Machine Learning Research
2017; 2(1): 1-9
http://www.sciencepublishinggroup.com/j/mlr
doi: 10.11648/j.mlr.20170201.11

Conference Paper

Investigation of the IOT Network of Packet Loss's Long-Range Dependence and QOE

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To cite this article:
Yibin Hou, Jin Wang. Investigation of the IOT Network of Packet Loss's Long-Range Dependence and QOE. *Machine Learning Research.* Vol. 2, No. 1, 2017, pp. 1-9. doi: 10.11648/j.mlr.20170201.11

Received: January 4, 2017; **Accepted**: January 21, 2017; **Published**: February 20, 2017

Abstract: The Internet of things, including Internet technology, including wired and wireless networks. Internet of Things and the Internet is the relationship between the parent and the child. In this paper, we aim to study the Investigation on the network packet loss's long-range dependence and QOE and gain a good result and conclusion. In order to better establish no-reference video quality assessment model considering the network packet loss and further gain a better QoE evaluation, so we build NS2 + MyEvalvid simulation platform to study the scale characteristic of the network packet loss, scale characteristic of packet loss through the influence of packet loss rate to influence QoE. The experimental results show that, packet loss processes have long-range dependence, the number of superimposed source N, shape parameter, Hurst parameter, the output link speed have impacts on long-range dependence. We came to the conclusion that when superimposed source N is more, the shape parameter is smaller, Hurst parameter is bigger, the output link speed is smaller, packet loss's long range dependence is larger, packet loss rate is high.

Keywords: No-Reference, Quality Assessment Model, Network Packet Loss, Long-Range Dependence

1. Introduction

At present, the development of international information prompted the international people's exchanges widely, network video business is increasing. In the information industry, network video business has become the most popular application of computer network field, from the international and domestic exchanges to life and entertainment, video penetrated into every aspect of our lives.

But the network itself is not perfect, in essence, is a kind of distortion network. Therefore, causes the academia and industry professionals think that, what causes the decrease of the quality of the video and how to evaluate the quality of the network video. So, we set up the video quality assessment model to evaluate the quality of video. Network TCP/IP protocol itself is only a best effort protocol [1], in this service model, all the business flows, fair competition for network resources, can not meet the bandwidth, delay, jitter and other special requirements of the new application. These new applications contributed to QoS (Quality of Service, QoS) concept appears. In addition, QoS and man-made factors together determine the user's Quality of Experience (Quality of Experience, QoE) [2]. The various businesses on computer networks, presents the long-range dependence [3, 4]. Only under the self-similar traffic network's performance, conducting the correct analysis and evaluation, we can make the network performance is optimized. One of the most important parameters in QoS is the packet loss rate, different output link speed will affect the packet loss's long range dependence, long-range dependence will further affect the packet loss rate.

In related work, the reference [5, 6] mainly proposed scale characteristic of packet loss, scale characteristic mainly refers to in the process of packet loss reflects the long correlation. Long-range dependence with the self-similarity are two equivalent concepts. Because of the long correlation will affect the packet loss and further affect quality of service (QoS), and finally affect the QoE. The packet loss rate is an

important measurement parameter in QoS. So study Long-range dependence has an important value and significance. References [7, 8] researches in network traffic, discusses several existing Long-range dependence model, comparing their respective advantages and disadvantages, and predict the network traffic associated short and Long-range dependence into account, is the future direction of the traffic model, and be able better to describe any network traffic development direction. Through the study found the number of superimposed source N, shape parameter, Hurst parameter, the output link speed has impacts on Long-range dependence, and further affects the packet loss rate. Finally, it is concluded that different output link speeds have a significant impact on long-range dependence, and further to affect the packet loss rate. At the same time, this conclusion will be applied to establish the no-reference video quality assessment model considering the network packet loss.

2. Method

2.1. NS2's Principles of Generating Self Similar Traffic

NS2 provides four types of traffic generator: (1) EXPOO. (2) POO: (On/Off) Pareto distribution generating traffic. (3) Generate traffic CBR use the determine rate. (4) According to the trace files to produce traffic's Traffic Trace. Including in OTCL class Application/Traffic/Pareto's one traffic generator is POO_Traffic. POO_Traffic according to Pareto on/off distribution, generate traffic, at a fixed rate send packets in the period of one, no packet transmission in an off period. Superimposed source N many heavy tail's On/Off source superposition can produce self-similar traffic flow. N is greater, the self-similar phenomenon is more obvious.

The location of each file: (1) Application class: In C++Application class (~/NS/apps/app. h). (2) trafficGennerator abstract base class

(~NS/tools/trafgeh. h"). (3) POO_traffic (~NS/tools/Pareto. cc). (4) CBR_Traffic (~NS/tools/cbr_traffic. cc) [9].

