WHATSAPP, VIBER & MESSENGER: COMPARATIVE ANALYSIS OF THE AMOUNT OF DATA TRAFFIC GENERATED BY THE EXCHANGE OF A VIDEO FILE

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Abstract: *Smartphone data traffic follows the rapid growth trend which is primarily driven by the simultaneous increase in the number of smartphones and the increasing amounts of data traffic generated by each device. Video-generated traffic is the dominant form of data traffic, and predictions are that in the next few years more than 80% of data traffic will be related to the video. On the other hand, the dominant segment of communication is achieved through instant messaging applications such as WhatsApp, Viber and Messenger. They are also increasingly used to transmit videos in communication between users. This paper analyzes the amounts of data traffic generated by popular instant messaging applications when sharing a one-minute video. Based on the results of various applications for measuring the amount of generated data traffic, similarities/differences in data traffic generation of instant messaging applications will be identified.*

Key words: *smartphone, data traffic, video, measurement, applications*

1. Introduction

Smartphone as a device continues to capture greater amounts of human time and attention. The smartphone is the passport to navigate the world of information oversupply. Mobile data is a source of insight and intelligence into human behaviour with modern technology. According to [1], the total number of mobile subscriptions was around 7.9 billion in Q1 2019. Subscriptions associated with smartphones account for more than 60% of all mobile phone subscriptions. At the end of 2018, there were 5.1 billion smartphone subscriptions.

Consumers' use of smartphones will continue to make up the majority of their media consumption. The average US adult will spend 3 hours, 43 minutes (referenced as 3:43) on mobile devices in 2019, just above the 3:35 spent on TV, as seen in Fig. 1. Longer term, smartphones will remain the dominant device for consumer media, according to [2].

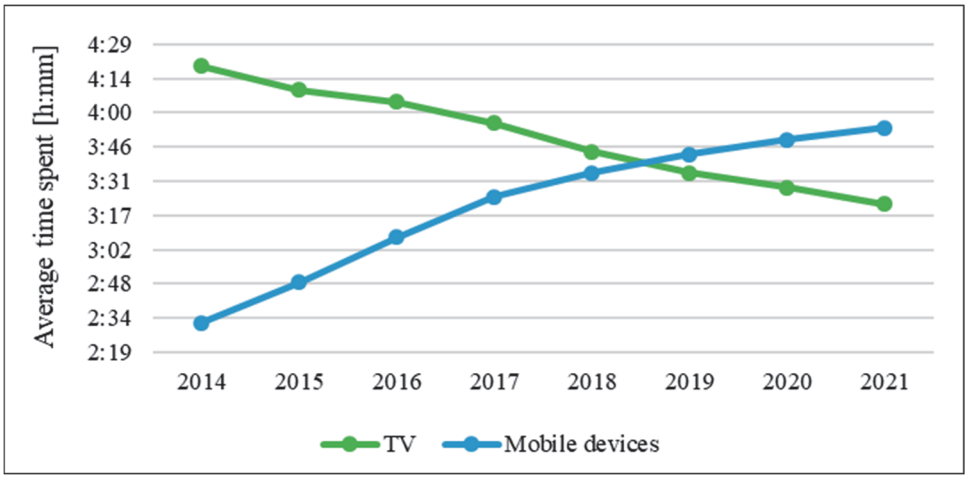

Figure 1. TV and mobile devices: Average time spent in the USA, 2014-2021 [2]

Data traffic generation is an inevitable segment of any mobile terminal device that has access to an Internet connection [3]. Mobile data traffic generated by mobile devices is growing every year. The growth in data traffic is driven primarily by the increase in the number of smartphone users and the increase in the average volume of data per user, driven primarily by video content. According to Cisco in [4], mobile data traffic has grown 17-fold over the past 5 years. Videos are one of the leading causes of the rise in generated mobile data traffic.

Data traffic generated by the smartphone applications contribute significantly to the load at the Internet backbone [5]. The dominant segment of communication is achieved through instant messaging applications such as WhatsApp, Viber and Messenger. Those instant messaging applications appear as top contributors to overall downstream and upstream data traffic.

This research shows how much data traffic is generated by the exchange of a video file between two smartphones by using WhatsApp, Viber, and Messenger.

2. Previous research

A substantial number of authors have analysed the use of smartphones within various contexts, but a minor number of studies has dealt with the generation of smartphone data traffic in the context of video file exchange by using instant messaging services/applications.

