

Computer Networks Department

Dianosis and Effective Management of Bandwidth in A Local Area Network

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ABSTRACT

Different broadband services require different amounts of bandwidth and have different priorities. For example, a connection for visual communications will in general require more bandwidth than one for data communications, and a voice connection will in general be of higher priority than either a data or a video connection. In response to these varied demands, the network designer may choose to assign different amounts of bandwidth to different types of traffic.

The project's priority is about bandwidth management. Furthermore, this task of providing guaranteed quality of service with high bandwidth utilization while servicing the largest possible number of connections can be achieved through a combination of intelligent admission control, bandwidth reservation and bandwidth management tools like (TES). The research is divided in three main sections. The first section which talks about the aim and objectives of the project. . The main aim of this project is to speed up network and effectively manage service/application within a local area network. The second section brings out the research designs of the project. It also shows the various steps on how the project was design. The third section talks about how the project was implemented and the various results at each stage.

The motivation for carrying out this project is to research deeply on poor network performance. While researching on why end- users and clients complain on poor network performance, discoveries were made that, these problems sum up to one word "**Bandwidth**". In organizations, company, offices and home people always complain of slow internet connection. The main aim of this project is to speed up network and effectively manage service/application within a local area network. The project will be simulated using a bandwidth management tool called TES in a local area network. Lastly, "improving bandwidth management is probably the easiest way for universities to improve the quality of their bandwidth for educational purposes.

KEY WORDS: Bandwidth, TES, LAN,

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I. INTRODUCTION AND BACKGROUND

1.1 Introduction and Background of the study

An estimated one-third of the world's population is online now, a proportion that is sure to grow. More users, more devices that connect to networks, and more data-heavy services to ride over the pipes are causing a "bandwidth explosion," D'Amboise said. The data reviewed by his IEEE committees over the past few years indicates that bandwidth demand is growing faster than our capacity to deliver it. But plenty of organizations are at work on the next generation of Internet and networking technologies, and they provide reason for optimism. The data explosion may not become a giant bottleneck thanks to continued research of the kind profiled below, which has already led to big advances in undersea cables, software-defined networking, and the research-oriented Internet 2 network.[1] Jon Brodtkin,.2016 Bandwidth usage

Researchers have studied the effects of bandwidth on network traffic since the 1920s. Research objectives have always focused on the development of encoding techniques and technology enhancements that allow more bits to be transmitted per unit of time. In 1933 Harry Nyquist discovered a fundamental relationship between the bandwidth of a transmission system and the maximum number of bits per second that can be transmitted over that system. The Nyquist Intersymbol Interference Theorem allows one to calculate a theoretical maximum rate at which data can be sent. Nyquist's Theorem encourages data communications professionals to devise innovative coding schemes that will facilitate the maximum transmission of data per unit of time. [2] Comer, Douglas E. Computer Networks and Internets. Upper Saddle River, NJ: Prentice Hall, 2001

What is Bandwidth?What we mean by bandwidth is the capacity of a network link to transmit information, expressed in bits per second. For example a 10 Base network has a total capacity of 10 Mbits/sec (Mbps), and a 100 Base network has a total bandwidth capacity of 100 Mbps etc. The data in your computer is measured in bytes rather than bits.

End-users face challenges like slow response to commands, packet delay and traffic congestion. The good news is, these problems can be resolved when the users of the network use the right tools and applications[3] Baldwin, Jaime. "Latency and bandwidth". 1stel.com. Jaime Baldwin. Retrieved 2 May 2016.

1.2 Problem statement: - Diagnosis and Effective Management of Bandwidth in a Local Area Network

Employees and End users sit down in front of a computer and complain about poor network performance without thinking of how anything on it works, just that it should work, and work fast. When employees experience latency on a VoIP call or cannot access websites, they see it as service not delivered on time. They sum up the problem with one word: **"bandwidth"**. End users say the corporate network is not providing the bandwidth they need to get their work done. Bandwidth is only one aspect of network performance and only one of several factors to look at when figuring out why a network application is not performing well. The first and most obvious is the raw capacity of your network and how much of that bandwidth is being used. To know whether it is being used efficiently, one also needs to look at which applications are generating the most traffic and between what endpoints. If the answer is still not clear, one may need to go to a deeper level of traffic analysis, looking at the speed and timing of the delivery of specific packets of data. To non-technical employees and managers, bandwidth is synonymous with network performance. What we mean by bandwidth is the capacity of a network link to transmit information, expressed in bits per second. That's certainly one major determinant of network performance, but often an even bigger one is how efficiently that bandwidth is used. [4] Leon Adato 2015,. How to fix bandwidth problems

1.3 Objectives of the study

In organizations, company, offices and home people always complain of slow internet connection. The main aim of this project is to speed up network and effectively manage service/application within a local area network. Main while the objective of this study is to create **awareness, diagnose, Monitor and Manage** bandwidth of a local area network.

The objectives of this study will help resolve bandwidth Issues. Common activities causing bandwidth problems are:

- Watching videos from Internet (YouTube, Netflix)
- Large file transfers between computers (greater than 100 megabytes in size)
- Constant stream of data (surveillance footage from security cameras)
- Downloading files from internet
- Wrong configurations

These activities almost always have two characteristics: large amounts of data, and extended duration.

Creating Awareness: End-users just want to use the network without even getting a little idea about the technology they are using. A client using 56kb dialup modem complains that connection is slow while he is downloading a file of about 300 megabyte. In this case one can say that the user is not aware.

Factors to diagnose in a local area network are:

- Traffic prioritization
- Security concerns
- Demands of hosted service/application

Monitor

Monitoring the network is a very important because it allows the network user to monitor bandwidth and traffic in an interface specific level with one minute granularity. Network Analyzer like TES can be used to monitor the network

Bandwidth Management

Bandwidth management is the process of measuring and controlling the communications (traffic, packets) on a network link, to avoid filling the link to capacity or overfilling the link, which would result in network congestion and poor performance of the network.

1.4 Research Question

How can bandwidth be important in an organizational setup?

How much bandwidth do I need to satisfy my Community College faculty, staff and students?

How will adding bandwidth affect my IT and company budget?

How do I know who provides Internet, MPLS, or point-to-point services to my location(s)?

How much bandwidth do I need for and organizational setup?
How will boosting the bandwidth better increase income within the company?
Why do we have to educated employees and end-users on bandwidth?

1.5 Scope of Study

In computing, bandwidth is the bit-rate of available or consumed information capacity expressed typically in metric multiples of bits per second. Variously, bandwidth may be characterized as;

- Network bandwidth
- Data bandwidth,
- Digital bandwidth.

The project **scope will be focused on Network performance bandwidth**. In addition, the thesis will be focused on how to resolve the challenges and problems of bandwidth within a local area network

1.6 Significance of study

Research as shown that, having a deep knowledge on how bandwidth works can impact an organization in a positive way. In most cases bandwidth may not be the problem, and increasing bandwidth will not solve it. But if end-users and clients have a deep knowledge on bandwidth and how it works, money cannot be wasted on buying more bandwidth meanwhile the problem is within the company. In that case, you would be like the restaurant manager who fires the waiter over complaints of slow service when really the problem was in the kitchen.