In this paper, on the basis of configuration POO_traffic's parameter is as follows:

```
set traffic [new Application/Traffic/Pareto]
$traffic set packetSize_ $size
$traffic set burst_time_ $burst
$traffic set idle_time_ $idle
$traffic set rate_ $rate
$traffic set shape_ $shape
```

Among them, the average on (sudden) time is burst_time_, average Off (free) time is idle_time_, during the sudden time, the package delivery rate is rate_, packet size is packetSize_, Pareto distribution's shape parameter is shape_ [10].

We can can synthetic business flow with self similar proprietorss N numbers Pareto On Offf [11] traffic generators. The topology structure, including n (0), and (1),, and (N-1) these N number sending nodes, or is the routing node and S is the receiving node. N+1 links: n (0), and (1), and (N-1) is N number links to R, 1MB is bandwidth, 10ms is the delay, discard the package excess capacity; 10MB is R to S bandwidth, 10ms is the delay, discard the package excess capacity. When shape parameter is 1.4, flow rate figure as shown in figure 1. The horizontal axis shows the simulation time is 300 s, flow rate value that is the vertical axis is the amount of packet loss per unit time, as can be seen from the figure of sudden change of the traffic flow [12], and the linear flow rate values most are 400, 500, 600 these three values.

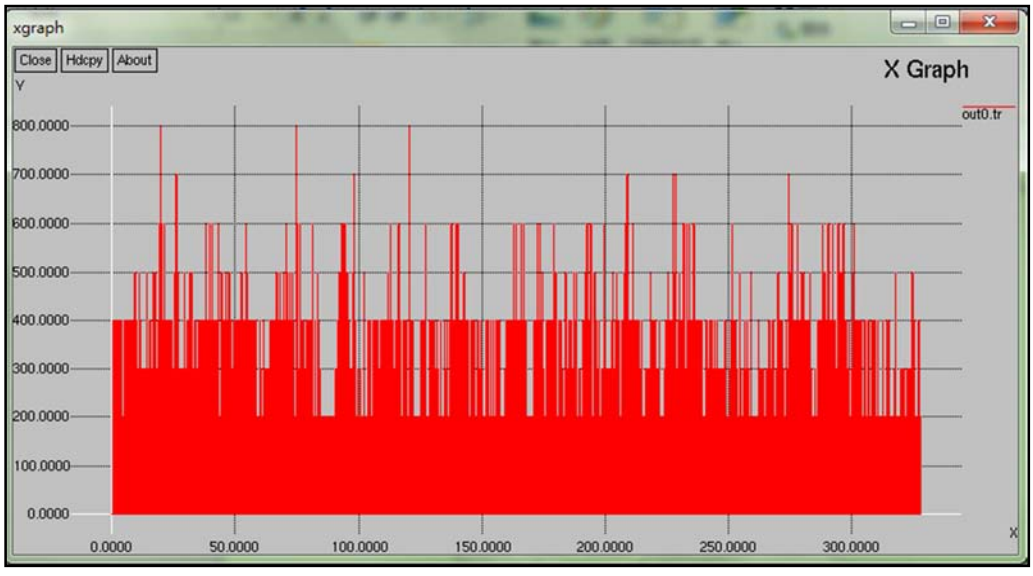

Figure 1. *Flow rate figure.*

2.2. The Definition of Self-Similar Processes

For a generalized stationary random process $\{ X_n \}_{n=0,1,2...,}$, set with constan my a: $\mu = E(X_i)$ and finite variance $\sigma^2 = E[(X_i - \mu)^2]\frac{1}{2}$, the self correlation coefficient is [13]:

$$r(k) = E[(X_i - \mu)(X_{i+k} - \mu)]/\sigma^2, (k=0,1,2,\ldots)$$

The self correlation coefficient only concerned with k, the number of network business entity in the k-th unit of time arrival is called X_k .

Use represents a soul, wly, ary, g function, that is $\lim_{t\to\infty}\frac{L_1(tx)}{L_1(t)}=1$, and for all X > 0 set up r(k)- $k^{-\beta}L_1(k)$, said the process to satis by the above conditions called progressive self-similar process [14].

Definition Generalized stationary discrete random process $\{\}_{n=0,1,2...,}$, called strong, progressive two order self-similar pro, ess, a, d have self-similar parameter H = $1-\beta/2$, $0<\beta<1$, if for any k > -1 self-similar funcation all meet $\lim_{m\to\infty} r(k)/k^{-\beta} = C < \infty$, C is constants.

Self-similar function H is also known as the Hurst parameter, it is the only parameter description of self similarity. Short time-related 0 < H< 1, when there is no correlation H = 1/2, long time-related 1/2 < H< 1. Because the network traffic is long-range dependent, therefore, the range is (1/2,1), H is bigger, the higher the degree of self similarity.

