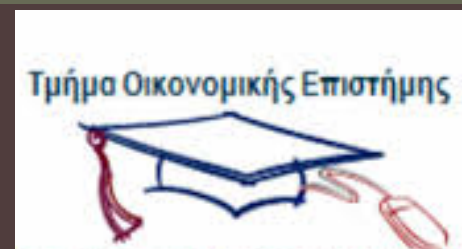


ΟΙΚΟΝΟΜΙΚΑ ΤΩΝ ΘΑΛΑΣΣΙΟΚΟΙΝΩΝΙΩΝ ΚΑΙ ΤΩΝ ΔΙΚΤΥΩΝ



ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ
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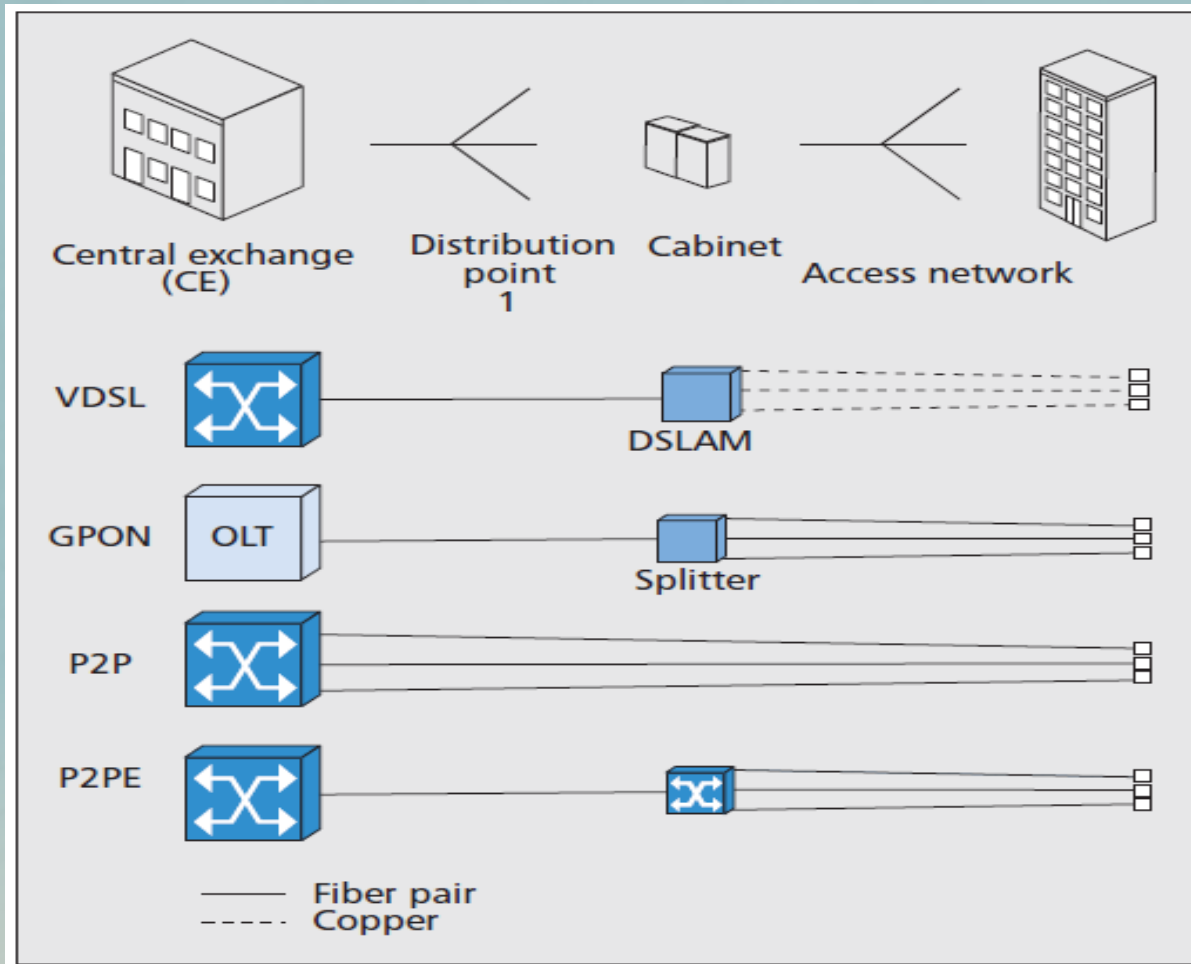
NEXT GENERATION ACCESS NETWORKS

INTRODUCTION

- Definition (EC, 2010)
 - NGA networks means wired access networks which consist wholly or in part of optical elements and which are capable of delivering broadband access services with enhanced characteristics (such as higher throughput) as compared to those provided over already existing copper networks.
- NGA technologies
 - Depending on the part of the copper wire being replaced, there are certain NGA architectures, the most common of which are:
 - Fiber-to-the-Curb (FTTC)
 - Fiber-to-the-Building (FTTB)
 - Fiber-to-the-Home (FTTH)
 - Gigabit Passive Optical Network (GPON)
 - Point-to-Point (P2P)
 - Point-to-Point Ethernet (P2PE)

NGA NETWORKS

TECHNOLOGICAL SOLUTIONS



DIGITAL AGENDA FOR EUROPE 2020

NGA GOALS

- Fast and ultra fast internet access
 - We need very fast Internet for the economy to grow strongly and to create jobs and prosperity, and to ensure citizens can access the content and services they want
- The Europe 2020 Strategy has underlined the importance of broadband deployment to promote social inclusion and competitiveness in the EU
- It restated the objective to bring basic broadband to all Europeans by 2013 and seeks to ensure that, by 2020,
 - i. all Europeans have access to much higher internet speeds of above 30 Mbps and
 - ii. 50% or more of European households subscribe to internet connections above 100 Mbps

DIGITAL AGENDA FOR EUROPE 2020

IMPLICATIONS

- NGA networks are very important for the society and the economy as a whole
- The DAE goals are related with the three-dimensional NGA investment decision
 - When to invest (date goal)
 - Where to invest (coverage goal)
 - Which technology to deploy in each covered area (speed goal)

NGA DEPLOYMENT

SOCIAL AND ECONOMIC IMPACT

“The EU single market for electronic communications services, and in particular the development of very high-speed broadband services, is key to creating economic growth and achieving the goals of the Europe 2020 strategy”

“The fundamental role of telecommunications and broadband deployment in terms of EU investment, job creation and overall economic recovery was notably highlighted by the Council”

“The cost savings in just four sectors of economy (transport, health, electricity and education) would justify the construction of a national FTTH network”

TELECOMMUNICATIONS INVESTMENT

SOCIAL AND ECONOMIC IMPACT

- Overall, a majority of the studies reviewed provide evidence that economic growth measured by GDP/GNP or GDP per capita is significantly and positively affected by landline telecommunications with all of the studies with data at the country level finding such an effect for at least some of the examined countries
- Some studies also indicate that the positive effect of telecommunications is mostly present in developed countries with a high number of mainlines, while evidence for developing countries with a lower number of mainlines is slightly less conclusive
- All of the studies focusing on wireline telecommunications find at least partially significant positive impacts on productivity, firm performance or market performance

BROADBAND INTERNET

SOCIAL AND ECONOMIC IMPACT

- Overall, four out of five studies that examine the impacts of broadband adoption on GDP and GDP growth with country-level data find a positive and significant effect (one study finds inconclusive results)
- This effect is increasing in the penetration rate of a country... it seems to be necessary for countries with low broadband penetration to reach a certain penetration level if they want to experience the largest possible benefits of broadband
- The majority of studies that focus on overall employment find positive links between broadband and employment growth
- The effect of broadband is significant in rural areas ... broadband can help these regions to catch up with more economically developed urban areas
- The evidence for a positive impact of broadband on productivity is mixed

