Republic of North Macedonia

Broadband Competence Office

Report

Skopje, March 2020

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Introduction

Pursuant to amendments to the Law on Electronic Communications (July 2019), the National Broadband Competence Office (NBCO) is defined as expert and advisory body for support of broadband network investments. Pursuant to the Law, NBCO is accountable before the minister of information society and administration for the operation thereof.

The National Broadband Competence Office (NBCO) was established in October 2019 upon decision of the minister of information society and administration and after the Parliament of the Republic of North Macedonia (PRNM) adopted amendments to the Law on Electronic Communications in July 2019 ("Official Gazette of the Republic of North Macedonia" no. 153/2019).

Pursuant to Article 71-a paragraph (2) of the Law on Electronic Communications ("Official Gazette of the Republic of Macedonia ", no. 39/2014, 188/2014, 44/2015, 193/2015, 11/2018, 21/2018 and "Official Gazette of the Republic of North Macedonia" no. 98/2019 and 153/2019), NBCO shall assume the following competences:

- Shall participate in the work of the broadband competence office network in the European Union and in the region,
- Shall issue opinions and proposals for faster development of electronic communications, and in particular of broadband in the country,
- Shall cooperate with state authorities, state administrative bodies, public enterprises, local self-government units, public institutions and legal entities with public authorizations and fully state-owned trade, and shall provide support for development plans/projects/studies related to broadband networks, as well as support in implementation thereof,
- Shall issue opinions and proposals for utilization and needed development of fibre-optic infrastructure that has been constructed or is to be constructed with public funds,
- Shall participate in establishment of target areas that would use state aid in construction and development of broadband networks,
- Shall issue opinions and proposals during construction of broadband networks with utilization of state aid for: potential technical solutions, investment and business models, criteria for selection of operator, price policy and related issues,
- Shall participate, issue opinions and proposals in preparation of plans for promotion of broadband in the country,
- Shall participate in public discussions and consultations related to construction of broadband networks with utilization of state aid,
- Shall participate in determining free WiFi internet access locations in municipalities,
- Shall participate, issue opinions and proposals in development of future national strategic documents and development plans related to broadband development,
- Shall monitor implementation of adopted national strategic document and plans for broadband development in the state, meeting national broadband targets set forth therein and shall issue opinions and proposals for review thereof,
- Shall, at least semiannually, deliver a report to the minister of information society and administration on broadband development in the country related to development of broadband market in the European Union pursuant to DESI (The Digital Economy and Society Index), as well as report on implementation of adopted strategic documents and plans for broadband development in the country, meeting of national broadband goals set forth therein.

Report on Implementation of Adopted Strategic Documents and Plans for Broadband Development in the Country

Implementation of National Operational Broadband Plan in the period November 2019 - March 2020

The National Operational Broadband Plan 2019-2029 (NOBP) was adopted on 01.04.2019 by the Government of RNM and is published on the designated website of the Ministry of Information Society and Administration (MISA): http://mioa.gov.mk/sites/default/files/pbl_files/documents/reports/north_macedonia_national_operational_broadband_plan_final_en.pdf.
NOBP is aligned with strategic goals of the EU's initiative "Digital Agenda for Europe", as rooftop strategy for development of information society 2010 and EU's strategy "Towards a European Gigabit Society for 2025" from 2016. NOBP was lodged to the European Commission and to the World Bank that have both issued positive opinions thereto.

Activities conducted by the Parliament of RNM, the Government of RNM and MISA in NOBP implementation

- In July 2019, the Parliament of RNM adopted Amendments to the Law on Electronic Communications with a view to allow establishment of National Broadband Competence Office (NBCO).
- In July 2019, the Parliament of RNM adopted Amendments to the Law on Establishment of PE MB with a view to assign new responsibilities of PE MB for construction, operation and maintenance of NOTN and NGA networks in white zones on the entire country territory.
- On the 21st Call for WBIF Proposals, MISA applied to receive technical assistance for preparation of Feasibility Study (FS) and other project documentation for NOTN construction. WBIF approved the application (amounting to 600.000 EUR).
- In August 2019, MISA announced a public call to select independent NBCO expert members.
- In October 2019, the minister of information society and administration established NBCO.
- EU member states delivered information to the BCO Network (https://ec.europa.eu/futurium/en/bconetwork) on NBCO establishment in RNM and participation therein.
- In October 2019, the Government of RNM appointed an inter-ministerial working group to prepare Analysis of current condition of the fibre-optic infrastructure in the country constructed with public funds and utilization thereof for construction and development of NOTN. The working group includes representatives of MEPSO, NER, PE MR – Infrastructure, PE SR, GA-MA, MISA, PE MB, ALSGU, Ministry of Transport and Communications. Preparation of the Analysis is underway.
- In October 2019, MISA, PE MB, NBCO and the World Bank (WB) finalized the ToR for procurement of consulting services to prepare FS for construction of NOTN and other project documentation related to NOTN. The contract is expected to be signed by WBIF and WB, following which preparation of FS may commence.
- In November 2019, NBCO designated website was launched (www.bco.mioa.gov.mk).

Activities conducted by PE MB in NOBP implementation

The initial phase of the Analysis of free fibre-optic infrastructure constructed with public funds has collected portion of needed information from public enterprises MEPSO, NER, GA-MA and PE Macedonian Railways – Infrastructure and PE State Roads. This infrastructure will be used to develop National Optical Transport Network (NOTN). The Analysis is underway and is not yet completed, and we believe that it would be completed by the end of the second quarter of 2020, prior to commencement of FS preparation.

In July 2019, PE MB initiated the process of mapping all public institutions (grouped by type and settlement) that would be connected to NOTN network nodes. Over 80% of information have been collected and processed thus far for the process of mapping central and local-level public institutions that would be connected to NOTN network nodes. The process is expected to conclude by the end of the second quarter of 2020.

In July 2019, PE MB initiated the process of mapping locations that would provide free WiFi internet access in municipalities (parks etc.) that would be connected to NOTN network nodes. A total of 93% of information have been collected and processed for proposed locations that would provide free WiFi internet access in municipalities. The process is expected to conclude by the end of the second quarter of 2020.

For the purposes of the process of mapping public institutions and locations in municipalities for free WiFi internet access, PE MB will procure GIS platform. This would be followed by a process of GIS platform implementation and training of employees that will operate with the platform.

Activities conducted by NBCO in NOBP

Since its establishment in October 2019, NBCO has held a total of 14 meetings. All minutes from held meetings, proposals, recommendations and opinions issued by NBCO are published on NBCO's designated website: http://bco.mioa.gov.mk/?page_id=188.

NBCO's operations, pursuant to the Rules of Procedure of NBCO, note continuous involvement of external experts with extensive knowledge and experience in the field of ICT and in particular broadband: Ljuben Talev, Milan Nikolovski, Blagoj Stojanov, Nikolche Mickoski, Zoran Murdzev, Sashko Stojkovski, among others. Their contribution in NBCO is deemed very important and, thus, necessary to continue in the upcoming period.

The first constitutive session of the National Broadband Competence Office (NBCO) was held on 25.10.2019 in the Ministry of Information Society and Administration. The session included adoption of NBCO Rules of Procedure.

NBCO's second session with representatives of the World Bank (held on 1st November 2019) covered discussions about the possibility of technical and financial assistance from WB for NOBP implementation. The second session continuation (held on 7th November 2019) included discussions about competences of the future Digital Agency in terms of infrastructure connection of public institutions and securing internal communication services as one of the competence pillars.

On 28th November 2019, NBCO held a meeting with representatives from MEPSO, wherein they informed about their activities and planned future steps related to realization of the project Balkans Digital Highway. During the meeting, it

was concluded that in future planning and modernization of MEPSO equipment, the possibility to share free capacities with PE MB for construction of NOTN should also be considered. In that, MEPSO expressed willingness for full cooperation, stating that they could be able to provide help in line with their opportunities if PE MB provides them with specific data and information about the planned future NOTN network. NBCO also adopted opinion and proposals about the project Balkan Digital Highway.

The session held on 4th December 2019 included a presentation of the prepared document titled "Digital Economy and Society Index – Methodology" that analyzes the country's progress towards digital economy and society, wherein it was further explained that DESI has a three-tier structure and covers five main dimensions (connectivity, human capital, utilization of internet services, digital technology integration and digital public services).
On 11th December 2019, the MP Club in Skopje hosted a working meeting between NBCO, operators and MEPSO, GA-MA, PE MB, PE Macedonian Railways, National Energy Resources (NER), the Agency for Electronic Communications, PE State Roads, the Ministry of Finance and the Ministry of Transport and Communications, among others. During the session, operators expressed further interest about multiple issues related to NOBP implementation and future cooperation with NBCO.

On 14th November 2019, NBCO held a session that included review and adoption of proposed competences of the Digital Agency with respect to provision of electronic communication networks and services for public institutions.

During the session held on 20th December 2019, NBCO discussed the glossary of information and communication technologies (ICT) and concluded that it is exceptionally important to have and use a glossary of ICT terms in order to properly use Macedonian equivalents to certain English language terms.

On 27th December 2019, NBCO held a session that covered discussions about NOTN feasibility study. During the meeting, it was highlighted that there is a need to map public institutions, free WiFi hotspots in municipalities, as well as to update previously determined white/gray zones (pursuant to mapping from 2018), prior to preparation of the feasibility study. As part of the discussion about the need to map utilization of the service 'internet access in settlements', it was established that the initial step should be to map utilization of the service at settlement level, whereas utilization of the service per household should be mapped after establishment of address register.

The session held on 17th January 2020 included discussions about requests from public institutions for additional data about fibre-optic infrastructure constructed with public funds. NBCO adopted "Manual for Delivery of Data about Fibre-Optic Infrastructure Constructed with Public Funds" and adopted the "Model/Templates for Inventory of Fibre-Optic Infrastructure Constructed with Public Funds in the Country". The documents were delivered to the inter-ministerial working group appointed to prepare Analysis of current condition of the fibre-optic infrastructure constructed with public funds in the country.

During the session held on 14th February 2020, NBCO adopted the „Methodology for Determining DESI-Digital Economy and Society Index " and "Template on the Form and Content of the Broadband Market Development Plan pursuant to DESI".

