MULTI-CONNECTION PHONE-BASED MOBILE INTERNET TO SUPPORT E-LEARNING AND ICT LITERACY FOR RURAL COMMUNITY

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Abstract

This research aims to assess alternative technologies in developing mobile Internet system using mobile phone. This system is needed to improve information flows in rural areas. Location of this research is limited to rural areas in Daerah Istimewa Yogyakarta (DIY) Province. The system studied is a Multi-connection Phone-based Mobile Internet (MCPMI) using cellular modem, by implementing load balancing so that the Quality of Service (QoS) is quite high. In addition, this research conducted a survey to obtain information on the extent of Internet access service using mobile phones has reached rural areas in DIY Province. The problem includes how to perform server load balancing for mobile Internet, how the performance of the server, and how the map of Internet access service using mobile phones. The results of this research are a prototype of Rural Internet Access Service Map and a prototype of Multi-connection Phone-based Mobile Internet Server using Zeroshell by conducting an experiment in configuration and implementation of failover or round robin load balancing. The performance testing of the prototype shows that multi-connection using two GSM modem with 500 Kbps up to 700 Kbps for each modem when downloading can generate the total bit rate of 1 Mbps up to 1.5 Mbps when downloading by implementing load balancing on two modems. Prototype of Internet Access Service Map and Multi-connection Phone-based Mobile Internet Server generated in this research is still in the form of a laboratory scale and its performance need to be tested in the field.

Keywords: e-learning, information and communication technology, load balancing mobile internet, modem GSM/CDMA,

1. Introduction

Most of the population of Indonesia is located in rural areas and the flow of information is still very slow. Internet network can be a cornerstone in improving the information flow so as to enhance the progress of the nation. However, until today the Internet access in rural areas are still very rare and even nonexistent. For that, a solution in providing Internet access service is needed by society, so that rural communities become more rapid progress.

Internet access using VSAT is an alternative to realize the Mobile Internet access services [1]. However, the investment and operational costs are quite expensive so that it is not in accordance with the conditions in rural areas. Another possibility is the Internet access using cell phones, because until now most of the rural areas including rural areas in Daerah Istimewa Yogyakarta has been attached many Base Transceiver Stations (BTS) of the various cell phone service providers.

Currently mobile phone devices has been widely known and used in rural communities. However, these devices have not been widely used for Internet access because the costs are still quite expensive and given bit rate is still limited. In addition, mobile phone devices with features that support for Internet access (3G) can not be owned by the rural community at large, as well as access

the Internet using a mobile phone has limitations because the size of the screen is too small making it less comfortable. Thus, there is need for alternative technologies to assist rural communities to recognize and use the Internet.

Another urgency of this research topic is the ability of communities to use information and communication technology (ICT), especially Internet access that is still very low, so that it needs guidance in using information and communication technology, especially in terms of Internet access.

This research aims to assess alternative technologies in developing mobile Internet access service system for rural areas. Systems studied are Multi-connection Phone-based Mobile Internet (MCPMI) uses Global System for Mobile Application (GSM) modem or Code Division Multiple Access (CDMA) modem by implementing load balancing.

Internet access using cell phones was started using Wireless Application Protocol (WAP) technology in the 1990's for 2nd generation (2G). WAP is a protocol used to access the Internet using mobile phone networks such as World Wide Web (WWW) technology using the Hyper Text Transport Protocol (HTTP). WAP supports various types of mobile phone technologies including GSM and CDMA. WAP using GSM technology has a bit

rate of 9.6 kbps, and 70 up to 80 kbps using CDMA 2000 1x technology.

The main issue in accessing the Internet data using WAP is data access speed (bit rate). GSM mobile phone developed a General Packet Radio Service (GPRS) with bit rates up to 153 kbps and then called with 2.5 G. Furthermore, Enhance Data Rate for GSM Evolution (EDGE) is used as an improvement of the GPRS and has a bit rate of 384 kbps. EDGE is used as the basis for the emergence of 2.75 G. Third generation (3G) use High-Speed Downlink Packet Access (HSDPA) with 14.2 Mbps as part of High Speed Packet Access (HSPA) family that has 14 Mbps in the downlink and 5.76 Mbps in the uplink. On the other hand, CDMA technology developed a data access technology namely 1xEV-DO or EV-DO with a bit rate of 2.4 Mbps [2] [3].

The investigated MCPMI services are expected to be used to enhance the ability of communities to use ICT to enhance the readiness of rural communities in the global competition. MCPMI system can also help create a connected society, so that information flows more smoothly and the welfare of rural communities is better.

Internet access technology in the research is geared toward rural communities, given that most of Indonesia's populations reside in rural areas and many areas are categorized as remote areas or are separated from the world of information. Thus, the system developed can be used as a means to assist governments in improving the ability to use Information and Communication Technology tools for the community even to people who live in rural areas.