BROADBAND INTERNET SOCIAL AND ECONOMIC IMPACT

service-based
competition

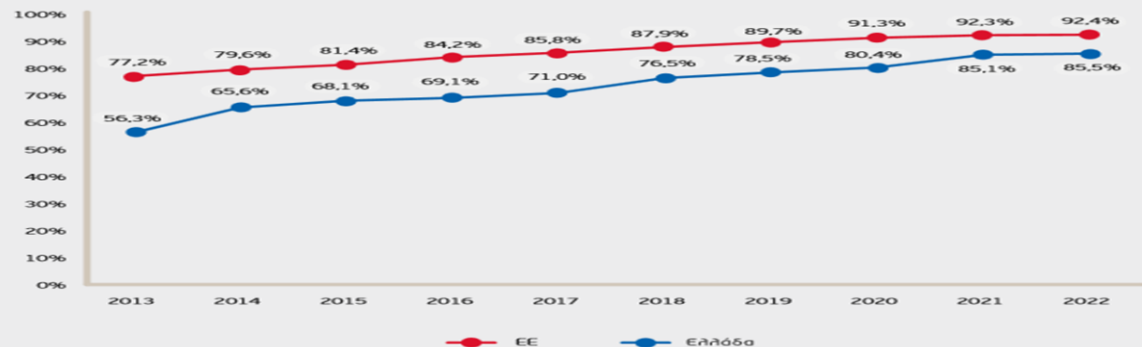


broadband
diffusion



economic growth

Διάγραμμα 1.129: Εξέλιξη διείσδυσης του Διαδικτύου στα νοικοκυριά σε Ελλάδα και ΕΕ



Διάγραμμα 1.120: Εξέλιξη της σταθερής ευρυζωνικής διείσδυσης σε Ελλάδα και ΕΕ

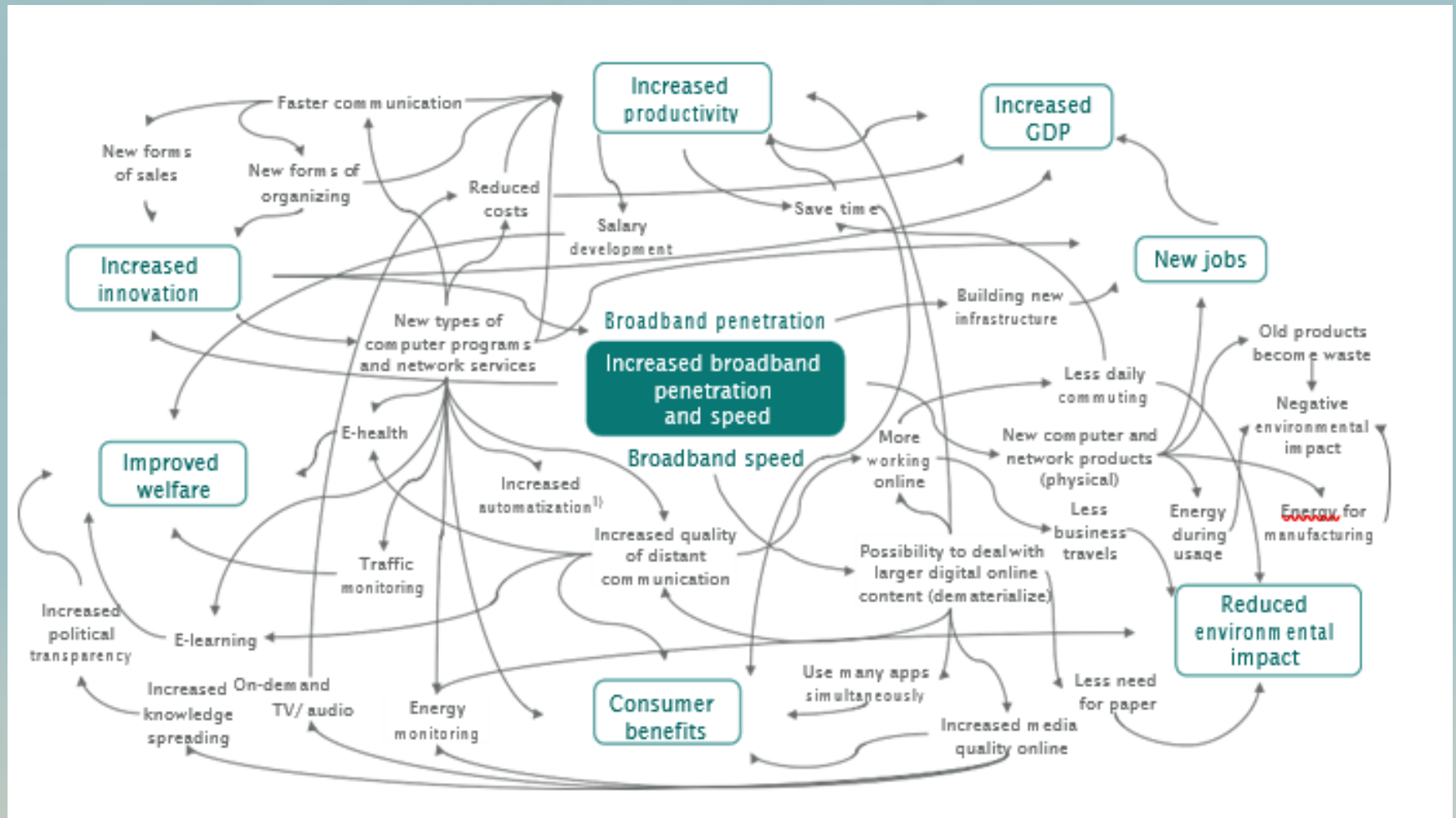


MAIN QUESTION

*Is this relationship multiplied when the
broadband speed increases?*

BROADBAND INTERNET

SOCIAL AND ECONOMIC IMPACT



NGA NETWORKS

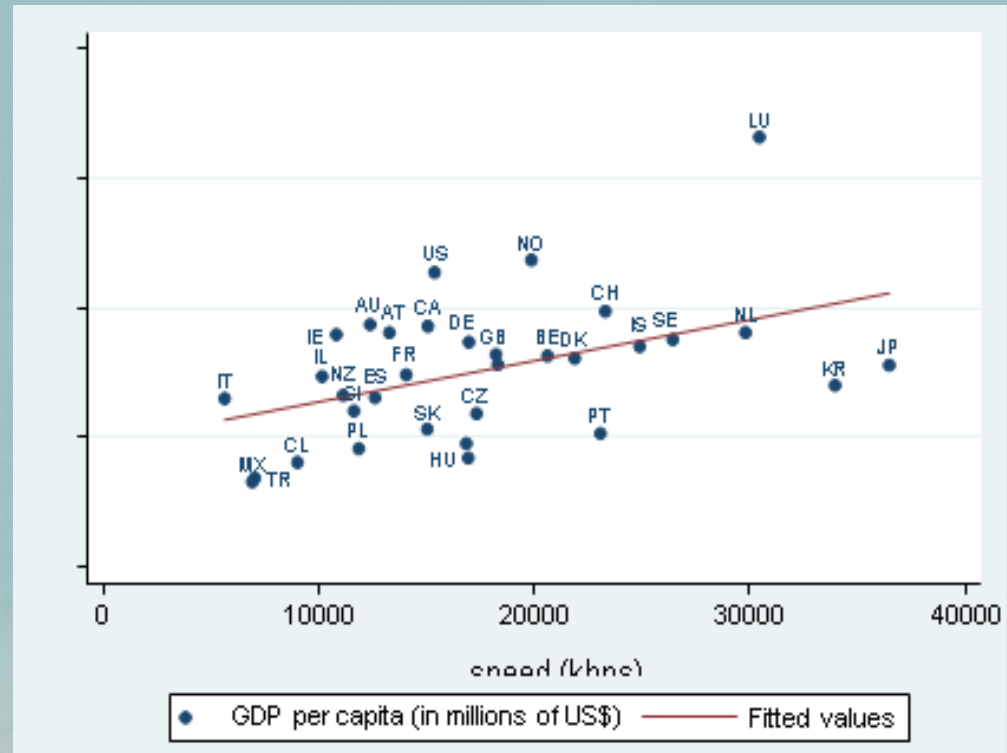
BROADBAND SPEED AND ECONOMIC GROWTH

- Rohman & Bohlin (IJMNE, 2012)

- ✓ Doubling the broadband speed will contribute 0.3% growth compared with the growth rate for the base year

- Ford (JTPO, 2018)

- ✓ Study the relationship between higher broadband speeds (10 Mbps versus 25 Mbps) and the growth rates
- ✓ No economic payoff from the 15 Mbps speed difference between the years 2013 and 2015



