LOW COST NETWORK EMULATOR WITH ETHERNET AND E1 INTERFACES

Zbynek KOCUR[1], *Jiri VODRAZKA*[1], *Peter MACEJKO*[1]

[1]Department of Telecommunication Engineering, Faculty of Electrical Engineering, Czech Technical University in Prague, Technicka 2, 166 27 Prague 6, Czech Republic

kocurz1@fel.cvut.cz, vodrazka@fel.cvut.cz , macejp1@fel.cvut.cz

Abstract. *Contemporary Next Generation Networks (NGN) are mainly built on the Internet Protocol (IP) and Ethernet. Major challenge for emerging types of wired and wireless IP-based networks is to provide an adequate Quality of Service (QoS) for different services. The quality of evaluation requires a detailed knowledge of the performance requirements for particular services and applications. The paper is primarily oriented to the end-to-end testing for the Ethernet-based terminal equipment. The low cost Ethernet network emulator was developed on the Department of Telecommunication Technology of the Faculty of Electrical Engineering of the Czech Technical University in Prague. The extension for emulation network with the E1 interfaces and TDM over IP transmission can be used with external converters.*

Keywords

Ethernet, network delay, network emulator.

1. Introduction

The Next Generation Networks are built mainly on the Internet Protocol (IP) stack and the Ethernet [2]. The simulator of the Ethernet and the IP network can be used for testing of new network elements and services. The Ethernet network emulator "EtherShaper" was developed on the Telecommunication Technology Department of the Faculty of Electrical Engineering of the Czech Technical University in Prague.

2. Description of Ethernet Emulator

The Ethernet network emulator "EtherShaper" is introduced in this section.

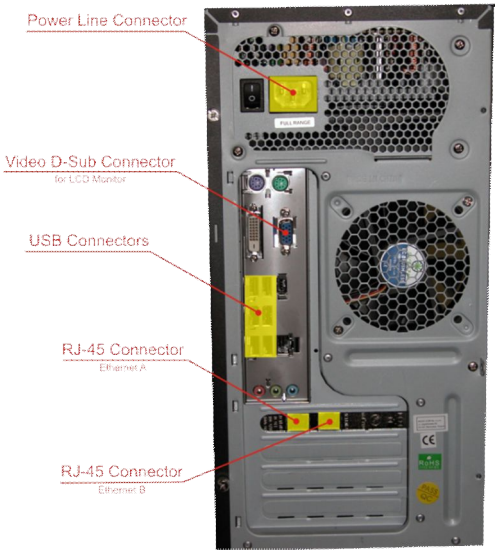

Fig. 1: HW platform on PC with double LAN card for EtherShaper.

The feature and capability of the EtherShaper includes the following items:

- two RJ-45 ports for Ethernet testing (port A and port B),
- supported Ethernet versions: 10Base-T, 100Base-Tx,
- duplex mode: Half, Full, auto-negotiation,
- speed: 10 Mbit/s, 100 Mbit/s, auto-negotiation,
- minimal Ethernet frame size: 50 bytes,
- maximal Ethernet frame size: 1500 bytes,
- independent adjustable true linear delay in both directions in range from 0,5 ms to 30 s,
- independent adjustable "RAMP" delay in both directions. RAMP is defined with start delay, end delay and incremented in s per ms,
- independent adjustable loss in both directions in range from 0 % to 100 %,

- load/Save user configuration.

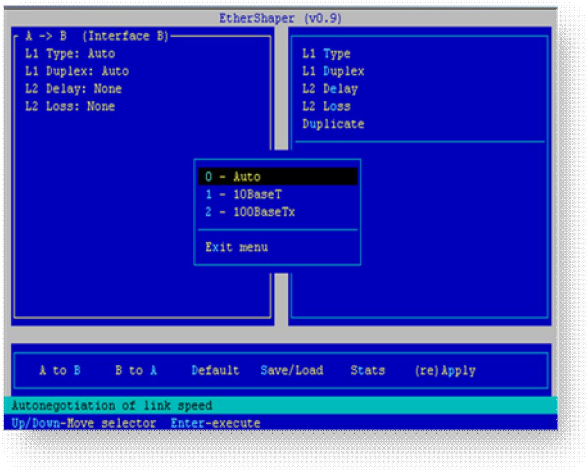

Fig. 2: HW platform on PC with double LAN card for EtherShaper.

