World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:6, No:2, 2012

A Survey: Bandwidth Management in an IP Based Network

M. Kassim, M. Ismail, K. Jumari and M.I Yusof

***Abstract*—**this paper presented a survey analysis subjected on network bandwidth management from published papers referred in IEEE Explorer database in three years from 2009 to 2011. Network Bandwidth Management is discussed in today's issues for computer engineering applications and systems. Detailed comparison is presented between published papers to look further in the IP based network critical research area for network bandwidth management. Important information such as the network focus area, a few modeling in the IP Based Network and filtering or scheduling used in the network applications layer is presented. Many researches on bandwidth management have been done in the broad network area but fewer are done in IP Based network specifically at the applications network layer. A few researches has contributed new scheme or enhanced modeling but still the issue of bandwidth management still arise at the applications network layer. This survey is taken as a basic research towards implementations of network bandwidth management technique, new framework model and scheduling scheme or algorithm in an IP Based network which will focus in a control bandwidth mechanism in prioritizing the network traffic the applications layer.

***Keywords*—**Bandwidth Management (BM), IP Based network, modeling, algorithm, internet traffic, network Management, Quality of Service (QoS).

I. Introduction

BANDWIDTH management that focuses on network performance is one of the important issues today in computer engineering applications and systems mainly in Network Management. Network performance analysis efforts would really help the computer network engineers or administrator in order to offer better services and excellent supervision in Network Management. Bandwidth is an extremely valuable and scarce resource in any networks. Efficient bandwidth management plays an important role in determining network performance in an organization [1]. A few adaptive bandwidth reservation and algorithms has been proposed in network to control the bandwidth used. This is to ensure quality-of-service (QoS) guarantees for higher-priority traffic services either in IP Based network, wireless and other Next Generations Network (NGN) communications. Under the dynamic network condition, changes and control decisions in the proposed algorithms are made adaptively to strike a well-balanced network performance. Bandwidth management is a dynamic approach that provides adaptability, feasibility and efficiency for real-world network operations. Thus many schemes were contributed and designed either with a simulation study, new algorithm or enhanced model which approximates optimized solution under widely diverse traffic load intensities [1]. One research has mentioned that there is a desired solution for deploying flexible access networks [2]. This research has identified that critical bandwidth used would require a mechanism for bandwidth reservation and not only for prioritization. Ideas on certain mechanism should enable bandwidth re-use such that the entire available bandwidth could be used for QoS demanding traffic and waste of bandwidth prevented [2]. The mentioned bandwidth reservation also should be practically viable, and then combined with an algorithm providing a simple way to compute the effectively required bandwidth. This is to allow for variable certain traffic profile needed.

This paper presented a comparison and analysis of a literature review survey on bandwidth management in broad network implementations but focusing on IP Based network. This survey is mainly to search the critical area for bandwidth management ideas and issue to proposed new scheme, enhanced modeling or contribution of new model or framework for bandwidth management that subjected in IP Based network. Although many researchers have done bandwidth management on many networks but only a few has contributed to the new knowledge in the areas on IP Based network. Most of them are done in the area of Multi-hop, wireless or mobile network. Detailed comparison and analysis on a focus area for bandwidth management is presented. Survey has scope down in IP Based Network where modeling structure, algorithm design and resource management is compared. Works on bandwidth management modeling that specifically concentrated on network applications area is tabulated. The sources were compared on its modeling, algorithm, resource application and the concept of the used in the mathematical equations. Results show five researches have been done on IP Based network. The survey also acknowledge that since many new network application were develop form time to time, thus demanding for high bandwidth to the internet has increased. A few new scheme or algorithm has been produced to improve the situations. This survey also proved that the research on bandwidth management on IP Based network is a need especially to analyze on the new released of applications and its technology used. Although a few scheme and algorithm has been proposed and taken play

M. Kassim is with Faculty of Engineering and Build Environment, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia and Faculty of Electrical Engineering, Universiti Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia and (Phone: 603-5521185; fax: 603-55435077; e-mail: murizah@salam.uitm.edu.my).

M. Ismail is with Faculty of Engineering and Build Environment, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia. (e-mail: mahamod@vlsi.eng.ukm.my).

K. Jumari is with Faculty of Engineering and Build Environment, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia. (e-mail: kbj@vlsi.eng.ukm.my).