NGA NETWORKS

THE CURRENT SITUATION AT EU LEVEL



**DESI 2022 Connectivity
Report**

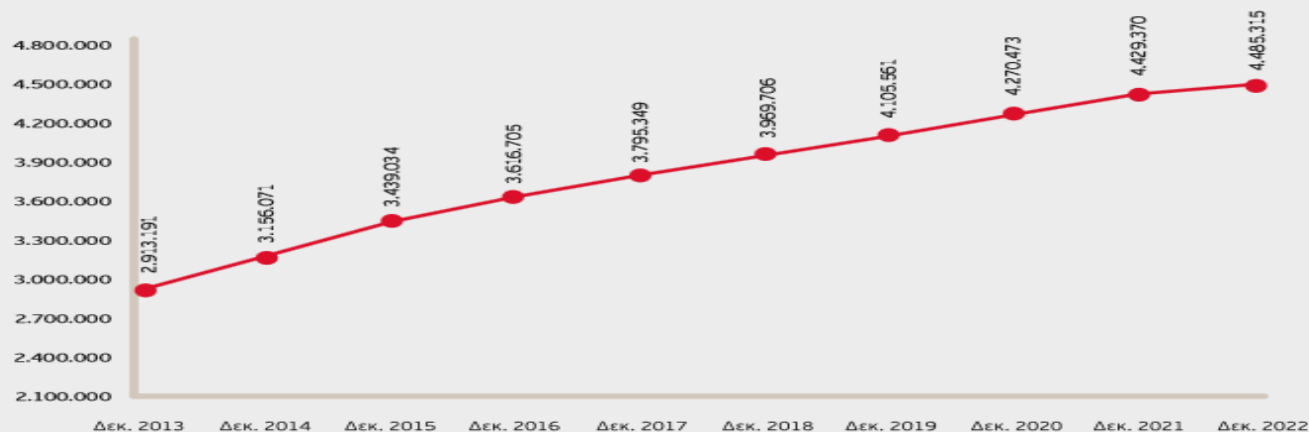


**Broadband Coverage in
Europe 2023**

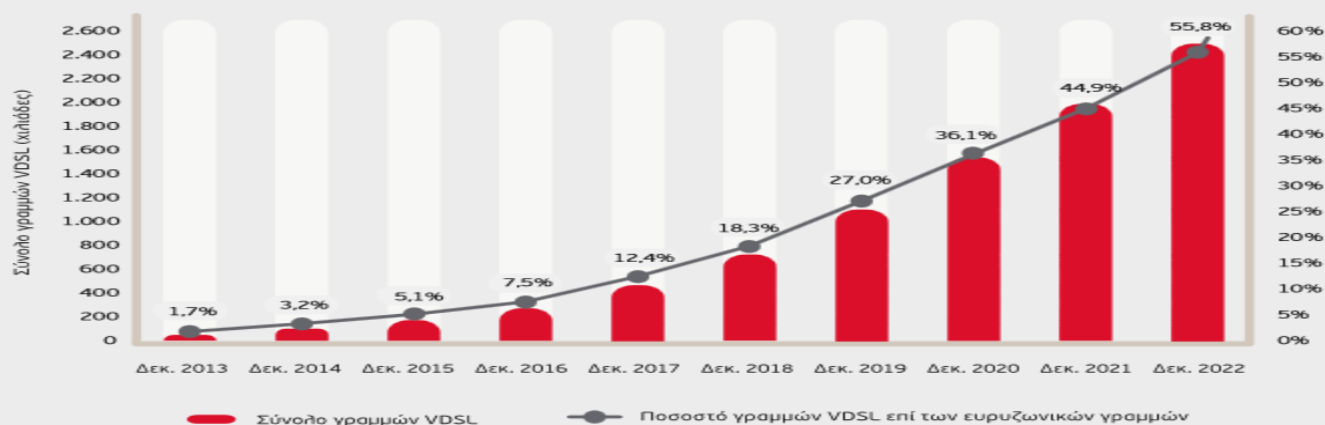
NGA NETWORKS

THE CURRENT SITUATION IN GREECE

Διάγραμμα 1.58: Εξέλιξη ευρυζωνικών γραμμών



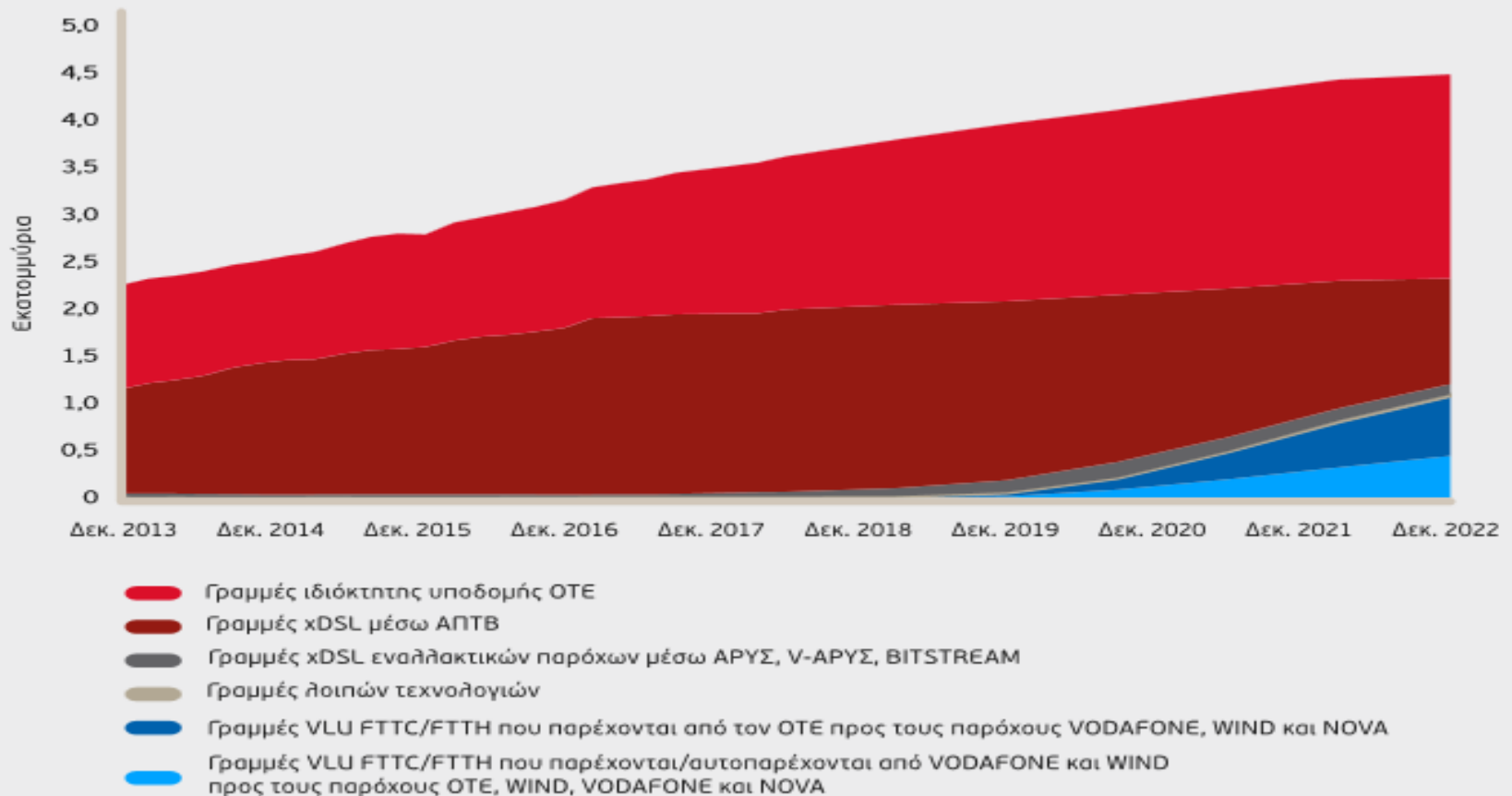
Διάγραμμα 1.63: Εξέλιξη γραμμών VDSL



NGA NETWORKS

THE CURRENT SITUATION IN GREECE

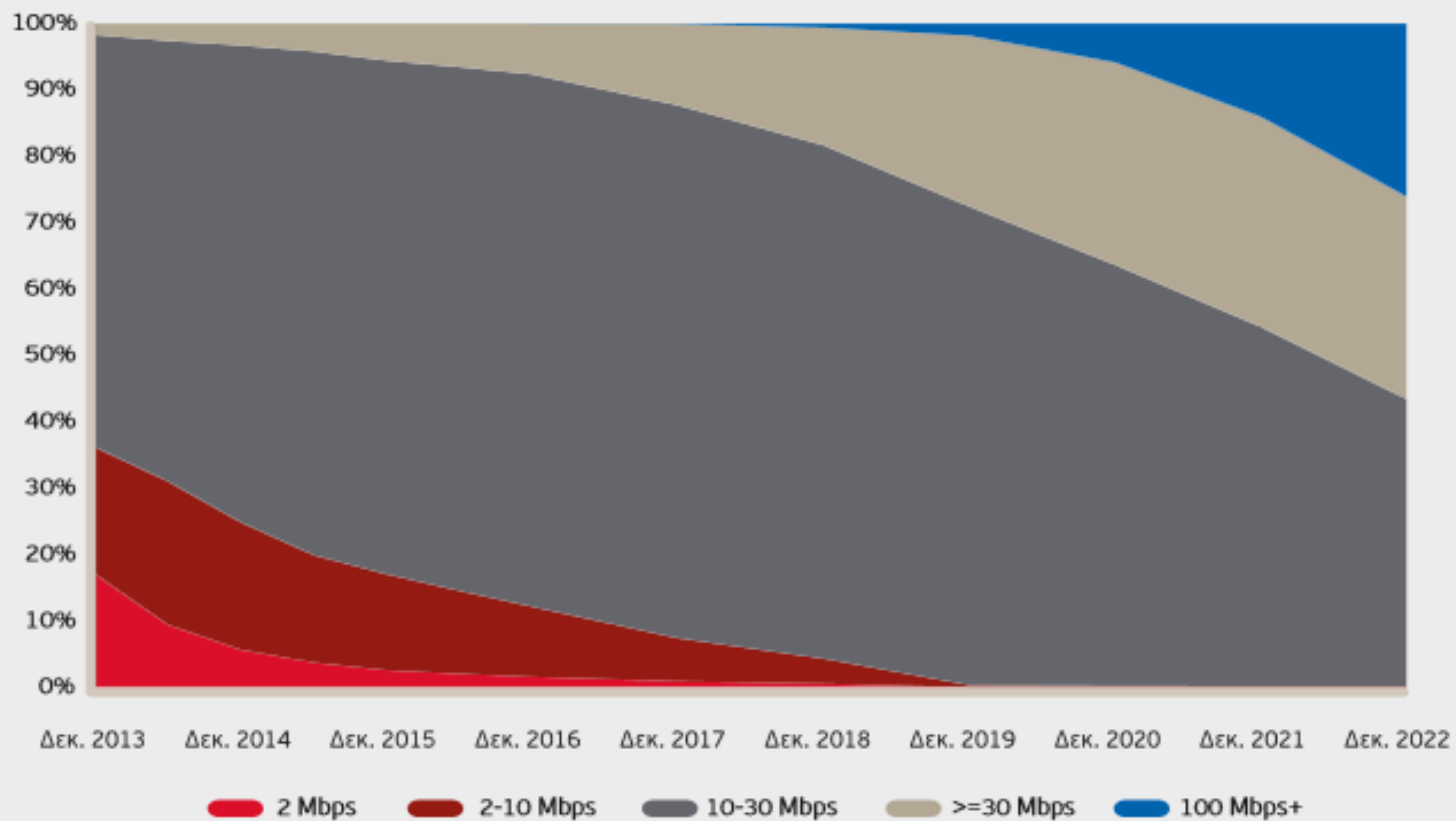