Research on MCPMI system is expected to generate an alternative technology in building a system of Internet access without cable and phone-based multi connection mobile phones using load balancing.

The system can also be developed for a learning tool for students of schools in rural or isolated areas that do not have Internet access especially in the task of learning ICT, both for elementary school (SD) or High School (SMP) or higher. This study is limited for rural areas in Daerah Istimewa Yogyakarta (DIY).

2. Research Method

The system under study is MCPMI system uses GSM/CDMA modem by implementing load balancing so that it can overcome the problems of Quality of Service (QoS), especially the amount of bit rate offered. The problem is how far the availability of facilities Internet connection using cell phones in rural areas of DIY, how the architecture of hardware and software needed, how to perform load balancing, and how the resulting system performance, as well as web content such as what can still be served by such a system is feasible.

This research activity is divided into several activities, namely: (1) survey the availability of Internet access services in some rural areas in DIY in order to obtain information types of hardware (modems) that can be used or a map service, (2) testing the MCPMI architecture and performance; and (3) what if the system is applied to access e-learning and the introduction of information and communication technology in rural areas.

Activities (1) and (2), conducted in First Year, while the activity (3) will be implemented in Second Year. This paper discusses the activities of First Year of mapping services, prototyping and testing the MCPMI.

The hardware architecture used to build a system MCPMI shown in Figure 1.
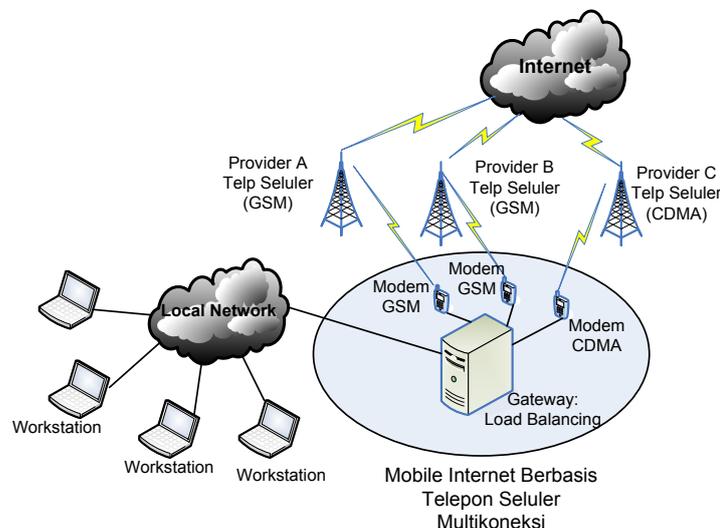

Figure 1. Hardware architecture of MCPMI.

3. Result and Discussion

3.1 Mapping of The Internet Access Service

Mapping the Internet access service for some mobile phone service providers with GSM or CDMA technology was done to prove what they have offered in their promotion. Activity of mapping bit rate Internet access services performed in this study begins by browsing the Internet to obtain information map of Internet access services to some good cell phone service providers that use GSM or CDMA technology.

Activities that have been conducted are data collection in some points especially in a district of Kulon Progo, Bantul, Sleman, and Gunung Kidul. Based on the observations, most rural areas have a minimum of affordable Internet access service even with the GPRS technology (for GSM) and CDMA 1x (for CDMA). While in some areas close to the District Office, most of them can enjoy 3G services in the form of Internet access with HSDPA or HSPA technology.

Based on these results the condition of each district in the Daerah Istimewa Yogyakarta can be explained as follows.

The area of Sedayu sub-district of Bantul has gained Internet access services using HSDPA, eventhough the signals obtained are still small (one bar), while for CDMA technology with the Internet access services using EV-DO have a very strong signal (2 to 3 bar). Kulon Progo district, especially Pengasih sub-district still using EDGE technology (for GSM) and CDMA 1x (for CDMA). Nevertheless, some areas located near the district town have HSDPA signals, such as Wates city and regions of Kulon Progo Dam.

Sleman district in general have enjoyed Internet access using HSDPA service, although for some areas away from the city district is still using EDGE or GPRS technology. Some locations in Gunung Kidul's got Internet access service using 3G technology (HSDPA), while for the southern region (near the south coast) still uses GPRS technology and even cell phone signals is negligible.

Mapping of the Internet access service in rural areas which is implemented in the form of DIY Map web-based Internet Access Service Information System provides information on: (1) the geographic location of rural areas based on GPS data; (2) types of mobile phones for the connection (GSM /CDMA); (3) types of data access services technology which is GPRS/EDGE/HSDPA/HSPA for the type of mobile phone GSM and CDMA 1x / EV-DO for CDMA cellular phone types.