As part of the fifth NBCO session held on 28th February 2020, representatives of PE MB held a presentation about "Mapping Public Institutions, Free WiFi Internet Access Hotspots". When mapping municipalities, a total of 80 local self-government units were contacted, of which 76 have provided complete data, three municipalities have not provided

any information, and two municipalities have provided partial data. According to analyzed data, none of the municipalities have constructed fibre-optic infrastructure, nor do they plan to do so in the following three years. When mapping institutions, a total of 1,488 public institutions have been contacted, of which 1,330 have provided complete data, 158 have not delivered any information, 10 have delivered partial data, whereas only 16 have constructed fibre-optic infrastructure with public funds. The data in question are merely initial and would be upgraded and reviewed. Doing that, however, requires assistance from NBCO, MISA and ALSGU for future mapping steps, primarily with a view to finalize proposals for WiFi hotspots.

In summary, since its establishment, from October 2019 to March 2020 NBCO has adopted the following acts:

- Proposal of competences of the future Digital Agency.
- Opinion and proposals about the project Balkan Digital Highway.
- Model for inventory of fibre-optic infrastructure constructed with public funds in the country.
- Manual for delivery of data about fibre-optic infrastructure constructed with public funds.
- Methodology for Determining the Digital Economy and Society Index – DESI in RNM.
- Proposal of form and content of the RNM broadband market development report (pursuant to DESI).

Report on Broadband Development in the Country

Pursuant to the Law on Electronic Communication, NBCO shall "*at least semiannually, deliver a report to the minister of information society and administration about development of broadband in the country relative to development of the broadband market in the European Union, pursuant to DESI (The Digital Economy and Society Index), and report on implementation of adopted strategic documents and plan for broadband development in the country, meeting national broadband targets set forth therein".*

To meet this obligation, in February 2020 NBCO adopted the "Methodology Determining the Digital Economy and Society Index in the Republic of North Macedonia " and Template on the Form and Content of the Broadband Market Development Report Pursuant to DESI. (www.bco.mioa.gov.mk)

The Methodology is based on EU's DESI Methodology and, according to this Methodology, NBCO is competent to monitor only the dimension "Connectivity".

This Report is prepared pursuant to the adopted Template on the Form and Content of the Broadband Market Development Report Pursuant to DESI.

When preparing the report on broadband market development in the dimension "Connectivity", as source of information for specific sub-dimensions and indicators, NBCO used data from:

- Agency for Electronic Communications, predominantly[1],
- State Statistical Office[2],
- National Bank[3],
- Information on RNM's Attained Progress for the Needs of the Sub-committee on Innovation, Information Society and Social Policy (March 2020)

Note:

This Report does not cover indicators that were not secured due to the limited timeframe.

CONNECTIVITY

To determine indicators for the dimension "Connectivity", it is necessary to define broadband network types pursuant to EU regulation[4].

Notably, a distinction could be made between so-called "Basic Broadband Networks" (hereinafter: basic broadband networks) and "Next Generation Access Networks" (hereinafter: NGA[5] networks).

The following are considered basic broadband networks:

- asymmetric digital subscriber lines (up to ADSL2+ networks),
- non-enhanced cable (e.g. DOCSIS 2.0),

[1] www.aec.mk
[2] www.stat.gov.mk
[3] www.nbrm.mk
[4] EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks
[5] Next generation access

- mobile networks of third generation (UMTS) and
- satellite systems.

At the current stage of market and technological development, NGA networks are access networks that rely wholly or partly on optical elements and that are capable of delivering broadband access services with enhanced characteristics as compared to existing basic broadband networks.

NGA networks should have at least the following characteristics:

- deliver services reliably at a very high speed per subscriber through optical (or equivalent technology) backhaul sufficiently close to user premises to guarantee the actual delivery of the very high speed;
- support a variety of advanced digital services including converged all-IP services; and
- have substantially higher upload speeds (compared to basic broadband networks).

The following are considered NGA:

- fibre-based access networks (FTTx: FTTC, FTTN, FTTP, FTTH and FTTB);
- advanced upgraded cable networks (using the cable modem standard "DOCSIS 3.0"); and
- certain advanced wireless access networks capable of delivering reliable high speeds per subscriber.

Coverage and take-up of NGA networks that deliver the following is of particular interest:

- fast broadband (download speed between 30 and 100 Mbps), and
- Ultra-fast broadband (download speed above 100 Mbps).

INDICATORS

Indicators for dimension “Connectivity“ for RNM are listed in Table 1.

Indicators	Desription	Unit	Value/ Reference date
1a1 Fixed broadband coverage	% of broadband covered households[6]: xDSL, cable (basic and NGA), FTTP or WiMax networks	% of households	97.87% (Q4/2019)
1a2 Fixed broadband take-up	% of households subscribed to broadband: xDSL, cable (basic and NGA), FTTP or WiMax networks	% of households	70.91% (Q3/2019)
1b1 4G coverage	% of settlements with 4G coverage: measured as medium coverage of telecommunication operators in every country	% of households	99.365% (Q4/2019)
1b2 Mobile broadband take-up	Number of mobile internet subscribers per 100 inhabitants	Subscribers per 100 inhabitants	81.61% (Q3/2019)
1b3 Preparedness for 5G	Portion of the spectrum intended and awarded for 5G utilization by the end of 2020 in so-called 5G pioneer bands. These bands include 700 MHz (703-733 MHz and 758-788 MHz), 3,6 GHz (3400-3800 MHz) and 26 GHz (1000 MHz in 24250-27500 MHz). All three frequency bands have equal weight	% of harmonized spectrum	0%

[6] The number of households in the country amounts to 564,296. (Source: State Statistical Office)

1c1 Fast broadband (NGA) coverage	% of households covered with broadband with at least 30 Mbps download speed. Affected technologies include FTTH, FTTB, cable Docsis 3.0 and VDSL	% of households	78% (Q1/2019)
1c2 Fast broadband take-up	% of households subscribed to broadband with at least 30 Mbps	% of households	21.03% (Q3/2019)
1d1 Ultra-fast broadband (NGA) coverage	% of households subscribed to broadband with at least 100 Mbps download speed. Affected technologies include FTTH, FTTB and cable Docsis 3.0	% of households	43,8% (Q1/2019)
1d2 Ultra-fast broadband take-up	% of households subscribed to broadband with at least 100 Mbps	% of households	0.98% (Q3/2019)
1e1 Broadband price index	The Broadband Price Index displays prices of 12 representative broadband baskets as % of income in household. The baskets include three speed categories (12-30 Mbps, 30-100 Mbps and at least 100 Mbps) and four product types (Internet only, internet + TV, internet + landline and internet + TV + landline)	Scale (0-100)	

Table 1. Indicators for dimension “Connectivity“ (March 2020)

COMPARISON WITH INDICATORS OF EU MEMBER STATES

1. Total income of telecom operators (in MKD, excluding VAT)

Data on operators' total income cover 2018, given that this report is prepared in a period when the law-stipulated deadline for submitting annual reports on total annual revenues for 2019 (15th March 2020) was not yet expired.

Service	Income (in MKD)
Landline	2,131,578,000.00
Fixed internet access	3,990,676,000.00
Mobile telephone line	6,823,893,000.00
Mobile internet access	1,468,488,000.00
Business internet users[7]	555,277,292.00

Source: Agency for Electronic Communications

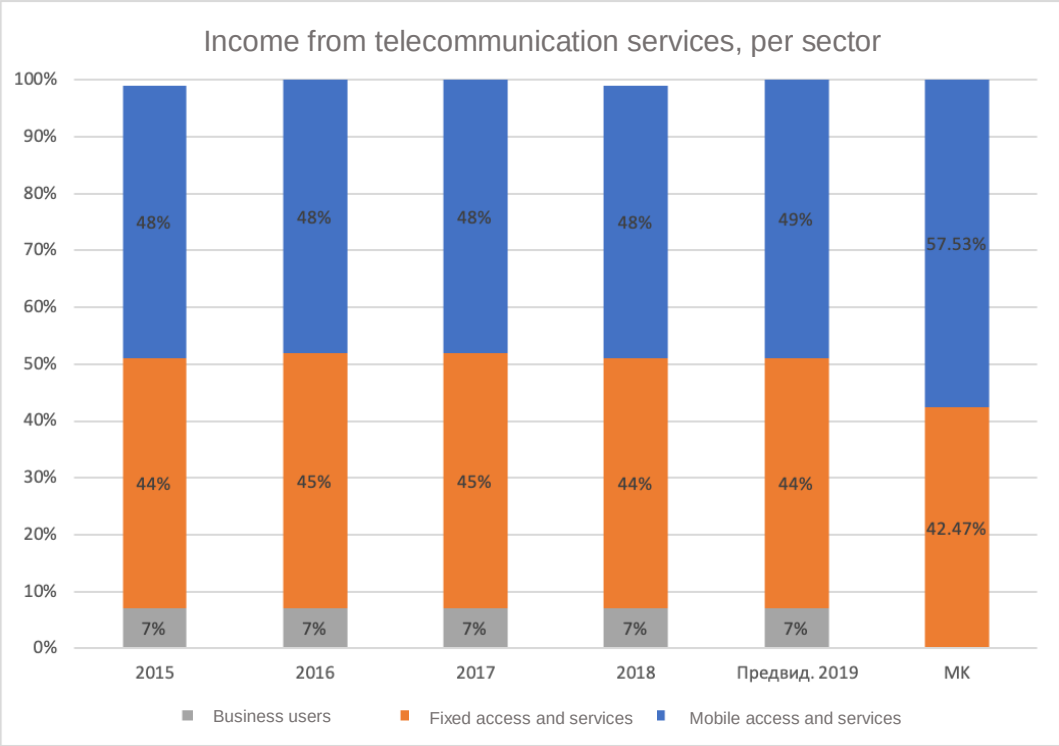

Figure 1: Income from telecommunication services (Data for 2015-2018 and predictions for 2019 concern the EU. In data related to RNM, business users are covered in data for fixed and mobile access. Sources: EITO, AEC)

[7] Only from independent service, package services not included. Income from business internet users is calculated in total income from fixed access and services and mobile access and services

2. Broadband Coverage

A. Fixed broadband coverage

A total of 552,327 households have fixed broadband coverage, which accounts for 97.87% of the total number of households in RNM.

