DATA TRAFFIC PATTERNS ON URBAN RESIDENTIAL WIFI DURING THE COVID-19 PANDEMIC IN INDONESIA

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ABSTRACT: The COVID-19 pandemic has hit all over the world, including Indonesia. The Indonesian government has adopted a policy in the form of Large-Scale Social Restrictions. Implementation is in the form of rules for carrying out activities from home, both work and school activities. Problems that arise to support online activities require data traffic. The Indonesian government needs accurate information about data traffic consumption patterns to support online activities. The purpose and objective of this study was to measure changes in data traffic usage patterns during the COVID-19 pandemic. We measure data on Residential Wi-Fi, which Indonesians widely use. Our method by observed 100 randomly selected clients. The contribution of this study is the amount of data traffic measured on Residential Wi-Fi during the COVID-19 pandemic in Indonesia. The average data usage per day before the COVID-19 pandemic was 35.13 M-Byte. During the pandemic 40.41 M-Byte per day. So, the COVID-19 pandemic experienced a 15.01 percent increase in data traffic. Our findings are that 30% of Residential Wi-Fi subscribers unsubscribe. The survey shows that 68% unsubscribed due to switching to an authorized ISP service with fiber optic access that offers high speed.

KEYWORDS: *Wi-Fi Offloading; Work from Home; Traffic Data; Internet; COVID-19.*

1.0 INTRODUCTION

The COVID-19 pandemic has hit the whole world. In Depok City, in February 2020, this virus was detected. In March 2020, a massive number of COVID-19 sufferers emerged. In the Government of the Republic of Indonesia, in mid-April 2020, a policy of restricting population mobility was implemented. All public activities in public places have been suspended, including school workers and students [1]–[3].

Information about the COVID-19 pandemic spread on television that started in China. This condition makes residents even more afraid, especially to permit small children or students to leave the house. They work from home according to the directives imposed by the Indonesian government. At the beginning of the COVID-19 pandemic, several countries implemented lockdown policies [4]. The Government of the Republic of Indonesia does not implement a lockdown policy. The rules issued are in the form of Large-Scale Social Restrictions. This policy regulates mobility. This mobility restriction regulation gave birth to several rules. Public sector workers are required to carry out work activities from home. This rule is also applied to the entire process of implementing school education activities. Students from kindergarten, elementary school to college use online learning. Work and school activities are carried out online to support the work-from-home policy. This activity requires sufficient data traffic. Furthermore, this is the problem faced by the Indonesian people in the early days of the COVID-19 pandemic.

According to an article released by Cisco in 2018, Indonesia was the country with the highest data traffic growth in the world. Indonesia's data traffic growth reached 142%. Cisco predicts 8.3 billion mobile communications and 3.3 billion machine-to-machine communications by 2021[5]. The growing demand for data traffic will not be able to be served by existing cellular phone operators. The technology will certainly not be able to serve data traffic needs. The solution to this problem is to take advantage of Wi-Fi [6]. Switching mobile phone subscriber data communications to a Wi-Fi network is called Wi-Fi Offloading [7], [8].

The problem in this study is the impact of government regulations of the Republic of Indonesia to implement Large-Scale Social Restrictions requiring all work and school activities to be carried out online. This

regulation changes the need for data traffic for online activities. The need for data traffic is the most crucial problem in Indonesia. The online system is supported by the lack of existing data communication infrastructure. Meanwhile, the data quota provided by cellular phone operators is expensive.

A Residential Wi-Fi was created to overcome the high cost of data traffic from cellular operators or internet service providers (ISP) [9]. A residential ISP is an extension of the official ISP[10], [11]. This study aims to measure the characteristics of Residential Wi-Fi customer data traffic. We will observe the data traffic profile before and at the beginning of the COVID-19 pandemic.

The expected result of this research is the profile of data traffic needs. This profile is expected to provide information for stakeholders in making decisions. The novelty and technological breakthrough in this research are that there is no measurement of data traffic after the implementation of WFH in Indonesia using Augmented Wi-Fi. The current research uses data from mobile operators. Government regulations for subsidizing suitable data traffic needs provide a solution during the COVID-19 pandemic in Indonesia.

