

About Methods for Visualizing Network Monitoring

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Abstract— Today effective management of computer networks becomes extremely important task which is based on network data monitoring. However, a rapid growth of the network traffic volume is lead to the accumulation of large amounts of data in monitoring systems and the resulting becomes difficultly it processing and analysis. Therefore, there is a need in use of more effective visualization methods of network data that will allow network administrators to carry out virtually instant visual monitoring of the network. The paper discusses and analyzes some of the existent visualization methods of networks data, which are used for monitoring and management of computer networks.

Keywords— network monitoring; network data; visualization methods

I. INTRODUCTION

Today, computer networks more and more widely cover the majority of spheres of activity of society and becomes one of important infrastructures of it activity. In this regard, effective management of computer networks becomes extremely important task which is based on network data monitoring. However, with a rapid growth of the infrastructure of modern computer networks, network data volume is much increased that lead to the accumulation of large amounts of data in monitoring systems and the resulting becomes difficultly it processing and analysis.

As, in modern monitoring systems, the network data are analyzed of the manual or the log-analysis modes, efficiency of monitoring and management of computer networks much more decreases. It is generally connected with that the analysis of network data needs a lot of time and as a result, the facts of violation of work of a network can be defined after they were already made. Therefore, there is a need in use of more effective visualization methods of network data that will allow network administrators to carry out virtually instant visual monitoring of the network.

Data visualization is a display of numerical tabular data in graphic representation. The purpose of data visualization is the representation of the data using methods that accurately reflect the data in graphical representation and simplify their understanding and interpretation [1].

Visualization of network data can briefly introduce and display a large amount of network data in a graphical representation and an effective mechanism for monitoring the performance of network traffic. Visualization of network data is particularly important for rapid assessments of the networks, which enables the administration of networks quickly and easily interpret the results of monitoring. Visualization of

network data allows you to dynamically present state of the network and identify bottlenecks, failures, improper use of network resources, etc. In addition, detailed imaging can be performed at various levels, such as network load, bandwidth, packet types, etc. For expression of the resulting image visualization uses different colors to facilitate their interpretation.

Today, for the visualization of network data there are various methods [2]. In generally, the feature of these methods consists in display of large volume of data on smaller space.

The paper discusses and analyzes some of the existent visualization methods of network data, which are used for monitoring and management of computer networks.

II. METHODS FOR VISUALIZING NETWORK DATA

Usually, the network data visualization methods include simple line graphs and charts that display the change in the parameters of network traffic. Thus, the metrics used can range from general measurements (e.g., bandwidth) to more specific indicators.

Simple line graphs and charts are very effective for displaying the majority of network metrics and are simple to understand and interpret. Therefore, a simple line graphs are one of the most common types of imaging and the most frequently used. Simple line graphs are used to visualize changes in the parameters of network traffic over time. In this case, each parameter is assigned a unique color. For network analysis, a simple line graph provides an intuitive picture and depending on the nature of the graphical display line, the network administrator can easily analyze traffic and take the appropriate decision.

Simple line graphs are used in many monitoring tools, such as the monitoring systems MRTG [3] and RRDTOol [4]. MRTG is used for visualization of use of the current bandwidth in time. Example output monitoring system MRTG is shown on Figure 1.

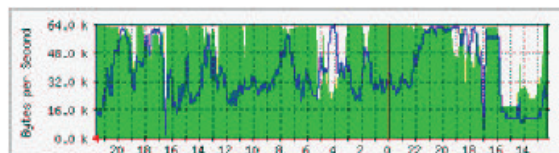


Figure 1. Example output of MRTG monitoring system

Incoming and outgoing traffic, usually built in two separate series on one graph, and can quickly and easily implemented and interpreted. This type of visualization, if necessary, can be

used for further in-depth analysis of the use of network bandwidth.

Another type of simple line graphs is the so-called layered or stacked graphs, which consist of different schedules. For example, a stacked graph used in the monitoring system is RRDTool [4]. Example output of RRDTool monitoring system is shown on Figure 2.