The low cost Ethernet network emulator is based on the PC platform with double LAN card (see Fig. 1) and OS Linux. The user interface of the EtherShaper is designed to be intuitive and easy to use. Using the monitor and keyboard, you can set up the Ethernet frames processing.

The navigation through the program menu is carried out by the cursor keys (Left, Right, Up, Down or Tab key) while the selection must be confirmed by Enter key (see Fig. 2 and 3).

The Ethershaper Unit uses a standard GNU/Linux operating system [3]. There is the only one requirement and that the kernel version which must be at least 2.6.21 (because of using a High-Res timer).

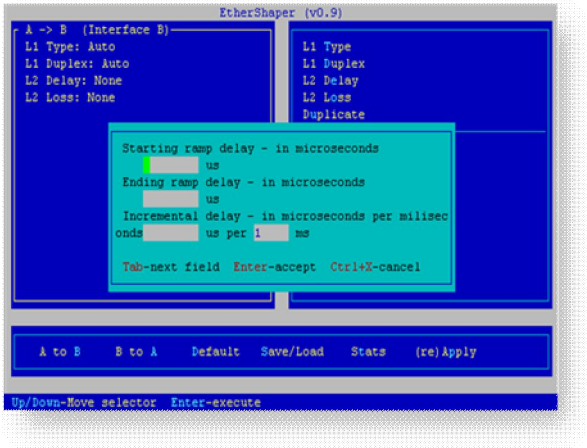

Fig. 3: User´s interface for ramp jitter mode (min. and max. delay can be selected).

3. Applications

The EtherShaper can be connected between the Ethernet Generator and Analyzer anywhere in a broadcast domain. In this case, the generated Ethernet traffic is modified in the EtherShaper and sent to the Analyzer. The Ethernet traffic can be modified only in one direction (see Fig. 5). Both - the EtherShaper Unit and the measuring equipment must be placed in the same broadcast domain.

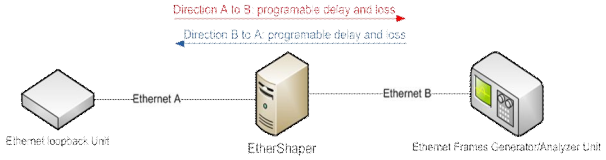

Fig. 4: Transmission testing with loopback.

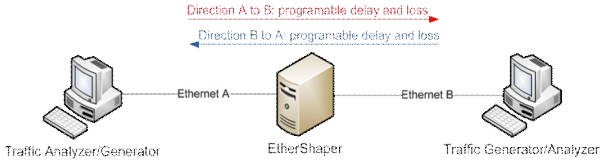

Fig. 5: End-to-end transmission testing.

The Ethernet network emulator EtherShaper Unit can be connected between the Ethernet Generator/Analyzer and the loopback units placed anywhere in a broadcast domain. In this case, the generated Ethernet traffic is modified in the EtherShaper and sent afterwards to the loopback device. The Loopback device loops the traffic back to the analyzer through the EtherShaper (see Fig. 4). The Ethernet traffic can be modified in the both directions. The EtherShaper and the measuring equipment must be placed in the same broadcast domain.

The Ethernet network emulator EtherShaper Unit can be utilized in the networks that are compatible with the Ethernet standard [1]. Placing the EtherShaper Unit into the same broadcast domain (as the devices whose traffic is shaped) is necessary condition for a good function.

The EtherShaper was used in the laboratory network on the Department of Telecommunication Engineering for education and for testing of new networks nodes and services.

4. Experimental

The SW development was provided in many phases. The main program and LAN card driver were optimized for minimal delay (process delay of emulator). The comparison of other EtherShaper version (the selected value of delay on axis x versus real value of delay on y axis) is presented in Fig. 6 (for 30 % traffic on interface 100BASE-T). The high value of delay offset in version 0.9

was reduced in version 1.0 and 2.0. The delay was measured by two analyzers SmartClass Ethernet Tester JDSU in end-to-end mode.