Data obtained from the field is then inserted into the Map Internet Access Service Information System that is built using Drupal and Google Map [4][5]. The display of data access Internet information system using mobile phones can be seen in Figure 2 below.
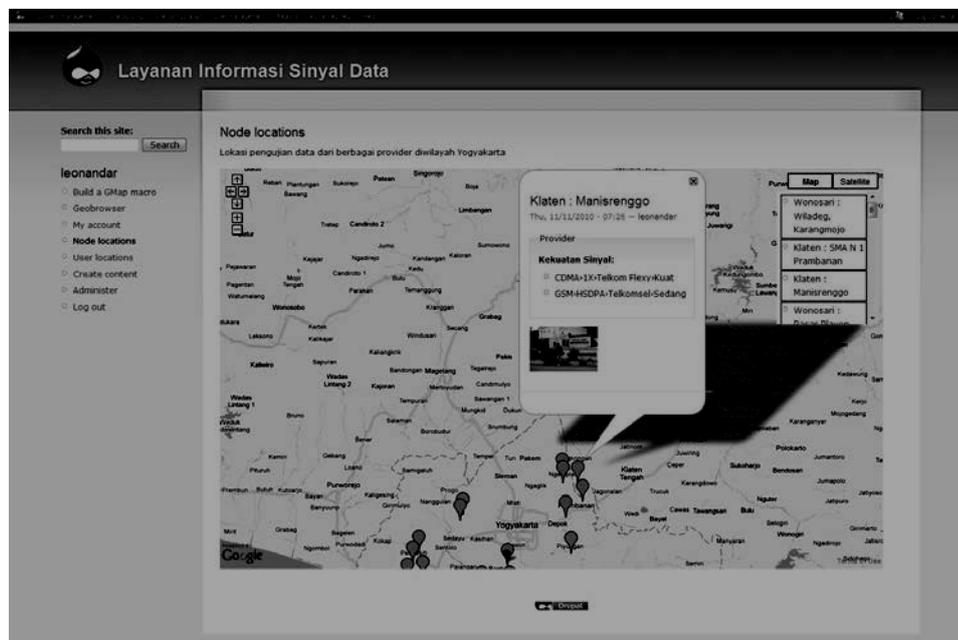

Figure 2. The web-based Map Information System of Internet Access Service mobile phone in rural areas of Daerah Istimewa Yogyakarta.

3.2 Server Gateway IMBMCCP

The MCPMI Server gateway in this study was developed using the Linux operating system and open source software in the process of multi connection load balancing. The reason for selecting the Linux operating system is the freedom of licensing factor and network system security. Linux operating system is the operating system most widely used in building a server that is connected to the Internet because it does not require a license in its use. In addition, reliability and security of a proven system guaranteed and any problems or bugs can be consulted to find a solution via the Internet easely.

In balancing the load of multi connection to the internet, it has been developed including open source Linux-based software. Zeroshell in this study has been chosen to do load balancing for several reasons, among others: (1) an open source software; (2) based on Linux; (3) user interface already allowing administrators make arrangements; (4) can handle multiple connections using GSM or CDMA modem which is limited although some types of modems; (5) settings which can be done via the client computer with a web-based connection facilities so as to facilitate the setting remotely.

Zeroshell used in this study is a Beta version of the application program, so it is still an opportunity to make changes or additions to the module according to the needs and source programs can be downloaded for free.

Zeroshell does not need to be installed, but it can simply be run in several modes, namely: (1) Boot CD; (2) Boot CD trough VMWare; (3) Boot using Flashdisk; (4) Install directly in Hard disk. All kinds of software can be downloaded from the address http://www.zeroshell.net/eng/download/. After finishing the download, Zeroshell can be burnt directly on CD or be run directly Vmware (Zeroshell downloads special for VMware).

This study uses the boot mode CDs which are installed on personal computers. This mode is considered more practical, although it need precision (burning speed selection and the quality is pretty good CD burner) when burning a CD so that CD burning can process the boot perfectly. It also tried to install stick the boot mode in the notebook as an alternative and increasing levels of mobility server.

To run the Zeroshell, it needs to be convinced first that the device connecting to the Internet as a modem GSM / CDMA, ADSL and others have been connected to the server. Thus, when the Zeroshell performs the boot process, it can run automatically each of the modem drivers that can be recognized. This study uses two modems of Sierra 881U with Telkomsel Flash Internet access services because those services have the APN as a major requirement to use Internet connection Zeroshell.

