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Static and dynamic alliance: the solution of reliable internet bandwidth management

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Static and dynamic alliance: the solution of reliable internet bandwidth management

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Abstract. In this study, we present a comprehensive study about the performance of Static and Dynamic Alliance method that can enhance the performance of PCQ. Moreover, the objective of this study is to combine the method of static and dynamic bandwidth management to become Static, and Dynamic Alliance focused on the performance of Static and Dynamic Alliance method through analysis the download speed between PCQ and Static and Dynamic Alliance method. The router fetched bandwidth usage data and PCQ bandwidth allocation data. Those data will be processed and fed into the control system. Using Per-Connection Queue (PCQ) analysis, evaluation of data transfer speed between static, dynamic and combination of both methods have been done. We found that when the PCQ Method was utilized, IDM has a higher bandwidth compared to Google Chrome. During download task processing without canceling or pausing, the application of static and dynamic alliance method of management bandwidth has been conducted into the router successfully. Both IDM and Google Chrome receive an equal amount of bandwidth. Combination of static and dynamic methods in response to internet download accelerator application provide more efficient bandwidth allocation significantly. Those strengthen that static and dynamic alliance is a feasible solution of reliable internet bandwidth management and it is recommended to apply this method for improvement of dynamic method.

1. Introduction

Nowadays the increasing internet requirement need efficient bandwidth management [1]. Unregulated internet bandwidth will cause vast problems, one of which is one or a group of users using as much bandwidth as they need, which will interfere with other users [2]. One way of internet bandwidth management is to limit internet bandwidth use, with the purpose is that total internet bandwidth capacity could not be monopolized by one or more groups of internet users [3]. In managing bandwidth management, the commonly used method is static bandwidth management which has a straight configuration. However, statically shared bandwidth may become either inadequate or not fully utilized. Users using less bandwidth requirement waste available bandwidth, while others with high bandwidth requirement are not satisfied. [4]. Another method of internet bandwidth management is dynamic which distribute internet bandwidth automatically. The disadvantage of the dynamic method is that it has to be monitored continuously to enable the network administrator or the network system dynamically adapt its bandwidth allocation over time [3,5,6].

Per Connection Queue (PCQ) is a dynamic bandwidth allocation method of Mikrotik. It was designed to be able to divide traffic into sub-streams based on selected classifiers. Therefore it can allocate internet bandwidth more fairly [7,8]. Whereas, PCQ can be bypassed by the download accelerator applications. The PCQ classifier with IP address source can be exploited by modern download accelerator applications which use many mirrors to accelerate download speed. It assumes that it is not as a single user, but many users are using the internet simultaneously. Therefore, single download accelerator could cripple an entire network. The objective of this study is to combine the method of static and dynamic bandwidth management to become Static and Dynamic Alliance to enhance the performance of PCQ through analysis of download speed between PCQ Method and Static and Dynamic Alliance method, particularly about how to distribute bandwidth equally and bandwidth utilization. Furthermore, this study will serve as a base of future advanced studies about internet bandwidth management, especially in Indonesia.

2. Research Method

2.1. Static and Dynamic Alliance

The basic concept of Static and Dynamic Alliance is the combination between static and dynamic method. In the static methods, the bandwidth of each user is allocated permanently regardless of the user's needs [5]. If there is a change in the total bandwidth from the ISP, then the bandwidth allocation for each user must be changed. However, the dynamic method allocates bandwidth quota automatically according to the user's needs [6]. If there is a change in the total bandwidth from the ISP, then we can simply change the total bandwidth value in the router configuration. It is just vulnerable abused by modern internet download accelerator application, especially Internet Download Manager (IDM). The PCQ method on Mikrotik is also affected by those problems. To enhance PCQ capability, we combine the static and dynamic method into Static and Dynamic Alliance, through fetching bandwidth usage data and PCQ bandwidth allocation data by the router. Those data will be processed and fed into the control system automatically to ensure the equal distribution of bandwidth.