M.I. Yusof is with Faculty of Electrical Engineering, Universiti Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia. (e-mail: dr.mat@ salam.uitm.edu.my).

in the running network but the way how it was filtered has to be updated or enhanced from time to time. This is to cater for the new mechanisms exist on the network recently to manage the usage on peer to peer applications which is mostly used. Therefore enhanced scheme and algorithm is still a need to resource management especially for bandwidth used for the new next generations IP Based networks.

II. PROBLEM SCENARIO

Providing a big pipe or larger bandwidth to the internet does not solve the issue of traffic and network performance on users or application used in the network. Users still complain having slow access or experience failed connections to a certain critical systems although phase by phase internet link has been upgraded especially in a large network. Therefore upgraded the internet link is the solution without investigate and analyze the actual problem of the traffic. This cost a lot of money. The second problem is that nowadays, internet misuse in the workplace is increasing at a high risk. It has become one of the major problems in an organization. Unfortunately, the misuse of Internet activities is done without the awareness by the Internet users' example of the harmful threat such as virus attacks, Spyware and Adware. These programs not only cause nuisance to the users but also uses a lot of bandwidth. However, the existence of Internet activities that are intentionally done by the users such as Internet games, adult materials, music downloading and many more has causing the reason why these activities may used a lot of bandwidth. Therefore, it causes unreliable network services in organizations. If there were no policy or control applied, the activities would grow without monitoring control. Loss of productivity is also arises when there are no control policies to the internet access. Technology such as the Internet and network has become an important element to employees or users to run specific task in an organization. It has become the mandatory needs to the users to carry out their work and communications used. Although there is potential of internet abuse that relates to the use of high bandwidth, employees still need access to the Internet. The fact mentioned above shows that there is a need to ease the Internet and bandwidth management especially in the universities or IP Based network.

III. BANDWIDTH MANAGEMENT PRACTICE

Bandwidth management is a process of allocating bandwidth resources to critical applications on a network. Without bandwidth management, an application or users can take control of all available bandwidth and prevent other applications or users from using the network [3]. Network traffics that comprises in the network applications layer is impossible to differentiate its type among all network traffic. Thus it is also impossible to control which users or applications have priority on the network. Applications can also require a specific quantity and Quality of service (QoS) that cannot be predicted in real time available bandwidth on a network. This can make some applications run poorly if bandwidth is not properly allocated to them when necessary.

Bandwidth management can be implemented by sorting outbound or inbound network traffic into classes by application and service type. Traffic is then scheduled according to minimum and maximum bandwidth configured for each traffic type. Intranet or internet that shares information and Web navigation have an increased demand for bandwidth, but simply upgrading to larger connections doesn't address the bandwidth issue because availability is not guaranteed. Therefore, using bandwidth management to allocate bandwidth to applications or users during peak times can prevent traffic congestion on a network. In spite of that, network congestion can be improved by using bandwidth management. This would allow guarantee minimum bandwidth and prioritize traffic based on rules or policy created on the Bandwidth Management interface by constructing an algorithm. By controlling the amount of bandwidth to an application or user, the network administrator can prevent a small number of applications or users to consume all available bandwidth [3].

IV. INTERNET ACCESS MANAGEMENT

Internet Access Management is one of the resource management on the network applications layer. The implement control of bandwidth on users at this level has a critical issue recently especially in a broad network organization. A few researches have been done and produced the task on the internet monitoring scheme [4][5][6]. Capturing data by monitoring and filtering the internet access to the internet is one of the scheduling schemes on the applications layer management. Internet access management system enables corporations, schools and other organizations to monitor, create reports and manage traffic travelling for inbound or outbound traffic in the network. With Internet access management, it can provides better network bandwidth management, increased employees productivity and reduced legal liability associated with undesirable Internet content. Many tools can be implemented in running the internet filtering management in data collections which is based on routing layer protocol or application layer protocol. Figure 1 shows how one of the tools can filter internet application which basically stands as the point before the gateway to the internet. It is based on pass-through filtering technology and organizations who experience using it mentioned that this task is most important in data collections to prove with most accurate, reliable and scalable method of internet filtering.