Authors in [6] analysed daily Internet data traffic generated in a smart university campus by using various devices. Other, like in [7], measure cost efficiency to effectively indicate the mobile user's economic efficiency of data traffic usage, while authors in [8] measure how mobile services and applications consume smartphone energy during their executing processes.

Some of the authors present methods of measuring the smartphone generated data traffic. Research [9] shows various approaches to measuring mobile data traffic, and the objective and subjective methods with their characteristics have been defined. Research

[10] represents a detailed overview of research methods, their advantages and drawbacks as well as the measuring points within the telecommunication network. Authors in research [11] have done measurement-driven modeling of smartphone subscribers' mobile data traffic usage in a metropolitan scenario.

Some of the authors analyse, apart from the mobile network, also the Wi-Fi network. Thus, research [12] with the developed application presents the weekly and daily distribution of smartphone data traffic by accessing mobile and Wi-Fi networks. Research [13], by using the developed application, presents the trends in generating smartphone data traffic and related applications by the access to mobile and Wi-Fi networks.

The drawback of previous studies can be seen in the fact that none of the studies measured the generation of mobile and Wi-Fi data traffic for the popular messaging services and their exchange of a video file. Further, not one research used more than one application for measuring generated data traffic, which will be presented in this paper.

3. Smartphone data traffic and video

The generation of mobile data traffic continues to grow. This growth has been partly prompted by the growth of the popularity of video recordings. In 2018, global mobile data traffic amounted to 19.01 exabytes per month. By 2022, mobile data traffic is expected to reach 77.5 exabytes per month worldwide [14].

As seen in Fig. 2, mobile video in 2017 accounted from 56,5% to 63% of total mobile data traffic generated, while in 2022 mobile video share of total mobile data traffic will be almost 80%.

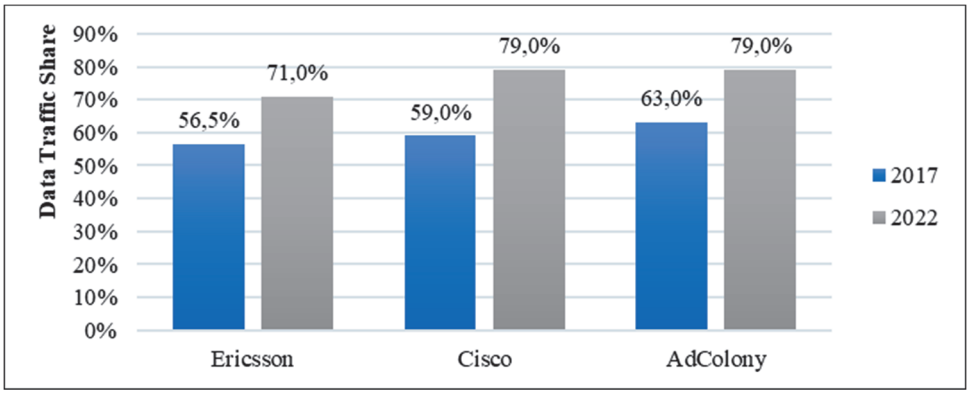

Figure 2. Comparison of mobile video share of total mobile data traffic generated in 2017 and 2022 [1], [4], [15]

An increasing number of smartphone users is the main actuator of the increase of mobile data traffic.

Between 2016 and 2022, the traffic generated by smartphones will increase by 10 times [1]. The average smartphone will generate 11 GB of traffic per month by 2022, more than a four and a half-fold increase over the 2017 average of 2 GB per month. By 2022, aggregate smartphone traffic will be seven times greater than it is today, with a CAGR of 48%. Smartphones will surpass 90% of mobile data traffic by 2022 [4].

According to [16], video traffic in mobile networks is forecast to grow by around 34% annually up to 2024 to account for nearly three-quarters of mobile data traffic, from approximately 60% in 2018. Main drivers for video traffic growth:

- Video is part of most online content (news, ads, social media, etc.)
- Video sharing services and streaming services
- Changing user behaviour – video being consumed anywhere, any time
- Increased segment penetration, not just early adopters
- Evolving devices with larger screens and higher resolutions
- Increased network performance through evolved 4G deployments
- Emerging immersive media formats and applications (HD/UHD, 360-degree video, AR, VR)

For mobile operators there is no ignoring the impact video will have on their business. There is also no ignoring the fact that networks need to be designed to support mobile video.

