The Home Network Traffic Models Investigation

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***Abstract*— The paper presents the results of the traffic investigation on the home networks for BitTorrent, Skype and M2M services. The traffic features are investigated on the test beds. One of them is created for Skype and BitTorrent traffic investigation. Another test bed is created for M2M traffic investigation. The related works on the teletraffic investigation area are analysed. The Poisson and self-similar traffic models are considered, including Skype and BitTorrent traffic models. The anti-persistent traffic models for M2M traffic in case of mass events is discussed. The anti-persistent traffic can mainly affect the traffic service. So, the most important task of the paper investigation is the detection of anti-persistent traffic on the home networks. The Hurst parameter is calculated by the analysis of change in dispersion method. The obtained results have shown that outcoming and incoming BitTorrent and M2M traffic have the anti-persistent features on the home network. It should be counted at the home network planning. The traffic control methods can be used on the home networks, for example traffic scheduling.**

***Keywords*— Home network, traffic, bittorrent, Skype, M2M, anti-persistent**

I. Introduction

The home networks is defined as "two or more nodes that can communicate with each other either directly or through a relay node at physical layer, or through an inter-domain bridge above the physical layer" [1]. This definition applies to the home network based on the wireless technologies as well [2]. The home network traffic models are the objects of present paper. Three types of the traffic is investigated. They are machine-to-machine traffic, torrent traffic and Skype traffic. Two domains are needed at least. Firstly, it is domain based on the PC/smartphone/tablet. These devices are used for Skype and torrent traffic services. The second domain is based on the sensor nodes and use of the M2M traffic service. The investigated home network structure is shown on the Figure 1. The Skype is very popular for the voice services, the torrent is widely used to the video services, and M2M is a base for smart home [3]. All this services can be offered to a user simultaneously and the features and joint effect of this traffic should be studied well. There are many investigations on the traffic features. The voice traffic model for circuit switching is usually Poisson [4]. The self-similar models are very popular for the packet switching. The WWW traffic model [5], the e-mail traffic model [6], the fail transfer model were developed as self-similar. The IPTV traffic models are self-similar as well with different Hurst parameters' values for unicast and multicast mode [7,8,9].

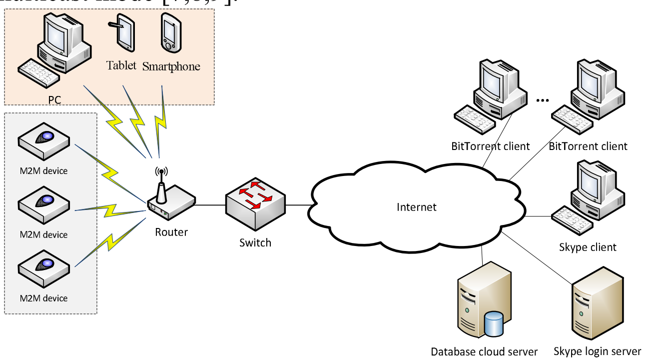

Figure 1. The investigated home network structure

The self-similarity is a feature when the Hurst parameter changes in the interval $0.5 < H < 1$. In the recent years the anti-persistent feature has been found during M2M traffic simulation [10]. The anti-persistent is a feature when Hurst parameter changes in the interval $0 < H < 0.5$. The anti-persistent traffic is characterized as the unpredictable traffic peaks and can largely affect another traffic types.

The main goal of this paper is the investigation of torrent, M2M and Skype traffic on the home network test beds and the anti-persistent features detection.

II. Related Work

The torrent traffic features have been investigated in the several articles. The BitTorrent packet traffic features over IPv6 and IPv4 were investigated in the [11]. The Hurst parameter values for both protocols were more than 0.7 for interarrival time and for the packet size. It matches big rate of self-similarity. The swarming BitTorrent model is applied to streaming data such as VoIP or video in accordance with [12]. The VoIP traffic model even in the All over IP network [13] is the Poisson. The self-similarity of the video traffic can be changed in vast limits. It defines the type of services (unicast or multicast). Thus the obtained Hurst parameters values were dependent from the experiment conditions. It confirmed the results from [14] which were obtained from torrents or twitter. The Hurst parameters of the stable peers are around 0.7 and sometimes can achieve over 0.9. On the other hand the Hurst parameters of the unstable peers are around 0.5 [14].

The M2M traffic antipersistent feature was obtained in the [10] by simulation. We will investigate the similar model on the test bed.

The Skype traffic self-similar feature was obtained in the [15]. The Skype traffic is self-similar with H = 0.6 for inter-arrival time and H = 0.7 for packet lengths.

III. Test Beds Structures

The test bed structures are depicted on the Figure 2 and Figure 3 for the BitTorrent and Skype traffic investigation and M2M traffic investigation respectively.

