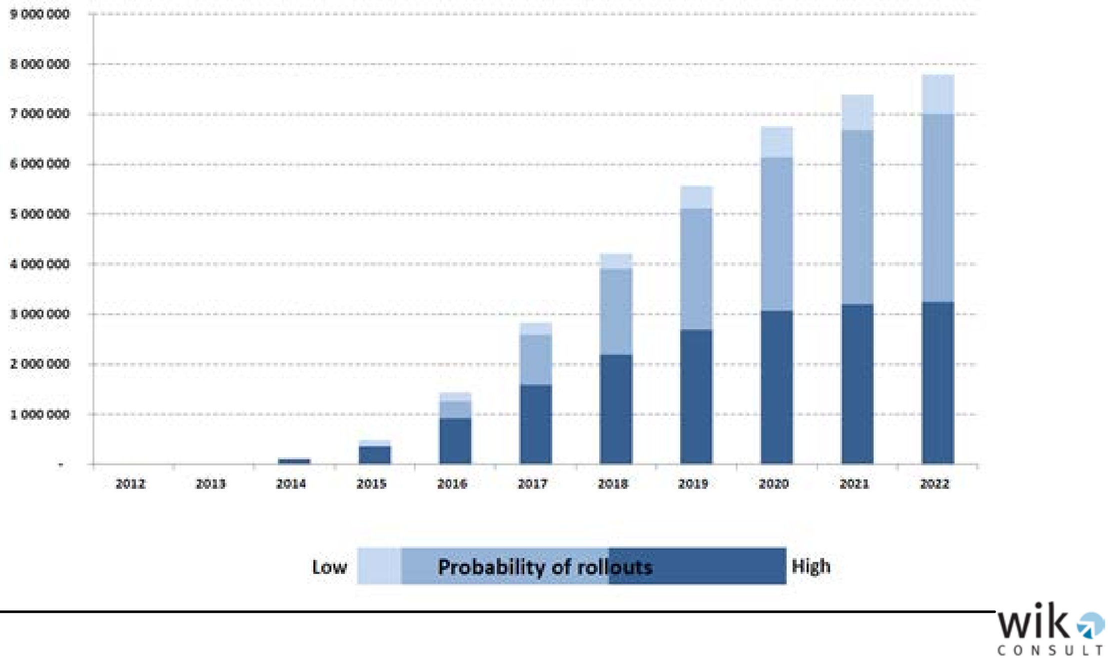
Source: Iliad

The numbers in Figure 2-1 also indicate that the number of premises (households) considered by ARCEP to have natural monopoly characteristics in the fibre terminating segment is 27,8 million or about 90% of households. In contrast, 3,2 million households are considered to be viable for infrastructure competition to the base of the building.

In order to implement the Plan, the Government created the Mission THD in 2012 within the Ministry of Economics and Finance responsible in particular for determining the eligibility of broadband projects to receive public funds. From a regulatory perspective, the publicly funded networks have to offer wholesale services on an open access basis, ensuring that any operator or service provider can access the network on equal terms. There is also a requirement that the network has to be technologically neutral so that any standardised technology can be connected to the network.

Mission THD forecasts that by 2022 between 3,25 to 8 million homes could be passed by FTTH covered by the deployment of Public Initiative Networks (PINs) (see Figure 2-2), depending on the probability of roll-outs. It has, however, to be noted that (at least) one the four fibre operators in France is partner in such public initiatives in most of the cases. This means, that there is some overlap with the intended and announced deployment plans of those operators. In 2015, around 100 PINs[50] were either operational or under construction in France; not too many of them covered FTTH deployment. Besides Orange and SFR, companies like Axione, Covage, Altitude and Tutar take partnerships in PINs.

Figure 2-2: Forecast of FTTH homes passed in public initiative areas



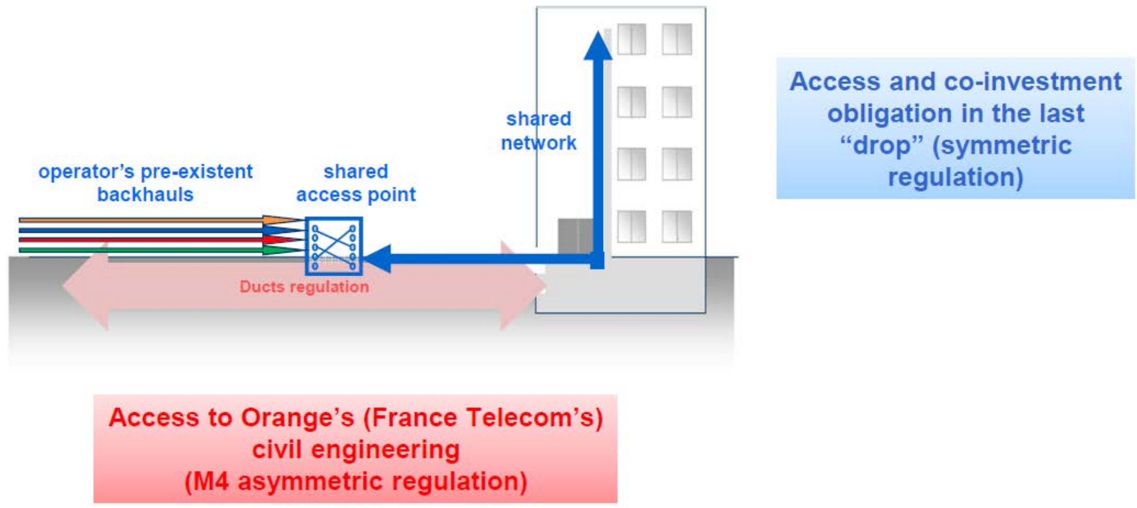
Source: France Très haut Débit

50 See http://arcep.fr/index.php?id=11040

2.2 The regulatory model for fibre deployment

The French regulatory regime for fibre deployment is focused on (a) nationwide regulated access to Orange's ducts in the local access regime under asymmetric SMP regulation[51] (with strict cost-orientation, no risk premium and equivalence of input) and (b) a symmetric regulatory regime applied to the terminating segment of FTTH networks which varies according to geography. The regime was initially elaborated through legislation and a series of ARCEP's decisions in the period 2008-2010. [52] Figure 2-3 exhibits this "dual" access regime.

Figure 2-3: The French dual access regime for FTTH



Source: Oisel (2014), p. 4

51 Duct access was imposed on FT-Orange for the deployment of fibre local loops in July 2008 by ARCEP Decision No. 2008-0835 of 24 July 2008 ("GC BLO").

52 The legislation governing symmetric access was approved in 2008-2009 Law n ° 2008-776 of 4 August 2008 on the modernization of the economy Law n ° 2009-1572 of 17 December 2009 against the digital divide. The symmetric access regime was elaborated in Decisions by the NRA in 2009-2010 Decisions of the Authority no ° 2009-1106 and n ° 2010-1312 of 22 December 2009 and 14 December 2010 respectively, adopted pursuant to Article L. 34-8-3 CPE.

Duct access

Duct access has to be provided by Orange under transparent, non-discriminatory and cost-oriented conditions. In November 2010 ARECP adopted a Decision[53] which significantly reduced the duct access charges by amending some of the key parameters. ARCEP's rationale was to enable competitors to deploy fibre networks under favourable and efficient conditions in high density as well as in rural areas. The costing process involved three stages:

(1) Civil engineering costs are allocated between local loops installed in ducts and local loops which are directly buried in the ground.

(2) Costs are allocated between local loop access and core network according to the length of cable infrastructure deployed in these segments.

(3) The duct costs of local loops installed in ducts are allocated between copper and fibre according to the number of retail access lines based on copper and fibre using the duct network. Such retail access lines include those used for residential and business purposes as well as other types of access such as mobile base stations.

This approach towards allocating ducts costs has the effect of allocating these costs in a dynamic manner over time reflecting the maturity of the fibre uptake. The practical effect of the approach is that the vast majority of duct costs are allocated initially to the copper network, making ducts relatively cheap for the installation of fibre, incentivizing deployment and allowing penetration pricing. As fibre take-up increases, the proportion of duct costs attributed to fibre would also increase, leading to an increase in duct tariffs. Ducts for (copper and) fibre deployment are valued on a CCA basis.

53 ARCEP Decision 2010-1211.

FTTH terminating segment access

The main principles of shared investment on a symmetrical basis and symmetrical access to the terminating segment of FTTH networks have been formulated by French law[54] and have been further specified by a series of ARCEP decisions. Accordingly, the terminating segment of the fibre network shall be shared among operators. The first operator that deploys fibre in a building is required to provide access to other operators at a mutualisation point. The mutualisation point is set by ARCEP based on its assessment of economic replicability and varies by geography. In very dense areas the mutualisation point should be:

- At the base of the building for buildings hosting more than 12 households or offices;
- At a point (outside a building) aggregating 100 lines for buildings hosting less than 12 households or offices.

In less dense areas the mutualisation point must be:

- At a point aggregating at least 1000 lines or,
- At a point aggregating at least 300 lines if backhaul is made available to a point aggregating 1000 lines.

Each operator can then use the network of the first moving operator from the mutualisation point onwards.

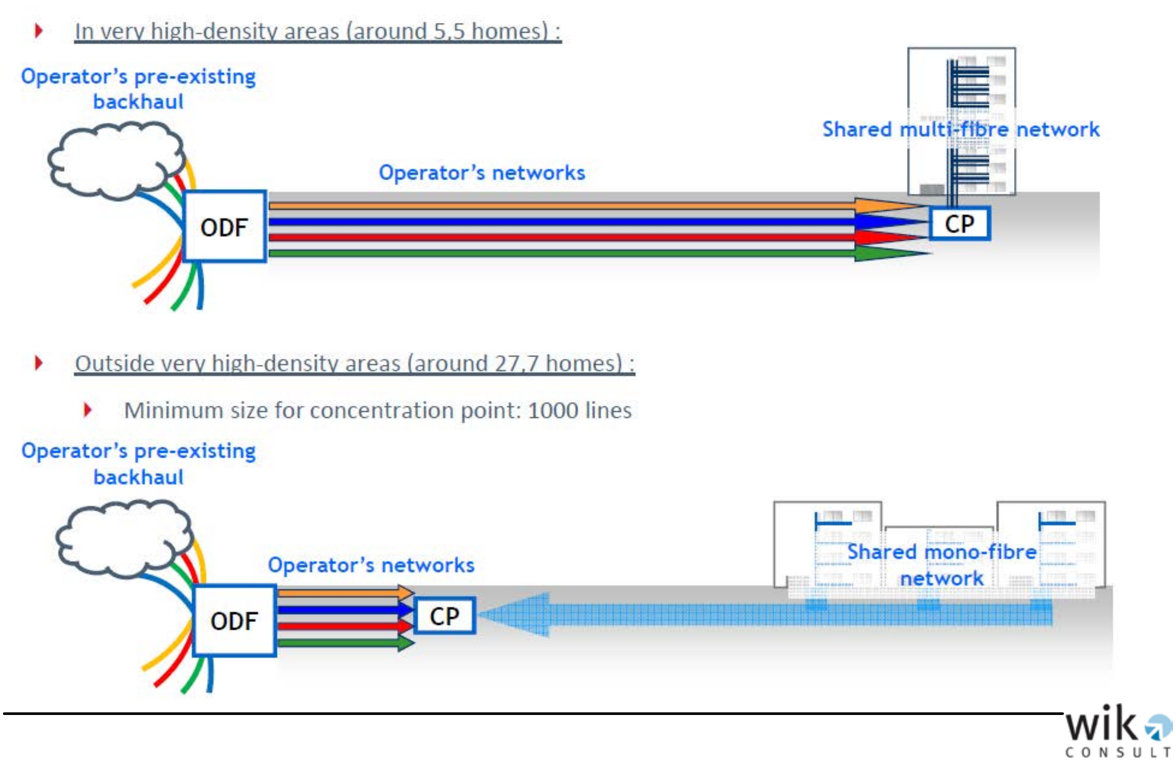
Although the mutualisation point was largely accepted by the industry, issues were raised concerning the definition of very dense areas. On the basis of actual experience in the market, ARCEP refined the boundaries over time, firstly in 2011 by identifying "low density pockets" within very dense areas, and then in January 2014 reducing the scope of the area defined as very dense. As a result, the very dense areas cover 5,5 million (or 17,7%) of population and the remaining 25,5 million (or 82,3%) of population belong to the less dense areas. Within the very dense areas 3,2 million households belong to high density areas and 2,3 million to low density areas (see Figure 2-1).

The regulatory regime generates a different architecture according to areas. In very dense areas each operator has to roll out its own horizontal fibre up to each building (see Figure 2-4) where it then has a passive access to its own fibre line within a multi-fibre network which is shared among co-investing operators. In the less dense areas, only one operator deploys the fibre network to the mutualisation point and or to the

54 The legislation governing symmetric access was approved in 2008-2009 Law n ° 2008-776 of 4 August 2008 on the modernization of the economy Law n ° 2009-1572 of 17 December 2009 against the digital divide.
The symmetric access regime was elaborated in Decisions by the NRA in 2009-2010 Decisions of the Authority No. 2009-1106 and n ° 2010-1312 of 22 December 2009 and 14 December 2010 respectively, adopted pursuant to Article L. 34-8-3 CPCE.

ODF). At the mutualisation point the co-investing second (or third) operator gets access in an unbundling type and gets access to dark fibre backhaul at the ODF.

Figure 2-4: FTTH architectures and access regimes in France



Source: Oisel (2014), p. 5

Several bilateral agreements have been concluded on the basis of the symmetric mutualisation regime. Orange made agreements of different types with both SFR and Free to jointly deploy FTTH in less dense areas. Bouygues signed an agreement with Orange to share investment in horizontal network segments in very dense areas. Furthermore, municipal and regional authorities have initiated FTTH roll-outs in partnerships with several operators, e.g.. Orange and SFR

In sum, the regulatory regime obliges all operators rolling out an FTTH network to grant access upon reasonable request and to publish an access offer. Transparent and non-discriminatory conditions of access at the mutualisation point allow economical and technical reasonable conditions for access seekers within a symmetric framework. Cost sharing has to be negotiated on objective terms and in line with the principle of efficient investment. The NRA has the possibility to detail the access conditions and to engage in dispute resolution procedures. The (first moving) building operator informs other operators about (a) the exact location of the mutualisation point, (b) technical conditions of access and (c) the address of the buildings and the number of lines rolled out. Operators are working on processes of standardisation and industrialization. Co-investment provides long-term rights of use for the lifetime of the infrastructure (30 or 20 years and renewable) in the form of indefeasible rights of use (IRU). Cost sharing entails upfront CAPEX payments and monthly OPEX payments covering the maintenance and civil engineering costs.

Active access

There is no downstream active access on NGA networks mandated by ARCEP under the SMP framework. However, as one of the conditions for its merger, the French national competition authority required cable operator Numericable-SFR to offer bitstream access to its cable network for an interim period of 5 years[55] at prices which are subject to the approval of the authority and do not create a margin squeeze. The aim of the requirement was not to set up a long-standing access obligation, but rather a “provisional” measure “to allow Numericable’s competitors to replicate its retail services during the period necessary for them to deploy their own fibre optic networks”. Cable bitstream access was provided on a voluntary basis by Numericable to Bouygues Telecom prior to the merger with SFR. Unregulated active NGA access (bitstream) is also available on some NGA networks constructed by local authorities.

ARCEP is also developing guidelines[56] at the request of the Government which aim to prevent public initiative networks from setting voluntary fibre bitstream charges too low – in order not to disincentivise network investment by others and ensure the long-term viability of that investment.

Pricing regime and co-investment

According to ARCEP’s basic decision from 2009, tariff conditions for access to fibre at the mutualisation point must be reasonable and comply with the principles of objectivity, relevance, efficiency, transparency and non-discrimination.[57] According to ARECP, these principles imply that the access provider should publish an access offer which sets the technical and pricing conditions which do not discriminate against third parties in comparison with its own services and which are justifiable according to the cost of relevant network elements as adjusted for risk. To verify the adoption of these principles, ARCEP introduced a cost-accounting obligation whereby operators installing fibre must provide investment details to the authority. ARCEP is also close to finalising a reference cost model for negotiating parties in order to settle prices for access. Although ARCEP does not intervene ex ante to set terminating segment prices, it may step in to resolve disputes. It is likely that ARCEP will use its cost model as a basis for settling pricing disputes.

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55 Authorite de la Concurrence approves Numericable SFR merger with conditions http://www.autoritedelaconcurrence.fr/user/standard.php?id_rub=592&id_article=2445

56 ARCEP press release accompanying the consultation on guidelines for the pricing of access to public initiative networks http://www.arcep.fr/index.php?id=8571&tx_gsactualite_pi1%5Buid%5D=1784&tx_gsactualite_pi1%5Bannee%5D=&tx_gsactualite_pi1%5Btheme%5D=&tx_gsactualite_pi1%5Bmotscle%5D=&tx_gsactualite_pi1%5BbackID%5D=26&cHash=a329002e955883477fe864abe8431b85&L=1

57 Article 3, Decision 2009-1106.

In less dense areas, the symmetric regime for FTTH pricing focuses around the cost of the termination segment as a whole (from the ODF to the mutualisation point as well as in-building wiring), while in very dense areas, pricing rules apply to in-building wiring only. In less dense areas both co-financing and rental offers for FTTH terminating segments must be made available by operators which install fibre to third parties.

A key element of the pricing regime aims to defray the risks of FTTH deployment and to focus on a long-term pricing approach. Therefore operators do not rent access on a per line basis, but purchase up-front the right to utilise a proportion of the lines. The rights are defined in slices of 5%. Co-investment payments grant IRU rights which appear at the balance sheet of co-investing operators and are depreciated accordingly. The co-investment offer must be made available (1) before the investment and (2) after the investment (a posteriori). The a posteriori offer implies price components or mark-ups which compensate for the (take-up) risk undertaken by a first mover. The IRU payment system consists of two components:

(1) A non-recurring charge, which is paid in two instalments. The general market price for this component is € 500 per line for the segment from the building to the first distribution point aggregating 300-1000 lines.

(2) A monthly recurring charge which is paid for each activated access line. This charge allows the cost recovery for the non-co-financed lines (insofar that represents unused capacity) as well as the rental and use of ducts and the maintenance of the lines. The general market price for this charge has been € 5 per line.

In addition to co-investment offers via IRU, the fibre installing operator has to provide a rental offer to cater for operators which have limited investment capability and by this making market entry easier. Rental is billed on a monthly basis per line and includes elements for the rental and exploitation of ducts and a contribution to the costs of constructing the network (depreciation and return on fixed capital). The approach to pricing line rental is however constructed to incentivise investment or co-investment in FTTH.

In order to provide greater clarity on appropriate tariff structures for IRUs before and after installation, ARCEP has developed a reference cost model. The aim of the model is to provide a template for bilateral negotiations on charges for the terminating segment of the fibre loop, ensuring consistency of charges amongst operators and between public and private investors in FTTH. ARCEP's guideline cost model covers three segments of FTTH terminating segments:

- In-building wiring,
- The point-to-point segment between the building and the mutualisation point, and
- Backhaul to the Optical Distribution Frame.

The model is based on a discounted cash flow approach. The investing operator should get a fair and stable return on investment over time. Total investment in each of the network elements should be covered by total revenues including those from wholesale access (co-financing and rental). The building operator can earn an IRR of 10% calculated over a 25 year period. A key pricing aspect is the use of differentiated mark-ups on this base-line WACC which aim to provide assurance of a fair return for the first mover and appropriately reward earlier co-investors for the additional demand risk they take compared to later co-investors. The various elements include:

- A risk premium of 2% included in the 10% IRR (net of inflation) in the ex-ante co-financing charge.
- An option value for waiting for the ex-post co-financing operator of 4,6% over 3 years above the ex-ante risk premium reducing over time with depreciation and a minimum of 0,4 by the end of the investment period.
- A supplementary risk premium for rental of 4% above the co-financing premium. The resulting monthly rental charge for FTTH terminating segments is around € 13 without in-building wiring.
- Because profitability is highly dependent on penetration (assumptions), an ex-post adjustment mechanism is envisaged. If penetration is below expectations the variable charges can be increased to achieve the target IRR. Conversely, if penetration exceeds expectations, variable charges could be reduced.
- A risk premium of 1% is envisaged for the construction of in-building wiring.
- Charges for in-building wiring could be adopted according to practical experience over time concerning churn (baseline assumption for churn: 10%)

Pricing for in-building wiring

Construction of the fibre in-building wiring is typically completed following a customer's subscription to the fibre service. It is therefore considered to present less risk than the terminating segment. Nevertheless, ARCEP assumes a risk mark-up of 1% for this element. The key issue to be solved in pricing is how to apportion the cost of an element which will be shared by different operators over a long period of time. Different approaches have been applied in very dense and less dense areas.

- The standard principle in very dense areas is that the (first) operator acquiring a customer (typically an apartment or office building) has the advantage of benefitting from assured revenues and bears 90% of the cost. The remainder part is covered by co-financing operators.

- In less dense areas the first operator acquiring the customer bears the whole cost. These costs are progressively shared over time as customers switch and the following operator makes a contribution to the installing operator. This contribution cost will decline over time to account for the depreciation of the asset.

Guidelines for public initiative networks

Public initiatives are likely to play a significant role in France's superfast broadband strategy because 43% of the population are located in areas of lows or no commercial viability. Public initiative networks are subject to the same symmetric obligations concerning the terminating segment as private operators. Some of them have voluntarily offered active bitstream access to their fibre networks. So far public initiatives do not contribute much to FTTH coverage in France. Their networks passed 0.9 million homes end of 2015 or 15.7% of total FTTH coverage.

ARCEP's guidelines aim at enabling homogenous retail market products nationwide as well as preserving the viability of public fibre initiatives in the longer term. The focus of the guidelines is therefore to set a lower boundary on applicable charges, and provide limits on discounts for fibre wholesale access. ARCEP plans to align wholesale fibre access charges in public initiative areas with those in commercial areas in three stages, whereby temporary discounts would be allowed in an initial phase to support marketing, while in the final phase charges would be benchmarked against those in commercial areas. The benchmark for the monthly fibre terminating segment charge is proposed at € 13, while the benchmark for (regional) bitstream access is proposed at € 24 (including the in-building wiring segment).

2.3 Market structure and competition

2.3.1 Infrastructure deployment

According to ARCEP's latest broadband observatory 30,2 million access lines of the copper network were viable for xDSL technologies in December 2015.[58] At the same time 14,5 million households had the opportunity of NGA access of at least 30 Mbps and 9,4 million had access to superfast broadband of at least 100 Mbps.

At the level of infrastructure deployment and accessibility 5,6 million households had access to FTTH. This is an increase by 12% compared to the third quarter of 2015 and by 38% on an annual basis. Numericable, France's cable operator, provides broadband access over cable via DOCSIS 2.0 (30 Mbps) and DOCSIS 3.0 (100 Mbps or more). While in total 8,8 million households have access to broadband over cable, 7 million have access to superfast broadband of 100 Mbps or more and 1,8 million have access to 30 Mbps. Altogether 14,5 million households had access to NGA, 10,6 of them via FTTH and cable. Despite the significant fibre roll-out in France, VDSL2 is also of growing importance as an NGA technology. By the end of 2015 5,3 million households could get (at least) 30 Mbps over VDSL2.

While fibre is being deployed progressively in France, the capabilities of the copper access network are still expanded by Orange as well as by altnets. 99,6% of all copper access lines are capable for DSL at 17.426 NRAs (=MDFs). Orange still is expanding the number of NRAs which are capable for DSL. In other NRA areas Orange is restructuring the nodes of the network such that the length of the copper loop decreases. Altnets are still expanding the scope of their network by connecting more NRAs to their network in low density (high cost) areas.

All major operators (except Numericable) are deploying VDSL from local exchanges and from street cabinets, but mainly from the local exchange. Free in particular is making extensive use of VDSL mainly from local exchanges. The company has upgraded more than 8000 local exchanges covering 90% of the population.

2.3.2 Network operators

Since the merger between SFR and Numericable four major operators dominate the French broadband market (see Table 2-1):

(1) The incumbent Orange represents a market share of about 40%. The company is the major investor in FTTH and is in particular dominating FTTH investment in less dense areas. The company served (in terms of homes passed) 5,1 million

58 See ARCEP (2016).

homes with FTTH by the end of 2015 and is planning to extend its coverage to 12 million in 2018 and to 20 million in 2022. This is more than the area which is assumed to be served profitable in France. Orange also heavily invested in FTTC/VDSL in the last years and reached a coverage of 0.5 million lines.

Table 2-1: The major broadband operators in France

Operator	Broadband market share (2014)	NGA Infrastructure	Actual coverage (% of households, 2015)	Target coverage (% of households)
Orange (Incumbent)	40%	FTTH FTTC/VDSL	FTTH: 5,1 mio (=16%) in Q4 2015 VDSL: 0.5 mio	FTTH: 12 mio or 39% (2018) 70% (2022)
SFR Numericable[59]	20% + 5%	FTTH/B, FTTC/VDSL (SFR) Cable and FTTLA/B (Numericable)	FTTx: 23% (2014) DOCSIS 3.0: 27% (2014) (SFR-Numericable)	FTTx: 43% (2017) 54% (2020) DOCSIS 3.0: 30% (2016) (SRF-Numericable)
Free (Iliad)	23%	FTTH FTTC/VDSL	FTTH: 2,5 mio; 8% VDSL in "more than 6000 central offices"	Expansion of FTTH footprint to cover 9 mio or 29% households (in 2018) on its own and through co-investment with Orange 70% in 2022
Bouygues	9%	FTTH/B FTTC/VDSL	FTTH: 1,5 mio; 5%	FTTH: 6,5 mio; 21% (in 2018)

Source: Analysys Mason (2015) and Iliad

(2) The cable operator Numericable served 8,8 million homes passed with its cable network. 7 million of homes can be served with DOCSIS 3.0 and can get broadband service at 100 Mbps and above. Another 1,8 million homes can only receive a broadband service of (at least) 30 Mbps on the basis of DOCSIS 2.0. In 2014 Numericable acquired SFR which was at the time the largest alternative fibre investor. After the merger the company no longer seems to invest in fibre and seems to focus on its cable network. The merged company represents a market share of 25%.

(3) Free holds a market share of 23% in the broadband market, mainly based on unbundling. By the end of 2015 the company had an FTTH coverage of 2,5 million homes. The company intends to achieve 9 million homes by fibre in 2018.

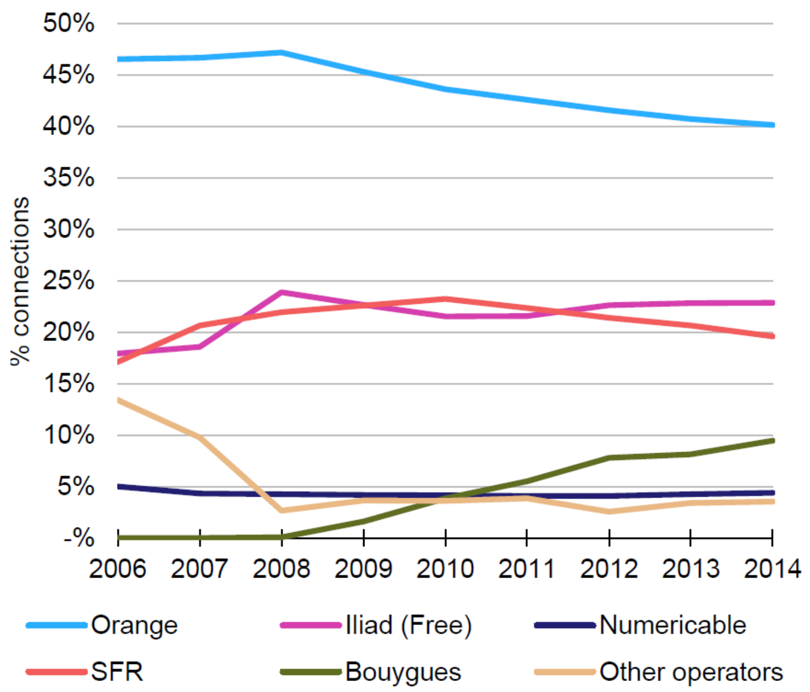
(4) With a market share of 9% Bouygues Telecom is the smallest fixed line operator. Bouygues also invests in fibre and intends to achieve a coverage of 6,5 million in 2018.

59 SFR and Numericable merged under the Altice group in 2014.

Besides the major national fixed line operators many small operators are active in the less dense areas. The same holds for public initiatives. These companies and initiatives together, however, only represent a few percentage points of the broadband market.

Figure 2-5 shows the distribution of market shares and their development over time. Orange's broadband market share is steadily decreasing since 2008 to 40%. SFR and Iliad represent about 20% each with some fluctuations. Bouygues, which entered the fixed line market late in 2008, steadily improved its market position to 10% in the meantime. Less successful (so far) is Numericable with just 5% market share.

Figure 2-5: Market share of total broadband connections



Source: Analysys Mason (2015)

Table 2-2 shows the distribution of broadband customers in Q4 2015.

