Table Of Contents

Introduction

1.1 Background

Bandwidth Management System:

A bandwidth management system is the process of regulating and controlling the flow of data over the network. A proper management can help to resolve the network congestion that can result in slow connections, dropped connections and other network issues. With the increasing demand for bandwidth the aspect of managing network traffic is crucial. Bandwidth management system is necessary to ensure that a network is operating at an optimal level, providing users with the necessary bandwidth to access critical applications and services while preventing congestion and maintaining network performance.

OpenWRT:

OpenWrt (from open wireless router) is an open-source project for embedded operating systems based on Linux, primarily used on embedded devices to route network traffic. OpenWrt provides a highly customizable and secure operating system for routers and other embedded devices, making it a popular choice for networking enthusiasts and professionals.

Virtual Box:

VirtualBox is open-source software for virtualizing the x86 computing architecture. It acts as a hypervisor, creating a VM (virtual machine) where the user can run another OS (operating system). The operating system where VirtualBox runs is called the "host" OS. The operating system running in the VM is called the "guest" OS. VirtualBox supports Windows, Linux, or macOS as its host OS. When configuring a virtual machine, the user can specify how many CPU cores, and how much RAM and disk space should be devoted to the VM. When the VM is running, it can be "paused." System execution is frozen at that moment in time, and the user can resume using it later.

1.2 Objectives

Some of the objectives of our project are:

- To prioritize the traffic based on the importance and provide the bandwidth accordingly.
- To avoid the network congestion and identify potential congestion issues.
- To ensure optimal performance of the network.
- To avoid bandwidth and server performance bottlenecks.

1.3 Motivation and Significance

The motivation behind implementing a bandwidth management system is to ensure that a network is operating at an optimal level, providing users with the necessary bandwidth to access critical applications and services while preventing congestion and maintaining network performance. Without proper bandwidth management, the network can become congested, leading to slower speeds, increased latency, and even downtime. This can result in a poor user experience and lost productivity, which can be costly for businesses and organizations that rely on the network for their day-to-day operations. By implementing a bandwidth management system, network administrators can prioritize traffic, control network traffic flow, and identify potential congestion issues, all of which contribute to a better user experience and increased productivity.

Significance of Bandwidth management system:

- Bandwidth management systems prevent network congestion and ensure optimal network efficiency.
- Bandwidth management systems prioritizes traffic and control network traffic flow.
- Bandwidth management systems help to identify potential congestion issues before they become major problems.
- Bandwidth management systems help to ensure fair usage of network resources.
- Bandwidth management system is an essential tool for maintaining network performance and ensures the critical applications and services are always available to the users.

1.4 Definitions

Bufferbloat:

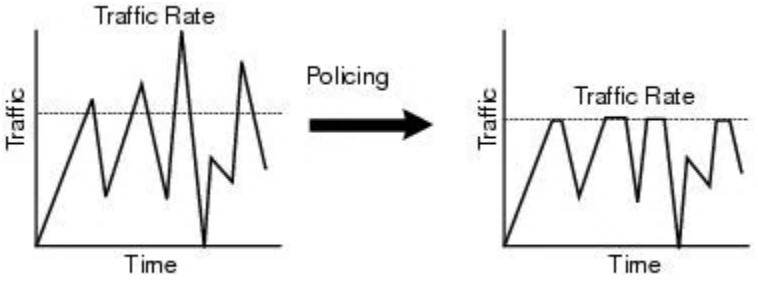
A phenomenon where excess buffering causes network latency and packet delay, leading to poor network performance.

Smart Queue Management:

A technique used to manage bandwidth by controlling network traffic flow and preventing bufferbloat, resulting in reduced latency and improved network performance.

