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An Analysis of Internet Traffic Behaviour During Movement Control Order (MCO): Case Study of University College TATI

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ABSTRACT

The COVID-19 pandemic prompted the implementation of stringent measures to halt the infection's spread. People's behaviors were changed by social distance and lockdown measures, while the Internet became a significant support for remote working, e-teaching, online collaboration, gaming, video streaming, and other activities. All these abrupt developments have put an unprecedented amount of strain on the network. The impact of lockdown enforcement on the UC TATI internet traffic is examined in this article. We present a picture of how the pandemic affected UC TATI network traffic in this article. The use of remote working and collaboration tools is our primary priority. Overall, this paper gives a picture of the rapid changes in campus traffic as a result of COVID-19 and modeling a better traffic pattern to show resilient in effectively coping with obstacles while keeping university operations running.

1.0 Introduction

Covid 19 has been announce as pandemic by World Health Organization (WHO) since 2020. This pandemic has its first outbreak between late 2019 and early 2020 in China. Until now, COVID-19 pandemic has had a massive impact on people's lives and habits. The need to maintain social distance and the implementation of lockdown measures to prevent the spread of the virus resulted in a shift in the production and delivery of a variety of services. Increased use of home delivery services, a move to online lessons, and the use of remote working solutions are just a few examples. People's mobility was limited by restrictions, but remote working, e-learning, and online collaboration platforms, as well as online leisure options like as gaming and video streaming, began to flourish. These new habits highlighted the fundamental role of the Internet. Correspondingly, Internet traffic volume has grown by about 40%, sometimes with a decrease in the download performance, questioning the resiliency of the Internet itself (Gember, et al, 2011 & S. Wu, et al, 2016).

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University College TATI (UCTATI) is a private university located in Teluk Kalong, Kemaman, Terengganu, Malaysia. It was established in 1993 with several times of changes to its name such as Terengganu Advanced Technical Institute (TATI) and TATI University College. UC TATI has been continuously providing excellent services for students in terms of diverse study options, relevant curriculum and teaching methods, ongoing partnerships with leading universities worldwide, strong industry linkages, up-to-date facilities and well-equipped campuses. Among the areas of courses offered by UCTATI including engineering computer graphic, computer network, IT and management technology with more than 20 courses is offered ranging from diploma to PhD.

Network traffic in an organization is one of the criteria that need to be planned and monitored to optimize the benefit of the network. Most of the network administrators see this task as a routine and always seek monitoring software to assist them. Among the popular software are Sangfor IAM, Dynatrace, Nagios XI and others. Some of this software are free and some need to be paid. In a university, this task is critical since all the people are using Internet for their educational purposes such as research, teaching and learning, meeting as well as online seminar and conference. However, since pandemic Covid-19 hit the world in 2020, more students and staff in university did not use the Internet as they are encouraged to work and study from home. This situation brings a common question on the internet usage pattern during the Movement Control Order (MCO). It is interesting to know the internet usage status during MCO because that information could be useful for network administrators to plan and execute more plan saving for network services. Moreover, they could propose to the management a new model of network traffic for the future as university now is moving forward for online class such as Massive Open Online Course (MOOC).

The present study analyzes the internet traffic model and its statistical parameters and investigates the traffic patterns to determine the user's behavior like number of users, protocols mix, and applications traffics, etc. in network of educational institution using traffic recorded in duration of one week. There are many features and criteria to make a successful of network usage in university. Regarding to Abdullah (2012), the result that collected from network in the university can be analyze and need to be taken into consideration by the developer, administrators, and users. Therefore, understanding the analysis of traffic behavior helps in managing the network. It helps the team in computer centers of educational institution to carry out maintenance through the comprehension of usage patterns and student's behavior. Thus, in this study, we dig deep on performance of Internet traffic in UC TATI during the Movement Control Order (MCO) to model the best traffic distribution for user and application. The findings will assist in creating an effective model of network behavior as in reality; there is a lack of real characterization of user activity in a network activity. This paper discusses the traffic pattern of internet usage in UC TATI in terms of applications used to provide a clear picture on the comparison of internet usage before and during MCO.

