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Research on Communication Lines Detection in WAMS

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Abstract: With the application of synchronized phase measurement devices and the rapid development of communications networks, WAMS is gradually becoming the focus of domestic and international science and technology researchers. Based on the OPNET simulation software, this article looks into the communication line of WAMS and conducts a study on WAMS link bandwidth and designs a new method of detecting traffic characteristic. Finally, it proves the conclusion that communication line traffic characteristic can be improved as bandwidth increases. The results will have a higher value for the design of wide area measurement system.

Keywords Wide area measurement, stability of link, traffic characteristic

INTRODUCTION

The development of wide area measurement system (WAMS) is closely linked with the progress of communication technology. The rapid development of modern communication technology brings new opportunities for the development of WAMS. In recent years, WAMS has been used in many fields of the national economy, and is getting more and more attention of people involved[1-2].

In 1995, the U.S. department of energy, collaborating with BPA and WAPA, works on the development of WAMS in the northwestern part of the country. So far, WAMS has been gradually implemented in many countries such as the United States, Japan, Britain and India[3]. With the progress of this technology, India's national grid got rapid development in 2012, which has gradually become a power system with an installed capacity of about 210 GW[4]. According to the national 11th five-year plan, all the 500000 volts substations and power plants of more than 300 MW in China must be connected to the WAMS. From the whole WAMS， it has a higher requirement on the stability of communication lines and the real-time transmission of communication signals. Therefore, the technological choice for communication links in WAMS has been continuously concerned by professionals[5-7].

MODELING AND SIMULATION FOR LINK MEASUREMENT OF WAMS

With the development of WAMS, some conclusions related to improving WAMS link performance have been analyzed theoretically[8]. OPNET simulation software can create all kinds of WAMS application models and make simulations on the transmission throughput, delay of traffic statistics and link utilization of model communication lines, through which it can be verified that the theories can enhance the line traffic characteristic. Hence, the simulation results play a very important and prospective role in the development and construction of WAMS[9].

There are multiple pathways to measure the traffic characteristic of WAMS communication lines[10]. Based on the OPNET simulation software, this section designs a method to measure the line traffic characteristic, that is, the bottleneck link method. The “bottleneck link” means to set an upper limit for a testing value, and when the testing value climbs to the set value, alarm will be triggered. This WAMS model uses fiber optic as the medium for the lines, the bandwidth of 10M, link using efficiency as the testing value, for which 75% is the upper limit. The lines exceeding the upper limit are tagged with rings, while the others are the normal ones. At this time, with flow loading, the model diagram is as follows.

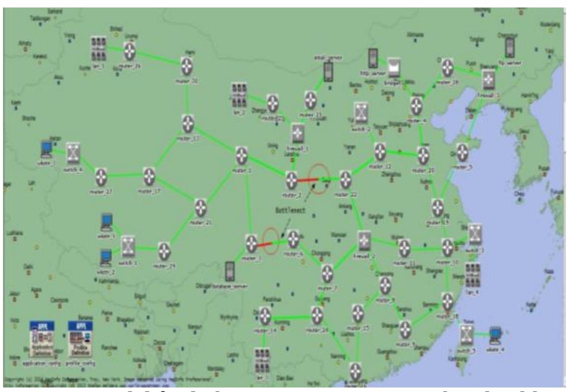

Fig. 1 Model for link measurement in 10M bandwidth

In the fig 1, most of the lines operate properly. That means most of the line using efficiency is in the range of 0%- 75%; but there are two lines tagged with rings in the diagram, the using efficiency of which has exceeded 75%. Here, a simulation for the link throughput, group delay time and using efficiency of the two lines is made in the diagram 2. Based on the analysis of group delay time of the flow characteristics and link throughput simulation, it can be determined that any flow through the two lines will cause link congestion, which will directly increase the line delay, and then lead to group delay. The link throughput shows that signals sent and received at the two ends of the lines are completely inconsistent, which leads directly a decline in performance of the channel capacity. Through the analysis on the link using efficiency chart, it can be concluded that the using efficiency of most lines is in the ideal range of 0%- 75%. The two lines with bottleneck links exceed 75% in using efficiency, even up to 100%. Such lines generally work overtime and will brings much hidden trouble for the stability of WAMS communication lines.