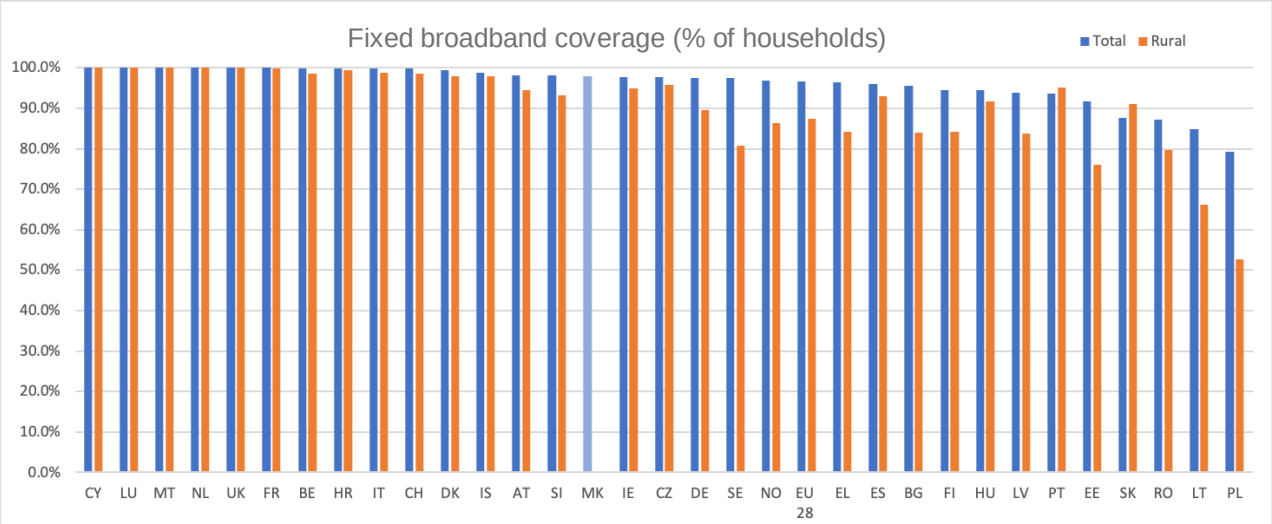

Figure 2: Basic fixed broadband coverage (% of household) (Sources: EC, NOBP, AEC)

A total of 445,233 household have fixed fast broadband coverage (download speed of at least 30 Mbps and not above 100 Mbps), accounting for 78% of the total number of households in RNM.

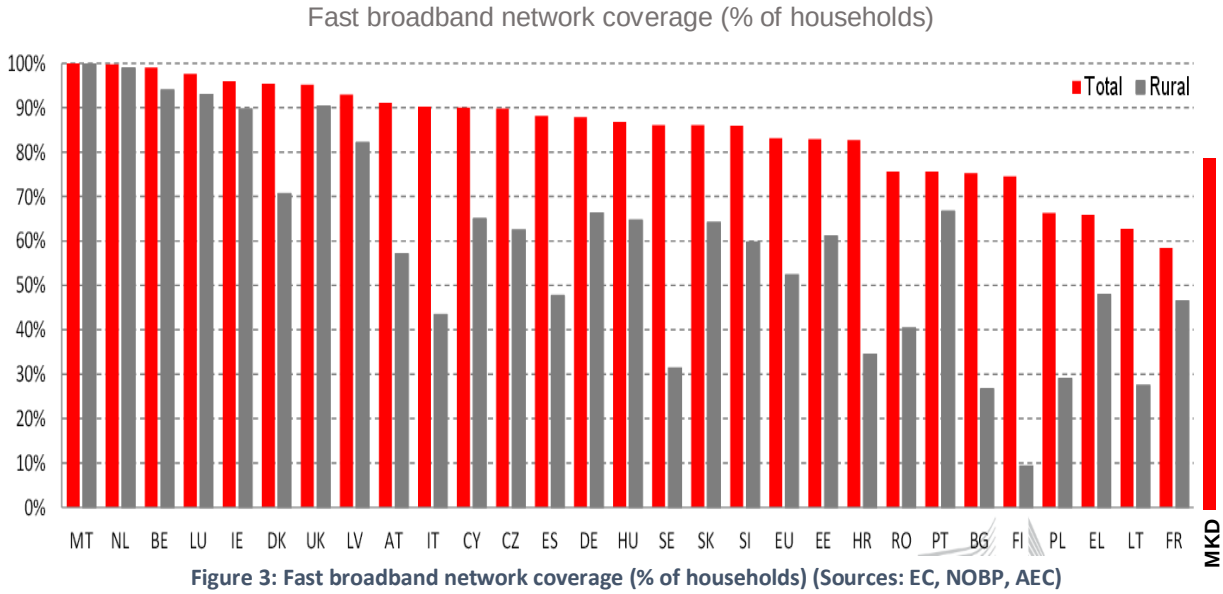

Figure 3: Fast broadband network coverage (% of households) (Sources: EC, NOBP, AEC)

A total of 249,979 households have fixed ultra-fast broadband coverage (download speed of at least 100 Mbps), which accounts for 43.8% of the total number of households in RNM.

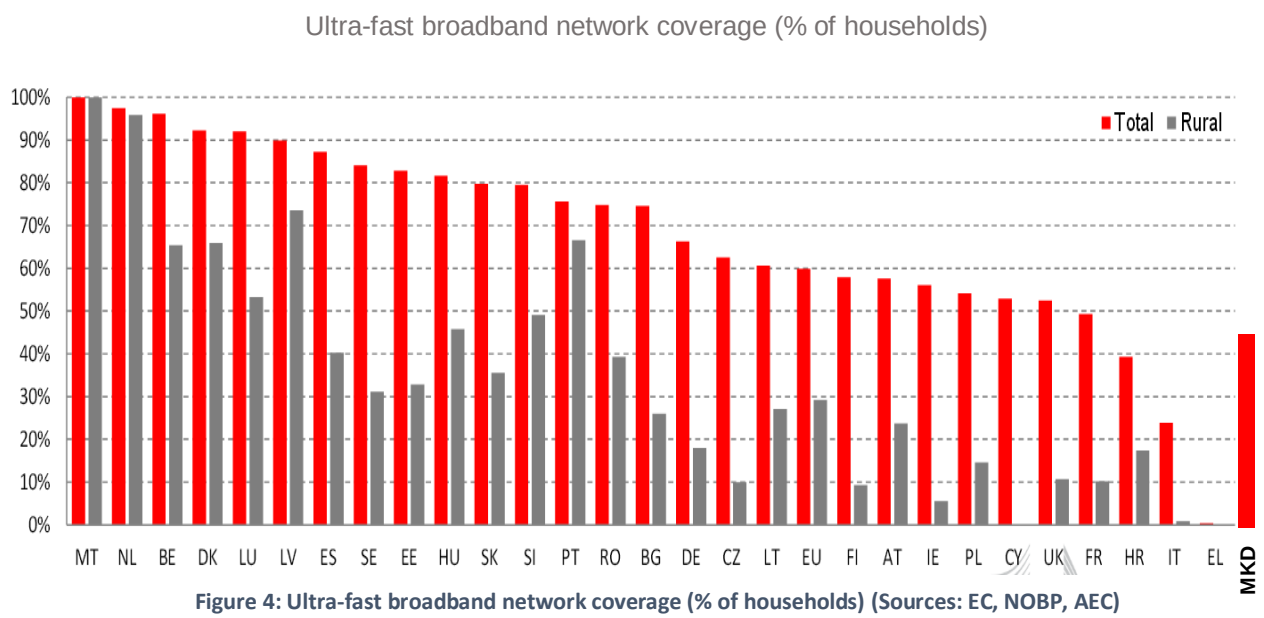

Figure 4: Ultra-fast broadband network coverage (% of households) (Sources: EC, NOBP, AEC)

Б. Mobile broadband access coverage

In RNM, 99.53% of households have 4G (LTE) network coverage (from at least one mobile operator).
The average 4G availability (as average value from coverage of both operators) is 99.365% of households in RNM

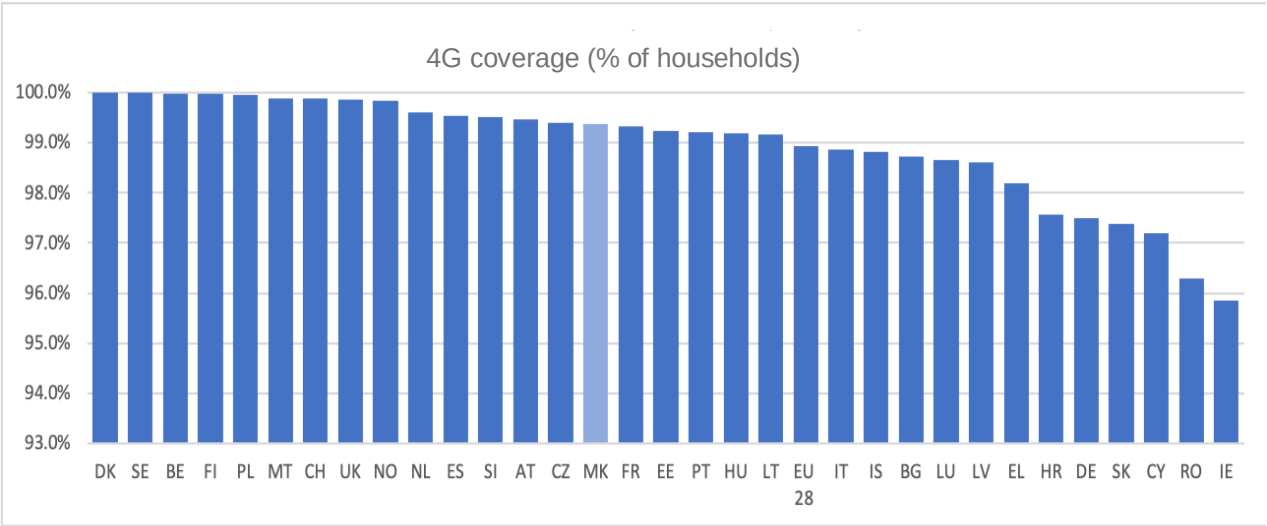

Figure 5: 4G coverage, percent of households (Sources: EC, AEC)

3. Fixed broadband take-up (% of households)

Fixed broadband take-up amounts to **70.91%**, i.e. **400,172 households in RNM have signed fixed broadband subscriber contracts**. (Source: Agency for Electronic Communications).
This indicates that fixed broadband take-up in households across RNM is close to the average fixed broadband take-up in EU member states, which accounts for 77% of households.