2.0 METHOD

According to the APJII report, most of Indonesia's population are cellular phone subscribers. They can access the data through the telephone operator. It is noted that some residents subscribe to data access other than cellular phone operators [12]. Subscribe to data traffic services using ISPs with various accesses. Some use fiber optics or radio broadband. In addition to this access, there is also augmented Wi-Fi. This access is known as the village neighborhood and territory association (RT/RW)[9], [10], [13]. We call it Residential Wi-Fi. Figure 1 illustrates the topology of a Residential Wi-Fi network [11].

Residential Wi-Fi operators, we call Residential Internet Service Providers (R-ISP) [10]. Residential Wi-Fi is widely used in housing in Indonesia. This provider is the choice because it provides much cheaper services than the existing official ISPs. Residential ISP is an additional technique of Wi-Fi networking using radio access. Data traffic speed quota is set by proxy by the provider. The service provided is in the form of unlimited access with a speed of 1 Mbps.

However, the traffic is congested at certain hours, and the speed will adjust accordingly.

When a cellular phone subscriber diverts data traffic to a Wi-Fi network, it is called Wi-Fi Offloading. Wi-Fi Offloading needs to be done for various reasons such as battery power efficiency on smartphones, costs, and technical reasons such as Radio Signal Strength [15]. Figure 2. shows the basic architecture of Wi-Fi offloading [17].

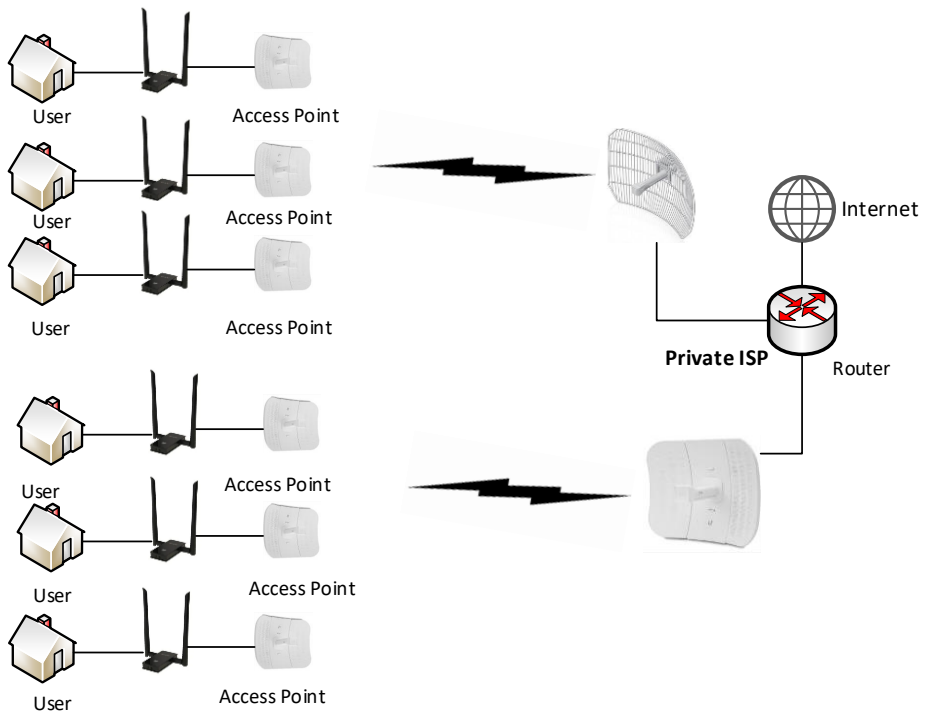

Figure 1: Residential Wi-FI network topology [14]

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Residential Wi-Fi development started with sharing Wi-Fi access with neighbors around the house. Over time, many neighbors are asking for Wi-Fi access. Start development with one server for data management. In the end, the number of subscribers reached more than 1,000 subscribers. The server, as a workstation, functions as a controller of all Wi-Fi activities. Good server management can monitor all problems in the network, optimize, maintain network security, and finally manage costs [18].