II. Literature Review

2.1 Introduction

The research will be focused on diagnosis and bandwidth boost within a local area network of school campus Catholic University Institute of Buea (CUIB). How much is enough? Determining the right amount of bandwidth for colleges has become a top problem for IT administrators and end-users. The prevalence of mobile devices on campus, coupled with integration of technology in the classroom has a huge drain on campus bandwidth.

2.2 Conceptual Framework

Conceptual Framework is the way ideas are organized to achieve a research project's purpose. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply. The research will focus on Models of operations research – Decision making. The rapid rate of technological change within the field of Computer and Networking Technology (CNT) has given rise to the need to future-proof student learning. This is achieved by omitting details of the underlying technological implementation, which may change rapidly as the technology progresses. Furthermore additional advantages of a bandwidth centric approach are that bandwidths can be readily measured in computer networks and bandwidths are often included in network equipment specifications. The conceptual framework will be based on bandwidth diagnose and boost of a local area network. A symptom of a bandwidth bottleneck is always slow network performance, however not every slow network is the result of a bandwidth issue. Many times IT departments simply add bandwidth when a network slows down. This is not always a good solution though, since it adds cost, and merely solves the symptom of the problem, not necessarily the problem itself. In order to diagnose a network problem one should use a network monitoring technology. Some popular “flow-based” technologies are NetFlow and sFlow. These technologies are able to “rewind” a network to the point where the slowdown was experienced. The main concepts of the research will be focus on boost and diagnoses of the CUIB local area network. [5] Ravitch, and Riggan. 2012 Reason and Rigor: How Conceptual Frameworks guide Research, Thousand Oaks CA: Sage p. xiii

2.2 Definition of Terms

Bandwidth: What we mean by bandwidth is the capacity of a network link to transmit information, expressed in bits per second

Traffic Engineering Server (TES):- is Internet Gateway Router (or Bridge) with powerful and easy to use bandwidth management, quality of service, security, acceleration/optimization, monitoring and filtering features
Network traffic monitoring:- Is the process of reviewing, analyzing and managing network traffic for any abnormality or process that can affect network performance, availability and/or security

Data streaming:- Is the transfer of data at a steady high-speed rate sufficient to support such applications as high-definition television (HDTV) or the continuous backup copying to a storage medium of the data flow within a computer. Data streaming requires some combination of sufficient bandwidth

Simple Network Management Protocol (SNMP):- Is an application-layer protocol defined by the Internet Architecture Board (IAB) in RFC1157 for exchanging management information between network devices. It is

a part of Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite .SNMP is one of the widely accepted protocols to manage and monitor network elements

Transmission Control Protocol (TCP) and User Datagram Protocol (UDP):-Is a transportation protocol that is one of the core protocols of the Internet protocol suite. Both TCP and UDP work at transport layer TCP/IP model and both have very different usage.

Upstream traffic:- Refers to data that is sent from a computer or network. This includes all types of outgoing data, such as sending an e-mail message or uploading a file. It may also include data sent over the Internet while playing an online multiplayer game.

Downstream traffic refers data that is received by a computer or network. This includes receiving e-mail messages, downloading files, or simply visiting Web pages. Online games also generate downstream traffic.

Local Area Network: - A computer network that links devices within a building or group of adjacent buildings, especially one with a radius of less than 1 km.

2.3 Empirical literature

Bandwidth boost management is the process of measuring and controlling the communications (traffic, packets) on a network link, to avoid filling the link to capacity or overfilling the link, which would result in network congestion and poor performance of the network. Bandwidth management is measured in bits per second (bit/s) or bytes per second.

Ben Anderson talks about determining the right amount of bandwidth for community colleges, increasing bandwidth and the benefits of bandwidth within a local area network. [6]BenAnderson.,(2014).bringing-your-community-college-bandwidth-up-to-speed

Bandwidth (computing). In this article, Douglas Comer and Behrouz A. Forouzan talks about the concept in network bandwidth consumption and asymptotic bandwidth. For use in signal processing and wireless communications, see Bandwidth (signal processing). For other uses, see Bandwidth (disambiguation).In computing, bandwidth is the bit-rate of available or consumed information capacity expressed typically in metric multiples of bits per second. Variously, bandwidth may be characterized as network bandwidth, data bandwidth, or digital bandwidth. This definition of bandwidth is in contrast to the field of signal processing, wireless communications, modem data transmission, digital communications, and electronics, in which bandwidth is used to refer to analog signal bandwidth measured in hertz, meaning the frequency range between lowest and highest attainable frequency while meeting a well-defined impairment level in signal power.

Network bandwidth consumption:-Bandwidth in bit/s may also refer to consumed bandwidth, corresponding to achieved throughput or goodput, i.e., the average rate of successful data transfer through a communication path. This sense applies to concepts and technologies such as bandwidth shaping, bandwidth management, bandwidth throttling, bandwidth cap, bandwidth allocation (for example bandwidth allocation protocol and dynamic bandwidth allocation), etc. A bit stream's bandwidth is proportional to the average consumed signal bandwidth in Hertz (the average spectral bandwidth of the analog signal representing the bit stream) during a studied time interval. Channel bandwidth may be confused with data throughput. A channel with x bps may not necessarily transmit data at x rate, since protocols, encryption, and other factors can add appreciable overhead. For instance, a lot of internet traffic uses the transmission control protocol (TCP) which requires a three-way handshake for each transaction, which, though in many modern implementations is efficient, does add significant overhead compared to simpler protocols. In general, for any effective digital communication, a framing protocol is needed; overhead and effective throughput depends on implementation. Actual throughput is less than or equal to the actual channel capacity plus implementation overhead.

Asymptotic bandwidth:-The asymptotic bandwidth (formally asymptotic throughput) for a network is the measure of maximum throughput for a greedy source, for example when the message size (the number of packets per second from a source) approaches infinity. Asymptotic bandwidths are usually estimated by sending a number of very large messages through the network, measuring the end-to-end throughput. As other bandwidths, the asymptotic bandwidth is measured in multiples of bits per seconds.[7] Behrouz A. Forouzan, Data communications and networking, McGraw-Hill, 2007.

Peter Bright talks about the right amount of bandwidth a university campus needs. All things being equal, it is preferable to have more bandwidth rather than less. But of course, cost and availability both limit the bandwidth we can actually install, forcing organizations to consider not the amount of bandwidth that they want but rather the amount they need. They must also consider how those needs will change; greater use of cloud services such as Office 365 and Google Apps can push bandwidth demands ever higher.

And once a company has that bandwidth, how does it treat the users who rely on it? If you're in control of the network, the temptation to just "lock it down" can be a strong one. But it's not always the best choice—and when it's needed, it can often be done in more or less helpful ways.