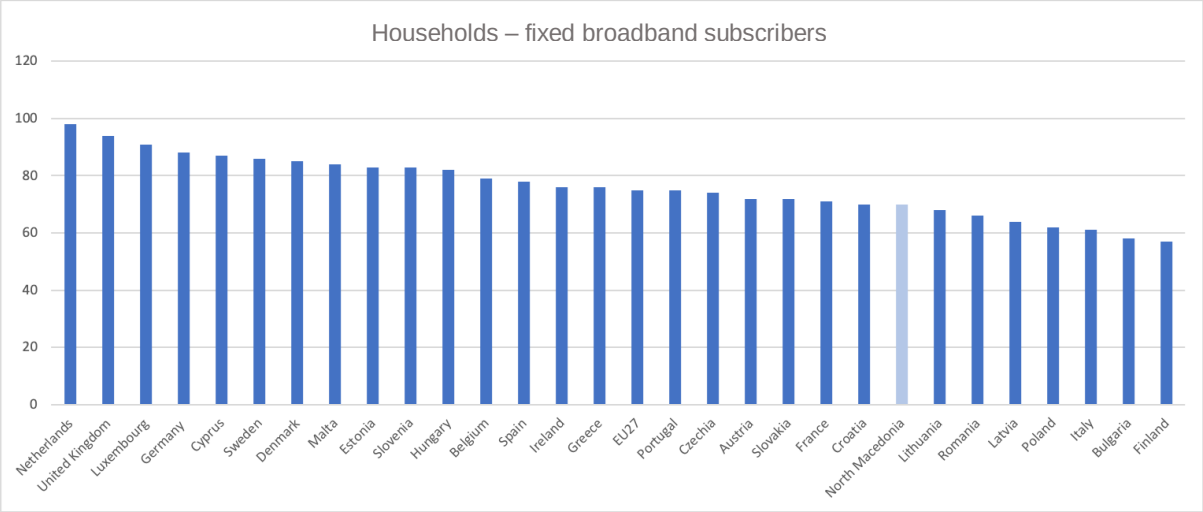

Figure 6: Households subscribed to fixed broadband (Sources: Eurostat, AEC)

4. Fast broadband take-up (% of households)

Fast broadband take-up for Q3/2019 amounts to **21.03%**., i.e. **118,714 households have signed fixed fast broadband subscriber contracts (for download speed of at least 30 Mbps and not above 100Mbps)**. (Source: Agency for Electronic Communications)

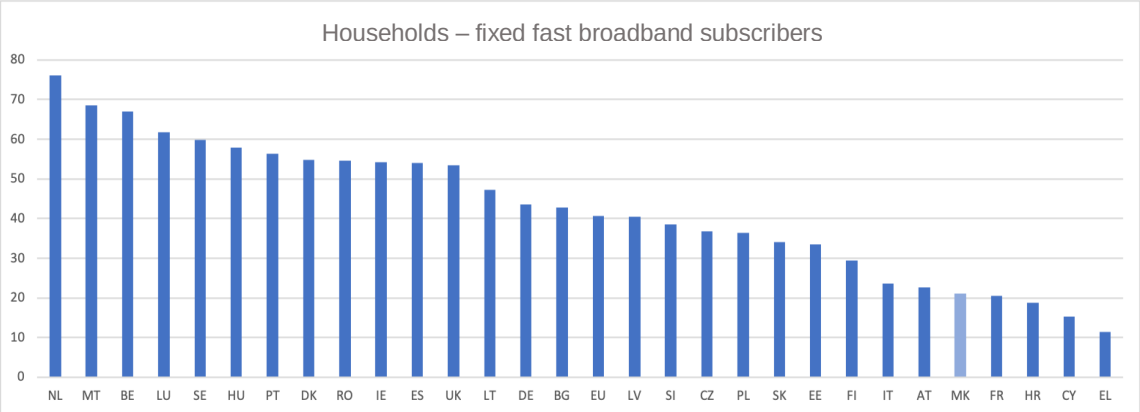

Figure 7: Households subscribed to fixed fast broadband (Sources: Digital Agenda for Europe, AEC)

5. Ultra-fast broadband take-up (% of households)

Ultra-fast broadband take-up for Q3/2019 amounts to **0.98%**., i.e. **5,544 households have signed fixed ultra-fast broadband subscriber contracts (for download speed of at least 100 Mbps)**. (Source: Agency for Electronic Communications)

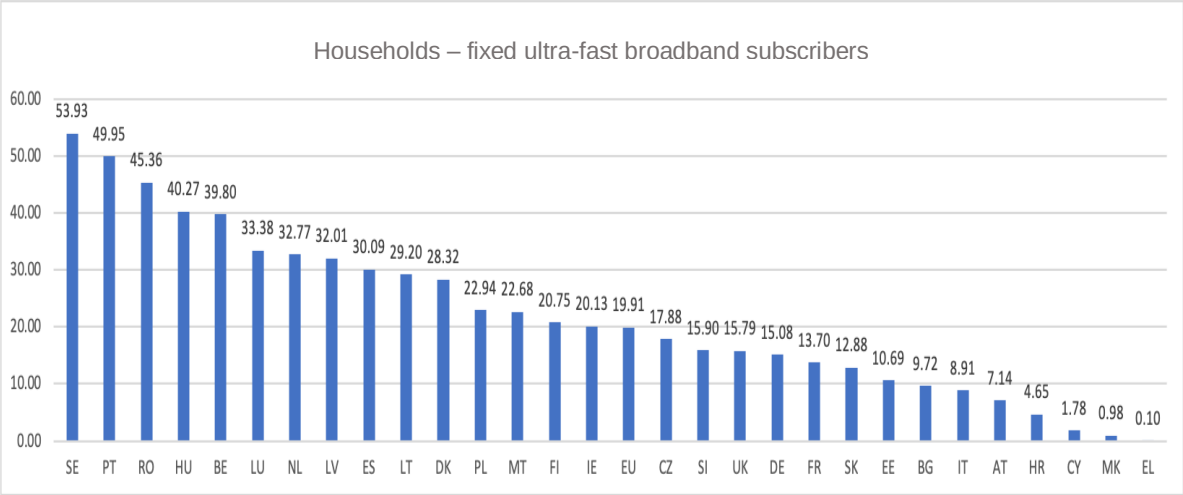

Figure 8: Households subscribed to fixed ultra-fast broadband (Sources: Digital Agenda for Europe, AEC)

6. Fixed broadband take-up, market share per technology

The following table illustrates the market share of technology used to provide fixed broadband:

Technology	Market share (%)
DSL (including VDSL)	30.75
Cable (including Docsis 3.0)	34.29
FTTH+FTTB	13.87
Other (LL-Leased Lines, LAN, Fix LTE)	21.09

Source: Agency for Electronic Communications

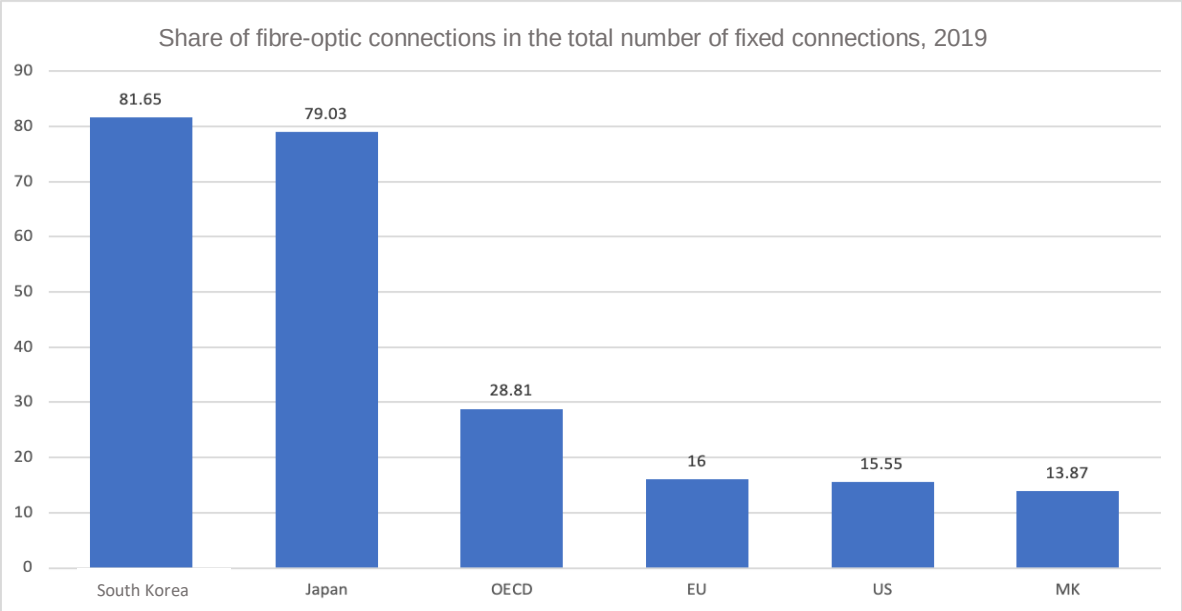

Figure 9: Share of access via fibre-optic infrastructure (FTTH+FTTB) in the total number of fixed broadband subscribers (Sources: OECD, AEC)

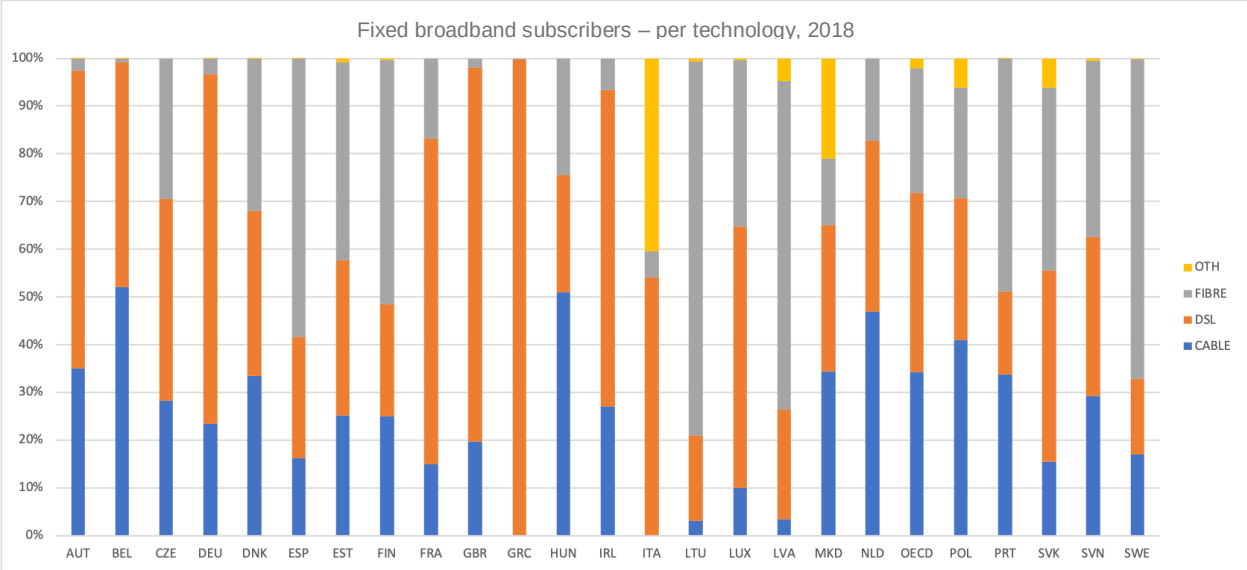

Figure 10: Technologies used to provide fixed broadband (Sources: Eurostat, AEC)

The share of access via fibre-optic infrastructure (FTTH+FTTB) in the total number of fixed broadband subscribers in RNM, amounting to 13.87%, is comparable to the average value of access via fibre-optic in the 28 EU member states, which amounts to 16%. Although at level of EU average the dominant technology is xDSL to which a competitor technology is the cable with Docsis 3.0, in RNM, according to the shares, the cable technology Docsis 3.0 has exceeded xDSL technology.