According to Cisco in [4], because mobile video content has much higher bit rates than other mobile content types, mobile video will generate much of the mobile traffic growth through 2022. Of the 77 exabytes per month crossing the mobile network by 2022, nearly 61 exabytes will be due to video.

Globally, the increase in monthly mobile data traffic per smartphone can mainly be attributed to three drivers: improved device capabilities, more affordable data plans and an increase in data-intensive content. In Central and Eastern Europe, over the forecast period seen on Fig. 3, the monthly traffic per smartphone is expected to increase from 4.5GB to 19GB [1].

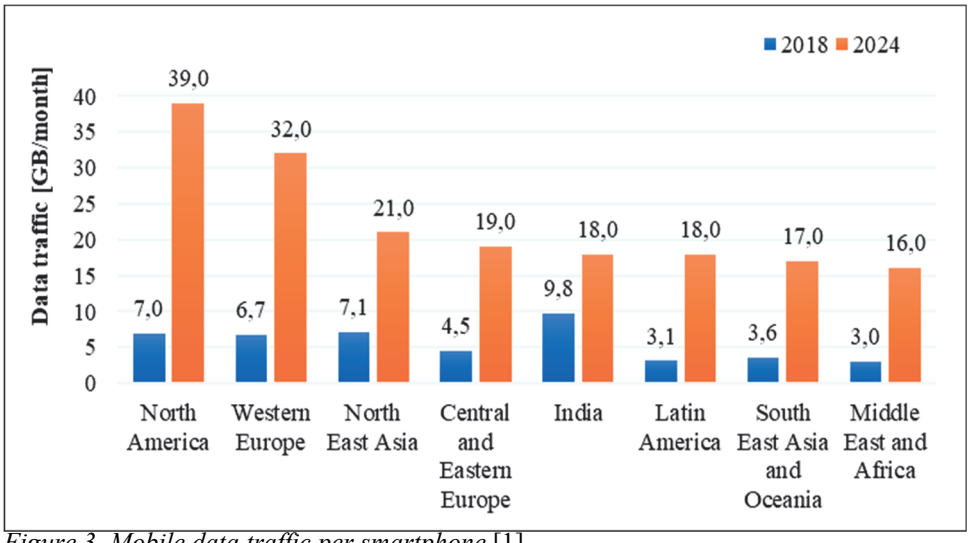

Figure 3. Mobile data traffic per smartphone [1]

In 2024, traffic generated by smartphones is projected to be 95% of total mobile data traffic [17].

4. Measurement: applications, methodology and results

This paper analyses the amounts of data traffic generated by popular instant messaging applications (WhatsApp, Viber and Messenger) when sharing a one-minute video file between two smartphones. Based on the results of applications for measuring the amount of generated data traffic, similarities/differences in data traffic generation of instant messaging applications will be presented.

4.1 Measurement applications

Methods and elements of telecommunication networks that allow measuring of smartphone generated data traffic have been described in detail in researches [9], [10] and [18]. Research [18] explains in detail the advantages of measuring data traffic on the device itself (handset-based measurement). The authors indicate that measurement on the device itself shows a number of advantages such as very good accuracy of measurement, quantitative and qualitative types of data that are collected, a wide variety of questions, etc.

It should be emphasised that measuring of generated data traffic on the device itself enables the display of data traffic generated by the access to mobile and Wi-Fi networks. This then realizes the actual results that cannot be realised by other methods of measurement, regarding their method of measuring. Third party applications for the management of the generated data traffic of the device can be subsequently downloaded directly on the device, with the same functionalities: mobile and Wi-Fi measurement, application details, reporting, alerts etc.

Given the large number of data traffic measurement applications available within the Google Play Store, the authors of this paper performed a detailed analysis of research needs and measurement capabilities of individual applications. In doing so, the main criteria required that the application provide the following:

- measurement of data traffic generated by mobile networks
- measurement of data traffic generated by Wi-Fi networks
- analysis of the data traffic generated by each application
- resetting the counter for multiple measurements (clear history)

In accordance with the above criteria, and after the analysis, Glasswire and 3G Watchdog applications were selected, with the specifications available in table 1 and the measurement details seen below.