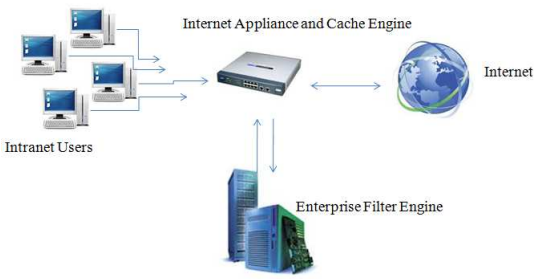

Fig. 1 Access Point to Filter Internet Application

Scheduling control on applications layer can be a modular server-based system specially tailored to provide the same

high level of performance, flexibility and security in networks. Coding and customizations can be virtually filtered at any size and configuration. Some tools and scheme can be derived to compose of an integrated system of software modules that combine to provide a powerful total Internet access management system. This flexible agent architecture allows the scheme to adapt to the unique network configuration and provide maximum speed and security regardless of how broad the users attach in an organization or has a large network. These schemes also need to be enhanced from time to time to support new network applications arise with different mechanism services supported that used higher bandwidth.

V. Enterprise Filter on IP Based Network

Figure 2 shows how the enterprise filter can be physically connected with the organizations proxy servers, firewalls, cache engines or other Internet appliances. Logically new scheme or new schedule policy can be setup at the internet appliance or cache engine box. Then data collections scheduling database can be build to capture all the traffic that will conjunction with the Enterprise filter called the Master Database. This database can be organized and customize any new feature such as peer to peer applications such as MP3 downloading, movies online or unprofitable internet serving. Certain filtering or scheduling scheme can be manage to block or permit access to individual categories by user, group or time of day. An Internet filtering system would allow an administrator to monitor and controlling Internet access. Certain restrictions are setup on the system according to policy used within the organization. These restrictions could be the outright blocking of access to certain types of Internet sites, or the requirement of authentication, time of day controls or login access controls. The enterprise filter scheme could consistently refines its master database of sites using any artificial intelligence technology and Internet analysts such as adding the new sites filtering daily and the enterprise filter database could be refined to automatically downloads updates to the database every night to ensure that the network administrator keeping up with the rapid evolution of the Internet. This scheme could be enhanced form time to time and generate statistical data on the internet usage from or out of internet traffic in an organization.

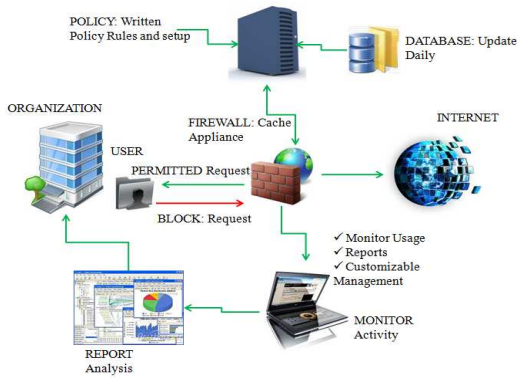

Fig. 2 Enterprise filter Illustrations as a Filtering Tool

VI. Modeling in Bandwidth Management Performance in an IP Based Network

Survey on the literature review that focuses on modeling for the bandwidth management performances in an IP Based network then is compared and tabulated as in Table 2, Appendix A. Comparison has been made from the scope down information in table 1 which detailed out there is only three published papers on IP based network. Three different models have been used to implement bandwidth management. This model focuses and implemented on the different resources management such as to filter the routing traffics in the network, supporting the DS-TE in the MPLS networks and QoS controlled between end to end data aggregation. The three implemented model used the ARMAX/GARCH model, MAM and a policy based model. A policy based model could be explore more in the next research where, it is an important plan or schedule need by the organizations. Different organization may need and want to implement a different policies based on their implemented network structure. This is why policies driven model can be enhanced further and new technique or algorithm can be produced based on this survey. Tabulated comparison in the table also shows that a different algorithm has been used in the different implemented model for the bandwidth management implementation. These algorithms are bandwidth allocations method, pre-emption algorithm and LSPs pre-emption algorithm and intserv-type of end to end point admission control. New techniques could be developed based on this algorithm method to improve the control and performance outcome.