2.2. Development Tools

The worldwide internet use which required data packages must be efficiently delivered to the user through the router. The computer network device mentioned as a router is responsible for managing data packets from one subnetwork to a different subnetwork based on the onboard routing table [9]. Mikrotik is one of the widely known router manufacturers which has two main products. The first is RouterOS, a network operating system which capable to turn a regular computer into a router. The second is RouterBoard, proprietary hardware with RouterOS preinstalled. Configuration settings can be done using WinBox, a specially designed software to manage Mikrotik router. Furthermore, the ability of RouterOS can be developed using onboard scripts. Those Mikrotik capabilities makes widely used in developing countries [10-11].

In this study, we used RouterBoard RB941-2nd and RouterOS v6.31 as depicted in figure 1 and 2.

Figure 2. Mikrotik RB941-2nd

The RouterBoard RB941-2nd is

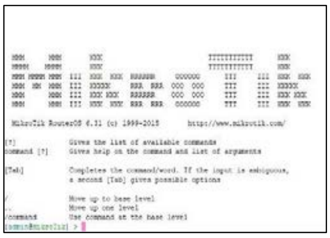

Figure 3. Mikrotik RouterOS

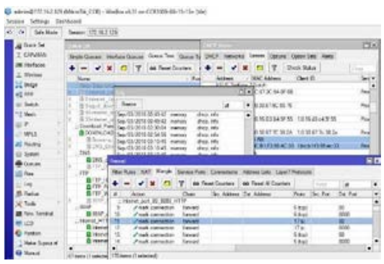

Figure 1. WinBox v3.15

a Mikrotik router with a 650 MHz processor, 32 MB of RAM, 16 MB of storage size, 4 (four) 10/100 Ethernet ports and 802.11b/g/n capable wireless chip. It has a RouterOS v6.31 preinstalled. Winbox v3.15 used to access and configure RouterOS, as shown in figure 3.

3. Method

The basic concept of static and dynamic alliance method is to develop a bandwidth management strategy in which the control system adapts to the bandwidth usage at the time. The network system must fetch and process bandwidth usage data; the result is fed into the control system. Figure 4 depicts the proposed architecture of the static and dynamic combination of bandwidth management.

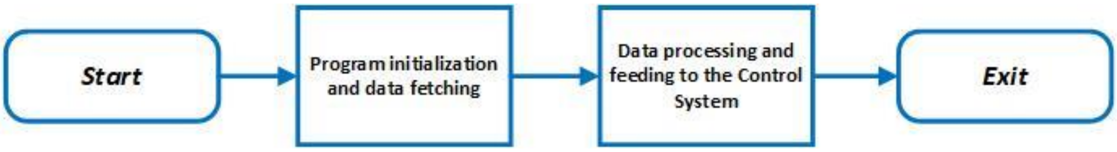

Figure 4. The proposed architecture of static and dynamic combination

When the program started, initialization and data fetching are executed, this step involves several steps. First, the router fetches and store the bandwidth usage at the time. Second, the total bandwidth which provided by Internet Service Provider must be inputted manually. The next step is to apply minimal bandwidth of 64k, to provide a minimum quality of service to the user. The last step, retrieve the PCQ bandwidth allocation value, enable the router to find the last bandwidth allocation configuration which is fed into the system, as illustrated in figure 5.