Table 2-2: Broadband market shares in Q4 2015

	Fixed		> 30 Mb/s	
T42015	**x1000**	**%**	**x1000**	**%**
Orange	10.734	40%	960	30%
SFR	6.172	23%	1.634	51%
Free	6.138	23%	185	6%
Bouygues	2.788	10%	406	13%
Other	1.033	4%		0%
Total	**26.865**			

Source: Operators, estimates by Iliad

Table 2-3: Fibre plans of major operators

	2015	2018	2022	References
Câble	7 700	7 700	7 700	http://www.latribune.fr/technos-medias/pourquoi-les-operateurs-telecoms-mettent-les-bouchees-doubles-dans-la-fibre-556759.html
Orange	3 600	12 000	20 000	http://www.orange.com/fr/Presse-et-medias/communiques-2016/communiques-2015/Essentiels2020-le-nouveau-plan-strategique-d-Orange
Iliad	2 500	9 000	20 000	https://www.iliad.fr/finances/2016/Slideshow_2015_100316.pdf
SFR	2 310	6 610	16 610	http://www.sfr.com/sites/default/files/Finance/Publications-resultats/num-sfr-fy-2015_results-presentation.pdf
Bouygues				

Source: obs-HD-THD-deploiements-T42015.pdf and obs-HD-THD-T42015-OPEN_DATA-030316.xlsx: Arcep broadband and ultra-broadband wholesale observatory ; Iliad

2.3.3 Wholesale market

Unbundling of the copper loop still is the major and by far dominant wholesale product essential for competition in the broadband market today. Altnets have connected 9.526 NRAs from a total of 17.426 NRAs. This number still increased in Q4 2015 by 186 NRAs. Altnets can reach 91,6% of population via unbundling.

By the end of 2015 12,35 million copper loops were effectively unbundled. This represents 40% of all about 31 million copper loops. This is one of the highest copper loop unbundling shares across EU member states. In Germany for instance only 22% of all copper loops have been unbundled in 2015.[60] Different to Germany the number of unbundled lines still is stable or even growing in France. While the number of unbundled lines decreased in Germany by 0,7 million lines, the number still increased in France by 0,1 million lines. Besides the unbundled lines another 1,21 million lines are provided via wholesale bitstream. 52% of all bitstream lines are demanded in NRA areas which are not unbundled.

The mutualisation regime indirectly also generates a wholesale relationship for passive access. 62% of all homes passed by fibre by the end of 2015 had the opportunity to subscribe to two or more fibre networks. From the 1,41 million fibre subscriptions 0,49 million or 35% are based on a mutualisation wholesale arrangement.[61] For 0,04 million lines fibre bitstream is provided as a wholesale product.

On a voluntary basis and under a commercial agreement Numericable supplies bitstream access to its cable network to Bouygues Telecom.

2.3.4 Fibre deployment in France

Fibre deployment started relatively early in France. It is interesting to note that in 2008 prior to the adoption of ARCEP's original decisions concerning the NGA/fibre regulatory regime, the largest three retail broadband operators had already begun FTTH deployments. The early fibre deployments by the alternative operators Iliad and SFR had been facilitated through the availability of access to sewers in the Paris area.

Table 2-4 shows the status of fibre deployment by the end of 2015 according to zones and initiatives.

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60 See BNetzA, Jahresbericht 2015.
61 See ARCEP (2016), p. 8.

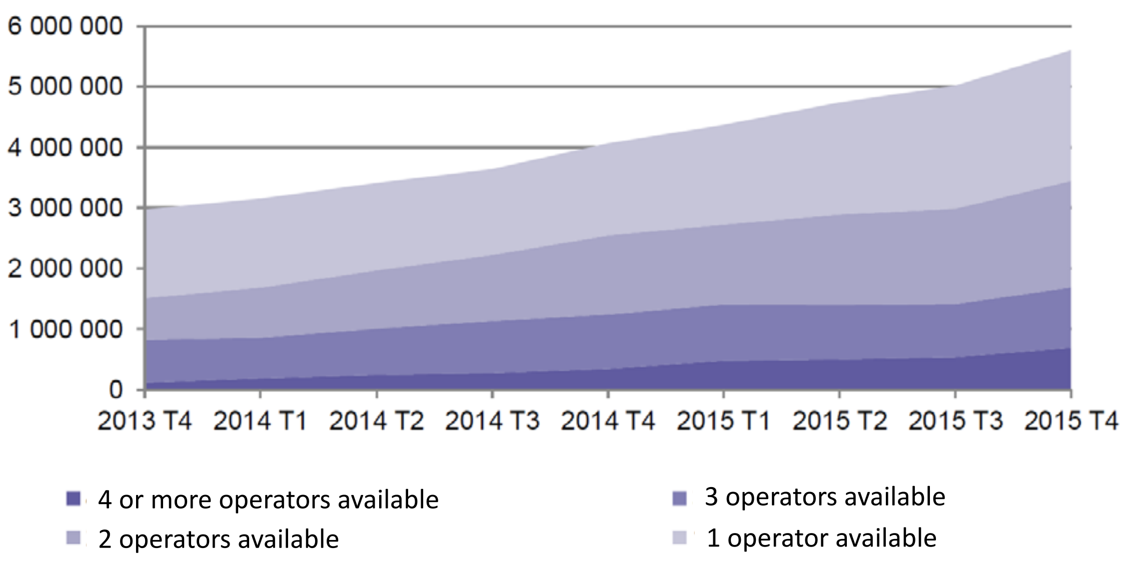
Table 2-4: Status of fibre deployment in France end of 2015

Investor	Very dense area	Less dense area	Total
Private initiative	3.171.00	1.547.000	**4.718.000**
Public initiative	239.000	642.000	**881.000**
Total	**3.410.000**	**2.189.000**	**5.599.000**

Source: ARCEP (2016), p. 7

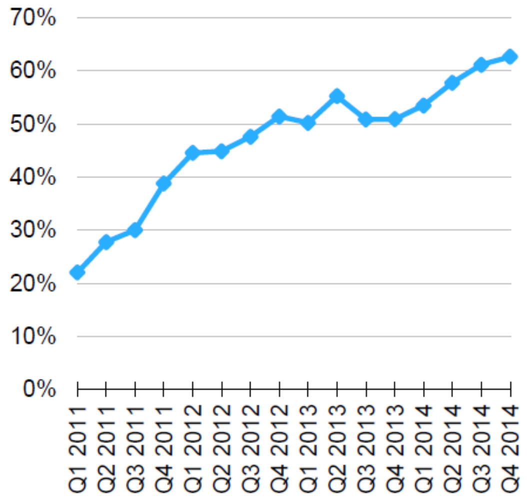
Infrastructure competition and the mutualisation regime have provided a choice to customers in a major part of the fibre deployment area. As shown in Figure 2-6, as of 31 December 2015, 62% of households served with FTTH had a choice of two or more suppliers under the passive access mutualisation regime. Figure 2-7 shows that this share has relatively steadily increased over time indicating that infrastructure competition has expanded over time under the mutualisation regime.

Figure 2-6: Households eligible for FTTH – Number of operators present



Source: ARCEP (2016), p. 8

Figure 2-7: Proportion of FTTH households passed in France that are supported by two or more operators using passive infrastructure access

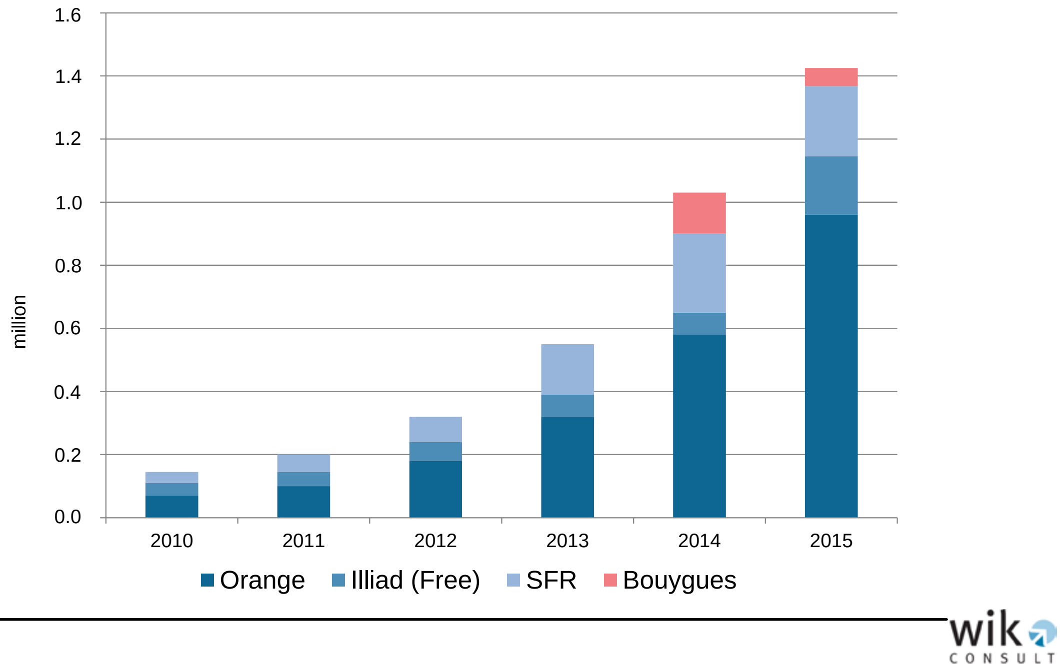


Source: Analysys Mason (2015)

Although precise data is not available, it is presumed that the incumbent operator Orange was the first mover in the majority of cases, with other operators participating as co-investors through committing CAPEX for a proportion of the lines. In the less dense areas it is realistic to assume that Orange is the first mover in the vast majority of the projects.

Figure 2-8 shows that Orange is dominating the market for fibre connections with a market share of about 55% in 2014, followed by SFR with about 30% and Iliad and Bouygues both with less than 10% market share.

Figure 2-8: FTTH connections by operator in France



Source: Analysys Mason (2015), operators, ARCEPl

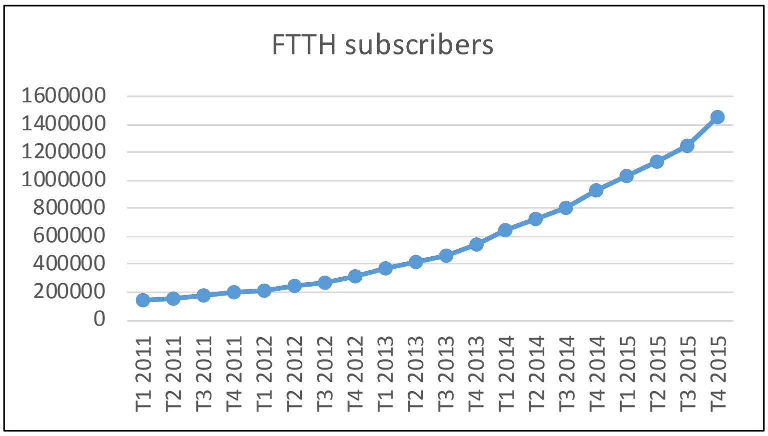
The majority of FTTH coverage today (60%) is in very dense areas, although the proportion of coverage in less dense areas is increasing from 20% at the end of 2013 to about 40% at the end of 2015.

Table 2-3 shows that Orange plans to achieve 20 million homes passed by fibre with its network in 2022 which represents 65% of all households in France. Iliad has announced to invest in fibre to achieve the same coverage by 2022. SFR still in 2015 announced to follow close with its own fibre investment and to achieve 16,6 million homes passed by 2022. This is, however, not coherent with its actual investment behaviour. The merged company seems to focus more on cable than on expanding its fibre footprint.

2.4 Fibre take-up

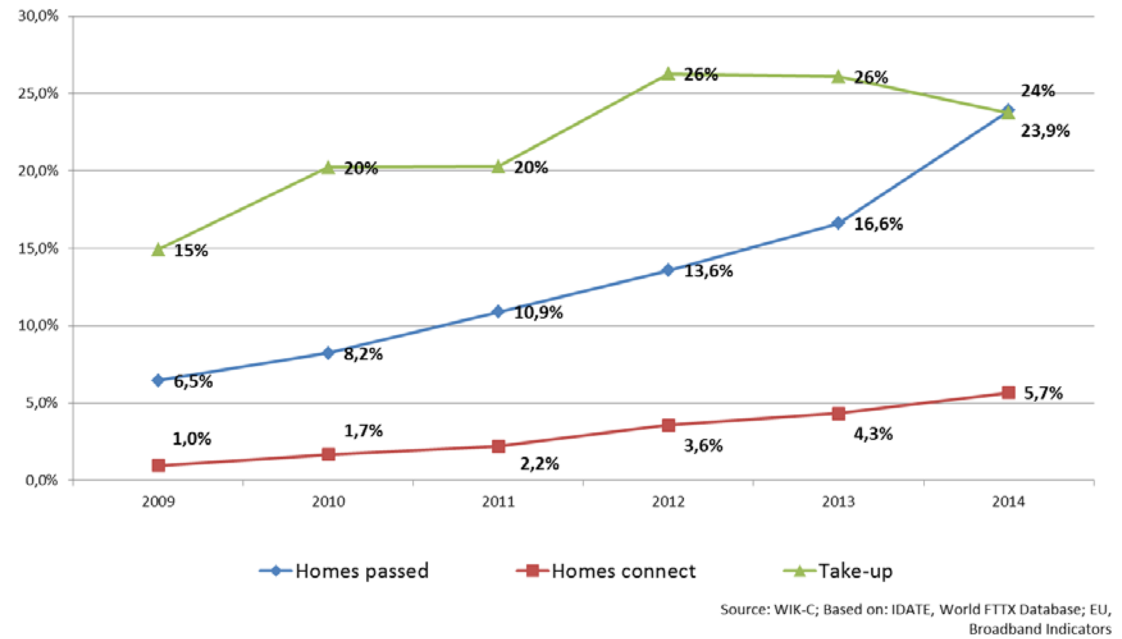
The demand for fibre connections is growing steadily in France. In the last few years the number of fibre connections increased significantly both in absolute terms (see Figure 2-9) and in terms of take-up of homes passed (see Figure 2-11). End of 2015 1,41 million customers use a fibre connection. That is a take-up rate of 25% compared to the 5,6 million homes passed by fibre. As the take-up rate grew from 15% in 2012 to 25% in 2015 demand developed faster than supply. This level of take-up is in the range of the European average (see Figure 2-10). Nevertheless, a take-up rate of 25% is low compared to the leading countries in Europe. Several countries show take-up rates of above 40% at high levels of fibre coverage. The highest take-up rate can be observed in Finland with 62% (see Figure 2-12) at a 25% level of coverage. In Sweden the take-up is 41% at a fibre coverage level of 70%. Figure 2-11 shows FTTH coverage, take-up and penetration in the same structure as Figure 2-10 shows for all Member States.

Figure 2-9: Fibre subscribers in France



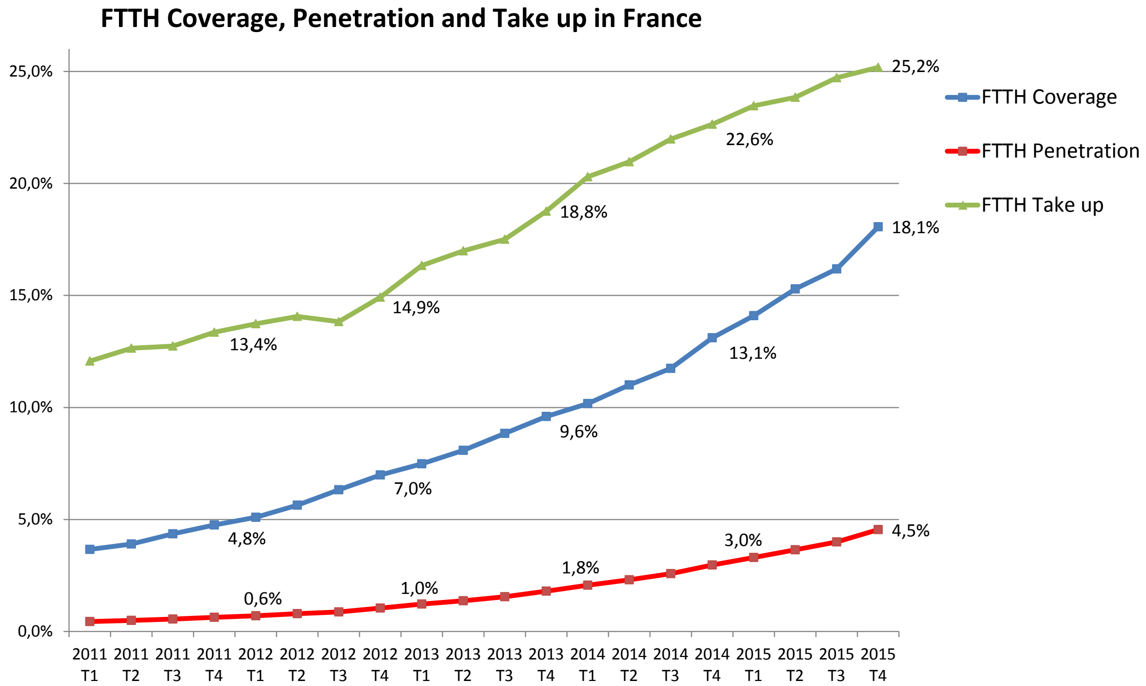
Source: ARCEP

Figure 2-10: Development of supply and demand for FTTB/H in the EU (2009-2014, HH)



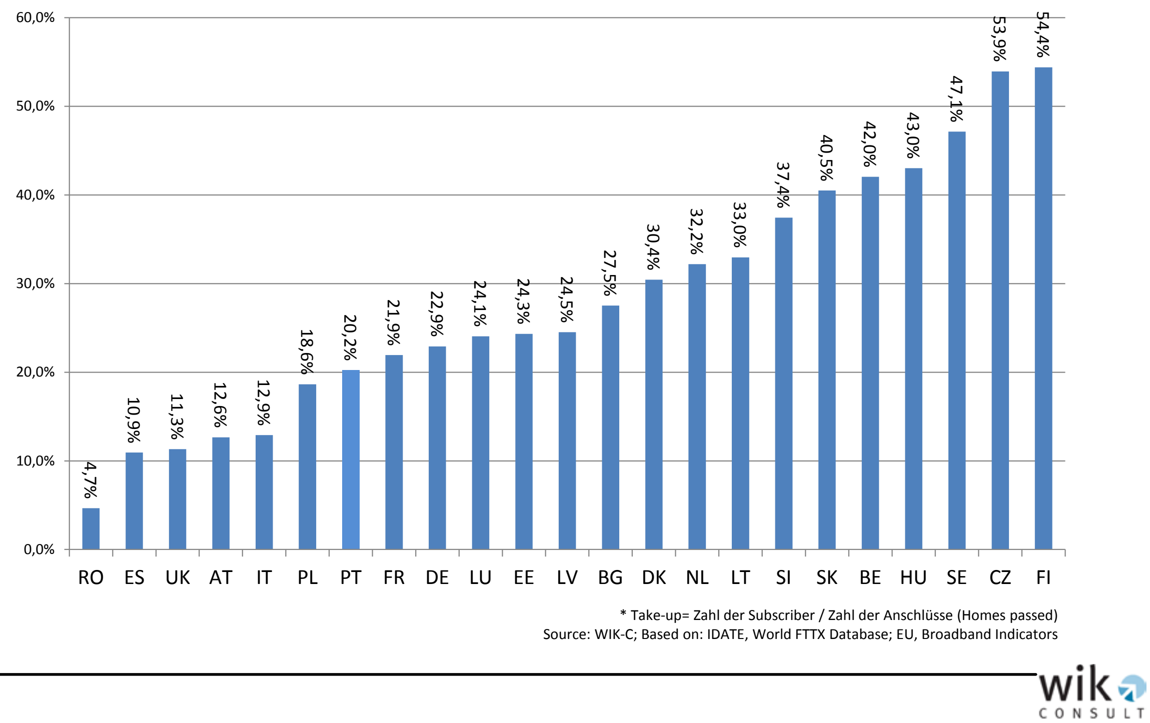
Source: WIK-C; Based on: IDATE, World FTTX Database; EU, Broadband Indicators

Figure 2-11: FTTH coverage, penetration and take-up in France (2011-2015)



Source: WIK-C calculations based on ARCEP data

Figure 2-12: FTTB/H take-up in the EU in 2014



Source: WIK-C; Based on: IDATE, World FTTX Database; EU, Broadband Indicators

The number of fibre connections represents a fibre penetration rate of 4,5% for fibre in France. This is below the level in the EU which is around 6% (see Figure 2-10). The leading countries like Denmark (21,6%), Sweden (28,3%), Latvia (34,8%) and Lithuania (36,5%) had already fibre penetration rates above 20% in 2014.

2.5 Fibre and the future of the copper loop in France

What will be the future of the copper loop in France in the foreseeable future, given the long-term targets of the French broadband strategy, the current status of fibre deployment and the further roll-out plans of operators?

- Will we have a nationwide FTTH fibre network by 2022 as the Government seems to intend and work for? Or will we still have a significant part of the population which can still only get access to superfast or fast broadband over the copper network infrastructure?

- Can we expect that the infrastructure competition model works in a way that the vast majority of users will have the choice between two or even more fibre operators?

- Will demand for superfast broadband and fibre connections accelerate and will users more and more migrate to fibre, further increasing the take-up rate?
- Will Numericable become more competitive and persuade more customers to use its network?
- Will a certain set of MDFs already be closed by 2022 and the copper network be switched-off in those areas?
- Will the copper cable network be dismantled when there are at least two alternative fibre access offers in France?
- Today about 90% of customers receive their communications service on the basis of copper access. What will that share be in 2022?

All the factors inherent in these questions above have an impact on the (remaining) demand for copper loops, the level of copper access in 2022, and the further speed of decline of copper loops in France. We are not aware of any detailed forecast of the number of copper loops over the next years. Thus, the development of viable numbers is like a view into the crystal ball. Nevertheless, it is possible to describe meaningful scenarios on the various factors and to derive a consistent picture on the future demand of copper loops on that basis.

On the basis of public operator announcements and statements the current level of fibre network coverage of 18% of all households may be expanded to 65% by 2022. Both Orange and Iliad have announced to expand their network to 20 million homes passed by then. Overall network coverage might be a bit higher because Orange's and Iliad's networks might not completely overlap. The greatest uncertainties on FTTH coverage are related to the "last" third of the country where fibre deployment is not profitable. Fibre deployment in those areas mainly depends on public initiatives and/or partnerships between public authorities and private operators. The Mission THD forecasts the potential range of FTTH homes passed by PINs in a range from 3,25 million to 8 million by 2022. If we take the midpoint of this estimate, another 5 million homed passed could theoretically be added to the national FTTH coverage. It has, however, to be noted, that the three major fixed line operators, in particular Orange, are co-investing with public authorities for fibre deployment. Therefore, there is an overlap between the PIN FTTH coverage and the operators' FTTH coverage. We assume a 50% overlap. If operators stick with their plans, 22,5 million households could be passed by FTTH in 2022. This would be a rather high number compared to the (likely) extent of fibre deployment in countries like Italy, Germany and the UK by then; those countries are expected to achieve a much lower level of fibre coverage by this time. The remaining 6 million or 20% of all households will only have access to superfast broadband on the basis of the copper network.

The success of the regulatory model for fibre depends on the investment of altnets in fibre. Only if altnets have a similar speed of fibre deployment, Orange is under pressure to keep the headstart advantage it currently has in fibre coverage compared to its competitors. Then the typical incentive mechanism will work, as we can observe in Italy, Germany and the UK where the level of ULL charges and limited competitive pressure at the infrastructure level does not generate relevant incentives to invest in fibre. There is less or no incentive for Orange to expand its own fibre footprint according to the announcements so far. There is another impact following from the co-investment model. Co-investment relatively decreases investment costs for each operator involved. If competitors do not follow, then fibre deployment becomes more expensive for the incumbent. Infrastructure competition also has an impact on the take-up rate of fibre. It is realistic to assume that the take-up rate depends on the number of competitors in the market which offer fibre-based services. If only the incumbent offers fibre-based services, the take-up rate is expected to be much lower than in a market environment where competing offers are available. In short, if the infrastructure competition model does not work properly, demand for copper access lines remains higher. Currently, the incumbent has a headstart in its fibre network footprint. Competitors have to accelerate their current investment path if competing fibre infrastructures are available in the whole fibre coverage areas. Thus, success of the French infrastructure competition model critically depends on the investment capabilities of altnets and their actual investment behaviour.

We have shown that fibre take-up in France is in line with the European average. Demand for fibre connections grew faster than the availability of fibre networks over the last few years. It is realistic to assume that the fibre take-up rate will further increase over the next years. It is also realistic to assume – as the experience in other countries shows – that the dynamic of the take-up increase slows down the more fibre is available. Even countries where fibre deployment started 5 to 10 years earlier than in France, still have take-up rates of less than 50%. In Sweden, for instance, the fibre take-up amounts to 47.1% in 2014.[62] Only in Czech Republic and in Finland take-up rates are above 50%. Therefore, only under rather optimistic assumptions a take-up rate of 50% (or even more) can be achieved by 2022 in France which would already be a doubling of the current rate.

About 5% of users currently subscribe to cable broadband today. Compared to the footprint of cable this represents a market share of about 15% in terms of the market addressable by cable. There are no indications that the footprint of cable will increase in the near future. Even if cable improves its competitiveness, it might be possible that its overall market share increases slightly. I will, however, realistically only achieve a level below 10% in 2022.

62 EU, Broadband Indicators; WIK-Consult, based on IDATE.

The final step of migration from copper to fibre is the switch-off of the copper access network and the de-commissioning of MDFs and street cabinets. Copper switch-off has already been subject to a policy debate in France. In late 2012, Orange set up a pilot trial for the switch-off of its copper infrastructure by 2014 in the municipality of Palaiseau in the Hauts-de-Seine area. The trial was encouraged by the French Government and ARCEP. Orange cooperated with the municipality to inform inhabitants and businesses about the project by organising information meetings and supplying information through municipal publications.

The trial has delivered several encouraging outcomes. For instance, the plan was well accepted by the users concerned and Orange had already migrated more than 90% of its residential retail subscriber base to fibre in early 2015. Furthermore, the switch from ADSL to fibre led to a significant increase not only in down- and up-stream traffic but also in the take-up of services such as pay-TV and catch-up TV.

However, the project has also faced a number of obstacles. For instance, the negotiations with alternative operators about closing down MDFs where the latter have installed their equipment ahead of schedule were unsuccessful and Orange is obliged to maintain these until 2018.

From the formal regulatory conditions, Orange is required not to de-commission its MDFs and street cabinets until a shared fibre network has been deployed in the respective area and allows the provision of services to all end-users which could be served through the copper network.[63] Unless an agreement is concluded between Orange and the access seekers on an appropriate migration plan and path, closure of MDFs or street cabinets will be subject to a prior notification five years in advance. This means that a prerequisite of a copper switch-off is that there not only has to be an Orange fibre network available, there has to be at least a second shared fibre infrastructure available too.

It is also not yet clear in the trial when and how the remaining users of legacy services will be migrated to fibre. While the vast majority of users has migrated to fibre already, a low number of subscribers has preferred preserving a traditional access line. Another question that has not been solved is how to handle certain legacy non-voice services, for which no substitute exists on an NGA network. Amongst others, this concerns a number of applications in the energy sector, tele-surveillance and tele-alarm systems, remote control of domestic appliances or elevator emergency lines[64]. The fact that these issues have not been tackled for the moment is partly related to the limited scale of the project. Businesses have shown only limited interest in getting involved in the

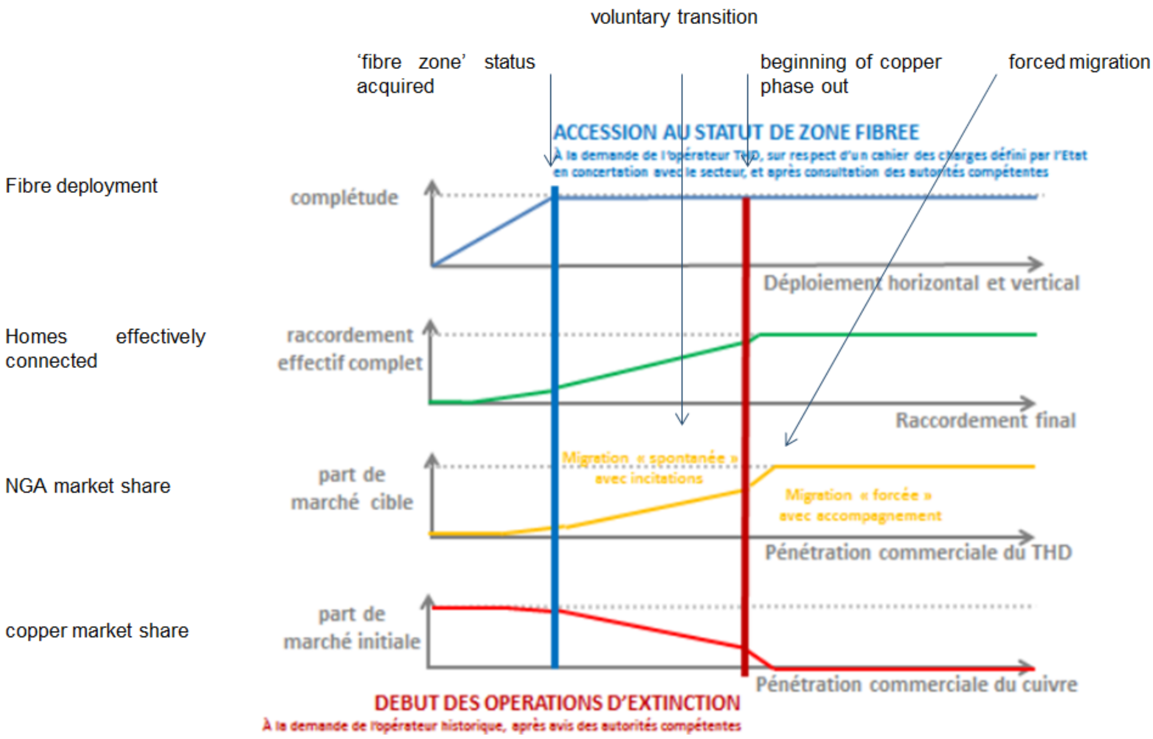
63 Commission Decision concerning Case FR/2014/1602 and FR 2014/1603, C(2014) 4048 final, 12.06.2014.

