

# Broadband in the Access Network Comparison Situation in EU and BiH

Zvezdan Stojanović, Dušan Savić

**Abstract**— new services, like IPTV, VoD, broadband access to Internet have very high demand for the bandwidth. xDSL technologies are mainly used as solution for this demand by the greatest operators in Bosnia and Herzegovina (BH Telecom, M:TEL). That technologies have restriction regarding from the distance between central office (CO) where is operator's equipment and subscribers. Solution for this problem is some form of the next generation access (NGA) technology which is used in European Union (EU). In this paper is made comparison between situation with broadband technologies in European Union and BiH with possible direction of development. It is described why broadband technologies in access network is so important.

**Index Terms**—: triple play, quadruple play, NGA, FTTx

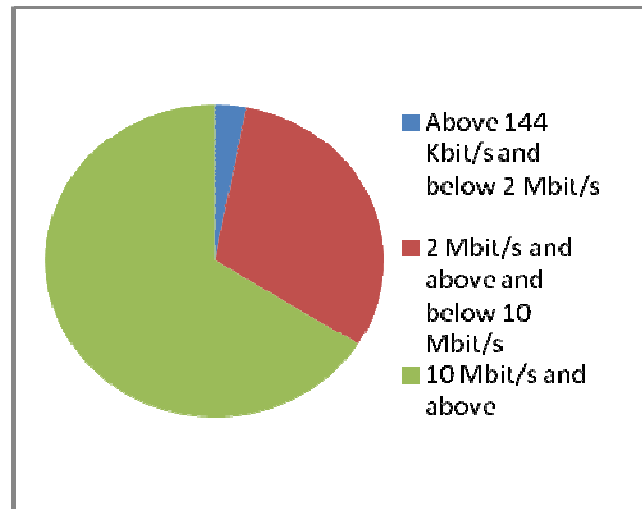
## I. INTRODUCTION

Telecommunication networks are in the transition phase to next generation networks (NGN) which are based on the packet commutation and IP protocol. This transitions are almost finished in backbone networks based on fiber-optic, but not in the access networks where copper infrastructure and xDSL technologies using that infrastructure is still dominant. But with development a new bandwidth intensive services and with their bundling (triple play and quadruple play concept) what is today trend, it is estimated that copper infrastructure in access networks become main bottleneck for development that services.

In European Union this problem is resolved with next generation access (NGA) technologies. In the next chapters situation in EU is considered and after that is made comparison with situation in Bosnia and Herzegovina (BiH) with the most probably direction of the further development.

## II. BROADBAND IN EU

There are many differences from which connection rate is used that connection is broadband type. In [1] broadband connection is defined as connection enabling higher than 144 Kbit/s download speed. But, it can be seen from figure 1, that speed in the most of the cases is much greater. It must be considered that there are significant differences between the advertised speed by telecom operator and the actual speed that consumers receive



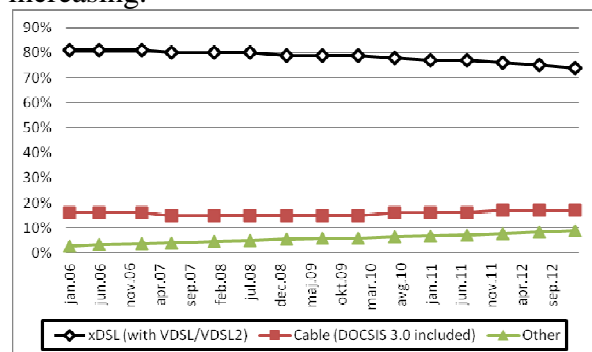
**Figure 1. Fixed broadband subscription by speed at EU level, January 2014**

Especially for DSL actual download speed is 76% of the advertised speed [1], [2].

Major broadband technologies in EU are:

- fixed technologies: xDSL, Cable, FTTx (FTTH, FTTB, FTTC),
- fixed wireless: WiMax,
- mobile wireless: HSPA and LTE.

