A study of Bandwidth Management in Computer Networks

Devajit Mahanta, Majidul Ahmed, Utpal Jyoti Bora

Abstract Bandwidth management is one of the most widely misunderstood subjects in modern networking. Bandwidth Management is a lot like economics, because the complexities of how it works are beyond simple logic. Internet "bandwidth" is not a spectrum; traffic streams are one bit at a time. Bandwidth on the internet can only be conceptualized over time, and the amount of time that you talk about can greatly change the user experience. For reliable data transmission within computer network and internet forms the basis for management and control of bandwidth. Without bandwidth management, an user will not be able to handle all available bandwidth on the networks. It will be impossible to differentiate between various network traffics, and it will also be difficult to control which user or application has priority on the network. Applications which require specific quantity and quality of service may not be predicted in terms of available bandwidth, thus making some applications run poorly due to improper bandwidth allocation. This work focus on the development of an application to combat the challenges facing easy flow of data transmission problems in network design as organization network evolves. Here PHP Script, Apache Server and MySQL are the development tools used.

Keywords- Bandwidth management, internet, data transmission, computer networks.

I. INTRODUCTION

A computer network, or simply a network, is a collection of computers and other hardware interconnected by communication channels that allow sharing of resources and information. Where at least one process in one device is able to send/receive data to/from at least one process residing in a remote device, then the two devices are said to be in a network.

1.1 Types of network

Networks are often classified by their physical or organizational extent or their purpose. Some of this are-

Personal area network:-A personal area network (PAN) is a computer network used for communication among computer and different information technological devices close to one person. Some examples of devices that are used in a PAN are personal computers, printers, fax machines, telephones, PDAs, scanners, and even video game consoles. A PAN may include wired and wireless devices.

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Home network:-A home network is a residential LAN which is used for communication between digital devices typically deployed in the home, usually a small number of personal computers and accessories, such as printers and mobile computing devices. An important function is the sharing of Internet access, often a broadband service through a cable TV or Digital Subscriber Line (DSL) provider.

Campus network:-A campus network is a computer network made up of an interconnection of LANs within a limited geographical area. The networking equipment (switches, routers) and transmission media (optical fiber, copper plant, Cat5 cabling etc.) are almost entirely owned (by the campus tenant / owner: an enterprise, university, government etc.).

Enterprise private network:-An enterprise private network is a network built by an enterprise to interconnect various company sites, e.g., production sites, head offices, remote offices, shops, in order to share computer resources.

Virtual private network:-A virtual private network (VPN) is a computer network in which some of the links between nodes are carried by open connections or virtual circuits in some larger network (e.g., the Internet) instead of by physical wires. The data link layer protocols of the virtual network are said to be tunneled through the larger network when this is the case.

Local area network:-A local area network (LAN) is a network that connects computers and devices in a limited geographical area such as home, school, computer laboratory, office building, or closely positioned group of buildings. Each computer or device on the network is a node (Figure 1).
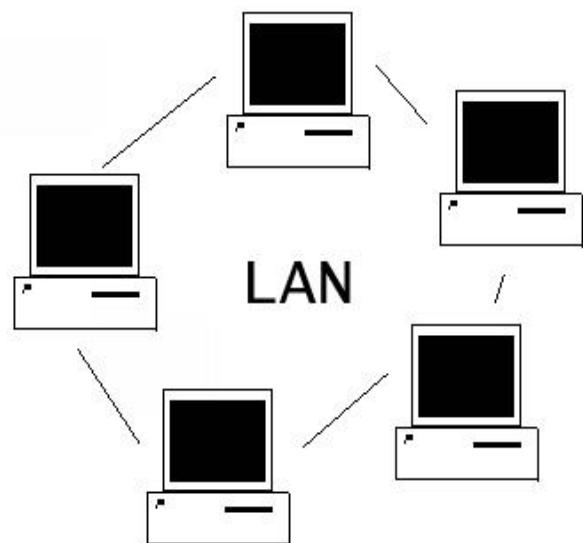

Figure 1: Local Area Network

Metropolitan area network:-A Metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus.