64 For further detail please refer to the Cogisys report commissioned by ARCEP; available at http://www.arcep.fr/uploads/tx_gspublication/etude-COGISYS-ARCEP-synthese-nov2014.pdf.

process and have been reluctant to invest in developing new solutions, as long as the issue is limited to a small geographic area.

To further investigate the question of how to implement the transition from copper to fibre, the French government requested former ARCEP president Paul Champsaur to conduct a study, which was published in February 2015[65].

Figure 2-13: Transition to fibre networks and copper switch-off (recommendation from the 'Champsaur' report)



Source: Mission on the transition to ultrafast broadband and switch-off of the copper network (2014)

The Champsaur report advocates a gradual transition rather than a hard deadline for the switch-off of copper infrastructure, due to the perceived financial and technical challenges associated with a switch-off obligation, including the potential need for compensation. It also suggests that the switch-off of the copper network should be organised by geographic areas, whereby the process begins after a given area has been defined as 'fibre area'. According to the report for being recognised as a fibre area, the network should

- meet the requirements of completeness as defined by French regulation,

65 Available at http://www.economie.gouv.fr/files/files/PDF/rapport-final-paul-champsaur_2014.pdf .

- commit to quality of service, notably universal service obligations over fibre,
- provide wholesale access on non-discriminatory terms,
- respect requirements in terms of engineering and information systems to ensure inter-operability.

Lastly, the Champsaur report advocates mechanisms to incentivise operators and users to migrate to fibre within fibre zones, noting that increasing wholesale prices for copper could make the infrastructure less attractive to alternative operators and users relative to fibre in circumstances where both infrastructure operate in parallel.

The law for the growth, activity and equal economic opportunities, also called “Macron law”, promulgated in mid-2015 takes up these proposals. Among three measures to accelerate the “Plan France Très Haut Débit” contained in the text is the creation of a “fibre area” status. The attribution of this status to an area is set to trigger measures to facilitate transition from copper to FTTH. This status can be obtained as soon as the establishment and operation of an FTTH network open to all ISPs is sufficiently advanced, at the request of the network operator or the local authority. This status is assigned by the Minister responsible for electronic communications, after consulting ARCEP.

All these factors together indicate that it is realistic to assume that still more than 50% of customers will receive their broadband service on the basis of the copper access network by 2022. We have tried to describe the fibre (and copper) development path by defining three scenarios for 2022:

(1) A scenario of dynamic migration,

(2) A scenario of slow migration,

(3) A realistic scenario.

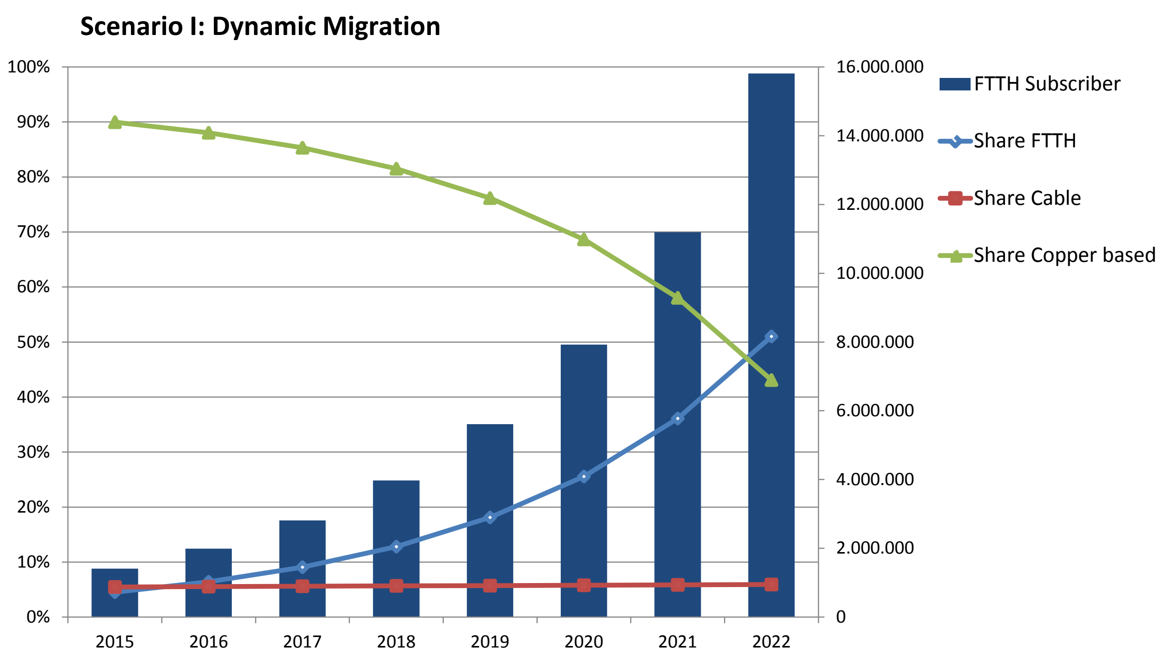
In the dynamic scenario we assume a rather high level of FTTH coverage which amounts to 85% of households. We also assume viable infrastructure competition for fibre and a further limited competitive position of cable. Furthermore, in this scenario demand for fibre connections accelerates to a high level take-up rate of 60% in 2022.

In the slow migration scenario fibre coverage does not exceed 65% in 2022. Competitors deploy their network slower. Because there is less competition, fibre demand, take-up and migration suffers. We assume a take-up rate of 40% in this scenario.

The outcomes of both, the dynamic and the slow migration scenarios are possible. At the same time the outcome of most of the driving parameters are unrealistic. Therefore, in the realistic scenario we assume a fibre network coverage of 75%, workable infrastructure competition and a take-up rate of 50% which would be in line with European peers.

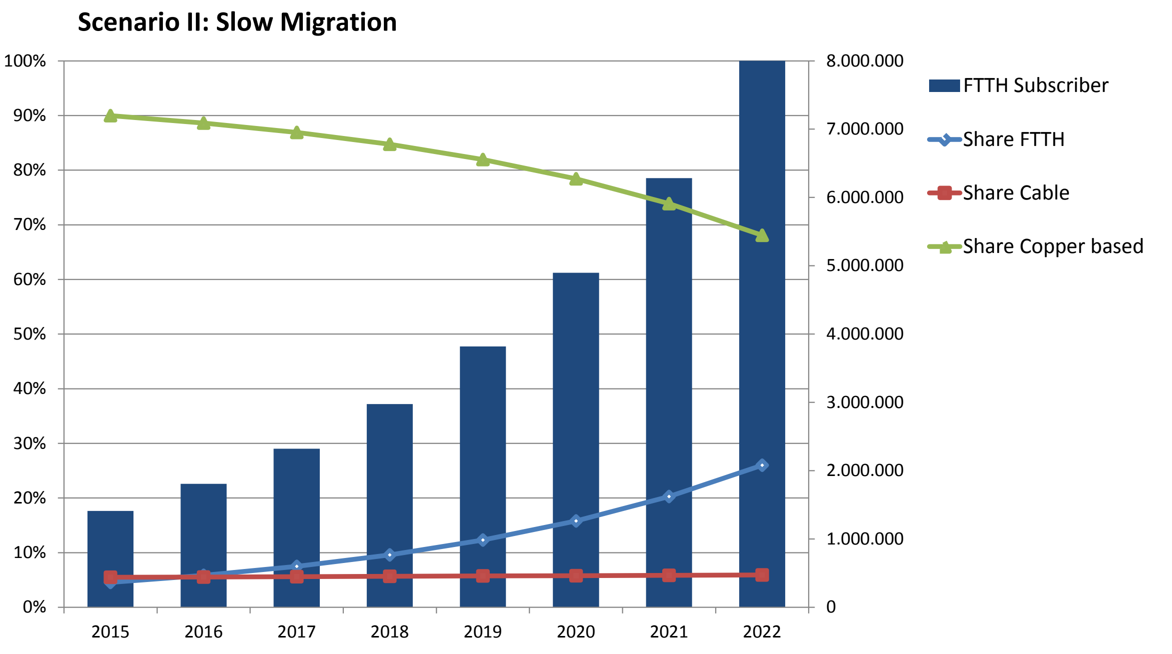
Figure 2-14 to Figure 2-16 show the relative shares of the three access technologies copper, cable and fibre and the number of FTTH subscribers in each scenario. Figure 2-17 shows in comprehensive form the resulting share of fibre access lines. In each scenario the starting point is defined as a 90% infrastructure market share of copper-based access. This share gradually declines in each scenario. Only in the dynamic migration scenario the copper market is lower than 50% (43.1%) in the last year (2022). In each other scenario and in each year more than 50% of customers will be served over copper access. In the realistic scenario the copper market share still amounts to 55% in 2022.

Figure 2-14: Scenario I: Dynamic migration



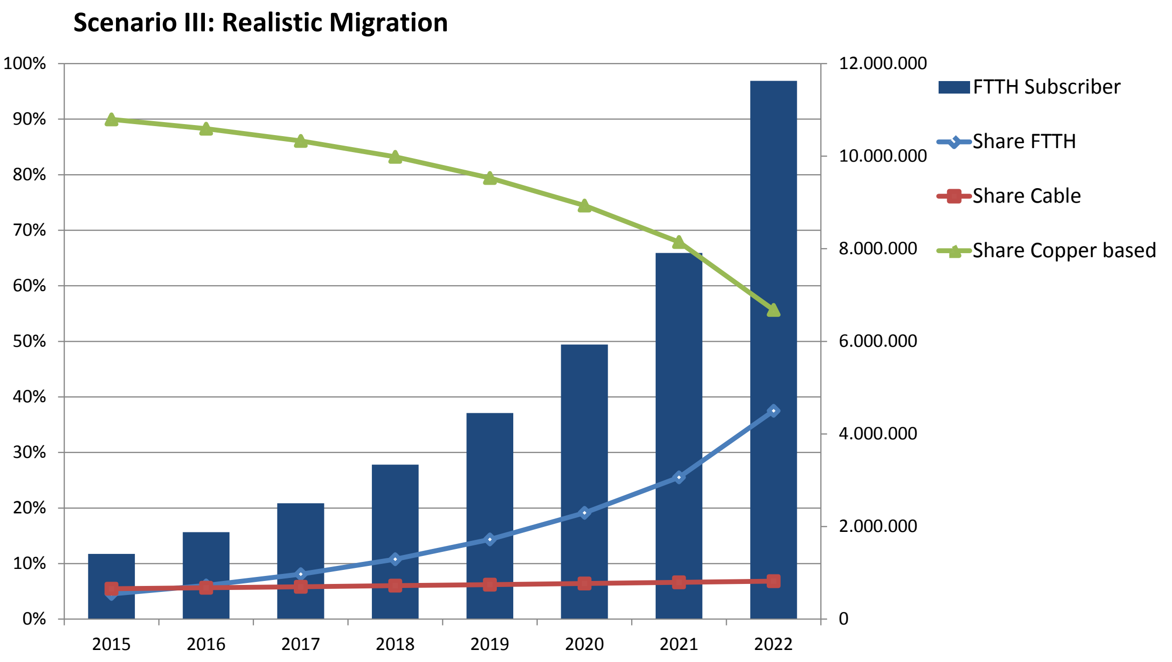
Source: WIK-C calculations

Figure 2-15: Scenario II: Slow migration



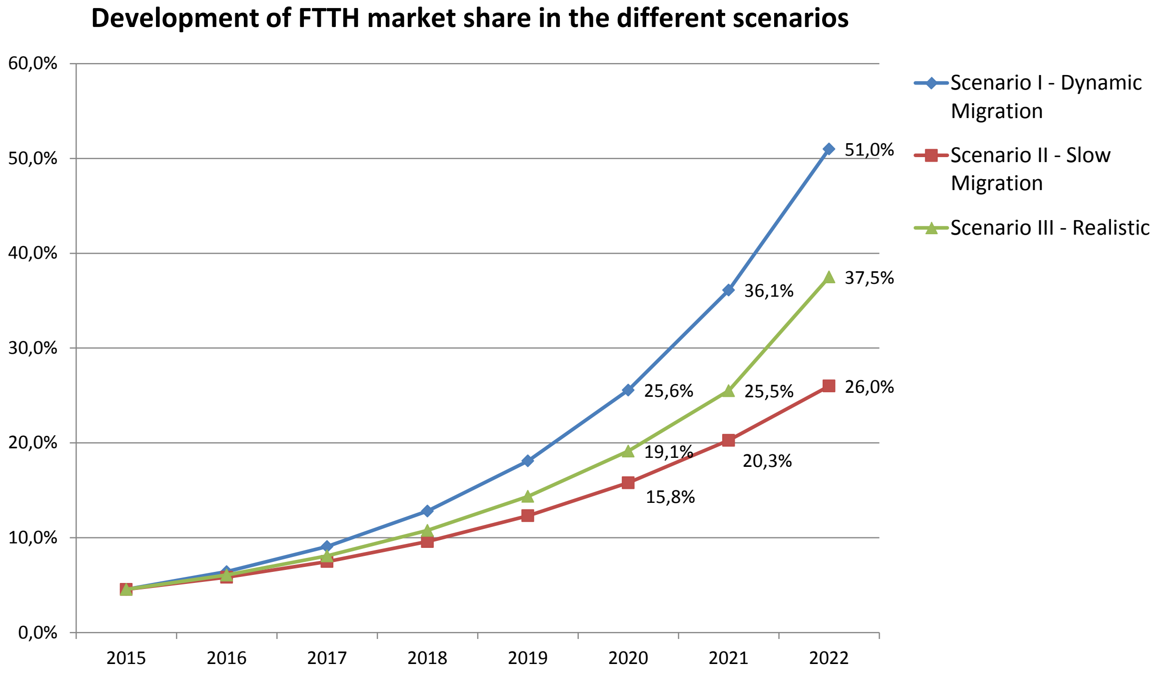
Source: WIK-C calculations

Figure 2-16: Scenario III: Realistic migration



Source: WIK-C calculations

Figure 2-17: Development of FTTH market share in the different scenarios



Source: WIK-C calculations

We do not intend to question the ambitious targets of the French broadband policy and strategy. We only want to stress here that over the next few years at least up and until 2022 most users will still receive their broadband access service by using the copper network. In that period altnets will use more copper than fibre loops to provide their services. Therefore pricing of the copper loop will have a major impact on their financing capabilities to invest in fibre furthermore. In addition, copper access will remain the anchor price which will have a crucial impact on the level of retail broadband pricing.

3 Pitfalls of applying traditional LRIC to copper-based access in a context of decreasing demand and migration from copper to fibre[66]

It has been a long tradition in regulatory economics to derive the Long-Run Incremental Cost (LRIC) pricing principle as the one which best fits with established principles and objectives of regulation, e.g. allocative efficiency and proper incentives to invest for dynamic efficiency. Furthermore, the relevant cost represents production efficiency at the technological frontier. Forward looking costs are the on-going costs of providing the relevant service in the future using the most efficient means possible and commercially available. This means in practice to base costs on the best in use technology and production methods and valueing inputs at current prices. Calculating forward looking costs also involves the cost providing the relevant services using modern equivalent assets. The LRIC costing and pricing methodology is assumed to provide efficient production, set the proper incentives to invest in new technology, enable the incumbent to compete against a new entrant who would set-up a new Greenfield network with the most efficient technology and set the proper incentives for the make-or-buy decision regarding the entrant's own network. Many (not all) European regulators apply the LRIC pricing principle based on current cost to calculate the wholesale price for the Unbundled Local Loop (ULL). Given the implied theoretical prerequisites of applying LRIC we will show in this study that none of the prerequisites for applying LRIC for a copper-based ULL holds anymore given the migration to NGA, to FTTH networks and generally to deploying fibre deeper into the network and closer to the end-user. There are indications that a further and simple orientation of ULL wholesale prices on current costs may even cause inefficiencies. The efficient pricing of the copper ULL needs a new platform and new answers in the process of migrating the access network to a new technology.

3.1 The theoretical basis of LRIC pricing

The provision that the wholesale bottleneck services are to be offered at a cost-oriented basis has been implemented under the so-called LRIC (Long-Run Average Incremental Costs)[67] standard within many European Member States.[68] It is the mostly used regulatory cost standard on a worldwide basis. LRIC as a long-run measure aims at the costs of efficient production of units where those variable and fixed costs are included which are essential for a group of services.[69] Consequently, outdated technologies and inefficiently incurred costs like redundant manpower are not reflected as relevant costs.

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66 This part of the study also relies on Hoernig et. al. (2011) and Neumann / Vogelsang (2016).
67 The abbreviation LRAIC would be correct but we use the more familiar LRIC here.
68 See Cullen International (2007); the methodologies mandated by European regulators differ somewhat with respect to cost bases and cost standards.
69 See IRG (2000).

„Long-Run" means that the time span of new investments is included in the cost consideration. It also means that all inputs are generally considered as variable. The long-run nature of costs is justified by the infrequency of regulatory price changes and, at least implicitly, by the difficulty regulators face in determining correct short-run costs, both in cases when these are to reflect short-run bottlenecks (risk of exploitation) or temporary low demand (risk of margin squeeze).

„Incremental" means that the additional cost of a multi-product firm are relevant. To include all relevant cost-volume relationships practical applications of LRIC usually rely on the total service concept which defines broad increments. That way „fixed" cost of the network are allocated to services. Only overhead costs remain to be allocated as unattributable costs.

In the forward-looking approach only the actual (forecasted) costs of operation are considered, hence the equipment is assessed at the replacement value and over-capacities are usually not taken into account.[70] The costs also include a reasonable profit depending on the risk of the investment. In order to calculate the average incremental costs per minute (or per loop or data volume), the sum of the costs considered are divided by the (actual or forecasted) traffic minutes or loops. Service-specific fixed costs are considered by that approach. De facto the LRIC approach makes all cost variable. This is justified because all costs are avoidable under a long-term perspective. From an economic perspective, LRIC results in wholesale access charges above short-run marginal cost (which are near zero for variations occurring between services within capacity constraints), since adequate fixed and common costs of production are also included. Overhead costs at the enterprise level are not considered as part of the LRIC of a particular service but a mark-up for them is usually added on the grounds that operators also need to recover overheads in order to continue staying in business.

The traditional approach of LRIC worked well for a while. Real options and (temporary) overcapacities due to the lumpiness of investment have been challenges. Regulatory authorities managed these challenges pragmatically. This was easy insofar as it became obvious that the calculated LRIC exceeded the actual cost of incumbents for ULL in any case. New challenges emerged through fixed/mobile substitution and NGA; both developments challenged the important assumption of a growing relevant market for copper-based services. The incumbents no longer had to invest steadily to meet the relevant demand. The missing need to invest violated the implicit zero profit constraint of LRIC. Instead, major windfall profits occurred. Profits exceeded those generated by the WACC to cover capital cost by far.

Furthermore, LRIC had to deal with technological progress and innovation in the form of NGA. The traditional LRIC approach is rather flexible and responsive to new

70 See Evans/Guthrie (2005) for the inclusion of optimally planned excess capacity under the heading of "optimized deprival value". Mandy/Sharkey (2003) calculate the effect of lumpiness on LRIC.

technologies because – if conceptually appropriately applied – it always reflects the newest relevant technology. This is expressed by the modern equivalent asset (MEA) approach. The newest technology represents the MEA for the old technology. Nevertheless, the implementation of MEA can cause problems which may be better solved by (small) deviations from the traditional LRIC approach. We will discuss such aspects of LRIC in growing or non-decreasing markets in more detail later on.

It is important to note that LRIC when calculated on the basis of regulatory bottom-up cost models are independent of the actual costs of the regulated firm. Insofar the resulting regulated prices generate the strongest incentive to reduce (actual) costs on the side of the regulated firm. These incentives are stronger than in the case of a price cap regulation which usually is adopted to actual costs within a few years. Forward looking long-run in particular means that the timing of new investment is in the relevant time frame of consideration. This long-run standard has its basis and justification in that the regulated prices should provide the proper market entry signals for competitors for downstream as well as for make-or-buy investment decisions. In a competitive market the incumbent operators also have to fear market entry from new competitors. Therefore, they also have a strong incentive to base their pricing and investment decisions on the standard. The fact that actual markets often do not represent the standard of a competitive market, does not mean that the LRIC standard should not prevail from a normative point of view. It is a major task to regulation to mimic the conditions of a competitive market. Users indirectly benefit from the application of the competitive market standard to wholesale pricing. While retail price regulation directly prohibits exploitation of end-users, bottleneck regulation benefits end-users indirectly through its positive impact on competition.

In assessing LRIC and potential alternatives we use the following criteria. First and second, the use of LRIC for wholesale pricing should lead to competition and lead to efficient market entry. Third and closely related is static efficiency with particular emphasis on low/affordable end-user charges and adequate quality of service. Fourth, wholesale pricing should provide efficient investment incentives for incumbents and entrants. This aspect includes reliability for investment planning. Dynamic efficiency is also largely included in the investment objective. Fifth, the concept has to be implementable in practice at reasonably low transaction costs. This criterion we will not address separately but rather where appropriate.

It is well-known that, in a perfectly competitive market, prices equal short-run marginal costs and, in the long-run, equal long-run average costs and long-run marginal costs. These conditions are not always feasible in markets with extensive economies of scale and scope. Nevertheless, achieving the next best to the perfectly competitive standard would be desirable. Markets characterized by scale and scope economies would yield long-run competitive prices between long-run incremental costs and long-run stand-alone costs (SAC).[71] LRIC always fulfil this condition and in growing markets are therefore always compatible with this competitive standard. LRIC will therefore allow as many entrants in the market as are warranted by economies of scale downstream in retail markets.

At the same time competitive pricing usually requires the flexibility to adapt prices to changing cost and demand conditions. Competitive market prices follow short-run (marginal) costs, particularly in capital-intensive industries. Prices at LRIC will not usually reflect such short-run considerations. The long-term averaging implied by regulated wholesale charges lacks this flexibility.[72] This will lead to some allocative distortions by missing out on market opportunities (e.g., for higher capacity utilization in times of temporarily low demand). It will then lead to inter-modal distortions in competition. It may be no consolation for a competitor (or the incumbent) that LRIC wholesale charges are correct on average if the current market conditions would warrant much lower (or higher) prices. This, however, is a problem of regulated prices that is thought to be more than compensated by the avoidance of strategic price setting through regulation. We will address these issues in the following section. As we will see, such fluctuating market conditions are major reasons why wholesale charges at LRIC can be associated with margin squeeze, because incumbents would like to sell at low prices in weak markets. It can in principle be addressed through certain types of price caps.[73]

A particularly relevant aspect of wholesale access pricing is competitive neutrality between alternative technologies for the same or related (competing) services. If both services are expanding, competitive neutrality is usually achievable if both technologies have comparable bottlenecks that are provided at LRIC prices. If one service has such bottlenecks while the other does not competitive neutrality may not be assured, due to the superior flexibility of the service without bottlenecks to respond to market opportunities. This inflexibility of LRIC therefore becomes more problematic under a certain degree of inter-modal competition if the other mode (e.g., CATV) is not subject to the same kind of wholesale regulation. Since neither regulating the other mode nor deregulating the bottleneck is an option, some flexibility in setting access charges might thus appear appropriate after all even when applying the LRIC cost standard.

Overall, purchasing access at LRIC, the other competitors should be able to compete in the downstream markets, especially after any margin squeezes have been eliminated by regulatory intervention.

Since market entry requires a long-run perspective and since entrants have to expect to cover their costs, LRIC will provide the lowest price, under which an entrant would

71 Stand-alone costs are the costs incurred by a firm producing only the single service in question (therefore not benefiting from economies of scope/synergies if any).

72 A similar tension regarding averaging also holds for geographic cost averaging.

73 See, for example, those suggested by Hogan, Rosellon and Vogelsang (2010) for electricity transmission.

enter an expanding market. The corresponding upper limit under competition would be SAC, under which entry would be possible for single-product firms only offering the bottleneck. SAC include all common costs that would be incurred by a multi-product firm. LRIC, as calculated in practice, include some common costs and therefore lie in between theoretically ('pure') LRIC and SAC. In expanding or at least not declining markets, wholesale charges at LRIC levels therefore give entrants competitive opportunities that resemble those of the incumbent. This will lead to efficient entry and efficient competition for end-users. As a result, investments downstream of the bottleneck will also be correctly incentivized for both incumbents and entrants.

The efficiency condition that wholesale access charges induce enough competition downstream cannot always be fulfilled because there may exist downstream economies of scale that severely limit the number of entrants. This can hold, for example, in rural markets. In this case, it is not only the wholesale access charge that matters but also the scope of the access product, which may have to be adjusted to assure enough downstream competition (like ULL vs. bitstream).

LRIC are reasonable average prices, but usually overestimate short-run marginal costs relevant for static efficiency. However, provided LRIC wholesale prices are able to induce sufficient competition by wholesale access seekers and other entrants (such as Cable TV) end-users will enjoy low prices and desirable qualities. In that case the level of wholesale charges will assure that the incumbent is charging adequately at the wholesale level and competition will assure that downstream mark-ups are competitive. Ideally in this case consumer surplus will be close to the maximum without the incumbent or entrants incurring losses. It only comes close to the maximum because LRIC access charges typically use mark-ups for fixed and common costs that are not differentiated by demand elasticities for the services. This is in contrast to Ramsey access prices which would allow for mark-ups reflecting such demand elasticities. Ramsey prices are, however, hardly used by regulators for a number of difficulties and will therefore not be considered here any further.[74]

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74 The idea of Ramsey access pricing is to allow the regulated firm to recover fixed and common costs in such a way that overall welfare is maximized. In doing this, regulators would have to determine simultaneously optimal mark-ups for access and retail prices. In their construction, Ramsey prices refer to both cost and demand characteristics by which informational requirements become very high; regulators not only have to be informed about cost conditions but they are also supposed to estimate interrelated demand (super-) elasticities. Since regulators generally fail to calculate Ramsey prices directly, price-cap mechanisms – which delegate the pricing decision to the typically much better informed firm – have been initially developed to solve the Ramsey pricing problem. However, if price caps are targeted only towards specific wholesale access products, the regulated firm loses the flexibility to rebalance all its prices according to the required Ramsey mark-ups. This is, in part, why Laffont and Tirole (1996) suggest that a single ("global") price-cap should be applied to both wholesale and retail products, arguing that an incumbent maximizes profits with respect to all products. Global price caps would induce Ramsey prices if weights attached in the basket construction (ex ante) were exactly proportional to realized quantities of the services involved. Here realized quantities refer to the ex post profit-maximizing prices under the price-cap constraint. But deriving optimal weights of the global price-cap basket would become tantamount to solving the Ramsey problem. Furthermore, global price caps would combine markets with highly different competition intensities (e.g. access and calls markets) which might give rise to anticompetitive

3.2 Implications for investment

3.2.1 General aspects

Academic and policy debate on LRIC has shifted from allocation efficiency and costing efficiency to investment incentives as a regulatory goal over the last ten years. Some commentators even argued that LRIC would lead to too low investment incentives for incumbents. This is surprising insofar as LRIC covers all relevant cost including investment cost. Specific and additional investment incentives are discussed by means of higher profits and the predictability and commitment of regulation towards long-term investment planning.

Companies invest, when they realistically can expect higher profits compared to the scenario where they do not invest. The assessment of investment projects also depends on whether the investment has a negative impact on existing revenue streams. Investment in new technology for instance can devalue existing sunk assets. Therefore, the comparison of profit streams with and without the planned investment has to deduct the sunk cost of existing assets.

LRIC means and implies to cover efficient costs. Profits are included in the cost concept as a risk-adjusted return on capital. Some regulators take into consideration some uplift of the WACC to incentivise further investment. Regulators also can apply a front loading tilted annuity approach to reduce the investment risk. While a balanced annuity approach leads to constant prices over the relevant time horizon, a front loading approach sets higher prices in the beginning and lower prices in the following periods according to a predefined formula. This reduces the risk of an investment by a new technology. The effects of front loading depreciation are ambivalent. Investment by incumbent and infrastructure-based competitors may be incentivised. At the same time downstream investment of access seekers may be discouraged through the wholesale price increasing effect. Also the potential effects of higher prices on investment may be arbitrarily. On the one hand the expectation of higher prices may make the financing of investment easier. On the other hand, the resulting higher retail prices may discourage investment again. In any case higher prices reduce consumer welfare. Price increase as a means to incentivise investment therefore needs careful consideration.

There is another pricing principle usually applied by regulators, the nationwide uniform wholesale pricing, which has an impact on investment. Geographic averaging of ULL charges impacts the build-or-buy incentives as well as opportunities for arbitrage. At a given national averaged wholesale price for network access there are different

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strategies on the part of the regulated firm as well as inefficient entry. It will also distort prices away from true Ramsey mark-ups. Since global price caps are incompatible with the European telecommunications framework's selective deregulation of telecommunications markets and since Ramsey prices are too hard for regulators to determine, the goal of setting regulated Ramsey prices is an unachievable standard. The distortion created by not achieving Ramsey prices is small if common costs are only a small fraction of total costs but could become substantial if most costs are common.

incentives to invest in high density areas compared to those in low density areas. There is in particular the risk of inefficient bypass by too much bypass in high density areas or too low bypass in low density (high cost) areas. Inefficient bypass occurs if an operator circumvents the bottleneck of the incumbent, even if the costs of the incumbent are lower. In more general terms bypass is inefficient if it reduces consumer welfare.

3.2.2 Investment of incumbents

3.2.2.1 Investment in existing services

LRIC will generally cover all costs that are expected over the lifetime of the assets and add mark-ups for common costs. Wholesale charges at LRIC levels will therefore provide correct expansion and replacement investment incentives for bottleneck assets of the incumbent. Higher than cost-covering charges would lead to less investment because of the reduction in downstream demand associated with higher downstream prices that especially competitors would have to charge. Lower charges would lead to lower investments on the part of the bottleneck provider because of insufficient cost coverage. Under cost and/or demand uncertainty a buffer may be necessary to cover for estimation risks. It is usually assumed that investment risks of the incumbent are correctly covered in the WACC used for the LRIC calculation.[75]

The main argument on missing investment incentives of LRIC is that access charges, which do not cover all investment cost like the cost for reserve capacities, crush investment. The proponents of LRIC argue that by definition LRIC entails all costs for the expansion investment in new infrastructure. As a consequence, any deficit in covering investment cost must be the result of measurement mistakes of costs or of mistakes in the respective cost models which would then not be properly specified.