Primary Internet access at home is provided mainly by fixed technologies: xDSL, cable and WiMax. xDSL family of technologies (ADSL2, ADSL2+, VDSL...) are still predominant technologies in EU broadband market (figure 2), but it can be seen that the market share of the xDSL technologies is declining and cable market share is increasing.



**Figure 2. Fixed broadband lines-technology market shares at EU**

Next Generation Access (NGA) technologies (VDSL, Cable Docsis 3.0 and FTTx) are capable to deliver at least 30 Mbit/s in download (fast broadband). NGA technologies are currently limited to urban areas. Fast broadband penetration in EU was 6.3% in January 2014. NGA subscription by technology is shown in figure 2 [1].

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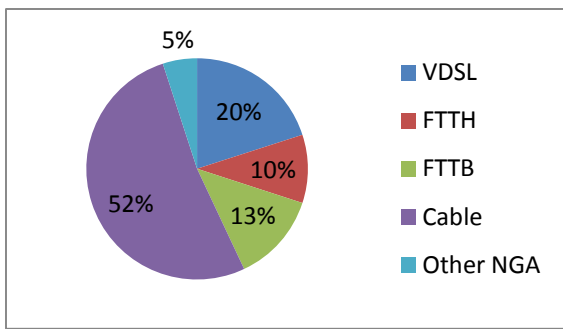


Figure 3. NGA subscription by technology at EU level, January 2014

Mobile broadband represents the fastest growing segment of the broadband market. Mobile data traffic in EU is doubled every year. For example in 2011, 14% of the people in EU using a mobile phone to access the Internet. This percent is doubled in 2012. It is expected that mobile data revenues will overtake voice revenues globally by 2018.

Third generation mobile broadband (HSPA) coverage reach 96.3 of population, while fourth generation (LTE) coverage 26.2 population. It is estimated that 3G data traffic represent 50% and 4G represent 14% from all mobile data traffic. Mobile broadband penetration in EU is shown in the figure 3.

### III. TREND OF DECREASING REVENUE AND OPERATOR STRATEGIES IN EU TO PREVENT THAT

Over-the-Top (OTT) apps are third-party messaging services that don't use the carrier's SMS delivery system and instead push messages through the mobile devices' connection. These OTT apps let users avoid SMS fees. The traditional voice service, which still contributes a quarter of overall telecommunications revenues is fading away very quickly, replaced by voice applications provided by OTTs (Skype, Google Talk, Viber, Facebook voicemails) [2].

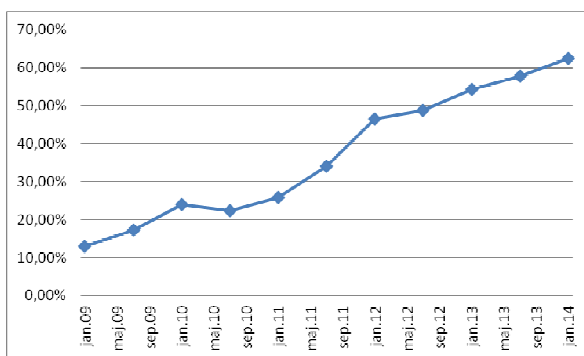


Figure 4. Mobile broadband penetration at EU

Mobile broadband doesn't substitute fixed broadband. Mobile device users sent an average of 36.6 billion messages per day throughout 2012. Analyst house Informa says that 19 billion messages were sent from mobile chat apps, while 17,6 billion were sent via SMS. All of the above forced operators to develop new, more aggressive pricing structures, as well as their own messaging products.

Now is transition period from legacy PSTN to IP broadband networks. In this period pricing for core and strategic telecom services proved to be either flat or in decline. European telecom operators are adopting strategies in order to improve their ARPU and secure their revenues.