Internet connection service that does not use the APN will not be recognized by Zeroshell. Stages in the running Zeroshell briefly are as follows:

1. All GSM/CDMA modems are already installed on the computer.
2. Booting a gateway server using the life-CD ZEROSHELL and wait until boot process is completed.
3. Setting an IP Address. Default IP Address Zeroshell is a class C which is 192.168.0.75 with a netmask of 255.255.255.0. Thus, all client computers must be set the IP address used is the class C 192.168.0.x, netmask 255.255.255.0, Gateway and DNS for client 192.168.0.75 filled. Zeroshell settings for the gateway server can be done using the client computer through a browser application program through https://192.168.0.75 address.
4. Standard accounts for Zeroshell using the username = admin dan password = zeroshell.
5. Zeroshell settings by following the instructions on the site where open source database.
6. Testing results of the settings can be done through the Utilities menu on the left menu column. Fill in the IP Address or hostname to test the connection and then click Check. This study uses a hostname google.com with the aim of testing the function of the DNS has been configured. Display test results are as follows.
7. Figure 3 shows that the connection to google.com is successfull demonstrating the function of DNS working with existing evidence google.com resolves hostnames into IP addresses.
8. After that all clients are connected to the LAN network to surf the Internet through the Gateway service Zeroshell which has connected to the Internet using these two 3G modems.
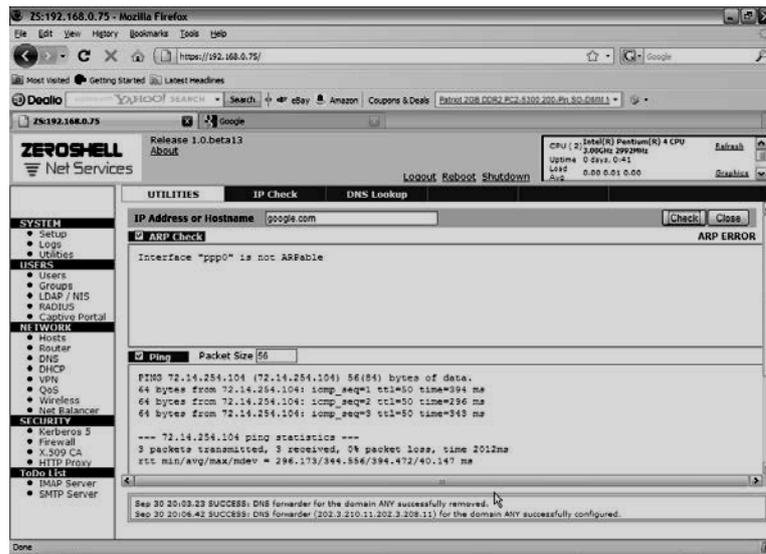
Figure 3. The display of test result

Based on test results of multi connection server load balancing using two GSM modems then the resulting bit rate is roughly 2 times the bit rate by using a single modem connection. Internet services are used in this study is an Internet service with a maximum capacity of 1 Mbps with a record of the use of Internet connections has not exceeded the allowable quota is 1 Gigabyte. Thus, the connection using two modems would generate a capacity of 2 Mbps.

Testing the average bit rate that can be obtained by using a modem with Telkomsel Flash in this experiment is 500 Kbps up 700 Kbps during downloads. So the connection using two modems will produce up to 1 Mbps bit rate 1.5 Mbps during downloads.

Figure 4. Display test results using 2 pieces of the bit rate modem

Minimum standard set of Internet services by government is 1 Kbps / user. Thus, a server with 2 pieces of this modem connection can serve approximately 1000 sd 1500 users.

If the average user want a bit rate that is more feasible to conduct an Internet connection such as a minimum threshold is 10 Kbps, the server-based mobile Internet gateway with 2 pieces of multi-modem connection can serve 100 to 150 users. Based on the analysis of experimental data shows that the server-based mobile Internet gateway multi

connection decent Internet connection is used to serve one class comprising 40 students smoothly.

If viewed in terms of bandwidth per month subscription fee, then the Internet connection by using two cellular phone modems are also relatively inexpensive, which is 2 x Rp. 110,000.00 = Rp. 220,000.00. However, the application server that has been tested in laboratory scale needs to be investigated further to determine the performance especially in the field significantly.

4. Conclusions and Future Work

The conclusions of this research are:
1. The prototype system uses software MCPMI Opensource Zeroshell software that implements load balancing work well and using the N numbers of cellular telephone modems will generate N x Bit rate of each modem. Tests using 2 pieces of modem with up to 500 Kbps data service 700 Kbps each modem will generate 1 Mbps to 1.5 Mbps.
2. Subscription cost of bandwidth for each packet is used in the testing service is Rp. 110.000, - each month, so by using 2 pieces of modems require a fee of Rp. 220.000, - each month for Internet access service with bit rate of 1 Mbps up 1.5 Mbps.

Future work:
1. MCPMI server prototype is still in the form of a laboratory scale and still needs to be tested in the field to obtain a picture of system performance significantly in rural areas.
2. Method of load balancing methods is still limited to "failover" and the need to develop another method of load balancing is more optimal.

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