4.2 Research measurement methodology

The goal of the research in this paper is to identify similarities/differences in data traffic generation for applications WhatsApp, Viber, and Messenger when sharing a one-minute video file. Smartphones and applications were used in the measurement according to the specifications seen in Table 1.

Table 1. Devices and applications used for the measurement

Unit	Specifications
Smartphone A	Samsung Galaxy S8+ (SM-G955F), Android 9.0
Smartphone B	Samsung Galaxy S9+ (SM-G965F), Android 9.0
WhatsApp	WhatsApp Messenger, Version 2.19.291
Viber	Rakuten Viber, Version 11.7.0.5
Messenger	Facebook Messenger, Version 238.0.0.14.120
3G Watchdog	3G Watchdog – Data usage, Version 0.44.4
Glasswire	Glasswire Mobile, Version 2.0.324r
Video file	MP4 file, 1:00 minute, Resolution: 640x360, Size: 5590 KB

The methodology for measuring data traffic included activities aimed at providing the same measurement conditions so that the external (additional) conditions would not affect the obtained results. The measurement involved the process of sending a video file from one smartphone to another, in one and the other direction of communication. In each measurement process, the methodology included the following activities:

- a video file uploaded to the device sending it
- video file is not located on the receiving device
- deactivation of all processes/applications on both devices except video sending/receiving application
- reset the data traffic counter to zero (for measurement applications)
- network activation (mobile or Wi-Fi) just before the video file is sent

In order to carry out the validation of the measurements, the research is using two applications for measuring the generated data traffic: Glasswire and 3G Watchdog. Confirmation of the measurement validation is the fact that the measurement results obtained through both applications were having identical values, which is shown in Table 2 as a single result.

Table 2. Generated data traffic of used applications via mobile/Wi-Fi network

Direction	Mobile/Wi-Fi generated data traffic [MB]					
	Smartphone A			Smartphone B		
	WhatsApp	Viber	Messenger	WhatsApp	Viber	Messenger
Smartphone A to Smartphone B	5.9	5.9	16	5.8	5.8	9.7
Smartphone B to Smartphone A	5.8	5.8	9.7	5.9	5.9	16

Table 2 shows the results of measurement of the data traffic generated by instant messaging applications WhatsApp, Viber, and Messenger when exchanging a one-minute video file.

5. Discussion of results

Research results present a few facts regarding used applications and generated data traffic. Measurements in this paper were performed separately: (1) by access to mobile and (2) by access to Wi-Fi network. Given the measurement results shown in table 2, the generation of data traffic of used instant messaging applications does not depend on the type of access network, i.e. the results are identical regardless of whether the video file transfer was performed using a mobile or Wi-Fi network.

The results of the research show that, regardless of the application and device used, the amount of generated data traffic is higher for the device sending the file than the device receiving the same video file, which is visible in Fig. 4.

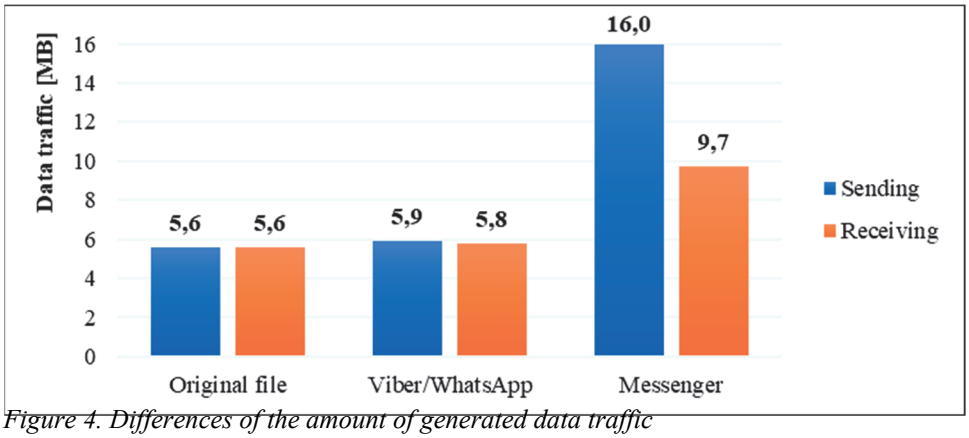

Figure 4. Differences of the amount of generated data traffic

The significant results obtained from the measurements relate to a comparative analysis of the generated data traffic of WhatsApp, Viber and Messenger applications. The measurements show that WhatsApp and Viber in all cases generate identical amounts of data traffic, both concerning sending and receiving video file.