Wide area network:-A wide area network (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances, using a communications channel that combines many types of media such as telephone lines, cables, and air waves (Figure 2). A WAN often uses transmission facilities provided by common carriers, such as telephone companies. WAN technologies generally function at the lower three layers of the OSI reference model: the physical layer, the data link layer, and the network layer.
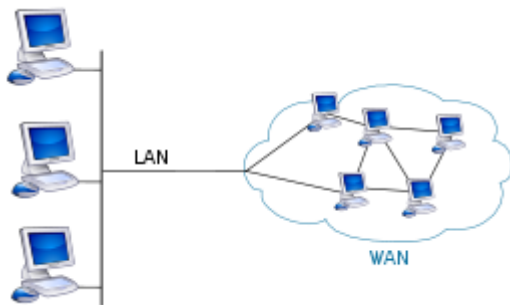

Figure 2: - Wide area network

1.2 Communications protocols:-

Communications protocols define the rules and data formats for exchanging information in a computer network, and provide the basis for network programming. Well-known communications protocols include two Ethernet, a hardware and link layer standard that is ubiquitous in local area networks, and the Internet protocol suite, which defines a set of protocols for internetworking, i.e. for data communication between multiple networks, as well as host-to-host data transfer, and application-specific data transmission formats. Computer networking is sometimes considered a sub-discipline of electrical engineering, telecommunications, computer science, information technology or computer, since it relies upon the theoretical and practical application of these disciplines.

1.3 Bandwidth

Bandwidth (Fig- 3) in computer networking refers to the data rate supported by a network connection or interface. One most commonly expresses bandwidth in terms of bits per second (bps). The term comes from the field of electrical engineering, where bandwidth represents the total distance or range between the highest and lowest signals on the communication channel (band).

Bandwidth represents the capacity of the connection. The greater the capacity, the more likely that greater performance will follow, though overall performance also depends on other factors, such as latency. In general, network bandwidth is a bit rate measure of available or consumed data communication resources expressed in bits/second or its multiples (kilobits/s, megabits/s etc.). Now a days computer Networks are play very important role our various job they can transfer and received voice, data, images, and video. But voice, data, images, and video have different requirements in terms of bandwidth, cell loss, delay, etc. In order to maximize the quality of service offered during the period of stress, as viewed by both the network provider and the customer, the following bandwidth challenges are to be considered:

a. Topology design and bandwidth allocation
b. Flow control and congestion avoidance.
c. Bandwidth allocation, the most critical challenge, is concerned with successful integration of link capacities through the different types of services. Given that a virtual path is a logical direct link composed of virtual circuits between any two nodes; and

Bandwidth management given following benefit

a. FASTER APPLICATIONS
b. REDUCE BOTTLENECKS
c. ACCELERATE & COMPRESS TRAFFIC
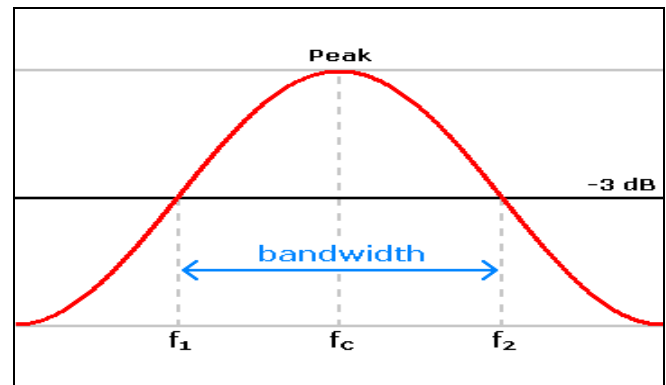d. BETTER CONTROL OVER YOUR NETWORK

Fig- 3 Bandwidth

Bandwidth management from Managed Communications enables our business to benefit by getting:

a) Get better information - we can better understand your bandwidth usage with comprehensive bandwidth management tools
b) Faster application speed - bandwidth management can allocate bandwidth to key critical applications enabling better performance
c) Reduce unwanted traffic - we can isolate P2P users or bandwidth hogs on your network so that you control the quality of performance seen across your data connections
d) More bandwidth - we can achieve up to 35 times the throughput with bandwidth management services.

In most cases you can count on doubling your throughput without a network upgrade.Without bandwidth management, an application or a user will not be able to control all available bandwidth and prevent other applications or users from using the networks. It will be impossible to differentiate between different types of network traffic, and it will also be difficult to control which users or applications have priority on the network. Applications which require specific quantity and quality of service may not be predicted in terms of available bandwidth, thus making some applications run poorly due to improper bandwidth allocation. Bandwidth management works by sorting outbound network traffic into classes by application and service type. There is an ever-increasing need for network bandwidth. Companies are growing, adding new offices and remote sites, using technologically advanced and powerful applications, and internet usage has exploded in the last decade.

Local area networks (LANs) are in need of bandwidth. How much is required depending on individual company and user, and user's requirement can changed unexpectedly and sporadically. Bandwidth can be expensive, and when LANs begin to slow down because of heavier usage, more bandwidth is often required. Corporate networks using intranets for information sharing and web navigation have an increased demand for bandwidth, but simply adding one more connection or larger connections does not address the bandwidth issues since availability is not always guaranteed.