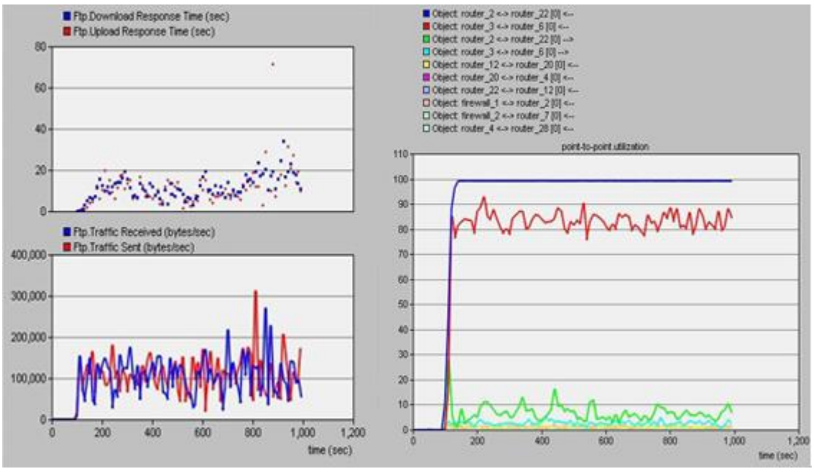

Fig 2 Simulation for flow characteristic measurement in 10M bandwidth

Faced with these problems, one solution that usually comes to people's mind is to increase the bandwidth of WAMS lines. However, at the moment, there is no compelling evidence to prove that the WAMS traffic characteristic can be improved by increasing the bandwidth. In reality, it costs too much to upgrade the bandwidth. If the desired result is not achieved after the upgrade, it will be a huge waste of resource and money and may bring serious consequences. Based on the OPNET simulation software, this article will make a model for a particular WAMS, and then simulate all the values to be observed, and finally demonstrate the conclusion. At this time, the original model is upgraded by increasing its bandwidth from 10M to 100M. We will come to the conclusion through observing the model chart and comparing the simulation results in the two different bandwidths. The upgraded WAMS model is charted as follows.

The model shows that after the bandwidth is upgraded from 10M to 100M, the two lines with bottleneck links in the 10M bandwidth model return to normal. All lines appear correct, the whole line using efficiency is in the range of 0%- 75% and no line reaches the upper limit value. Therefore, links are upgraded by increasing the bandwidth. Chart 4 makes a simulation for the link throughput, group delay time and using efficiency of the two lines.

By comparison of chart 2 and chart 4, it can be included that, after upgrading the bandwidth to 100M, all links work well and there is no congestion; group delay is decreased. The throughput chart shows that link throughput remains stable; the network is well connected and signals are sent and received in consistence. From the using efficiency chart, all lines are in an ideal state of less than 12% and in the acceptable range of the line stability.

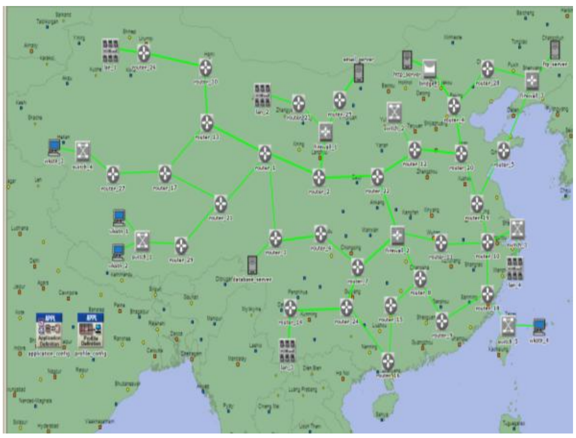
Fig 3 Model for the ink measurement in 100M bandwidth

Based on the above observations and analyses, it can be concluded that, to upgrade the bandwidth from 10M to 100M removes the bottleneck links existed in the original WAMS two lines, increases the communication traffic, makes the line using efficiency in an ideal state and improves the line stability. Meanwhile, it also proves that the WAMS traffic characteristic can be improved by increasing the bandwidth. Of course, to what extent the bandwidth should be increased still needs further study, or new problems like the lower link using efficiency will appear.

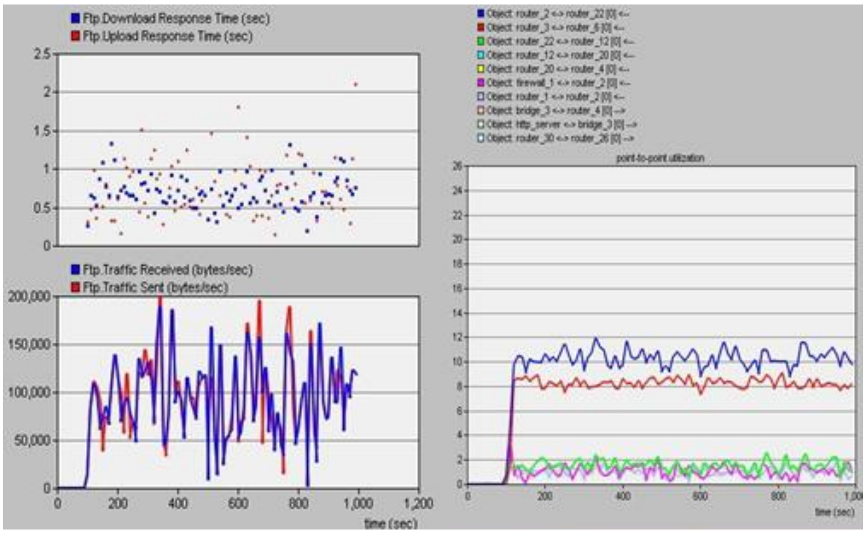

Fig 4 Simulation for flow characteristic measurement in 100M bandwidth

CONCLUSION

This article creates models for WAMS with the use of the communication simulation software OPNET, studies the line stability and communications line traffic characteristic of WAMS, and finally produces the following conclusions:

1. Using the method of bottleneck link to monitor communication lines has a good effect.

2. Through analyzing and comparing group delay, link throughput and link utilization in 10M and 100M bandwidths, it unfolds that traffic characteristic is improved as bandwidth increases. Thus, the simulation results provide support for the hypothesis that communication traffic characteristic can be improved by increasing WAMS bandwidth.

The above analyses and conclusions are of high value for the wide area measurement system and can also provide a reference for the future wide area measurement system design in such fields as communication, electric power, etc.

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