In terms of network infastructure, UC TATI has a local area network that could support all the IT activities and services. It uses the latest technologies of LAN including fiber optic and UTP cat6 as well as wireless connectivity to connect each others in the network.

Next section discusses related literature review followed by results and discussions. The conclusion is presented in the last section.

2.0 Literature Review

2.1 Internet in Education

In this millennium era, the Internet plays pivotal roles in providing educational access. It has become a very crucial part for almost every college student. Kononov & Chiang, 2015 in their research mention the majority of college students think that the Internet aids them in their studies by allowing them to conduct research and communicate with their

classmates and lecturer. Cooper, 2012 agree that in education, technological advancements contribute to various impacts on education. Investment on technology has been made by the universities. As we can see, nowadays universities actively promoting Internet usage in their education (Taherdoost, 2019).

Exploring the frequency and intensity of Internet usage among university students is also very important to understand the relationship between Internet usage and academic performances (Faris & Lestari, 2020). Several previous studies in Pakistan found that Internet usage had a positive influence on increasing marks, and reading, writing, as well as information processing skills (Taherdoost, 2019). Students who search for information online obtain better marks because they have access to more data sources and are, thus, better informed on the subject.

2.2 Network Measurement

The importance of network measurement lies in the observation and understanding of networks. There are various studies focusing on this topic, both in passive and active modes of measurement.

Abdullah et al. (2017) focus on performance of Internet traffic depending on user behavior and network performance in educational institutions. The findings observe that most bandwidths are consumed by the applications of social networks and UDP of user applications [1]. Moreover, the packet length between 80-159 bytes is very high and the throughput arrives at 25% of trafficson Sunday with the load being increased.

Lei et.al (2017) in their studies using real-world traffic data show that flow achieves comparable performance to representative techniques in traffic categorization while considerably decreasing the number of processed packets. It demonstrates that it is resilient to packet loss and the absence of flow direction. This classifier is capable of recognizing TCP mice flows with more precise.

Adeyemi (2018) presented a graph-based model of internet traffic that captures application interactions throughout the whole network. For a period of twelve months (January–December 2017), data investigation was conducted on everyday Internet data traffic generated on a smart university campus. The Internet data download and upload traffic at Covenant University in Nigeria was monitored and correctly logged for each day of the one-year research period utilizing the needed application software, which included FreeRADIUS, Radius Manager Web application, and Mikrotik Hotspot Manager. In a smart campus setting, the data is being utilised to properly anticipate Internet data flow. This data article's robust data investigation will assist university network managers in gaining helpful insights into traffic peak and off-peak hours.

Laboshin (2016) analyzed distributed cloud-computing framework based on the Big Data approach where both storage and computing resources can be scaled out to collect and process traffic from a large-scale network in a reasonable time. Their research has built a module for a FreeBSD networking subsystem that makes possible to intercept and log traffic that passes over a high-speed digital network in a hidden way when no changes to topology and configuration of other devices needed.

Khairunizam et al (2020) evaluate and analyze user behaviour pattern at Kolej Universiti Poly-Tech MARA (KUPTM) website using Google Analytics (GA) as one of the web analytic tools. The usage of web analytic tools such as Google Analytics has provided a better solution in measuring, analyzing, and identifying the traffic sources for a website.

2.3 Network Traffic Management Application

Dynamic updates are essential in today's network management for traffic engineering and fast reaction to security concerns. Such updates are based on network traffic monitoring to compute numerical values based on a range of network metrics. In this

section, it will be presented some of example of tools that can be used to analyze the network traffic commonly use in university.

Yuan et.al, (2017) used NetQRE to do quantitative network monitoring. By using a few lines of code, NetQRE can express a wide range of quantitative monitoring applications. It also can achieve line-rate throughput performance which is comparable to that of carefully hand-crafted optimized low-level code while significantly outperforms other measurement and IDS tools. It also can be used in an SDN setting to monitor network traffic and update switches in real-time in response to specified NetQRE policies.

