Study for the
European Competitive Telecommunication Association (ECTA)

The Economics of Next Generation Access

– Executive Summary –

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Executive Summary

1. The European Competitive Telecommunications Association (ECTA) commissioned this study on "The Economics of Next Generation Access" from WIK-Consult on April 29. The main objective of the study is the assessment of the viability of next generation access business models and the analysis how regulation might support viable duplication of infrastructure whilst ensuring competition in the provision of services to consumers and businesses. The study also gives an overview of recent studies dealing with NGA in Europe and abroad (Australia, Singapore, Japan and the USA).

2. To meet the objectives of the study, we have developed a generic business model. This model on the one hand enables the assessment of the viability of next generation access business models and the potential national coverage of NGA. On the other hand it provides the opportunity to derive conditions (in particular regulated wholesale services) that allow a maximum degree of viable duplication (replicability) of a first mover's investment. However, as the term "generic" suggests, the model structure and logic itself is independent from the conditions in a specific country or area. Rather, the model requires to feed in real world data about a country or an area within a country in order to generate actual empirical results (which are then country/area specific). The model for the first time gives particular emphasis on the impact of certain regulatory decisions on access regarding NGA.

3. There are already several studies that focus on various facets of fibre deployment in the access network. Likewise, there are already several models available which are focusing on certain aspects of the viability of deep fibre deployment. The present study covers all relevant aspects in a comprehensive way. We review the relevant literature and models, we analyse actual fibre deployment approaches in several countries in and outside Europe, we present the main features of our model and we apply this model to generate empirical results for altogether six European countries (Germany, France, Italy, Portugal, Spain, Sweden). For all six countries we provide comprehensive empirical evidence on the viability of replication of VDSL/FTTC infrastructure as well as of the deployment of FTTB/H infrastructure. We also show quantitatively and not only qualitatively the impact of regulatory measures like duct and dark fibre access, fibre loop and sub-loop unbundling on the replicability of NGA roll-out and competition. On the basis of our model results we derive recommendations on the necessary regulatory conditions for effective competition in NGA.

4. We have structured the model to calculate fibre deployment for eight coverage areas or "clusters" in each country defined by population density with the expectation that profitability of NGA deployment depends on population density.

5. We assume an advanced state of network development in which 80% of all subscribers to fixed telecoms receive double or triple play services whilst the remainder receive telephony alone. This is higher than the take-up of these services today, but is considered a reasonable expectation over the horizon of an investment decision.

6. Market shares listed indicate shares of all households and businesses (potential subscribers), which may include households without fixed connections or with cable services. The results should be read in this context. For example a typical leading entrant serves 10-20% of broadband subscribers in the market today. In a country where 50% households subscribe to broadband, this broadband market share would equate to a market share of between 5-10% of all households (potential customers).

Model results

7. We have modelled three architectural approaches for NGA: FTTC/VDSL, FTTH PON and FTTH P2P. In general, the investment requirements (and the resulting impact on coverage and critical market shares to be achieved for profitability) are ranked in the order above. The lowest investment is required by VDSL, followed by PON and then by P2P. This ranking does not consider the different capabilities of the architectures to support high bandwidth, to be future-proof or to facilitate any unbundling requirements.

8. NGA deployment requires significant investments. The following table shows the investment per home connected across the various NGA architectures derived from our model.

Investment per home connected (in Euro), market share 50%, urban cluster, stand alone first mover **

Network Type	Country [in €]					
	DE	FR	SE	PT	ES	IT
VDSL	457	n.v.	352	218	254	433
PON	2,039	1,580	1,238	1,411	1,771	1,110
P2P	2,111 (54%)	2,025	1,333	1,548	1,882	1,160

** Based on the investment of the urban cluster and a market share of 50%. If other marekt shares are used, it is mentiond in brackets.

n.v. – not viable

The investment requirements are reported for the urban roll-out cluster and a market share of 50% of the potential customer base. They include CPE and inhouse cabling in case of FTTH. The figures in the table show the investment requirements for an operator without existing infrastructure such as ducts and are based on current costs. As such they are most relevant when assessing the costs

for alternative (non-incumbent) operators in the absence of regulation. The following results are worth highlighting.

