Minimizing the Broadcast Traffic in the Jordanian Discovery Schools Network using PPPoE

Sameh H. Ghwanmeh

Abstract—Discovery schools in Jordan are connected in one flat ATM bridge network. All Schools connected to the network will hear broadcast traffic. High percentage of unwanted traffic such as broadcast, consumes the bandwidth between schools and QRC. Routers in QRC have high CPU utilization. The number of connections on the router is very high, and may exceed recommend manufacturing specifications. One way to minimize number of connections to the routers in QRC, and minimize broadcast traffic is to use PPPoE. In this study, a PPPoE solution has been presented which shows high performance for the clients when accessing the school server resources. Despite the large number of the discovery schools at MoE, the experimental results show that the PPPoE solution is able to yield a satisfactory performance for each client at the school and noticeably reduce the traffic broadcast to the QRC.

Keywords—Education, networking, performance, e-content.

I. INTRODUCTION

THE Ministry of Education (MoE) in Jordan embarked upon a challenging and extensive e-learning initiative. Several key issues were targeted beyond the obvious introduction of PC hardware and software as learning tools in all of its public schools. New training programs for teachers, supervisors and school principals were initiated to support the deployment of PCs in schools. This training was focused on both the computer literacy and pedagogy areas. To support e-learning, the required infrastructure based on connecting all 3000 public schools via a fiber network, was planned and phased for implementation over several years. Similarly, all curricula are undergoing a major reform process, guided by the development and approval of a framework for curriculum and learning assessment. This is leading to the production of new programs and courses in all subjects at all grade levels that are in accordance with expectations for learning in the current world.

These are based on general and specific learning outcomes, increased e-content delivery, and are also rich in multimedia. Suitable and appropriate tools and techniques for assessment, monitoring, and overall learning management are also being developed in alignment with the new curricula and the new methods of teaching and opportunities for learning.

Ministry of Education in Jordan is planning to roll out Math online to all discovery schools. There are additional four curricula under development and it will be deployed in the future. All contents will be hosted in Queen Rania Center

Sameh. H. Ghwanmeh is the Director, Computer and Information Centre, Department of Computer Engineering, Yarmouk University 211-63, Irbid, Jordan, (e-mail: sameh@yu.edu.jo).

curricula under development and it will be deployed in the future. All contents will be hosted in Queen Rania Center (QRC)-MoE Data Center, and discovery schools are connected to QRC via ADSL line where it is available to access contents. All discovery schools will be connected to the national broadband network in phase one to be completed in mid 2005. The discovery school has at least one ICT lab with 15-20 PCs connected together via LAN. The majority of discovery schools will be equipped with one math lab furnished with 10-20 computers (depends on students populations). Each discovery school will have LAN, wireless LAN, Internet Security Accelerator (ISA) server, network printer(s), laptops, ICT lab, and math lab. Math teachers, and grades 1-3 teachers will have wireless laptop. Wireless LAN will provide teacher the ability to move from one classroom to another, and have connectivity back to Queen Rania Center.

II. CURRENT ARCHITECTURE

Discovery schools has at least one ICT lab with 15-20 Computers connected to a local fast Ethernet switch via Cat 5 or Cat 6 twisted copper cables. ADSL modem is connected to the fast Ethernet switch via Cat5 or Cat 6 twisted copper cable. The ADSL modem is connected to Jordan Telecom Network via phone line (Fig. 1). All schools are connected together in one big ATM bridge network [1], [2]. Broadcast from any workstation will spread to all Schools connected to the network. This architecture has many limitations, and can not support future growth. The school does not have a local DHCP server, and all PCs get an IP address from QRC via ADSL connectivity. All schools share one pool of IP addresses and the school does not have assigned IP addresses. The school does not have local file server.