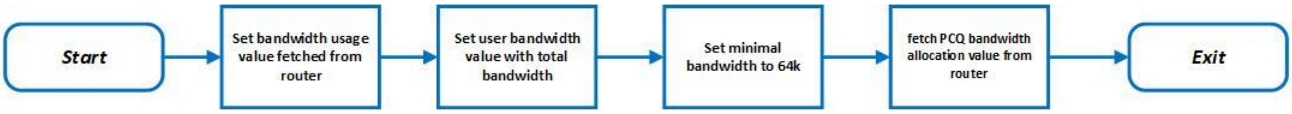

Figure 5. The process of program initialization and data fetching

The data processing begins with verification of PCQ bandwidth allocation. The result of the verification determines the bandwidth allocation for each user. In the event of the bandwidth usage value exceed or equal user bandwidth value, the allocation will be divided by 2 (two). However, if the bandwidth usage value below user bandwidth value, the allocation will be multiplied by 2 (two). The idea is to increase or decrease bandwidth allocation for each user based on the values obtained from program initialization and data fetching step. Those steps will be repeated to ensure fair distribution of bandwidth (equal amount of distribution), as depicted in figure 6.

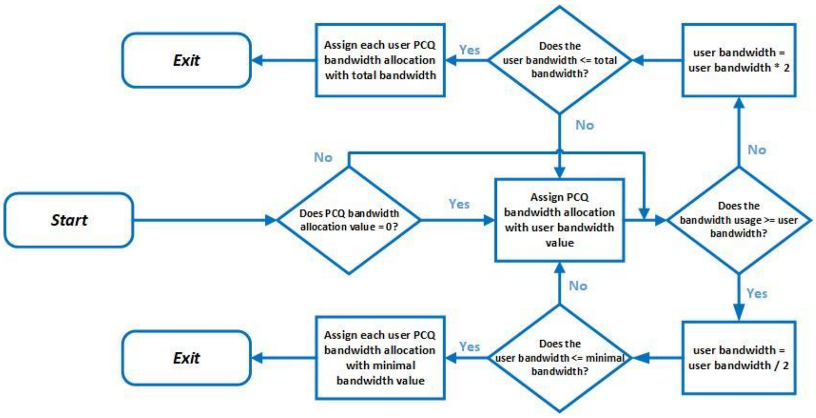

Figure 6. The process of data feeding into the control system

3.1.Topology
Figure 7 shows the network topology used for this paper.

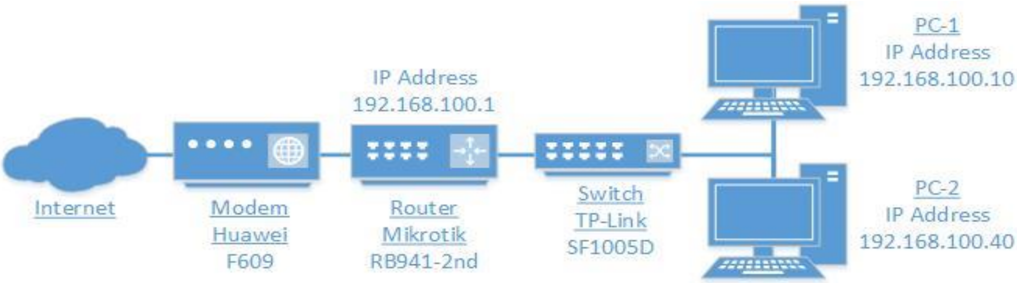

Figure 7. The network topology of static and dynamic alliance

To the network work perfectly, it has to be configured firstly. The configuration of the network topology of the static and dynamic alliance is explained in table 1.

Table 1. The network configuration of the static and dynamic combination.

Hardware	IP Address	Gateway	DNS Server
Modem Huawei F609	Dynamic from ISP	Dynamic from ISP	Dynamic from ISP
Router Mikrotik Rb941-2nd	192.168.1.2	192.168.1.2	192.168.1.2
Switch TP-Link SF1005D	-	-	-
PC-1	192.168.100.10	192.168.100.1	192.168.100.1
PC-2	192.168.100.40	192.168.100.1	192.168.100.1

3.2. Experiments
In this section, we provide how experiments were carried out. Huawei F609 was used to access the internet. Router RB941-2nd was placed before the switch, whereas modem could not be regulated by the router as every network device. Switch *TP-Link SF1005D* was used to connect PC-1 and PC-2. The PCs we used was a regular computer that uses Internet Download Manager (IDM) and Chrome browser.