Palúchová, (2020) use Matlab R2018b in monitoring model based on a selection of critical nodes in the network. The testing shows that with monitoring of 64% of all nodes in the network, it able to gain 86.7% knowledge of all network elements. In terms of artificial traffic, it proved the reduction of 15.7% - 57.4% of bandwidth consumption in simulated SDN topologies.

Yaseen et, al. (2020) design, understand and optimize a computer network that it is often useful to identify and rank common patterns in its usage over time. They used tpprof, a profiler for network traffic patterns. tpprof is built around two novel abstractions: network states, which capture an approximate snapshot of network link utilization and traffic pattern subsequences, which represent a finite-state automaton over a sequence of network states. This tool able to build user-centric profiling, visualization, and automation tools. tpprof is agnostic to the application set running over the network and can profile networks in site, making it an ideal fit for multi-tenant or transit networks. It also can do a profiling for several classic applications in order to demonstrate its utility.

2.4 Online Learning

Duwi Leksono Edy (2020) Online learning is a learning system that uses internet media as a learning model. Implementation of online learning activities using various media such as Webex, Google Zoom, Google Meet. During COVID 19, online learning was needed for the continuity of the learning process.

Wei Wang (2020), The emergence of COVID-19 has significantly changed the teaching environment of universities resulting in lots of studies on college students' online learning engagement and learning performance. most universities around the world have closed and switched to online teaching, as a result, the learning environments of students have changed dramatically

3.0 Methodology

For this study, two period of times have been used to compare network usage before and during MCO. 1 January 2020 till 29 Februari 2020 was selected for network usage before MCO and 1 Mac 2021 till 30 April 2021 as period for MCO at focus on office hours (7.00 AM till 5.00 PM). Justification of selection date and duration especially during MCO, 1 Mac 2021 till 30 April 2021 because this date Ministery of higher education (MOHE) announce student can back to campus. And after that government announce MCO 3.0 on end of April 2021. Sangfor IAM with 11.6 version software was used to record the internet applications used by network users for both periods. Then the data and results were analysed and discussed.

4.0 Result and Discussion

4.1 Overview of UC TATI Network Structure

As for internet connection, UC TATI has subscribed to use metro-e type of direct internet access from Telekom Malaysia (TM). the speed of this package is 600Mbps (download and upload). figure 1 shows the general layout diagram for logical topology of network in data center at uctati. this connection starts from tm fiber line, follow by tm router from huawei

switch (coming fiber and output cat 6) and utp cable cat 6 straight away insert cisco router (1gbps) port. these two switches are providing, control and provision by tm team.

UC TATI has used Sangfor brand. Sangfor is a leading global vendor of it infrastructure solutions, specializing in cloud computing & network security with a wide range of products & services including hyper-converged infrastructure, virtual desktop infrastructure, next-generation firewall, internet access management, endpoint protection, ransomware protection, managed detection and response, wan optimization, sd-wan, and many others. there are two types of model from Sangfor technology are used. first the next generation application firewall (NGAF) firewall model a5500 and second is Sangfor (internet access management) IAM. for capturing internet access activities use by the network user in UC TATI, Sangfor IAM was used as its capable to provide uniform resource locator (URL) filtering engine, application control, dynamic management, end point management, traffic report and other activities