VII. Network Application Layer Model

Network applications layer schedule for bandwidth management is one of the most critical areas to improve the network performances and realize the real issue. This paper mentioned that recently more and more network applications has been programmed, distributed and used on network applications [25]. This paper presented facts that network has been known as the new technologies today that could help user to communicate, work and transfers faster in the internet world. People can't work without internet surfing, email, communicate, fund transfer, cloud computing and more. Because of the need, more applications were develop to supply these services but yet still these tools need to be monitor for business purposes and prioritize the network bandwidth used. Network applications have given the top ranks of bandwidth used on the internet. Table 3 in Appendix A tabulated the comparison of bandwidth management modeling on network applications layer. Five published papers have been reviewed based on the previous network area comparison as in table 1. Five different modeling is presented and each of them used a different mathematical equation to model the bandwidth management method in a network. A few type of resource application has been filtered according to respective algorithm used in the tabulated table. The first modeling on bandwidth management is bandwidth allotment model that used a triggered dynamic mechanism [25]. The algorithm mainly focuses to control the Bit Torrent (BT) applications which sit on the application's network layer. Bit

Torrent is one of the examples of peer to peer (P2P) traffic which occupy main network bandwidth affects compared to other normal network application. The triggered dynamic mechanism that manage resource of Bit Torrent bandwidth shown the utilization percentage of the router input and output cache. Therefore this mechanism could estimate the potential network congestion and triggered to control the P2P bandwidth dynamically. The novelty of this research has put forward a new way to control BT bandwidth utilization by intercepting the massage packets of BT. The experiments results verify that the proposed method for BT bandwidth management can manage BT bandwidth effectively.The second modeling demonstrates an implemented bandwidth management system for the QoS assured network architecture [26]. The algorithm naming the Call Admission Control (CAC) provides a cost-effective priority service mean that the service providers should utilize the bandwidth in the existing core network. The presented system has shown a dynamically optimization on the resource allocation at the edge of the network. The bandwidth management has considered the current bandwidth usage along the path in the core network which has the capability to estimate the usage of the bandwidth in the core network by IP flow analysis for dynamic network reconfiguration. The performance to utilize the bandwidth in the core network and scalability to process hundreds of IP flows assumed as video streaming are evaluated. Results have produced the overall throughout evaluations and the necessity of bandwidth management is indicated. The third model based on internet architecture called CABO [27]. CABO is a multiple routing architectures that can run on a shared physical infrastructure, which is carried out with network virtualization. The research has its own value where it presented the design and evaluation of a bandwidth allocation algorithm based on multi-commodity flow problem solver that integrated with a traffic predictor. The traffic predictor is called a linear predictor with dynamic error compensation or L-PREDEC. It is design to provide some failure in the Multi-commodity Flow Problem (MFP) computation which implies one or more links. It also design for links which do not have enough available capacity or violates the linear constraints on the commodities for each link when modeling the MFP. An employed traffic predictor was generated and simulate in this model to evaluate result. The research found also that MFP solver makes better resource utilization by using all available bandwidth and virtually the network can accept more service requests. The algorithm also was done where the traffic predictor can adjusts the largest occupation or (bottleneck link) the link by periodically monitoring the traffic rate of a user link and adjusting the reserved bandwidth based on the prediction made from the traffic history. The results show the performance comparisons of the predictor-integrated algorithm and the allocation algorithm only by Solving MFP. The comparisons are based on the mean packet delay, the variance of the packet delay, and the buffer requirements. This research has presented the test where predictor-integrated algorithm works better performance than the allocation algorithm by Solving MFP by using three metrics [27].The forth model proposed a novel concept by using the sharable bandwidth of public-shared network as example in FON network. FON network is a free Wi-Fi service online. It is the world's first global Wi-Fi network built by internet users themselves or it is called a crowd sourced Wi-Fi. This model is developed to construct an efficient video delivery system on FON. It discussed detail on the problem of constructing architecture to serve the video streaming requests by using a minimum amount of sharable bandwidth called NP-Hard. A linear approximation algorithm is proposed to manage the public-shared bandwidth so that all clients are served and the total amount of employed sharable bandwidth is not greater than twice of the optimal solution [28]. The fifth model on network application presented a transparent application bandwidth management system (TACS) [29]. This paper mentioned that rapid advance of computer and network technology exist today and grown more and more applications especially in the customer side network. Thus, these applications require different quality of service (QoS), but they have to share a few bandwidth limited internet connections. The QoS requirements are hard to be satisfied in the IP based networks in order to support the best effort delivery mechanism [29]. This paper mentioned that there are plenty of QoS solutions in research and industry areas so far in a difference approach depend on a network. But, this model provides a solution based on a simple and clear model which able to transparently deployed at the inner side of customer's gateway device and controlled in the application oriented way. It introduced a straight forward QoS policy definition language to allow user to create QoS rules for various applications. An evaluation was conducted on a proto type system running upon mid-end industrial personal computer under both the lab test bed and the practical network. The lab test system has achieved 200Mbps throughput where in the practical field test, the system successfully manages a 100Mbps internet link for over 3000 active users.

