MANAGEMENT OF INTERNET BANDWIDTH IMPLEMENTING COOVACHILLI AND FREE RADIUS

Rabindra Phoju[1], Krishna Prasad Bhandari[2]

[1]*Department of Electronics and Communication, Khwopa Engineering College, Libali-8, Bhaktapur, Nepal*
[2]*Nepal Telecom, Doorsanchar Bhawan, Bhadrakali Plaza, Kathmandu, Nepal*

Abstract

With rapid growth in popularity and use of Internet in academic institutions, the institutions are struggling to keep up with the demand. They need capability to effectively control, monitor and optimize the available bandwidth to ensure good service at optimum cost. This paper has described implementation of Coovachill and free radius for management of internet bandwidth in academic institutions. During this research, freeware tools such as Freeradius and CoovaChilli have been used to manage Internet bandwidth on a per-user basis based on user credentials. The mechanisms have been used to control bandwidth of Wireless users. Same can be used for wired connections also. When a user tries to connect, the user is redirected to a captive portal under CoovaChilli. There the user provides login and password. Based on the credentials thus provided, CoovaChilli checks identity with the Freeradius. If authorized, the client is allowed access with the bandwidth as mentioned in the profile of the user in WISPr attributes define in Radreply table of Freeradius. When the user is not authorized, CoovaChilli sends an error message. This paper demonstrates that bandwidth can be effectively monitored, managed and optimized by using cost-effective open-source tools in the existing network scenario of the institution.

1. Introduction

Due to technology the whole world has become a global village. Particularly internet has affected information seeking behavior of researchers and social scientists. It has played a significant role to spread education and updating information (Bhatti, 2013). On college, about 41% of students have three or more devices connected to the Internet at one time. That's a problem for the 76.4% of institutions looking to reinforce their networks to support more devices (Pan, 2012).

The growing popularity of online learning tools, web-based rich content (such as video), interactive digital textbooks, e-books, online assessment and the increasing dependence on the Internet for student and teacher learning will continue to contribute to rapidly increasing flows of digital traffic demanding more and more bandwidth. As per the current market trend, most of the students like to carry 2-3 devices with them like mobile, tablets, laptops, iPods etc. to campus. As these devices devour bandwidth, colleges and universities are struggling hard to keep up with the bandwidth demand. Educational Institutions have major requirements of user access control, control over bandwidth consumption. These campuses with wired and wireless internet access require seamlessly roaming facility to access internet from class room to library to labs and residential areas.

The demand for bandwidth within academic institutes is on a constant rise. The available bandwidth is generally not enough to meet demands and to support optimal usage. Academic Institutes are faced with a major challenge in their use of the Internet. As video and voice services also move to

the network, managing bandwidth to provide quality of services for time sensitive applications will become more important. Academic Institutes are under pressure to provide their faculties, staffs and students with reliable Internet access. The demand for bandwidth within institutes is constantly rising and the overall bandwidth usage continues its upward trend (Sharma et al., 2011).

2. Methodology

The Purpose of bandwidth management is to optimize network performance in order to be secured. In this study, freeware tools such as CoovaChilli and Freeradius have been used to manage internet bandwidth on a per-user based on user credentials. The mechanisms have been used to control bandwidth of wireless users as well as for wired connections also. CoovaChilli an open source captive portal application has developed by Chillispot which control LAN and WLAN (wireless LAN) for the internet access based on using RADIUS server for authentication. With this, user can use machine with at least two physical network interfaces. Usually, an Ethernet WAN interface and subscriber LAN interface that CoovaChilli will control - it can be either an Ethernet or WiFi interface. In this study, we usetwo Ethernet interfaces for the WAN (eth0) and LAN (eth1).
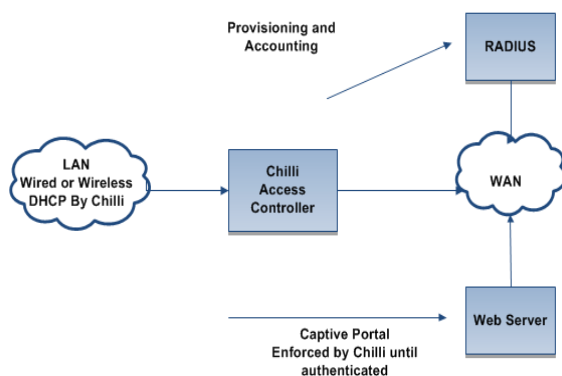

Fig. 1 Captive portal login Section (Mondru, 2004)

CoovaChilli takes control of the internal interface (eth1) using a raw promiscuous socket. It then uses the vtun kernel module to bring up a virtual interface (either a tun or tap) to pass and receive packets to and from the WAN. In fact the vtun kernel module is used to move IP packets from the

kernel to user mode, in such a way that CoovaChilli can function without any non-standard kernel modules. CoovaChilli then provides DHCP, ARP, and HTTP Hijacking on the "dhcpif" interface, in our case that's eth0.