8.1 NGA investment requirements are very much dependent on national specificities (e.g. low civil engineering costs in Portugal, renting ducts in the distribution cable segment in Italy instead of own investment).

8.2 FTTC/VDSL requires much less investment than FTTH due to saving the distribution cable segment by using the existing copper sub-loops and saving the inhouse cabling.

8.3 FTTH requires roughly 5-times higher investments than VDSL. The more future-proof and open network friendly P2P FTTH architecture requires less than 10% additional investment than the PON architecture.

9. A nationwide NGA roll-out is not profitable in any of the six countries analysed on the basis of current costs. This result holds for any NGA technology and even for a monopolistic market structure (except VDSL in Italy, due to country specific circumstances). The area of NGA coverage beyond the level of profitable roll-out can only be expanded with public funding or subsidies.

10. The following table provides an overview of the proportion of households that could be profitably covered by incumbents for all six countries considered in this study on the basis of current costs (neglecting already depreciated assets). The results are shown for all three architectures.

Viability of NGA roll-out for incumbents across countries and technologies

Network Type	Country					
	DE	FR	SE	PT	ES	IT
VDSL	71.5%	n.r.	18.3%	39.0%	67.4%	100.0%
PON	25.1%	25.2%	18.3%	19.2%	12.2%	17.6%
P2P	13.7%	18.6%	18.3%	19.2%	12.2%	12.6%

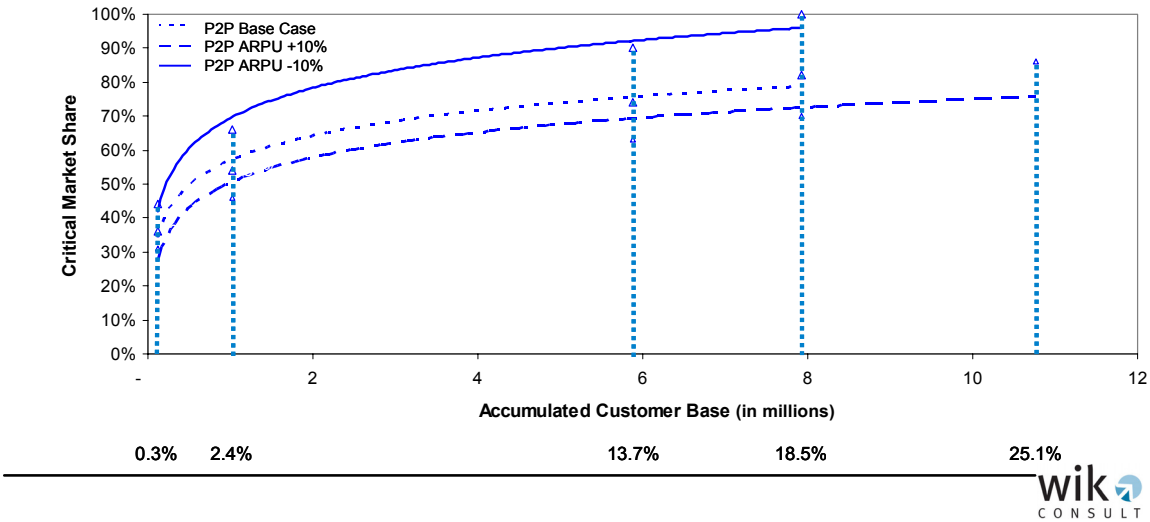
n.r. – not realisable

The incumbent in Germany can profitably roll out VDSL for 71.5 % of the population while economic viability in less densely populated Sweden ends at 18.3 % of population. The profitable range for an FTTH roll-out is significantly lower and is in the range from 12 to 25 % across the six countries.