In RNM, the share of NGA subscriber contracts[8] (download speed of at least 30 Mbps) from the total number of fixed broadband subscriber contracts in the country amounts to **30.03%.**

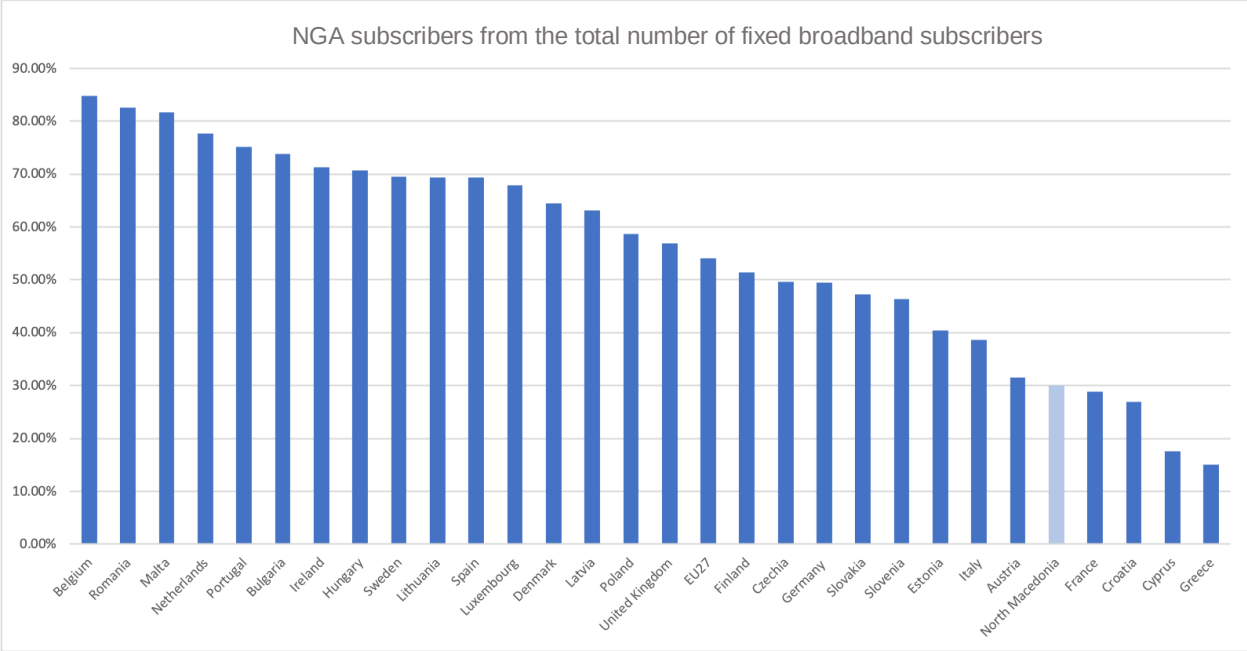

Figure 11: NGA subscribers (>30Mbps) from the total number of fixed broadband subscribers (Sources: Eurostat, AEC)

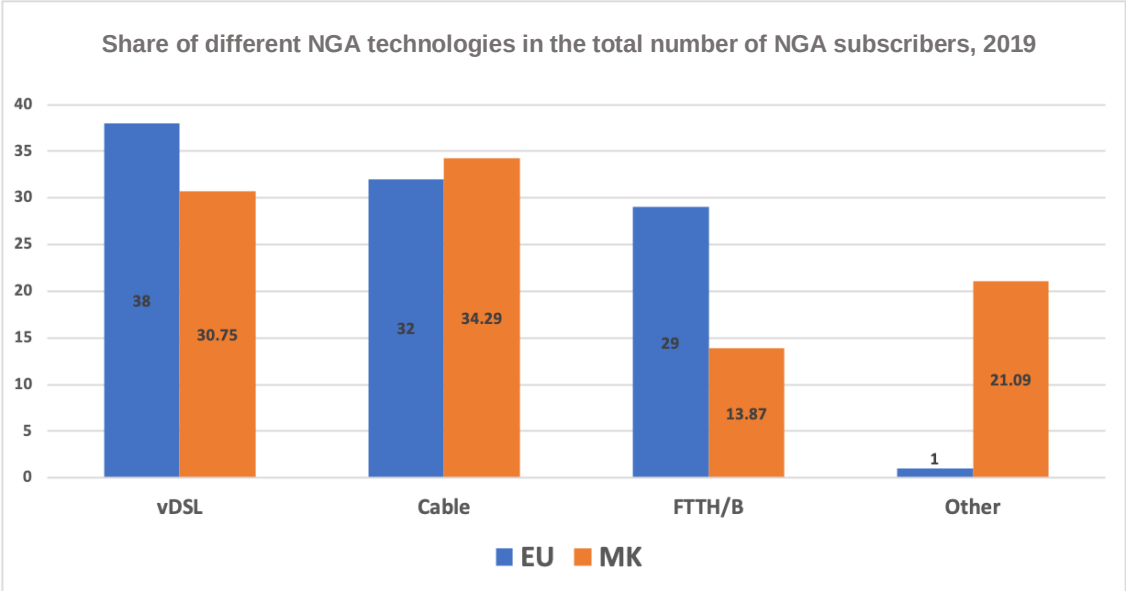

Figure 12: Share of different NGA technologies in the total number of NGA subscribers (Sources: DESI, AEC)

[8] Residential and business users

7. Fixed broadband market competition[9]

In RNM, the share of the incumbent operator "Makedonski Telekom" on the fixed broadband market in Q3/2019 amounts to **39.77%** according to the total number of subscribers (residential and business) and all fixed broadband technologies. On the other hand, the share of new operators on the fixed broadband market amounts to **60.23%**. (Source: Agency for Electronic Communications)
This ratio according to market share between the incumbent operators and new operators in RNM is relative to the average of the 28 EU member states, wherein incumbent telecommunication operators still control 40% of subscribers.

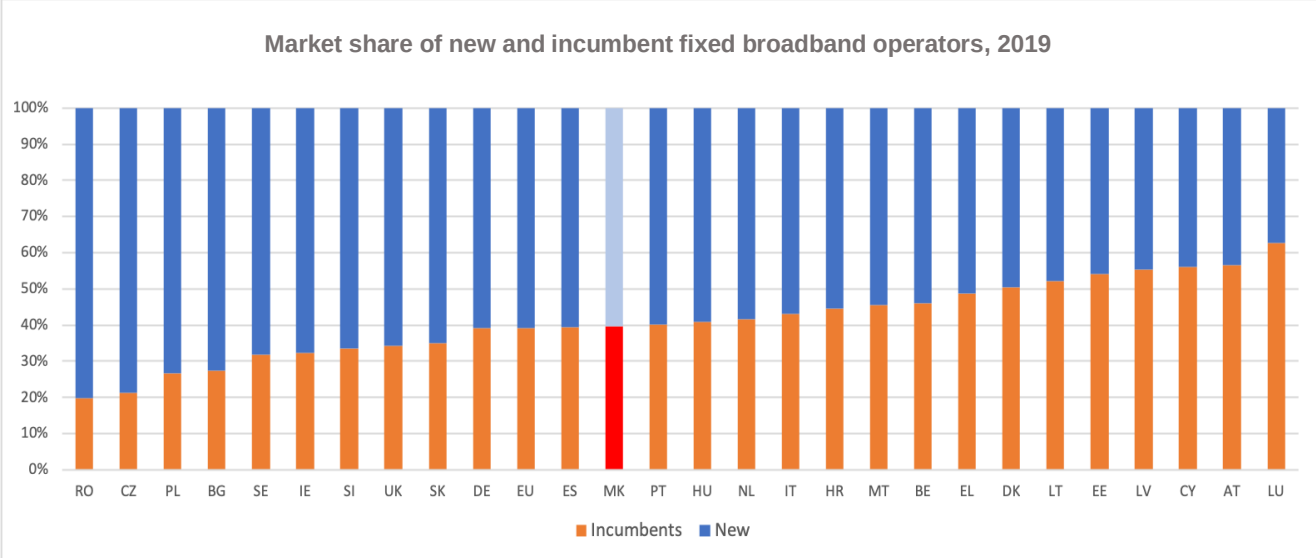

Figure 13: Fixed broadband market share according to number of subscribers (Sources: Digital Agenda for Europe, AEC)

8. Mobile broadband take-up (subscribers per 100 inhabitants)

The mobile broadband take-up for Q3/2019 accounts for **81.61%,** i.e. **the total number of subscribers that use mobile broadband amounts to 1,695,160**[10] (Source: Agency for Electronic Communications)

[9] Lists fixed broadband market share at national level for incumbent operator and for new operators, according to number of users. One of regulatory measures to decrease domination of the incumbent operator on the market is unbundled access to local loop, i.e. xDSL technologies. Thus, thee share of the incumbent operator on the fixed broadband market is shown according to technology, as follows: total and separate for NGA, DSL, VDSL, cable, FTTH/B.