To see how such bandwidth decisions get made, we turned to our readers. As readers work at organizations large and small, from offices of ten or fewer right up to sites with thousands or tens of thousands of users. Network provisioning is similarly variable, from ADSL at a measly 3Mbps downstream/1Mbps up to multiple gigabits of Tier 1 connectivity.. A more typical allocation was 6,000 users sharing a 2Gbps connection, for 41kBps per user. Managing this bandwidth follows different protocols. At one educational establishment of 6,500 students, with more than a gigabit of Internet bandwidth and high speed connections to Internet2, students sucking up bandwidth causes "some problems," but these are "partially controlled" by the threat of litigation; administrators "happily give names and addresses" when subpoenaed as part of lawsuits. A similar hard-line stance was taken by one of our readers who works at an Australian Web hosting company. Although the company has a "fair bit [of bandwidth] lying around," and it doesn't have bandwidth problems attributable to BitTorrent usage, staff members have nonetheless been fired for torrenting—not because they were detected by bandwidth monitoring systems, but because their torrents contained viruses or other undesirable material. At one software-as-a-service provider, the company grew faster than did its bandwidth. Connectivity problems came to a head when employees switched from YouTube to high-definition Netflix streams for their "idle entertainment," with a corresponding rise in bandwidth usage. The administrator, wise to what was going on, e-mailed the company with a graph showing the bandwidth spike and a demand to "pause the movie." Three things alleviated the issue. Netflix was banned—though other streaming media services like Pandora have somewhat filled the void—more bandwidth was installed, and sales and marketing moved to a different building. . [8] Peter Bright., 2015. Howmuch bandwidth a university really need.

III. Methodology

3.1 Introduction

In this chapter the research will deal on the steps, designs and tools used to carry out the project. Bandwidth requirements for network multimedia applications can range anywhere from 100 Kbps to 70 or 100 Mbps. Figure [1] Network bandwidth usage shows the amount of bandwidth that the various types of network multimedia applications require.

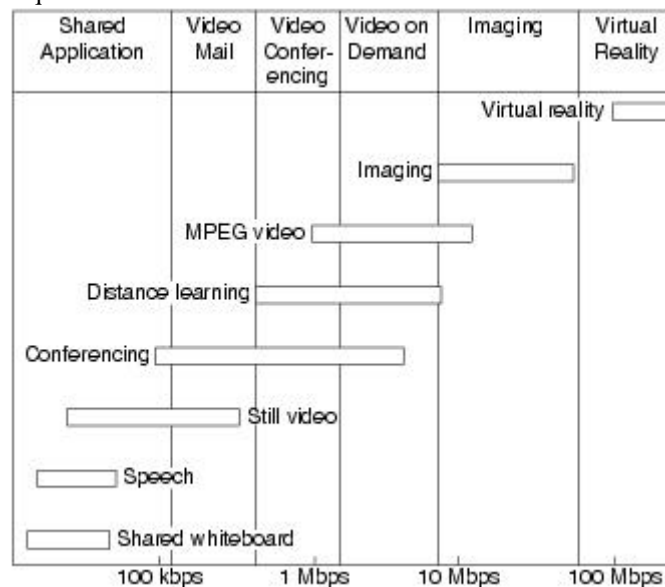
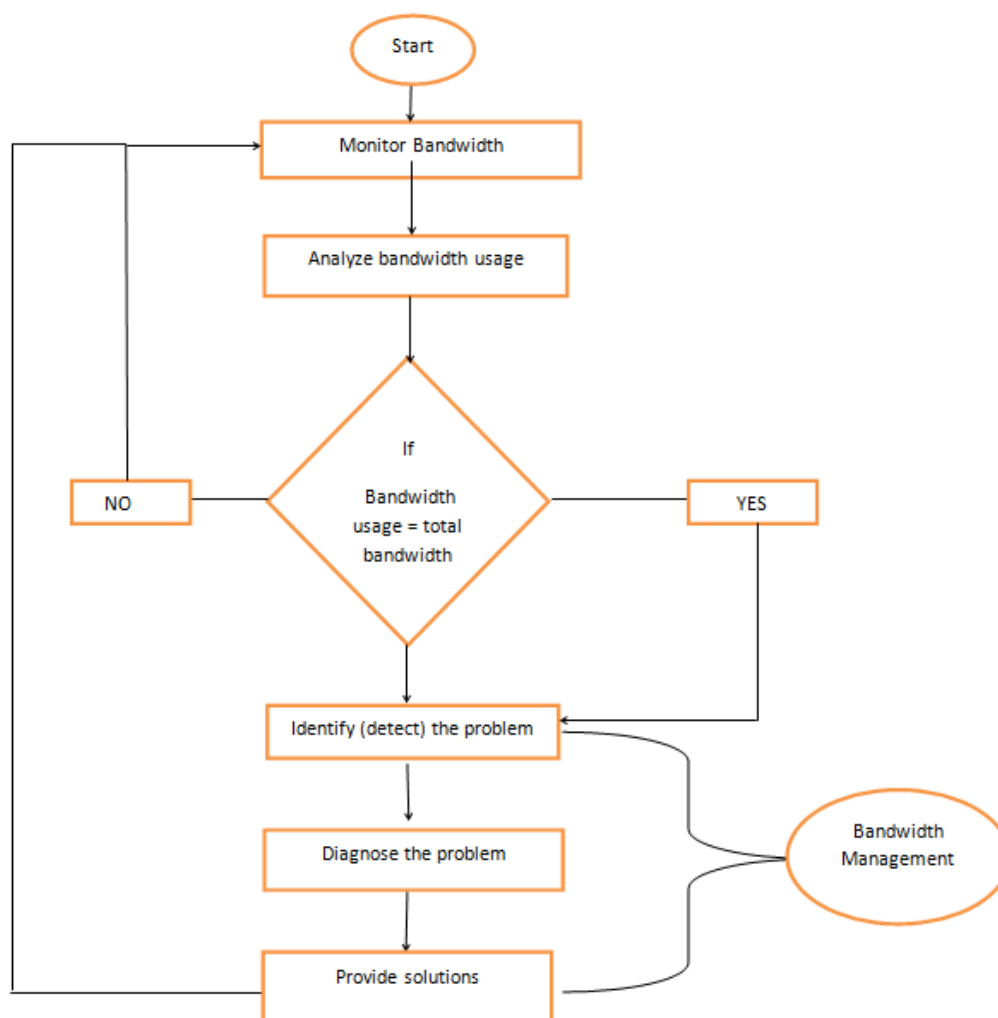


Figure 1: Network bandwidth usage

Network bandwidth usage indicates, the type of application has a direct impact on the amount of LAN or WAN bandwidth needed. Assuming that bandwidth is limited, the choice is either to select a lower quality video application that works within the available bandwidth, or consider modifying the network infrastructure to deliver more overall bandwidth.

3.2 Research Design



3.3 Analysis and Presentation

Monitor Bandwidth

TES will help analyze and monitor bandwidth within a local area network. Furthermore, TES has become more responsive in providing user-based details to manage the company's bandwidth more efficiently. Today, download trends has captured attention of all IT Managers with its impact on company's bandwidth. This feature helps IT to ensure that company's bandwidth allotted for users is adequately used.

For a network administrator to effectively monitor the network, he needs to take the following factors in consideration;

- Check bandwidth usage details of each users in real-time.
- Know the most common applications accessed by users list.
- Locate the access point connected by the user

Benefits of monitoring the network

- Helps to make you aware of shadow IT users
- Helps to keep control of bandwidth for business critical apps
- Provides more insights to let you locate the fault

Identify the network problem (Complaints)

Bandwidth is only one aspect of network performance and only one of several factors to look at when figuring out why a network application is not performing well. The first and most obvious is the capacity of your network and how much of that bandwidth is being used. To know whether it is being used efficiently, one also needs to look at which applications are generating the most traffic and between what endpoints. If the answer is still not clear, one may need to go to a deeper level of traffic analysis, looking at the speed and timing of the delivery of specific packets of data.