Telecom operators are considering some of the following strategies:

- Geography diversification of their businesses in emerging markets: like Deutsche Telekom invested in Croatia, Austria, Slovakia, Greece, Hungary, Netherlands, Poland, USA.
- Bundling services: there exist many different types of bundled services, which can include either a combination of fixed line telephony and broadband access or fixed broadband access and television (double play), products combining fixed voice, broadband access and television (triple play) and more recently quadruple play products, which offer mobile plus triple play offerings (quadruple play).
- Developing policies to retain existing consumers and attract new ones, better understanding of the changing consumer behaviour and strengthening consumer care services, customer profiling and customization of products using big data.

### IV. NGA TECHNOLOGIES

From the previous, bundling services is operators trend in EU, but in the next chapters we will see that it is trend in the BiH too. Triple play and quadruple play services need high bandwidth (broader in the next chapter). xDSL family of technologies are still dominant broadband technologies in EU. From the figure 5 it can be seen the greatest disadvantage of this technologies: insufficient bandwidth, with great impact of the distance. With shortening subscriber loop, greater bandwidth can be achieved. In this case, it can be used VDSL and VDSL2 technologies with very high bandwidth but in the short distance from the operators equipment (DSLAM) of about 300-400m. VDSL and VDSL2 are used in combination with fiber optic (FTTB and FTTC concept). The best solution is the optic from end to end, what mean, from subscriber side to operator equipment (FTTH concept), but it is the most expensive solution.

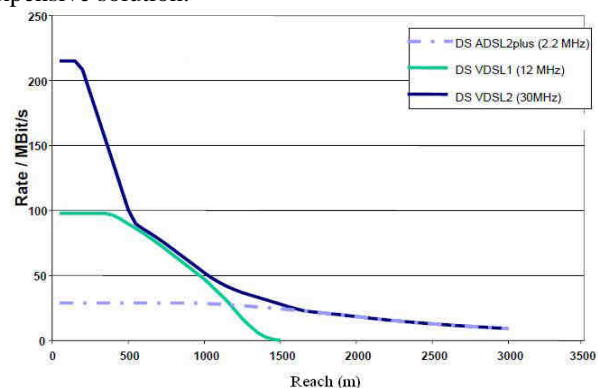


Figure 5. Dependence of data flow from distance

Using NGA technologies in the access network is possible solution for the bottleneck in access network. From the figure 2 and figure 3 it can be concluded that trend in EU is that cable connections (mostly DOCSIS) are increased and number of xDSL connections are decreased.

DOCSIS (Data over Cable Service Interface Specification) defines communications and operation support interface

requirements for a data-over cable system. DOCSIS permits high-speed data transfer over existing CATV system. Cable operator employ DOCSIS to provide Internet access over existing HFC infrastructure.

Cable infrastructure in BiH is not so developed as in some EU countries. The greatest operators in BiH (BH Telecom, M:TEL and Eronet) would not use cable infrastructure. They mostly use xDSL technologies in the access network and recently FTTx technologies. It is reason why FTTx technologies is explained in the next

### A. FTTx Technologies

It can be seen from the figure 6 that the main difference between different type of FTTx technologies is in the point where optical fiber is terminated: in the house (FTTH), building (FTTB) or in some distance from the building, in the cabinet (FTTC) [3-6].

The role of the some components from the figure are:

- OLT is located in operator CO and it is connection between optical access network and operator WAN network,
- ONU (Optical Network Unit) is point of termination optical distribution network (ODN-optical network between ONU and OLT); its main role is opto/electrical conversion and differentiation subscribers services; it is used for the many subscribers what depends from the splitting ratio,
- ONT is special case of ONU and it is used only for one subscriber.

Point-to-Point FTTH (Fiber to the Home) concept (case 1 from figure 6) is the best choice for broadband solution, but it is not the most economic way, because one fiber to one subscriber is very expensive. P2P solution gives a great bandwidth of about 100 Mbit/s in a very great distance and that is reason why is P2P permanently solution.