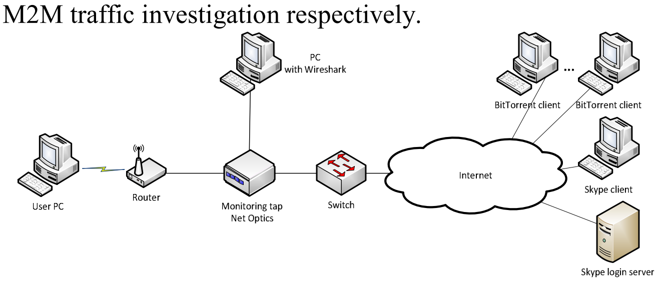

Figure 2. The test bed to investigation of the BitTorrent and Skype traffic

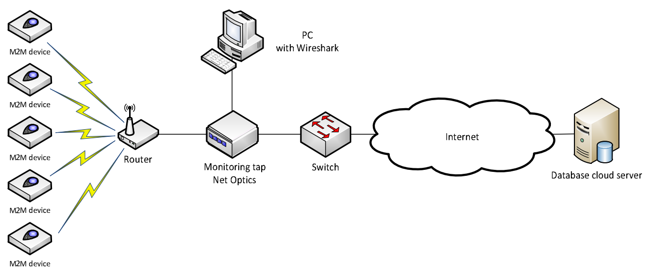

Figure 3. The test bed to investigation of the M2M traffic

We assume that the home network is located in the modern apartments PS, smartphone, tablet, WiFi router and sensor nodes from M2M system "smart home" that are acceptable. The simultaneously conversation on Skype, files downloads by BitTorrent and data transmission from sensor nodes can lead to overload of home network. Thus, the M2M traffic, BitTorrent traffic and Skype traffic should be studied well.

The both types of traffic outgoing and incoming are obtained on the test bed. The network coupler from NetOptics vendor is used for traffic flows interception. The NetOptics support the technology Zero Delay that can warranty the uninterrupted system operation even during power failures. The traffic parameters are fixed by Wireshark. It can have a possibility to obtain traffic parameters in real time.

IV. Skype Traffic

We have obtained the voice Skype traffic. The mean traffic value for voice conversation is likely 500 Kbit/s. We use the analysis of change in dispersion method for Hurst parameter calculation.

The base formula for this method is:

$$\sigma^2[Y^m] \square m^{-k},$$

where Y – original sequence, m – block size, k=2-2H.

The H parameter calculates the next method. The dependence $\sigma^2[Y^m]$ from m are built on the logarithmic scale. Further, the straight line is defined by least square method and the Hurst parameter is calculated by the slope of the line.

The Hurst parameter estimations by the analysis of change in dispersion method for outgoing and incoming voice Skype traffic are shown on the Figure 4 and Figure 5 respectively.

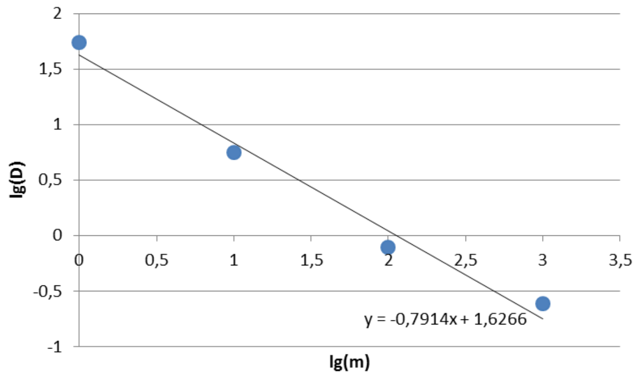

Figure 4. The Hurst parameter estimation by the analysis of change in dispersion method for outgoing voice Skype traffic

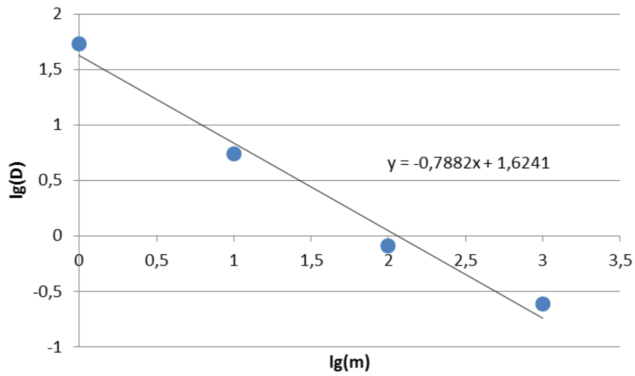

Figure 5. The Hurst parameter estimation by the analysis of change in dispersion method for incoming voice traffic

The Hurst parameters value for outgoing and incoming the voice Skype traffic about the same and equal H=0.6. This estimation is almost the same as the one from [15]. Thus, the voice Skype outgoing and incoming traffic in the home network is the self-similar with small rate of self-similarity.

V. BitTorrent Traffic

The file with size 1 Gbait was downloaded. The method of the analysis of change in dispersion for Hurst parameter calculation was used.

The Hurst parameter estimations by the analysis of change in dispersion method for outgoing and incoming BitTorrent traffic are shown on the Figure 6 and Figure 7 respectively.

The Hurst parameter estimation for outgoing BitTorrent traffic is H=0.36. The Hurst parameter estimation for incoming BitTorrent traffic is H=0.38. Both estimations reveal the anti-persistent BitTorrent traffic nature for the home networks. This can be possible in accordance with transmission mass of short packets to home network from mass computer that is located all over the world. The transmission mass of short packets from the computer of the home network to mass computer that is located all over the world is the reason for H=0.36 for outgoing BitTorrent traffic.