There are differences generated data traffic using the application in relation to the data traffic of the original video file (table 3). The big difference and percentage of change in generated data traffic is related to the Messenger application. The percentage of change is 185.71% increase when sending and 73.21% increase when receiving a video file by Messenger application in relation to the data traffic of the original video file.

Table 2. Generated data traffic of used applications via mobile/Wi-Fi network

	Original file [MB]	**WhatsApp/ Viber [MB]**	**Difference 1 [%]**	**Messenger [MB]**	**Difference 2 [%]**
Sending	5.6	+ 0.3	+ 5.36	+ 10.1	+ 185.7
Receiving	5.6	+ 0.2	+ 3.57	+ 3.9	+ 73.21

The reasons for the increase in generated data traffic, especially from the point of view of the Messenger application, will be the subject of further research in this area.

6. Conclusion

Mobile voice, data and video services are becoming an integral part of users' lives. The bandwidth demand for data and video content continues to increase, and next few years have to involve in adoption of mobile video. Mobile operators need to prepare for the impact which video has on their networks.

The next few years will be important for operators and service providers to plan future network deployments regarding characteristics of the smartphone users and their usage of applications. Video sharing and high data transfer rates also mean higher amounts of generated mobile data traffic.

Analysing more deeply the trends and making decisions by using the insight into the data on the users and applications, the operators have the opportunity of using more efficiently the total demand for data traffic.

This research gives a new perspective on smartphone generated data traffic at the application level. The measurement results prove that data traffic generation largely involves an application that participates in video sharing.

The main contributions of this paper are as follows: (1) generated data traffic of instant messaging applications (WhatsApp, Viber and Messenger) does not depend on the type of access network; (2) measurement results of applications for measuring generated data traffic (Glasswire and 3G Watchdog) are identical; (3) the amount of data traffic generated on the device sending the video file is higher than the device receiving the video file; (4) applications WhatsApp and Viber generate identical amounts of data traffic when transferring a video file; (5) application Messenger generates significantly more data traffic

This research has made an important step towards the analysis of smartphone generated data traffic involving popular instant messaging applications for the exchange of a video file.

Mobile network operators, based on the available results can realise some additional factors regarding quantities of the data traffic that are generated by using mobile and Wi-Fi networks. If the operators have the possibility of understanding the differences in using various applications by their users, they can use the mentioned insights for the construction of the user targeted proposals. For instance, for the construction of dedicated tariff plans for popular applications which do not generate high amounts of data traffic for the same content.

This research opens up a new area on the measurement and analysis of smartphone generated data traffic at the application level. In order to optimise the business of mobile operators and service providers regarding subscriber's access to mobile and Wi-Fi networks, difference of various smartphone applications in generating data traffic for the same content should be analysed.

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Rezime: *Saobraćaj podataka generisan od strane pametnih telefona sledi trend rapidnog rasta koji je primarno podstaknut istovremenim povećanjem broja pametnih telefona i sve većim obimom generisanog saobraćaja pojedinačnih uređaja. Saobraćaj generisan videozapisima predstavlja dominantan vid saobraćaja podataka, a predviđa se da će u sledećih nekoliko godina više od 80% saobraćaja podataka biti vezano uz video. S druge strane, dominantan segment komunikacije ostvaruje se putem instant messaging aplikacija, kao što su WhatsApp, Viber i Messenger. Iste se sve više koriste i za prenos video zapisa u međusobnoj komunikaciji korisnika. U ovom radu analizira se obim saobraćaja podataka generisan od strane popularnih instant messaging aplikacija pri razmeni video zapisa u trajanju od jednog minuta. Biće ustanovljene sličnosti/razlike u generisanju saobraćaja podataka instant messaging aplikacija na temelju dobijenih rezultata različitih aplikacija za merenje obima generisanog saobraćaja podataka.*

Ključne reči: *pametni telefon, saobraćaj podataka, video, merenje, aplikacije*

WHATSAPP, VIBER I MESSENGER: KOMPARATIVNA ANALIZA SAOBRAĆAJA PODATAKA GENERISANOG RAZMENOM DATOTEKE VIDEO ZAPISA

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