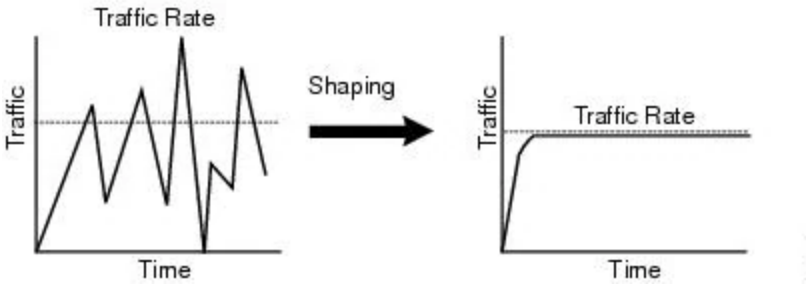
Traffic Policing:

A method of managing network traffic by enforcing a maximum rate of data transfer for specific traffic streams.



Traffic Shaping:

A technique used to prioritize and manage network traffic by controlling the rate at which data is transmitted.



Quality of Service:

A mechanism used to prioritize and manage network traffic based on the specific needs of the application or service, ensuring that critical traffic receives the necessary bandwidth and resources.

Unified Configuration Interface:

A tool that provides a single interface for configuring and managing various network components, such as routing, firewalls, and network interfaces.

OPKG:

A package manager used in OpenWrt to install and manage additional software packages.

Luci_app_sqm:

A web interface used to configure and manage Smart Queue Management (SQM) in OpenWrt.

NetFilter:

A firewall framework used in Linux-based operating systems, such as OpenWrt, to filter and manipulate network traffic.

Iptables:

A command-line tool used to configure NetFilter rules in Linux-based operating systems, such as OpenWrt, to filter and manipulate network traffic.

Procedure

2.1 Virtualbox setup

First of all Virtualbox was installed on our computer. And the virtualbox LAN network was configured. The adapter was configured manually and the DHCP server was disabled as shown in the figure below.

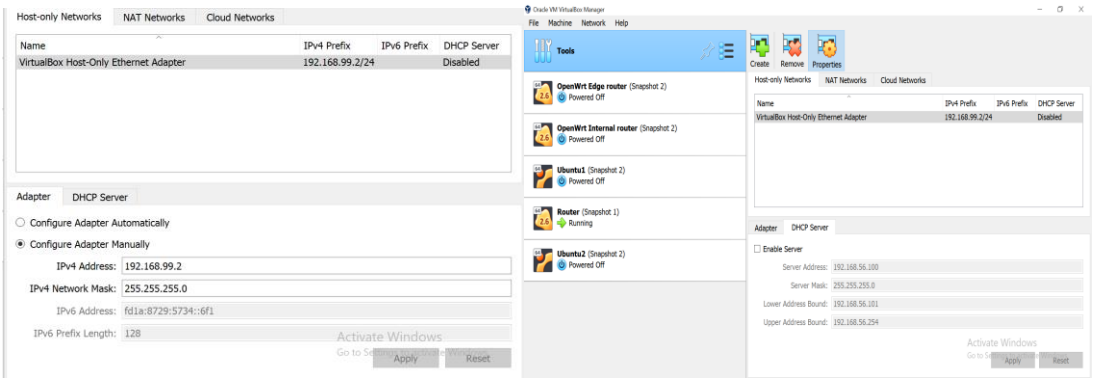


Figure: 2.1.1 Virtualbox LAN setup

2.2 OpenWRT setup

An image file of OpenWRT was downloaded in our computer and converted to vdi and resized for installation as the official website for OpenWRT suggests. The Network parameters of OpenWRT were set up where Adaptor 1 was attached to the host-only adapter and Adaptor 2 was attached to Bridged Adapter.