III. NEW ARCHITECTURE

Ministry of Education is in the process of building a math lab with 20 PCs, and file server. Math teachers will use laptops and multimedia data shows to teach math online. The laptop will have either wireless capability build in, or via PCMCIA card. The discovery schools will have wireless access points installed at key location at each discovery school to provide full network coverage inside the discovery school. Site survey will be preformed at each discovery school to determine the exact location of each access point, and number of access points needed at each discovery schools. Cisco fast Ethernet switch with inline power will be placed at each discovery school to provide power to the access points, and to serve as back bone switch at each school. The access points will be connected via Cat5 or Cat 6 cable to Cisco 3550-24 PWR fast Ethernet switch. The access points will use inline
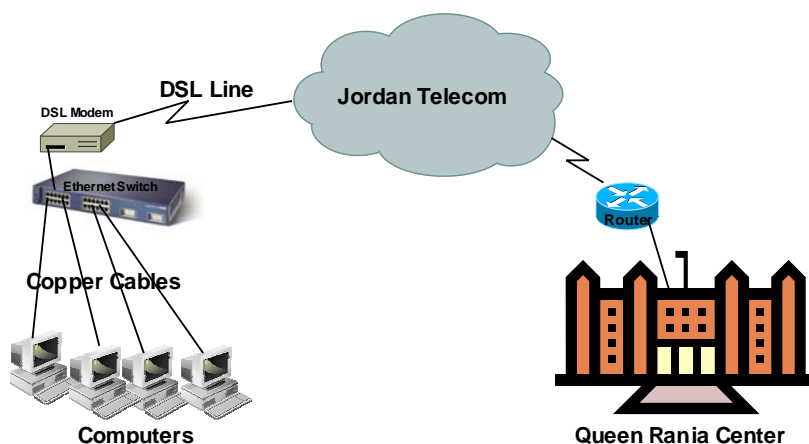
Fig. 1 QRC current infrastructure

power provided by the Cisco switch, and it does not need dedicated AC power line. The Cisco fast Ethernet switch is connected to the ADSL modem via Cat 5 or Cat 6 cable, and it has the ability to connect to broadband network via fiber in the future.

Math lab will be build at each discovery schools beside the existing ICT lab(s). Personal computers inside the math lab will be connected to existing local fast Ethernet switch or new local fast Ethernet switch at each discovery school. Existing fast Ethernet switch in the ICT lab(s), and new fast Ethernet switch in the math Lab will be connected to the Cisco 3550-24 PWR switch as indicated in diagram below. The new Cisco fast Ethernet switch and access points will be configured according to configuration guidelines published by MoE. One file server will be deployed at each discovery school for local support including DHCP server, local temporary storage for students and other users, software update for PCs and laptops, and any other requirements in the future.

Each discovery schools will have an assigned IP addresses according to MoE IP addresses architecture. DHCP server functionality will be at each schools using file server. This will help in troubleshooting network problems, minimize traffic to Queen Rania Center, and provide the ability for PCs, laptops, and servers to communicate in case of ADSL line failure. Future connectivity to the broadband network can be done via connecting Cisco 3550-24PWR fast Ethernet switch by using GE uplinks on the switch (Fig. 2).
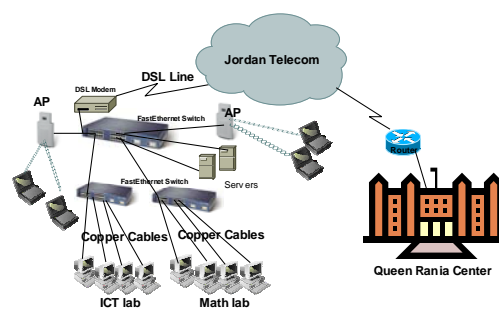

Fig. 2 QRC new infrastructure

IV. PROPOSED PPPOE SOLUTION

Point-to-Point Protocol over Ethernet (PPPoE) is a specification for connecting multiple computer users on an Ethernet local area network to a remote site through common customer premises equipment, which is the telephone company's term for a modem and similar devices. PPPoE can be used to have an office or building-full of users share a common Digital Subscriber Line (DSL), cable modem, or wireless connection to the Internet. PPPoE combines the Point-to-Point Protocol (PPP), commonly used in dialup connections, with the Ethernet protocol, which supports multiple users in a local area network. The PPP protocol information is encapsulated within an Ethernet frame [3], [4], [5].