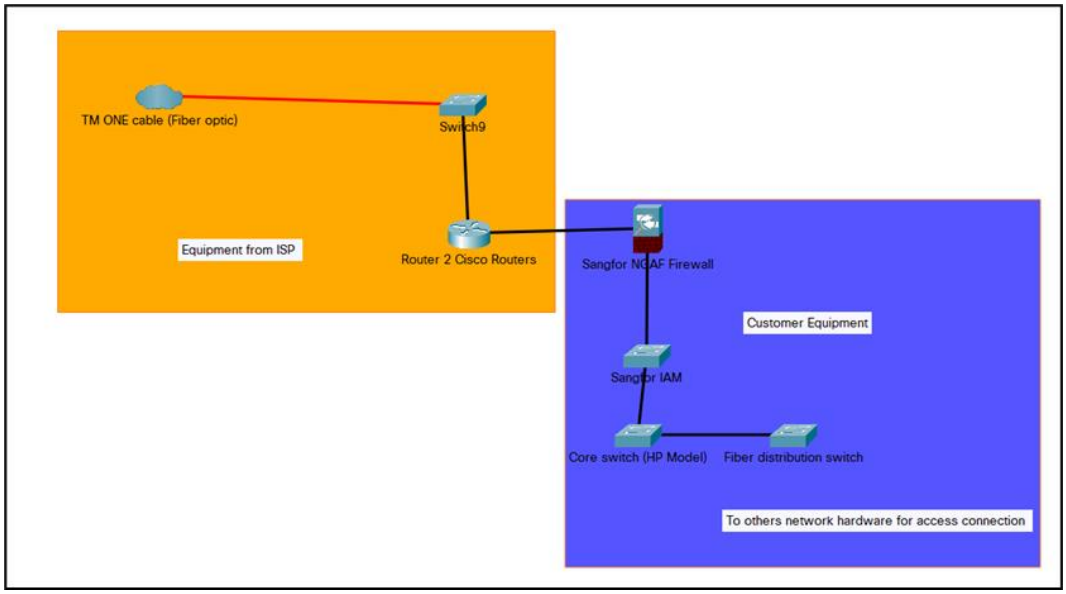


Figure 1: Logical Network Connection

Some features that SANGFOR IAM provide are Advanced Report Center records, audits and counts every single network behavior of intranet user in graphical reports. With reports, curves and statistics, IT managers are provided with all the detailed information they need to know about their network, including Internet access activities, bandwidth consumption and viewed contents. Reports are self-generated by the device and automatically & regularly sent to an appointed e-mail address to e_ectively assist in the network design, secure it and optimize the usage of the bandwidth.

4.2 Active User of UC TATI Network

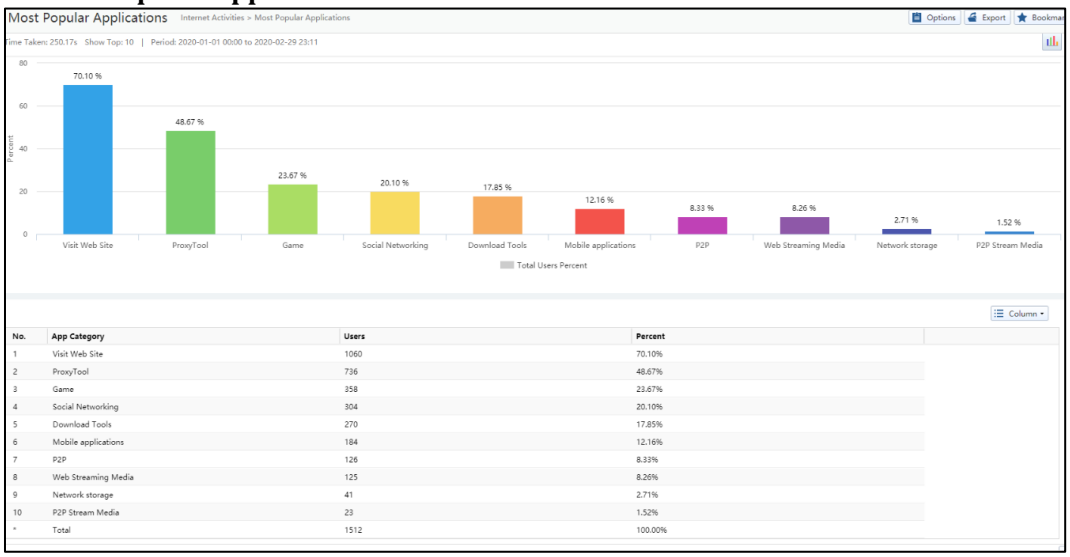
In general, as for 1 January 2021, total number of registered network users is 2919. This number included staff and student from various faculties and departments. Table 1 shows the detail of network users. Table 1 show the number of users based on user type, department and designantion at UCTATI, Most of the user is students that name with college user group. Then the staff from various department and faculty.