2.3. Influence Factors of Long-Range Dependence

2.3.1. The Influences of Superimposed Source N on Long-Range Dependence

According to the principle of the experiment we can assume, when N is bigger, self-similar is bigger, Hurst parameter is bigger, packet loss rate is bigger. Therefor, do four experiments, when the shape parameter is 1.5, the values of N respectively, are 5, 7, 9, 11, and make flow rate figure under the condition of N value are these values, the horizontal axis represents time, the vertical axis represents the numbers of packet arrival per unit time. When the N value is 5 rate figure as shown in 2, when the N value is 7 rate figure as shown in 3, when the N value is 9 rate figure as shown in 4, when the N value is 11 rate figure as shown in 5.

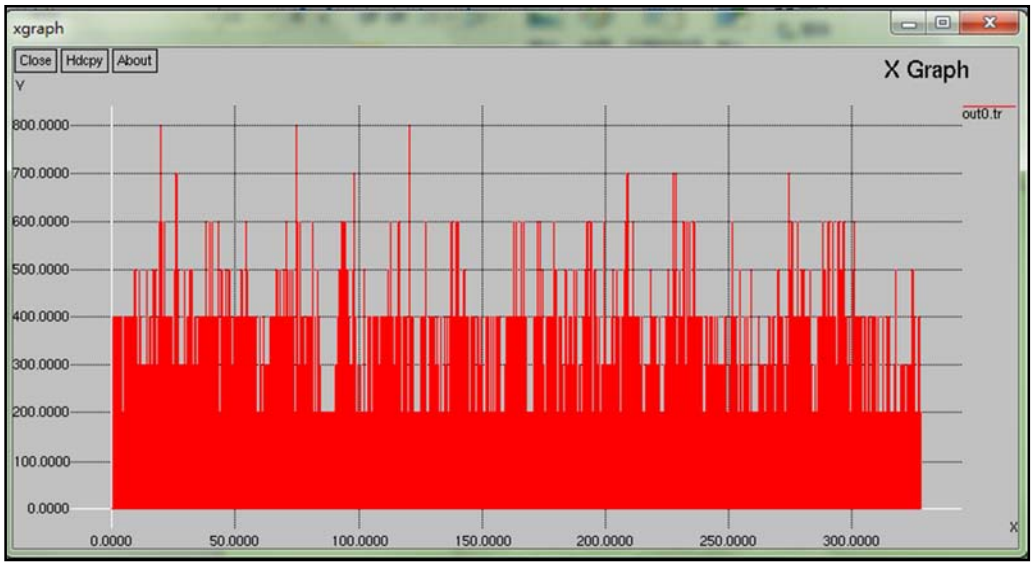

Figure 2. *Rate figure of N value is 5.*

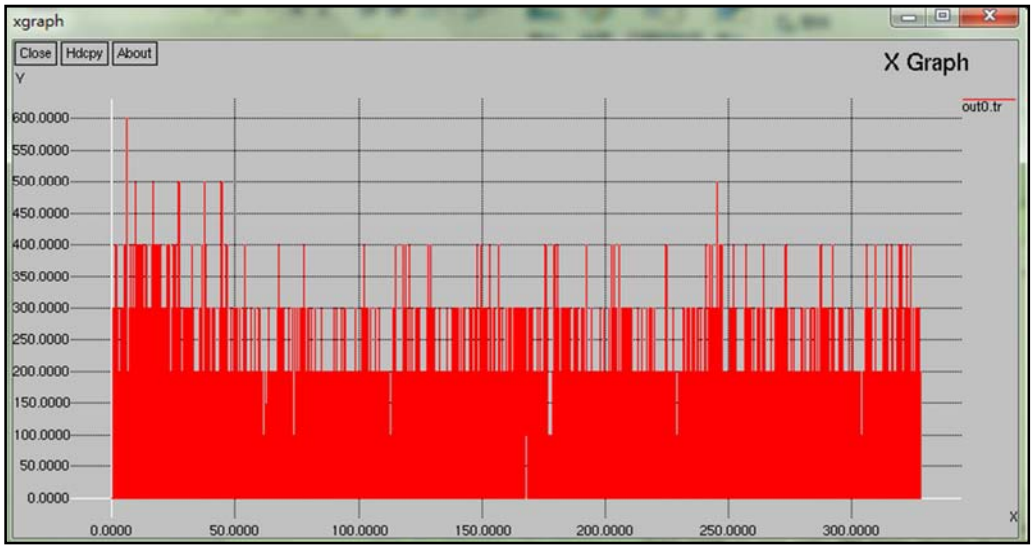

Figure 3. *Rate figure of N value.*

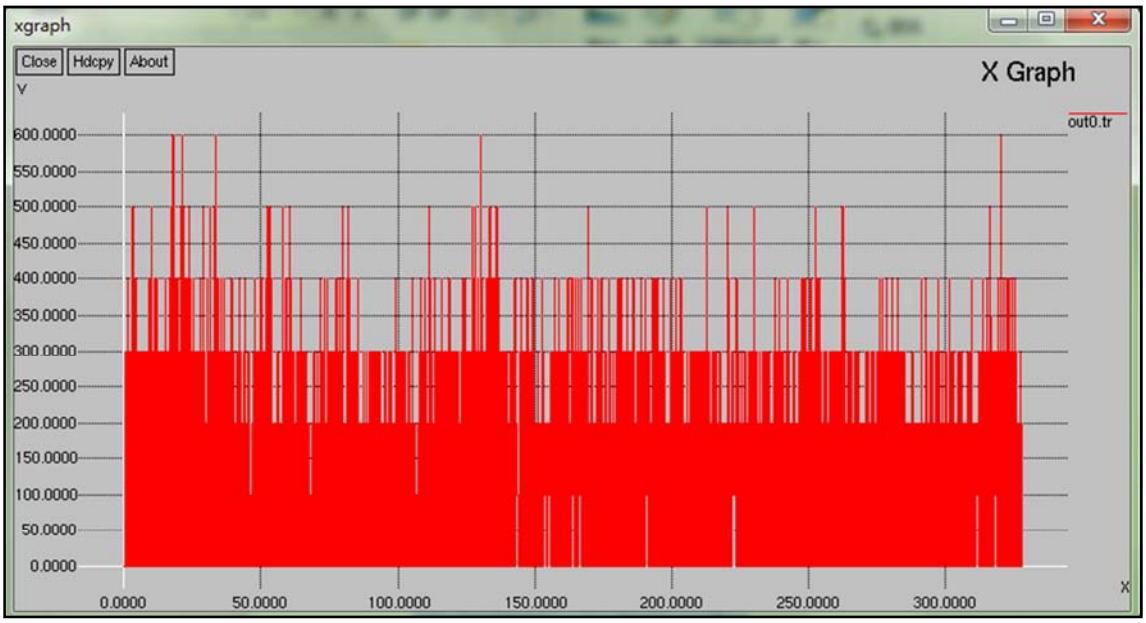

Figure 4. *Rate figure of N value is 9.*

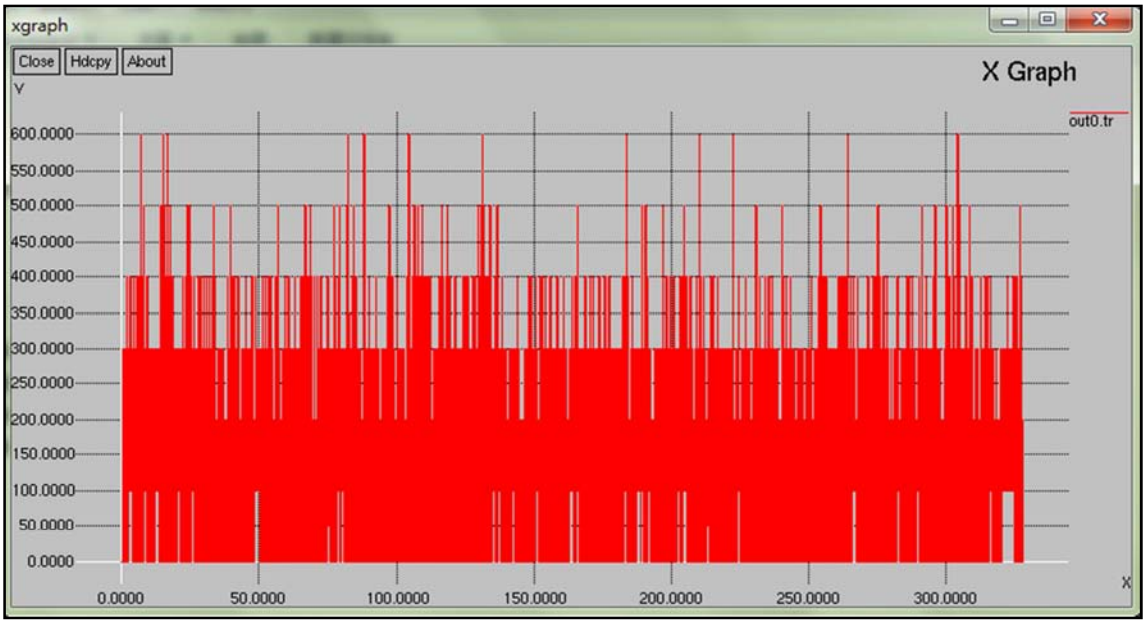

Figure 5. *Rate figure of N value is 11.*

By observing the above four line types of the figures and the area the lineup and the horizontal axis enclosed we can find, with the increasing of N value, the numbers of packet arrival per unit time that is with flow rate is increasing, self-similarity is obvious, Hurst parameter is bigger, packet loss rate is bigger. Thus, we can come to the conclusion that N is bigger, self-similar is bigger, Hurst parameter is bigger, packet loss rate is bigger.