Διάγραμμα 1.65: Εξέλιξη ευρυζωνικών γραμμών ανά τεχνολογία



NGA NETWORKS

THE CURRENT SITUATION IN GREECE

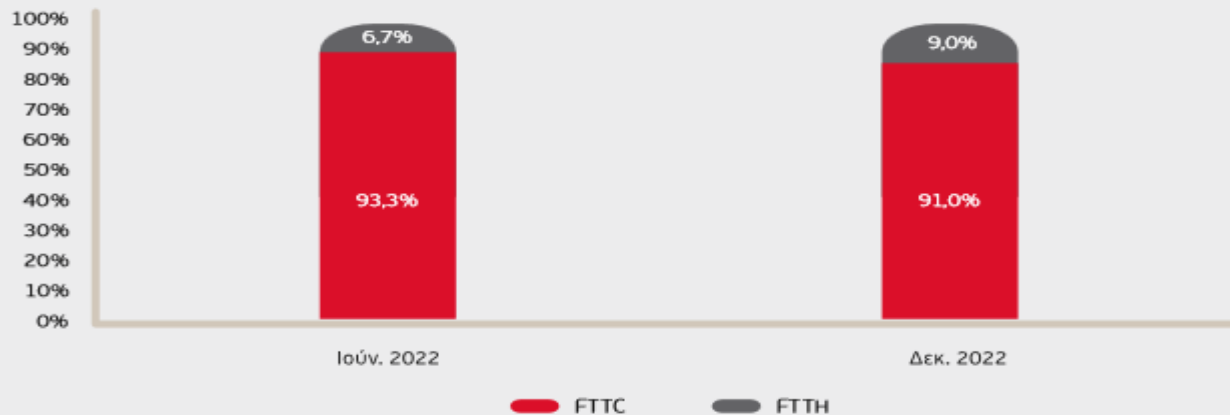
Διάγραμμα 1.68: Εξέλιξη ονομαστικών download ταχυτήτων πρόσβασης ευρυζωνικών γραμμών



NGA NETWORKS

THE CURRENT SITUATION IN GREECE

Διάγραμμα 1.66: Εξέλιξη μεριδίων των γραμμών VLU FTTC/FTTH



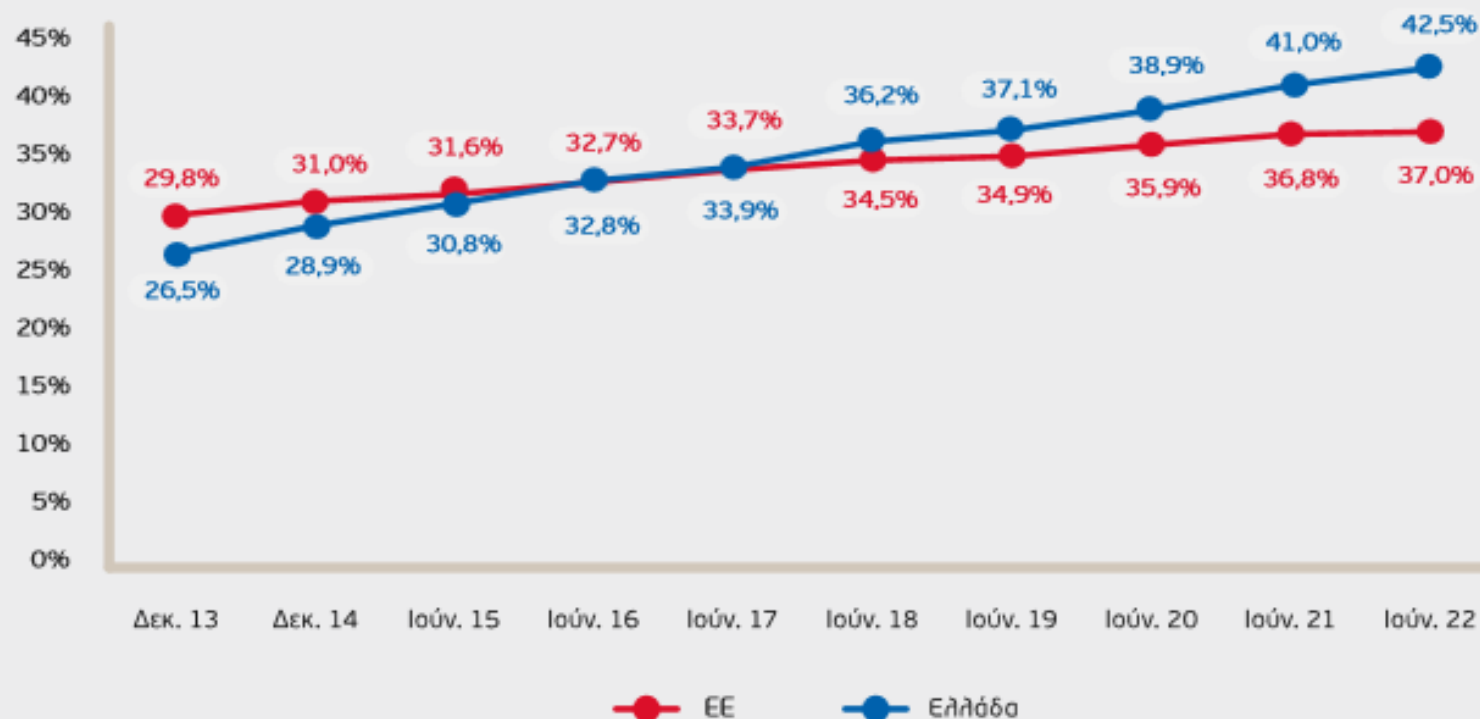
Διάγραμμα 1.59: Εξέλιξη μεριδίου γραμμών FTTH ως προς το σύνολο των ευρυζωνικών γραμμών