Table 1: Number of users based on type

No.	Type	No of user	Remark
1.	College	2590	Students
2.	Staff	55	Other departments such as Acc
3.	FKMPT	52	Faculty computer media and technology management
4.	FTKP	50	Faculty of manufacturing Engineering
5.	FTKK	24	Faculty of Chemical Engineering
6.	FTKEA	44	Faculty of Electrical and Automation Engineering
7.	Clerk	82	Clerk staff
8.	Account	8	Staff form account department
9.	VIP	14	Rector, HOP, HOD and Top management person
TOTAL		**2919**	

According to Figure 3 and Figure 4, the active user before MCO is 1512 users whereas during MCO is 986 users. According to this fact, there is significant difference in terms of numbers of network users before and during MCO and increment in internet usage. This difference is due to most of the users have change to online mode during MCO. The government has encourage student and staff to be at home. Therefore, students allowed to study from home and staff also allowed to work from home.

4.3 Popular Application Pattern



No.	App Category	Users	Percent
1	Visit Web Site	1060	70.10%
2	ProxyTool	736	48.67%
3	Game	358	23.67%
4	Social Networking	304	20.10%
5	Download Tools	270	17.85%
6	Mobile applications	184	12.16%
7	P2P	126	8.33%
8	Web Streaming Media	125	8.26%
9	Network storage	41	2.71%
10	P2P Stream Media	23	1.52%
*	Total	1512	100.00%

Figure 2: Most popular Application before MCO

In terms of network usage, Figure 2 shows the most popular applications from 1 Jan 2020 to 29 February 2020 before MCO 1.0 was implemented in Malaysia. The 1st application is come from visiting website (70.10%) that contain 1060 active user, which is not surprising.

The second is follow by ProxyTool (48.67%) with 736 users, This application only recorded by AIM but this the really is blocked by policy. For info user use proxy tools to bypass block website or traffic like pornography, gambling and any harm website.

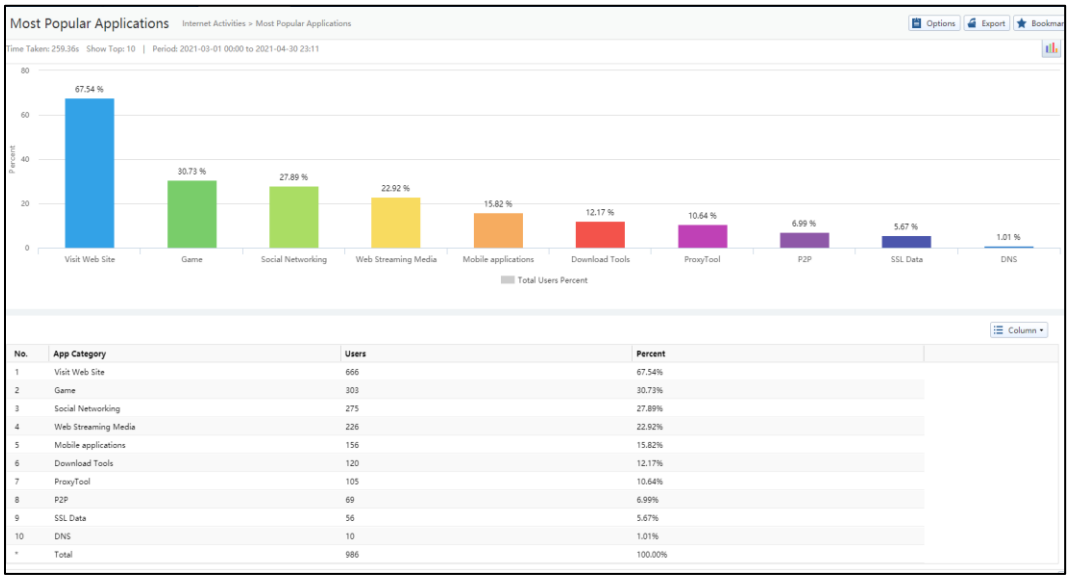
Third places is Game (23.67%) with 358 users, Maria Kihl1 (2010) the Game sites are related to computer games and other gaming activities. Most popular game is from mobile application, this trend is become popular nowadays. Some mobile game are PUBG and Mobile Legend, this two game is likely not just students but also staff play it. For info

UCTATI encourage students to become expert play this kind of game because is part of sport that we call it ESPORT. But the policy is set only non office hours can access this game. Also this game can release stress for some students and staff.