2.3.2. The Influences of Shape Parameter on Long-Range Dependence

According to the relation type we can assume, the shape parameter is smaller, Hurst is bigger, so self-similarity is obvious, packet loss rate is bigger. Therefor, do four experiments, shape parameter respectively, are 1, 1.4, 1.5, 2, under the condition of shape parameter are these values's rate figures respectively are as shown in figure 6, figure 7, figure 8, figure 9. Rate figure's horizontal axis represents time, the vertical axis represents the numbers of packet arrival per unit time. Among them, H= (3-a) /2.

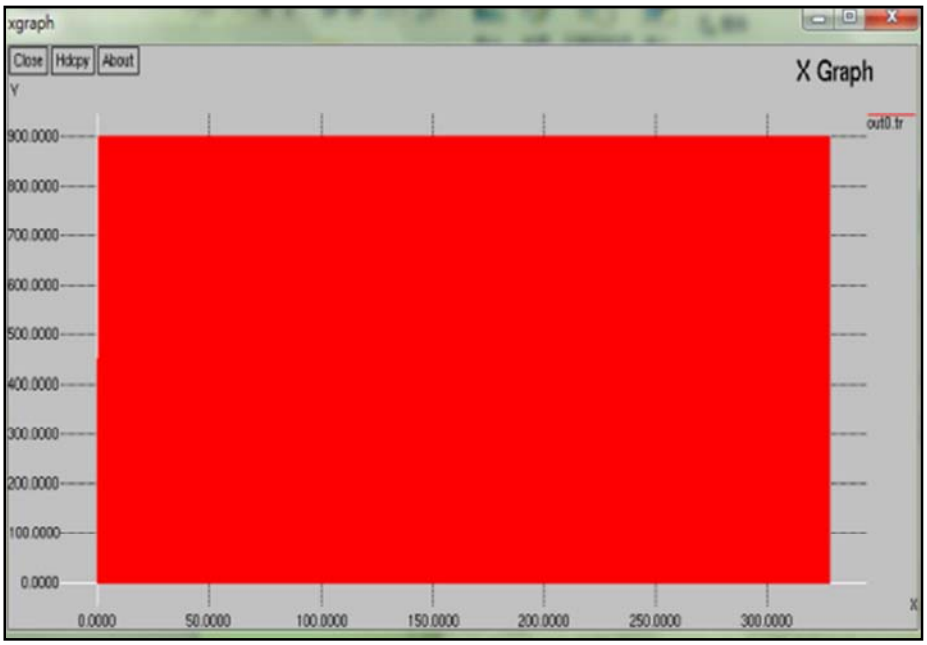

Figure 6. *Rate figure of shape parameter is 1.*

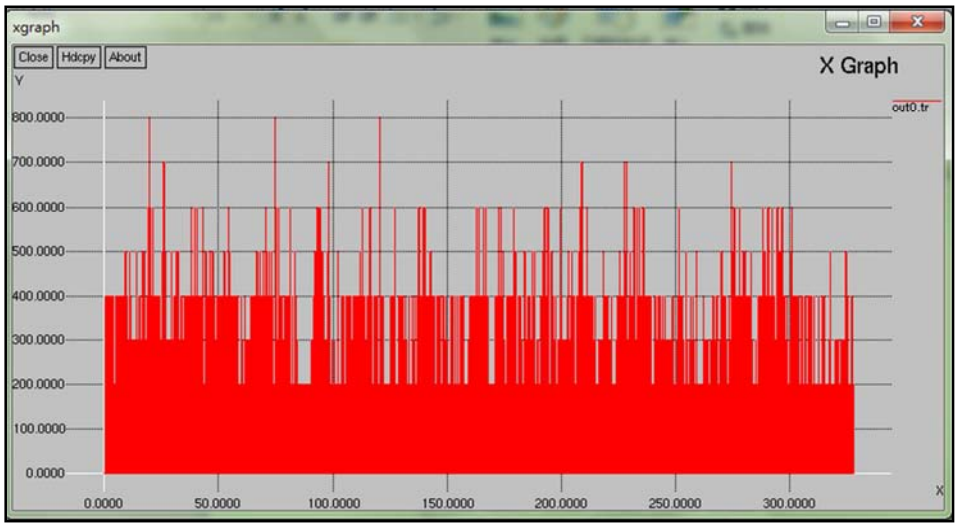

Figure 7. *Rate figure of shape parameter is 1.4.*

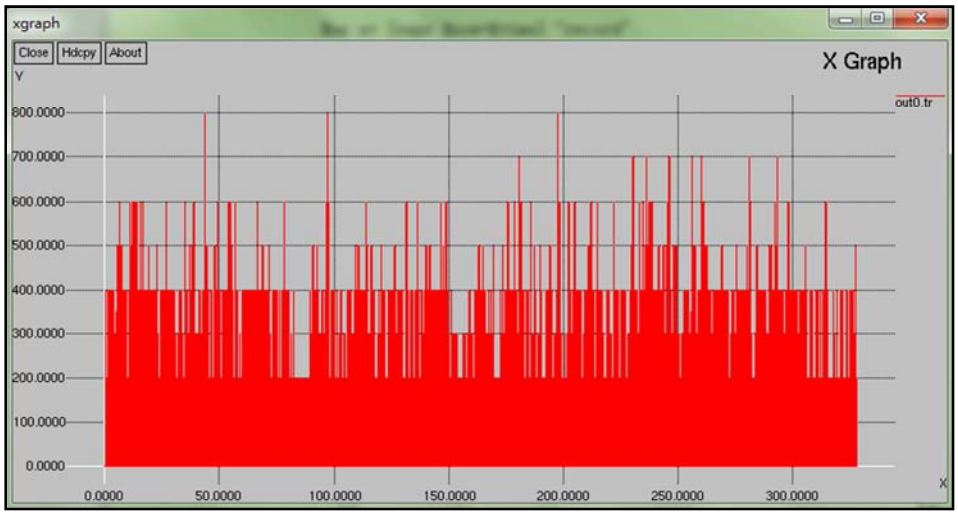

Figure 8. *Rate figure of shape parameter is 1.5.*

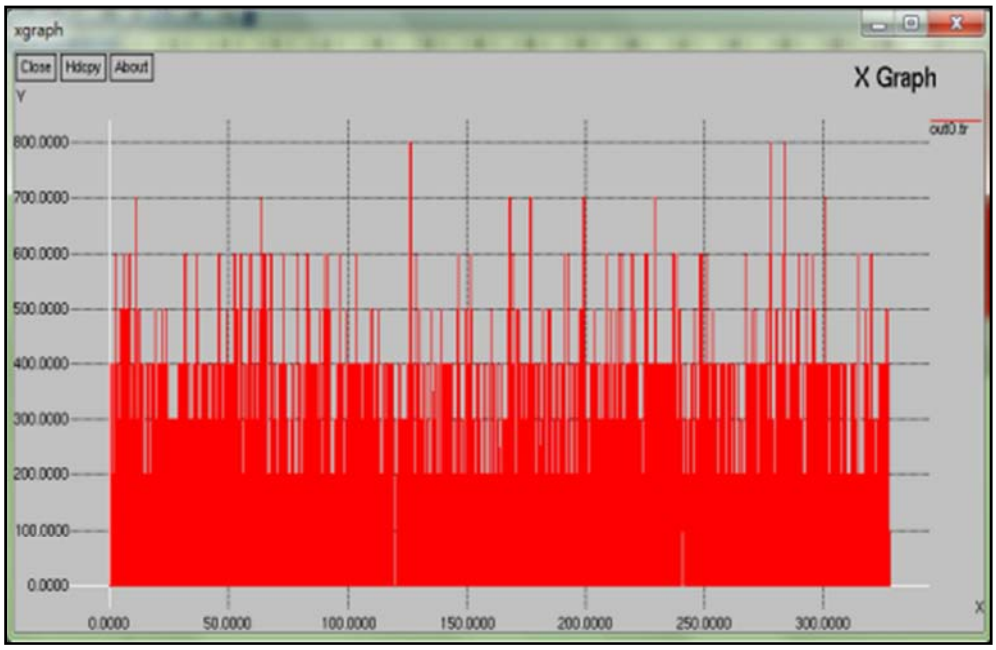

Figure 9. *Rate figure of shape parameter is 2.*

By observing the above four line types of the figures and the area the lineup and the horizontal axis enclosed we can find, with the increasing of the shape parameter, self-similar is decreasing, Hurst parameter is decreased, packet loss rate is smaller. Thus, we can come to the conclusion that shape parameter is bigger, self-similar is smaller, Hurst parameter is smaller, packet loss rate is smaller.

3. Result and Discussion

3.1. The Influences of Hurst Parameter on Long-Range Dependence

According to the relation type H= (3-a) /2 we can come to the conclusion that Hurst parameter [15] is bigger, self-similar is bigger, packet loss rate is bigger. The specific experiment as 2.2.1 part.

3.2. The Influences of the Output Link Speed on Long-Range Dependence

N=5, Hurst parameter is 1.5. link=10MB. We can assume the output link speed [16] is bigger, self-similar is smaller, Hurst parameter is smaller, packet loss rate is smaller. The output link speed respectively set to 5MB, 10MB, 15MB, 20MB, under the condition of these settings the flow rate figures are as shown in figure 10, figure 11, figure 12, figure 13.