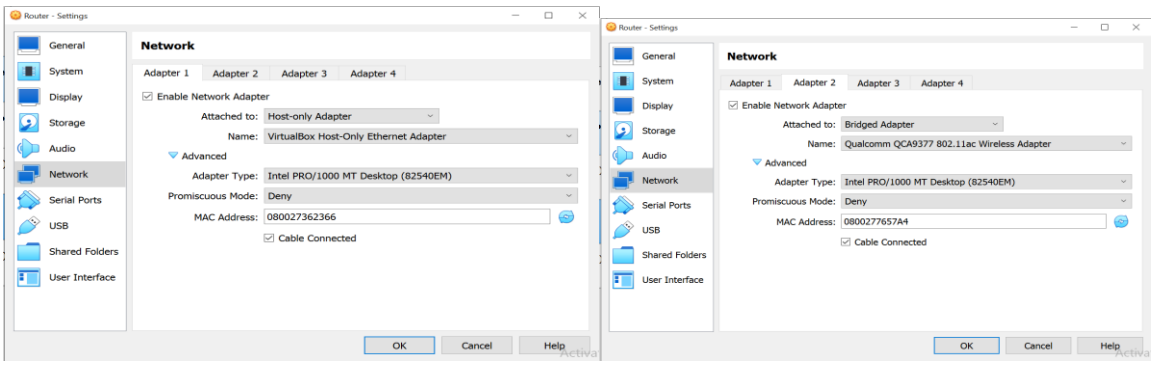


Figure 2.2.1:OpenWRT Router Network setup

We then provide an Static IP to lan of OpenWRT so that we can access the web interface of the router. For that we use the command: *uci set network.lan.ipaddr="192.168…"* which is now the LAN ip address. Now from the router we can ping the host and other hosts on the internet. We can also access the web interface using this ip.

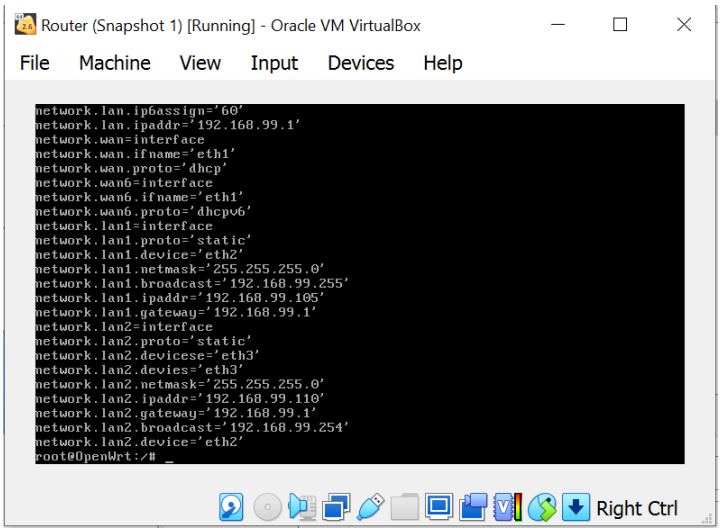


Figure 2.2.2: Router Network status

2.3 Ubuntu setup

Now we setup two ubuntu devices ubuntu 1 and ubuntu 2 as shown in figure 2.1.1. For this we download the iso file for our device architecture from the official website and install ubuntu in virtualbox with the instructions given in the website. After installation we also need to set up its network parameters.

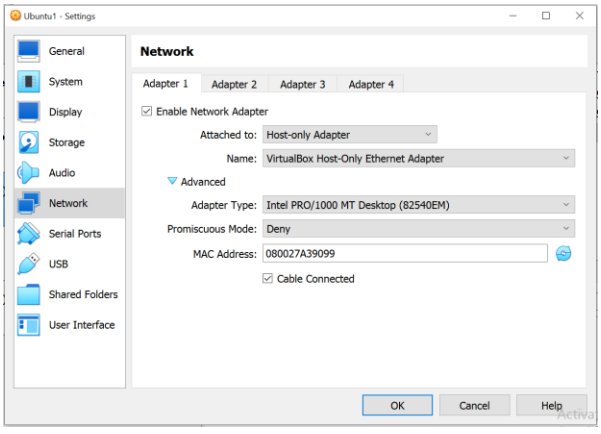


Figure 2.3.1: Network parameters for ubuntu device

Adapter 1 is attached to the host-only adapter and Adapter 2 is disabled.

We will need to assign a static ip to our Ubuntu devices. We do this through the device settings. We set the gateway as the ip of our router.