[10] Total population in the country: 2,077,132. (Source: State Statistical Office)

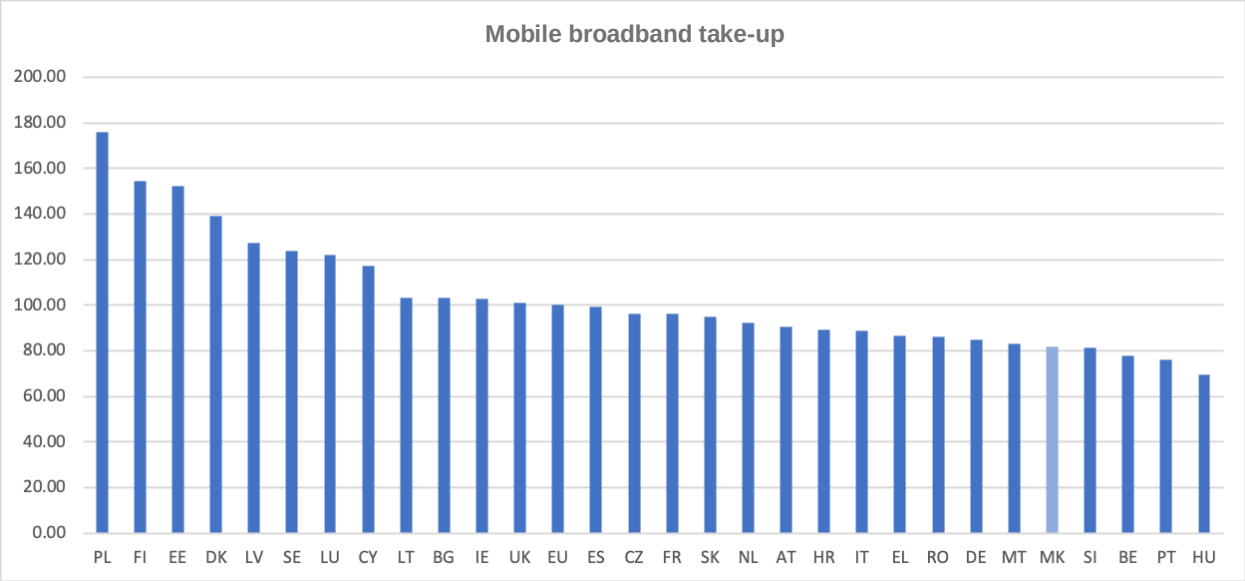

Figure 14: Mobile broadband take-up (Sources: Digital Agenda for Europe, AEC)

9. Households that only use mobile broadband home access (% of households)

During preparation of this report, data was provided that **692** residential subscribers use 3G USB Stick. (Source: Agency for Electronic Communications)

If we assume that 3G USB Stick as mobile broadband technology is the only way to access broadband from that household, with penetration of **0.122%** from the total number of households, RNM follows the European trend whereby households primarily use fixed technologies to access the internet.

10. Internet (IP) traffic per capita

i. The fixed broadband internet traffic per household during a month amounts to **84 GB**. (Source: Agency for Electronic Communications)

The fixed broadband internet traffic per capita during a month amounts to **22.82 GB**.

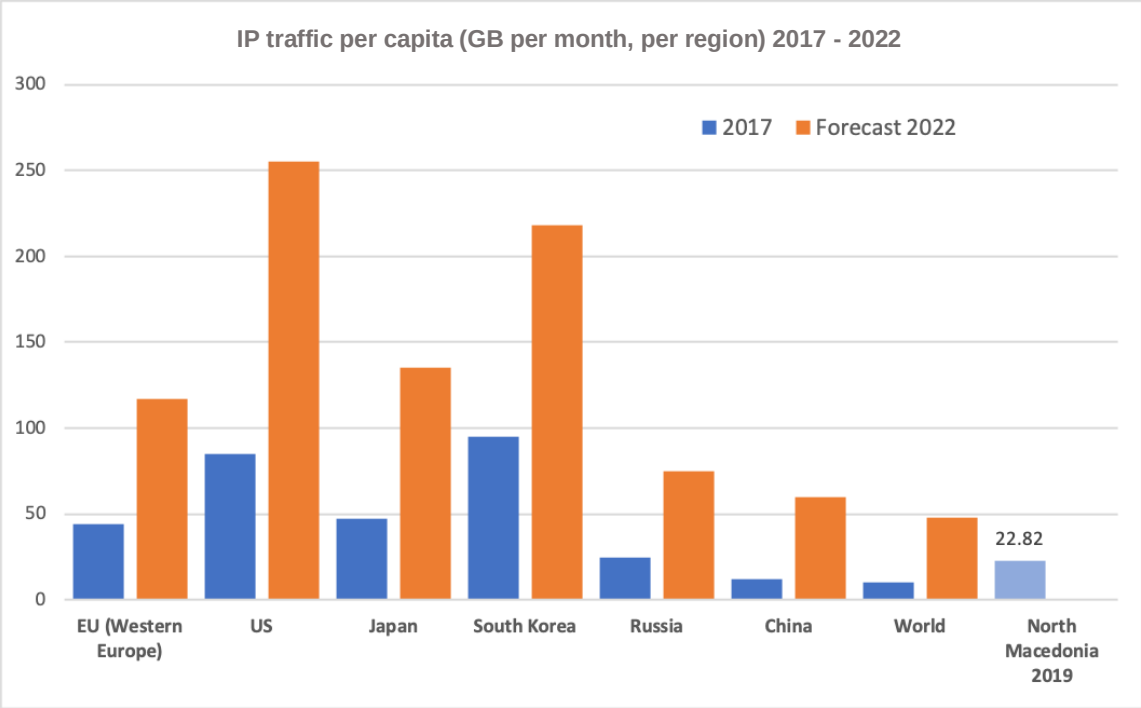

Figure 15: IP traffic per capita, in GB per month, per region (Sources: CISCO VIN, AEC)

ii. Mobile broadband internet traffic per subscriber that uses mobile internet during a month amounts to **2.76 GB**. (Source: Agency for Electronic Communications))
In the EU, the average mobile broadband traffic is 2.4 GB.

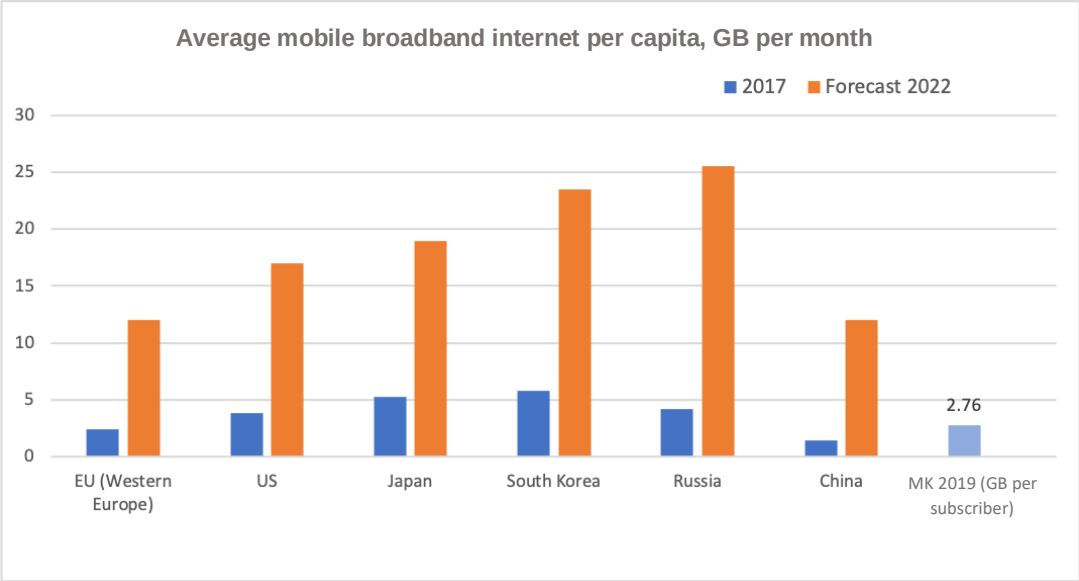

Figure 16: Average mobile broadband internet per capita, GB per month, per region (data for RNM are per subscriber, for 2019) (Sources: CISCO VIN, AEC)

11. Number of users of packaged services – service bundles[11]

Package description	Households	Business entities	Total
Two-service bundle (Double Play)	119,319	14,532	133,851
Three-service bundle (Triple Play)	143,352	16,259	159,611
Four-service bundle (Quadruple Play)	88,588	638	89,226

Source: Agency for Electronic Communications

- The number of households using packaged services in Q3/2019 amounts to **351,259**, i.e. **62.23%** of households use packaged services, which is close to the average of EU member states that accounts for 67%.

- The share of household using **two-service bundle (Double Play) amounts to 21.1%,** whereas the average of EU member states amounts to 31%.

- The share of household using **three-service bundle (Triple Play) amounts to 25.40%**, which equals that of EU member states (25%).

- The share of household using **four-service bundle (Quadruple play) amounts to 15.69%,** whereas the average of EU member states amounts to 20%.

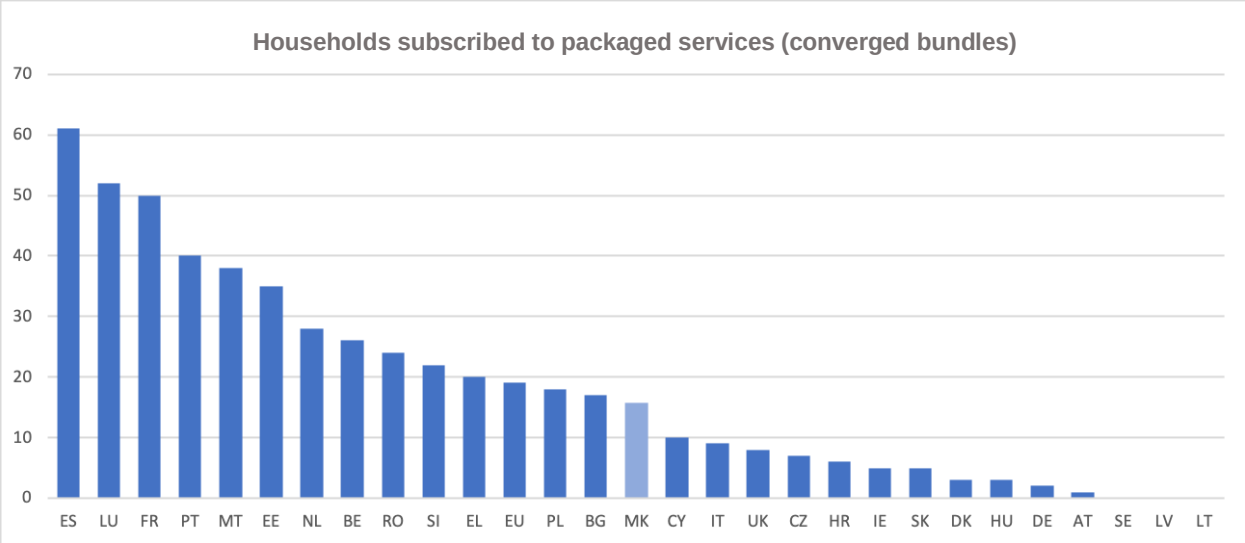

Figure 17: Household subscribed to FOUR-service bundle (Sources: DESI, AEC)

[11] Take-up of service bundles is related to the regulatory environment. An increasing number of regulatory authorities take into account converged and multiplied services in their market analyses.
Analysis is underway of % of households that use converged bundles (including fixed and mobile services).