VIII. Conclusion

Many researches on network bandwidth management are still in the progress whether to enhanced the scheme, new algorithm or design a new framework to supports the quality of Services in all network areas today. The tabulated information has shown and compared the differences of the scheme, algorithm and model used recently for the previous three years for bandwidth management services in networks. Thus this show that although network has been long time used and serviced but still bandwidth management monitoring issue and QoS factors play an important role for the administrator to trouble shoot and manage for a good network. The arisen of many new applications used on the internet and network is one of the current issues why bandwidth management should be taken as priority to qualify the network services. Time to time management is a crucial task that should not be led down by the network admin. This paper will be valuable for network administrator as guidance and reference for them in handling and manage the network. New scheme, new algorithm or new model can be build to educate the current network situations problem. This survey also has presented the information on a few issue arise in IP Based network especially on the applications layer. It would give a basic idea to further on investigate or design the new framework for the current

bandwidth management implementations in an IP based network. Universities could be taken as the scope or sample in handling the bandwidth management test because of the existence of students who are the key players in using the network applications or internet access. Further concentrated can be done to implement the method, identifying policies and design the overall framework structure for network bandwidth management mainly for network applications layers.

TABLE I
CONTRIBUTION ON NEW KNOWLEDGE IN A FOCUS NETWORK AREA

Focus Network Area	New Scheme /Algorithm	Enhanced Scheme /Algorithm	New Framework	New Model	Enhanced Model
IP Network [7],[8],[9]		1	1	1	
IPTV Network [10],			1		
Multi-hop/Hybrid /Mobile/ Wireless Network [2],[11],[12],[13],[14],[15],[16],[17][18],[19],[20],[21],[22],[23]	8	4		1	
Multimedia Wireless Network [24]		1			
Network Application & QoS [25],[26],[27],[28], [29]	3	1		1	
Network Protocol [30]	1				
Satellite Network [31],[32]		1		1	
System Performance [1],[33], [34],[35]	2	1			1
Total Knowledge Contributions	14	9	2	4	1

TABLE II
BANDWIDTH MANAGEMENT MODELING ON AN IP BASED NETWORK

	Knowledge Area on Wired Network	Model	Algorithm	Resource Management
1.	Yongtao Wei; Jinkuan Wang; Cuirong Wang; Ling Cai [11]	ARMAX/GARCH	Bandwidth Allocation on throughput and packet loss	Routing Traffic
2.	Kotti, A.; Hamza, R.; Bouleimen, K [12]	MAM model	pre-emption algorithm and an LSPs pre-emption algorithm	supporting DS-TE in MPLS networks
3.	Ravindran, K.; Rabby, M.; Liu, X[13]	a policy-based model	intserv-type of end-point admission control	end-to-end QoS control between data aggregation points

TABLE III
BANDWIDTH MANAGEMENT MODELING ON NETWORK APPLICATIONS

	Knowledge Area on Network Applications	Model	Algorithm	Resource Application	Mathematical Equations
1.	Rong OuYang; Hui Cao; Xianghua Xu; Jian Wan[29]	Bandwidth Allotment Model Of BTBM	A triggered dynamic mechanism	P2P – Bittorent	All bandwidth allotted to No. j BT connection is $B_{allot}^{(ij)} = B_{allotup}^{(ij)} + B_{allotdown}^{(ij)}$
2.	Kashihara, S.; Tsurusawa, M[30]	Edge resource allocation	Call Admission Control (CAC)	IP Flow on bandwidth	$E_{kj} = F_{kj} + \frac{L_{ij} - \sum_{p=M}^{N} F_{pj}}{N - M + 1}$. (3)
3.	Yongtao Wei; Jinkuan Wang; Cuirong Wang [31]	L-PREDEC	bandwidth allocation scheme	Bandwidth traffic	$\int_{x>0} \frac{1}{\sqrt{2\pi}\sigma_{err}} \exp(\frac{-x^2}{2\sigma_{err}^2}) dx$
4.	Nen-Fu Huang; Hong-Yi Chang; Kuo-Shiang Hsu; Han-Chi Liu; Yuan-Wei Lin[32]	A linear approximation	The Next-Fit algorithm	Video streaming	Therefore we have $H(D) = \sum_{j=1}^{n-1} w_j + w_n < \sum_{j=1}^{n-1} w_j + w_l < 2 * \sum_{j=1}^{n} u_i \leq 2 * \sum_{j=1}^{m} w_j^* = 2 * OPT(D)$ □
5.	Xianqin Chen; Xiang Long; Xiaopeng Gao; Junjie Ma;[33]	System Model	QoS policy, netfilter packet processing	http ,ftp and bittorent	$P_{out} = \bigcup_{i=1,2...n} ts_i(\vartheta(<cHost_i, sHost_i, aProto_i>)) \subseteq P_{in}$

