Analysis and solutions of traffic shift on 4G networks in the campus environment during the Covid-19 pandemic

N A Salim, V N Sulistyawan and F T Intan

Electrical Engineering, Faculty of Engineering, Universitas Negeri Semarang, Gedung E11, Kampus Sekaran, Semarang 50229, Indonesia

nurazissalim@mail.unnes.ac.id

Abstract. The monitoring and management of Internet data traffic is an important requirement to be used and interpreted as a resource to make informed network management decisions. At the time of the covid-19 pandemic there was significant internet traffic changed caused by most of the students who returned home because of home-based lecture policies. Earlier Internet traffic that was in offices, college areas, schools and public places was so high even tended to overload. However, at present Internet traffic shifts to residential or residential areas. However, currently internet traffic is shifting to this problem, the telecommunications operator to do optimization to reduce expenses due to decreased income in the area around the campus. Optimization is done by dynamic carrier shut down, one carrier will be turned off if its utilization is lower than a predetermined threshold.

1. Introduction

On January 30, 2020, who announced a new strain of virus called corona virus (covid-19). Since first announced, the covid-19 virus has kept 213 countries in the world currently confirmed infected with the virus. This is due to the rapid spread of a covid-19 so massive. As a result, billions of people are encouraged or compelled by governments to stay in their homes to reduce the spread of the virus. The coronavirus (COVID-19) outbreak is causing widespread concern and economic hardship for consumers, businesses and communities across the globe [1]. These measures change major habits of the global population, which now depend on homegrown Internet connectivity for jobs, education, social interaction, and entertainment. The decline in traffic certainly affected the income of telecommunications carriers, especially on the cell-cell covers an area around the campus.

Changes in Internet user behavior are common, but they are usually gradual and over a long period of time. Changes in Internet user behavior are common, but they are usually gradual and over a long period of time [2]. Data traffic's growth is also increasing daily, and demand for good networking capacity and quality becomes an intolerable need. In the pre-covid-19 pandemic nearly all cell-cell 4G had high altitude traffic utilizations especially in the college area but by the time the covid-19 pandemic swept across the country, the region around the campus was drastically reduced because the lecture was being made from home to reduce the covid-19 epidemic outbreaks. The graveyard system changes during the pandemic made most of the normal students living around the campus return to their own homes, which led to a significant decline in traffic. The decline in traffic certainly affected the income of telecommunication carriers, especially on the cell-cell covers an area around the campus. The system changes during the pandemic made most of the normal students living around the
campus return to their own homes, which led to a significant decline in traffic. In the sectors of cellular networks or telecommunications networks, the issue of energy consumption has come to attention [3].

To address the problem of this unexpected phenomenon, the telecommunications operator needs to have an opticum to reduce expenditures, as the market for the region is declining. One way that optics can be done is by nodes sleep [4], which step is made by nodes sleep. Strategies to shut down nodes sleep can suppress the use of electricity or consumption [5], with a reduced use of electricity expected to keep the operator down. This needs to be done in the face of the collapse of the cooks around the campus area. The above effort is also expected to extend life from mobile telecommunications networks and increase operator profit [6].

Weight-adaptive network operation is a promising opportunity to improve the energy efficiency of telecommunications networks. In addition to the adaptation of the load elements of telecommunications network as well as the supporting headquarters equipment such as the power supply unbroken and essential to the energy efficiency of the web site as a whole. Such efforts greatly increase the energy efficiency of web sites in terms of the overall adaptive operating regime of telecommunications networks [7]. Power-efficient modes can be extended from minute to hour, and are particularly effective in reducing power consumption. This form of power reduction reduces the power consumed, as well as the heat emanating from the radio. The challenge of turning off the radio is to wake him up. Waking up the radio might not be instant; Radio designers, therefore, need to reduce the impact of latency and tissue disorders [8]. Another method of power consumption is the dynamic carrier shut down. To run the activity on this paper would be more focused on tuning the parameters, as it is easier and more practical to conduct the experiment.

2. Methodology

2.1 Research Mode

Contrary to the problem and the purpose of the research, the method used in this study is the library study method by taking a statistical reporting data that has been processed by the relevant vendor

2.2 Research Tools

The research tool in question is the tool used to collect the needed data in the study, analyze the data, and execute the changes in parameters for which the experiment would be experimented. Fossilized data obtained from raw data and will need to be reworked using Microsoft excel and make graphs.