Opponents to LRIC argue that regulatory authorities systematically ignore the need for reserve capacities and that they should uplift the WACC to take care of real options. The first argument is prominently presented by Mandy and Sharkey (2003) who ask for correction factors for indivisibilities and for actual use of capacity. The second argument is prominently represented by Hausman (1999) and Pindyck (2007). According to Hausman's calculations LRIC should be increased by 50 % to 100 % to properly reflect real options related to such cost when those loose value over time. Regulators have often discussed these issues in various procedures. But as far as we know no regulator has adopted its LRIC calculations to take care of indivisibilities and real options. For us indivisibilities are not a relevant issue at all if cost models – at least those which we have developed – properly take care of indivisibilities and reserve capacities. Real options face various trade-offs, there are effects in different directions. Therefore it is a

75 We are here only assessing the appropriate level of a regulated wholesale access charge that is levied on a wholesale access service on a pay-as-you-go basis. Alternative access arrangement, such as investment sharing may or may not provide better investment incentives. See, for example, Nitsche and Wiethaus (2010).

priori unclear what their impact on the level of LRIC would be if they were taken into consideration.

The argument of insufficient investment of incumbents under LRIC has in our view a different background. There is a fundamental problem with proper incentives to invest if the old copper-based services no longer grow. LRIC only generates a competitive level of profits in the hypothetical LRIC world. If there is less or no investment in the old technology which is still in use due to lack of growth, major contributions occur in a forward looking sense. Major parts of the network is sunk and only costs for maintaining and operating it occur. LRIC as traditionally calculated on the basis of current cost then become very profitable. LRIC then leads to a significant over-recovery of actual costs. The copper access network thus becomes rather profitable under a traditional LRIC calculation. It then becomes the ideal cash cow. In such an environment investment into innovation and new access network technologies are only conducted if they are even more profitable. The more probable outcome is that the incentives to invest in new networks are low in such a scenario.

3.2.2.2 Investment in new services

The argument that investment in new services requires high access charges for the old services is weak. For that to happen the higher profits for the old services need to be transposed into higher profits for the new services. There, is however, a cannibalization effect which prohibits that to happen. The cannibalization argument says that the incumbent will only invest in new services if the expected profit from the new services will be larger than the contribution lost from the sunk old network. The old services generate higher profits from increased access charges anyhow. If thereby profits of new services will not be increased, the incentives for innovation and investment into new services decrease. To show and prove this we first of all assume that the new products replace the old ULL offers one by one (diversion ration = 1). This means that the company loses one unit of the old products for each unit it sells of the new products. If the new products are not regulated, a price increase for ULL would increase the opportunity costs of innovation for the incumbent and would therefore reduce its incentive to innovate. Similar impacts hold if the new products are regulated. With or without regulation of the new products the innovation incentives of the incumbent resulting from a wholesale price increase of the old products probably will be negative or neutral at its best. Innovation incentives depend more on the relative prices than on the absolute prices of the old and the new products.

If we give up the full substitution of the old by the new services it may be the case that the investment in new services generates additional demand which will not be fully lost for the old service. In that case it may theoretically be possible that the increase in profits (by increasing the access charges) may be higher for the old service than for the new service. This holds in particular in case of parallel regulation.

In Section 3.3.4 we will deeper analyse the migration effect. The migration effect generates a positive relationship between investment in new services and the level of wholesale access charges. According to this effect more customers migrate to the new retail product if the access price for the old product will be increased and retail prices increase. In such a case the relative prices between the old and the new products change in favour of the new product. A decreasing price distance between the products make the new product more attractive to end-users. The migration effect alleviates the impact of the cannibalization effect because the new product becomes more (or earlier) profitable if penetration increases. This, however, only holds, if the price of the wholesale fibre product will not increase by the same amount as the copper-based wholesale product.

3.2.3 Investment of competitors

Besides the incentives of the incumbent to invest in bottlenecks wholesale, access charges also have an impact on network investments of competitors either to bypass the bottleneck by own network investments and/or to invest (further) downstream.

Bottleneck investments are related to the traditional make-or-buy decision. With the same risk proviso LRIC also provide the correct incentives for bottleneck bypass investments of those alternative competitors that depend on bottleneck access. If wholesale charges are too high alternative competitors will invest in bypass even if their costs are higher than those of the incumbent. If wholesale charges are too low they will not invest in bypass even if their costs are lower than those of the incumbent.[76] But those desirable properties of LRIC hinge on the assumption that regulated markets are expanding.

If demand shrinks the decision relevant cost for bypass investment are the incumbent's cost minus its sunk cost.

Alternative intermodal competitors (such CATV and FTTH), who are not dependent on bottleneck access, benefit from higher wholesale access charges imposed on access seekers because of less competition from entrants and/or because the incumbent must keep end-user charges high in order to avoid margin-squeeze allegations. Again, wholesale charges at LRIC in principle provide competitive neutrality for intermodal carriers.

Downstream investments of competitors in concentration and core networks benefit from lower bottleneck rates which reduce their cost. In reverse, there would be too low downstream investment if bottleneck rates were too high. This is due to two effects.

76 See, however, Sappington (2006), who shows that the efficient make-or-buy decision can be quite independent of the level of access charges. In contrast, Mandy (2009) limits the generality of this view and states “The necessary condition shows that input prices are relevant for Make-or-Buy decisions except under restrictive and often unverifiable assumptions on the demand structure…”.

Firstly, lower cost of competitors from lower wholesale rates lead to lower end-user prices and increased demand volumes. Secondly, the relative competitive position of competitors against the incumbent (and intermodal competitors) improves. The second effect is a bit arbitrary because lower wholesale rates also lower the opportunity cost of the wholesale service for the incumbent. Furthermore, it is not obvious that lower wholesale rates lead to lower end-user prices, at least not to the same amount. This depends on the competitive intensity of the retail markets and this "waterbed" effect is less than 100%. In any case insofar as lower wholesale rates lead to lower end-user prices, higher downstream investments of competitors and probably also of the incumbent can be expected.

If it comes to analysing the incentives to invest for altnets into fibre networks, an important element of the French regulatory framework plays a decisive role. Different to most assumptions in theoretic regulatory models, French fixed line competitors will not get wholesale access to the incumbent’s fibre access network. They only get duct access to build their own networks. Under the French regulatory system altnets do not have any right to get access to the incumbent’s fibre infrastructure on basis of active access products like VULA or bitstream. If they want to serve customers with superfast broadband access, they have to deploy their own fibre access infrastructure on the basis of a co-investment model with the incumbent. To a certain degree or moment in time they might not deploy their own fibre infrastructure and take the option of wait and see. The more the incumbent itself invests in fibre and the more the customers subscribe to superfast instead of fast broadband the more they lose market share if they do not deploy their own fibre network. This means altnets cannot hold (or even improve) their level of profitability by not investing in fibre. The incentive structure created by this regulatory model is by far stronger than any potential uplift on ULL charges. The risk of being thrown out of the market generates a much stronger incentive to invest than any (marginal) uplift of copper ULL charges. Uplifting cannot intensive the investment incentives stronger than they already are. This approach, however, limits their ability to invest financially.

3.2.4 A case study: Lack of access investment in Germany

Germany provides an interesting case study on the lack of access network investment induced (at least to a relevant degree) by the ULL wholesale pricing regime.

Since the beginning of the regulatory unbundling regime in Germany in 1999 the German regulator BNetzA applies a FL-LRIC costing approach to calculate ULL cost. ULL prices are determined on the basis of the current cost of an efficient copper access network. The capital costs of the network are determined on the basis of a bottom-up cost model.

Starting form a level of 12.99 Euro in 1999, prices gradually decreased over time. This trend changed for the first time in the ULL pricing decision in 2013, where prices went up slightly to 10.19 Euro per line.

Although demand for copper loops gradually decreased over time (from about 40 million copper loops to about 35 million loops today), BNetzA did not change its calculation method. The reference architecture still is a (new) copper access network despite the fact that Deutsche Telekom did not invest in the renewal of the network.

The access network basically has remained a copper network. Germany has one of the lowest fibre coverage rates in Europe. Only about 2 million households have access to a fibre connection which is a network coverage in terms of homes passed of about 5%. Deutsche Telekom contributes only about 0,5 million to the homes passed by fibre. The company had a fibre deployment program for two years (2011-2012) and then stopped its fibre roll-out strategically. Instead, the company is upgrading its copper network for NGA capabilities and is conducting an aggressive FTTC/VDSL/Vectoring roll-out with the intention to cover about (at least) 85% of households by 2018 on that basis. Without going into details, Deutsche Telekom has announced to go a step further by increasing broadband speeds by introducing Super-Vectoring[77] and G.fast technology soon.

It is well known that the current cost-based calculation method of ULL charges in Germany (as in many other countries) has resulted in prices which exceed actual costs significantly. The ULL charge is based on the current cost of a brand new copper network which includes even assets which are already fully depreciated.[78] Deutsche Telekom is earning significant profits for its copper network at the retail as well as at the wholesale level. These economic rents have their basis in a low level of (re-)investment in the access network. These huge profits stem from the fact that the current cost LRIC pricing approach for ULL implies that the regulated firm gets compensated for the investment to steadily upgrade and renew the network. The ULL charges implicitly entail investment premia or investment contributions for upgrading the copper access network to a modern equivalent asset. If the regulatory regime does not take care whether those investments are actually conducted or not, missing investment is a major source of such economic rents.

In a recently published study Neumann and Vogelsang (2016) have quantified the investment gap resulting from the ULL pricing regime in Germany. Since the beginning of ULL regulation Deutsche Telekom has received about 40 billion Euro as depreciation for using its copper access network for retail and wholesale purposes. For conducting the calculation the authors have estimated the depreciation cost component in the regulated ULL price and multiplied this component with the (declining) number of copper loops. The resulting annual depreciation amounts have been accumulated over the period 1999 to 2015. The annual amounts of depreciation have then been

77 VDSL2 Profile 35b with vectoring.
78 For more details we refer to Neumann/Vogelsang (2016):

compared to the annual investment of Deutsche Telekom in the access network. For each year (except year one) the depreciation earned has been higher than the access investment. The accumulated access investment amounts to 18 billion Euro. As a result, depreciation earnings exceeded investment by more than 20 billion Euro. This is even a rather conservative estimate of the investment gap because it only considers the self-financing part of the investment. Effectively, companies finance investment with debt and equity.

The investment gap or investment contribution has been used by the incumbent for other means than for innovating the access network.

The huge size or dimension of the investment gap becomes obvious if one compares it with two major investment projects in the German access network. According to modelling calculations conducted by WIK[79] the nationwide coverage of VDSL/Vectoring in Germany requires an investment of around 17 billion Euro. 50% of that investment relates to the passive part of the network which is relevant in this context. This means that the total invest for a nationwide FTTC/VDSL network in Germany could have been financed with less than 50% of the depreciation Deutsche Telekom has received for its copper access network. The passive part of the FTTC network would even have been financed with less than 25% of the depreciation earned.

The second comparison is related to a nationwide FTTH network for 43 million households and businesses in Germany. For the passive part of this network an investment of about 45 billion Euro still is needed in Germany.[80] This is only about 10% more than the depreciation earned by Deutsche Telekom in the access network.

3.2.5 Interim conclusions

To conclude, the investment effects are arbitrarily. If at all there are only small positive effects of wholesale rates above LRIC for incumbents to invest in new network architectures and innovation. Higher wholesale rates improve financing for incumbent's investment. On the other hand the resulting retail price increase reduces demand for the relevant services and thereby investment in existing services. Investment in new substitutive services will be impeded by the cannibalization effect of higher wholesale rates but will be promoted by migration effects. The net effect remains unclear and depends on the relative strength of the different effects. As Bourreau et al. (2012) have shown the optimal ULL price is defined by a compromise of these various effects. However, the move from expansion to decline of the copper access network has significantly increased the relative importance of cannibalisation. In case of declining demand the decision relevant cost of the incumbent become the SRIC+. In case of migration, he is losing the difference between the actual wholesale price and the SRIC+

79 See Plückebaum et al. (2014).
80 See Jay et al. (2012).

as a profit. The optimal compromise between the three effects has moved into the direction of a lower ULL price.

Positive investment effects of higher wholesale rates may occur for intermodal competitors like cable and mobile operators. Bypass investment of access seekers may be incentivised because it becomes more profitable to substitute the wholesale service. At the same time financing resources will be decreased by higher wholesale rates which hampers investment again. The net effect depends again on the relative strength of both effects. In any case downstream investment of competitors will suffer from the cost increase which make competitors less competitive and compress demand.

3.3 Problems of applying LRIC

3.3.1 Decreasing demand

The concept of LRIC has been conceptually developed for an expanding market, where additional capacity is being installed. The market for copper-based access, however, is shrinking and appears to continue to shrink at an even accelerating degree, due to substitution by cable and fibre. LRIC relies on the evaluation of the assets deployed on the basis of their replacement through new assets, either by expansion or full replacement. If such investments, however, are not conducted (anymore) then they are also no longer part of the long run forward looking costs.

Since a large portion of the copper-related costs are sunk and therefore overcapacities develop, true forward-looking costs will therefore be much lower than LRIC as traditionally calculated by NRAs. Some cost calculation approaches applied by NRAs signal increasing (unit) costs in case of decreasing demand. The second one, relevant if LRIC are still used at that point, is that increasing input costs (in particular copper) would lead to increasing charges for access. As a result, incumbents offering wholesale access under such charges would be over-recovering their investments, which have largely been incurred in the past at lower costs. Third, the notion of LRIC is based on a replacement by the most modern technology. Copper access, however, does not appear to be the most modern access technology anymore. One can therefore argue that LRIC should be calculated for a modern equivalent asset rather than for copper.

Decreasing end-user demand leads to excess capacities. In competitive markets this would lead to price reductions which should not only hold at the retail level but also at the wholesale level, because wholesale demand is a derived demand. Also in this stage of the market an operator in a competitive environment would wish to take advantage of wholesale demand to defend its position against competing technologies. But if LRIC were still applied this would, as argued below, lead to price increases due to the allocation of fixed costs to a then reduced quantity base. In other words, favourable economies of scale in case of market expansion generate increases of costs in case of shrinking demand. This inevitably leads to tensions between incumbent and altnets. Thus, entrants that for their own offers have to rely on regulated wholesale prices would not be able to compete on terms that correspond to market conditions. In contrast, incumbents can respond to the pressure by reducing their retail prices so that relative to LRIC margin squeezes result. If then there is no corrective action on the part of the regulator, LRIC would prevent competitive results from being achieved. Such an application of " LRIC" prohibits an efficient competitive market result.

Given that LRIC are based on average costs and that economies of scale prevail, a long-term or permanent reduction in demand would mechanically lead to an increase in wholesale access charges when the regulator takes into account this average volume decline. The resulting feed-back mechanism would foster even further future volume decline, not least because the freedom for competitive price decreases on the retail level is typically also limited on the part of the regulated (incumbent) firm. In order to protect intra-modal competition, NRAs sometimes apply a margin-squeeze test, according to which prices (P) must satisfy $P_{Retail} \geq P_{LRIC}$ + *retail costs and other wholesale costs*. ULL charges have been determined that way in Austria since years. When the margin-squeeze condition is binding and if such a margin-squeeze test was effectively applied, higher wholesale access charges would lead to higher retail prices, increasing excess capacity. Otherwise, a margin squeeze would result.

How important and relevant are the allocative implications of the underutilization of capacity? Figure 3-1 und Figure 3-2 provide a simplified picture of this problem.

Figure 3-1 shows the extent of allocative inefficiencies (area ABCD) when "cost-based" access charges (P_{LRIC}) are to be maintained with excess capacities ($K_0 > X_{LRIC}$). As Figure 3-1 indicates, there might be a positive rationing price $P_r < P_{LRIC}$ where existing capacity (K_0) is fully employed. But in fixed-networks one might also end up in a situation with capacity exceeding demand at any positive rationing price ($K_1 > Demand(P_r = 0)$). Allocative inefficiencies thus increase with the amount of excess capacity. In a situation where there is fierce inter-modal competition retail prices would be driven down to short-run marginal costs (*SRMC*), which is, as mentioned above, usually prevented by some form of ex ante regulation / margin-squeeze tests. But even at these prices, as just mentioned, excess capacity may prevail. Incumbents can respond to this downward pressure on retail prices because of the typically high share of sunk investments in network industries such as communications. Given the long-run market demand decline, sunk costs have then become irrelevant for pricing decisions, both from the point of view of fixed-network operators and that of efficiency considerations.

Figure 3-1: Short term welfare losses at LRIC and "low" overcapacity

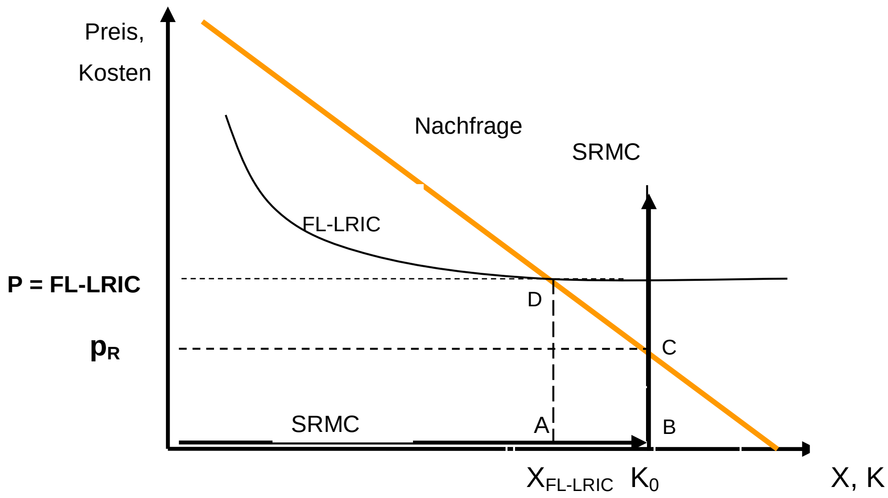
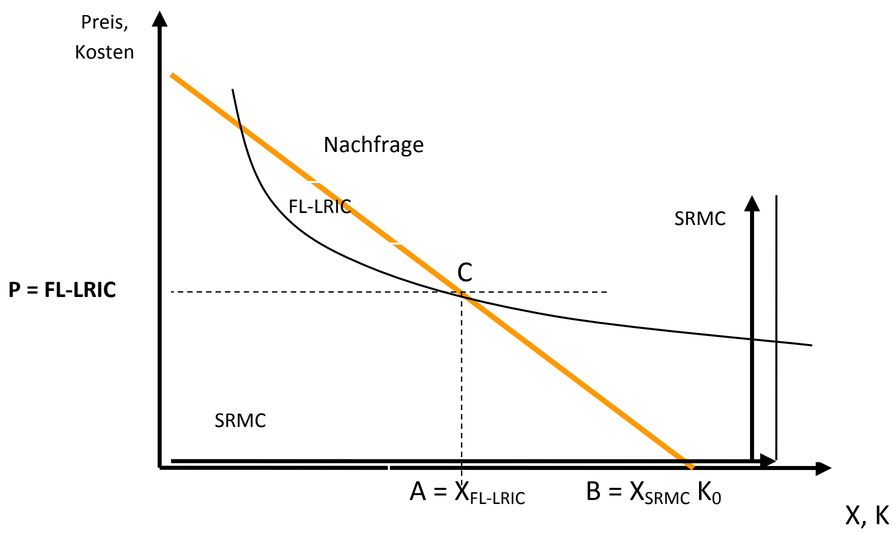


Figure 3-2: Short term welfare losses at LRIC and "significant" overcapacity



While capacity is fully utilized at the rationing price in Figure 3-1, this is not the case in Figure 3-2. Here overcapacity remains even at a very low price. The short-term welfare loss then amounts to ABC.

This self-fulfilling tendency of further decreasing demand by mechanically applying LRIC on the old technology, induced increased overcapacity and increasing welfare losses lead to a cul-de-sac. This situation can only be overcome by changing the price setting methodology.

In a recent published article Decker (2016) presents and discusses a broad set of economic literature on regulating networks in decline. According to Decker[81] the regulatory framework may need to adapt in case of declining demand to take account of the following factors:

(1) Substitution and opportunities of traditional regulated network services are not always comprehensive and not all of the under-utilized capacity on networks can automatically be re-used for another purpose.

(2) New issues regarding cost-recovery emerge.

(3) Regulation may face the situation that in some circumstances the network operator may reduce the service quality in order to cut costs.

(4) Regulation may face new distributional challenges because the declining networks can create both winners and losers.

In our context the cost recovery issues are most relevant for pricing. “On the one hand, if the level of allowed revenues is not adjusted to reflect new levels of demand, this can give rise to static efficiency losses as captive users are required to pay for any historic investments in network assets which are redundant given current and (expected) future network utilization. Moreover, not adjusting in revenues and prices to account for changes in demand can contribute to the further decline in the demand for network services.”[82] On the other hand, stranded assets may create dynamic disincentives for investment. It is obvious that shifting the revenue risk associated with declining demand onto consumers generates allocative inefficiencies. Economic literature has developed different forms of sharing mechanisms between network users and network operators to share the burden of paying for historic investments. One mechanism is the one-off revaluation of assets as e.g. foreseen in the EU costing Recommendation which we discuss in Section 4. For more sophisticated economic approaches we refer to Decker (2016).

Briglauer and Vogelsang (2011) have suggested a pricing rule which specifically addresses the anti-competitive margin squeeze aspect which often occurs in the market environment of declining demand. In case of declining demand the decision relevant cost for the incumbent no longer is the LRIC of the old technology. He has an incentive to reduce retail prices such that a margin squeeze occurs under a LRIC-based wholesale price to keep users on his platform. The retail minus rule represents an often used rule of thumb to avoid a margin squeeze. Briglauer and Vogelsang therefore suggested that the ULL charge should be the minimum of two values: LRIC or a price which is determined by applying the retail minus rule. An LRIC price then becomes the

81 See Decker (2016), p. 353.
82 See Decker (2016), p. 354.

price cap for the wholesale price and it becomes most likely that in our situation the effective price will be determined by the retail minus rule.

Also the product life cycle managerial literature[83], which develops optimal pricing strategies over the life cycle of a product, supports the pricing approaches developed by the regulatory economics pricing literature. This literature suggests that in the decline phase of a product which follows its maturity stage prices and margins get depressed. In the life cycle phase of that product sales and volumes are declining. Optimal strategies in the decline phase include phasing out of weak product items and cutting prices. That is part of a strategic approach which maximises profits over the life cycle of a product. Companies in a competitive market usually apply such pricing strategies.

3.3.2 Market entry and exit

If demand for copper-based access lines is decreasing and NRAs still apply their previous method of calculating the wholesale prices according to LRIC at current costs, wholesale prices will not decline but probably increase due to reducing volumes and increasing input prices. This also holds for the calculation method currently applied by ARCEP. In such a case the margins of competitors will decline up to the point where they become negative. Without regulatory intervention entrants face a loss due to a margin squeeze situation. Entry and competition will be discouraged.

More concretely, in a situation of long-term decreasing demand there is little incentive for new firms to enter. This would per se be true for new firms that would erect new networks, but it would probably also hold for new firms that use, for example, the copper ULL as an input. The situation should in particular arise if a new market is emerging that is replacing the shrinking one. On the other hand, however, it is questionable whether exit of existing firms should be induced. Such exit is nevertheless likely if wholesale access charges continue to be based on LRIC so that alternative providers cannot adjust their retail prices downwards (or even force them to increase their retail prices) in response to declining demand.

In an environment of shrinking demand, normal notions regarding the effects of the scale of output on cost become meaningless. This is due to the presence of sunk costs which are no longer decision relevant. For existing firms, previously relevant economies of scale for given outputs lose importance. This raises the question regarding the appropriate prices for the inputs for alternative providers since there is no a priori or efficiency reason for their exit. It is unambiguous, however, that diseconomies of scale and average costs faced by new firms entering with new assets would increase so that new entry would make little or no sense. Competitors already in the market may face the situation of becoming unprofitable and having to leave the market.

83 See for instance Levitt (1965) and Kotler/ Armstrong (2010)

As a result, in shrinking markets wholesale charges calculated on the basis of -LRIC provide little incentive for market entry, in particular if margin squeeze situations may occur. LRIC based wholesale charges could, however, generate too much market exit because altnets are forced to set retail prices which even accelerate the loss of volumes.

3.3.3 Cost recovery

LRIC is oriented towards covering efficient cost. Users get the best possible deal under the constraint that the regulated firm can cover its cost. Wholesale prices on the basis of LRIC are calculated such that all forward looking costs are covered. This does not imply that in an ex-post consideration effectively all costs are being covered. That is the reason and the justification that capital costs include a risk premium.

A standard argument by incumbents has been that LRIC wholesale prices do not allow them full cost recovery because network costs are declining over time so that LRIC because of the forward-looking nature do not allow the incumbents to recover the higher costs they incurred in the past. This is not a valid argument in the case of ULL, for which it is rather the case that costs are increasing due to economies of scale and increasing input prices (e.g. copper) so that forward-looking costs as traditionally calculated would be higher than the costs incurred by incumbents in the past. This would hold to the extreme if the network is not expanded or replaced at all so that high LRIC were applied to investments that were all made in the past. In addition to being an efficiency issue, it is primarily one of equity between incumbents and entrants. Given the long lives of the copper access network and given that pricing in the past has only started to be determined according to appropriate cost standards relatively late, this could mean that the incumbent has already been fully compensated or even been overcompensated for the actually incurred cost. This would come in addition to the fact that entrants would overpay for access to a network that is not being expanded and was acquired at the lower costs in the past.

Equity or fairness has always been viewed as a legitimate issue in regulatory practice. However, from a perspective of economic analysis one should pursue equity objectives with policies that are also associated with superior efficiency. Copper ULL has the problem that a forward-looking approach should not include sunk costs from an efficiency perspective. From an equity perspective, incumbents have until now benefitted from higher access charges compared to lower actually incurred costs in the past. To the extent that existing ducts etc. are used, an opportunity cost approach may be warranted.

3.3.4 MEA and technological change

Another challenge for the LRIC concept follows from the growing market relevance of FTTH because the relevant market for copper-based access service correspondingly declines. Because a major part of copper access costs are sunk and overcapacities arise, the actual forward looking costs therefore are significantly lower than the traditionally calculated LRIC by NRAs. If LRIC still is calculated on the basis of the old technology, this would – as we have shown in Section 3.3.1 – lead to wholesale price increases due to lower volumes of demand. This (inappropriate) understanding of LRIC would generate unnecessary overcapacity for the old technology and would induce allocative inefficiencies regarding the use of the copper network.

The LRIC methodology if properly applied is able to deal with new technological developments. In light of technological progress the old access technology should no longer be the reference architecture for calculating LRIC. Instead, the new technology should be regarded as the modern equivalent asset (MEA) for determining the access charges for the old technology. During the production of goods and services it is common practice that in case of technological progress old production assets are substituted by those of the new technology. In such cases it is common practice in competitive markets that old production assets are depreciated under economic depreciation such that they still can compete (at least in some submarkets) with the new generation assets as long as the new technology is not completely dominating the market.

This even holds if the old assets are barely used. Insofar the assets of the old technology will face a MEA evaluation relative to the cost of the new technology. The value of the old assets after their devaluation represent the MEA value of the old assets. The MEA approach therefore is a natural or inherent part of the LRIC concept and therefore also fully compatible with it. Incumbents often reject this understanding of MEA because the new technology is not (yet fully) representing the actual network technology. In a competitive market, however, not the actual structure of network elements and their (historic) book values count. What is relevant is the proper valuation of assets such that they represent an efficient future proof network.

This can be demonstrated with the pricing of mobile services. If a new technology or generation is introduced in the market, operators have to adopt their retail prices of the old generation such that they fit with the prices of the new generation technology. In case of mobile, retail prices for 3G products had to be reduced still to be competitive against the more capable and superior 4G technology. That is a typical MEA pricing reaction in a competitive market.

This behaviour of a firm in a competitive market is also relevant in the regulated market. The demand for wholesale products is a derived demand from the corresponding retail products. Regulators should value assets as they would be valued in a competitive market because it is their task to simulate such conditions in their regulatory decisions. The MEA approach, which reflects the valuation of the old assets relative to the LRIC of the new assets, therefore is a basic element of LRIC under technological progress.

Sometimes it is assumed that the relevant cost of the old technology could be compared one-by-one with the cost of the new technology. This is correct in principle as long as the new technology generates the same goods and services as the old technology, only at lower costs. If the last feature would not hold, the new technology would not be superior. In most cases, however, a new technology not only operates at lower cost, but also generates qualitatively better outputs or new services. In this case the traditional MEA approach falls apart and generates mistakes, because it does not take this performance difference into account.

Three issues are relevant and have to be properly considered as part of a MEA based LRIC determination:

(1) The first issue relates to the level of penetration or demand to be assumed for the MEA. Because the MEA represents the actual substitute for copper access as well as the hypothetical or potential substitute, total demand for copper access prior to its decline becomes the relevant demand. All access demand which has migrated to another technology remains part of the relevant MEA demand. FTTH becomes the MEA even if it is not (yet) fully deployed at a certain point in time.

(2) The second issue relates to the MEA valuation of re-usable assets. In a forward looking sense some assets of the existing old copper access network like ducts can be re-used for a FTTH or FTTC network. Re-usable assets could be valued at their (full) replacement costs or at a value which is closer to their actual cost. Some NRAs and the EU Commission have developed approaches[84] which try to prohibit that windfall profits arise due to the full replacement cost valuation of re-usable assets. Such considerations are closer to the behaviour of firms in a competitive market which make the best use of all available resources.