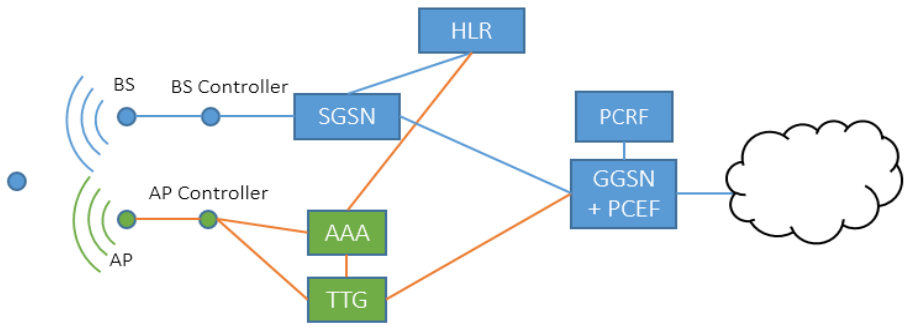

Figure 2: Architecture detail Wi-Fi Offloading

The research location is in an urban area. We chose the location in Citra Indah City, Jonggol, Bogor Regency. In this residential area, there are about 100,000 housing units. The number of Residential Wi-Fi subscribers is more than 2,500. Figure 3 shows the location photo of the research from google earth.

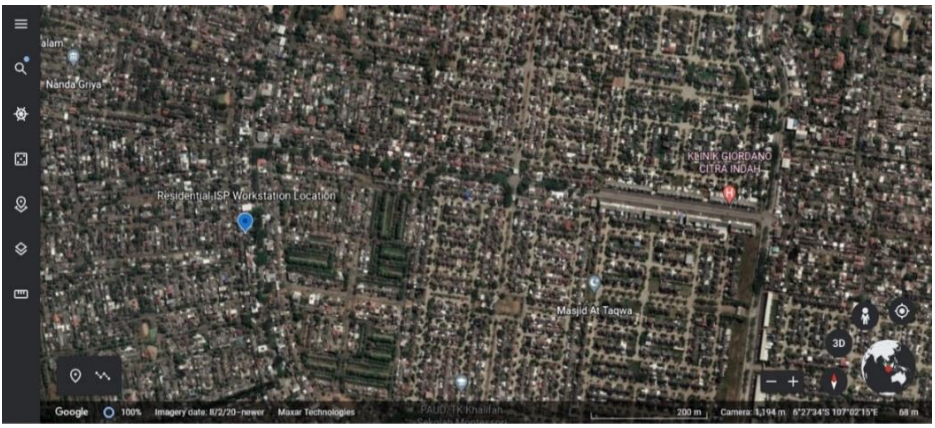

Figure 3: The research location is from google earth

In this study, we observe all data traffic activities that exist for each user. Our observations are in the form of the amount of data accessed. We divide the amount of data uploaded and downloaded [19]. Our following observation covers the apps accessed. Accessed applications can be classified based on the IP accessed to obtain this data [20].

Deep Packet Inspection (DPI) software can monitor all client activities [21]. Figure 4 is an example of a wireless client history display. The history can be displayed as date/time, which displays the date and time connected, duration displays the duration of being connected to the network, and down/up, which is the amount of data downloaded or uploaded. DPI information can be enabled to monitor applications accessed by each client. The application will display the name of the accessed application, with the amount of data downloaded in bytes. Figure 5 shows the reading of the application accessed by the client.