2.3 Dynamic Carrier Shut Down

In MIMO mode, the carrier for a cell is transferred through different transmission channels. When no traffic is on the cell, the carrier can be switched off on part of transmission channels. In this way, the power consumption of the eNodeB in empty load mode is decreased. When there is traffic, the carrier can be switched on automatically to have the cell run normally again. Without load, the eNodeB can switch off carrier on some transmit channels to reduce the power consumption of the eNodeB. An eNodeB in the LTE system is usually configured with two or four antennas. The traffic in the cell varies by time. In some certain periods, for example, from the midnight to the early morning (operators can customize the periods), there is no traffic. When the idle status is detected by the eNodeB, it switched off the carrier on one transmission channel (if there are two transmission channels) or on two transmission channels (if there are four transmission channels) to decrease the power consumption. When a UE accesses the cell or the periods end, the eNodeB can automatically switch on the carrier that is switched off. Then, the cell recovers to the normal state and continues with services. The service quality of the cell is not affected [9].
2.4 Key Performance Indicator
The KPI value attainments are obtained using a statistical report back on the vendor that has been processed \[10\], the KPI seen and analyzed on this study are as in Figure 1.
1. 4G user: average number of users using 4G network in both bands 1800 and 2100
2. 4G Total Traffic Downlink/Uplink (GB): Sum of downlink and uplink traffic
3. 4G DL Average Throughput (MB/s): The average Throughput is the amount of a product or service that a company can produce and deliver to a client within a specified period of time
4. 4G No Radio Resource: Number user fail to establish due to RRC (traffic increase)
5. Adaptive Power Consumption: Adaptive Power Adjustment and eNodeB regular time shutdown and startup

![Figure 1. OOS and Database Engineer](image)

2.5 Research Zone
In this research the plan is to optimize the parameters of cluster XXX with nine site sites, which is categorized as sub-urban, as revealed in Figure 2.

![Figure 2. Research Area (mini cluster)](image)
2.6 *Pra Implementation and Optical Implementation*

At the pre-implementation stage there is a determining of what parameters to change and a record of the current conditions before implementation is made. The parameters that will be changed cover the idle/cell reselection & handover control parameters. All the detailed parameters that will be altered are detailed in anticipation of a possible fallback step if there is collateral damage or an unexpected performance degradation after the parameters change execution. The next step is to prepare the script for the execution process, both the fallback script and the fallback script.

Implementation of the above strategy was made with the hope of increasing network performance (key indicator). This strategy begins with a pick or cluster which will be made a place for implementation, as will a gradual implementation time. The Figure 3 below shows a diagram of the flow of implementation process and optics from beginning to end. This process includes: data collection (cell and cluster), changes in parameters and scripts, implementation execution, analysis and optimization, and oss monitoring, as given in Figure 3.

![Figure 3. Study Channel Diagram](image)

3. **Result and Analysis**

4G users as shown in Figure 4 experienced a decrease in comparison on day 15 to day 21 compared to day 36 to day 42 (coinciding with the start of learning from home). The decline in 4G users reached 1300 users or around 46% as illustrated in Figure 4.
Figure 4. 4G User

4G total downlink/uplink Traffic (GB) as shown in figure 5 also experienced a decrease compared to day 15 to day 21 compared to day 36 to day 42. Decreased 4G total traffic downlink / uplink (GB) reached 45 GB or about 36%. Traffic is obtained from the number of downlink traffic plus uplink traffic as described in Figure 5.

Figure 5. 4G Total Traffic Downlink/Uplink (GB)

On the other hand, 4G DL Average Throughput (MB/s) as shown in figure 6 has increased by comparison on the 15th to the 21st day compared to the 36th to the 42nd day due to a decrease in the number in $G DL Average Throughput (MB/s) reaching 6 MB/s or around 47%.
The number of 4G no radio resources as shown in figure 7 has decreased by comparison on the 15th to the 21st day compared to the 36th day to the 42nd day in line with the decrease in the number of users and traffic.

Active carrier (%) vs Power Consumption (kWh) as show in figure 8 decreased since day 47, this has happened since the implementation of the dynamic carrier shutdown feature.
4. Conclusion

Despite the covid-19 interference, it caused a shift in traffic that was significant enough, resulting in income declining as well. The only way to get used to this problem is with the dynamic carrier shut down. Implementation can also be applied in areas that have similar user profiles and traffic.

Reference

[1] Lawley M J and Wagner J 2021 COVID-19 and the Telecommunications Industry https://www.pwc.com/us/en/library/covid-19/telecommunication-impact.html
[2] Adekitan A I and Awosope C O A 2020 Indonesian Journal of Electrical Engineering and Computer Science 17 1442-52
[3] Wijanarko H 2016 Jurnal Integrasi 8 68-73
[4] Lee R, Pinner D, Somers K and Tunuguntla S 2020 The Case for Committing To Greener Telecom Networks https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-case-for-committing-to-greener-telecom-networks?curator=TechREDEF
[5] Eramo V, Hesselbach-Serra X and Luo Y 2014 Journal of Electrical and Computer Engineering 2014 1–2
[6] Anonymous 2021 Despite the challenge of competition and COVID-19 pandemic XL axiata achieved solid growth in 2020 https://www.xlaxiata.co.id/en/news/xlaxiata-pandemic-challenge-and-competition
[7] Vereecken W, Deboosere L, Colle D, Vermeulen B and Pickavet M 2008 13th European Conference on Networks and Optical Communications p 44-51
[8] Feldmann A, Gasser O, Lichtblau F, Pujol E, Poese I, Dietzel C, Wagner D, Wichthuber M, Tapiador J, Vallina-Rodriguez N, Hohlfeld O and Smaragdakis G 2021 Communications of the ACM 64 101-108
[9] Narmanlioglu O and Zeydan E 2018 IEEE Access 6 65405–17
[10] Bhatti M I, Awan H M and Razaq Z 2014 Quality & Quantity 48 3127–43