11. Our base case assumes, consistent with fibre-rich countries such as Japan and with developments in European markets such as France, that consumers will not pay substantially more for higher bandwidths provided over NGA but we reflect in the ARPU assumptions that telecoms operators will capture a higher proportion of the TV market than is typical today. Sensitivity tests show that an increase of 10%

in ARPUs for VDSL in Germany would reduce the critical market share required for a stand-alone first mover in most geographic areas by around 25% compared with the base case whilst FTTH viability is less sensitive to ARPU increases – reducing the critical share by 13% for PON and 16% for P2P (see diagram below). A reduction in expected ARPUs would reduce the area of profitable roll-out.

APRU sensitivites for the P2P stand-alone case, effects on critical market shares in Germany



12. Our model exhibits the importance of scale and scope economies limiting the degree of replicability. Where viable, replication of the incumbent's NGA requires a more significant scale and/or market share for alternative operators compared with current business models based on local loop unbundling. This limits the number of feasible competitors in the access network.

13. The next table shows the profitable range of a second mover's NGA roll-out. These results are provided for the optimistic scenario that the second mover has access to 80 % of existing ducts at current cost-based prices or equivalent facilities such as sewers. Where duct or sewer access is available or under negotiation actual or proposed prices have been used for the model.

Replicability of NGA roll-out for a second mover, 80 % access to existing ducts at current cost-based prices

Network Type	Country					
	DE	FR	SE	PT	ES	IT
VDSL	18.5%	n.r.	n.v.	39.0%	n.r.	17.6%
PON	0.3%	6.8%	n.v.	n.v.	n.v.	1.6%
P2P	0.0%	6.8%	n.v.	n.v.	n.v.	0.2%

n.v. – not viable
n.r. – not replicable

VDSL in Portugal is replicable for 39 % of population and for 18.5 % in Germany. Across all countries there is only relatively low replicability of FTTH infrastructure. The most viable country for FTTH duplication is France where, mainly due to accessibility of sewers in Paris, at least 6.8 % of the population can be profitably covered by a second mover.

14. Replicating the incumbents' VDSL network roll-out by alternative operators is less viable than the current LLU approach of alternative operators. In a VDSL NGA environment, the current degree of LLU based competition does not seem to be replicable. These results are similar to those generated in studies carried out for NRAs in the Netherlands, Ireland and Belgium.

15. As indicated by other studies and/or analytical expectations, our model results support the finding that civil engineering cost and inhouse wiring are key barriers to replicability in FTTB/H NGA deployment. However, addressing these barriers by regulatory measures will not alone be sufficient to deliver competitive outcomes.

16. Incumbents are better placed than alternative operators to invest in NGA on a large scale:

    16.1 Incumbents can rely on the availability of major network elements needed for NGA (locations of street cabinets, ducts, fibre) which they might use at their book values. Alternative operators still have to invest.

    16.2 Incumbents can save (economically) investments by generating lump-sum revenues due to dismantling of MDFs and selling the respective locations. These savings are modelled in the incumbent scenarios included in the report.

    16.3 Incumbents can make better use of economies of scale and scope due to their larger subscriber base (80-90% of local loop, around 50% of retail broadband customers) compared to that of the leading broadband competitor (10-15% retail market share), which they can migrate to NGA.