PPPoE has the advantage that neither the telephone company nor the internet service provider (ISP) needs to provide any special support. Unlike dialup connections, DSL and cable modem connections are "always on." Since a number of different users are sharing the same physical connection to the remote service provider, a way is needed to keep track of which user traffic should go to and which user should be billed. PPPoE provides for each user-remote site session to learn each other's network addresses (during an

initial exchange called "discovery"). Once a session is established between an individual user and the remote site (for example, an internet service provider), the session can be monitored for billing purposes. Many apartment houses, hotels, and corporations are now providing shared Internet access over DSL lines using Ethernet and PPPoE [6], [7].

Schools in Jordan are connected in one flat ATM bridge network. All Schools connected to the network will hear broadcast traffic. High percentage of unwanted traffic such as broadcast, etc. consumes the bandwidth between schools and QRC [8], [9]. Routers in QRC have high CPU utilization. Each PC in the Schools will have a separate connection to the routers in QRC. The number of connection on the router is very high, and may exceed recommend manufacturing specifications.

One way to minimize number of connections to the routers in QRC, and minimize broadcast traffic is to use PPPoE solution. The ISA server in the school is equipped with two FastEthernet cards. One FastEthernet interface is connected to the intranet network via ADSL. The interface has static IP address to allow remote management. The IP address should comply with MoE IP Architecture. Each school has PPPoE client with unique ID and password. The server should be able to reach all servers and services in QRC. The second FastEthernet interface is connected to the LAN in the school. The interface is connected to the Cisco 3550-PWR switch. The interface has static IP address, and the server has DHCP server enabled for PCs in the school. Access Points, FastEthernet switches, file server, and network printers have static IP addresses from local assigned IP addresses unique to each school. Each school is assigned private class C addresses. The class C IP private address was assigned as following:

x.x.x.1 router
x.x.x.2 to x.x.x.6 FastEthernet switches
x.x.x.7 to x.x.x.10 servers at schools
x.x.x.11 to x.x.x.20 wireless access point
x.x.x.21 to x.x.x.25 network printers, and scanners
x.x.x.26 to x.x.x.255 for hosts

III. EXPERIMENTAL RESULTS

In all experiments each test is run for 5 minutes and 10 simultaneous users are used with 10 seconds between clicks. Three different experiments were conducted based on three different server configurations: bridging configuration, PPPoE without ISA, and PPPoE with ISA.

The bridging configuration experiment results is shown in Fig. 3. The average user bandwidth is 24 Kbps which shows unacceptable performance to access the server resources. Additionally, with the bridging mode the network is facing a lot of traffic since each client gets its IP from the QRC DHCP server. In the second experiment where PPPoE without ISA is used, the average user bandwidth is almost the same as in the previous case (Fig. 4). However, when PPPoE and ISA is used the average user bandwidth is dramatically increased to 2400 Kbps (Fig. 5) which demonstrates high performance for the clients to access the server resources at each school. The ISA caching feature is employed and each client gets its IP from the DHCP at the school and hence reduce the network traffic accessing the QRC servers.
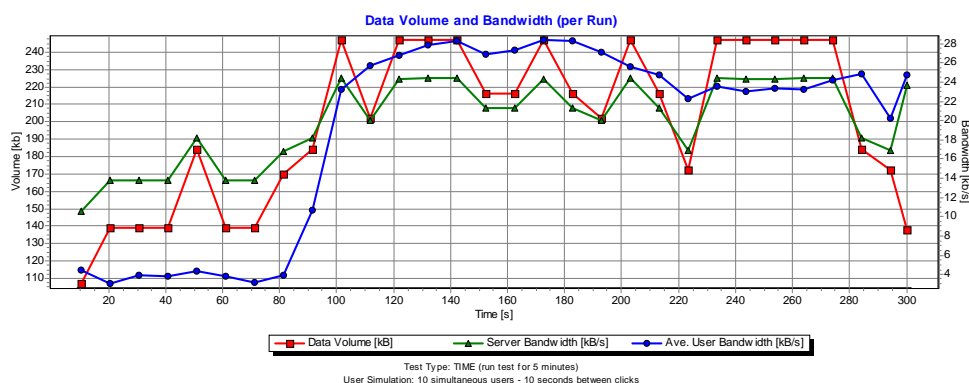