(3) Because FTTH based access services and the corresponding retail services are not a perfect substitute for copper-based access, the FTTH wholesale access is not a perfect MEA. There are relevant quality differences which have to be taken into consideration. There is no doubt that FTTH provides superior services compared to copper-based access. The use of FTTH as the relevant MEA for copper without quality adjustment would therefore overestimate the LRIC of the "true" MEA by a performance delta. To give an example: Assume that the calculated LRIC for FTTH and for a copper access network are the same. FTTH should be the MEA. Assume a willingness to pay for FTTH which is 5 Euro per month higher than for copper-based products. In this case an access seeker would (in the MEA case without a performance delta) pay the price for FTTH but just receives copper access. In this

84 We will describe such approaches more in depth in Section 4.

case copper-based access would not be competitive against FTTH-based access. The consideration of the performance delta in the wholesale pricing regime would generate this competitiveness.

In an article by Neumann and Vogelsang (2013) a specific market based approach to quantify and determine the performance delta has been presented. This approach has originally been developed for the Swiss NRA.[85] According to this proposal the performance delta (Δ_{perf}) relies on the market valuation of the services which are provided over copper and fibre access represented by the corresponding retail prices. Under this approach an access seeker becomes indifferent (at the margin) between copper and fibre access. Thus, wholesale access becomes technological neutral under this approach. The MEA approach therefore becomes technological-neutral between copper and fibre access. A copper access price determined that way also becomes migration-neutral. We discuss this concept in more detail in Section 4.5.1.2.

3.3.5 Further conclusions

To conclude, LRIC has proved to be quite valuable in setting regulated prices, in particular prices for wholesale services in markets under expansion. Conceptually, it is the cost standard on which, at least on average, prices are based that would obtain under effective competition. Prices set this way provide entrants with the necessary information in respect of buy-or-make decisions and at the same time provide incumbents with correct signals regarding their investment decisions. They assure (if properly applied) entrants the opportunity to take advantage of the business prospects offered by growing retail markets on essentially an equal footing with the incumbent. In the final analysis, they are one of the cornerstones assuring that consumers will get the best deal.

Relying on the LRIC standard alone would induce unnecessary over-capacities and allocative inefficiencies in copper networks. Furthermore, such an approach is likely to lead either to margin squeeze and the exit of competition or distortions between different technologies. To avoid such a “vicious circle“ one has to look for more suitable forms of access price regulation which allow for a lowering of wholesale charges and increased pricing flexibility at the retail level.

85 See WIK-Consult (2012).

3.4 Alternatives to LRIC

3.4.1 Pricing according to short-run cost

In case of systematically underutilised assets and capacities the concept of short-run incremental cost (SRIC) gets relevance for regulatory pricing decisions. In case of overcapacities prices should at least cover their SRIC.

The differentiation between short- and long-term cost follows from the fact that physical assets are long lived. Long-run cost occur at the time of installation, although the assets will provide services over a long period of time. Short-run cost mostly represent operation and maintenance. The difference between both cost concepts is related to the degree of irreversibility of costs. Physical assets of a telecommunications network are mostly sunk, once they are installed. Such costs can only be recovered through its productive use for the intended purpose and time.

The important point is that the company will use the installed assets even if they will no longer earn their capital cost. Only if prices would fall below the level of short-run cost, the company would close down the network and decommission or dispose the corresponding assets. If the price still exceeds its short-run costs, the company still earns contributions to cover long-run costs. Only if prices fall below that level the company loses the economic incentive to use the asset for productive purposes anymore.

In case of overcapacity the company (in a competitive market) would not (necessarily) set the price equal to its SRIC. It would set it at a level of SRIC+ where the "+" is a mark-up which cannot be determined on the basis of cost calculations. Instead, it follows from the maximisation of the contribution (or the minimization of a loss) given the relevant demand reactions on price. This mark-up is difficult to determine for a regulator. In particular if the relevant service is produced in a joint production network environment, where the relevant service is produced in combination with other wholesale and retail services.

3.4.2 Pricing according to historic costs

Historic costs of assets equal their original purchase price minus accumulated accounting depreciation. Using historical costs as the relevant asset base avoids over-recovery or under-recovery of “actual” costs and thereby balances the interest of access provider and access seeker. It has, however, two drawbacks. The first is that the relationship between historic costs and the efficiency prices for economic efficient decision making is purely coincidental and varies from regulatory and accounting system and from carrier to carrier, due to different asset age structures and depreciation methods. The second is that decisions about investment, shrinking and abandonment of copper networks must be forward looking. Historic costs do not inform about the future. As mentioned earlier their main value is in their equity properties and their guarantee of the recovery of actual costs.

There are two major differences between pricing according to historic cost accounting (HCA) and the LRIC cost standard as discussed so far. One major difference is that asset values under HCA are based on the historic expenditure for the respective assets and certain additions or disposals over time. Depreciation is determined as a fraction of the (remaining) book value. A second major difference is that the existing asset base may include obsolescent and inefficient assets which do not represent modern equivalent assets and may also include overcapacities. If HCA should become the basis for price determination of regulated wholesale prices, such inefficiencies should be identified and corrected for. Assets which are fully depreciated but still in use, no longer generate (capital) cost under HCA costing. Otherwise, over-recovery of actual costs would occur.

Three aspects of HCA are in particular relevant for wholesale pricing in telecommunications:

(1) If the prices for equivalent assets increase (e.g. because of inflation) or decrease (e.g. because of technological progress) costs derived from HCA no longer reflect the current value of the resources used.

(2) A consistent application of HCA over the whole lifetime of the assets would (in the absence of inflation) guarantee that the respective assets are fully financed by the revenues received. This holds independent of the depreciation method, as long as this is applied consistently.

(3) Prices under HCA which include inefficiencies, overcapacities and assets which do not reflect modern equivalent assets do not generate efficient 'build-or-buy' signals and are not compatible with the competitive standard.

Thus, if HCA is used for fairness reasons, efficiency aspects suffer or additional instruments are needed to ensure efficiency, e.g. two-part tariffs. HCA nevertheless has the advantage of being more transparent and predictable than pricing according to current costs and of being more compatible with strict cost recovery. Thus, there are trade-offs which indicate that the appropriateness of applying HCA depends on the nature of the assets, the speed of technological progress and the level of replicability.

3.4.3 Pricing according to opportunity costs

Opportunity costs differ essentially from LRIC in that the yardstick for the cost of the service is not the cost of the resources anymore with which the service could currently be produced, but exclusively the valuation by demanders of the types and volumes of services that could be produced by the existing capacity.

To make this point more precise, consider that a competitor would be willing to pay for the existing copper infrastructure. The hypothetical scenario for this case could be that of a switched local and long-distance network that intends to add an access network, believing that it can serve the market even with a copper network. In this case the increment would be the whole access network, and the price that the competitor is willing to pay would represent its opportunity cost. The appropriate definition of opportunity cost would be based on a competitive end-user market and competitive prices at that market. Opportunity costs are usually defined as representing the value of the corresponding service (or asset) at its best alternative use. If the value of the alternative use is above the cost of production then those represent the opportunity cost. Opportunity cost as alternative to LRIC only becomes relevant if the best alternative value is below LRIC. LRIC therefore becomes the upper limit of opportunity costs because competitors could build the network at that value by themselves.

In the absence of additional costs for giving up a service (such as social costs of laying-off personnel or of tearing down lines or buildings) the floor of opportunity costs is given by the short-run marginal costs (or short-run avoidable costs), because below those costs the service (or the asset) would be abandoned. These short-run costs include the disposal value of assets that could be sold in a (second-hand) market, such as real estate. A ceiling for opportunity costs would be given by conventional LRIC because at that price a competitor would be induced to build the infrastructure herself (although, in the short term or medium term the ceiling could be higher).

Because opportunity cost represent the value of a service in a competitive market, they represent the cost which should be the basis for LRIC. The opportunity cost approach is the more general one. It is applicable in a situation of increasing as well as in a situation of declining demand. Because LRIC are an upper limit of long-run opportunity cost, regulation on the basis of opportunity cost can only lead to deviations from a strict LRIC standard if the opportunity costs are lower than LRIC. Exactly that is the situation in case of overcapacities due to a shrinking demand.

In case of long-term declining demand we can expect that the opportunity cost floor will be relevant. When that happens the access provider may end up receiving nothing for the use of his existing assets. This may be viewed as inequitable and may deprive the incumbent of his ability to finance new services, such as fibre. It may therefore be appropriate to consider a wholesale access price that exceeds opportunity costs in order to provide liquidity for risky investments. The adequate or efficient mark-up on the price floor is, however, hard to determine. A competitive model to be developed as a tool for such a determination based on performance criteria, such as the effect of alternative wholesale access charges on consumer surplus and welfare may provide at least a theoretical solution. Also the approach of the EU costing Recommendation which we analyse in detail in Section 4 may be seen as a practical implication of an opportunity cost approach.

In competition with fibre the relevant cost base for copper may well be short-run avoidable costs as the lower limit, while for fibre, as already pointed out, it would be LRIC. The reason is that copper should only be definitely abandoned if it can no longer earn its short-run avoidable costs while investment in fibre should only definitely occur if it earns its full investment costs. Exceptions from this rule can occur when part of the copper network can be used to build fibre access or when the build-out of fibre leads to increased value of fibre (because of learning and network effects).

There is one particular implication if ducts as an important part of the copper network can be used to build the fibre access network and these are in oversupply due to the fact that fibre needs less than the capacity being released by the decline in the copper network. If this oversupply is not of a temporary nature and expected to exist in the future, the argument developed above for the whole copper network would also apply to ducts as a component of the fibre network. Also in this case one could ask in a thought experiment what fibre network providers would be willing to pay for the part of ducts that they could use to roll out their fibre networks. Practically, it would be very difficult to get this answered non-strategically. Again, in competition the relevant cost base for these ducts may well be short-run avoidable costs.

To conclude the discussion on opportunity cost-based pricing, this notion is also fairly well known from the debate about the efficient component pricing rule (ECPR).[86] According to this rule the relevant costs of wholesale access include the marginal (or incremental) costs of producing it plus the downstream margin that the access provider foregoes by not selling the resulting service itself in the downstream market. The problem with this notion of opportunity costs is that the access provider might set a price downstream that reflects market power so that the ECPR may include monopoly rents. A proper definition of economic opportunity costs therefore would only allow for the inclusion of a competitive downstream margin and therefore be based on competitive retail prices. This would require something like a “hypothetical competition test”. If done correctly the test should lead to opportunity costs that are consistent with those that one would obtain in the hypothetical scenario discussed earlier in which a competitor bids in an auction for the whole copper access network.

3.4.4 Assessment of alternatives

Each of the alternatives to LRIC have some desirable features which have relevance for a proper pricing of copper-based wholesale access. Short-run incremental cost provide a relevant price floor in declining markets and also in a MEA environment. Historic cost can have relevance for asset valuation to avoid the danger of cost under-recovery or

86 See, for example, Vogelsang (2003) for an overview of the debate.

windfall profits. This can have relevance if strict LRIC in declining markets generate excess profits as well as if an opportunity cost approach would generate cost under-recovery.

The opportunity cost approach is theoretically most appealing, because it comes closest to the ideal simulation of the conditions in a competitive market in growing as well as in declining markets. This approach, however, needs to be translated into a practical feasible approach. In expanding markets the practical translation is LRIC. In declining market it is the range between SRIC as the lower bound and LRIC as the upper bound calculated the last time before declining demand. The exact price in that range should be determined to maximise economic welfare.

The floor for the wholesale price should be the short-run incremental cost (SRIC) of providing the copper ULL. The SRIC consists of the out-of-pocket expenses for continuing to offer the product. If retail prices fall to such a level that the derived wholesale price of the copper ULL falls below the level of SRIC, the incumbent would lose money even in the short run. When prices reach that level the rational business decision then is to take that network out of business. In any case, at such prices the incumbent would actually be motivated to cease offering the service altogether, both at the retail and wholesale level, and in general such a shut-down of operations should not be prevented by regulatory intervention. It would in any case hold that by this time the migration from copper access to fibre access would for all intent and purposes have been complete. Maintaining an offer of copper ULL under these circumstances would then not be justified any more.

The approach of the EU costing Recommendation[87] generates a specific value in that relevant range as well as our MEA performance delta approach.[88]

87 See Section 4.
88 See Sections 4.5.1.2 and 6.3.2.

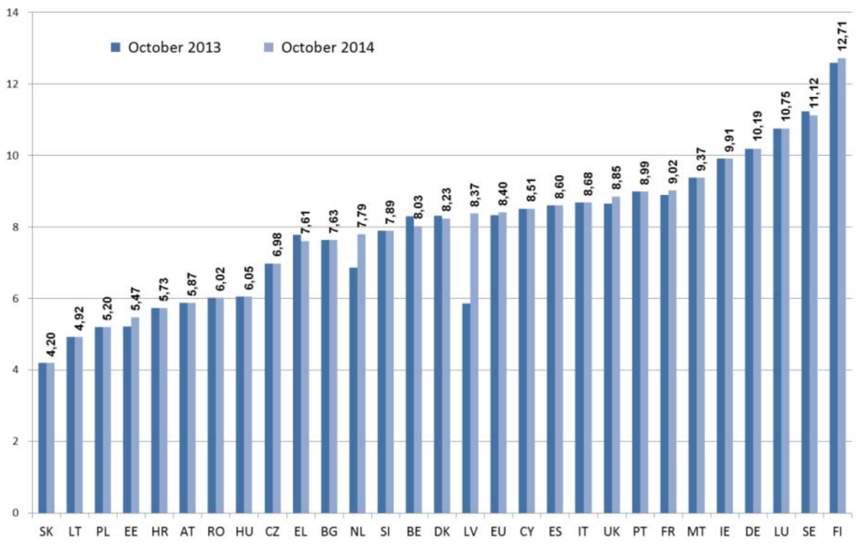
4 The EU costing Recommendation and its potential implementation in France

4.1 Background of the costing Recommendation

Already in 2010 the Commission had identified that the NRAs apply quite different costing methodologies to determine cost-based wholesale prices. Even when the same cost standard was used, significant deviations could be identified with the implementation in detail. The conclusion of the Commission was and still is that the significant deviations of wholesale prices within the EU cannot solely be explained by objectively existing national differences in costs. The Commission saw and still sees impediments to the internal market following from these discrepancies and in particular disadvantages for the operators' investment. These effects are assumed to follow from a missing predictability and uncertainty for investors, competitors in the market and new entrants.

Figure 4-1 shows the spread of the monthly ULL charges in the Member States 2013 and 2014. At an EU average value of 8,48 Euro in October 2014, the ULL prices spread between 4,20 Euro in Slovakia and 12,71 Euro in Finland. The French ULL charge with a value of 9,02 Euro was significantly higher than the EU average value at that time. Because ULL charges have been reduced in several Member States, meanwhile this discrepancy even has enlarged.

Figure 4-1: Monthly ULL charges in the EU



Source: EU Commission, Financial Indicators, Fixed and mobile telephony, Broadcasting and bundled services indicators, 2014

From this identification of facts and problems the Commission announced in its Digital Agenda[89] to work out a recommendation to develop guidelines to calculate wholesale charges on the basis of a uniform costing methodology. Special emphasis was addressed to the transition from copper to fibre networks. The extensively discussed Recommendation also includes guidelines for consistent non-discrimination obligations and for margin squeeze tests. These two latter aspects are not relevant in our present context.

4.2 The basic concept of the Recommendation

The Recommendation starts from the baseline of classical principles of efficient wholesale pricing. This includes in particular:

(1) Competition standard: The relevant access price shall as much as possible represent the outcome of an effectively competitive market.[90]

(2) The costing methodology should be based on a modern efficient network.[91]

(3) Cost recovery: The regulated company shall be ensured to cover costs that are efficiently incurred and receive an appropriate return on invested capital.[92]

(4) Bottom-up cost modelling: The relevant cost should be calculated on the basis of a bottom-up cost model.[93] The cost model shall model the cost of a hypothetical efficient operator.

(5) Cost standard: Costs should be determined on the basis of the LRIC+ cost standard and represent the current cost that an efficient network operator would incur to build a modern network today. The total service approach should be applied: The efficient operator produces all relevant access services in one network.[94]

(6) The costing methodology shall provide the appropriate 'build-or-buy' signal and an appropriate balance between ensuring efficient entry and sufficient incentives to invest in NGA.[95]

89 See EU (2010).
90 EU (2013), Rec. (25).
91 EU (2013), Rec. (25).
92 EU (2013), Rec. (26).
93 EU (2013), Rec. (29).
94 EU (2013), Rec (29) and (30).
95 EU (2013), Rec. (27).

These general principles are further specified before the background of network migration towards NGA networks. Additional targets are formulated in this context. These are the following:

(1) Stable and predictable wholesale prices: The costing methodology should reflect the need for stable and predictable wholesale copper access prices over time.[96] Significant fluctuations and shocks should be avoided. Thereby, the copper access price should serve as an anchor for NGA services.

(2) Constant demand: The costing methodology should deal appropriately and consistently with the impact of declining volumes caused by the transition from copper to NGA networks.[97] This should be achieved by modelling a single efficient NGA network for copper and NGA access products. Relevant demand should then be the sum of copper access and NGA line demand.

(3) MEA: Since no operator would today build a pure copper network anymore, the costing methodology should be based on a modern efficient NGA network as the relevant MEA.[98]

(4) The costing methodology should ensure transparency and consistency within the EU. Nevertheless, specific national circumstances should be reflected.[99]

(5) Price band: The Commission anticipates that there is only the potential for limited local cost variations if a uniform costing methodology would be applied within the Member States. To ensure stable and predictable wholesale copper access prices the Recommendation sets a price band for the average monthly rental access price for the full unbundled copper local loop in the range between 8 Euro and 10 Euro (net of all taxes) expressed in 2012 prices.[100]

These general and the (NGA) specific targets should be achieved by a set of specific and detailed guidelines. This includes in particular:

(1) The MEA reference architecture.

(2) A different treatment of re-usable and newly invested assets.

(3) The determination of the assets of the regulatory capital basis.

(4) The valuation of the regulatory asset base.

(5) Determination of the relevant demand.

96 EU (2013), Rec. (25).
97 EU (2013), Rec. (25) and (39).
98 EU (2013), Rec. (31).
99 EU (2013), Rec. (28).
100 EU (2013), Nr. 41.

We will describe and assess these guidelines in more detail in Sections 4.4 to 4.9. In this context we will also provide proposals how to implement the guidelines and recommendations against the backdrop of the specific and concrete market situation in France. We will also try to close some gaps and inconsistencies in the concept of the Recommendation by conducting practical implementation proposals. Before that, in Section 4.3, we will give a brief summary of the discrepancies between ARCEP's current costing methodology and the Recommendation.

4.3 Why is ARCEP's current costing methodology not in line with the EU costing Recommendation?

NRAs have to take utmost account of the costing Recommendation when determining ULL charges. However, NRAs should ensure that the recommended costing methodology is implemented by 31 December 2016 at the latest. However, under certain conditions NRAs may continue to apply the costing methodology they currently use beyond 2016. No. 40 of the Recommendation formulates four criteria, which the applied costing methodology must satisfy besides meeting the objectives as set out in recitals 25 to 28, to be exempted:

(1) If modelling an NGA network, it should reflect a gradual shift from a copper network to an NGA network.

(2) It should apply an asset valuation method that takes into account that certain civil infrastructure assets would not be replicated in the competitive process.

(3) It should be accompanied by documented projections that ULL charges will not fluctuate significantly and therefore will remain stable over a long period of time. Furthermore, regulatory transparency, predictability and price stability should be ensured.

(4) It should require only minimal modifications with respect to the costing methodology already in place in order to meet the first three criteria.

Furthermore, the currently used costing methodology should meet the objectives of the recommended methodology. In the following paragraphs we will show that ARCEP's current costing methodology is neither coherent with nor does it comply with the costing methodology developed by the Recommendation. Then we will show that the conditions of an exception according to No. 40 do not comply in the French case.

For the following reasons and in the following respects ARCEP's cost determination approach is not coherent with and does not comply with the costing methodology of the Recommendation:

(1) The ULL prices do not meet the competitive standard: In case of decreasing demand and technological progress, the value of an old technology as well as the corresponding prices will not increase but decrease in a competitive market.

(2) ARCEP's cost model is not based on a modern efficient network. Instead, it relies end-to-end on the outdated copper technology.

(3) The ULL charges cover more than the efficiently incurred cost to provide the ULL services and lead to over-recovery of the relevant cost in several respect.

   a. Cost determination is based on actual (outdated) network assets and costs and not on those of an efficient network and the efficient operation of it. ARCEP does not even conduct efficiency corrections to close the gap between actual and efficient cost.

   b. Part of the ULL cost base are costs which are exclusively caused by and therefore incremental to fibre and not to copper access.

   c. Capital costs are determined on the basis of the gross CCA value of the assets and not on the CCA value net of depreciation in the past as requested by the Recommendation. Capital costs are inflated by this approach.

(4) ULL costs are not calculated by means of a bottom-up cost modelling approach but on the basis of a top-down costing approach without efficiency adjustments.[101]

(5) Costs are calculated by using a CCA FDC cost standard and not the LRIC+ standard as requested by the Recommendation.[102] Costs do not represent the current costs that an efficient network operator would incur to build a modern network today.

(6) The costing methodology does not provide the appropriate 'build-or-buy' signals and the appropriate balance between efficient entry and sufficient incentives to invest.

(7) ARCEP's costing methodology does not generate stable and predictable ULL wholesale prices. Instead, it generates progressively increasing charges over time.

101 Therefore, inconsistencies in the asset volumes may occur. See our analysis in Section 4.7.
102 The difference between FDC and LRIC follows from (missing) efficiency adjustments.

(8) The current costing methodology leads to increasing costs if demand migrates from copper to NGA. Therefore the methodology does not comply with the requirement of migration neutrality regarding demand in the Recommendation.

The conditions of No. 40 for not meeting the requirements of the Recommendation are not fulfilled in the French case. ARCEP's costing methodology does not meet three of the four conditions:

(1) ARCEP's model does not represent an NGA network.

(2) ARCEP's approach can and actually does apply a specific asset valuation for non-replicable assets.

(3) ARCEP's costing methodology does not generate stable and predictable ULL charges. Charges will progressively increase in the future. This follows from the methodology itself as well as from ARCEP's intentions.

(4) In order to comply with the recommended costing methodology not minimal but major modifications or even a totally new costing set-up is needed.

4.4 The MEA reference architecture

According to the Recommendation the cost model should be based on an efficient NGA network architecture as a reference network. The Recommendation itself does not determine this architecture. A modern and efficient NGA network could be an FTTB network, an FTTH network, an FTTC network or a combination of two or all of them. The Recommendation leaves it up to the NRA to determine the relevant MEA reference architecture according to the specific national conditions. In the words of the Recommendation: "*When modelling an NGA network NRAs should define a hypothetical efficient NGA network, capable of delivering the Digital Agenda for Europe targets set out in terms of bandwidth, coverage and take-up, which consists wholly or partly of optical elements.*"[103]

The Recommendation also provides the option that the copper costs are obtained by modelling an NGA overlay network, where two networks (copper and fibre, either FTTH or FTTC) share to an extent the same civil infrastructure.[104]

What are the relevant MEA options in France? We see two relevant options: (1) A nationwide FTTH network. (2) A combination of FTTH and FTTC, where the FTTH coverage area represents the intended coverage area realistically achievable in the medium term and FTTC covers the rest of the country.

103 EU (2013), Rec. (32).
104 See EU (2013), No. 37.

4.4.1 FTTH for the intended FTTH coverage area

Currently, the access network is still dominated by a copper access architecture. Orange's FTTH network covers 5.5 million homes in Q1 2016 (which represents 17.7% of all households) and its FTTC network covers an additional 500.000 lines. The rest of the network remains purely copper-based access. These numbers, however, only describe the actual deployment status at a certain moment in time. The LRIC+ standard and the Recommendation, however, clearly request that the relevant network platform is not the structure of the existing architecture. Instead, the relevant reference architecture should be a nationwide NGA network.

Both, for technological reasons as well as against the background of the actual network deployment in France, it seems reasonable to choose an FTTH network architecture as the relevant MEA for cost determination. Only an FTTH network can provide Gigabit bandwidth without (any) restrictions and at full symmetry and the highest quality levels. Since wholesale access prices shall provide the right signals towards the most future proof network architecture in a long-term perspective the decision relevant cost should therefore be based on an FTTH network as the MEA for a copper access network. Different to other Member States, that is what operators in France actually do in their deployment strategy.

Should FTTH be the reference architecture on a nationwide basis? As we have shown in Section 2.3, operators heavily invest in fibre. Nevertheless, there will not be a nationwide coverage by 2022, but 80% plus. Up to 20% of the country will still only be served by a hybrid fibre/copper FTTC access. This part of the population will only get access to superfast broadband via an FTTC NGA architecture and its limited broadband perspective. Therefore, it is a viable approach to have a mix of FTTH and FTTC as the relevant NGA MEA in France. Nobody knows today when a nationwide FTTH architecture can realistically be achieved. The technology mix architecture has the advantage to be adapted gradually to a nationwide FTTH coverage just by changing the mix. In a medium-term perspective we would regard a 80% FTTH and 20% FTTC mix as appropriate.

4.4.2 FTTC for the rest of the country

For that part of the country where FTTH is not (yet) the appropriate MEA reference architecture, FTTC should be the relevant NGA architecture. The FTTC coverage area is part of the less dense area as defined by ARCEP. This area should be that part of France where it is most costly to deploy FTTH. Instead of constructing the fibre access lines to every building it is significantly cheaper to make utmost use of the existing final drops of the copper access lines, because these represent the largest part of the investment required otherwise.

The higher the transmission frequency used, the higher the attenuation on a copper cable. The higher the bandwidth, which shall be transmitted, the higher the frequency required and the shorter the copper access line can be. Modern broadband copper transmission systems allow for access line length of a few hundred meters between the end-customer location and the traffic and access line aggregating DSLAMs. So the DSLAMs will be installed in street cabinets beside the existing ones or replace them. The existing subloops will be re-used. Modern DSLAMs using VDSL2 Profile 35b enable broadband capacities of 150 Mbps over a maximum distance of 300m. Beyond that distance the capacity decreases and is at a few Mbps at 500m[105].

To generate a sufficient NGA performance it may be necessary to shorten the long copper loops in this area. Compared to the current network architecture this may require to install new and/or additional cabinets in order to bring DSLAMs closer to the customers premises. This may require additional fibre investment in the feeder segment. If the modelling approach is bottom-up that is not an issue. The appropriate DSLAM locations will be efficiently located in the area taking into account restrictions like the maximum subloop length and the DSLAMs capacity constraints, also efficiently minimizing civil engineering cost for cabling along the most efficient routes. This is a state-of-the-art modelling approach, which in bottom-up modelling has to be performed in any case. A top-down modelling approach works differently, because it starts with the existing cabinet locations and is not able to efficiently modify them. In that case the relevant network elements have to be deployed anyhow. That is different in a top-down modelling approach. Here the prevailing network architecture is not capable of building the appropriate asset base. Therefore a bottom-up modelling approach is highly advisable.

105 This capacity may be increased by eliminating the crosstalk between the copper pairs using the vectoring technology. Disadvantage of vectoring is the fact that it only works if one operator operates all copper access lines of the downstream cables und by this restricts infrastructure competition, i.e. ULL or SLU. We understand, that the use of the vectoring technology is not debated in France at all and not allowed to deploy.

4.5 Cost determination

4.5.1 FTTH

4.5.1.1 Cost modelling

It is not the intention and the scope of this study to develop a blueprint for or guidelines of a bottom-up fibre cost model in France. We understand that ARCEP has a fibre model[106] at its disposal which was used to identify the profitability of fibre deployment throughout France and to determine the location of mutualisation points. In principle, this model infrastructure should also be capable of calculating (fibre) ULL cost. At least, the basic building blocks of the model should be usable to build a suitable model.

In our point of view the following basic construction principles should be considered in the modelling:

(1) To calculate (copper) ULL cost the fibre architecture should be a point-to-point architecture as this is a viable FTTH architecture which is coherent with a copper network architecture.

(2) The model should be built in a Brownfield and not in a Greenfield environment. The deployment of the network should make the most efficient use of available infrastructure. This holds in particular for ducts but also for poles. These non-replicable assets should be valued according to the principles of the Recommendation.[107]

(3) The modelling approach shall assume that the whole relevant fixed line demand is served by the fibre access network.

(4) The access line deployment shall be performed in the most cost efficient manner by optimizing the trench length and, where appropriate, a deployment on both sides of a street.

(5) As the vast majority of copper inhouse cabling has been paid for by house owners in France, in any case they belong to the house owners, this should also be the costing platform for the fibre network. This holds independent of the fact that currently most of the fibre inhouse cabling has to be invested in by operators.

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106 See ARCEP, Coûts de déploiement des réseaux FttH; Consultation publique du 15 juin au 22 juillet 2011.

107 See Section 4.6.

(6) A 80% fibre coverage is not profitable in France. According to ARCEP's calculations, only 57% of the population can be covered economically viable.[108] A private operator would not provide that degree of coverage without public subsidies. Such subsidies reduce the investment requirements for providing coverage. If those subsidies were not taken into consideration when calculating ULL charges, users would have to pay twice for coverage: firstly in their capacity as taxpayers and secondly as broadband users. Such subsidies are not only relevant in the case of fibre deployment, they also were present in deploying the copper network as a nationwide network.[109]

(7) The cost of the fibre network should be calculated on the basis of a penetration rate which is identical with that of the whole fixed line network(s) today which is the sum of fibre and copper access lines today. That is the relevant steady state demand for calculating LRIC and not a certain migration status to fibre.