12. Broadband price index[12]

The OECD methodology "Revised OECD Telecommunication Price Baskets" dated December 2017[13] was used to analyze retail prices offered on the fixed broadband service market in RNM. Notably, the methodology anticipates analysis of retail offers of the three highest ranked operators according to market share by number of users, whose joint total share amounts to at least 70%.

The analysis covered retail offers of operators: "Makedonski Telekom ", "A1 Makedonija" and "TRD ROBI – Telekabel", whose joint share on the fixed broadband market amounts to 86.5%.

None of the covered operators have retail offer for the category "Internet + TV".

1 EUR value = 61.69 MKD (Source: National Bank)

The value of Purchasing Power Parity (PPP) for RNM has been calculated according to data from the World Bank[14] to 2.504938271.

Category	Internet		Internet + landline		Internet + TV + landline	
	Offer	Lowest price	Offer	Lowest price	Offer	Lowest price
12-30 Mbps	Cable internet Lightspeed 30/1	500 MKD 8.1 EUR 20.29 (PPP)	A1 Net Neon 15/1	599 MKD 9.70 EUR 24.32 (PPP)	A1 Combo Neon up to 15/1 Mbps	799 MKD 12.95 EUR 32.42 (PPP)
30-100 Mbps	Fibre-optic, package Optic 40 40/40	1000 MKD 16.2 EUR 40.58 (PPP)	A1 Net Neo S up to 50/3 Mbps	699 MKD 11.33 EUR 28.38 (PPP)	A1 Combo Neo 4M 50/3 Mbps	1,199 MKD 19.43 EUR 48.66 (PPP)
>100 Mbps	Fibre-optic, package Max Optic 1 Gps/1 Gps	2199 MKD 35.64 EUR 89.29 (PPP)	Makedonski Telekom XL Package	2999 MKD 48.61 EUR 121.77 (PPP)	Makedonski Telekom XL Package, up to 300 Mbps / 300 Mbps + Max TV XL	3508 MKD 56.86 EUR 142.44 (PPP)

[12] Broadband price index is a result (0 to 100, where 100 is deemed the best) that presents prices for 12 representative broadband baskets from household incomes.
The baskets include three speed categories (12-30 Mbps, 30-100 Mbps and at least 1000 Mbps) and four product types (Internet only, Internet + TV, Internet + Landline and Internet + TV + Landline).
Data about retail prices (in the least expensive month, adapted to Purchasing Power Parity (PPP)) are shown for the three speed categories and the four product types.

[13] http://www.oecd.org/sti/broadband/DSTI-CDEP-CISP(2017)4FINAL.pdf

[14] https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita and https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal)

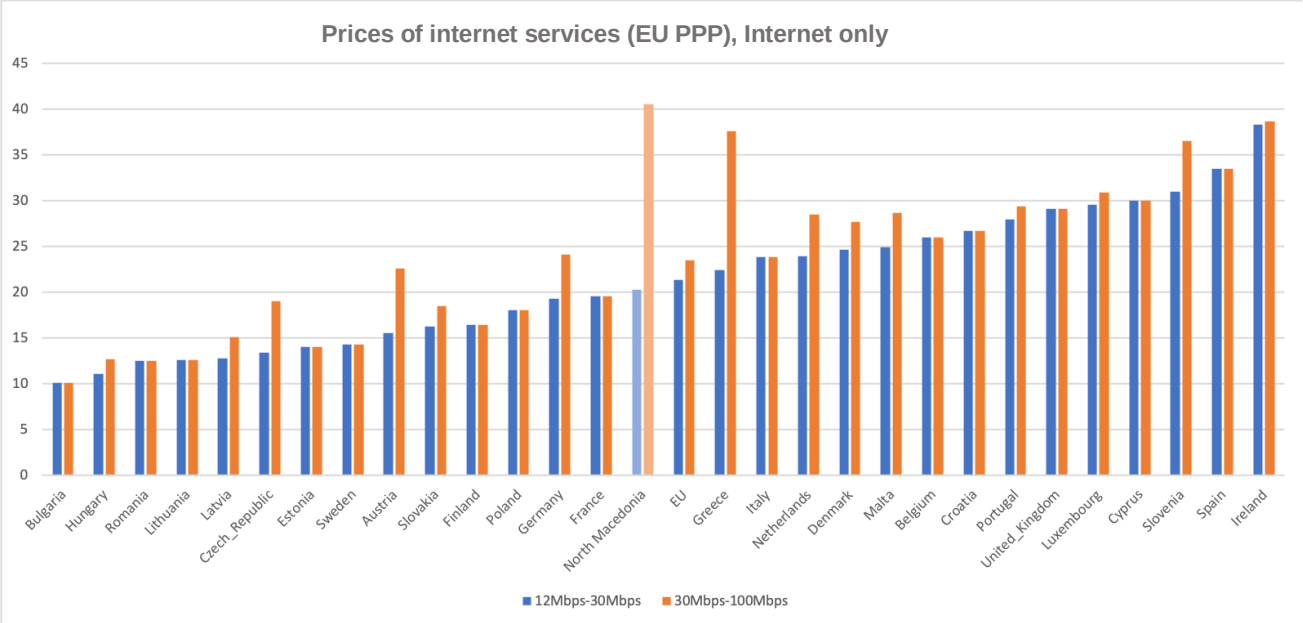

Figure 18: Prices of internet services (EU PPP), Internet only (Sources: Empirica, offers of commercial operators in RNM)

The least expensive offer of three-service bundles (Triple Play) with fast broadband access, landline and TV for the 12-30 Mbps speed category amounts to 32.42 (PPP), which is lower than the average of EU member states that amounts to approximately 40.00 (PPP).

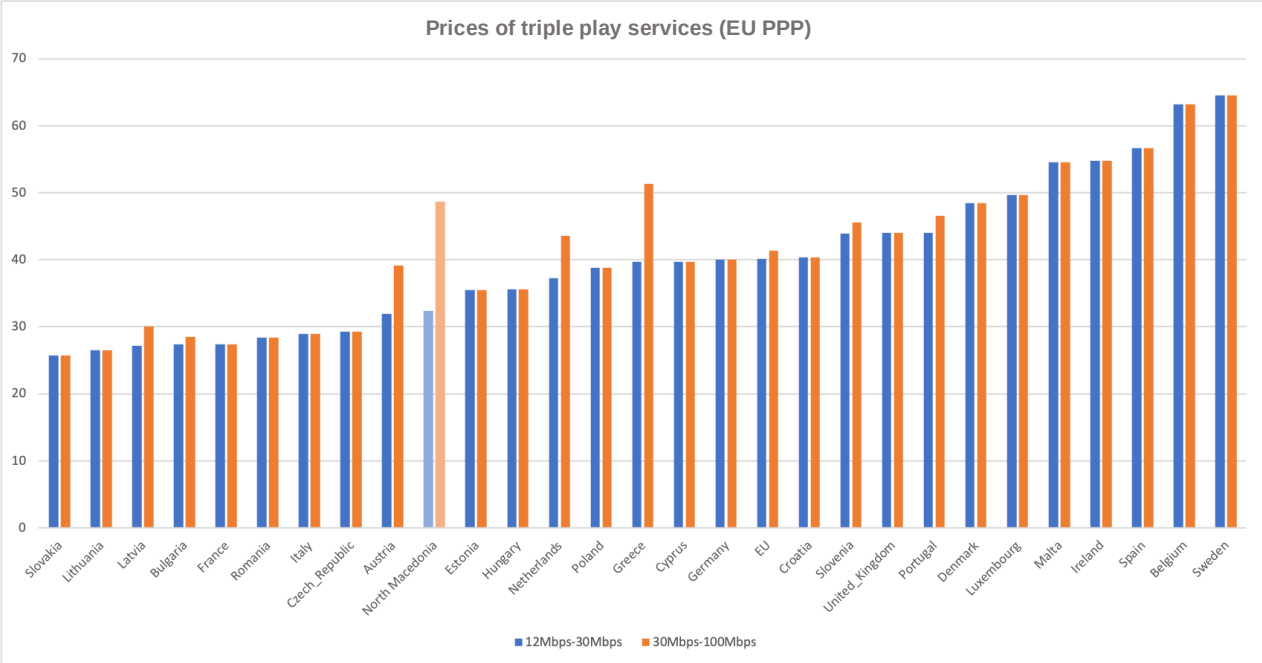

Figure 19: Prices of triple play services (EU PPP) (Sources: Empirica, offers of commercial operators in RNM)

Operators' offers for broadband with download speed of above 100 Mbps in RNM are as follows:

- 89.29 (PPP) for Internet only, Fibre-optic, package Max Optic with 1 Gbps/1Gbps (upload/download) speed;
- 121.77 (PPP) for two-service bundle XL Package "Internet + Landline", with internet service speed of 300 Mbps/300 Mbps (upload/download);
- 142.44 (PPP) for three-service bundle "Internet + Landline + TV", with internet service speed of 300 Mbps/300 Mbps (upload/download).

13. Telecom markets: general trend

A. Investments announced by operators in broadband networks

For the purposes of preparation of National Operational Broadband Plan, in-depth mapping was conducted in 2018 on current coverage and operators' plans for future investments in NGA networks.[15]

Mapping data indicate that white zones W_{30} (area wherein: there is no NGA fast network, nor there is intention to build such network within 3 years) are predominantly found outside cities, whereas white zones W_{100} (area wherein: there is no NGA ultra-fast network, nor there is intention to build such network within 3 years), in addition to rural areas, is also found in some parts of major cities.

Investments announced by operators for the following three years:

- Number of household that would have access to fast NGA networks in the following three years: 484,826 households, which accounts for 84.94% of the total number of households. This would imply an increase of 6.94% in the number of households that would have access to fast NGA networks (from 78% to 84.94%).