NGA NETWORKS

THE CURRENT SITUATION EU VS GREECE

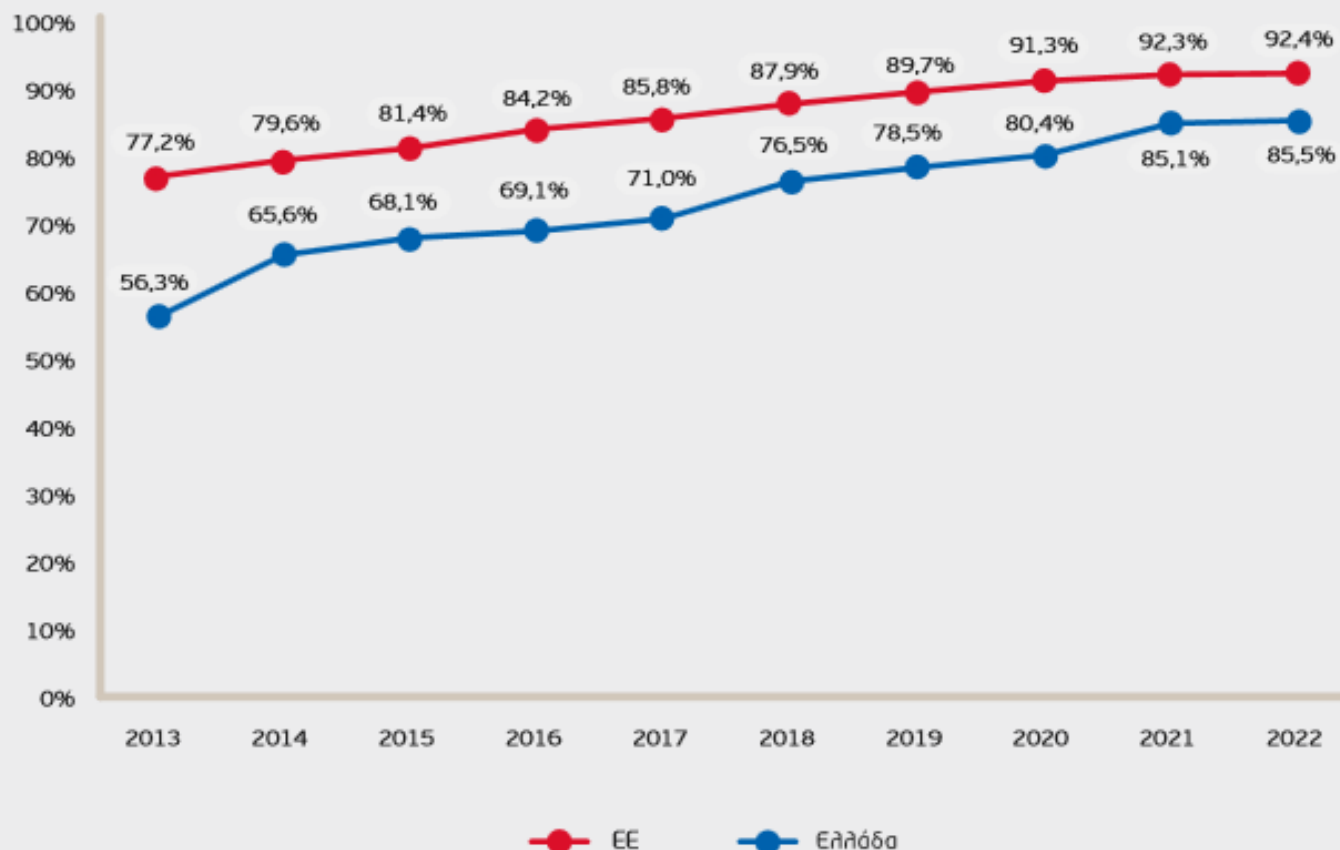
Διάγραμμα 1.120: Εξέλιξη της σταθερής ευρυζωνικής διείσδυσης σε Ελλάδα και ΕΕ



NGA NETWORKS

THE CURRENT SITUATION EU VS GREECE

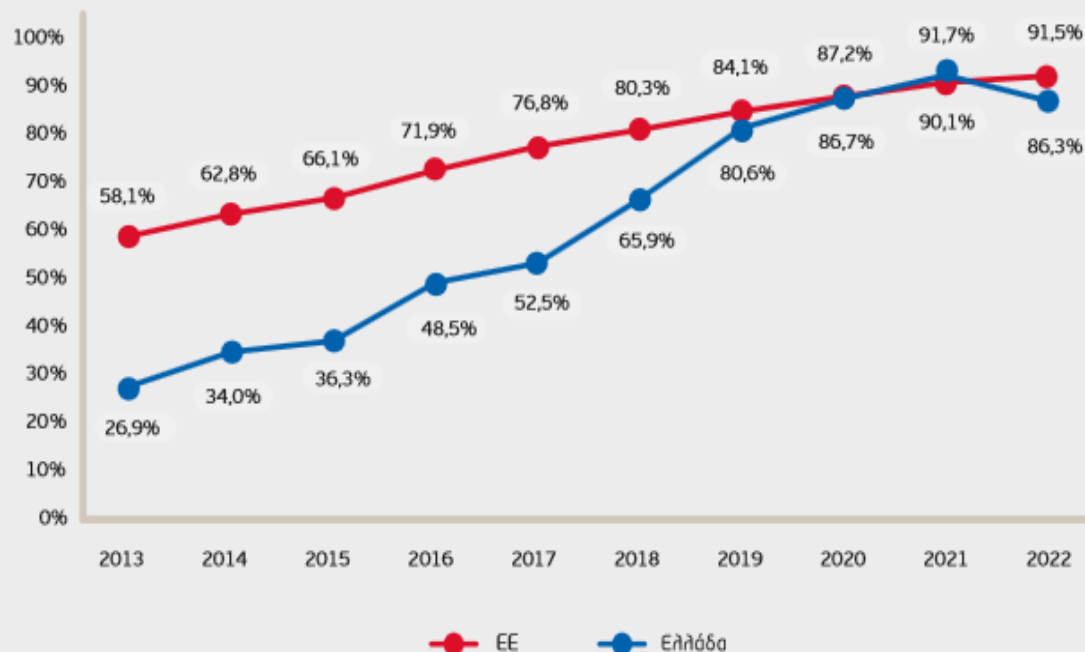
Διάγραμμα 1.129: Εξέλιξη διείσδυσης του Διαδικτύου στα νοικοκυριά σε Ελλάδα και ΕΕ