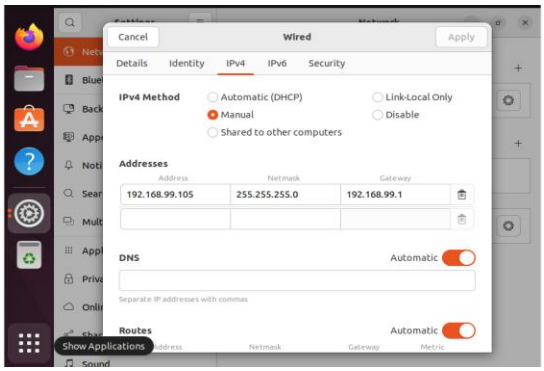


Figure 2.3.2: Giving manual ip to our ubuntu device

We now create LAN interfaces in our router, this device is set up as eth1 in the LAN interface.

2.4 Bandwidth Allocation

We then manually allocate bandwidth to the devices. For this we will need to install a sqm package in our router which will allow us to manually allocate bandwidth to the devices.

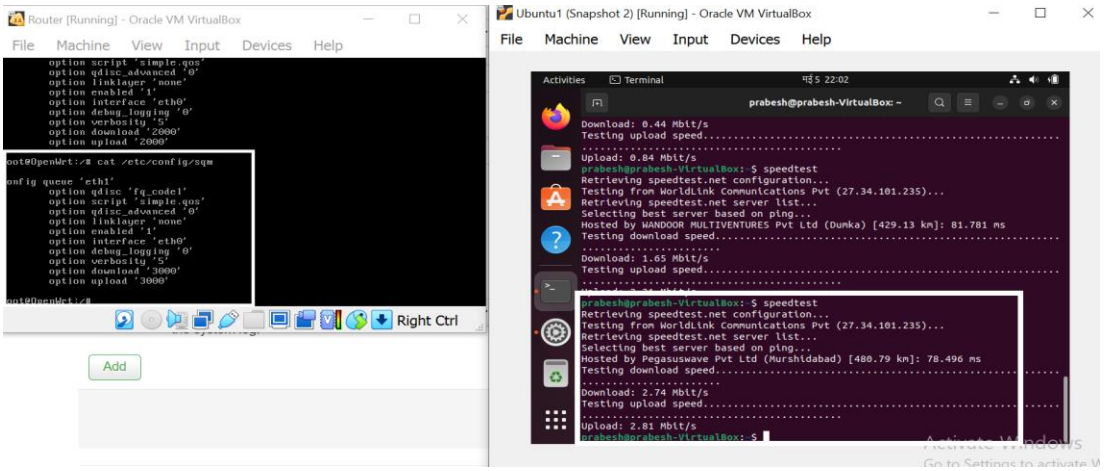


Figure 2.4.1: Bandwidth of the virtual device when 3000 Kbits/s was manually assigned to the device

In figure 2.4.1 we have manually allocated bandwidth of 3000 Kbps for upload and download to ubuntu 1. And checking in the ubuntu device we can see that the bandwidth is being properly managed.

Observation

Here we can see that as we assign different bandwidth to different devices, The speedtest in those devices shows that change in bandwidth. It shows that the Bandwidth management in different devices with openWRT is working as intended.