(8) There seems to be some common sense that investing in fibre currently is more risky than operating the legacy copper network today. Such a higher risk is basically related to the take-up of and the migration to fibre. These transitional aspects are, however, not relevant for an LRIC calculation. Such risk factors are not present in a fibre reference scenario which represents the steady state of the scenario where all customers have migrated to the fibre platform as the sole fixed line network platform. Thus, there is no fibre specific risk to be included as a WACC uplift.

The individual network elements of a copper and a fibre network may cause different costs. We have listed these differences in Table 4-1. These differences can only be properly addressed and quantified in the context of a concrete access network cost model. If, however, the same principles of modelling are applied for the copper and fibre network, which we have listed before, there are some indications that copper and fibre access line costs should not differ much. This follows from the fact that the by far dominating civil engineering costs are basically the same. Table 4-1 lists the major cost differences between a copper and a fibre access network.

That is also the result of the cost calculation of the Swedish regulator PTS[110]. The prices for copper and fibre access lines are identical (at 287 SEK per quarter or 10,31 €/month on a national level). In Sweden consistency of pricing in the cost oriented products for different technologies are ensured through the use of the same BU-LRIC+ cost model. Copper ULL charges are based on the same cost calculation model as fibre unbundling/ODF access on the basis that fibre is the MEA for copper (with the exception of remote areas, where wireless connections are considered to be the

108 See Section 2.1.
109 See Section 1.2.
110 PTS price determination decision of 19.02.2015: http://www.pts.se/upload/Beslut/Internet/2015/11-9306-rattelse-beslut-lokalt-tilltrade-150320.pdf

relevant MEA). FTTB as well as FTTH is considered in the cost calculation. This ensures – according to PTS – consistency between the cost of copper and fibre and allocation of duct and common costs between them.

There is no difference in the WACC for copper and fibre calculation on the basis that fibre in Sweden in typically rolled-out in response to demand and is not subject to a specific risk. Cost calculations for fibre in the model are based on five geographic zones (1. city areas (mainly multi-dwelling), 2. urban, 3. rural (mainly detached houses), 4. single houses in rural areas and 5. sparse areas). Although the WACC and the relevant costs are the same, ODF access/fibre unbundling charges are higher per household than those for copper ULL for access to single dwellings. This is because PTS calculates the charges for access to single dwellings for all geographic areas on the basis of costs calculated in relation to geotype 3. This cost is considered to be more representative in general of the costs of fibre deployment in any detached house area and reflects the fact that such fibre access may still be underdeveloped and therefore characterised by a higher roll-out risk.

Table 4-1: Cost comparison of network elements of a copper and a fibre access network

Network element	Cost comparison
MPoP/MDF	Fibre distribution frame significantly more expensive than copper frame
Copper/fibre cables	Fibre cables slightly less expensive
Greenfield deployment cost	Slightly lower for fibre (lower cable diameter)
Ducts/manholes	Equal
Joints/splices/splitter	Significantly more expensive for fibre
Network termination	More expensive for fibre
Street cabinets	Not necessary in a fibre network
Active equipment (GPON)	Not relevant for copper
OPEX	Significantly lower in a fibre network

4.5.1.2 Performance delta

We have introduced already the basic approach of the concept of copper access pricing according to FTTH MEA in Section 3.3.4. We have only shortly covered there the question how to determine the performance delta between copper and fibre access. This will be worked out further in this subsection.[111]

Fibre as the new access technology represents the MEA for copper access. The MEA technology not only provides the services of the old technology, in addition it provides additional and superior services. If the old technology should be priced according to the MEA technology, not only cost differences have to be taken into account but also the differences in the services provided. The latter one we call the performance delta. MEA pricing then would imply:

$$LRIC_{MEA} = LRIC_{FTTH} - \Delta perf.$$

There is as of now no established methodology available for measuring Δperf. We see the following potential methods:

(1) Capacity differences in the provision of services,

(2) Measurable QoS differences,

(3) Bandwidth for services as a measure for the services provided for end-users,

(4) Value differences.

The Danish regulator DBA has based its MEA approach on cost differences between fibre and copper access.[112] This criterion is in our view not appropriate because it is input- and not output-based. Performance of a technology is, however, related to the output of the technology. Although fibre and copper access are produced at slightly different costs – as we have discussed in the previous subsection – these differences are not related to the performance differences.

Obviously the largest difference between copper and fibre lies in the transmission capacity of both, which is the reason for exchanging the transmission medium. At a quick glance transmission capacity is quite easy to determine and might be easily used determining a performance delta between the two transmission media copper and fibre access. In fact it is not an appropriate approach: While the copper transmission capacity not only has an upper limit, but in addition depends on the line length, a fibre access line is length insensitive. The transmission capacity of an NGA network strongly depends on its architecture chosen. We illustrate this with some examples: FTTC with

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111 The analysis presented here relies on Neu/Neumann/Vogelsang (2012) and Neumann/Vogelsang (2013).

112 See Section 5.2.3.

VDSL2 profile 35b may provide 150 Mbps downstream on short sub-loops. This performance will drop significantly with the loop length. FTTH GPON is limited in capacity to 2,5 Gbps down- and 1,25 Gbps upstream, upgradable to XGS-PON with 10 Gbps symmetrical, but the capacity is shared between up to 128 end-customers. FTTH in a Point-to-Point topology allows to exploit the fibre's capacity completely and individually per customer, just determined by the transmission systems connected at both ends. An Ethernet architecture offers standard interfaces up to 100 Gbps; DWDM transmission systems support several Tbps, so some magnitudes more. A pure ADSL2 driven copper access line may support up to 16 Mbps on short length, a fibre access line up to 16 Tbps with today's equipment and in fact length independent[113]. Thus capacity differences between the transmission media copper and fibre are very disperse, depend on line length and network architecture and thus are hard to be determined and are not suitable for being taken as a serious representation of the performance delta[114].

There is a variety of measurable QoS components in which copper and fibre access differs. This is e.g. speed, break down risk, ability and type of applications etc. These quality differences are often but not in all cases measurable. In the case at hand these differences can be huge representing multiples. It is not an obvious task how to aggregate and to weight the different quality components. This holds in particular for quality features which are not quantifiable. Such differences can only be identified by transforming them into their value assessment by customers. They cannot be quantified technically.

The most straight forward approach to measure Δperf technically would be based on the quality indicator bandwidth. There is no aggregation problem if bandwidth is taken as the sole relevant quality component. FTTH bandwidths, however, tend to be large multiples of copper bandwidth. If a copper loop today provides 100 Mbps and a fibre loop 1 Gbps, then the performance delta would be a factor of 10.

The obvious problem of such approaches to identify and measure Δperf technically is that such quality indicators are very imperfectly related to the monetary values which users attribute to the different access services. User valuation usually generates a non-linear relationship between capacity (bandwidth or quality) and the monetary valuation by users which goes back to the general economic law of declining marginal benefits. Value differences therefore are much lower than capacity and quality differences.

This indicates that any method to calculate the performance delta which is not based on value considerations, will overestimate the delta by far. This valuation has to be transformed into value differences to be applicable as opportunity cost differences.

113 Over a distance of 100 km without repeaters.
114 As an intellectual game: Take DWDM capacity as a starting point, GPON capacity as an intermediate point, assume a linear scale: this could drive down a copper price close to zero, significantly below its SRIC, or even into the negative sphere.

Which value differences are of importance? How are they measurable? Market prices (to the extent available) are the most acceptable means for economists to measure such value differences. Market based and determined value differences express the performance delta therefore much more correctly than other methods.

One relevant method could be 'hedonic pricing'.[115] This approach considers FTTH as a new combination of already existing services, for which market valuations are known. This method is of particular relevance, if market prices for FTTH are not (yet) available.

We propose a more direct method based on observations of retail market prices for both copper and fibre access.

Product offerings in the retail market consist of a variety of product bundles, which change and develop over time. The prices of wholesale products, on the other side, which are used to produce a variety of end-user products are relatively easy structured. Therefore not all retail products can be directly attributed to wholesale products but only the whole set of services of a supplier. The average revenues per user (ARPUs) of a supplier can represent all packages of retail products. FTTH allows for different and more valuable packages compared to copper ULL. Therefore higher ARPUs can be earned on the basis of FTTH. The observed ARPU differences therefore reflect the value differences on the demand side. This holds for competitive markets. Market power or strategic behaviour may potentially distort the efficient outcome.

The basic idea of the MEA concept is to identify the proper relationship between the copper wholesale price and the relevant LRIC of the unbundled fibre line. The performance delta is adequately determined if the access seeker is indifferent between buying copper access at a_C and buying FTTH access at $a_F = LRIC_{FTTH}$. This is equivalent to build the fibre network itself. This holds if Δperf solves

$$a_C = LRIC_{FTTH} - \Delta perf.$$

Δperf is not directly given by the price differences between the respective retail access products. The relevant Δperf has to include in addition to the difference in the retail price the difference in costs incurred downstream. Therefore it holds:

$$p_F - C_{Fdownstream} - LRIC_{FTTH} = p_C - C_{Cdownstream} - a_C = p_C - C_{Cdownstream} \underbrace{- LRIC_{FTTH} + \Delta perf}_{-a_C} \qquad (1)$$

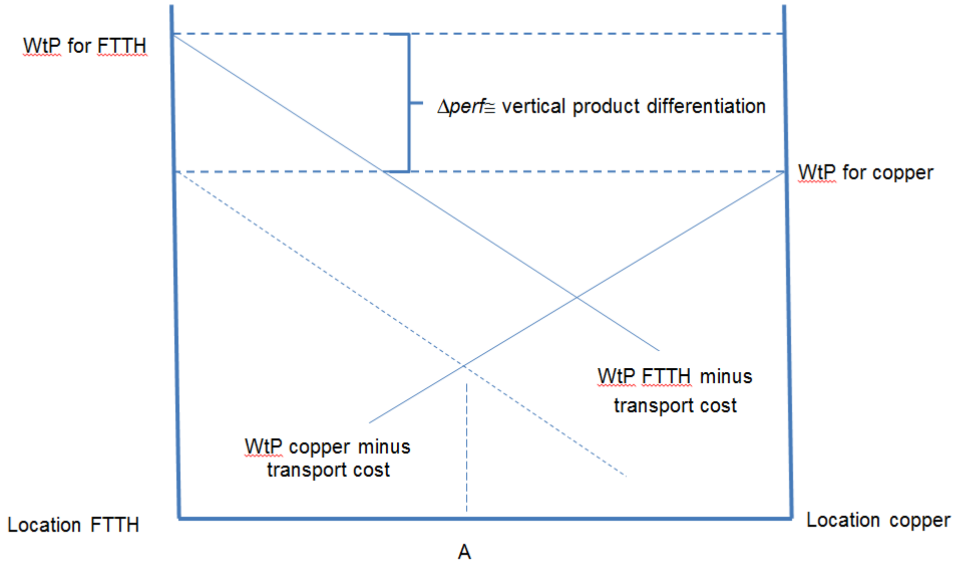
Here $C_{Fdownstream}$ and $C_{Cdownstream}$ are the average downstream variable costs of providing FTTH and copper at retail. The equation implies:

$$\Delta perf = (p_F - p_C) - (C_{Fdownstream} - C_{Cdownstream}), \qquad (2)$$

115 Pioneered by Rosen (1974).

which is the difference between the downstream mark-ups of copper and FTTH. This specifically neglects any fixed costs downstream, which are irrelevant for price setting, but could be relevant for entry and exit decisions of alternative service providers.

Figure 4-2: Illustration of Δperf in a simple Hotelling model



Source: Neumann, Vogelsang (2013)

Figure 4-2 illustrates some relationships between the MEA approach and product differentiation in the context of a simple Hoteling model.

The practicability and the equilibrium features of this MEA pricing concept have been tested in a numerical game theory based simulation model presented in Neumann/Vogelsang (2013), which was originally developed by Hoernig et al. (2010 and 2011). We do not want to go into the details of this exercise here and refer to Neumann/Vogelsang (2013) for details. Here we only want to highlight a few important results:

(1) The model provided very consistent results, in line with theoretical expectations.

(2) A process which starts at the current (distorted) level of copper access prices converges to the "correct" and stable Δperf in a glide path with a few model iterations.

(3) There are limited incentives for strategic behavior.

(4) The method tends to be conservative meaning that the measured Δperf underestimates the theoretical Δperf.

(5) Δperf could be overestimated if the incumbent exercises market power in the FTTH markets.

(6) According to the philosophy of the MEA approach, retail prices of altnets should inform the Δperf. Averaging between incumbent's and altnets' prices could make the price data more robust and avoid strategic behavior.

(7) Changes in the willingness to pay of end-users result in consistent changes in the Δperf values

(8) To protect against extreme outcomes, SRIC+ and $LRIC_c$ could be introduced as lower and upper bound for the resulting copper access charge.

4.5.2 FTTC

If the MEA reference architecture is represented by an FTTC architecture the problem arises that the access network terminates at the cabinet and no longer at the MDF. In this case the fibre link between the cabinet and the MDF, the so called feeder segment, no longer is part of the access network, but part of the backhaul or aggregation network. Furthermore, it is a fibre and no longer a copper link as would be needed for ULL. The Recommendation offers two options for solving this problem:[116] According to the first option the cost difference between the modelled NGA network and the access product entirely based on copper should be estimated by replacing the optical elements (in the feeder segment) with efficiently priced copper elements. This detour is not necessary in our view. A bottom-up copper-based engineering cost model directly delivers the result as the detour approach would. That is the way the Danish NRA has taken.[117]

In the second option the copper costs could be obtained by modelling an NGA overlay network, where two networks (copper and FTTC) share to an extent the same civil infrastructure. The overlay approach assumes a different mix of technologies in each period, whereby the share of the new technology increases over time. That way, a migration path explicitly becomes part of the cost calculation. This approach has been implemented by the Spanish NRA, as we show in Section 5.2.4.

4.5.3 Cost averaging

Calculating ULL cost for the FTTH coverage area generates a distinct ULL cost. These costs can in principle be calculated for each individual MDF/ODF area. According to our experience they may also be different for each MDF/ODF area. Usually costs are however homogeneous according to some geotype parameters of MDF/ODF areas. In our own bottom-up fibre modelling in several countries we found that MDF/ODF areas

116 See EU (2013), No. 37.
117 See Section 5.2.3 of this study.

can be appropriately clustered according to customer density in the MDF/ODF areas.[118] Calculating the cost in such substructures helps understanding the economic problems of a nationwide roll-out of broadband network infrastructure and the potential subsidies required.

We understand that a nationwide uniform wholesale pricing has been a strong and guiding principle in the French regulatory policy. According to our understanding of statements and policy papers of the French Government and ARCEP nationwide uniform access conditions are also a highly important policy goal for NGA at least so far. Therefore, we assume that ARCEP will generate a uniform fibre cost from a fibre cost model. In deficit areas the subsidies should be dimensioned supporting this goal.

What does this policy goal mean and imply for those areas where FTTC will be the NGA MEA architecture? Firstly, calculating ULL cost for the less (or least) dense areas will generate higher ULL cost per end-customer than in the denser areas. Costs per line may spread by a factor of five or even more. This holds independent of the underlying NGA architecture. By taking properly dimensioned subsidies into account the goal of a nationwide harmonized access price may be achieved. Nonetheless, the end-customers will experience the fact, that they do not receive services of the same quality (and bandwidth). This fact may become part of a political debate about a digital divide and additional subsidies allowing to overcome this disadvantage.

What would be the incentive implications of a separate and higher ULL price in the FTTC coverage area? These implications of price differentiation leads to the clear conclusion that only a nationwide uniform ULL price for both the FTTH and the FTTC coverage area is consistent with the French regulatory and broadband policy targets (so far). This can be the weighted average of both cost figures.

4.6 Different treatment of non-replicable and replicable assets

When modelling an NGA network, NRAs should – according to the Recommendation[119] – not assume that each network element of an NGA network should be newly deployed. Instead, NRAs should reflect the usual business practice of operators to include any existing civil engineering assets that are generally also capable of hosting an NGA network for the deployment of the relevant NGA network. In other words: network deployment should not follow a Greenfield but a Brownfield approach. The Recommendation is guided by the following considerations: On the one hand, it shall be secured that the access provider can cover its efficiently incurred costs. On the other hand, cost over-recovery should be avoided. This risk is high for assets which are re-usable for an NGA network as civil engineering infrastructure. Another aspect is that the

118 See for example our fibre cost modelling in Germany. The overall results of this modelling are, published in Jay, Neumann, Plückebaum (2012).
119 See EU (2013), No. 32.

re-usable civil engineering infrastructure is not economically replicable by access seekers in a viable way because of economies of scale and scope. We support this assessment. Conceptually, the approach of re-usable assets needs more precision.

Assets of today's copper access network are re-usable if they can be used as essential network elements within the architecture of the NGA network which is going to be modelled. These network elements do not require new investment. The Recommendation mentions in this context ducts, manholes, trenches and poles[120] as examples. On the other hand, technical equipment and the transmission medium (e.g. fibre) are mentioned as replicable assets.

The concept of re-usable assets needs more precision. First of all, such assets can only be defined on the basis of the relevant NGA architecture. There are other assets re-usable for an FTTH network than for an FTTC architecture. The following assets and network elements are re-usable for an FTTC network:

(1) In the feeder network (links between MDF and street cabinets)

    a. Ducts, trenches and manholes

    b. Poles (in case of aerial cabling).

(2) In the distribution network (links between end-user and street cabinet)

    a. All network elements of the distribution network, including

        i. Street cabinet locations

        ii. Ducts

        iii. Trenches

        iv. Manholes

        v. Poles

        vi. Copper cables

        vii. Inhouse cabling.

For an FTTH network (only) ducts, trenches, manholes and poles can be re-used. Most NRAs dealing with the re-usability concept only treated civil engineering assets as re-usable. A limitation of re-usable assets on these assets categories is insufficient, conceptually inappropriate and not convincing in the case of FTTC. Each SMP operator uses its whole existing copper distribution network for its FTTC network. An FTTC

120 See EU (2013), Rec. (34).

network is defined that way. This view also is supported by the replicability concept. No competitor builds or is able to build its own copper distribution network. Economies of scale and scope do not allow replicability of these network elements. Competitors rely on the incumbent's legacy infrastructure for these network elements. Thus, the (whole) distribution network (including all copper cables) is re-usable for FTTC NGA, both for the incumbent and for altnets.

4.7 Determining the assets of the regulatory capital base

Besides classifying relevant assets according to their replicability feature, their volume has to be determined. Re-usable assets which should be valued according to the indexation method (see Section 4.8) would rely on historical data on expenditure, to the extent that these are available from regulated operator's accounts and financial reports.[121] The Recommendation does not directly address the determination of relevant asset volume. The implicit assumption seems to be that the financial accounts provide the relevant asset volumes. This assumption is conceptually critical, contradictory and impracticable.

The asset volumes from the accounts – if available at all in the relevant detail and disaggregation – are not identical to those which represent the asset volumes of an hypothetical (NGA) efficient network determined on the basis of an engineering bottom-up model. This is the usual outcome of any reconciliation process which NRAs conduct to compare top-down and bottom-up-modelling results. Usually the asset volumes of the historic network are higher than those of the efficient network. In the case at hand such discrepancies are inevitable because the actual architecture of the network is different to the reference architecture. Just for that reason the financial accounts cannot deliver the relevant asset volumes.

Coherent results only can be achieved if the relevant volumes of network elements and assets are derived from the cost model itself. The age structure of various asset types then can be determined from the financial accounts; corresponding ratios can then be applied to the asset volumes of the model to identify the amount of fully depreciated assets and to determine the net book value of the assets to apply the RAB valuation approach as proposed by the Recommendation. That is in our view the only viable approach to be in conformity with the efficiency requirement.

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121 See EU (2013), Rec. (36).

4.8 Valuation of the regulatory asset base

The Recommendation foresees different valuation methods for re-usable and for all other assets. Re-usable assets should be valued according to the indexation method while all other assets should be valued according to their current cost. The indexation method relies on determining the net current cost value of the assets. It would rely on historical data net of the accumulated depreciation at the time of calculation and indexed by an appropriate price index, such as the retail price index.[122] In our view the retail price index is inappropriate for the purpose of generating the current cost for replacing the network assets today. Instead of looking for the appropriate index for replacing (old) assets today, it would be much easier to directly rely upon current cost of today. Fully depreciated assets are no longer part of the regulatory asset base. Furthermore, the net book values form the basis for determining the capital cost.

4.9 The relevant demand

The Recommendation addresses the conceptual costing problem of cost inflation due to declining demand. Active copper lines are decreasing due to customers migrating to cable, fibre and mobile networks. Depending on the modelling approach two types of cost inflationary effects may occur:

(1) Unit costs increase due to economies of scale in the access network.

(2) The fixed costs of the access network are distributed over a decreasing amount of active copper lines.

The second cost inflationary effect only occurs in a top-down modelling approach where all sunk costs are treated as fixed and therefore unit costs increase if the number of active lines decreases. This is different in a bottom-up modelling approach which designs the network according to actual demand. The size of the network in this case gets smaller if demand declines. In both modelling approaches the economies of scale aspect prevails. Given ARCEP's modelling approach, unit costs significantly react to decreasing demand.

The approach of the Recommendation to model a single efficient NGA network for copper and NGA access products neutralises the inflationary volume effect that arises from customers migrating from copper to NGA.[123] This recommendation would be implemented by considering the sum of copper and fibre demand as the relevant demand.

122 See EU (2013), Rec. (36).
123 EU (2013), Rec. (39).

The Recommendation does not solve the problem of increasing unit costs due to migration to other infrastructures like cable and mobile. The theoretical problems of (technically) applying LRIC in case of declining demand – as we have pointed out in Section 3.3.1 remain relevant independent of the source of declining demand. In a competitive market prices usually do not increase if an old technology becomes less competitive against superior technologies. To avoid this theoretical problem it is appropriate also to neutralise for this volume effect. This is best implemented by assuming a constant demand.

4.10 Final assessment

There is often the misunderstanding of the Recommendation that it steps away from the current cost valuation principle for a major part of the assets – those which are re-usable for NGA – and that it moves to a historic cost valuation. That is effectively not the case. The Recommendation still keeps the general valuation principles of current cost valuation. In case of re-usable assets they should only be determined differently, namely by indexing historic book values so that they can be replaced at current prices. Conceptually, using the "perfect" index transforms historic asset values to their current replacement cost. The CPI, however is not a "perfect" index to guarantee that.

By calculating the capital cost for re-usable assets on the basis of the asset value net of the depreciation in the past and by excluding fully depreciated assets from the cost base the Recommendation takes care that there will not be over-recovery of the re-usable assets' cost. Compared to applying annuities on the gross book values of assets this has a major impact on costs given the usual age structure of civil engineering assets.

Despite some conceptual open issues and problems the application of the costing principles of the Recommendation makes a lot of sense because it brings ULL charges into the relevant band of the opportunity costs as we have defined them in Section 3.4.3. In this sense application of the Recommendation generates efficiency improvements, compared to a mechanical application of the LRIC calculation approach.

5 First experiences in implementing the EU costing Recommendation

5.1 Overview

The costing Recommendation of 2013 requests form NRAs that they recalculate the ULL prices as soon as possible if the respective national ULL charge falls outside the 8 € to 10 € (in 2012 prices) price band. If the copper price falls within this band, the respective NRA may continue to use its previous costing methodology until December 31, 2016.

Many but not all NRAs have opted in the meantime to adopt their previous costing methodology to the one proposed by the Recommendation and have chosen their particular implementation approach. In Section 5.2 we will demonstrate in four specific national case studies how divergent implementation approaches have been chosen.

Table 5-1 shows that many NRAs (9 from 25) did not change their ULL prices in the period October 2013 to June 2015. Therefore, it may at the moment be a bit premature to assess the impact of the (full) implementation in all Member States. Some further snapshots in April 2016 indicate that not many price changes occurred between June 2015 to April 2016. Nevertheless, some NRA significantly increased (Latvia, Netherlands, UK) the ULL charges, some other (Denmark, Finland, Hungary, Luxembourg, Sweden) significantly reduced charges. The European average ULL charge remains at a (nominal) level of 8 €, mostly unaffected in that period. This also means that it is decreasing in real terms.

Only in Finland, Germany, Sweden, and the UK ULL charges exceed the upper bound of the price band in nominal terms.[124] In real (2012) prices probably all countries will fall into the price band. Most ULL prices fall into the European price band. Remarkable 14 countries have even set their ULL charges below the lower bound of the price band.

Compared to the European average price, there is stability of the ULL charges. This, however, does not hold for each country. Major changes have been conducted in individual cases. The spread of ULL charges has only slightly reduced in that period: form 4.20 € to 12.59 € in October 2013 (= 8.39 €) to 4.20 € to 10.70 € (=6.50 €) in June 2015.

124 The strong price increase in the UK in Table 5-1 mainly represents an exchange rate effect.

Table 5-1: ULL monthly rental charges in the Member States (October 2013 – June 2015; net of value added tax)

			October 2013	October 2014	June 2015	Change 2013 - 2015
1	AT	Austria	5,87 €	5,87 €	5,87 €	0,0%
2	BE	Belgium	8,30 €	8,03 €	8,03 €	-3,3%
3	BG	Bulgaria	7,63 €	7,63 €	7,41 €	-2,9%
4	HR	Croatia			5,77 €	
5	CY	Cyprus	8,51 €	8,51 €	8,51 €	0,0%
6	CZ	Czech Republic	6,98 €	6,98 €		
7	DK	Denmark	8,31 €	8,23 €	7,82 €	-5,9%
8	EE	Estonia	5,21 €	5,47 €	5,47 €	5,0%
9	FI	Finland	12,59 €	12,71 €	10,70 €	-15,0%
10	FR	France	8,90 €	9,02 €	9,05 €	1,7%
11	DE	Germany	10,19 €	10,19 €	10,19 €	0,0%
12	EL	Greece	7,78 €	7,61 €	7,61 €	-2,2%
13	HU	Hungary	6,05 €	6,05 €	5,72 €	-5,5%
14	IE	Ireland	9,91 €	9,91 €	9,91 €	0,0%
15	IT	Italy	8,68 €	8,68 €	8,68 €	0,0%
16	LV	Latvia	5,86 €	8,37 €	8,34 €	42,3%
17	LT	Lithuania	4,92 €	4,92 €	4,92 €	-0,1%
18	LU	Luxembourg	10,75 €	10,75 €	9,47 €	-11,9%
19	MT	Malta	9,37 €	9,37 €		
20	NL	Netherlands	6,86 €	7,79 €	7,87 €	14,7%
21	PL	Poland	5,20 €	5,20 €	5,30 €	1,8%
22	PT	Portugal	8,99 €	8,99 €	8,99 €	0,0%
23	RO	Romania	6,02 €	6,02 €	6,02 €	0,0%
24	SK	Slovakia	4,20 €	4,20 €		
25	SI	Slovenia	7,89 €	7,89 €	7,89 €	0,0%
26	ES	Spain	8,60 €	8,60 €	8,60 €	0,0%
27	SE	Sweden	11,24 €	11,12 €	10,39 €	-7,5%
28	UK	UK	8,66 €	8,85 €	10,09 €	16,5%
		Average	**7,91 €**	**8,04 €**	**7,94 €**	**0,5%**

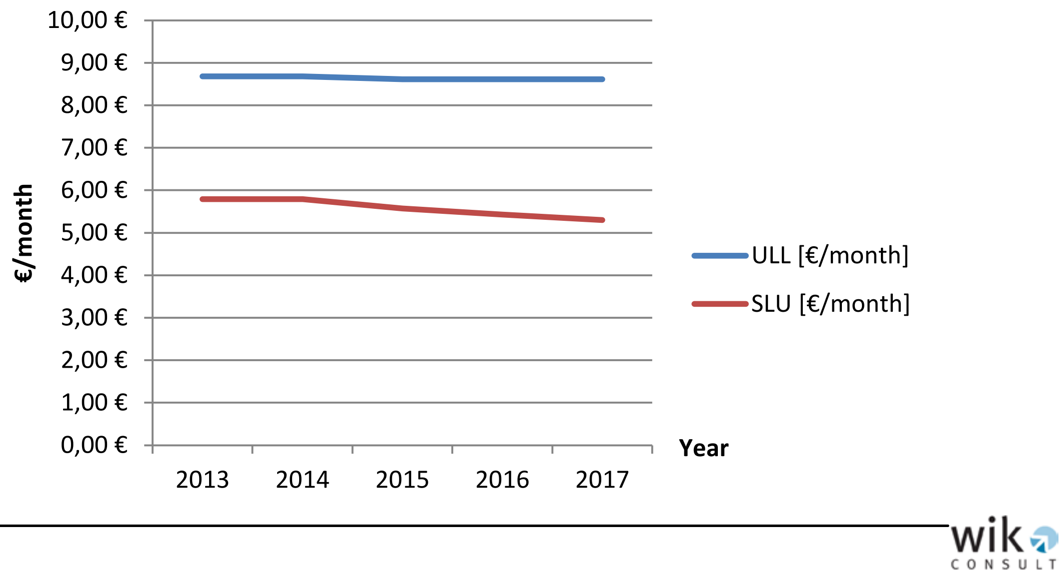
Source: EC; Financial indicators, fixed and mobile telephony, broadcasting and bundled services indicators – 2014; https://ec.europa.eu/digital-agenda/en/connectivity ; for 2015: Iliad

5.2 Country studies

5.2.1 Italy

The Italian regulatory authority AGCOM[125] in its recent market analysis of the wholesale fixed access market (market 3a and 3b of the recent EC market definition guidelines 2014/710/EC) on November 5th 2015 i.a. decided on the fees for ULL, SLU, VULA and bitstream[126]. Figure 5-1 shows the prices for ULL and SLU from 2013 to 2017.