A client or user connecting to this interface is limited to a captive portal until authorized. The user identity (username and password) through a captive portal web page before accessing the internet is required. Authentication (and authorization) in CoovaChilli typically happens in one of two ways. Either it was a MAC based authentication or it was the more typical "Universal Access Method" (UAM). This method uses a captive portal that initiates authentication. When a non-authenticated client tries to connect to a web-page (on port 80) the request is intercepted by CoovaChilli and redirected to the captive portal. In our case, we used a perl-script called hotspotlogin.cgi (served by apache over https) hotspotlogin.cgi serves a page to the end-user with a username and password field. These authentication data are then forwarded to the FreeRADIUS server, which matches them with information in mysql. A user is then either rejected or authenticated by FreeRADIUS, prompting hotspotlogin.cgi to present either a rejection message or a page with a success message and a logout link to the user (Mondru, 2004).

We discuss the bandwidth management supporting packets and services that open source software. Generally, the authentication servers are connected as a terminal and the verification is doing by captive portal in the middle. In addition CoovaChilli is based on a centralized structure which provides less waste of network resources and less processing time. Implementing CoovaChilli requires some applications pre-installed which include freeradius, bind9 and finally lamp server.

To improve stability and decrease the bug problem we choose the version Ubuntu server 14.04-04 LTS 32bit because the CoovaChilli's 32 bit version is more stable than 64 bits.

Radius stands for Remote Authentication Dial-In User Service which serves to provide security mechanisms and users management. Security mechanism is a distributed client-server systems

with user authentication. Furthermore, Radius is developed for the Authentication, Authorization, and Accounting (AAA), which is an access control mechanism that checks and authenticates users by applying challenge or response methods.

Freeradius is an open source authentication radius server offering high performance free Radius authentication service, it supports LDAP (Lightweight Directory Access Protocol), MySQL, PostgreSQL and Oracle. In this study MySQL server is used to manage user's login and password, which need to install freeradius-mysql module to help freeradius using Mysql Query.

Lamp-server is open source web server software which provides web page treatment, database driven, including three components necessary for web service, first, Apache server who manages the communication with client, second, the MySQL Server used to respond to client SQL query, it includes SQL client daemon, finally, PHP the script language used to generate dynamic web page.

Bind9 is the most famous Domain name resolving service in the internet; it is an open source service. This open source software is recommended to secure connection between two CoovaChilli's servers. It claims key exchanging at the start of the connection.

Haserl is a quite small tool that allows writing scripting code directly in normal html pages. It's used with an existing command line interpreter like bash or hush. Haserl is necessary to interpret the CGI program to be readable by user's personal computer.

A captive portal is a user web page portal that must be accessed before accessing the internet. In general, captive portals are typically used in places that offer free Wi-Fi hotspot and wired network for internet users. The captive portal has a main component consists of Radius server and router machine that a traffic filter function from internal to external network. The main purpose of captive portal is the user forcing fill in their identity (username and password) before the internet access is provided and also blocking unwanted connections by the Radius server. In working principle, user acquires an IP address (DHCP - Dynamic Host ConFig.uration Protocol) after they do verification or fill in the registration (login) form. If the identity is correct then the user could be given access the internet.

The Linux require less memory, processing unit and disk space but authentication process can consumes more processing resources. So Computer with one CPU, 512 Mbit of RAM memory and 30 GB disk space be more than enough. The CoovaChilli servers are placed in the middle of the network so they need to Network interface cards to work. For the network equipment we used one switcher and an Access Point and a router with at least two Ethernet interface to keep the network extensibility (Amine et al., 2015).

3. Results and Discussions

This section describes the process of designing and implementing per user bandwidth management using CoovaChilli, Remote Authentication Dial- In User service (RADIUS) protocol and Authentication, Authorization and Accounting (AAA) server.

First of all start CoovaChilli in server and freeradius is running on debug mode. Then connect personal computer or laptop into server. For example when user starts browse googel.com in their browser. Instead of the browser loading this home page, it loads a Welcome Page from the Hotspot Operator that allows the user to login with a username and password. Once authenticated, a Start Page appears from the Home Entity and the user can access his original home page such as google.

In the beginning, all http traffic is denied; the server listens to the incoming traffic until the receipt of the http request. The server sends it to the authentication page. When the users log in, the CoovaChilli checks identity with freeradius then act. If he exists, he will be authorized and then placed in the already authorized list. Else, he remains denied.