Fourth application is Social Networking (20.10%) with 304 users. Some example of this application is facebook, twitter, tik tok, Instagram and so on.

Download tools (17.85%) followed by Mobile applications (12.16%). P2P applications at seventh places (8.33%), in Maria Kihl1 (2010) eMule and Bit Torrent generated the most P2P traffic, as info the policy is allowed for certain user for access P2P applications and for some purpose.

Web streaming media is ranking eight (8.26%), with only 125 users active. Some streaming media are youtube, microsoft teams, Zoom, Google meet, Zoom and so on. Then on ninth and tenth is unpopular traffic we see, there are network storage (2.71%) and P2P Stream Media (1.52%) with only 23 users. The total users within this period ios 1512 users.



No.	App Category	Users	Percent
1	Visit Web Site	666	67.54%
2	Game	303	30.73%
3	Social Networking	275	27.89%
4	Web Streaming Media	226	22.92%
5	Mobile applications	156	15.82%
6	Download Tools	120	12.17%
7	ProxyTool	105	10.64%
8	P2P	69	6.99%
9	SSL Data	56	5.67%
10	DNS	10	1.01%
*	Total	986	100.00%

Figure 3 : Most popular Application during MCO

Figure 3 show the most popular applications during MCO from 1 Mac 2021 till 30 April 2021, noted that this period students allowed by MOHE (Minister of high education) back to campus. The figure shows that the most popular applications is still the same before MCO, which is visiting the websites (67.54%). This is because there is no changes in terms of the most needed applications by the UCTATI users, which is visiting the various websites for seeking and managing the information including e-learning, e-mails and other websites-related applications as before the implementation of MCO. Another applications that almost have similar patterns in terms of popularity before and during MCO is Gaming and Social Networking. This facts is consistent with reality that most of the Internet users are using Internet for types of activities.

Nevertheless, there is one application that has the most significant difference in terms of popularity for these two period of times, which is Web Streaming. Before MCO, this application recorded only 8.26% of it's popularity. However, during MCO, it increase to 22.92%. This is an clear indicator that during MCO, there is a significant demand on online learning in terms of online lectures, videos and other streaming applications. This is a new phenomena and norms in education resulted from Covid-19 and the implementation of MCO. More educational providers also are switching from face-to-face to online eduations.

Table 2 shows the comparison of the applications for two periods of time. It clearly show that web streaming has the most significant difference in terms of usage. This result confirms that web streaming is the most important application during MCO because more people are encourage to minimize the contact with each other including in education of teaching and learning.

Table 2: Comparison of Application

Before MCO	Frequency	**During MCO**	Frequency
Visit Website	1060	Visit Website	666
Proxy Tools	736	Proxy Tools	105
Game	358	Game	303
Social Networking	304	Social Networking	275
Download Tools	270	Download Tools	120
Mobile applications	184	Mobile applications	156
P2P	126	P2P	69
Web streaming media	**125**	Web streaming media	**226**
Network storage	41	Network storage	0
P2P Stream Media	23	P2P Stream Media	0

6 Conclusion

As MCO take effect of daily life especially students and lecturer. Lecturer move all class into online method. Two graph on Most Popular Application seen significant change on Web streaming application. It's application use for media such Microsoft Teams, Zoom and others streaming application. Before MCO web streaming is ranking number eight and during MCO is ranking number fourth. This means user behaviour rapid change and focuse on Streaming application. While Game applications minor change before and during MCO, yet game application still top popular application in campus internet usage.

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