Computation Technique for IP-Traffic Tensor Modeling

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Abstract - **Computation technique for IP-traffic tensor modeling developed for access network. Directed two-colored open graph determined for client-server model.**

Keywords – **IP-traffic, matrix graph, tensor model.**

Efficient maintenance and utilization of access networks capacity is *an actual issue* for modern enterprises, academic and governmental institutions. Advance network control means determining adequate digital network model based on graphs, queuing theory, statistical analysis, tensor methods etc. However, the computational technique of network flow tensor analysis needs further investigation. This work aims computation technique for IP-traffic tensor analysis in the access network.

The overall network flow model determined as two-colored directed open graph G for client and server vertices. The graph Fig.1 presents two clients (c1, c2) and two servers (s1, s2).

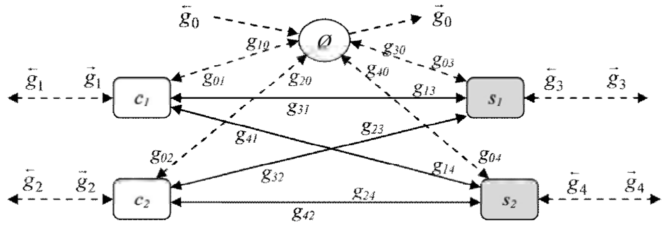

Fig. 1. Two-colored open graph G for control object

Graph G is open due to the open inter mediate vertex *Ø* (***zero-element***), introduced into the set of vertices *X={Ø, c1, c2, s1, s2}*. All the other vertices of G may have (or not) the open interior and/or exterior arcs. The matrix of G is Fig. 2. The diagonal elements of G-matrix are open arcs. The mono-color vertex relations neglected in the model. The matrix graph G next turned into the complex tensor [1].

G(n,n)=

n \ m	0	1	2	3	4
0	g_0	g_{01}	g_{02}	g_{03}	g_{04}
1	g_{10}	g_1	0	g_{13}	g_{14}
2	g_{20}	0	g_2	g_{23}	g_{24}
3	g_{30}	g_{31}	g_{32}	g_3	0
4	g_{40}	g_{41}	g_{42}	0	g_4

Fig. 2. Open matrix graph *G*

The issue of the network tensor modeling is how to reduce the complexity of network graph due to the great amount of interacting parties (clients and servers) within the modeling network. The following computation technique proposed for the network traffic modeling to manage this issue.

1) Dump the 24-hour IP-traffic in the core router of the access network into 288 of 5-minute zipped files for about of 200 to 800 Mb each (the first 64 bytes of every packet captured). Any dump file further unzipped and dropped by WireShark analyzer into drop-files of about 3 million of IP-packets per one drop-file. The WireShark drop-file analysis results array $p_c = \{ \overleftarrow{p}(x_n \leftarrow x_m), \overrightarrow{p}(x_n \rightarrow x_m)\}$, $n \neq m$; $n, m = 1,2,\ldots,M$. Here M is the total number of IP-addresses within a piece of 5-vinute dump file; $\overleftarrow{p}$ is the total number of IP-conversations directed from x_m to x_n; $\overrightarrow{p}$ is the total number of IP-conversations directed from x_n to x_m .

2) Buffer p_c array and paste it in a *txt*-file that further processed by the MS Excel macros. Macros constructed to produce an ordered array $p^{\%}(n)$ of IP-address differential activity rating shown in Fig.3. Next, calculate the integral activity function $P^{\%}(M)$, Fig.3.

$$P^{\%}(M) = \sum_{n=1}^{M} p^{\%}(n)$$

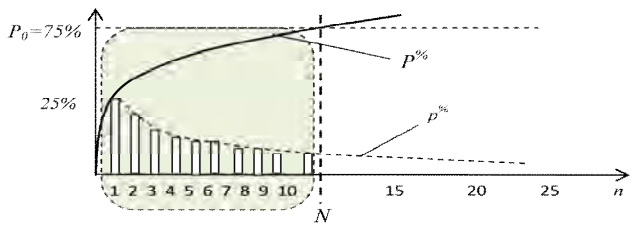

Fig. 3. IP-addresses activity rating

3) Take a confidence interval $P_0^{\%}$ for integral activity $P^{\%}$ (for instance, $P_0^{\%}$ =75%). Due to the $P_0^{\%}$ value the *N*- top list of the IP-addresses chosen for the network traffic presentation, Fig.3. This results the $N \times N$ matrix frame for the open graph $G(n,n)$, Fig.2. The correspondent arc values of G obtained from the p_c array and put into the non-diagonal entries of G. Paint the *N*-top list of addresses in two colors: white (for the access network clients) and dark (for the Internet servers), Fig.2. Determine the diagonal elements $g(n,n)$ of G as "*in-and-out*" conversation of the top-list members x_n, $n = 0,1,\ldots,N$ with exterior parties x_m, $m > N$ (non presented in the top-list).

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