We configured Mikrotik RB941-2nd side to use PCQ as a dynamic bandwidth provision. We also wrote the codes of the proposed architecture using the onboard script, as depicted in figure 8. The final script was tested at least 80 times to ensure that the script works as intended.

```
# ------------------------------------------------------------
   :while ( $bandwidthUsageValue>=$userBandwidthValue and $continueWhile2 ) do={
      :set userBandwidthValue ($userBandwidthValue / 2);
      :log info "test while 2"
      :if ( $userBandwidthValue <= $minimalBandwidthValue ) do={
         :set pcqBandwidthAllocation $minimalBandwidthValue;
         /queue tree set Download_Browsing max-limit=$pcqBandwidthAllocation;
         /queue tree set Download_Browsing limit-at=$pcqBandwidthAllocation;
```

Figure 8. Part of the static and dynamic combination method script

The files that would be tested for download was an Ubuntu ISO file with a size of 812 MB. To download the file, PC-1 used the Internet Download Manager (IDM) while PC-2 used Google Chrome.

4. Result and Discussion

4.1.Result

In this study, to analyze the performance of a static and dynamic combination of bandwidth management, we had compared PCQ, static and dynamic alliance method. Furthermore, we assumed that the total bandwidth value for all the clients was 1 Mbit/sec. Figure 9 shown the expected result for both clients using PCQ method.

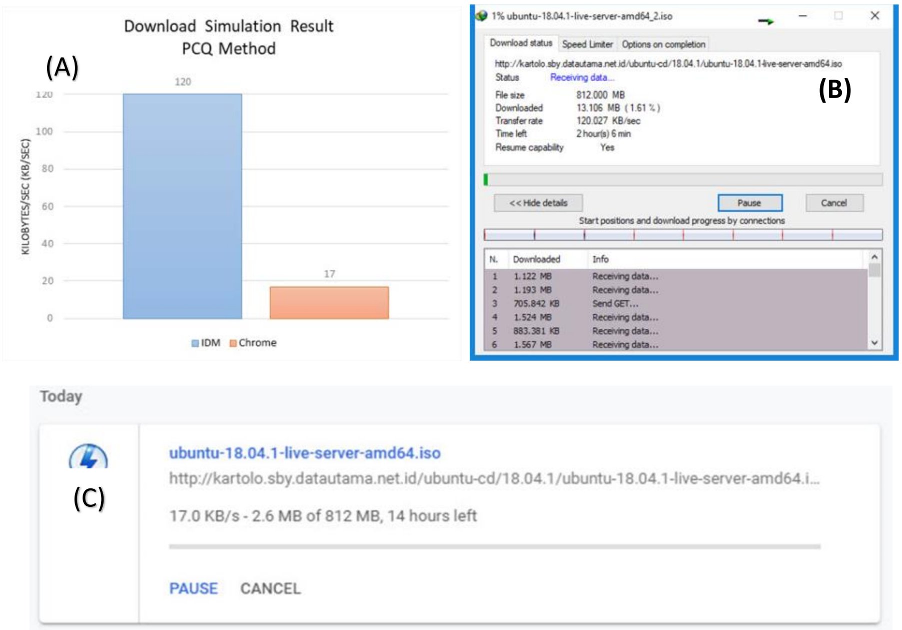

Figure 9. (A) Download simulation result using PCQ Method: IDM had higher bandwidth compared to Google Chrome (120 KB/sec); (B) Download simulation result on IDM using PCQ Method; (C) Download simulation result on Google Chrome using PCQ Method

It was obvious that PC-1 using IDM had a higher bandwidth of 120 KB/sec compared to PC-2 bandwidth of 17 KB/sec using Google Chrome. During download task processing without canceling or pausing, the application of static and dynamic alliance method of management bandwidth had been conducted into the router successfully. The router automatically retrieves the bandwidth usage value, user bandwidth value and PCQ bandwidth allocation value at the moment. Those will serve as the basis for comparing bandwidth usage value and user bandwidth value. The result of the comparison will be used to determining the next PCQ bandwidth allocation value, which will be fairer in bandwidth distribution based on the current conditions. This is reflected by PC-1, and PC-2 received an equal amount of bandwidth with an average of 57 KB/sec as shown in figure 10.