These types of graphs allow to visualize the common network traffic, to represent various traffic protocols (for example, TCP and UDP) or subnets by graphs series. Accordingly, these graphs allow defining visually which part of an available bandwidth consumed protocols or subnets.

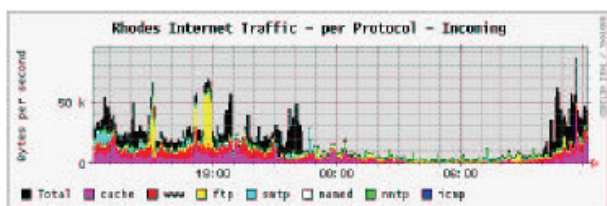


Figure 2. Example output of RRDTool monitoring system

The main disadvantage of this approach is the complexity of the detailing of the common network traffic, that is, if necessary, the display of common network traffic on all range of TCP and UDP ports, the number of different series may be in the thousands. However, in practice, even in relatively large networks, the full range of ports are rarely used, therefore, to solve this problem, the number of series are limited to two dozen, as above this limit by human eyes become difficult to distinguish colors.

The advantage of this approach is that network administrators can easily determine how protocols use network bandwidth. Also, network administrators, based on the results of imaging can monitor the results of actions taken to manage the network.

In addition to these methods proposed more complex methods have been, for example, in [5] monitoring network traffic has been proposed, the so-called radial traffic analyzer, which uses concentric rings represent the hierarchical relation between the various measurements.

In general, this method of visualization is used for quantitative analysis of hierarchically structured data and is very well suited for visual analysis of network data. Also, this method can be used for all data sets, which have hierarchical relationship.

Figure 3 shows an example of radial traffic analyzer [5], which shows the relative bandwidth, one used by IP-addresses and transfer protocols.

On this example, the radial traffic analyzer shows the distribution of network traffic on the local computer, where the two inner rings of the radial graph represent the source and destination transmissions. Outgoing traffic of this local computer can be recognized by the lavender colored circle segment in the inner ring. And the outgoing traffic of local this computer can be recognized by the lavender colored segments

on the second ring. Two outer rings of the graph represent ports of the source and destination transmission. Moreover, the ports used for each transfer is determined by the transmission protocols such as HTTP or FTP. On this example is dominated by web traffic (port 80 is colored green), remote desktop and login applications (port 3389 - red, port 22 -bright red) and e-mail traffic (blue).

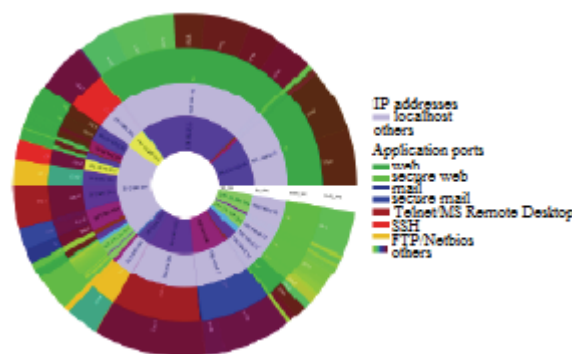


Figure 3. Example of radial traffic analyzer

CONCLUSION

Today, effective management of computer networks is becoming an extremely important task, which is based on monitoring network data. However, with a rapid growth of the infrastructure of modern computer networks, network data volume is much increased that lead to the accumulation of large amounts of data in monitoring systems.

The use of visualization methods of network data will allow administrators to analyze quickly network infrastructure and to identify conditions of use of network resources and as a result effectively to operate their redistribution. Visualization of network data also will allow to present dynamically a state of a network and to define bottlenecks, refusals, no-purpose bandwidth using etc.

To achieve higher efficiency of monitoring and managing computer networks appropriate to the joint use of several visualization methods. This will greatly increase the amount of available information for administrators on the states of the network, without increasing the complexity of the individual imaging techniques.

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