The more economic solution is point-to-multipoint FTTH, P2MP (case 2 in figure 6). There is one fiber from OLT to passive optical splitter and after that there are one fiber to one subscriber. Number of fibers after splitter depends from splitting ratio (1:16, 1:32 or 1:64). There is no need for electrical power nor active switch. All components are passive and for that reason, that network is called Passive Optical Network (PON).

There are four main type of the PON networks: APON (ATM over PON), EPON (Ethernet over PON), BPON (Broadband PON) and GPON (Gigabit PON).

GPON is mostly used in EU and the rest of the Europe. In BiH, using PON is in its beginning, but like EU, GPON is used.

GPON is FTTH point-to-multipoint solution. GPON has capacity of about 2.5 Gbit/s for download and 1.25 Gbit/s for upload for the distance of the 20 km (asymmetric variant). It can be used also in symmetric variant with 2.5 Gbit/s rate in both direction. With splitting ratio of the 1:32 and 1:64 (and with assumption that all subscribers is active, small possibility), average garanted bandwidth is about 80 Mbit/s (for 1:32) or 40 Mbit/s (for 1:64).

In downstram, data from the core network (MPLS backbone from the figure 6) is sent using broadcasting from

OLT to all ONU units. Each ONU unit received only part of data which is intended to it.

TDM is used to avoid collisions on the fiber in upstream. Each ONU send data in certain time slot. For more effective allocation bandwidth, two algorithms are used: Fixed Bandwidth Allocation (FBA) and Dynamic Bandwidth Allocation (DBA). FBA algorithm is easy for implementation, but it not consider current changes in the network. DBA performs the allocation bandwidth in upstream to ONUs based on the current value of the traffic.

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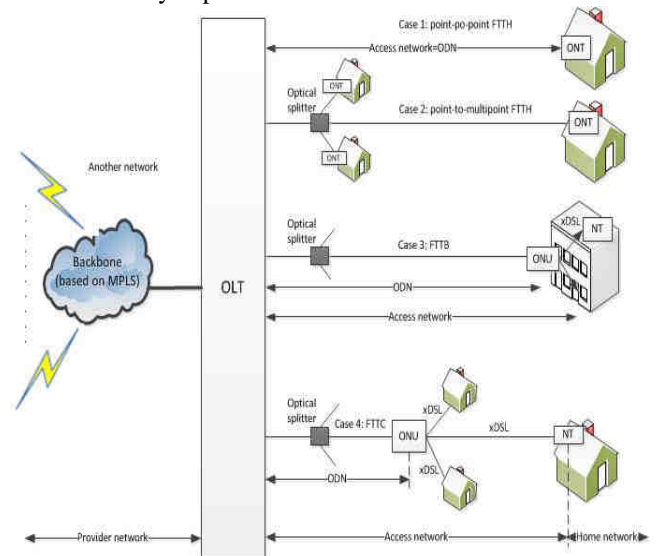


Figure 6. FTTx tecnology

## V. BROADBAND IN BiH

The broadband services from year to year in BiH continue to increase, so that the number of broadband subscribers has reached 99.38% [7].

Penetration of broadband subscribers in relation to the total population of BiH was 13.42%. Within the structure of broadband connections (in fixed networks), xDSL access still leads with 57.14% out of the total number of broadband connections, with the rise of cable Internet access and FWA connections (Fixed Wireless Connection) compared to the previous year (figure 8), [7].

UMTS (Universal Mobile Telecommunication System) is the third generation (3G) mobile telecommunications system that enables the provision of broadband services in wireless and mobile communications. HSPA (High-Speed Packet Access) is a collection of mobile telephony protocols that extend and enhance existing UMTS protocols.