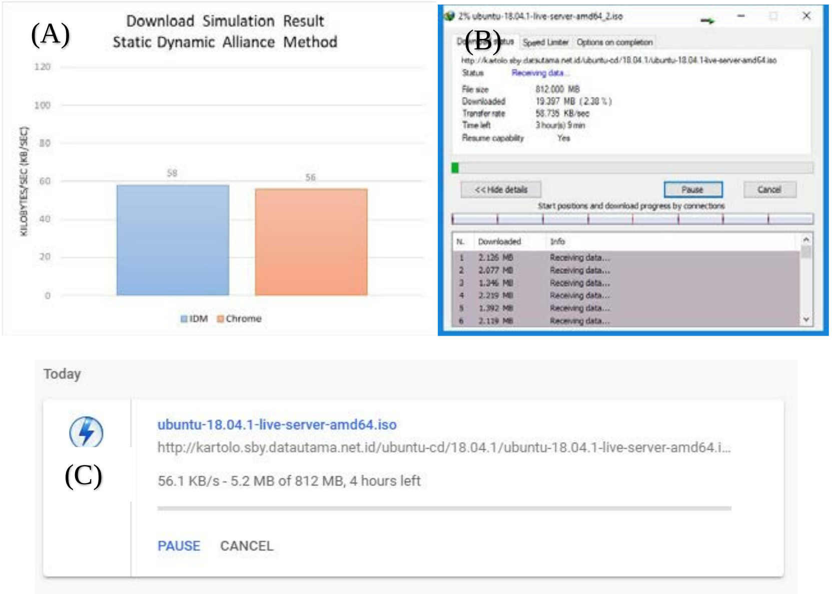

Figure 10. (A) Download simulation result using Static Dynamic Alliance Method, it able to distribute equal amount of bandwidth to IDM and Google Chrome; (B) Download simulation result on IDM using Static Dynamic Alliance Method; (C) Download simulation result on Google Chrome using Static Dynamic Alliance Method

During the download simulation, we also record the bandwidth utilization at that time. PCQ method used 1163 Kbit/sec, while the static and dynamic alliance method used 990 Kbit/sec as shown in figure 11. Assuming a maximum total bandwidth was 1 Mbit / sec, the PCQ method uses 113% of the available bandwidth, while the static and dynamic alliance method uses 96% of available bandwidth. This proves that Static Dynamic Alliance method was able to enhance the PCQ Method by sharing the bandwidth equally and reducing bandwidth utilization below the maximum available bandwidth.