For a network administrator to effectively detect network problems, he needs to take the following factors in to consideration;

- Identify users, applications, and protocols that are consuming bandwidth down to the interface level
- Highlight IP addresses of top talkers and store and graphically display network performance statistics in real time via dynamic, drillable network maps.

3.4 Steps to Diagnosing Bandwidth Complaints

The solutions to bandwidth complaints are often obvious, once you know where to look. So how do you know where to look? Once you have a picture of activity across the network, that's often obvious, too. To see what is going on, you need a network monitoring tool that will let you visualize the flow of bandwidth and spot bottlenecks at a glance. Now that you have identified the weapons in your arsenal, here is how to deploy them. You can understand what's really going on with your network bandwidth in three steps.

3.4.1 Analyze SNMP data for your network links

If they really are saturated, that should be obvious. If you are getting complaints from a location that has a 10 Mbps LAN circuit and only 3 Mbps of usage, then clearly the LAN is not overloaded and something else must be going on.

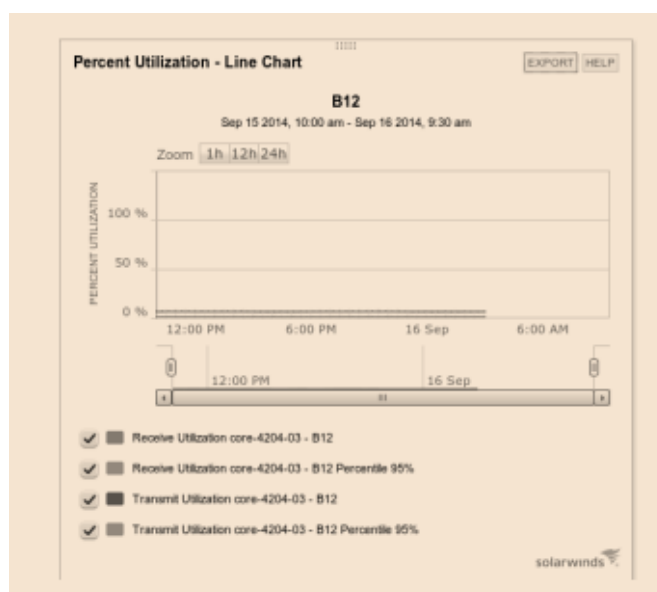


Figure 2: Network with no bandwidth issues

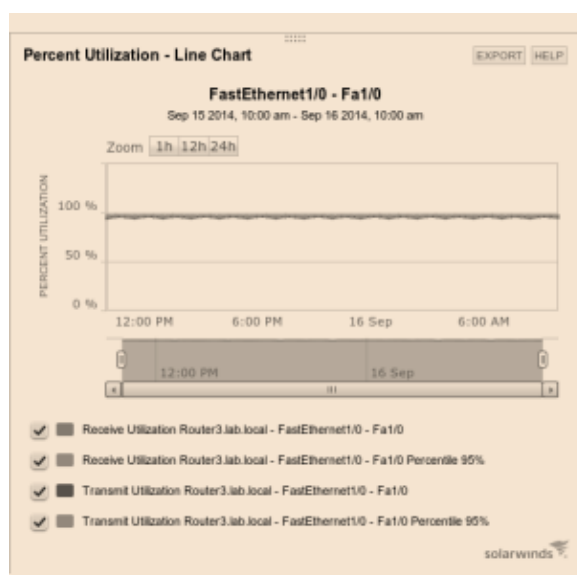


Figure 3: Network with bandwidth issues

3.4.2 Listen in on conversations

No, we are not really suggesting you spy on everyone. But if network usage is exceeding capacity, it's important to understand how it is being consumed. You don't have to snoop into the content of the messages to see who is talking to whom. In networking, a "conversation" is a series of requests and responses, such as the request for a web page and the data returned by the server. Most networking devices make this conversation data easily available using TES.

3.4.3 Look deeper into application behavior

Identify the applications consuming the most bandwidth and how they are being used. You can start by looking at Internet Protocol port numbers as an indicator of applications in use — for example, UDP port 514 for Syslog. A more sophisticated analysis would include deep packet inspection, which gives you more information about the protocols in use, the nature of the content, and the timing of the delivery of those packets.

Those are not necessarily sequential steps, but they are the three basic components of bandwidth analysis. With the help of a good monitoring tool, you should be able to look at all three in rapid succession. If in Step 1 you confirm the existence of a bandwidth capacity problem, Step 2 and Step 3 become important for pinpointing the source.

You might find that Fred Mendez in accounting has been downloading an entire season of Orange Is the New Black during work hours, and that's the real reason his colleagues haven't been able to access the financial data warehouse at just the time when they need to close the books for the month. (You wouldn't want to be George when his boss finds out.) Or maybe a router, switch, or some other critical component in the chain is failing and only performing at a fraction of its rated capacity. Replace it, and everyone is happy again.

3.5 Providing Solutions to Bandwidth Complaints

Research proved that, the best tool to use for bandwidth management is traffic engineering server (TES). Providing a solution to bandwidth complaints within the network can be very simple but complicated. The network administrator needs to identify the particular problems slowing down the network. It may be poor network connection from the internet service provider (ISP), video streaming or downloading using bit torrent. The network administrator needs to act by blocking or limiting the amount of megabytes given to a user or service consuming more bandwidth within the local area network. The following techniques will help manage and provide solutions to bandwidth complaints using (TES);

3.5.1 Techniques to Efficiently Manage Bandwidth Complaints

In order to start using of bandwidth management mechanisms of TES AP like traffic shaping and throttling, select "Preferences" in "Bandwidth Management" menu of TES Platform's the web administration panel. By default this feature comes with TES AP disabled so once you implemented TES into your network you might enable it and configure according to your bandwidth management needs

3.5.2 Bandwidth throttling

Is the intentional slowing of Internet service by an Internet service provider. It is a reactive measure employed in communication networks to regulate network traffic and minimize bandwidth congestion. Bandwidth throttling can occur at different locations on the network. On a local area network (LAN), a sysadmin may employ bandwidth throttling to help limit network congestion and server crashes. On a broader level, the Internet service provider may use bandwidth throttling to help reduce a user's usage of bandwidth that is supplied to the local network.

Throttling can be used to actively limit a user's upload and download rates on programs such as video streaming, BitTorrent protocols and other file sharing applications, as well as even out the usage of the total bandwidth supplied across all users on the network. Bandwidth throttling is also often used in Internet applications, in order to spread a load over a wider network to reduce local network congestion, or over a number of servers to avoid overloading individual ones, and so reduce their risk of crashing, and gain additional revenue by compelling users to use more expensive pricing schemes where bandwidth is not throttled.

3.5.3 Activity limit

If the global usage of your Internet access link is low, then it makes sense not to enable Throttle for subscribers and allow them to consume any amount of traffic they want, so the bandwidth isn't be wasted. The Activity limit defines the maximum Internet access link utilization percentage under which throttle engine will ignore all traffic consumption violations.

For example, if you have a 10 Mbps link to the Internet on download and the Activity limit is set to '20', Throttle engine will not take any actions until the total link load is more than 2 Mbps (20% of 10Mbps).