    16.4 Alternative operators usually face a higher cost of capital than incumbents due to their size and risk position.

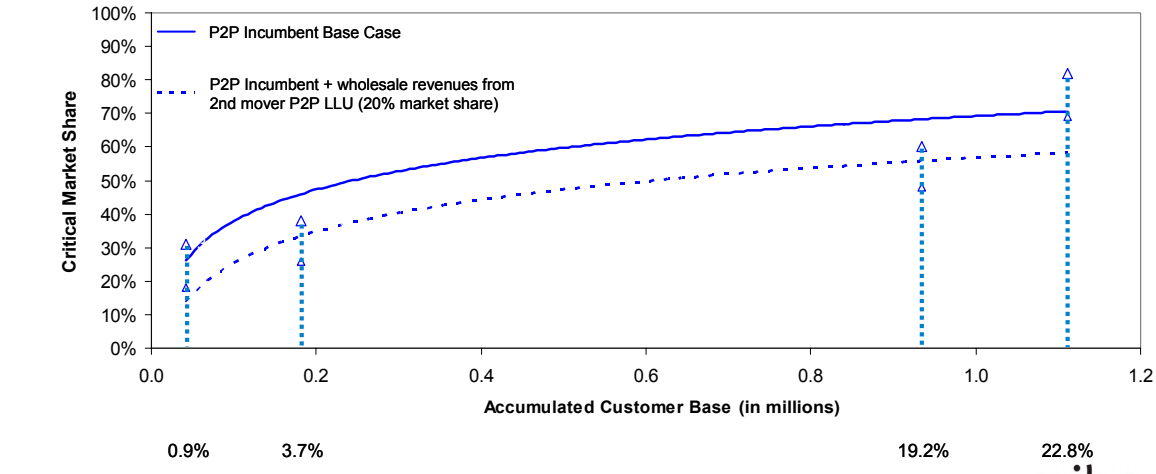
    16.5 Due to the factors mentioned above, investments in NGA are more risky for alternative operators than for incumbents. Yet, alternative operators may act as first movers in NGA because their current business model as a whole is under threat.

    16.6 For areas shown as viable, and where incumbents currently have the required market share of access lines to make a fair return and have

depreciated existing copper loops, little or no risk may be incurred, and the FTTx investment constitutes normal infrastructure renewal.

17. Our model results show that incumbents can reduce their own costs by infrastructure sharing, can increase the profitability of their NGA roll-out and can reach profitability with a lower level of retail market shares if they provide wholesale services (i.e. wholesale revenues can substitute for retail revenues to a significant degree). This result suggests that investment cases of incumbents may be supported rather than undermined through open access regimes, whilst delivering market outcomes that are more compatible with effective competition. Our model suggests in the sample case of Portugal that if only duct access were available, the presence of second market players deploying fibre access would significantly improve the incumbent's profitability but the market structure would tend to support only two significant fibre operators. A model in which wholesale fibre LLU or SLU was available would lower the critical retail market share for the incumbents' profitability whilst supporting a number of additional players (see diagram below).

Critical market shares for the P2P incumbent case with additional wholesale fibre LLU revenues in Portugal



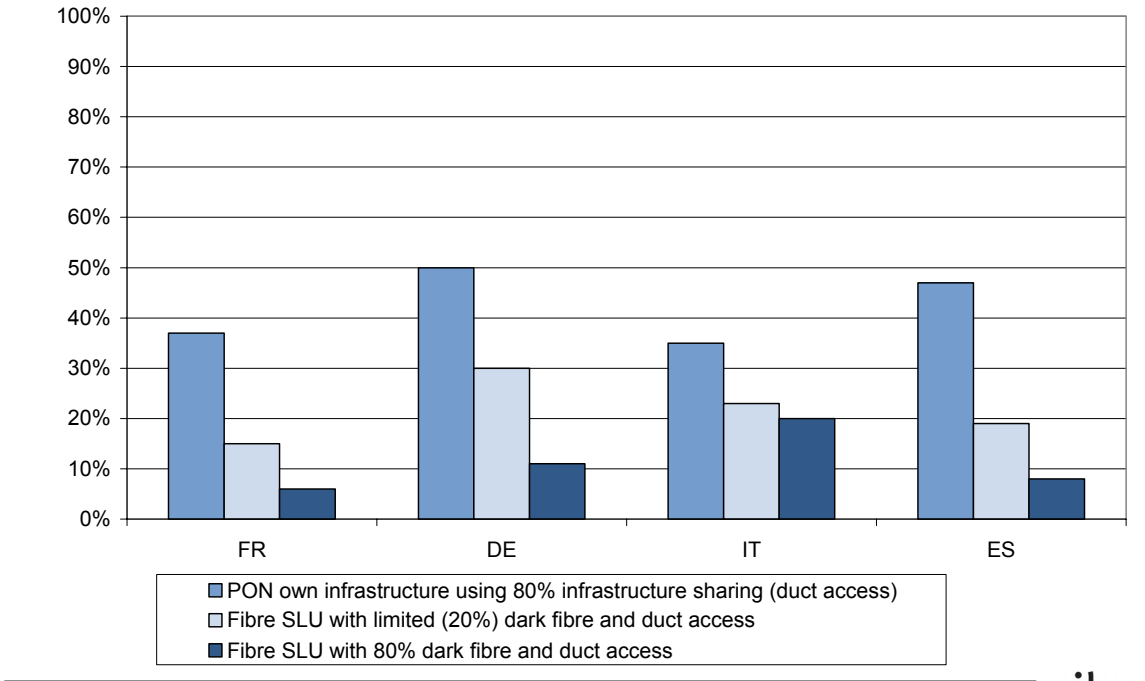
18. Our model results underline the importance of efficiency in the duplication of infrastructure. If more access networks are rolled out than suggested viable by the model or if particular access network providers fail to achieve the critical market shares calculated, market players would either need to charge higher retail prices to recoup their investment or have to face major stranded investment failing to make a fair return on investment. A similar situation due to overinvestment in backbone and undersea cables occurred when the internet bubble burst in 2000/01.