- Number of household that would have access to ultra-fast NGA networks in the following three years: 396,542 households, which would account for 69.47% of the total number of households. This means that, in the following three years, we expect an increase of 25.67% in the number of household that would have access to ultra-fast NGA networks (from 43.8% to 69.47%).

It could be stated that investments planned by operators in RNM mostly concern ultra-fast NGA networks, with particular focus on cities.

Pursuant EU recommendations, transport networks are necessary to retail operators to deliver services to end-users, whereas state aid projects aimed to finance transport networks (with available access to all operators and technologies) demonstrate particularly competitive characteristics.

Б. Planned state aid in broadband networks

The National Operational Broadband Plan 2019 - 2029 (NOBP), adopted by the Government of RNM on 01.04.2019, sets forth ambitious infrastructure coverage goals and identifies the construction of National Optical Transport Network (NOTN) and NGA infrastructure in white zones as key measur. NOTM will connect:

- white zones,
- selected gray zones,
- public institutions, including educational institutions (schools, universities, libraries, research centers etc.), healthcare institutions, ministries, courts, municipalities and other state administrative bodies and authorities; and

[15] http://bco.mioa.gov.mk/wp-content/uploads/2019/12/Национален-Оперативен-Бродбенд-План.pdf

- selected locations with free WiFi internet hotspots.

Construction, development, maintenance and management of NOTM and NGA infrastructure in white zones are law-stipulated responsibility of PE MB, pursuant to the Law on Establishment of PE MB.

Construction of NOTM and NGA infrastructure in white zones will be funded by the Government.

14. Development of national broadband plan: anticipated goals per year

The following are national broadband targets set forth in NOBP for RNM:

- By the end of 2023, at least one larger city should be covered with 5G signal.
- By the end of 2025, pursuant to the Treaty for Founding the Transport Community, the main corridors on basic and comprehensive road network in the country should be covered with uninterrupted 5G signal.
- By the end of 2027, all towns in the country should covered with uninterrupted 5G signal.
- By the end of 2029, anyone should have the opportunity to access the internet via 5G with at least 100 Mbps internet access speed.
- By the end of 2029, at least 50% of the total number of household subscriber contracts across the country should anticipate internet access of at least 100 Mbps.
- By the end of 2029, all households should have affordable opportunity to access a network that allows download speed of at least 100 Mbps, with a possibility for upgrade to Gigabit speed.
- By the end of 2029, all public institutions (schools, universities, research centers and other education institutions, healthcare facilities, ministries, courts, local self-governments and other state authorities and bodies) should have symmetrical internet access with a speed of at least 1Gbps.

Note: Due to extraordinary measures and state-of-affairs in the country stemming from the global coronavirus pandemic, deadlines set forth in National Broadband Targets may undergo review.

15. Free WiFi hotspots in municipalities

In July 2019, PE MB initiated the process of mapping locations that would provide free WiFi internet access in municipalities (parks etc.) that would be connected to NOTN network nodes. A total of 93% of information have been collected and processed for proposed locations that would provide free WiFi internet access in municipalities.

Note: Although though the process is expected to conclude by the end of the Q2 2020, due to extraordinary measures and state-of-affairs in the country stemming from the global coronavirus pandemic, this process will be delayed.

16. Harmonization of radio frequency spectrum within EU[16]

A working group comprised of representatives of AEC, PE MB and operator “One.Vip“ (legal predecessor of “A1 Makedonija“) worked on implementation of the Decision of the European Parliament 2017/899 from 17.05.2017

[16] The converge management approach of the spectrum is a basis for support of 5G investments

(Decision (EU) of the European Parliament of the Council on the use of 470-790 MHz frequency band in the Union) and prepared a plan to change frequencies of DVB-T radio frequency transmitters and to implement the Gödöllő Agreement. The working group also prepared a timeframe for implementation of changes to free the 694-790 MHz band by 01.07.2020 the latest.

17. Implementation of Net-neutrality Regulation (EU) 2015/2120)

Towards the end of 2018, AEC adopted two new Rulebooks on measuring public electronic communication network quality parameters for broadcasting networks and for cable networks. These rulebooks are published in the "Official Gazette of the Republic of North Macedonia " no. 35/2019 on 12/02/2019.

On 28th January 2020, AEC announced a public discussion on the proposed Rulebook amending the Rulebook on Quality Parameters for Public Electronic Communication Services Delivered via Public Broadcasting Network.

Main amendments to this Rulebook concern the parameter Speed of data transfer via broadcasting network for test routes that is proposed to be above 40 Mbps, whereby 1GB test file will be used. This is due to the fact that on the last measurements, operators had average speeds of 55 Mbps, i.e. 36 Mbps, respectively.

18. Roam-like-at-Home (RLAH) and increasing roaming traffic

After a series of meetings held in Brussels upon initiative of the European Commission and RCC, which noted attendance of representatives of competent ministries and national regulatory authorities from the six Western Balkan countries (WB6), an Agreement was reached to further reduce roaming prices in WB6 and to introduce roaming services with prices equal to services in domestic countries (Roam Like At Home) starting 1st July 2021. The Agreement also anticipates significant reduction of roaming prices for WB6 in the transition period 1st July 2019 – 1st July 2020.

Pursuant to this Agreement, reduction is anticipated of retail and wholesale prices of roaming services in WB6 according to the table below:

	1 July 2019	**1 July 2020**	**1 July 2021**	**1 January 2022**	**1 January 2023**	**1 January 2024**	**1 January 2025**	**1 January 2026**
Wholesale internet access price (per MB)	€ 0.025	€ 0.015	€ 0.0077	€ 0.006	€ 0.0045	€ 0.0035	€ 0.003	€ 0.0025
Retail data transfer service (per MB)	Retail price + surcharge of €0.025, but not surpassing €0.18	Retail price + surcharge of €0.015, but not surpassing €0.18	Roam Like at Home					
Wholesale outgoing call service (per minute)	€ 0.05	€ 0.04	€ 0.032					

Retail outgoing call service (per minute)	Retail price + surcharge of € 0.05 but not surpassing € 0.19		Roam Like at Home
Retail incoming call service (per minute)	€ 0.04	€ 0.025	Roam Like at Home
Wholesale SMS service (per SMS)	€ 0.02	€ 0.02	€ 0.01
Retail outgoing SMS service (per SMS)	Retail price + surcharge of €0.02, 05 but not surpassing € 0.06		Roam Like at Home
Retail incoming SMS service (per SMS)	No surcharge		Roam Like at Home
Wholesale price for international incoming calls for calls connected to roaming calls	€ 0.04	€ 0.025	€ 0.016

Internet traffic of mobile subscribers from RNM when they are in mobile networks of EU member states amounts to **22,155,433 MB** for the first three quarters of 2019.

In addition, with mediation by RCC, discussions commenced between WB6 and the European Commission to initiate a process for reduction of roaming prices.

19. European Emergency Call Number E-112

The project E-122 is under the competence of the Center for Crisis Management (CCM). Implementation activities of the European Emergency Call Number 112 are ongoing as part of the project "Further Upgrading the Tetra System (Tetra 4) and the Establishment of the E-112 Emergency Call Number" – IPA 2016. The company Bonumstrat Consulting Ltd. from Hungary (project implementation consultant), together with members of the Steering Committee for Implementation of the European Emergency Call Number 112 (members of the Crisis Management Center, Ministry of Interior, Ministry of Health, Agency for Electronic Communications and the Territorial Firefighting Unit - Skopje) defined the concept and conceptual system design of E-112. Moreover, the technical specification has been prepared and endorsed by the Project Steering Committee, whereas international tender procedure for selection of company (contractor) for implementation of the project is to be announced (Q1 2020) by the Delegation of the European Union.

The Center for Crisis Management notes progress in reconstruction and adaptation of facilities for the E-112 operating center. The main Skopje call center is finalized in 2019, whereas activities continue to remodel regional facilities anticipated to be used for the E-112 call center with budget allocated by the government. Implementation of the project is to be completed mid-2021

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20. Preparedness for 5G, demonstrated through 5 different elements[17]

a. National 5G plan:

The national 5G is covered under NOBP.

b. 5G testing:

In 2019, AEC awarded two Approvals for using radio frequencies with temporary validity of 12 months in the 3.6 GHz band. One approval has been awarded to A1 Makedonija with validity period by 14/07/2020, and the other has been issued to Makedonski Telekom with validity period by 30/10/2020 to perform testing og their 5G test networks.

In December, 2019 AEC performed non-ionizing radiation measurements to determine the contribution of the new 5G NR technology from Makedonski Telekom's test network. Two base stations were active during the measurement period, one mounted on the top of Makedonski Telekom building, and the other on the TK Centar building (Makedonski Telekom). The measuring point is in front of the AEC building, 160 meters from the first base station. The Report, published on AEC's official website, states: limits and legislation on non-ionizing radiation, measuring equipment used to perform measurements, measurement protocol, purpose of measurement, dominant sources of electromagnetic radiation and description of measurement site, measurement results and contribution of technologies to total electromagnetic field exposure coefficient (%). The measurements indicate that the total coefficient of exposure to the electromagnetic field is 14.9% of the maximum allowed value under ICNIRP, whereas the contribution of 5G to the total exposure coefficient is 32%, to LTE 49%, to UMTS 8% and to GSM 11%.

c. 5G cities:

Pursuant to NOBP, by late 2023 at least 1 (one) city should be covered with 5G signal, whereas by late 2027 all cities in RNM should be covered with 5G signal.

d. Awarding 5G frequencies:

In accordance with NOBP, on 05/02/2020 AEC announced a Public Call for Stakeholder Opinion on Issuing Approvals to Use 5G Radiofrequency. The public call should have concluded on 06/03/2020.The purpose of this call is to provide stakeholder opinion that would result in investments for introduction of 5G technology in the Republic of North Macedonia, to define conditions and criteria for announcement of tender procedure for allocation of required radio frequencies. In the Republic of North Macedonia, the bands: 700 MHz, 3.6 GHz and 26 GHz are intended for provision of 5G technology services. Both Macedonian operators asked AEC to postpone the period for delivery of opinions to the public call with a view to successfully implement 5G, whereby the final date for delivery of opinions was postponed to 20/04/2020.

[17] The indicator "5G Preparedness " in DESI indicates the portion of the spectrum intended for 5G goals as % of the complete harmonized 5G spectrum

e. 5G corridors (cross-border connectivity):

Under consideration.