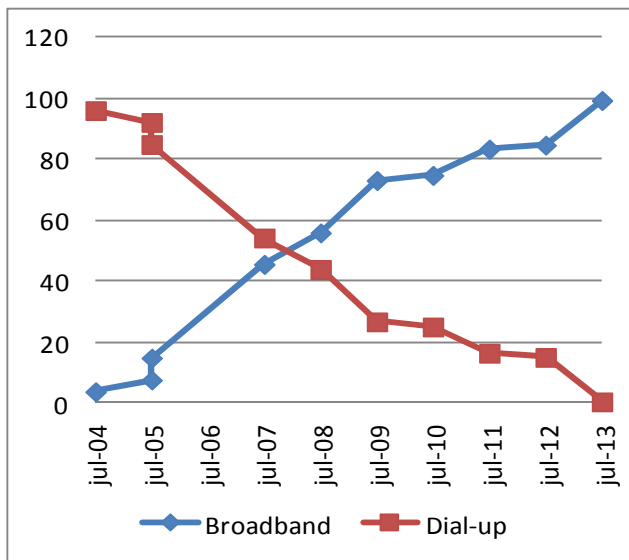


Figure 7: Percentage ratio between broadband and dial-up connections

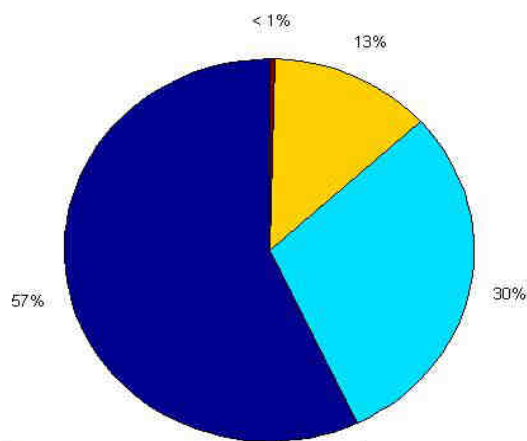


Figure 8. Structure in broadband connections in BiH

Access to Internet via 3G can be enabled on two ways:

- via a mobile phone that supports 3G; that makes much faster access to (compared to GPRS/EDGE) content on the Internet,
- via computers and PCMCIA card/USB modem/mobile phone that supports 3G; computer and mobile phone must be connected via the appropriate cable, infrared port (IrDA), or Bluetooth.

Operators who have the license for public fixed and mobile telephone services that enables them to provide fixed and mobile telephony services in the whole territory of Bosnia and Herzegovina are:

1. JP BH Telecom Sarajevo,
2. Telekomunikacije RS a.d. Banja Luka (M:TEL),
3. JP Hrvatske Telekomunikacije d.d. Mostar.

Coverage of the population with 3G services for all operators in BiH is:

1. for BH Telecom, 87,05%
2. for M:TEL, 71,36%

3. for HT Mostar, 71,5%

### VI. BUNDLING OF SERVICES

From the operator point of view, revenue from services like fixed telephony is constantly decreasing (is same as EU), and forming packages with more promising services (like IPTV, VoD, broadband access to Internet) with less promising (like fixed telephony) is one way for increasing average revenue per user (ARPU) and way for keeping existing subscribers. This is called bundling. This is analogous as operator's trend in EU (see chapter 3)

There are two types of bundling: pure bundling and mixed bundling, [8].

1. "Pure bundling" is case in which operator offers to subscriber (end users) package of services at a single price and in that case subscribers haven't impact on the package's performance.
2. "Mixed bundling" is case in which subscribers may to choose some individual service from package (collection of services) and subscribers have possibility to choose some performances of the services, like data flow, prices and so on.

Here are two basic reasons [8] why a subscriber may choose to purchase a package of the service (bundle):

1. Operator may decide to offer only bundling and in this case it is only solution for the subscribers.
2. Bundling is cost saving for subscribers, because it is cheaper to buy packet of the service than to buy each service individually.

1. In Table 1 and Table 2 is used data from Annual Report of the CRA for 2013 year [7].

Table 1. Number of subscribers per collections of services

Two services	2011	2012	2013
IPTV and Internet	42.844	77.789	68.371
Fixed telephony and IPTV	495	762	1.1281
Three services			
Fixed telephony, Internet and IPTV	160	142	207

In Table 1 is shown number of subscribers per collections of services in BiH for all operators.