19. The economics of FTTx do not support multiple replication of the access network sufficient to achieve effective competition. In case of (theoretical) replicability usually only one or in rare cases two operators (in addition to the first mover) can profitably invest in NGA infrastructure. In any case, replicability is limited to denser populated areas.

20. Introducing access remedies and/or wholesale products in addition to duct access lowers the critical market shares required for profitability and increases the degree and potential for competition. Access opportunities enable competition wherever a first mover (e.g. the incumbent) rolls out a FTTH NGA infrastructure and require lower market shares for profitability commensurate with market shares that might be realistically achievable in a competitive environment. Fibre LLU and SLU are also the prerequisite for getting (at least) the same degree of competition as under the current unbundling model in the PSTN.

21. The following diagram shows for those countries where this scenario is most relevant the critical shares of potential subscribers (all households and businesses) for an entrant in the urban cluster for different regulatory scenarios.

Impact of regulatory measures on the critical market shares of alternative operators in the urban cluster



22. We have modelled several regulatory measures relating to the use and sharing of infrastructure. These measures can be combined with each other in a relevant form. Some combinations of regulatory measures result in more efficient network

roll-outs than pure solutions of one type, depending on the architecture. Thus, choice between different regulatory options (wholesale products) increases the efficiency of NGA investments.

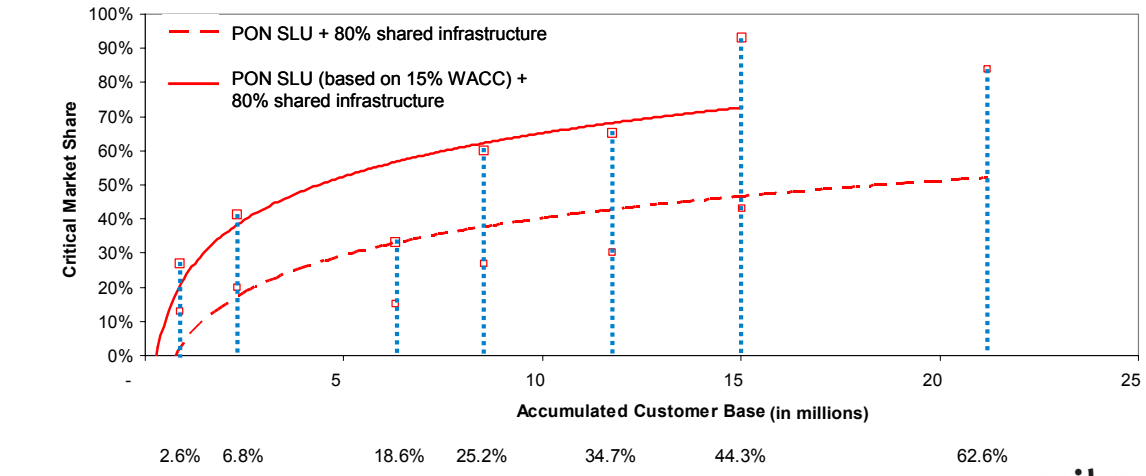
23. In a VDSL/FTTC environment, our model results show quantitatively the importance of efficient backhaul solutions between the street cabinet and the operator's network node. The necessity of establishing stand-alone backhaul services limits the replicability of FTTC NGA development significantly. Thus, the availability of proper access products and the choice between duct access and dark fibre backhaul, improves replicability.