NGA NETWORKS

THE CURRENT SITUATION EU VS GREECE

Διάγραμμα 1.125: Ευρυζωνική κάλυψη δικτύων νέας γενιάς (NGA) σε Ελλάδα και ΕΕ

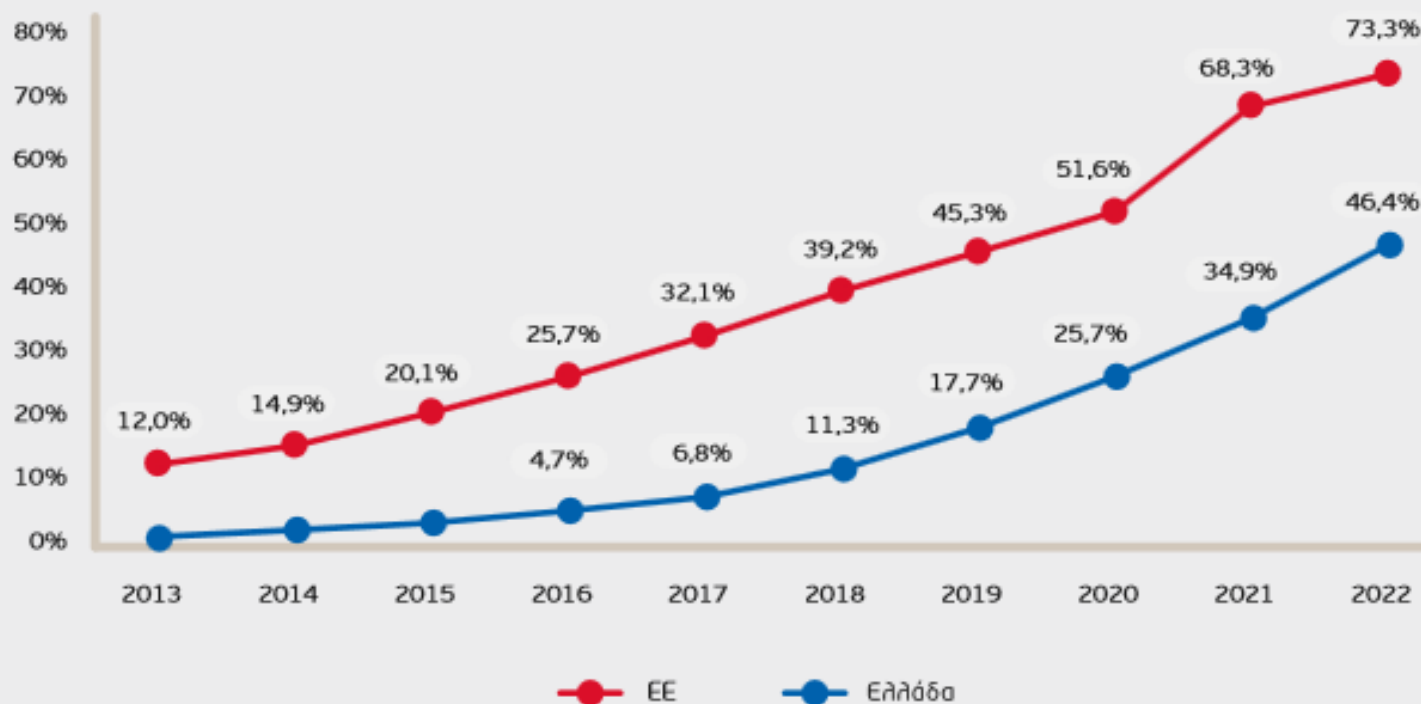


- Η μείωση του 2022 οφείλεται στην απόφαση του ΟΤΕ να μην προσφέρει υπηρεσίες VDSL σε περιοχές όπου δεν ήταν δυνατό να παρέχει τις ελάχιστες ταχύτητες που είχε δεσμευθεί

NGA NETWORKS

THE CURRENT SITUATION EU VS GREECE

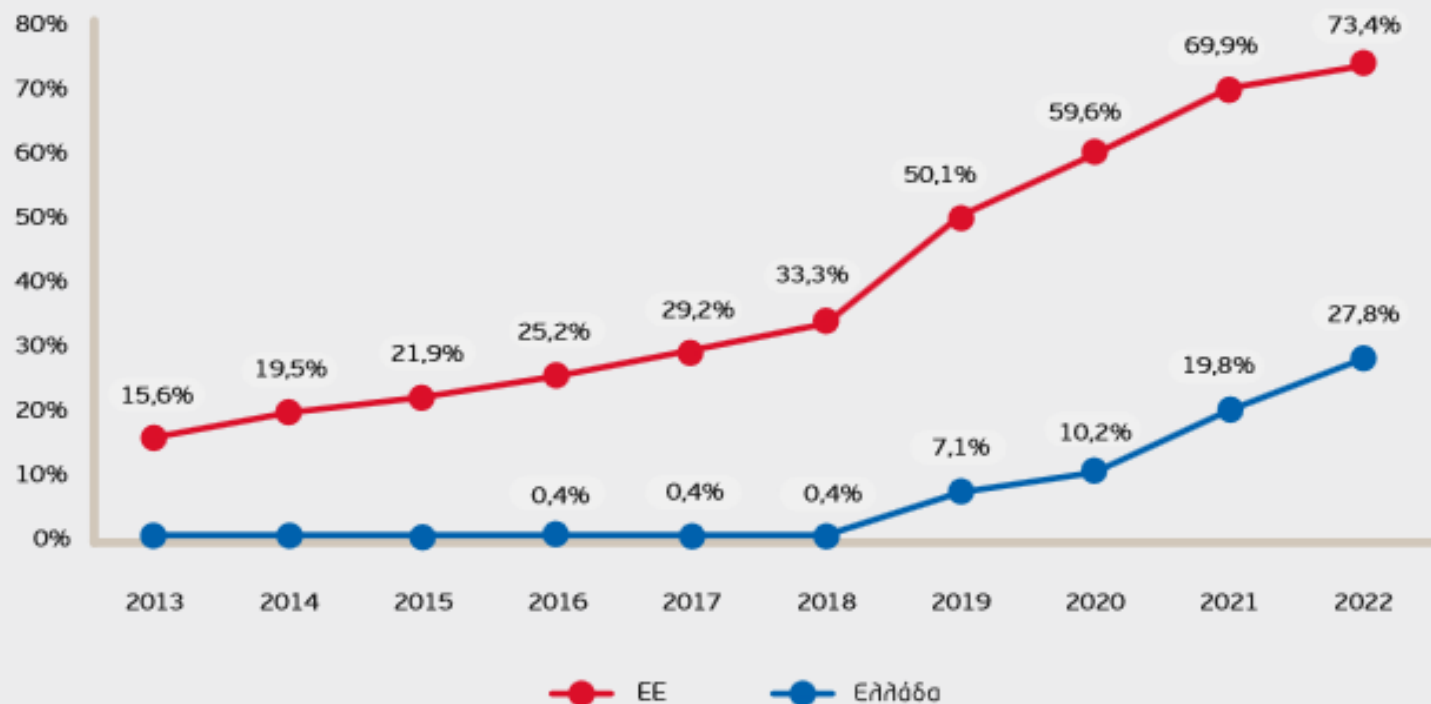
Διάγραμμα 1.126: Ευρυζωνική διείσδυση δικτύων νέας γενιάς (NGA) σε Ελλάδα και ΕΕ



NGA NETWORKS

THE CURRENT SITUATION EU VS GREECE

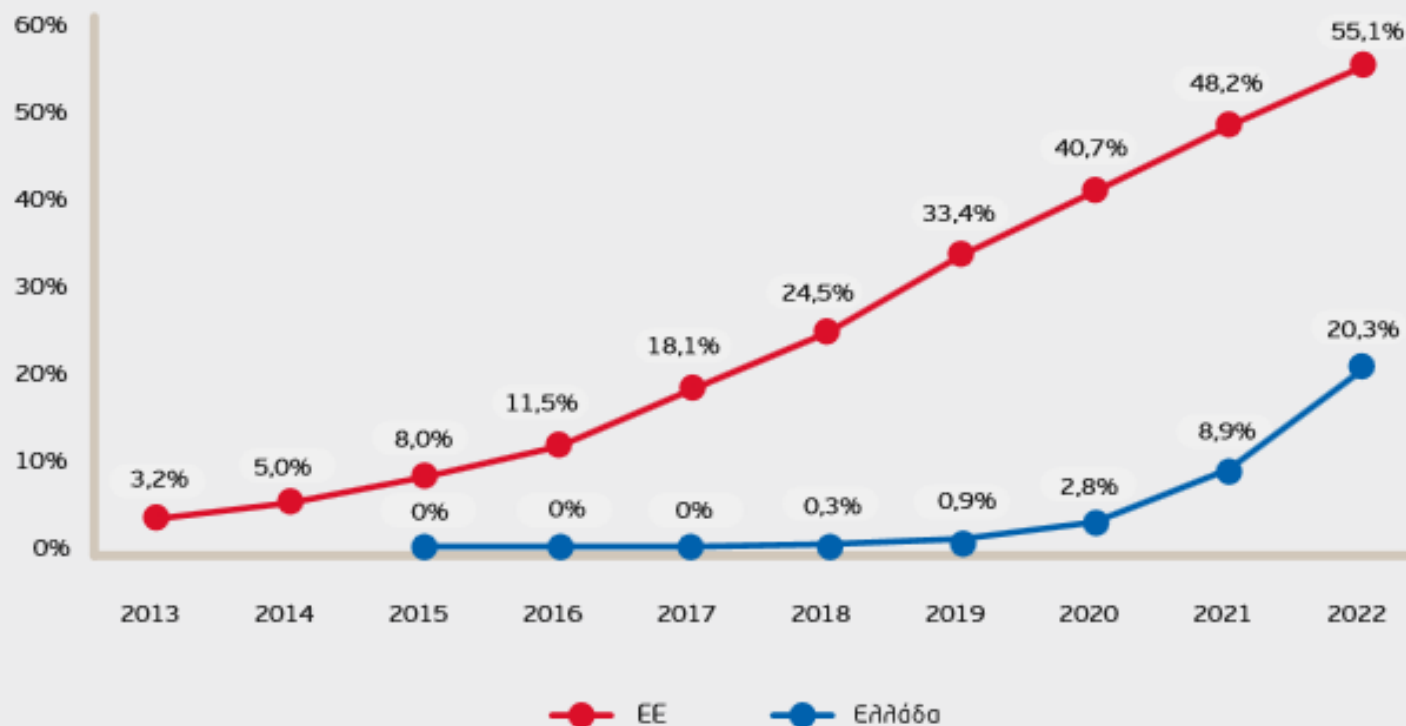
Διάγραμμα 1.127: Ευρυζωνική κάλυψη δικτύων πολύ υψηλών ταχυτήτων (VHCN) σε Ελλάδα και ΕΕ