Throttled uplink: -Specifies the maximum bandwidth amount on upload the IP will be limited to if threshold has been met.

Throttled downlink:-Specifies the maximum bandwidth amount on download the IP will be limited to if threshold has been met.

Ignore activity limit: -Enables TES to ignore Activity limit and throttle all the time.

3.5.4 Bandwidth allocation

How can the project give a download limit for each user. For example, when using Ether Fast Cable/DSL router with an 8-port switch. That device supports QoS policy settings to limit bandwidth based on three potential criteria: device priority, Ethernet port priority, or application priority. To satisfy your requirement, setting up a rate-limit based on device priority would ensure that you have limited the rate at which that particular user can transfer data through that device

3.5.5 Quality of Service (QoS)

Refers to the capability of a network to provide prioritization to certain network traffic. TES may control the traffic flows and prioritize your preferred applications traffic as well as deprioritize unwanted traffic.

TES AP supports 7 QoS levels (from 0 to 6) for prioritization. QoS level zero is of highest priority and can be used to provide QoS for mission critical applications e.g. VoIP or DNS. Seventh level is of the lowest priority and is usually used for unwanted network applications (e.g. P2P). If you want to make sure your subscribers always receive the best browsing performance, you can put HTTP and HTTPS protocols into QoS level 0. Equivalently, if you want to defeat excessive levels of unwanted P2P traffic, you can put P2P applications in the QoS level 7 so they won't overlap applications traffic attributed to better QoS levels. Select item "Quality of service" in the main menu in order to configure TES QoS.

3.6 Study Area

The research project will focus on network bandwidth. Bandwidth may be characterized as;

- Network bandwidth
- Data bandwidth,
- Digital bandwidth.

The research will seek to effectively manage resources within a local area network. Furthermore, the project will be simulated in the SIT lab CUIB campus.

3.7 Tools/ Requirements

- Computers/ Server
- CD disk.
- Ethernet cables
- Switch
- Modem
- Two network Adapter

3.8 Design Setup

Traffic Engineering Server (TES) is Internet Gateway Router (or Bridge) with powerful and easy to use bandwidth management, quality of service, security, acceleration/optimization, monitoring and filtering features. TES solutions are especially suitable for Small and Medium-sized University campus. Broadband and Wireless Internet Service Providers (ISPs). Providing numbers of tools to control analyze measure and filter TCP/IP traffic TES helps to share Internet connection within subscribers in highly efficient and optimized way increasing LAN performance and security.

The main goal of deploying TES Platform is to achieve the best network Performance, reliability and security by highly efficient Internet backbone resources utilization, malicious traffic filtering and effective bandwidth management implementation like Quality of Service as well as accurate and reliable traffic shaping

A quick 10-minute installation workflow can be outlined in the following steps:

- Download TES Platform installation CD image from website <http://www.bctes.com>.
- Burn downloaded ISO file to a blank CD and boot hardware server with it
- Install TES Platform software
- Connect your local network and Internet access gateway to TES Platform
- Establish web browser connection with TES
- Configure TES Platform network interfaces
- Re-initialize the TES
- Do basic routing tests, setup additional TES features

To install TES Platform onto the hardware server which meets requirements in section 1.1 please follow instructions below:

- Download the latest ISO image from www.bctes.com
- Burn downloaded ISO file onto a blank CD.

- Connect monitor and keyboard to your hardware server.
- Boot the server with a CD prepared before. In order to do it restart server and press keyboard key you are told is needed to enter BIOS Setup. In the Boot section you should adjust the settings like Boot Order, Boot Device Priority or possibly some other section. Make sure that your CD drive is set to be your first boot device, save BIOS settings and restart computer to boot from bootable CD.

The diagram below will better explain the concept of Traffic Engineering Server

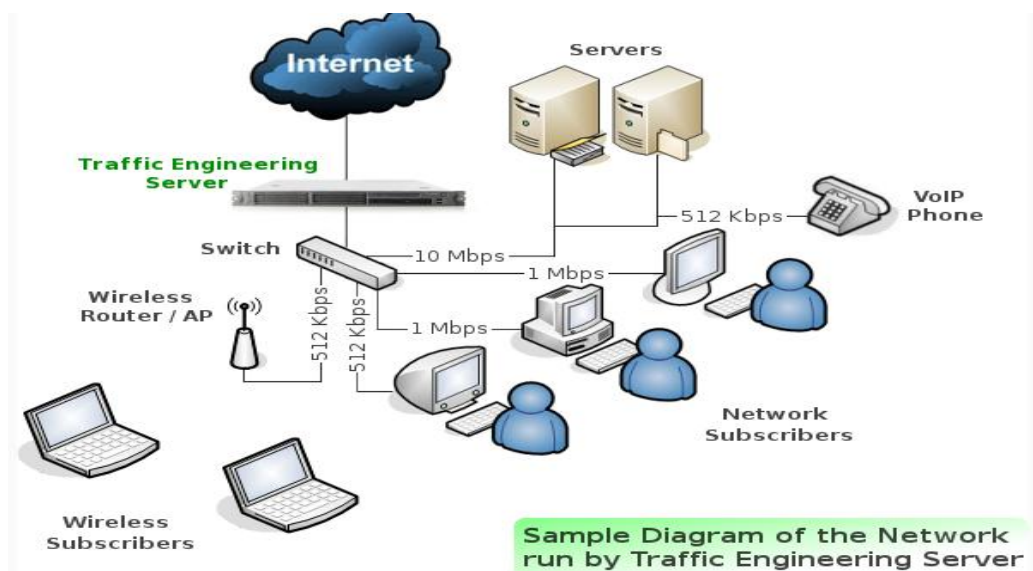


Figure 4: Diagram of A Network Run by Traffic Traffic Engineering Server

IV. IMPLEMENTATION AND RESULTS

4.1) Introduction

This chapter shows the implementation details of Diagnosis and effective management of bandwidth project. It also shows the steps required to achieve the complete bandwidth management process. Also, it introduces the project testing using different features of Traffic Engineering server (TES) and the results after testing.

USING TES PLATFORM

The TES platform offers two panels to access it features and functions

4.2 Terminal Access Panel for basic configuration of TES Platform when HTML GUI is not available or for accessing features which are available only through Terminal Access Panel (e.g. real time network interfaces statistics or health status information).