24. In an FTTH NGA environment, the current degree of competition based on LLU can only be maintained if fibre SLU (in case of PON architecture) and/or fibre LLU (in case of P2P architecture) are available as access products together with appropriate backhaul. Fibre LLU and fibre SLU increase replicability significantly and enable viable competition in all clusters where a first mover rolls out the FTTH infrastructure. Replicability is not given in less populated clusters.

25. Our model results show that the market shares required for SLU solutions are compatible with competitors having significant scale in the mass market and focusing on covering in more densely populated regions. However, these market shares are unlikely to be achievable for business service providers whose coverage is more dispersed and whose local market shares are typically lower.

26. The effectiveness of regulated access on increasing replicability and competition is strongly affected by the price of access including the WACC. Sensitivities on the level of the cost of capital show the critical dependency of NGA profitability and coverage from this parameter. Increasing the WACC for instance in France from 10.25% to 15% reduces the viable coverage of a PON FTTH infrastructure from 18.6% to 6.8% of population. In the viable areas the critical market shares for profitability increase significantly. If only the WACC for the regulated wholesale services on the SMP operator is increased by the same degree, the critical market shares (or the costs) of competitors increase significantly and the viable addressable customer base decreases (see diagram below). These results show how careful regulators have to deal with a risk premium approach to incentivise investments in NGA. If wholesale rates are fixed significantly above the relevant NGA project risk, replicability and competition can be heavily affected.

Increase of WACC from 10 to 15% applied on SLU fees in the case of PON SLU in France



Regulatory and policy recommendations

27. The economics of rolling out fibre access networks require high market shares which in most cases are not compatible with effective competition. This is a structural issue relating to the high costs of laying physical infrastructure in a typical European environment (medium density, buried cables). Policy-makers should set realistic objectives for regulators on this basis which recognise that there are structural barriers to infrastructure-based competition in the access network and more widely in rural areas which must be addressed by regulators to achieve effectively competitive outcomes.

28. Open access models should be positive for investors and favoured by policy makers exploiting the potential of innovation and competition.

29. Policy-makers and regulators must act quickly to identify their preferred model for NGA deployment and expectations regarding openness of networks. Whilst policy makers cannot mandate particular network structures, signaling expectations of reasonable access conditions in case of SMP and indicating that access pricing will be calculated on the basis of efficient architectures can help to ensure that access owners take account of requirements for openness in the network architectures they adopt.

30. Policy-makers should take care that local loop unbundling and sub-loop unbundling are defined in a technologically neutral manner that includes fibre lines and not just metallic lines. It is likely that regulated access to fibre networks will be needed, in addition to duct access, to deliver effective competition in most cases.

31. Policy makers should aim for efficient investment so that infrastructure is rolled out profitably, with minimum risk for the economy and with a maximum reach. Policy-makers should avoid making assumptions on the degree of investment which is efficient, but enable operators to invest efficiently based on a set of options (the ladder of investment).

32. Policy makers should promote service competition and infrastructure-based competition at the same time. Provided the wholesale price is correctly established and allows a fair return, regulated access to fibre does not preclude and can provide a platform for further infrastructure duplication where this is efficient. Our model shows that reasonably priced access is also compatible with and enables fibre investment with lower retail market shares and less risk than would otherwise apply.