REFERENCES

[1] Taecheol Oh; Kiyeon Lee; Sangyeun Cho; , "An Analytical Performance Model for Co-management of Last-Level Cache and Bandwidth Sharing," Modelling, Analysis & Simulation of Computer and Telecommunication Systems (MASCOTS), 2011 IEEE 19th International Symposium on , vol., no., pp.150-158, 25-27 July 2011

[2] Scopigno, R.; Vesco, A.; , "A distributed bandwidth management scheme for multi-hop wireless access networks," Wireless Communications and Mobile Computing Conference (IWCMC), 2011 7th International , vol., no., pp.534-539, 4-8 July 2011

[3] Murizah Kassim and Hafizoah Kassim,"An Analysis on Bandwidth Utilization and Traffic Pattern for Network Security Management", Journal of International Proceedings on Computer Science and Information Technology, www.ipcsit.com, Vol 13, page 51-56, October 2011.

[4] Rong OuYang; Hui Cao; Xianghua Xu; Jian Wan; , "A Triggered Dynamic Mechanism for Bit Torrent-Like P2P Bandwidth Management," Intelligent Systems and Applications (ISA), 2010 2nd International Workshop on , vol., no., pp.1-6, 22-23 May 2010

[5] Kashihara, S.; Tsurusawa, M.; , "Dynamic Bandwidth Management System Using IP Flow Analysis for the QoS-Assured Network," GLOBECOM 2010, 2010 IEEE Global Telecommunications Conference , vol., no., pp.1-5, 6-10 Dec. 2010

[6] Yongtao Wei; Jinkuan Wang; Cuirong Wang; Ling Cai; , "Bandwidth Management of a Future Internet Architecture," Multimedia Technology (ICMT), 2010 International Conference on , vol., no., pp.1-4, 29-31 Oct. 2010

[7] Yongtao Wei; Jinkuan Wang; Cuirong Wang; , "A Traffic Prediction Based Bandwidth Management Algorithm of a Future Internet Architecture," Intelligent Networks and Intelligent Systems (ICINIS), 2010 3rd International Conference on , vol., no., pp.560-563, 1-3 Nov. 2010

[8] Kotti, A.; Hamza, R.; Bouleimen, K.; , "New Bandwidth Management Framework for Supporting Differentiated Services in MPLS Networks," Communication Software and Networks, 2009. ICCSN '09. International Conference on , vol., no., pp.762-767, 27-28 Feb. 2009

[9] Ravindran, K.; Rabby, M.; Liu, X.; , "Bandwidth measurement and management for end-to-end connectivity over IP networks," Communication Systems and Networks and Workshops, 2009. COMSNETS 2009. First International , vol., no., pp.1-8, 5-10 Jan. 2009

[10] Iqbal, M.Z.; Rikli, N.-E.; , "A generic framework for dynamic bandwidth management of SDH networks for Unicast NGN service solutions," Electronics, Communications and Photonics Conference (SIECPC), 2011 Saudi International , vol., no., pp.1-4, 24-26 April 2011

[11] Shankaraiah; Venkataram, P.; , "Bandwidth management in a hybrid wireless network: For superstore applications," Communication Systems (ICCS), 2010 IEEE International Conference on , vol., no., pp.517-521, 17-19 Nov. 2010