Figure 5-1: ULL and SLU prices in Italy



Source: WIK/ AGCOM

Table 5-2: ULL and SLU prices in Italy from 2013 to 2017

Year	2013	2014	2015	2016	2017
ULL [€/month]	8,68 €	8,68 €	8,61 €	8,61 €	8,61 €
SLU [€/month]	5,79 €	5,79 €	5,57 €	5,43 €	5,30 €

Source: AGCOM

In contrast to Spain or France, where FTTH is the prevalent NGA architecture and cable-TV networks offer competing services, in Italy FTTC is the predominant NGA architecture. The existing FTTH deployment in the area of Milan and some other smaller areas will not be expanded in the next future. CA-TV does not exist at all, so no

125 Agencia per le Garanzie nelle Communicazioni.
126 AGCOM Delibera N. 625/15/CONS.

alternative competing infrastructure exists. Because of short subloops so far no operator intends to deploy a vectoring based transmission method, so the competition based on physically unbundled subloops is unrestricted in this regard.

We observe a small decrease of the ULL price by 0,07 €/month in 2015, caused by the decrease of some cost components (reduction of WACC from 9,18 to 8,77%, reduction of the wholesale sales mark-up from 4 to 3,5%, reduction of the corrective maintenance cost from 1,48 to 1,19 €/line and month). This significant cost decrease has been largely compensated by a significant reduction of the ULL lines being migrated to FTTC as SLU NGA access lines.

Compared to the ULL price the SLU price decreased significantly more. This is caused by an additional decrease of the corrective maintenance cost from 0,80 €/line and month to 0,49 €/line and month. Furthermore, the expected lifetime for SLU became significantly longer compared to the ULL lines, now lasting between 40 and 45 years, while ULL assets are expected to live between 20 and 25 years.

Since 2015 AGCOM[127] did apply a regulatory asset base (RAB) approach for the re-usable assets, the ducts of an FTTH network, taken as the modern equivalent asset network in this respect, while for all other considerations the FTTC network was taken as MEA. The basic LRIC modelling was not changed. This inconsistency of the approach is not argued for. So AGCOM ignored the re-usable trenches and copper cables in an FTTC NGA network. For the ducts AGCOM states having estimated the remaining life time based on an European benchmark and data about the access network of Telecom Italia. They do not explicitly state how they treated fully depreciated assets, but being in line with the EC costing recommendation.

5.2.2 Germany

Since the beginning of the regulatory unbundling regime in Germany in 1999 the German regulator BNetzA applies a FL-LRIC costing approach to calculate ULL cost. LLU prices are determined on the basis of the current cost of an efficient copper access network. The capital costs of the network are determined on the basis of a bottom-up cost model. Operating costs are derived from the incumbent’s accounts.

Starting form a level of 12,99 Euro in 1999, prices gradually decreased over time. This trend changed for the first time in the ULL pricing decision in 2013, where prices went up slightly to 10,19 Euro per line.

In April 2016 BNetzA published a draft ULL pricing decision for national consultation for new ULL charges to be applied for the period 01.07.2016 to 30.06.2019.[128] Compared

127 See Allegato C alla delibera n. 625/15/CONS.
128 See BNetzA, BK 3c-16/005 of April 2016.

to the current ULL price BNetzA reduced the ULL price from 10,19 € to 10,02 € (a reduction of 1,7 %) and the sub-loop price from 6,79 € to 6,77 € (a reduction by 0,3%).

BNetzA came to these results by applying the EU costing Recommendation in a certain way. The relevant assets of the access network were determined as in previous decisions on the basis of a bottom-up model. These assets were all still valued according to their current cost. BNetzA, however, deducted fully depreciated ducts and manholes following the costing Recommendation. The age structure of the relevant assets were determined from Deutsche Telekom's accounting information. The resulting share of fully depreciated assets determined that way was then applied to the relevant asset volumes determined by the cost model.

The cost reduction effect of applying the Recommendation was limited because the degree of ducting in the German access network is rather low, in particular in the distribution network. BNetzA did not apply the indexation method to trenches of buried cables.

The overall effect of the cost reduction was the result of a variety of reverse effects:

- a significant reduction in the WACC (from 6,77% to 5,9%);
- a reduction in the asset base following the application of the EU Recommendation;
- an increase of deployment cost;
- a cost increase due to a reduced volume of copper access lines.

In its previous ULL decision of 2013 BNetzA had already adopted its depreciation policy to cope with the NGA development in Germany which basically relies on FTTC/VDSL. At that occasion BNetzA reduced the asset lifetime for copper cables in the feeder network from 20 to 15 years. At the same time it increased the lifetime for copper cables in the distribution network to 25 years. The lifetime of ducts was increased to 40 years (from 35 years before).

5.2.3 Denmark

5.2.3.1 General implementation rules and DBA actions

The costing Recommendation generally foresees an implementation of the recommended costing methodology until 12/31/2016.[129] Here the EC provides several options and exceptions.[130]

The Commission has on a number of occasions reminded the Danish Business Authority (DBA) to bring its costing model in line with the costing Recommendation as soon as possible.[131] The main reason was, that the Commission questioned the partial use of historic costs for setting the VULA access prices[132] and called DBA to amend as soon as possible its methodology for calculating VULA prices by modelling a hypothetically efficient NGA network and estimating the cost difference between FTTC/FTTH and copper based access services as requested by the Recommendation.[133]

Consequently, the DBA revised its fixed BU-LRIC model, which also calculates LLU copper and bitstream access prices, in order to ensure compliance with the Recommendation and implemented the price control obligation imposed for the year 2015.[134] One year later, DBA launched the next and latest notification for price determination in the year 2016.

In the latest notification for price determination in the year 2016, DBA did not process further adaptions relating to the Recommendation (only the WACC was decreased and the principles for calculating "Dual Pair Bonding" wholesale product prices were changed).[135] So in the following we only describe the actions taken by DBA concerning the revision processed in the notification for setting prices in 2015.

5.2.3.2 Bottom-up methodology and MEA

The Commission recommends the implementation of a bottom-up long-run incremental costs plus costing methodology (BU LRIC+) for the purposes of setting copper and NGA wholesale access prices, where cost orientation is imposed as a remedy.[136] Hereby the BU LRIC+ costing methodology should be based on the behavior of a hypothetical efficient operator, building a modern efficient network, which is an efficient

129 See EU (2013), Rec (43).
130 See EU (2013), Rec No. 38. – 47.
131 See DBA (2014), cipher II.1.
132 See DBA (2013), cipher II.1.
133 See DBA (2013), cipher III.
134 See DBA (2014), cipher II.2.
135 See DBA (2015).
136 See EU (2013), Rec 30.

NGA network (MEA concept).[137] An efficient NGA network is defined as a network, that consists wholly or partly of optical elements, depending on national circumstances, and should be capable of delivering the targets of the Digital Agenda for Europe set out in terms of bandwidth, coverage and take-up.[138]

The DBA decided to use a fibre (FTTH) network as a modern equivalent asset for copper and cable TV access networks[139] as basis for its BU LRIC+ model built by the consultancy TERA.[140] This decision is based on the evaluation of the consultancy TERA of various criteria[141]:

Table 5-3: Overall findings for the MEA approach

Criterion	Is FTTH the MEA for copper?	Is FTTH the MEA for cable TV?
Technological criterion	++	+
Cost criterion	- For CAPEX but + for OPEX	/
Subscriber criterion	++	+
Operator's strategy criterion	++	++
Retail price criterion	/	/
Best practices	+	/

Source: TERA Consultants

5.2.3.3 Cost adjustment

The Recommendation foresees, that, when determining the access prices of services that are entirely based on copper, NRAs should adjust the cost calculated for the modelled NGA network to reflect the different features of wholesale access services that are based entirely on copper.[142] The Commission proposed two options for doing that: a) by estimation of the cost difference by replacing the optical elements with efficiently priced copper elements or b) by modelling an NGA overlay network, where two networks (copper and fiber, either FTTH or FTTC) share to an extent the same civil infrastructure.[143]

DBA decided to model all access technologies and to perform a cost adjustment on the fibre-based MEA network in order to price copper-based services.[144] In a first step DBA decided, that, in order to simplify the modelling process for the industry, it appears

137 See EU (2013), Rec 31.
138 See EU (2013), Rec 32.
139 See DBA (2014), cipher II.2, Revised costing model.
140 See TERA (2014), p. 7 and 104.
141 See TERA (2013), chapter 2.2.7.
142 See EU (2013), Rec 37.
143 See EC (2013), Rec 37.
144 See DBA (2014), see cipher II.2, Revised costing model.

therefore appropriate to model passive components specific to copper on the basis of the copper cost model (including FTTC) and passive components specific to FTTH and cable TV on the basis of a FTTH cost model[145]:

> *"For the passive part of the access network, DBA intends to develop a LRAIC model for the copper technology (including FTTC) and for the FTTH technology. While FTTH is considered as a MEA for copper, it is indeed considered that the computation of copper-based regulated product prices requires the development of a LRAIC model for copper to identify cost differences between copper and FTTH. Especially, as TDC does not intend to deploy a large scale FTTH network in the medium term, it appears necessary to calculate the cost of a copper access network (including FTTC)."* [146] [147]

Table 5-4: Overview of passive and active equipment to be modelled

Technology	Passive components - Access	Active components - Access	Active and passive components – Core
Copper	Trenches, copper and sometimes fibre (FTTC)	DSLAM, Aggregation nodes	TDC IP core infrastructure
Cable TV	Trenches, fibre, splitters	MPEG station, CMTS, Amplifiers, Optical nodes	
Fibre		OLT	

Source: TERA (2013)

DBA decided to choose option a): estimation of the cost difference by replacing the optical elements with efficiently priced copper elements in order to realize cost adjustment in relation to copper based services. Here DBA processed the adjustment in several steps:[148]

1. modelling a nationwide MEA FTTH-network,
2. replacing ducts and fibre cables by copper cables (trenching of MEA FTTH network is kept, copper cables are 100% direct buried due to incumbents copper network reality),
3. replacing copper cables for selected FTTC nodes by fibre cables reflecting FTTC roll-out reality of incumbent: Incumbent's reality was easily taken into account in the BU model because the FTTC locations of the BU-modelled

145 See TERA (2013), chapter 2.4.
146 See TERA (2013), chapter 4.
147 See TERA (2013), chapter 2.4.
148 Confirmed by correspondence with Christoffer Kjældgaard Giwercman, Chief Advisor, Danish Business Authority, 05/09/2016.

network are determined by a scorched node approach of central offers and distribution points of upper access network level (PDP).[149]

Further model issues are handled in detail in the Model Reference Paper of TERA.[150]

Finally, DBA based its price decision on a least-cost approach comparing cost results (LRIC+) of the copper access network model and the fibre access model. This comparison led to the conclusion of DBA, that LLU copper costs for a nationwide network are lower than LLU fiber costs for a nationwide network, so that the LLU copper price was fixed on the basis of the lower LLU copper costs.[151]

5.2.3.4 Legacy civil engineering assets

The Recommendation foresees, that NRAs should include any existing civil engineering assets that are generally also capable of hosting an NGA network.[152] Instead of using replacement costs as recommend for the rest[153], for those legacy civil engineering assets costs have be determined by considering two factors:[154]

a) The regulatory accounting value net of the accumulated depreciation at the time of calculation,

b) indexed by an appropriate price index, in order to reflect asset price development for the residual value of the particular legacy civil engineering asset.

DBA states, that the revised LRIC model takes into account reduced trenching costs.[155] This cost reduction bases on the assumption, that a hypothetical efficient operator with SMP would be able to obtain a discount, if a nationwide trenching project would be ordered. This reduces trenching costs by 5 percent.[156] A further cost reduction was considered causing a trench sharing by 10 percent.[157]

This reduction does not reflect the legacy civil engineering assets approach of the Recommendation. In DBA's notification of 2014, DBA did not take the Recommendation concerning the legacy civil engineering assets into account:

"*When the new rules enter into force, they will lower the deployment costs of the LRAIC model's efficient operator. The LRAIC model should therefore*

149 See TERA (2014), p. 25.
150 See TERA (2013), chapter 2.4 .
151 Confirmed by correspondence with Christoffer Kjældgaard Giwercman, Chief Advisor, Danish Business Authority, 05/04/2016.
152 See EU (2013), Rec 32.
153 See EU (2013), Rec 33.
154 See EU (2013), Rec 34.
155 See DBA (2014), cipher II.2, Revised costing model.
156 See DBA (2014) consultation, p. 43f.
157 See DBA (2014) consultation, p. 44f.

> *be prepared for allowing a civil engineering discount following implementation of this regulation. DBA is aware that the new EU regulation can lower the costs for deploying broadband. However, DBA believes that it is too early to assess the impact of this new set of rules in the new LRAIC model.*"[158]

The current opinion of DBA is, that the legacy civil engineering assets approach of the Recommendation would have only a very low effect on wholesale access prices. The incumbent has installed ducts only to a very limited extent when deploying copper cables, so that there are only small parts of the network which can be re-used for a roll-out of the MEA network. This explanation was accepted by the Commission.[159]

5.2.3.5 NGA migration effects

The Commission stated, that an appropriate costing methodology should avoid an artificial increase in wholesale copper access prices caused by customers migrating to the NGA network of the SMP operator.[160] Therefore the Commission recommends, that the cost methodology deals appropriately and consistently with the impact of declining volumes.[161]

In this context DBA decided to model a single efficient NGA network for copper and NGA access products in order to neutralize the inflationary volume effect as recommended.[162] This is implemented in practice by considering full demand on the copper access network: "*In line with the MRP, the model includes a nationwide copper network (i.e. a network covering all premises passed by TDC's copper network, TDC's cable-TV network and TDC's FTTH network) with full demand (i.e. combined demand for TDC's copper network, cable-TV network and FTTH network).*"[163]

158 See DBA (2014) model first draft, p. 84.
159 Confirmed by correspondence with Christoffer Kjældgaard Giwercman, Chief Advisor, Danish Business Authority, 05/04/2016.
160 See EU (2013), Rec (25).
161 See EU (2013), Rec 41.
162 See DBA (2014), cipher II.2, Revised costing model.
163 See TERA (2014), chapter 2.4.

5.2.3.6 Lifetime of civil engineering and other assets

The Commission recommends, that NRAs should set the lifetime of the civil engineering assets at a duration corresponding to the expected period of time during which the asset is useful and to the demand profile and this would lead, for example, to a lifetime which is normally not less than 40 years in the case of ducts.[164] The DBA decided to prolong the economic lifetime for copper cables from 20 years to 30 years.[165] The following table gives an overview used in the LRIC+ - model from the year 2015 onwards:[166]

Table 5-5: Economic asset lives

Ntw.	Asset category	Asset life
Access	Trench routes, ducts, manholes in the copper scenario	30
Access	Copper, Fibre and Coax cables and joints in the copper scenario	30
Access	Trench routes, ducts, manholes in other copper scenarios	35
Access	Copper, Fibre and Coax cables and joints in other scenarios	35
Access	Distribution frames, distribution points, splitters, and wireless assets	20
Access	Network termination points, amplifiers	10
Access	Cable modems, MPEG station equipment (CMTS, servers etc.)	8
Core	MDF/ODF	15
Core	Active equipment	8
Core	International Media Gateway	10
Core	Sites – Power supply. A/C	15
Core	Sites – Security, site preparation	10

Source: DBA

DBA did not follow the Recommendation for using not less than 40 years for ducts, because cables would have a lifetime of 30 – 35 years and this divergence to a 40 years lifetime for ducts would lead to cost inefficiency by re-digging only a short period later. The Commission did not comment on this.[167] In any case with a low amount of ducts the change of a duct lifetime from 30 to 40 years would not have any impact. But to be clear, the duct lifetime is not strictly coupled to the cable's lifetime, which may be shorter. A cable may be exchanged twice during duct lifetime, saving all trenching cost being required in case of a direct buried cable. It will be exchanged in any case when

164 See EU (2013), Rec 36.
165 See DBA (2014), cipher II.2, Revised costing model.
166 See TERA (2014), chapter 9.2.
167 Confirmed by correspondence with Christoffer Kjældgaard Giwercman, Chief Advisor, Danish Business Authority, 05/04/2016.

the ducts have to be reinvested. Thus, the duct lifetime shall be a multiple of the cable's lifetime.

5.2.3.7 Comments of the Commission

The Commission mostly accepted DBA's notification. Only concerning the lifetime of copper cables, the Commission asked DBA to further justify the rationale for extending the copper loop lifetime to 30 years, particularly in view of the economically useful life of the copper loop, and the technological developments like pair bonding, phantoming, G-fast.[168] This has to be seen in the context, that DBA proposed a reduction of the LLU copper price from approximately € 8,20 to € 7,80 per month without taxes and so price comes below the recommended price corridor of € 8,00 to € 10,00 per month without taxes.[169] DBA presented different price scenarios depending on different lifetimes on request of the Commission. In the end the Commission accepted a lifetime of 30 years and did not comment on the lifetime when DBA notified the 2016 pricing decision.[170]

5.2.4 Spain

The Spanish regulatory authority CMT, now CNMC[171] on July 18th 2013 decided on the charges for ULL and duct access[172]. SLU is not covered, because there is no SLU offer in Spain[173]. There is no update of this decision so far, because there is no regulatory need in Spain to review the price decision periodically (e.g. every three years) as long as there is no market demand. Furthermore, the decision already anticipated the costing Recommendation of 11th September 2013 and its final price of 8,60 €/month is in the proposed price range of 8 – 10 € of this Recommendation. So today there are no actual or announced plans for reviewing the ULL price decision of 2013 now or in the near future.

While the previous ULL decisions of CMT took the book values of Telefónica at historic and current cost into account, the 2013 ULL decision was the first decision of CMT taking also its new bottom-up LRIC cost model into account[174], which had been

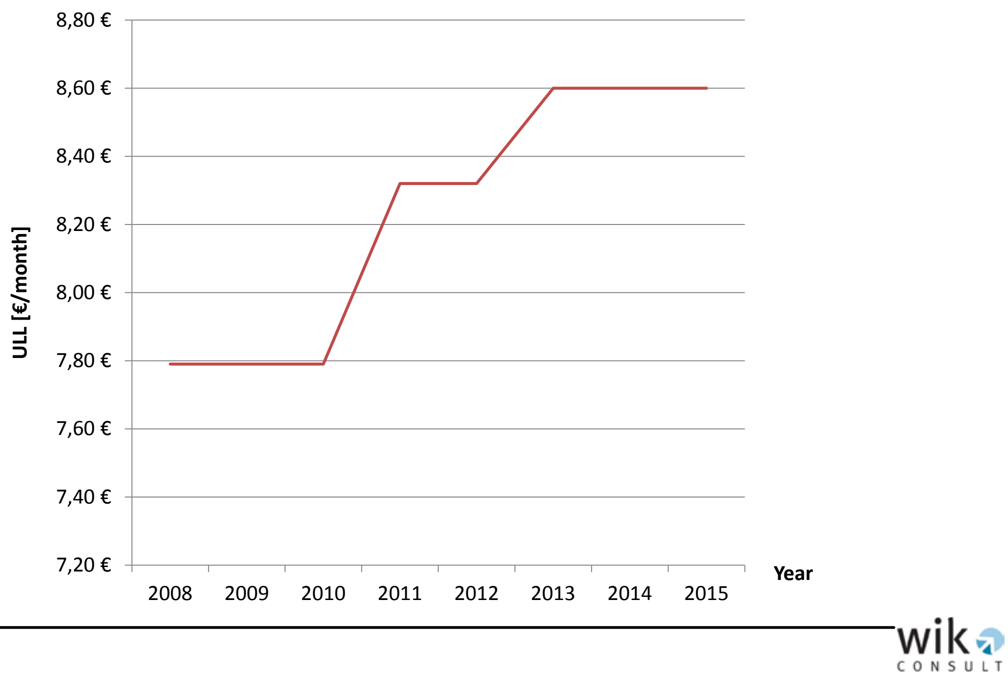
168 See DBA (2014), cipher III.
169 See EU (2013), Rec 41.
170 Confirmed by correspondence with Christoffer Kjældgaard Giwercman, Chief Advisor, Danish Business Authority, 05/04/2016.
171 CMT Comsisión del Mercado de las Telecominicaciones, CNMC: Comisión Nacional de los Mercados y la Competencia
172 http://telecos.cnmc.es/c/document_library/get_file?uuid=dfd4e441-de2c-479b-b308-f37def31f8f7&groupId=10138
173 Typically there are no cabinets for street distribution frames in Spain, but all cable distribution is performed in large underground chambers with almost no option of sharing it with competitors.
174 This model had been developed by WIK-Consult and is published by CNMC at: http://telecos.cnmc.es/consultas-publicas/-/asset_publisher/4TGbQ55LnXPi/content/20130528_modeloscostes;jsessionid=461FBDAE4703D2DCB199B451E08DCA64?redirect=http%3A%2F%2Ftelecos.cnmc.es%2Fconsultas-publicas%3Bjsessionid%3D461FBDAE4703D2DCB199B451E08DCA64%3Fp_p_id%3D101_INSTANCE_4TGbQ55LnXPi%26p_p_lifecycle%3D0%26p_p_state%3Dnormal%26p_p_mode%3Dview%26p_p_col_id%3Dcolumn-3%26p_p_col_count%3D1

developed by WIK-Consult. Besides these values CMT also took an EU LLU benchmark of four major member states (United Kingdom, France, Italy and Germany) into consideration. The relevant values had been:

- 9,34 €/month Telefonica book values at current cost (also 2011),
- 9,16 €/month EU-Benchmark 2013 for the four major Member States,
- **8,60 €/month 2013 CMT price decision,**
- 7,26 €/month bottom-up LRIC cost model result.

Taking all values into account CMT decided on a value of 8,60 €/ month, not only relying on its new cost model results, but also on benchmarking and the current cost approach based on Telefonica's book values. The history of CMT's ULL pricing decisions can be seen in Figure 5-2. We observe two increases over the last 8 years, in 2010 from 7,79 to 8,32 €/month and in 2013 from there to 8,60 €/month. The latter increase may be reduced by the recognizable lower results of the bottom-up cost model, because the other determining factors (benchmark, current cost and historic cost on Telefónica's book values) did increase even more.

Figure 5-2: ULL price in Spain over time



Source: CNMC 2016

The Spanish bottom-up LRIC cost model is an overlay model, allowing to either calculate a pure copper, a pure fibre or a common copper/fibre deployment, including wholesale duct demand in all cases. For very remote buildings a fixed wireless access

(FWA) connection is taken into account instead of a copper or fibre line, limited to some 100.000 access lines. The copper deployment is a point-to-point topology with some restricted and well defined FTTC areas with remote concentrating nodes. The fibre deployment is either point-to-point from the existing MDF locations, or point-to-multipoint with two stage splitters, one at the building and one in the street (in a handhole). The typical FTTH deployment in Spain is GPON on a two-stage point-to-multipoint fibre topology. The trenches for the access network include either direct buried cables, ducts for cables or aerial cabling. All trenches will be shared with other network layers and with utilities' and other public authorities' passive infrastructure, as applicable.

In case of copper/ fibre overlay the fibre demand over time has to be defined long term (20 years) into the future. The copper demand decreases accordingly. Typically the remaining book values for switched or (migrated) copper lines are considered as stranded investment, so they cannot increase any remaining copper cost by reducing the divisor "all copper lines" for the total copper cost. While the model allows to apply linear, tilted annuity and economic depreciation, for fibre deployment the economic depreciation methodology has been chosen in order to equalize the initially very high fibre cost with the high copper demand and therefrom resulting lower fibre cost per line in the long term future. The fibre deployment considered in the model covers 15 million homes passed, but at the start only 2 million homes are connected. Both values increase over time according to the operator's announcement.

The model allows to be fed with different book values for the assets. In the application here the civil engineering assets have been considered completely depreciated for 40 – 60% of the assets, so these assets are no longer considered within the asset's depreciated cost, but still are taken into account in the OPEX, because they still have to be maintained and operated. The remaining assets considered are indexed by a price index to current cost. Thus, they are effectively valued at current cost.

In Spain the cost of the vertical (in building) cabling is due to the operators, so typically it is included in the ULL prices, taking different deployment forms into account (staircase, façade, ICT). In buildings constructed since 1998 the ICT structured cabling is mandatory and has been applied in the model, allowing for direct sharing of these cost between operators, thus in these cases Telefonica's cost share has been considered only.

Summarizing the model application in Spain, which informed CMT's copper ULL price decision in 2013, results in:

- Copper/ fibre overlay for a final fibre coverage of 11 million homes passed, 2 million homes being connected by fibre,
- FTTH GPON point-to-multipoint fibre topology,

- Civil engineering assets, half of it fully depreciated and taken out of calculation,
- Civil engineering construction considered in regional typical mix of direct buried, ducted and aerial deployment at its specific cost,
- Both, copper and fibre had been economically depreciated, so the option of stranded copper investment has not been chosen and the asset investment has been covered completely,
- Cost of (inhouse) building cabling is included, depending on the construction date, cost sharing in the (inhouse) building segment for ICT buildings (constructed since 1998).

6 Regulatory pricing options in France

6.1 No change

ARCEP could decide not to change its price determination method for ULL and continue to use its current input parameter generation process, the current model and its calculation algorithms. As already seen from the 2016 and 2017 price determination, this would lead to a progressively increasing level of the ULL charges. Different to the outcome of a competitive market, the price of an old technology increases although it becomes less competitive.

Insofar as access seekers have to increase their broadband access retail prices because their decision relevant (input) cost increases, users face a higher price level. Those who live in a fibre covered area (which is currently 18% of households) have the option to migrate to fibre. Whether they can avoid the price increase depends on the fibre price level and the provider's pricing strategy. It is not impossible that an increase of copper-based retail prices will also induce a fibre retail price increase. In the areas not yet covered by fibre, users have no option to avoid the price increase. In the next few years, the vast majority of users cannot avoid the price increase because they do not live in a fibre covered area. It is not only the customers of the access seekers which would face the price increase. At first hand, the largest competitor, the access provider Orange, would not face an increase of its decision relevant cost, they are unaffected. Insofar, however, as Orange has to be compatible with a margin squeeze requirement its decision relevant cost for retail price decisions also are affected by a ULL charge increase. Margin squeeze behaviour will become more and more difficult to identify when more complex price bundles between fixed and mobile services dominate the market. In any case, the risk for access seekers of becoming subject to anticompetitive price behaviour increases, simply because the incentives and the ability of the incumbent to engage in anticompetitive behaviour increases. In that case at the margin Orange has to increase retail prices too. This price increase will generate significant allocative inefficiencies and welfare losses. These welfare losses are increased if there is an impact on broadband subscription and on penetration.

If broadband penetration is affected, some more negative externalities and further welfare losses occur. Several studies show the significant impact of broadband penetration on GDP growth and other macroeconomic parameters. Czernich et al.[175] show that an increase in the broadband penetration rate of 10% increases the annual per capita GDP growth rate in OECD countries by 0.9% to 1.5%. Similar results are derived by Hätönen[176] for EU countries. These results indicate that regulators should be very concerned about the impact of their decisions on broadband penetration. If there is a trade-off of a measure between impacting penetration and impacting

175 See Czernich et al (2009).
176 See Hätönen (2011).

broadband speed, then small impacts on penetration rates can easily compensate relative larger impacts on broadband speed.

We have shown in Section 4.3 that the current ULL cost calculation method is not compatible with the EU costing Recommendation. Furthermore, the conditions for becoming exempted from applying the Recommendation are not valid in the French context. NRAs have to take utmost account of Commission's Recommendations. This does not necessarily mean that they have to be fully compliant. In any case they would have to justify deviations. We have argued that independent of the compliance implications, a change in the costing methodology becomes necessary for regulatory economics and efficient pricing reasons. The Recommendation provides a framework to bring prices closer to the relevant efficient pricing band.

Further increases of ULL charges include a transfer of resources from altnets to Orange if they cannot increase retail prices correspondingly. Insofar as shifting the wholesale price increase into a retail price increase is not possible, the EBITDA of access seekers will decrease. The corresponding increase of the EBITDA of the incumbent is significantly higher due to two effects. Firstly, the EBITDA increases according to the wholesale price increase because costs do not change (they are mostly sunk). Secondly, to avoid a margin squeeze the incumbent will also increase its retail prices thereby increasing its EBITDA furthermore.

The total surplus welfare criterion is at first sight neutral with regard to a transfer between firms. Such a transfer, however has an impact on investment. There is reason to assume that the level of (total) investment will decline. Relative to their EBITDA altnets invest more than the incumbent. A transfer of EBITDA therefore at the margin would reduce investment.

Besides limiting the ability of investment for altnets, increasing ULL charges will distort the investment and infrastructure competition of altnets. Limiting the investment capabilities limits and reduces the ability of altnets to act as first movers as well as second movers in an area to deploy fibre. The area where two or more fibre competitors compete will be smaller. The lower level of infrastructure competition and co-investment also has an impact on the level of investment conducted by Orange. If less competitors engage in co-investment the relative investment requirements for Orange increase in areas where it is the first mover. If also Orange faces a capital constraint in its fibre investment, it will (ceteris paribus) reduce its level of network coverage. If Orange has to fear altnets less as a first mover in deploying fibre areas, it will also have less incentives to invest in fibre.

We have shown that increasing ULL charges will only have a minor impact on customer migration, if at all. We have argued in previous paragraphs that increasing ULL charges will limit the ability of altnets to invest in fibre. They will become less able to act as first movers in a new fibre area. The weakened competitive pressure for a first mover position reduces the incentives for Orange to deploy in new fibre areas. They will also become less able to act as co-investors to a first mover. This makes it more costly for first movers, which is mainly the incumbent in France, to deploy new fibre areas. For those reasons the time path of the Government's fibre deployment plan will be delayed.