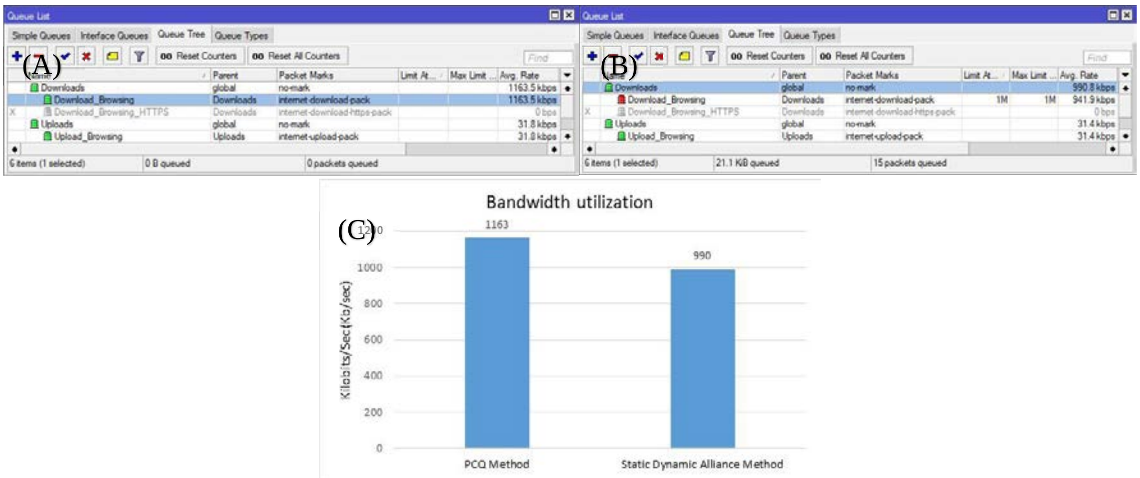

Figure 11. (A) The WinBox shown bandwidth utilization of PCQ method was above 1 Mbit/sec; (B) The WinBox shown bandwidth utilization of Static and Dynamic Alliance method was below 1 Mbit/sec; (C) The summary of WinBox indicated Static and Dynamic Alliance method were capable to reduce bandwidth utilization to below maximum bandwidth value of 1 Mbit/sec.

Internet around the world has become a basic necessity for daily human lives. The cost of internet bandwidth is quite expensive forcing the use of internet bandwidth management. Unregulated internet bandwidth will make users compete to use as much bandwidth as possible. The methods commonly used in bandwidth management are static and dynamic. The PCQ method is a dynamic bandwidth allocation method of Mikrotik, which can be bypassed by the modern download accelerator applications such as IDM. Based on the research result, the download simulation shows that the Static and Dynamic Alliance method able to share the bandwidth equally between IDM and Google Chrome. Moreover, the bandwidth utilization of the PCQ method is maxed while the static and dynamic alliance method is below the maximum bandwidth. This confirms that IDM is not only able to exploit the PCQ method, but also uses all available bandwidth. Those cause unequal bandwidth distribution for all user so that some users will be difficult to access the internet. Static Dynamic Alliance method enhance the PCQ Method through covering PCQ weaknesses that can be exploited by IDM and reduce bandwidth utilization.

The recent efforts to analyze and improve bandwidth management have been carried out in previous publications. Related to study of the performance and usage implications of internet upgrade on rural area [2], revealed that even with large bandwidth, none of the guarantees would be sufficient due to competition between users to use available bandwidth as much as possible. Moreover, Mufadhol M. *et al.,* 2017, [3] shown the concept design of improved bandwidth management, but it did not test further. Both papers did not investigate the effect of modern download accelerator that could cripple an entire network regarding the amount of bandwidth.

5. Conclusion

In this study, we developed a Static and Dynamic Alliance method to enhance the PCQ Method and run the comparative analysis. We built a simple experiment environment using two (2) PCs that use IDM and Google Chrome to download an Ubuntu ISO file. Both PCs internet connection is regulated by Mikrotik which has been configured to use the PCQ Method.

Our research Result indicated that during download simulation test using PCQ Method, IDM has higher bandwidth than Google Chrome. Without canceling or pausing, we run the Static and Dynamic Alliance method, and both PC had similar bandwidth. Also, the WinBox show that the Static and Dynamic Alliance method reduces bandwidth utilization below the total bandwidth provided. This proves that despite the existence of IDM, Static and Dynamic Alliance method of bandwidth management is not only able to distribute an equal amount of bandwidth to each user but also reduce bandwidth utilization. This finding strengthens that static and dynamic alliance is a feasible solution of reliable internet bandwidth management, and will serve as a base of future advanced studies about internet bandwidth management.
Furthermore, in our future work, we will evaluate the ability and long-term stability of Static and Dynamic Alliance on large bandwidth networks.

Acknowledgment

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