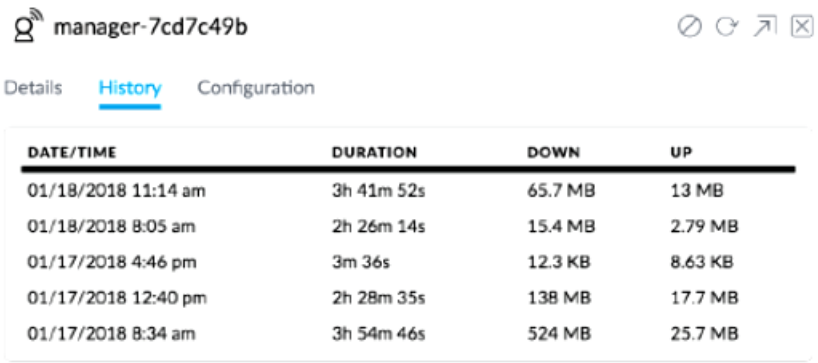

Figure 4: Wireless client history

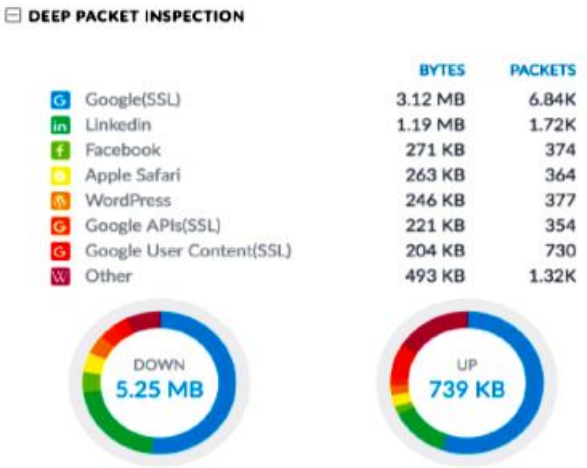

Figure 5: The Deep Packet Inspection information

In the Wi-Fi server, the manager can monitor the total data usage used for upload and download [22]. Wi-Fi Manager can monitor the total data traffic within a certain desired period. The monitoring process is carried out through the accessed IP address that is being accessed [23], [24]. Because this monitor is private, it must be allowed by the client.

Table 1 shows examples of IP addresses for some applications. Various tools can monitor the network and determine which applications are freeware and paid. In this study, permission is needed for volunteers to monitor the most accessed applications.

Table 1: The IP address of several applications used

No	Application	IP Address
1	Whatsapp	69.171.250.60
2	Youtube	172.217.194.190
3	Facebook	69.171.250.35
4	Zoom.us/meeting	3.235.71.132
5	Classroom	74.125.24.83

3.0 RESULT AND DISCUSSION

On March 31, 2020, the government of the Republic of Indonesia announced the implementation of WFH. WFH is the implementation of regulations for the implementation of large-scale social restrictions. The initial data we took was the use of data in the month prior to the COVID-19 pandemic. We collected data for the period December 2019 to March 2020. Next, we observed data traffic at the beginning of the pandemic in April and May 2020.

We did not observe the months of June and July because some schools have long holidays in that month. Our observational data Table 2. From Table 2, we can display it in a graph illustrated in Figure 6. From Figure 6, there was a significant increase in data precisely in March 2020 it can be seen. In March 2020, the COVID pandemic was an issue in Indonesia. In April and May, data usage increased compared to the average before the pandemic. The period of WFH in Indonesia is mid-April. If we average four months before April 1.07 TByte and compare it with the data used in April and May 1.23 GByte, there is an increase of 14.85%.

Table 2: The table of the results of the month's traffic measurement

Period	Upload (TByte)	Download (TByte)	Total (TByte)
December 2019	0,13	0,82	0,94
January 2020	0,13	0,84	0,96
February 2020	0,16	0,79	0,94
March 2020	0,16	1,28	1,44
April 2020	0,16	1,06	1,22
May 2020	0,17	1,08	1,24

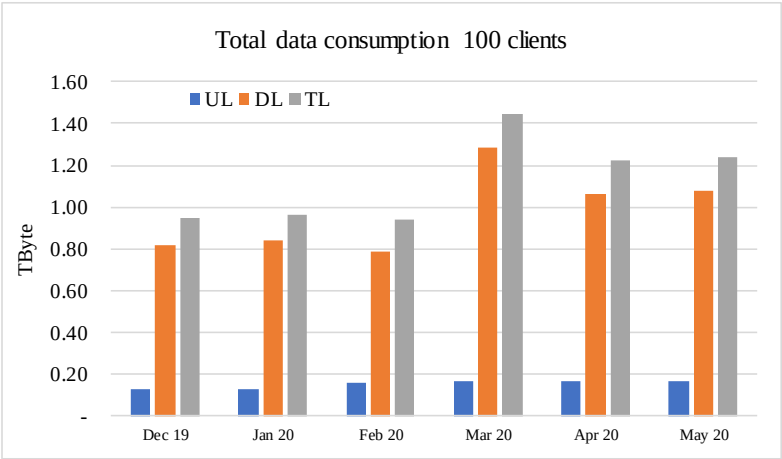

Figure 6: Graph of the average monthly data traffic usage

Table 3 shows the calculation of the average daily data usage. Figure 7 is a graphic display of the average daily data. The graph provides an overview of the average daily data usage for the six months of observation. Figure 7 shows the Wi-Fi client's average daily data consumption.