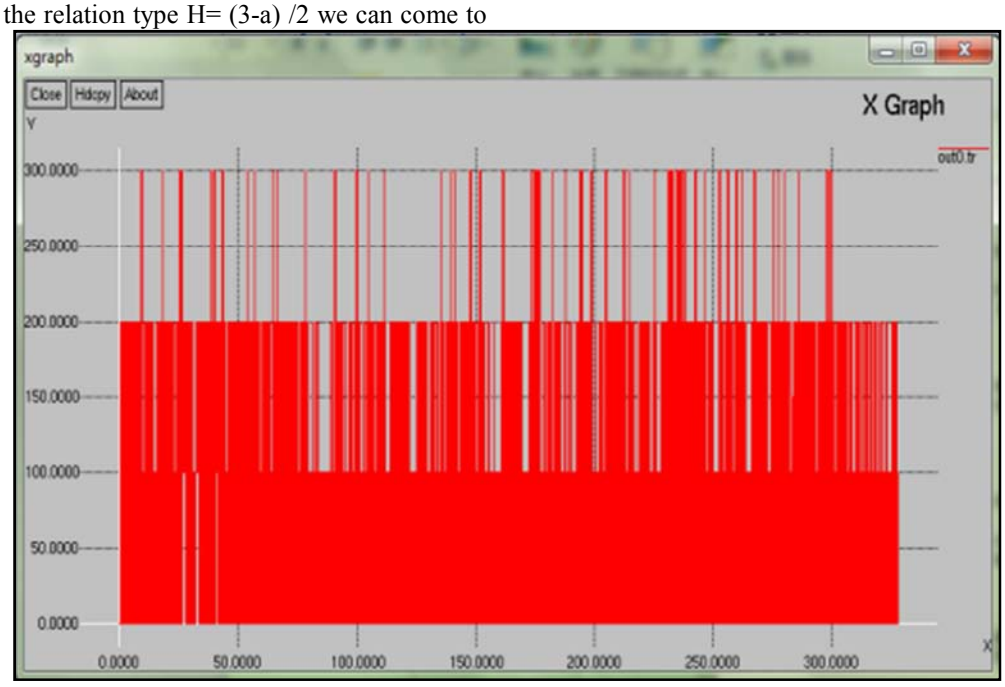

Figure 10. *Rate figure of the output link speed is 5MB.*

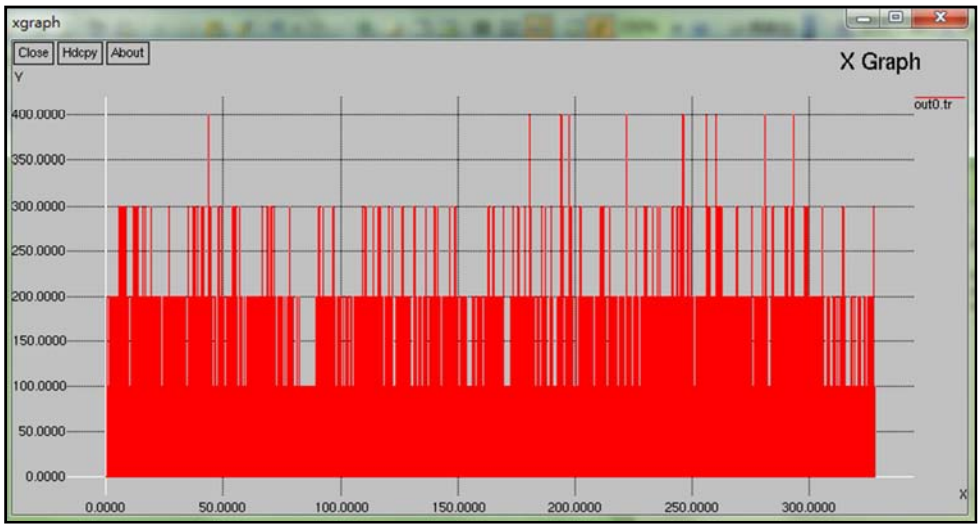

Figure 11. *Rate figure of the output link speed is 10MB.*

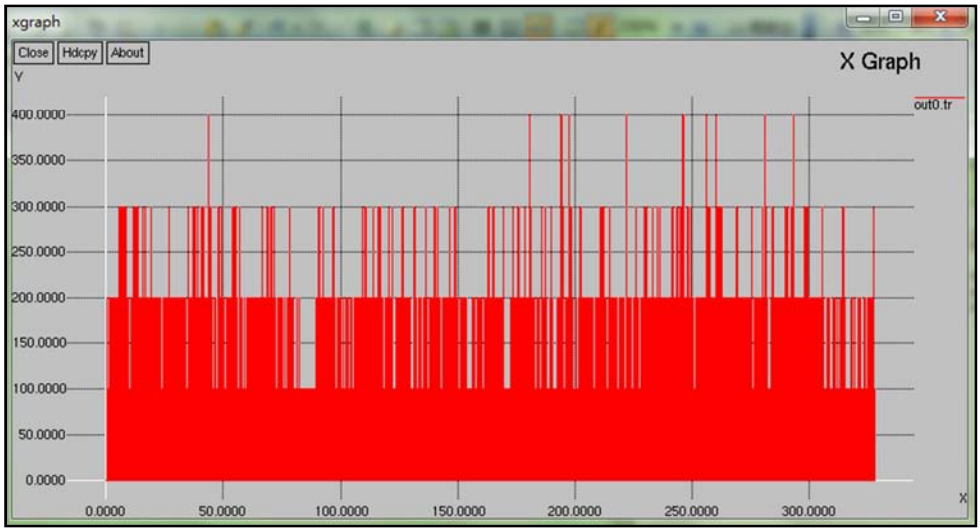

Figure 12. *Rate figure of the output link speed is 15MB.*

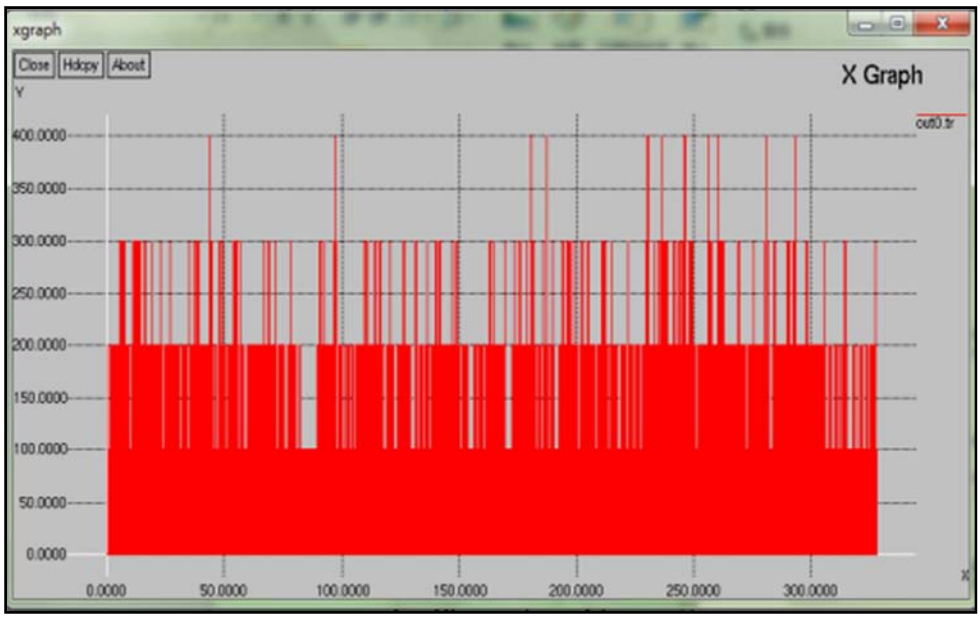

Figure 13. *Rate figure of the output link speed is 20MB.*

By observing the above four line types of the figures and the area the lineup and the horizontal axis enclosed we can find, with the increasing of the output link speed, self-similar [16] is decreasing, Hurst parameter is decreased, packet loss rate is smaller. Thus, we can come to the conclusion that the output link speed is bigger, self-similar is smaller, Hurst parameter is smaller, packet loss rate is smaller.

4. Conclusion

First, introduce NS2's principles of generating self similar traffic. Second, discuss the number of superimposed source N, shape parameter, Hurst parameter, the output link speed has impacts on long correlation, and further affects the packet loss rate. Finally, it is concluded that different output link speeds have a significant impact on long-range dependence, and further to affect the packet loss rate. At the same time, this conclusion will be applied to establish no-reference video quality assessment model considering the network packet loss, select the output link speed as a parameter to establish the model.

Acknowledgements