Graphic view of Terminal Access Panel

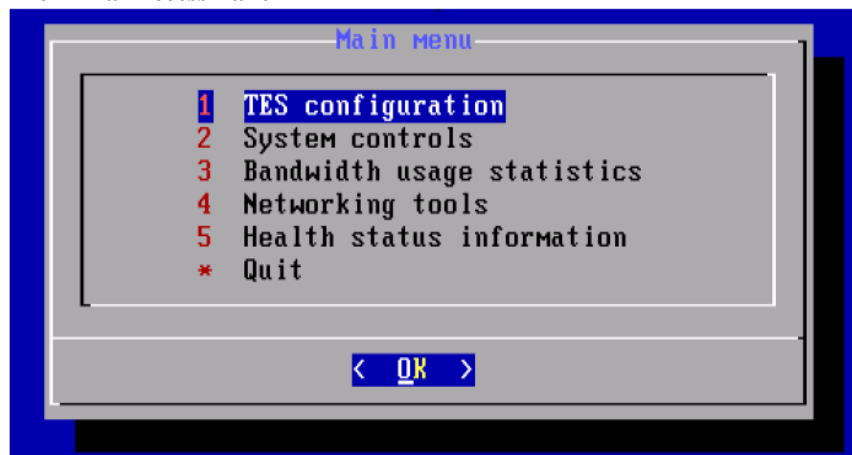


Figure 5: Terminal access pane

4.3 Web Administration Panel (HTML GUI):-For main configuring purposes using Internet browser.
Graphic view of Web administration panel

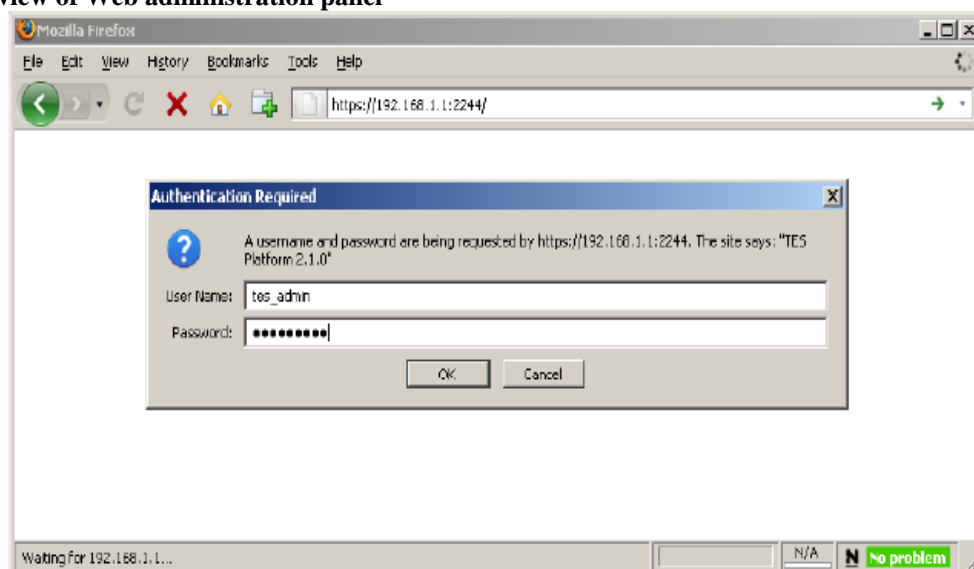


Figure 6: Web administration panel

Use the following details to access both administration panels:

- Username: **tes_admin**
- Password: **tes_admin**

The project will focus on **HTML GUI** as it is the most intuitive way to get started. It is meant to be used via mostly any web browser including Mozilla Firefox, Opera and others. Every component and routine of TES Platform and TES AP (if installed) can be configured and controlled through web administration panel. The TES Platform software comes pre-configured with LAN and WAN network interface cards (NIC) assigned Internet Protocol (IP) addresses: 192.168.1.1/ 255.255.255.0 and 192.168.0.1/255.255.255.0 respectively (router networking mode). Once TES Platform and the computer are in the same network/subnet (192.168.1.0/255.255.255.0), use your web browser to access HTML GUI as it is depicted as If your web browser shows Secure Connection Error, you can add security exception by pressing option” link or other depending on web browser you are using.

The project will focus on how to access web administration panel. In order to access Web Administration Panel it is necessary to connect your PC or laptop via Ethernet cable (e.g. UTP CAT5) to TES Platform with the subnet set as (192.168.1.0/255.255.255.0)or (192.168.0.0/255.255.255.0) and point your browser to the following URL: https://192.168.0.1:2244 (or https://192.168.1.1:2244) An example of connection between PC and TES Platform is depicted at Figure 2. It assumes a crossover Ethernet cable and the following IP set up at the desktop PC: 192.168.1.2/255.255.255.0.

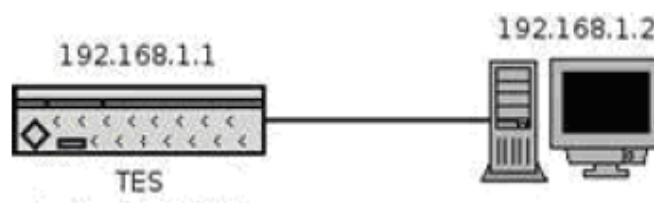


Figure 7: Interconnection between TES and PC

4.4 Implementation and Configuration Graphic view of TES ControlSystem

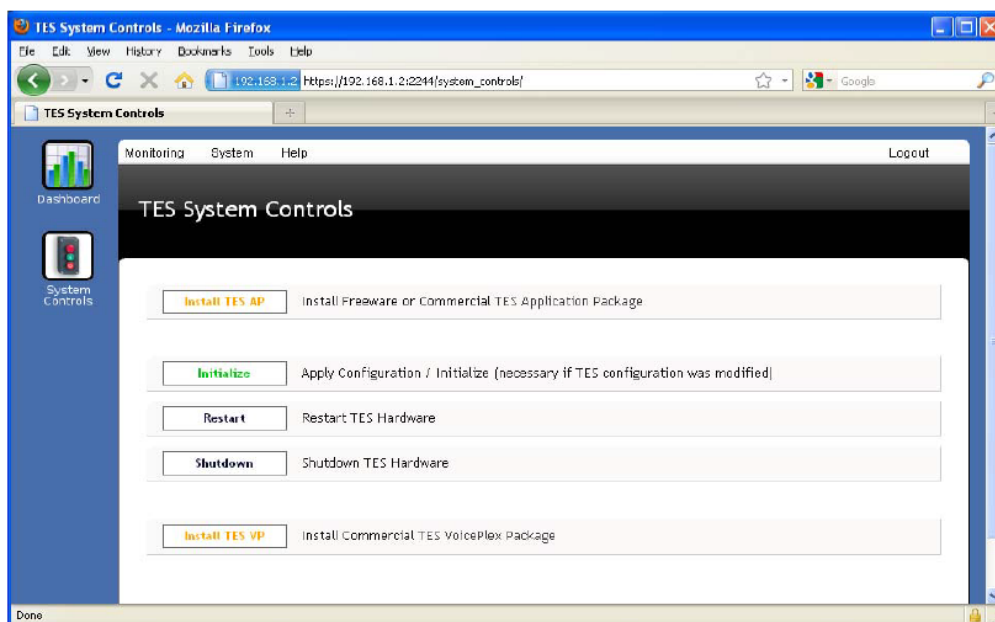


Figure 8: TES Control System

4.5 Bandwidth Management Setup

In order to start using of bandwidth management mechanisms of TES AP like traffic shaping and throttling, select “Preferences” in “Bandwidth Management” menu of TES Platform’s the web administration panel. By default this feature comes with TES AP disabled so once you implemented TES into your network you might enable it and configure according to your bandwidth management needs.