The administrator has the option to allow, after authentication, the hotspot client to be redirected to the original URL that the user intended to visit or to another URL. For example: The user originally requested www.google.com, and was redirected to

the login page because they were unauthenticated. After successful authentication if redirect to the URL that the user intends to visit is selected that user will be redirected to www.google.com. If redirect to the following URL is selected then the user will be redirected to URL specified in the field.

Bandwidth-Max-Up and Bandwidth-Max-Down attributes specify the maximum rate at which that corresponding user is allowed to transmit (Up) and receive (Down) data. Since the user may be connected to the hotspot via local LAN connection that has higher bandwidth than the available WAN bandwidth out of that hotspot, when specified, the hotspot should throttle down the amount of data the user can transmit and/or receive.

Bandwidth limit can be set up using WISPr Attributes. Two attributes can be used for this purpose, which is
1. WISPr -Bandwidth-Max-Down
2. WISPr-Bandwidth-Max-Up

These attributes must be defined in radreply table of Freeradius Operator: = is commonly used.

Firstly prioritize user's bandwidth as one user to 1mbps for transmit rate. Limits the bandwidth at which the user can send data into the network and 128kbps for receive rate and define in the radreply table of Freeradius.

WISPr- Bandwidth-Max-Down: = 1024000 bps

WISPr-Bandwidth-Max-Up: = 128000 bps

Similarly, for other user to 128 kbps for transmit rate and 16 kbps for receive rate and define in the radreply table of Freeradius.

WISPr- Bandwidth-Max-Down: = 128000 bps

WISPr-Bandwidth-Max-Up: = 16000 bps

After prioritizing two users as one user to high transmit rate and high receive rateand other user to lower transmit rate and lower receive rate with compared to first one, we test internet speed of user first and second users by using speed Tester. Internet speed of first user using speed Tester was found nearly equal as defined in radreply table of Freeradius as shown in Fig. 2.

Similarly, Internet speed of other user using speed Tester was also found nearly equal as defined in radreply table of Freeradius as shown in Fig. 3.
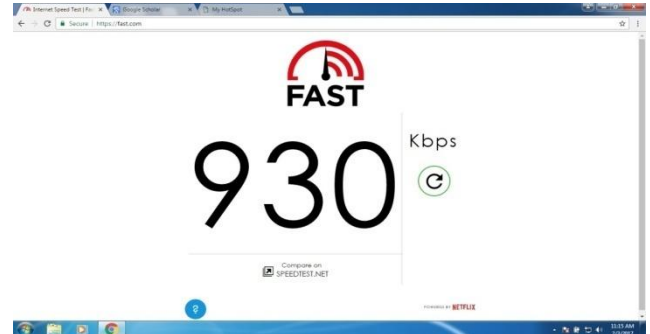

Fig. 2 Internet speed of first user (testing using speedTester)

Fig. 3 Internet speed of second user (testing using speed Tester)

Conclusion

In this paper, bandwidth can be managed by using Remote Authentication Dial-in User Service (RADIUS) protocol and Authentication, Authorization and Accounting server (AAA) that integrat with CoovaChilli. With CoovaChilli, user authentication with the login and password, it makes users feel reliability, and captive portal is able to provide convenience for the administrator in monitoring users who access the internet.

This paper demonstrates that bandwidth can be effectively monitored, managed and optimized by using cost-effective open-source tools in the existing network scenario of the institution. Since academic

institutions are normally budget- constrained for big investments, such low- cost solution are ideal and appropriate.

References

[1] Wifi Hotspot Solution for Single & Multi-Location University Campuses. Retrieved jan 17, 2017, from 24onlinebilling: http://www.24onlinebilling.com/school-college-wifi-bandwidth-management.html

[2] Mondru AB (2004). Retrieved from chillispot: http://www.chillispot.org/chilli.html

[3] Bhatti, R. (2013). Impact of ICT on social science faculty members' information usage pattern at Bahauddin Zakariya University, Multan, 2-3.

[4] Med AMINE, H., Assem, J., & Med Amine, D. (2015, feb). Monitoring And Security Of Coovachilli Wlan. *Nngt Int. J. on Computer Networking and Communication, vol. 2, 2.*

[5] PAN, B. J. (2012, AUG). 76% of Colleges Struggle to Meet Bandwidth Demands. Retrieved 01 17, 2017, from mashable: http://mashable.com/2012/08/03/college-bandwidth/#AcdA0syLpPqJ

[6] Radius. (2014). *The Freeradius Technical Guide, 7-10.*

[7] Sharma, V., Kumar, V., & Thakiu, B. (2011). Need of Bandwidth management and formulation of policy framework for Effective utilisation of Internet services within a University campus. *International Journal of Computer Science and Communication, 2*(1), 173--178.

[8] Van der Walt, D. (2011). *FreeRADIUS Beginner's Guide.* Packt Publishing Ltd.