6.2 Partial changes

In this subsection we consider regulatory policy options which keep in principle ARCEP's current calculation method in place. Certain aspects of the methodology, however, will be changed to correct for critical assumptions in the calculation approach. We have reasoned these critical aspects in Section 1.5. For better isolating effects we consider these partial changes isolated from each other. It is, however, also useful to apply these partial changes in combination.

The partial changes considered here do not make ARCEP's costing methodology (fully) compliant with the costing Recommendation. They would, however, justify the conditions of an exemption more than the current costing methodology.

6.2.1 Compensating for decreasing demand

This approach would keep ARECP's current cost calculation model. It would only compensate for decreasing demand. The approach would address one major element of the Recommendation which is currently differently approached in ARCEP's costing methodology.

The approach could be implemented in two different conceptional options:

(1) Compensating for migration to fibre only;

(2) Compensating for migration to any other infrastructure.

The first option would be implemented by taking the sum of copper loops and fibre connections as the relevant demand. This option is the approach proposed by the Recommendation. Because some migration to cable and mobile occurs, this approach would ceteris paribus generate a moderate ULL charge increase over time.

The second option would be implemented by assuming a constant demand. This option is justified conceptually by generally contributing to solve the theoretical problems of applying a current cost approach in case of declining demand.[177] This approach has

177 See Section 3.3.1.

been applied by the New Zealand Commerce Commission in its latest ULL pricing decision.[178]

Compensating for decreasing demand can be implemented rather easy. Only one parameter in ARCEP's cost calculation would need to be changed. The approach would generate rather stable and predictable ULL charges over time. This could justify an exemption according to number 40 of the Recommendation. The existing cost over-recovery problem of the current method would not be further increased.

Incentives to invest in fibre remain at their current level and no further distortions of the level playing field of competition occur. Overall efficiency is affected insofar as the current level of charges is excessive.

6.2.2 Move to HCA valuation of ducts

Ducts are a network resource with an unknown lifetime which can be used for the legacy as well as for the fibre network. The pricing of duct access is neutral with respect to the transition from copper to fibre. There is no technological obsolescence or competition which would challenge the economically useful lives of ducts. For these reasons cost recovery is the main pricing objective for this asset.[179] HCA pricing guarantees cost recovery and excludes over- and under-recovery. To be more precise, HCA guarantees full recovery of actual costs but still over-recovery of efficient costs.

Compared to the indexation approach currently applied for ducts, HCA pricing would significantly reduce the level of ULL charges. Stability from the lower level over time is not guaranteed and would depend on demand assumptions. HCA for ducts would be easy to implement because ARCEP is already applying the indexation method on historic asset values. This aspect and the exclusion of fully depreciated assets from the cost base would be in line with the costing Recommendation.

Lowering ULL charges will reduce Orange's profits on ULL and at the same time the opportunity costs of further using it.[180] This increases the incentives to invest in fibre. Lowering ULL charges will also increase the ability of altnets to invest in fibre and to conclude further co-investment projects. Infrastructure competition will be intensified which will positively impact efficiency in the fibre market. The fibre deployment plans of the Government will be more realistically achieved in time and coverage.

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178 See Commerce Commission (2015).
179 See Cave et al. (2012), p. 152.
180 See Hoernig et al. (2011).

6.2.3 Efficiency corrections in OPEX

We have highlighted in Section 1.5.3 that the OPEX component in the ULL charge which amounts to 2.10 € per line represents the actual cost of an old copper network. If OPEX were corrected to reflect the cost of a new (copper) network, the resulting cost component would be significantly lower. On the platform of a fibre MEA, OPEX would be reduced furthermore. Fibre networks have no electromagnetic interference, fibre cables are not sensitive to humidity like copper cables. Further efficiency improvements can be achieved by process efficiency improvements in fibre networks. Altogether these efficiency improvements can reduce the OPEX component in the ULL charge by 50% or by around 1 €.

The costing Recommendation requests that only efficiently incurred costs can be recovered by wholesale prices. Conducting and implementing these efficiency corrections for OPEX would be in line with and even be requested by the Recommendation.

Efficiency corrections on actual OPEX could be identified and quantified on the basis of benchmarks. Furthermore, French operators have already a lot of experience in the operation of fibre networks. Inputs from these experiences need to be carefully analysed and assessed because the scale of this network operation is not yet at the same level as the copper network. Once appropriate efficiency correction factors have been identified, the efficiency corrections can easily be implemented into the cost calculation. The level of the ULL cost would be reduced in a one-time step. The path increase problem remains under this option.

The effects of such improvements would be comparable, at a lower scale, to those mentioned in the previous Section. There is more free cash flow for the altnets being willing to co-invest and take some penetration risk from Orange, and by this improving competition and increasing broadband access demand.

6.2.4 Capital costs based on net book value

We have shown in Section 1.5.4 that annuities calculated on gross book values can lead to over-recovery of costs. Given the age structure of the relevant assets we have shown simulations indicating that the capital cost calculations as applied by ARCEP actually lead to over-recovery of costs. The simulations presented also show that a regime change towards calculating capital costs on the basis of net book values would reduce the level of ULL costs significantly.

This calculation approach is in line and requested by the costing Recommendation. It would be easy to implement. All the building blocks and input data for applying a net book value approach are at ARCEP's disposal. Only the calculation method has to be adopted.

This approach would also improve the infrastructure competition induced by co-investing altnets and would speed up the achievement of the Government's broadband goals.

6.2.5 5 year price cap approach

ARCEP could fix a price cap for ULL over the next 5 years. This approach would generate the most stable and predictable outcome of the regulatory process. Any uncertainty would vanish. Investors and operators would find clear inputs for their fibre investment decisions.

Given our assessment on the over-recovery inherent in the current price level, this price level should be the upper bound of this price path. It is even advisable to define a price path which brings ULL charges stronger in line with efficient costs. This path would foresee a steady reduction of the charges. The reduction should be moderate, not to impediment the migration to fibre.

Like with the options mentioned before, this approach would bring additional cash flow into the system for co-investment and broadband infrastructure competition.

6.3 Direct and full implementation of the costing Recommendation

6.3.1 Overlay modelling

For determining the copper network cost the Recommendation on costing methodologies proposes to model an NGA network and to replace the NGA assets by copper assets, where appropriate (see Section 4.4). Alternatively, especially if the NGA and copper topologies differ from each other to an extent where the simple replacement is not feasible, as it often is the case with FTTH networks using no cabinets in a point-to-point topology or using splitters at a different scale and location in point-to-multipoint topologies, the NRA is encouraged to model "*an NGA overlay network, where two parallel networks (copper and fibre, either FttH or FttC) share to an extent the same civil infrastructure network*" (side note 42). Point 37. of the Recommendation does not concatenate the alternative solution of an overlay modelling to the topological mismatch of copper and NGA network topologies, but allows the alternative overlay modelling as an option, where appropriate and where two networks share to an extent the same civil engineering infrastructure.

We understand that in France there are many ducts (and poles) already existing at the incumbent fixed network operator’s trenches, so that there is more or less no additional investment required for deploying a fibre network. Thus, the existing copper and the new fibre network will in fact share the same trenches and ducts to a significant extent. So the prerequisites for modelling a copper/ fibre overlay network instead of a single NGA network exist in France, as it did in Spain also.

The use of an overlay network requires that both infrastructures, for copper and fibre, exist in parallel from the beginning of the model period – at least to a significant extent. The civil engineering infrastructure covers almost 100% of the homes passed which shall be covered. The fibre cables themselves may be deployed over time on demand. The copper cables already exist. We see two methods of modelling the demand for copper and fibre:

1. The copper and fibre demand will be summed up and the total demand of both is the dividend for the sum of the infrastructure cost. By this the demand, despite the migration from copper to fibre, is more or less constant over time, only affected by a reduction of the total fixed network demand due to customers switching to cable or mobile.

2. The demand for copper and fibre access are treated separately.

    a. The copper demand may be kept constant over time, because a decreasing demand is not coherent with a bottom-up LRIC approach in general. Furthermore, a shrinking demand and increasing cost are not coherent with the Recommendation’s goal of constant pricing. There is also an economic rationale for neglecting the cost of those copper lines, which are switched of and typically will never be used again, because they are outdated: The investment – not only for the copper pair itself, but for the share of the trenches and ducts - allocated to this copper line is stranded.

    b. The fibre demand is increasing. This is a prerequisite for applying bottom-up LRIC. The low initial demand and the resulting higher cost compared to copper may be equalized by applying the economic depreciation.

In approach 1. there is no major difference between copper and fibre cost. A difference may only occur due to higher copper cable cost, if the cost of the cables is treated individually, or due to a higher duct space demand for the copper cables because of its larger size. These effects will not change over time, so the goal of relatively constant prices is met. The slightly higher cost for copper compared to fibre would be contra-intuitive to an expected performance delta, where copper performs poorer than fibre.

In approach 2. both costs, for copper and for fibre, are treated in an economically reasonable manner. They will not cross-subsidize each other over time. The copper price is expected to be cheaper than the fibre price, as the performance delta lets one expect. The fibre price only is covering the infrastructure cost for the fibre lines, while the cost for the infrastructure of copper is stranded, as long as it is not already fully depreciated. This is in line with the economic expectation.

The Recommendation states that the cost for the copper network shall be determined by an overlay network model. According to the Recommendation’s text there is no intention to consider the cost for the fibre access network in an overlay network manner, but just the copper cost. Looking at approach 2 one can consider both networks are independent from each other, so that the Recommendation’s conditions may be satisfied. In this case we ignore, that the fibre ducts are cheaper compared to a stand-alone deployment, but this is in line with the incumbent operators reality.

6.3.2 FTTH MEA and performance delta approach

We have developed in Section 3.3.4 the relevance of the MEA concept for copper ULL pricing. In Section 4.5.1 we have broken down the MEA approach into a concrete pricing rule. According to this rule the ULL price would be derived from the LRIC of fibre access minus the performance delta between copper and fibre-based access products. The performance delta should basically be determined on the basis of retail price differences between copper-based and fibre-based access products. Implementing this concept requires to calculate ULL cost for an FTTH network and the performance delta. In Section 4.5.1 we have developed concrete proposals how to model FTTH costs and the performance delta.

The costing Recommendation formulates the need for making adjustments to reflect the different features of the networks when the copper access price will be determined on the basis of the costs of the NGA network by stating in No. 37:

> *"When determining the access prices of services that are entirely based on copper, NRAs should adjust the cost calculated for the modeled NGA network to reflect the different features of wholesale access services that are based entirely on copper."*

The Recommendation highlights then to conduct these adjustments on the basis of a costing approach of network elements. The wording of the Recommendation does not exclude other methods of making the adjustments. In previous versions of the Recommendation value based approaches for making adjustments have explicitly been taken into consideration. From that perspective we regard the FTTH MEA performance delta approach as compatible with the Recommendation.

From our economic perspective this approach is conceptually and theoretically the most appealing one. This will become obvious when we discuss the implications and impacts of this pricing concept.

The resulting copper access price will not exceed the traditional LRIC value of the status quo as currently calculated by ARCEP. A different outcome would be theoretically possible but is effectively excluded through the imposition of an upper bound. At the same time the lower bound $a_c > SRIC +$ makes sure that the incumbent has no incentive to degrade copper quality. Because price flexibility of the incumbent for FTTH remains mainly unrestricted, the incentives to innovate remain.

The MEA approach generates competitive neutrality between FTTH and copper and therefore supports a level playing field between incumbent and altnets independent of the access network technology. The proposed wholesale pricing rule still keeps investment in the new technology attractive. The MEA approach balances the investment incentives between technologies and market layers without providing an artificial advantage to fibre.

It is not totally obvious to finally assess the static and the dynamic welfare properties. This is similar to traditional LRIC pricing. Neither the traditional LRIC approach nor the MEA approach use Ramsey pricing mark-ups on marginal costs to determine wholesale prices. Compared to traditional LRIC-based wholesale charges, the overall mark-ups will be reduced under the MEA approach. The net effect on welfare will therefore be ambiguous, but the MEA approach would improve consumer welfare compared to traditional LRIC prices. This result will also be supported by the quantitative simulation results presented in Neumann/Vogelsang (2013).

In an environment with parallel operation of copper and fibre access networks over a longer time span the investment incentive properties depend on the interaction of two effects, the so called replacement effect and the migration effect. [181] The replacement effect calls for a large enough difference between the copper and fibre access charge so that profits from copper alone are lower than profits from operating both a copper and a fibre access network. That means replacing copper with fibre needs to be sufficiently profitable in order to induce fibre investment. The MEA approach provides for such an access charge difference although it is likely to be smaller if only the replacement effect were relevant. Lower copper access charges would under the replacement effect incentivize more fibre investment. The migration effect, on the other hand, calls for a small enough price difference between copper and fibre access so that end-users have incentives to switch from copper to fibre once fibre is available. The MEA approach leads to price differences that are precisely based on such a consideration. It is not tilted to favour artificially fibre. However, with the expected

181 See Bourreau, Cambini and Dogan (2012).

underestimation of the measured as compared to the theoretical performance delta a preference for fibre should result which would favour fibre investment.

6.4 Geographical deaveraging of ULL charges depending on the fibre take-up

ARCEP might consider the option to geographically deaverage ULL charges. If the target of incentivising migration to fibre is in the forefront of regulatory policy, then deaveraging could be implemented according to the status of fibre deployment. Only in areas where fibre effectively is available, users have the opportunity to migrate to fibre. In those areas the policy issue of incentivising users by uplifting DSL retail prices – by uplifting the ULL wholesale charge – might get relevance. In the rest of the country users do not have (yet) the option to migrate to fibre. Having a migration tax also in those areas just causes a redistribution of wealth from end-users and access seekers to the owner of the legacy infrastructure. There would be no support of any migration approach by a uniform migration tax. A geographically deaveraged migration tax becomes a much more targeted policy instrument as compared to a nationwide uniform migration tax.

There is another dimension of relevant characteristics of the fibre areas which ARCEP has to take into consideration under such an approach. If ARCEP introduces a migration tax independent of the market structure in the fibre market in a particular fibre area it might be the case that only one operator provides fibre products in that particular area. In this case it is highly probable that the migration tax also inflates fibre access prices at the same amount as it inflates DSL prices because there is no competitive constraint for the fibre operator against such profit maximising behaviour. In that case the relative prices between DSL and fibre do not change. Then the migration tax effectively does not contribute to migration. For that reason a migration tax approach only makes sense – if at all – if it is applied in fibre areas where there is effective competition in the fibre market. Additionally, it would be appropriate to apply the migration tax concept only in fibre areas where there is a certain degree of take-up already materialised. Only at a certain minimum level of take-up in particular fibre areas it is realistic to assume that relative prices play some role for customers' decision to switch to fibre.

Several NRAs in Europe faced a somehow similar challenge when they decided on the need to further regulate the wholesale broadband access market ("bitstream"). The NRAs in UK, Germany, and Portugal decided to geographically separate the bitstream market because they found in their market analysis that the relevant market in certain local areas was sufficiently competitive compared to the rest of the country. BNetzA and Ofcom assessed a local bitstream market as competitive if at least four fixed-line suppliers were present in the respective retail market and the market share of the incumbent would not exceed 40%. In both countries cable operators were treated as part of the relevant market.

ARCEP could apply similar considerations for assessing the competitiveness of a local fibre area. A fibre area would then be treated as competitive if

(1) The fibre market share of the incumbent does not exceed 40%;

(2) There are at least four operators in that fibre area which provide superfast broadband access (including the incumbent and the cable operator);

(3) The fibre take-up in the fibre area exceeds 30%.[182]

In fibre areas characterised by these features ARCEP could either set a ULL charge which includes a migration tax component or ARCEP could give up ex ante price regulation of ULL charges, let the incumbent determine the price and just control it ex post whether or not it is excessive.

6.5 Competitively neutral use of excessive ULL profits

We have shown in Section 6.3.2 that a migration neutral copper access price has to be determined by using a FTTH MEA cost equivalent minus the performance delta between copper- and fibre-based access retail products. The calculation of the fibre cost is based on the re-use of non-replicable assets.

Because we have not conducted such a price calculation for the French market context, we cannot speculate on the exact size of such a ULL price. For two reasons it is, however, realistic to assume that such a price would be lower than the current ULL price for two reasons

(1) Fibre costs are not too much different compared to copper cost if calculated according to the same principles.

(2) On the basis of some reference to relevant retail prices we would expect the performance delta based on revealed preferences of French users closer to 5 € than to 1 €.

Already at today's ULL price level and even more if ARCEP continues to increase ULL charges, the resulting ULL charge is not migration neutral but includes a migration tax. If there is a rationale in such an approach, then a migration tax would have the intention to incentivize access seekers to increase the retail prices of copper based services to motivate users to migrate from copper to fibre. By artificially increasing the cost of the lower quality product access seekers have to increase the corresponding retail prices if

182 This is slightly above the current take-up rate of 25%.

they want to keep their previous profit level. The incumbent would have to follow if he has to avoid a margin squeeze situation although its costs do not increase.

Many studies have shown that price only is one factor which influences the switch or the migration of customers from DSL to fibre products. Some studies also find that the cross-elasticity of demand for fibre compared to DSL is less than one. Using data from EU 27 over the period 2004-2013 C. Cambini for instance found that the cross-substitution between a change in the DSL price and the adoption of fibre connections range between 0.6 – 0.64.[183]

If the migration tax is introduced as an uplift to the relevant costs of copper ULL, the proceeds of that tax would automatically flow to the incumbent Orange. This actually is the concept of ARCEP and its intended approach for the future, if it really will follow the approach of progressively increasing copper access charges.[184] It is, however, neither obvious nor efficient that the proceeds of a tax which should incentivise users to move to a higher quality level product should flow to the owner of the legacy infrastructure who is at the same time a major investor in fibre and a competitor of the access seekers.

If the proceeds of a migration tax flow to the incumbent, the infrastructure competition between the incumbent and the access seekers will be significantly distorted. Only if broadband access demand is fully elastic, access seekers can increase prices. If they cannot increase prices correspondingly, the migration tax also becomes a transfer of profits from access seekers to the incumbent. Thereby, the investment capabilities of access seekers will be reduced. Their ability to invest in fibre will be reduced and infrastructure competition will be hampered in France.

The inefficiency of the migration tax approach becomes even more obvious in case end-users do not even have the option to migrate to fibre. As we have shown in Section 2.3.4 currently only 18% of French users have the option to migrate to fibre. In the nationwide uniform wholesale price approach also these users are paying the migration tax without having the option to avoid it by migrating to fibre. We also have shown that in the next few years the vast majority of users will use copper based broadband products and will suffer from a price increase. These price increases will generate significant welfare losses without any impact on migration. Handing over the proceeds in this case to the incumbent therefore just becomes a transfer of wealth from access seekers and end-users to the incumbent. The migration tax inherent in an inflated ULL price does not generate any incentive effects with regard to enhancing the up-take of fibre. The migration tax will even generate further welfare losses due to externalities of reducing broadband demand.

183 See Cambini (2015).
184 See Section 1.1.4 for these intentions.

The welfare criterion of consumer surplus is neutral with regard to distributional impacts of a price change. One might even say that this welfare criterion ignores distributional impacts. It does not matter which consumer groups face a net benefit or a net cost of a price change. Given the high relevance of avoiding a digital divide in France as a public policy concern and goal, distributional aspects of broadband price changes cannot be ignored. Structural demand characteristics of broadband demand in France indicate that lower income percentiles have lower penetration rates of broadband access.[185] These structural demand characteristics reveal strong distributional and digital divide impacts of a migration tax approach to foster fibre take-up. The negative impact of a copper retail price increase will over-proportionally reduce penetration of low income households. The already existing digital divide problem will be aggravated.

Those which do not have broadband access yet will be discouraged to apply for it even more. In addition, users more concentrated in remote and rural areas who do not subscribe to broadband and only use fixed line voice will have to pay more for their basic communications. On the other hand, the positive net benefits of fibre externalities will be more concentrated in favour of higher income households and business.

The arguments against a migration tax approach by artificially uplifting copper ULL charges are in principle valid for a nationwide as well as for a local application of the concept. It only holds, that the negative welfare effects of a local copper charge uplift only causes relatively lower welfare losses than its nationwide application.

The analysis developed so far raises significant reservations on our side on the effectiveness and the efficiency of a migration tax approach at all. Nevertheless, if ARCEP still favours that approach for the future, there is no reason why the proceeds of the (implicit) tax should be transferred to the incumbent. This generates additional distortive effects on competition. If the approach still will be applied despite its distortive implications, the proceeds of the (implicit) tax should be used either to foster migration in a less distortive way, e.g. by directly subsidising users for migration. Or, the proceeds may be used to support fibre investment in a competitively neutral way. In this case all potential investors should have non-discriminatory access to such a fund and not only the incumbents in its role as access provider. While subsidizing customer migration does not deal with the disadvantage of the competitors financing the high copper prices, reducing their free cash flow, and may be supporting end-customers in their migration to the incumbent's fibre services, only the latter solution seems to really support broadband infrastructure competition and coverage directly.

A similar proposal has been made by Laurent Benzoni in a contribution on the financing of a universal fibre coverage in France.[186] According to his calculations, the copper access charge is overpriced by about 2 Euros per line. This is due to the valuation of the access network assets which increased from 9.2 billion Euros at the time of FT's

185 This is indirectly shown by a study of ARCEP (2015), p. 142.
186 See Benzoni (2012).

privatization to more than 18 billion Euros in 1997 and the way in which ARCEP calculated capital costs in its annuity approach.[187] Benzoni proposed the option not to reduce copper access charges by 2 Euros per line but to contribute this excess profit component to a “fibre fund”. This fund would then receive 600 to 800 million Euros per year. Over a period of 13 years (up to 2025) this approach would generate in sum 8 to 9 billion Euros which would – according to ARCEP’s own calculations - be exactly the amount of public contribution required for a nationwide fibre network in France.[188]

187 See Section 1.2.

188 It has to be noted that Benzoni’s calculation actually overestimates the proceeds of the fund to a certain degree because the number of copper lines declines over time.

7 Implications and assessment of regulatory pricing options

7.1 Assessment criteria

Assessing potential options for changing the ULL price calculation methods needs a framework of relevant criteria. From our analysis so far six criteria seem to be most relevant:

(1) Cost recovery/over-recovery,

(2) Incentives to invest,

(3) Level playing field of competition,

(4) Migration to fibre,

(5) Predictability of outcome, and

(6) Overall efficiency.

(1) Cost recovery/over-recovery

Although it is questionable from a pure efficiency perspective whether sunk cost and stranded cost of an old technology need to be covered under all circumstances, cost recovery plays a significant role under the perspective of regulatory commitment and fairness. Cost recovery has a significant role in regulatory pricing decisions and is a relevant criterion. As we have shown in Section 3.3.3 cost recovery does not mean that any actual costs need to be recovered. To keep the incentive structure intact, it is only the efficiently incurred cost which need to be recovered. At the same time it is an efficiency concern that there is not an over-recovery of relevant costs. Over-recovery leads to windfall profits which are associated with a loss of consumer welfare. Furthermore, over-recovery distorts efficient investment decisions and causes asymmetries in the investment or infrastructure competition between access provider and access seekers.

(2) Incentives to invest

The French Government has formulated a challenging superfast broadband network development strategy. Under that strategy (nearly) universal fibre network coverage should be achieved by 2025. Compared to a fibre coverage of 18% or around 6 million homes passed significant investments in the amount of several billion Euro still have to be conducted by operators and public authorities to achieve this target. There is a second policy target in France which has to be supported by proper incentives to invest in order to achieve this target. The French regulatory policy model for NGA does not rely on access-based competition but on infrastructure competition. Therefore it is essential that not only one operator deploys the fibre network in a particular area but two, three or even four operators should invest to make that competition model happen. Access to the fibre terminating network segment, co-investment and duct access have been developed as regulatory tools and remedies to make the infrastructure competition model viable.

(3) Level playing field of competition

The model of infrastructure competition only generates efficient market outcomes if there is a level playing field of competition between the operators which invest (or intend to invest) in fibre. Only at efficiently priced (copper) ULL prices financial resources between access provider and access seeker are efficiently distributed such that those operators can take the role of a first mover in a particular fibre area which have the greatest comparative advantages of taking that role.

(4) Migration to fibre

From a pure efficiency point of view the regulator and the regulatory pricing regime should be neutral with regard to technology choice. It should neither favour nor discourage a certain technology choice. This holds with regard to operators as well as to end-users. In France there is, however, a rather clear and strong governmental intention to move to superfast broadband. This holds for network coverage as well as for penetration of fibre networks. As a consequence, it has become an important regulatory policy target to support the migration to fibre.

(5) Predictability of outcome

Operators which have in front of them huge investment programs of a long-term nature need a stable and predictable regulatory framework which affects the direction, the intensity of their investment and their financial ability to conduct this investment. This holds for the incumbent and for its competitors. Concerning ULL the relative economic importance and impact of ULL charges is much higher for altnets than it is for the incumbent. This is demonstrated by the fact that the relative cost share of the ULL charge in the unbundling business model amounts to around 50%. Around 50% of the cost of a corresponding retail product depends on a cost component which is not under the control of the supplier. The revenue share of ULL for incumbents on the other hand amounts to less than 10% of their total revenues. Although the ULL charge also has a relevant impact on the business, in particular the investment decisions of the incumbent, the decisions of altnets depend significantly more on that charge. Being able to predict the outcome of the regulatory pricing regime becomes a key factor of generating sufficient certainty for investment and pricing decisions. The less predictable the outcome is, the higher the risk and the lower the corresponding investment in fibre.

(6) Overall efficiency

The various regulatory pricing options more or less contribute to economic welfare and efficiency. It is common sense in regulatory economics to focus on consumer welfare and not on total surplus which includes operators' profits. Consumer welfare has a static and a dynamic dimension. The latter one includes the incentives to invest. This means that not only the short-term interest of facing low retail prices becomes relevant but the long-term interest of users which includes innovation and quality improvement by proper investments.

7.2 Assessment of options

We have distinguished altogether 10 options of changing ARCEP's current costing and pricing methodology including the option of "no change". Table 7-1 lists our assessment of these options according to the six criteria developed in Section 7.1 in a schematic form.

It is obvious from our analysis in this study that the option of not changing the current methodology fails by (nearly) any criterion and therefore is not coherent with economic efficiency. The current approach does not properly incentivize investment of the incumbent and the altnets. It has some credit with regard to migration but effectively does not support migration significantly. The current approach fails in particular with regard to the goal of cost-recovery and a level playing field of competition. Because excess profits are generated as a consequence of the approach which flow to the incumbent, infrastructure competition is significantly distorted.

The options (2) to (6) maintain ARCEP's current methodology in principle but change certain critical assumptions or elements in the calculation approach. All these options are superior to the option of 'no change' in terms of overall efficiency. Depending on their impact on the level of the ULL charge the individual options more or less support the other criteria. The strongest positive impact would be generated by the move to a HCA valuation of ducts. The most significant contribution to the predictability of the regulatory outcome is contributed to the option of setting a five year price cap on ULL charges. This option reduces investment uncertainty significantly and therefore has a positive impact on fibre investment for the incumbent and for altnets.

Given the fact that ARCEP's current cost calculation approach does not comply with the EU costing Recommendation, there is strong reason not to conduct partial changes to its methodology but to directly and fully implement the proposals of the Recommendation. We discuss two different possibilities: The first approach models an overlay network architecture between copper and fibre access which implies a gradual and overtime increasing share of fibre access. The second approach treats FTTH as the MEA for copper access and derives the copper price from the cost of a fibre access network and taking into account the performance difference between copper and fibre access. The second approach is more in line with the efficiency criteria of an LRIC approach. Therefore, we express a clear preference for this approach although the overlay modelling approach also has a lot of credentials.

Instead of keeping its current approach of uplifting the ULL charge to incentivize migration on a nationwide basis, ARCEP may deaverage this approach geographically. In areas where there is effective competition in fibre, ARCEP may consider to uplift the ULL charge, in the rest of the country it may follow a more traditional cost-based pricing approach. This approach reduces the inefficiencies associated with the option of 'no change' to some extent, but the collateral damages of the approach on cost-recovery, a level playing field of competition and incentives to invest remain. In addition, the outcome of such a pricing regime becomes highly unpredictable to market players causing additional uncertainty.

Policy approaches to uplift ULL charges for migration purposes usually are introduced in the way that the proceeds of that (implicit) migration tax would automatically flow to the owner of the legacy infrastructure. This is neither compelling nor efficient and it distorts competition. We discuss the option of using the proceeds of the (implicit) migration tax in a competitively neutral and efficient way. The proceeds may be used to directly subsidizing users for migrating to fibre and/or for supporting fibre investment through a fund model where all investing parties have access to in a non-discriminatory way. This option has a lot of benefits with regard to a level playing field of competition and incentives for efficient investment. The general inefficiencies associated with uplifting ULL charges, however, remain.

Table 7-1: Assessment of the regulatory pricing options

Option	Cost (over-) recovery	Incentives to invest		Level playing field of competition	Migration to fibre	Predictability of outcome	Overall efficiency
		Incumbent	Altnets				
(1) No change	– –[1)]	–	–	– –	+	–	– –
(2) Compensating for decreasing demand	–	+	+ / –	+	+	+	+ / –
(3) Move to HCA valuation of ducts	+ / –	+	+	+	+	+	+
(4) Efficiency correction in OPEX	–	+	+ / –	+	+ / –	+ / –	+ / –
(5) Capital cost based on net book value	–	+	+	+	+	+	+ / –
(6) 5 years price cap approach	–	+	+	+ / –	+	++	–
(7) Copper/fibre overlay network	+[1)]	++	++	+	++	+	+
(8) FTTH MEA and performance delta	++[1)]	++	++	++	++	+	++
(9) Geographical deavaraging	– –	–	–	–	+	– –	+ / –
(10) Competitively neutral use of excessive ULL profits	+	+	++	++	+	+	+

Note: 1) Recovery of efficiently incurred costs

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