Table 2. Number of users per package of the services in BiH (for all operators)

Double play package	2011	2012	2013
IPTV and Internet	45.494	36.59	61.204

Fixed telephony and Internet	17.523	22.985	25.511
Fixed telephony and IPTV	25.823	42.555	58.375
<b>Triple play package</b>			
Fixed telephony, Internet and IPTV	30.94	61.176	96.574
<b>Quadruple play package</b>			
Fixed telephony, Internet, IPTV and mobile telephony	864	999	3.052

In Table 2 is given number of subscribers per packages of services in BiH for all operators.

Each of the three main operators in BiH have own packages of the services and price politics.

In Table 3, Table 4 and Table 5 is shortly described their packages of the services, [9-11].

**Table 3. Packages in BH Telecom network**

PACKAGE	CONTENT OF THE PACKAGE
Moja TV BH	47 IPTV channel; 20 radio channel, timeshift TV, EPG; games
MojaTV Basic	140 IPTV channel;30 radio channel;timeshift TV; EPG; games
MojaTV Phone+	MojaTV Basic+Fixed telephony (Free calls within BH TEL's fixed network)
Moja TV Net	Moja TV Basic+Flat Internet 5000/512
MojaTV Net Speed	Moja TV Basic+Flat Internet 40000/1
MojaTV Full+	MojaTV Net+Fixed telephony
MojaTV Full+Speed	MojaTV Net Speed+Fixed telephony
Moja TV Premi	MojaTV Full+Mobile post-paid subscription+500 MB mobile Internet

**Table 4. Packages in HT Eronet network**

PACKAGE	CONTENT OF THE PACKAGE
Du01	Fixed telephony+Flat Internet 3072/320
Duo2	Fixed telephony+Flat Internet 38192/512

Duo3	Fixed telephony+Home:TV
Duo Pro	Fixed telephony+ Flat Internet25000/2000
Trio	Duo3+Flat Internet 4096/320

**Table 5. Packages in M:TEL network**

PACKAGE	CONTENT OF THE PACKAGE
Duo fixed+Internet1	Free calls within M:TEL's fixed network; flat Internet 2048/192
Duo fixed+Internet2	Free calls within M:TEL's fixed network; flat Internet 4544/320
Duo fiksna+Internet3	Free calls within M:TEL's fixed network; flat Internet 10240/640
Duo IPTV+Fixed start	Free calls within M:TEL's fixed network; start IPTV package
Duo IPTV+Internet start	Start IPTV package+Flat Internet 2624/248
Trio start	Free calls within M:TEL's fixed network; start IPTV package; flat Internet 2624/248
Quadro1	Trio start+100 minute free calls within M:TEL mobile network+100SMS+500MB mobile Internet
Quadro2	Trio start+200 minute free calls within M:TEL mobile network+250SMS+500MB mobile Internet
Quadro3	Trio start+500 minute free calls within M:TEL mobile network+250SMS+1GB mobile Internet
Quadro4	Trio start+500 minute free calls within M:TEL mobile network+500SMS+2GB mobile Internet

## VII. CONCLUSION

Access network is estimated as a major cause for bottleneck in providing new services for the end users. In this paper is made comparison between broadband in the access network in EU and BiH. NGA technologies described shortly here are in its beginning. Some pilot project with FTTH in great towns in BiH is made (especially GPON). The greatest operators in BiH are ready for LTE (4G). Cable operators in BiH are using DOCSIS 3.0. Operators strategy for increasing ARPU is same as in EU. In this paper is described bundling (triple play and quadruple play) and networks for realization both concepts. All mention earlier is indicator that BiH is on the right way, and that it follows global trends in area of telecommunications, but a major effort is required to reach infrastructure of the middle-income countries in EU.

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