[12] Diaconu, F.; Scripcariu, L.; , "Bandwidth management methods for QoS assurance in wireless communication network," Electrical and Electronics Engineering (ISEEE), 2010 3rd International Symposium on , vol., no., pp.220-223, 16-18 Sept. 2010

[13] Kumar, P.; Vasudev, K.R.; Hegde, M.; Anand, S.; Kumar, A.; Kuri, J.; , "ADWISER: An integrated approach for Internet access bandwidth and performance management of an enterprise network," Communication Systems and Networks (COMSNETS), 2010 Second International Conference on , vol., no., pp.1-2, 5-9 Jan. 2010

[14] Changwon Nam; Jongwook Lee; Saewoong Bahk; , "Interference type based channel management using adaptive bandwidth in wireless LANs," Personal Indoor and Mobile Radio Communications (PIMRC), 2010 IEEE 21st International Symposium on , vol., no., pp.1360-1365, 26-30 Sept. 2010

[15] Andersson, K.; Granlund, D.; Elkotob, M.; Ahlund, C.; , "Bandwidth Efficient Mobility Management for Heterogeneous Wireless Networks," Consumer Communications and Networking Conference (CCNC), 2010 7th IEEE , vol., no., pp.1-6, 9-12 Jan. 2010

[16] Traver, L.; Tarin, C.; Cardona, N.; , "Bandwidth Resource Management for Neural Signal Telemetry," Information Technology in Biomedicine, IEEE Transactions on , vol.13, no.6, pp.1083-1084, Nov. 2009

[17] Arcia, A.; Montavont, N.; Paltrineri, A.; Ros, D.; , "Improving uplink bandwidth management in 802.16 networks," Local Computer Networks, 2009. LCN 2009. IEEE 34th Conference on , vol., no., pp.233-236, 20-23 Oct. 2009

[18] Peart, A.; Adda, M.; , "Quality of Service: Dynamic Authentication Bandwidth Management for the Wireless Environment," Information Science and Engineering (ICISE), 2009 1st International Conference on , vol., no., pp.5366-5369, 26-28 Dec. 2009

[19] Yue Li; Kouvatsos, D.; Weixi Xing; , "Performance modelling and bandwidth management of WiMAX systems," Wireless Communication, Vehicular Technology, Information Theory and Aerospace & Electronics Systems Technology, 2009. Wireless VITAE 2009. 1st International Conference on , vol., no., pp.485-491, 17-20 May 2009

[20] Mogre, P.S.; Hollick, M.; Dimitrov, S.; Steinmetz, R.; , "Incorporating spatial reuse into algorithms for bandwidth management and scheduling in IEEE 802.16j relay networks," Local Computer Networks, 2009. LCN 2009. IEEE 34th Conference on , vol., no., pp.384-391, 20-23 Oct. 2009

[21] Agbaria, A.; Gershinsky, G.; Naaman, N.; Shagin, K.; , "A bandwidth management approach for quality of service support in mobile ad hoc networks," Pervasive Computing and Communications, 2009. PerCom 2009. IEEE International Conference on , vol., no., pp.1-5, 9-13 March 2009

[22] Jantaweetip, A.; Prommak, C.; , "Bandwidth management for hybrid association control schemes and load balancing inWLANs," Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology, 2009. ECTI-CON 2009. 6th International Conference on , vol.02, no., pp.1000-1003, 6-9 May 2009

[23] Haidar, M.; Msakni, M.; Dziong, Z.; , "Power Management and Bandwidth Allocation in a Cognitive Wireless Mesh Network," Communication Networks and Services Research Conference, 2009. CNSR '09. Seventh Annual , vol., no., pp.391-396, 11-13 May 2009

[24] Kim, S.; , "Cellular network bandwidth management scheme by using nash bargaining solution," Communications, IET , vol.5, no.3, pp.371-380, Feb. 11 2011

[25] Rong OuYang; Hui Cao; Xianghua Xu; Jian Wan; , "A Triggered Dynamic Mechanism for Bit Torrent-Like P2P Bandwidth Management," Intelligent Systems and Applications (ISA), 2010 2nd International Workshop on , vol., no., pp.1-6, 22-23 May 2010

[26] Kashihara, S.; Tsurusawa, M.; , "Dynamic Bandwidth Management System Using IP Flow Analysis for the QoS-Assured Network," GLOBECOM 2010, 2010 IEEE Global Telecommunications Conference , vol., no., pp.1-5, 6-10 Dec. 2010