Table 3: Table of average data usage each day

Periode	Upload (Mbyte)	Download (Mbyte)	Total (Mbyte)
December 2019	4,06	26,37	30,44
January 2020	4,04	26,98	31,02
February 2020	5,39	27,09	32,48
March 2020	5,24	41,36	46,60
April 2020	5,46	35,33	40,79
May 2020	5,32	34,70	40,03

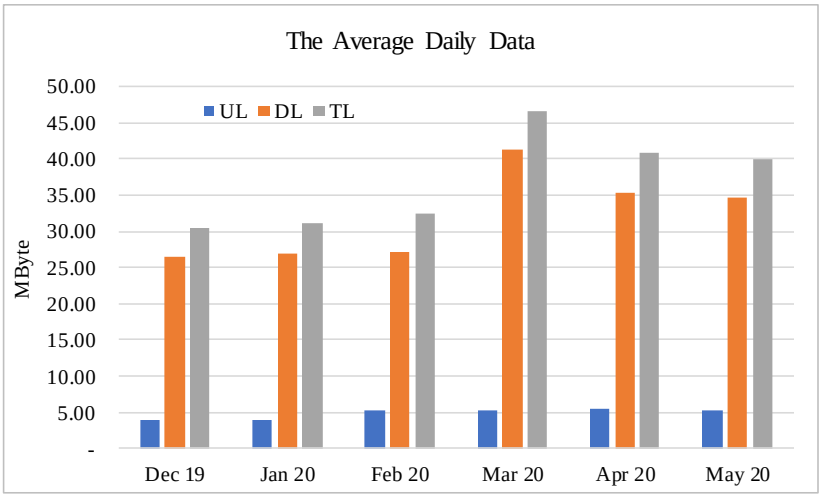

Figure 7: Graph of average daily internet data traffic

Average data usage per day before the COVID-19 pandemic was 35.13 MByte. During the pandemic 40.41 MByte per day. So, the COVID-19 pandemic experienced a 15.01 percent increase in data traffic. Based on DPI, the apps consume the most data we collect. The application that consumes the most data is YouTube. The data reached 29% and was followed by other applications. We sorted the applications based on the ranking of data size in Table 4.

Table 4: Graph of applications used before WFM

APPLICATION	VALUE (%)
Youtube	29,72
Whatsapp	20,23
Facebook	19,09
Instagram	4,54
Others	26,42

Schools began to carry out online activities during the work-from-home period in mid-April and May. Based on the survey, the online meeting application is still unknown to workers or students. The primary communication used in communication is Whatsapp. After that, the Google Meeting and Zoom Meeting applications began to be used. Table 5 shows that this application is included in the order of applications that consume data.

Table 5: Applications accessed by users

APPLICATION	VALUE (%)
Youtube	30,39
Whatsapp	20,23
Facebook	7,59
Instagram	4,54
Zoom meeting	8,91
Google Meet	7,90
Others	20,44

After about a month of the implementation of the work-from-home regulation, almost 30% of its subscribers stopped their subscriptions. Based on a survey conducted on 100 users who unsubscribed due to switching to an ISP that offers higher speed with network access using fiber optic to their homes. The number of customers who switched to fiber optic providers reached 68%. Subscriptions with fiber optic access are up to 4 times more expensive than Residential Wi-Fi. However, some other reasons are because they stop working 24% and cannot continue subscribing anymore. Moreover, the remaining 8% unsubscribed without giving a reason. The COVID-19 pandemic in Indonesia has dramatically affected people's lives, especially the lower middle class.

4.0 CONCLUSION

The regulation of work from home resulted in an increase in internet data traffic by 14.85%. The YouTube application is the most accessed application. This application experienced an increase during the COVID-19 Pandemic from 29.72% to 30.39%. The list of applications that appeared during the Pandemic is online meeting applications. Zoom meeting 8.91%, and Google Meeting 7.90%. Impact Within two months of the COVID-19 Pandemic, the number of Residential clients was reduced by 30%. The main reason for unsubscribing is the low data traffic rate. The total reached 68% and switched to ISPs with fiber optic access.

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