This work was partially supported by the Beijing University of Technology doctoral student scholarship and grants, Beijing University of Technology software college scholarship and grants, Tutor scholarship and grants. Thanks to Yi bin Hou, provide a good research platform and environment, teach Methods of scientific research, he is generous in the atmosphere. This work was partially supported by the National Natural Science Foundation of China (No: 61203377, 60963011).

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Biography

Yibin Hou graduated from xi'an jiaotong university computer science department, with a master's degree in engineering, graduated from the Netherlands EINDHOVEN university of technology department, received a doctor's degree from the department of engineering. From 2002 to 2013 as vice President of Beijing university of technology. The Beijing university of technology, professor, doctoral supervisor, dean of the school of software, embedded computing, director of the institute, Beijing university of technology, deputy director of academic committee and secretary-general, Beijing Internet software and systems engineering technology research center director. His research interests are the Internet of things and software engineering.

Jin Wang received a Bachelor's degree in Software Engineering from Beijing University of Chemical Technology, Beijing, China, in 2012.6. And won the National Scholarship in 2009 and 2010. She received a Masters graduate in Computer Application Technology in Shijiazhuang Tiedao University in 2015.1. Published many papers and she is a Primary Science and Technology Committee, Deputy Minister of Finance. From 2015.4 she is in the school of software engineering, Department of information, Beijing University of Technology, read PHD. Her research interests are the Internet of things and software engineering.