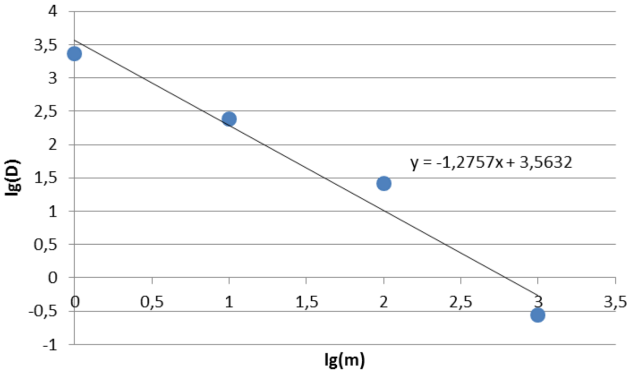

Figure 6. The Hurst parameter estimation by the analysis of change in dispersion method for outgoing BitTorrent traffic

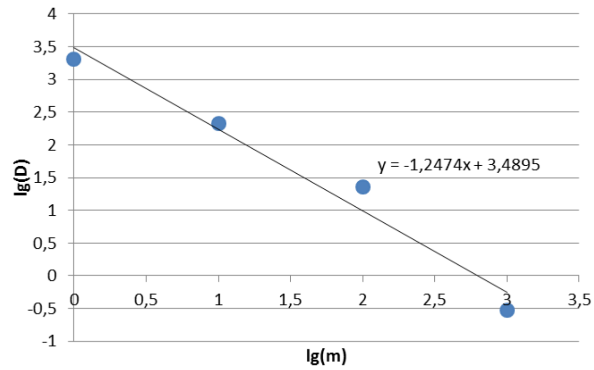

Figure 7. The Hurst parameter estimation by the analysis of change in dispersion method for incoming BitTorrent traffic

VI. M2M TRAFFIC

The method of the analysis of change in dispersion for Hurst parameter calculation was used for estimation M2M traffic. The anti-persistent nature of M2M traffic was obtained in the [10] in case of mass event detection.

The Hurst parameter estimations by the analysis of change in dispersion method for outgoing and incoming M2M traffic are shown on the Figure 8 and Figure 9 respectively.

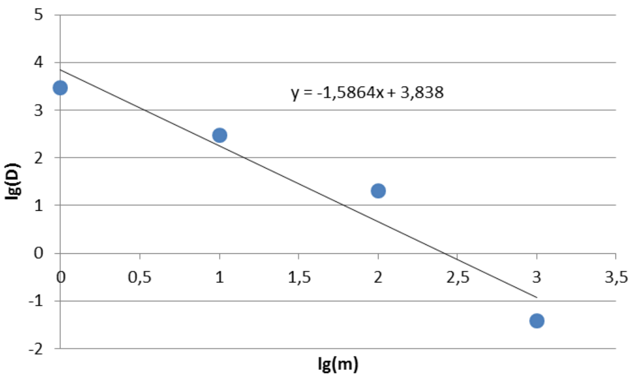

Figure 8. The Hurst parameter estimation by the analysis of change in dispersion method for outgoing M2M traffic

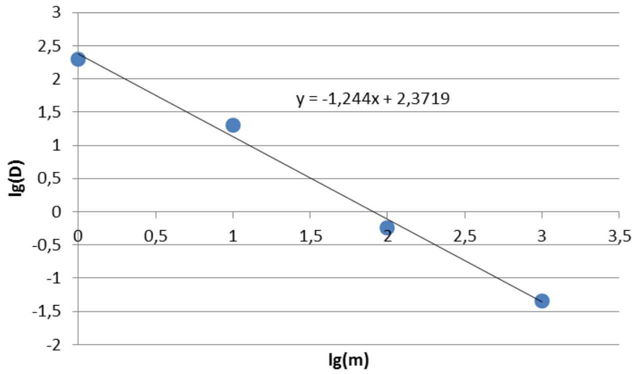

Figure 9. The Hurst parameter estimation by the analysis of change in dispersion method for incoming M2M traffic.

The Hurst parameter estimation for outgoing M2M traffic is H=0.21. The Hurst parameter estimation for incoming M2M traffic is H=0.38. Both estimations reveal the anti-persistent M2M traffic nature for the home networks. The outgoing M2M traffic is a traffic with big value of anti-persistent.

VII. CONCLUSIONS

In this paper we investigated the BitTorrent, Skype and M2M traffic on the home wireless network with PC, smartphone, tablet, WiFi router and sensor nodes. The test beds were used for investigation. The obtained results has shown that outcoming and incoming BitTorrent and M2M traffic have the anti-persistent features on the home network. The anti-persistent features of the BitTorrent and M2M traffic can deeply affect the quality of services and the quality of experience. The methods for anti-persistent traffic control on the home networks should be developed.

FUTURE WORK

In the future we will investigate M2M traffic effect to the IPTV quality of experience. Furthermore, the anti-persistent traffic scheduling methods for the home networks will be developed.

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