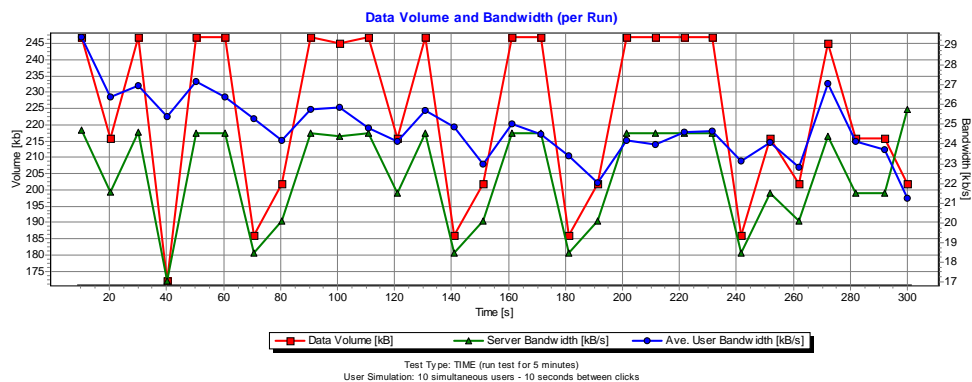Fig. 3 user bandwidth in a bridging mode configuration

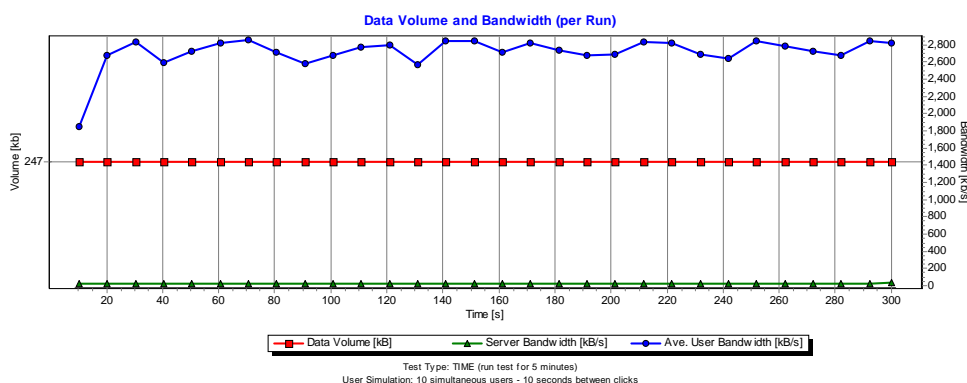Fig. 4 user bandwidth in a PPPoE without ISA configuration

Fig. 5 user bandwidth in a PPPoE with ISA configuration

IV. CONCLUSIONS

A PPPoE solution to the traffic broadcast at the Jordanian discovery schools has been presented which shows high performance for the clients when accessing the school server resources. PPPoE featured that neither the telephone company nor the internet service provider needs to provide any special support. Despite the large number of the discovery schools at MoE, the experimental results showed that the PPPoE solution is able to yield a satisfactory performance for each client at the school and noticeably reduce the traffic broadcast to the QRC. The presented PPPoE solution has been implemented in each discovery school at MoE in Jordan and the network covers this structure is currently running smoothly with high performance and each session is monitored separately for accounting purposes.

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