NGA NETWORKS

THE CURRENT SITUATION EU VS GREECE

Διάγραμμα 1.128: Ευρυζωνική διείσδυση δικτύων πολύ υψηλών ταχυτήτων (VHCN) σε Ελλάδα και ΕΕ



DIGITAL AGENDA

FEASIBILITY & FUTURE GOALS

- Based on the actual data, do you believe that the goals of the Digital Agenda for Europe are feasible?
- The Commission's strategy on Connectivity for a European Gigabit Society (adopted in September 2016) sets a vision of Europe relied on three main strategic objectives for 2025:
 - Gigabit connectivity for all of the main socio-economic drivers
 - Uninterrupted 5G coverage for all urban areas and major terrestrial transport paths
 - Access to connectivity offering at least 100 Mbps for all European households

NGA INVESTMENTS IMPEDIMENTS

- High investment cost
 - 180-260 billions for providing 100Mbps to 50% of EU households
- Demand uncertainty
 - Penetration of the customer base
 - Consumers' willingness to pay for the new fibre-based services
 - Market dynamics and the evolving competitive situation
 - Market shares of the investor and the access seekers
- Regulatory uncertainty
 - It is socially not optimal for the regulator to make *ex ante* commitments for an unreasonably long regulatory period
 - Positive effects of greater certainty on investment incentives VS possible negative effects of erroneous intervention on welfare

NGA DEPLOYMENT

SOCIAL AND ECONOMIC IMPACT

“The social benefits from investment in digital infrastructures by far exceed the private incentive for investment”

“Like many infrastructure investments, NGA networks may create positive spillover effects that are not captured in any individual user’s willingness to pay. This implies a clear public policy case for governments to facilitate the roll out of NGA networks by reducing the risk for the investor ”

NGA REGULATION

COMPETITION AND INVESTMENTS

- Impact of cost-based access prices on investment incentives (theoretical works)
 - Incumbents are adversely affected to upgrade existing facilities or to invest in new ones, whereas the entrants are encouraged to deviate from the socially optimal level of investment and entry (Jorde, Sidak and Teece, 2000)
 - When firms invest under regulatory certainty (i.e. access price is set prior to the investment decisions), cost-based access prices achieve static efficiency, but fail to promote dynamic efficiency (Jorde, Sidak and Teece, 2000)
 - Under regulatory uncertainty, the regulator will set the welfare-maximizing policy (i.e. cost-based access prices) once the NGA network has been in place. Thus, the incumbent underinvests in relation to the socially optimal level (Kotakorpi, 2004)
 - Potential entrants, who can free-ride on the incumbent's network, will wait for the incumbent to invest in access infrastructures and then seek access (Valletti, 2003)

NGA REGULATION

COMPETITION AND INVESTMENTS

- Impact of cost-based access prices on investment incentives (empirical works)
 - ✓ Significant negative effect (Grajek and Röller, 2012)
 - ✓ Reduces the incumbent's incentives to invest unless a certain degree of rivalry has already emerged in the markets (Garrone and Zaccagnino, 2013)
 - ✓ It is uncertain whether competition spurred by mandatory unbundling encourages investments in new infrastructures by the incumbents (Jung, Gayle and Lehman, 2008)
 - ✓ However, the impact of such unbundling policy on the entrants' incentives to invest in alternative access infrastructures in order to be facilities-based competitors is unambiguously negative (Jung, Gayle and Lehman, 2008)
 - ✓ Entrants would more than double their infrastructure over 5 years if they had no regulated access to the incumbents' local loops (Friederiszick, Grajek and Röller, 2008)

NGA REGULATION

COMPETITION AND INVESTMENTS

- Cost-based access prices
 - Boost efficient entry and promotes service-based competition within one network
 - Discourage incumbents and, especially, entrants to invest in new facilities
 - Results in a substantial deviation from the socially desirable outcomes in terms of network deployment and timing of investments
 - Imply significant losses in dynamic efficiency
 - Cannot serve as a stepping stone from service-based to facilities-based competition

NGA REGULATION

POLICY CHALLENGES

- The most challenging task for academics, governments and policy makers is to design a regulatory policy that encourages investments in NGA networks and promotes sustainable competition
- In other words, the current regulatory policy focuses on establishing sustainable service-based competition over NGA networks, thus improving both static and dynamic efficiency
- This implies that regulators aim at facilitating the migration from service-based competition over copper access networks to service-based competition over NGA networks

ALTERNATIVE REGULATORY APPROACHES

COMPETITION AND INVESTMENTS

- Deviation from cost-based access prices
- Deviation from the permanent regulation of access
- Deviation from usage access prices

EC RECOMMENDATION 2010

COMPETITION AND INVESTMENTS

- EC Recommendation on regulated access to NGA (2010)
 - Main goal: to foster the development of the single market by enhancing legal certainty and promoting investment, competition and innovation in the market for broadband services, in particular in the transition to next generation access networks
 - Regulatory approach: the EC envisions that a cost-based access price that includes a risk premium for compensating the investor for NGA specific-risk strikes a balance between on the one hand providing adequate incentives for undertakings to invest (implying a sufficiently high rate of return) and promoting allocative efficiency, sustainable competition and maximum consumer benefits on the other (implying a rate of return that is not excessive)

EC RECOMMENDATION 2010

LIMITATIONS

- European Telecommunications Network Operators' Association (ETNO)
 - The proposed risk premium will not solve the lack of incentives for widespread NGA roll-out in Europe
 - A risk premium removes the structural disadvantages of investing only when the NGA investment turns to be successful
 - Even if the probability of success is relatively high, the proposed risk premium does not reflect the structural cost advantage of the second-movers
 - Make-or-Buy decisions by entrants
 - Access seeker can exit the market at low cost (before making its own investment)
 - Wait-and-see option for the entrants
 - Even if a risk premium results in higher wholesale revenues for the investor, raising prices for the new infrastructure may lead to a competitive disadvantage of NGA networks vis-à-vis competing platforms and the existing copper network that often will coexist with NGAs for some time

EC RECOMMENDATION 2010

LIMITATIONS

- European Competitive Telecommunications Association (ECTA)
 - Sunk investments: Alternative operators invest in all network elements that are replicable and they seek access to network elements that are not replicable
 - Costly critical mass: The “wait-and-see” option is not costless because the first mover will have already taken over the most interesting part of the market
 - The “make-or-buy” option is of low interest in the case of NGA, and especially in the case of FTTH, because the degree of replicability of such networks is very limited

EC RECOMMENDATION 2013

COMPETITION AND INVESTMENTS

- Three years after the EC Recommendation on regulated access to NGA, the EC announced a new Recommendation
- Obviously, the previous one did not fulfilled its goal
- There were no investment initiatives
- EC Recommendation (2013) on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment

EC RECOMMENDATION 2013

COMPETITION AND INVESTMENTS

- NRAs should adopt a bottom-up long-run incremental costs-plus (BU LRIC +) costing methodology
 - Includes a mark-up for the recovery of common costs
- Estimates the current cost that a hypothetical efficient operator would incur to build a modern efficient network
 - Capable of delivering the Digital Agenda for Europe targets set out in terms of bandwidth, coverage and take-up
- NRAs should ensure stability without significant fluctuations when setting cost-oriented access prices
- NRAs can decide not to impose or maintain regulated wholesale access prices when certain criteria are met
- NRAs can geographic access price discriminate

ALTERNATIVE APPROACHES

DEVIATION FROM COST-BASED RULE

- Inclusion of mark-up as in EC Recommendation (2013)
- Investment-contingent access prices
 - Such prices are dependent on the level of the investment, and hence, higher NGA deployment results in higher access prices
 - The investor is compensated for the higher uncertainty of an NGA deployment in more rural areas and/or a fibre deployment closer to the consumers' premises
 - Under regulatory certainty, an access fee that is contingent on firms' (non-overlapping) investments can implement the socially efficient investment level
 - This outcome holds either if the access charge depends on the investments of both the incumbent and the entrant (Henriques, 2011) or on each operator's own investment level (Sauer, 2011)

ALTERNATIVE APPROACHES

DEVIATION FROM COST-BASED RULE

- Regulatory uncertainty
 - The regulator has significant incentives to deviate from an investment-contingent access price (once the investments are in place) by setting the access price at the marginal cost of providing the access in order to maximize social welfare
 - This means that firms invest prior to the regulation of the access
- No certainty, no uncertainty
 - NRAs are encouraged (in order to provide greater certainty) to clarify to the greatest extent possible (i.e. not to fully commit) how foreseeable changes in market circumstances might affect remedies
 - It is uncertain whether the regulator will set an investment-contingent or a welfare-maximizing access price after the NGA deployment

ALTERNATIVE APPROACHES

INVESTMENT-CONTINGENT ACCESS PRICE

- Tselekounis and Varoutas (JTPO, 2013)
 - The regulator sets the access price at the marginal cost of providing the access with some probability and gives an access mark-up, which equals the average cost of the investments, with the complementary probability
 - Inclusion of a markup with probability α
 - Inverse demand function

$$p = 1 + \beta I - (q_1 + q_2)$$

- Deployment cost

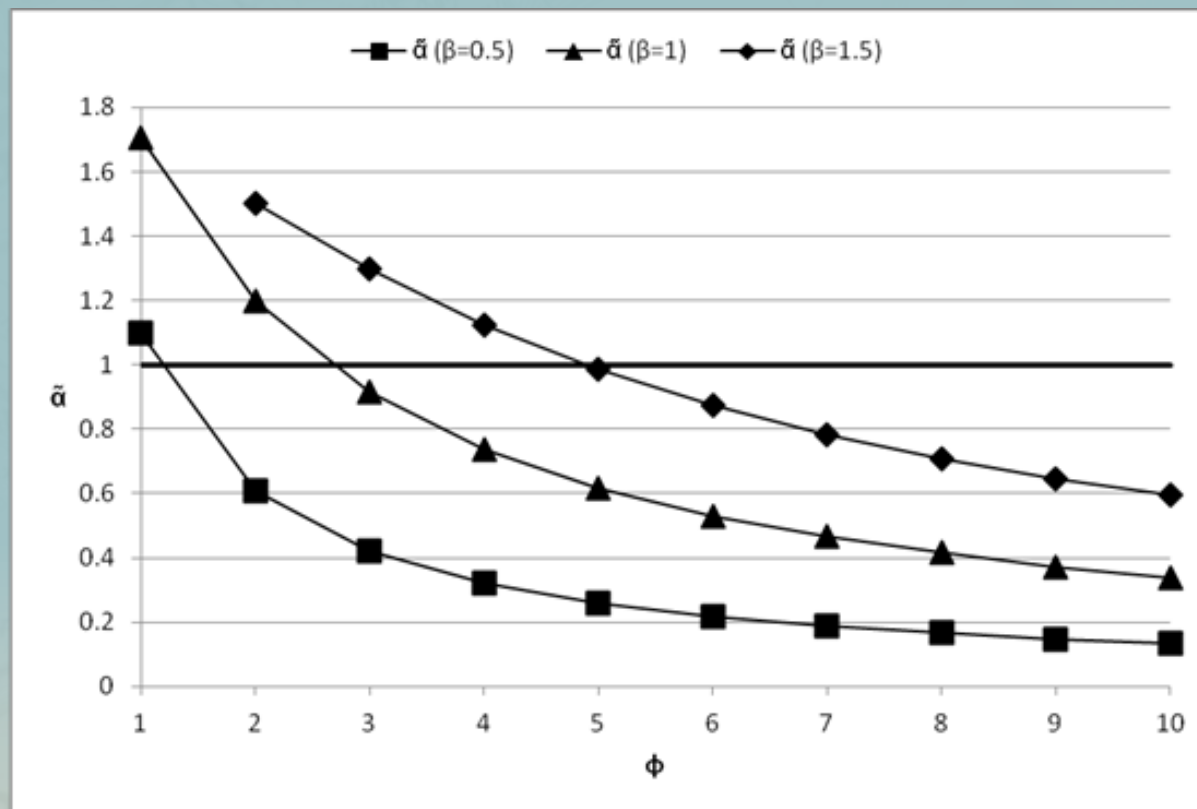
$$C(I) = \varphi I^2 / 2$$

- Let $\tilde{\alpha}$ denotes the positive value of α that induces the incumbent to undertake the socially optimal investments

ALTERNATIVE APPROACHES

INVESTMENT-CONTINGENT ACCESS PRICE

- Tselekounis and Varoutas (JTPO, 2013)



ALTERNATIVE APPROACHES

DEVIATION FROM PERMANENT REGULATION

- Permanent regulation
 - The ex ante imposed remedies hold for the whole lifecycle of the NGA investment
- Regulatory forbearance
 - There is no ex ante regulation on NGA networks
- Regulatory holidays
 - The investor is not imposed to any regulatory constraints for a pre-determined period of time
- Sunset clauses
 - The regulator commits that access obligations will be withdrawn after a pre-determined date

ALTERNATIVE APPROACHES

DEVIATION FROM PERMANENT REGULATION

- Charalampopoulos, Katsianis and Varoutas (2011) and Gavosto, Ponte and Scaglioni (2007) find that regulatory holidays maximize the incumbent's investment incentives
- However, their effectiveness on promoting service-based competition is rather ambiguous
- Geographic price discrimination (Tselekounis, Maniadakis and Varoutas, EARIE, 2013)
 - Provides the monopolist with higher incentives to deploy a larger NGA network (i.e. the NGA investment is extended to rural, less densely populated areas)
 - Results in better welfare outcomes than uniform pricing as long as the investment cost is not extremely low
- Geographically differentiated deployment (Tselekounis, Xylogianni, Varoutas and Martakos, ITS, 2013)
 - Provides the unregulated monopolist with incentives to install a nationwide NGA deployment, although the monopolist underinvests in terms of NGA quality
 - Cannot meet the 2nd goal of DAE, but the 1st goal is feasible

ALTERNATIVE APPROACHES

DEVIATION FROM USAGE ACCES PRICES

- Two-part tariffs
 - Access prices (as well as retail prices) can consist of one-off fees and periodic fees (e.g. monthly rentals)
 - By giving the investor the choice to recoup fixed costs via a one-off fee, the investor can affect his own investment risk and the entry risk resting on the buyers of unbundled fibre access
 - The early recoupment of parts of the investment leads to a lower capital requirement over time, a decrease in the investment risk and an increase in the investor's willingness to invest
 - If relatively many costs are charged as one-off tariffs, this raises the barrier for purchasing services, because a buyer is confronted with higher start-up costs
 - May not solve the dynamic consistency problem even when the regulator can commit *ex ante* to a particular access pricing policy

NGA INVESTMENTS

STATE INITIATIVES

“The existence of network effects and the often small incentives for broadband providers to supply rural areas due to high costs and low revenues suggest that public initiatives and financial aid should be considered as instruments to achieve increased broadband development, particularly in countries with a large share of the population living outside of urban area”

Examples from the Greek telecom market

Rural Broadband

Ultra Fast Broadband

Smart Readiness

Superfast Broadband

Gigabit Voucher

Q & A



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