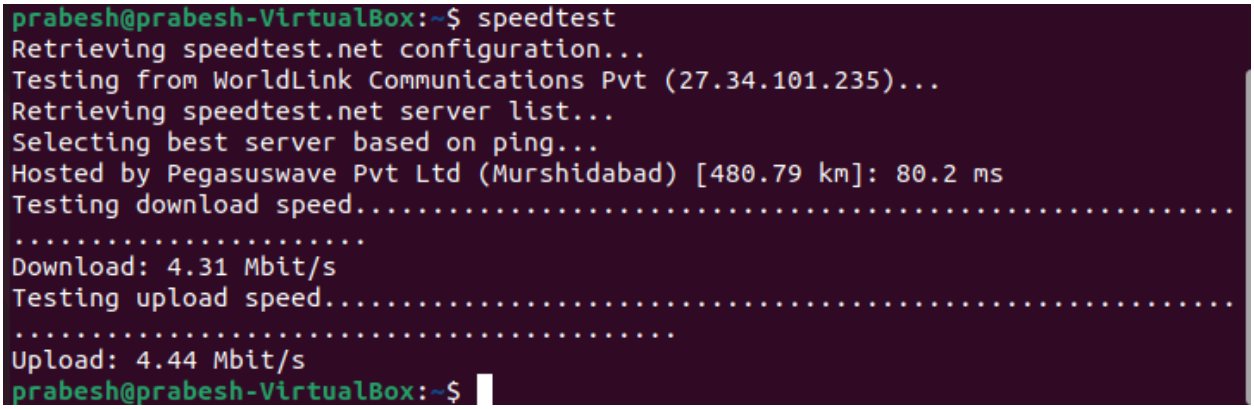


Figure 3.1: Allocating bandwidth in first ubuntu device

In figure 3.1 the device has been assigned 5000 Kbps of download and upload speed.

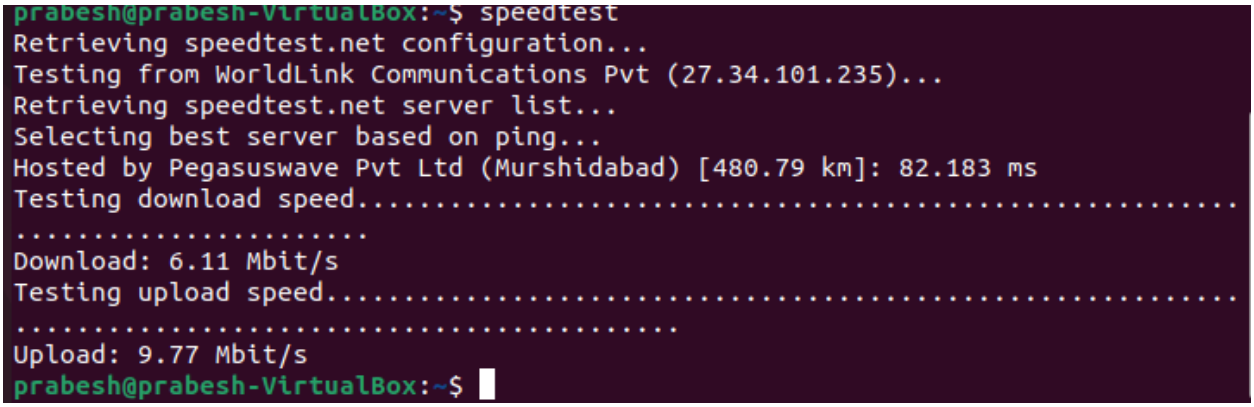


Figure 3.2: Allocating bandwidth in second device

In figure 3.2 the device has been assigned 10000 Kbps of download and upload speed. And the Bandwidth management system is working properly.

Conclusion

In conclusion, our project to set up a bandwidth management system using OpenWRT and two Ubuntu devices has been a success. By configuring OpenWRT on a virtual machine acting as a

router, we were able to implement advanced networking features like bandwidth management. The bandwidth management system we set up allows for efficient network usage in multi-user environments. By limiting the upload and download speeds for different types of traffic, we ensured that both devices got a fair share of the network bandwidth.

References

Brown, R. (2022) *Welcome to the openwrt project*, *OpenWrt Wiki*. Available at: https://openwrt.org/ (Accessed: May 8, 2023).

Alex (2021) *OpenWrt as Router device*, *OpenWrt Wiki*. Available at: https://openwrt.org/docs/guide-user/network/openwrt_as_routerdevice (Accessed: May 8, 2023).

(2020) *YouTube*. YouTube. Available at: https://www.youtube.com/watch?v=JwPD1GWw5go (Accessed: May 8, 2023).

Welcome to Virtualbox.org! Oracle VM VirtualBox. Available at: https://www.virtualbox.org/ (Accessed: 08 May 2023).

Ubuntu (2023) *Wikipedia*. Available at: https://en.wikipedia.org/wiki/Ubuntu (Accessed: 08 May 2023).