33. Rewarding risk appropriately is important in ensuring that investment occurs. A solution could be to increase the allowed WACC for risky projects. However, policy-makers should not recommend particular (additional) risk premiums for all NGA investments. Investing in next generation access networks may be risky in some circumstances and may constitute relatively risk-free renewal of equipment in others. The assessment of the level of riskiness and calculation of the appropriate price should be carried out on a case by case basis by the regulator. A WACC that is too low will limit investment, whilst an excessive WACC would undermine the degree of competition which is sensitive to the price of access.

34. Certain models of risk rewarding or sharing are not compatible with competition or may at least harm competition. Legislators should not stipulate pricing structures, but adopt the principle that regulated prices must allow a fair return appropriately reflecting risk, and that pricing structures adopted should achieve this whilst also being compatible with promoting competition.

35. Transparency about planned deployment of NGA networks is a prerequisite both for developing a proper regulatory framework for effective transition and for providing economic efficient incentives for NGA deployment. This presumption holds in particular for the investment decisions of alternative operators; it is, however, of important relevance for incumbents' investment decisions as well. Despite the fact that NRAs have the legal power based on Art. 5 FD to request the relevant information from operators, there is significant lack of transparency of the incumbents' NGA strategy and the future of the existing unbundling wholesale services in many Member States. Lack of transparency can increase the level of sunk cost in the transition to NGA, can generate economically unjustified first mover advantages and reduce the potential for competition in NGA.

36. A range of access products are needed for a competitive NGA market:

    36.1 Duct and dark fibre access increase the level of infrastructure replicability, but are not alone sufficient for viable competition.

    36.2 Physical collocation at the street cabinet level increases the limited degree of replicability in case of FTTC.

    36.3 Fibre full local loop unbundling (at metro core locations) and fibre sub-loop unbundling (at OSDF) increase the scope for competition significantly, and are particularly relevant for established mass-market broadband providers.

    36.4 Bitstream access remains important to maintain existing levels of competition where full LLU is not technically feasible, to support the ladder of investment concept, for less urban areas where unbundling is not economically viable and for business service providers whose market shares are unlikely to reach critical levels.

    36.5 In addition, the regulatory framework has to deal with the sunk investments of competitors related to LLU infrastructure to enable a viable migration path to NGA.

37. NRAs should develop unbundling approaches for fibre loops in the context of market analysis and remedies relating to the new Market 4. The current unbundling approach defined for the copper PSTN network should be expanded in a technologically neutral manner to fibre. In case of a P2P architecture fibre local loop unbundling should be provided at the metro core locations. In case of a PON architecture fibre sub-loop unbundling should be provided at the OSDF. The location of the OSDF should allow the efficient replication of network infrastructure.

38. NRAs have to take care that incumbents do not receive first-mover advantages in NGA deployment such that possible replicability will de facto be jeopardised. This means in particular that relevant access products are not only available in principle but are effectively available in due time.

39. Regulators should do more than they did with regard to LLU to shorten the gap between imposing NGA related remedies and the actual availability of the relevant wholesale services. In the case of LLU the implementation delay in some countries amounted to several years. Given the relevance of first-mover advantages, similar gaps in NGA can endanger the (limited) potential of replicability even more or totally.

40. When mandating wholesale broadband access NRAs should ensure that the SMP operator makes available, on a non-discriminatory basis, all technical capabilities embedded in its NGA, to enable alternative operators to define their own products with own QoS. Multicast capability is one such technical capability.

41. NGA development per se does not require to address the issue of sub-national markets. NGA will only have an impact on the need to define sub-national markets for certain markets and/or to differentiate remedies on a geographic basis if the degree of replicability of access services increases due to NGA investments.

42. To minimise the level of sunk costs in the transition to and to set proper incentives for efficient investments in NGA, NRAs should use their statutory powers immediately to make the transition to NGA in their respective country transparent if they haven't done so yet.