Graphic View Of Bandwidth Management Setup

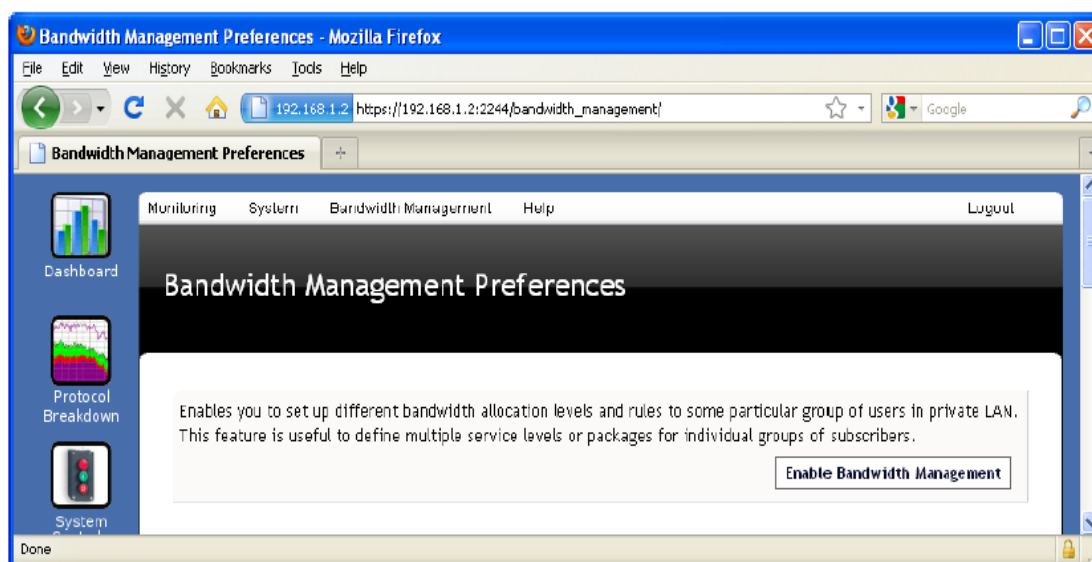


Figure 9: Bandwidth Management Preferences

4.6 Bandwidth Management configuration

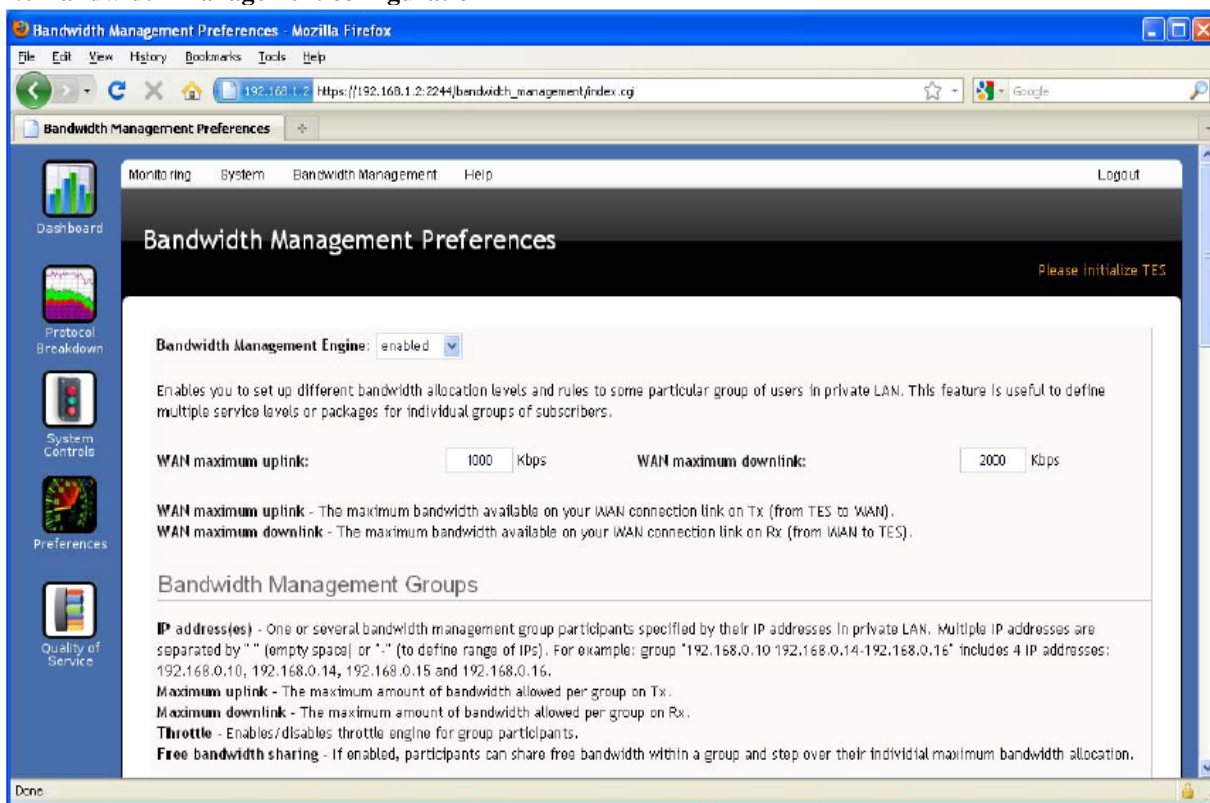


Figure 10: Bandwidth Management configuration

The tool used by was project had limitations; the main objectives of the research are to monitor and provide solutions to bandwidth problems. Complaints like the network is slow or the transition of data is slow. TES has a perfect feature called “**Throttle**” under bandwidth management to solve issues of poor network performance.

Throttling

TES has a throttle engine which automatically analyses traffic consumption levels per each local IP in real-time mode and takes decisions to limit the bandwidth per any particular IP if the threshold level has been met. Throttle is useful to prevent small percentage of network subscribers occupying the large portion of your Internet access link by aggressively and continuously downloading large multimedia content. It also helps to prevent accidental flood and virus traffic to seize the whole link

4.7 Throttle Engine configuration

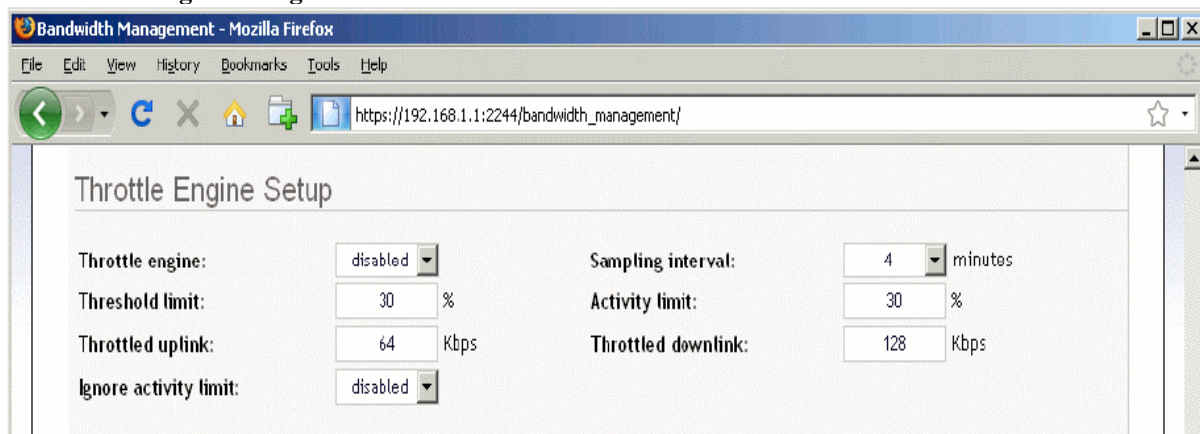


Figure 11: Throttle Engine configuration

Sampling interval: - Specifies desirable time interval for Throttle engine to analyze traffic consumption levels in minutes. For example, setting the interval to '4' means the engine will check traffic statistics and will take decisions every four minutes.