This work helps in bandwidth management and efficient bandwidth allocation, which reduces the traffic congestion on the network and increasing the speed of data transfer and handling whole bandwidth.

II. SYSTEM DESIGN

The current application is wireless-based thus the evolutionary prototyping which allow for gradual development of a system in an environment where the system requirements may change over time was adopted.

2.1 SYSTEM DESIGN TOOLS:

The following software development tools were employed for this wok.

a) PHP :- PHP is an open source general-purpose server-side scripting language originally designed for Web development to produce dynamic Web pages. It is one of the first developed server-side scripting languages to be embedded into an HTML source document rather than calling an external file to process data. The code is interpreted by a Web server with a PHP processor module which generates the resulting Web page. It also has evolved to include a command-line interface capability and can be used in standalone graphical applications. PHP can be deployed on most Web servers and also as a standalone shell on almost every operating system and platform free of charge. A competitor to Microsoft's Active Server Pages (ASP) server-side script engine and similar languages, PHP is installed on more than 20 million Web sites and 1 million Web servers.PHP was originally created by Rasmus Lerdorf in 1995. The main implementation of PHP is now produced by The PHP Group and serves as the formal reference to the PHP language. PHP is free software released under the PHP License, which is incompatible with the GNU General Public License (GPL) due to restrictions on the usage of the term *PHP*.

b) MySQL :- MySQL is the world's most used open source relational database management system (RDBMS) as of 2008 that runs as a server providing multi-user access to a number of databases. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation.

MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open source web application software stack (and other 'AMP' stacks).

c) Notepad++ :-

Notepad++ is a text editor and source code editor for Windows. It aims to be a lightweight and robust editor for a variety of programming and scripting languages. One advantage of Notepad++ over the built-in Windows text editor, Notepad, is tabbed editing, which allows working with multiple open files. Notepad++ is distributed as free software. The project was hosted on SourceForge.net, from where it has been downloaded over 27 million times and twice won the Source Forge Community Choice Award for Best Developer Tool.[4] The project is hosted onTux Family since June 2010. To display and edit text and programming language source code files, Notepad++ uses the Scintilla editor component.

d) Apache:

The Apache HTTP Server, commonly referred to as Apache is a web server software notable for playing a key role in the initial growth of the World Wide Web. In 2009 it became the first web server software to surpass the 100 million website milestone. Apache was the first viable alternative to the Netscape Communications Corporation web server (currently named Oracle i Planet Web Server), and since has evolved to dominate other web servers in terms of functionality and performance. Typically Apache is run on a Unix-like operating system, and was developed for use on Linux. Apache is developed and maintained by an open community of developers under the auspices of the Apache Software Foundation. The application is available for a wide variety of operating systems, including Unix, FreeBSD, Linux, Solaris, Novell NetWare, OS X, Microsoft Windows, OS/2, TPF. Released under the Apache License, Apache is open-source software.

e) Browser:- A browser is a software application for retrieving, presenting and traversing information resources on the World Wide Web. An *information resource* is identified by a Uniform Resource Identifier (URI) and may be a web page, image, video or other piece of content. Hyperlinks present in resources enable users easily to navigate their browsers to related resources. A web browser can also be defined as an application software or program designed to enable users to access, retrieve and view documents and other resources on the Internet.