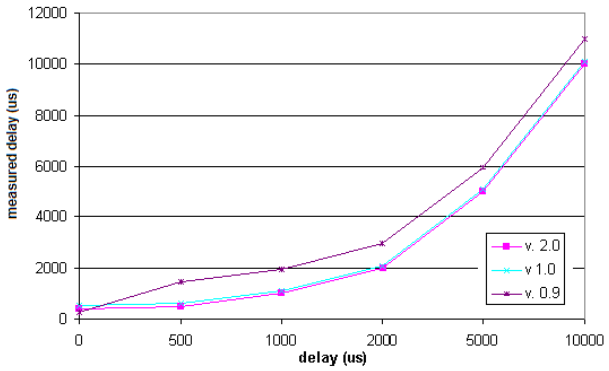

Fig. 6: Selected value of delay on axis x versus real value of delay on y axis for other version EtherShaper.

The extension for emulation network with E1 interfaces and TDM over IP transmission uses external standard serial produced converters RAD Communication IPmux-2L. The values of adding delay of convertor is presented in Tab. 1. The mode with minimal number of bytes for packet (1x48) must use for minimal delay. The delay was measured by one analyzer Trend Victoria PDH/SDH in trip round delay mode.

Tab.1: Adding delay of E1 to Ethernet convertor for other TDM over IP modes.

Bytes for TDMoIP packet	Measured packetization delay (ms)	Theoretical packetization delay (ms)	Difference (ms)
1x48	0,731	0,367	+0,364
5x48	2,289	1,84	+0,449
10x48	4,342	3,672	+0,67
15x48	6,308	5,508	+0,8
20x48	8,323	7,344	+0,979
25x48	10,332	9,18	+1,152
30x48	12,274	11,016	+1,258

5. Conclusion

The paper represented the integration of the EtherShaper Unit within a common wired and wireless networks based on the Ethernet. The EtherShaper was used in laboratory network on Department of Telecommunication Engineering for education and for testing of new networks nodes and services.

The adding software modules for other types of variable delay will be developed during this year. The extension for emulation network with E1 interfaces and TDM over IP transmission uses external standard serial produced converters which change E1 to Ethernet. The program must calculate the adding process delay for TDM to the packet conversion.

Acknowledgements

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References

[1] HASSAN, M.; JAIN, R. *High Performance TCP/IP Networking*. 1st edition. New Jersey: Pearson Education, 2004. ISBN 978-0130646347.

[2] *IEEE 802.3 ETHERNET WORKING GROUP* [online]. 2007 [cit. 2008-01-05]. Available at WWW: <http://www.ieee802.org/3/>.

[3] *Voyage Linux Noiseless, green and clean computing* [online]. 2008 [cit. 2008-01-05]. Available at WWW: <http://linux.voyage.hk/>.

About Authors

Zbynek KOCUR was born in 1982. He received his M.S. degree in electrical engineering from the Czech Technical University in Prague in 2008. Since 2008 he has been studying Ph.D. degree. He is teaching communication in data networks and networking technologies. His research is focused on wireless transmission and data flow analysis, simulation and optimization. He is currently actively involved in projects focused on high speed data transmission from fast moving objects and data optimization via satellite network.

Jiri VODRAZKA was born in Prague, Czech Republic in 1966. He joined the Department of Telecommunication Engineering, FEE, CTU in Prague in 1996 as a research assistant and received his Ph.D. degree in electrical engineering in 2001. He has been the head of the Transmission Media and Systems scientific group since 2005 and became Associate Professor in 2008. He participates in numerous projects in cooperation with external bodies. Currently he acts also as vice-head of the Department

Peter MACEJKO received his MS degree in electrical engineering from the Czech Technical University in Prague in 2006. Since 2006 has been studying PhD degree. He is teaching networking technologies and distributed systems. His research is mainly focused on scheduling in distributed systems. He is currently involved in projects focused on low latency routing and distributed computing.