Threshold limit:-Defines the maximum allowed sustained throughput per each local network subscriber, specified in percent's from the maximal allowed bandwidth per subscriber - on the downlink. For example, if the Threshold limit is set to '30', Sampling interval set to '2' and the maximum amount of bandwidth on download is set to 300 kbps, the throttling Threshold will be defined as 90kbps ($300 * 30\% = 90$ kbps). In this particular case, if a single IP in your local network passes traffic at the speed of equal or more than 90 kbps during the whole 2 minutes interval, its bandwidth will be automatically limited to prevent such an abuse.

Activity limit:- If the global usage of your Internet access link is low, then it makes sense not to enable Throttle for subscribers and allow them to consume any amount of traffic they want, so the bandwidth is not be wasted. The Activity limit defines the maximum Internet access link utilization percentage under which throttle engine will ignore all traffic consumption violations. For example, if you have a 10 Mbps link to the Internet on download and the Activity limit is set to '20', Throttle engine will not take any actions until the total link load is more than 2 Mbps (20% of 10Mbps).

Throttled uplink specifies the maximum bandwidth amount on upload the IP will be limited to if threshold has been met.

Throttled downlink specifies the maximum bandwidth amount on download the IP will be limited to if threshold has been met.

Ignore activity limit enables TES to ignore Activity limit and throttle all the time.

4.8 Bandwidth Simulation Results

The results of the project will be based on throttling bandwidth within a local area network.

4.8.1 Graphic view of Local Area Network with no throttle

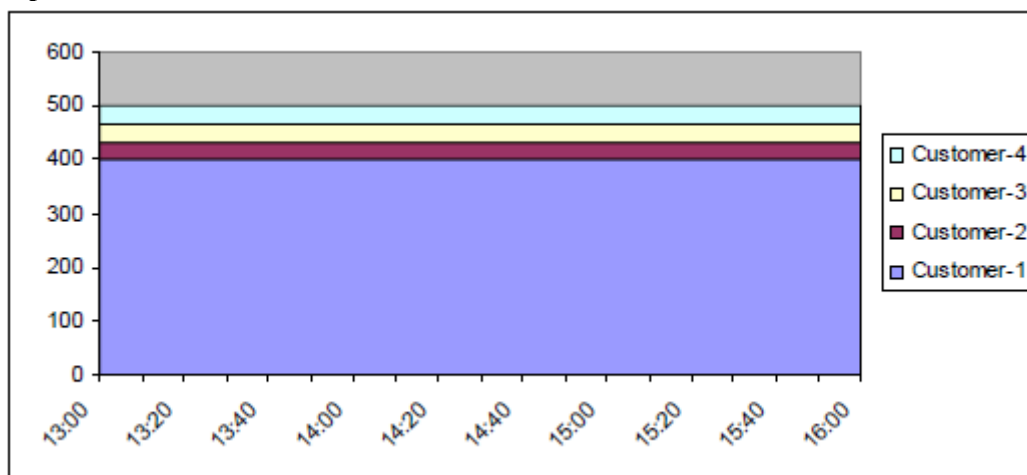


Figure 12: Local Area Network with no throttle

Assuming your Internet connection supports a maximum of 500 kbps, the throttling chart at Figure [13] depicts a Customer-1 steadily consuming 400 kbps of bandwidth with an always on download seizing almost all the Internet access link and compromising the service performance for the remaining customers. Such kind of a download abuse is a pretty frequent occurrence in nowadays networking world with larger media content now appearing in the Internet – such as video and audio files, ISO images and similar files sizing hundreds of megabytes or even a couple of gigabytes.

4.8.2 Graphic view of Local Area Network with throttle

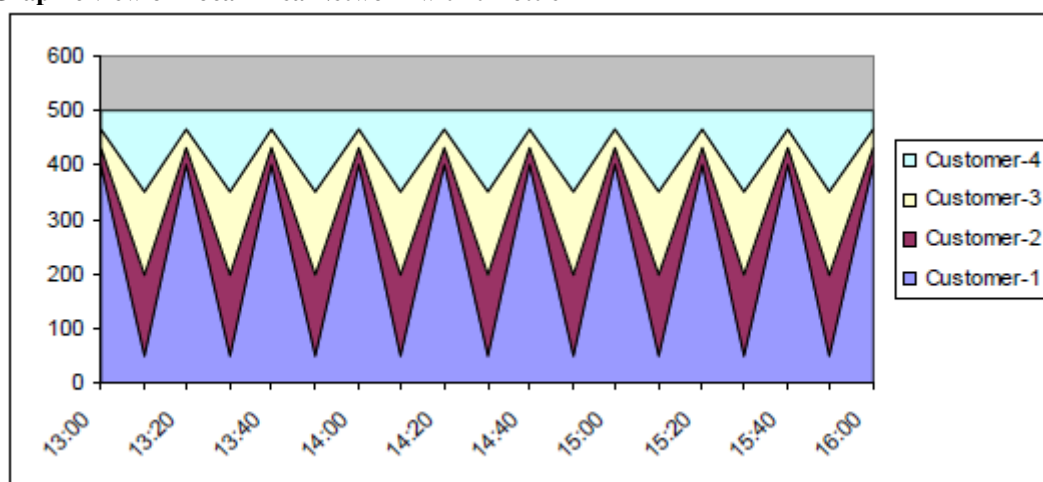


Figure 13: Local Area Network with throttle

With a Throttling Engine turned on, the Customer-1 is automatically throttled back to 50 kbps every 4 minutes, allowing remaining customers to receive a better level of service. Please notice that these charts are for indicative purposes only and your throttling settings should be setup the way they reflect the actual throughput situation of your network and your Internet connection.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary Of The Study

The study seeks to guarantee quality of service with high bandwidth utilization while servicing the largest possible number of LAN connections can be achieved through a combination of intelligent admission control, bandwidth reservation and statistical multiplexing. The motivation for carrying out this project is to research deeply on poor network performance. While researching on why end- users and clients complain on poor network performance, discoveries were made that, these problems sum up to one word “**Bandwidth**”. In organizations, company, offices and home people always complain of slow internet connection. The main aim is to boost network speed and manage service/application effectively within a local area network.

5.2 Conclusion

It allows us to give appropriate priority to education and business related network traffic while at the same time allowing recreational traffic at low priority. Bandwidth management will save us money on bandwidth while allowing us to provide better and more appropriate network access.

5.3 Challenges and Recommendation

5.3.1 Challenges

The project demanded a lot of time and configuration. In addition, the project had challenges with setting up the environment for installation. It had problems with lack of equipment’s to meet up the demands of the TES installation.

5.3.2 Recommendation

The project recommends dedicated and reliable communication within the local area network. If there is no dedicated internet service, 3G/4G WIFI can be used as backup. Furthermore, 59% of institutions do not monitor or manage bandwidth at all efficient bandwidth monitoring tools are recommended within any local area network to avoid congestions and poor network performance. Improving bandwidth management is probably the easiest way for universities to improve the quality of their bandwidth for educational purposes

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