[27] Yongtao Wei; Jinkuan Wang; Cuirong Wang; Ling Cai; , "Bandwidth Management of a Future Internet Architecture," Multimedia Technology (ICMT), 2010 International Conference on , vol., no., pp.1-4, 29-31 Oct. 2010

[28] Nen-Fu Huang; Hong-Yi Chang; Kuo-Shiang Hsu; Han-Chi Liu; Yuan-Wei Lin; , "On the complexity of the bandwidth management problem for scalable coding video streaming on a public-shared network," Communications Letters, IEEE , vol.13, no.1, pp.61-63, January 2009

[29] Xianqin Chen; Xiang Long; Xiaopeng Gao; Junjie Ma; , "TACS: A Transparent Application Bandwidth Management System," Computer and Information Technology, 2009. CIT '09. Ninth IEEE International Conference on , vol.2, no., pp.46-51, 11-14 Oct. 2009

[30] Daniel, A.K.; Singh, R.; , "Swarm Intelligence Based multicast Routing and Bandwidth Management protocol for Ad-hoc wireless Network Using Backpressure Restoration," Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference on , vol.5, no., pp.516-520, 9-11 July 2010

[31] Aqun Zhao; Yingjing He; Mangui Liang; , "A bandwidth management strategy for DVB-RCS system," Advanced Intelligence and Awarenss Internet (AIAI 2010), 2010 International Conference on , vol., no., pp.315-318, 23-25 Oct. 2010

[32] Huai-Yi Wang; Xue-Mai Gu; , "An adaptive bandwidth resource management scheme for multimedia LEO satellite networks," Mobile Congress (GMC), 2010 Global , vol., no., pp.1-6, 18-19 Oct. 2010

[33] Yiqi Xu; Lixi Wang; Arteaga, D.; Ming Zhao; Yonggang Liu; Figueiredo, R.; , "Virtualization-based bandwidth management for parallel storage systems," Petascale Data Storage Workshop (PDSW), 2010 5th , vol., no., pp.1-5, 15-15 Nov. 2010

[34] Kaseridis, D.; Stuecheli, J.; Jian Chen; John, L.K.; , "A bandwidth-aware memory-subsystem resource management using non-invasive resource profilers for large CMP systems," High Performance Computer Architecture (HPCA), 2010 IEEE 16th International Symposium on , vol., no., pp.1-11, 9-14 Jan. 2010

[35] Yi-Nung Liu; Meng-Che Chuang; Shao-Yi Chien; , "Bandwidth and local memory reduction of video encoders using Bit Plane Partitioning Memory Management," Circuits and Systems, 2009. ISCAS 2009. IEEE International Symposium on , vol., no., pp.766-769, 24-27 May 2009.

M. Kassim currently is pursuing her PhD study in Computer Engineering at Universiti Kebangsaan Malaysia, Bangi, Malaysia. She is a lecturer from Faculty of Electrical Engineering, Universiti Teknologi MARA. M. Kassim was born in 1970 in the state of Kedah, Malaysia. M. Kassim received her Diploma in Computer Science in 1992, BSc (Hons) in Data Communications and Networking in 2003 and MSc in Information Technology in 2007 from the Faculty of Mathematics and Computer Science, Universiti Teknologi MARA (UiTM), Malaysia.She has experienced in the technical and project management during her services in the Centre for Integrated Information System CIIS, the core IT centre for UiTM for 15 years. She work in various network project implementations and managements for 13 years, as project manager in development the university smartcard applications and system for three years and database design and structure for a year. She joined the academic since January 2009 and has published more than 20 papers in refereed international proceedings in the area of computer networking and engineering. She is actively doing research in the area of computer engineering and currently has completed 3 researches. Her research interest includes Network Traffic Management, Network Security, Contactless Smartcard Applications, MIFARE Technology Applications, Protective Management System, E-Content Management and Development and WEB-Based applications development. Ms. Kassim also recently has been certified as International Journal of Computer Theory and Engineering (IJCTE) editor which is an international academic journal which gains a foothold in Singapore, Asia and opens to the world. Ms. Kassim currently is the instructor for CISCO Academy Malaysia, member of IEEE Computer Section Malaysia and member of the International Association of Computer Science and Information Technology *(*IACSIT) organization.