2.2 System Description

Here the system of this work simulates a simple wireless based intranet network environment which calculates the size of any file that is to be sent over the network. when the file size exceeds the allotted bandwidth by the administrator, the transfer process is terminated. The system also enables an administrator to change the allowed network bandwidth based on preferences. Clients systems are allowed to share and transfer files as long as they are within the allowed bandwidth range. The Network layout, system architecture and the system flowchart are depicted in Figure 4,5,6 respectively.
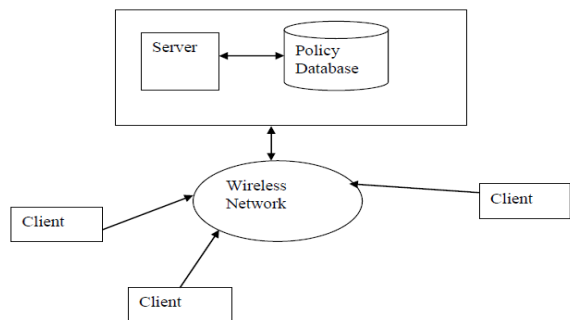
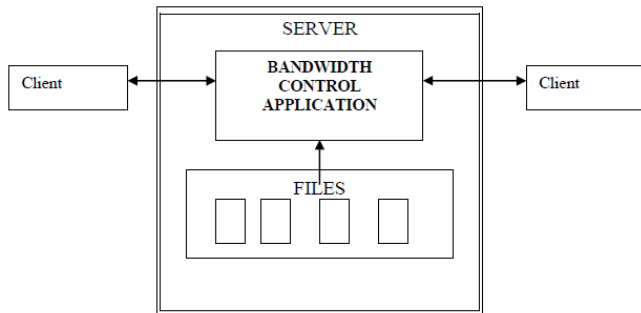Figure 4: Network layout of the simulated environment
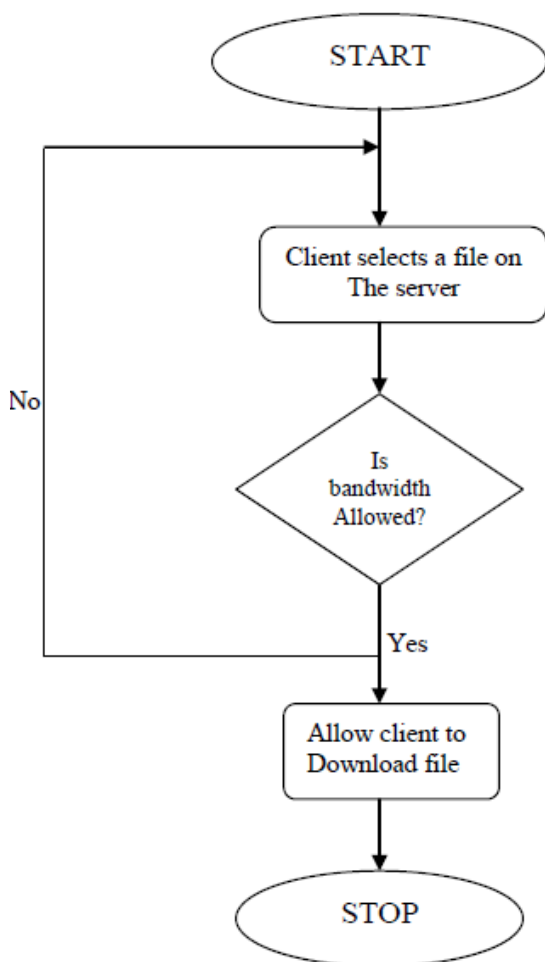

Figure 5: Architecture of the system

Figure 6: A flowchart of the system

Table 1: The admin table

	Field	Type	Collation	Attributes	Null	Default	Extra
☐	admin_id	mediumint(10)			No		
☐	first_name	varchar(255)	latin1_swedish_ci		No		
☐	last_name	varchar(255)	latin1_swedish_ci		No		
☐	username	varchar(255)	latin1_swedish_ci		No		
☐	password	varchar(255)	latin1_swedish_ci		No		

Table 2 The bandwidth_policy table

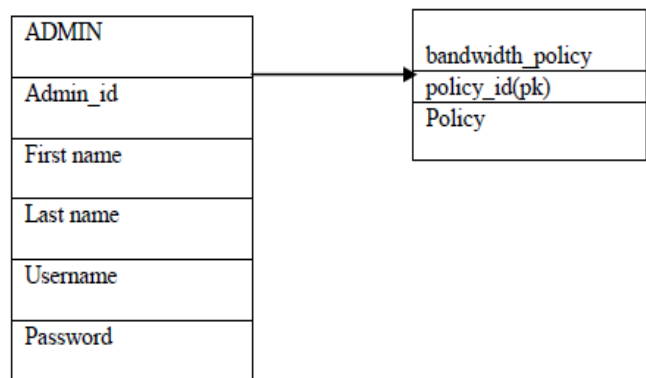|	Field	Type	Collation	Attributes	Null	Default
☐	policy_id	mediumint(10)			No	
☐	policy	varchar(255)	latin1_swedish_ci		No	

Figure 7: Entity relationship diagram of the system

III. IMPLEMENTATION

Here various modules are integrated together through as single interface. All modules has been packaged .The packaged modules also installed on the testing server, each module has some specific requirements but generally certain minimum specifications that are met. This application will consist of the following modules:

3.1 Login Module

This module (figure 8) enables a registered administrator to login after the user must have provided correct details. It returns an error message when the admin does not enter the correct username and password. For entry under this require a correct correct username and password.
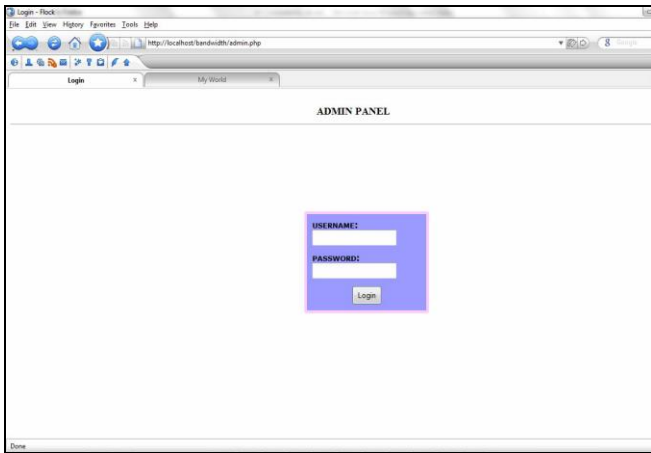
2.3 Database Design

Here the databases for this application consist of 2 tables. They are-
Table 1: The admin table.
Table 2: The bandwidth policy table
The entity relationship model (ERD) is depicted in Figure 7.

Figure 8: Administrator login module

3.2   Update Policy Module

In **Update Policy** module (figure 9) enables the administrator to change the allocated bandwidth size. Here, the admin is presented with a form field to enter the size. After entering the size, this module displays a success

message. If the administrator enters alphabets in the provided form field, an error message will be returned. If the update button is also clicked without entering any data into the form field, an error message is also returned.

Figure 9: Update policy module

3.3   The files directory module

The files directory module (figure 10) shows a list of files on the network available for download. It shows the name of the file and with their size. This is also provides a link with which the user can download the file for future work.
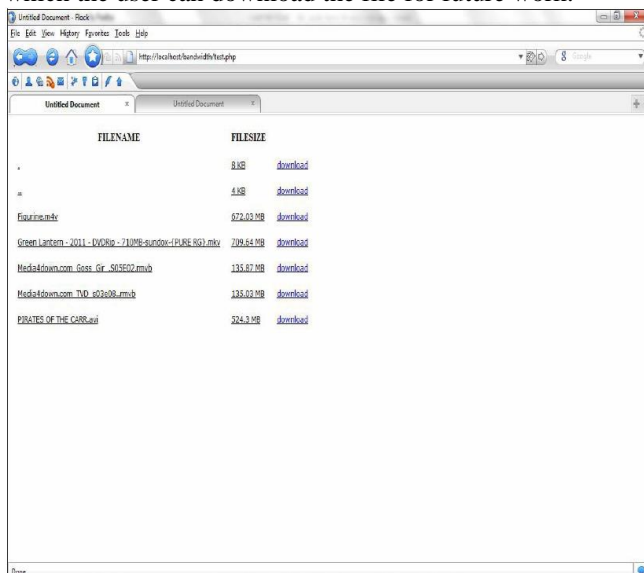

Figure 9: Files directory module

3.4 Download module

This module requires any third party software for downloading files. Popular ones include Internet download manager, Firefox download manager, download accelerator ,internet exploler,google chrome etc. Depending on the allocated bandwidth, the download manger might download fast or slow. If the allocated bandwidth is high, download is extremely fast and vice versa as depicted in figure 11.
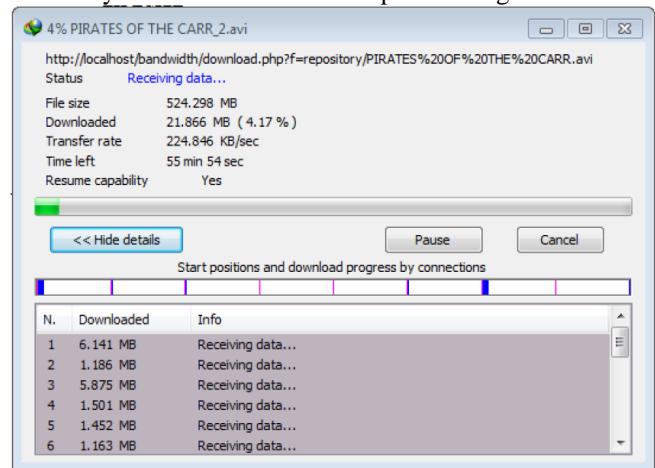

Figure 11: Download module

IV.   CONCLUSION AND FUTURE WORK

Using bandwidth management to allocate bandwidth to applications or users during peak times can prevent traffic congestion on the network. When bandwidth is bought and controlled, data's and communications are transferred around easily. Networks make it very easy for users that need to send information at a fast pace. This work presents a testable application that combat the challenges facing easy flow of data transmission problems in network design as organization network evolves. Further work improvement on the system is recommended to assist large scale organizations in the management and control of their computer networks bandwidth.

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