Improvement combined metrics routing of IP-telephony

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Abstract

The introduction of modern technologies in the production process is a pledge of improving the quality and efficiency. The introduction of IP-telephony - is no exception. The purpose of this article is to analyze basic modern routing protocols, identification of deficiencies. The task - to propose ways to improve algorithms of traffic routing optimization. This article briefly described mechanism of action of static routing. More are detailed modern dynamic routing protocols. As examples are presented RIP, OSFP, IGRP, EIGRP protocols, as most implemented in modern routing devices. It was a comparative analysis, revealed the advantages and disadvantages of the algorithms given routing protocols, was shown comparative table of described protocols with basic characteristics. Based on analyzed data were revealed existing challenges of routing protocols such as lack of consideration of an unlimited number of criteria and non-obviousness of impact of priority criteria to choosing route . It was suggested the most optimal solution implementation of the algorithm routing protocol in case of IP telephony, which simultaneously takes into account any amount of criteria and allows the administrator to intuitively distribute the impact those or other criteria of channel that to choose route of traffic through the node. Was analyzed example of the work of proposed algorithm, the conclusions are made.

Keywords:

IP-telephony
packet switching
routing
multi-criteria optimization

1 Introduction

The first steps in the development of IP telephony has made an Israeli company VocalTec in 1995 [1]. The company has developed the first version of the program, which allowed to make calls via Internet, regardless of the distance between the subscribers and call duration. With the implementation of a VOIP, communication is simplified, reduces the cost and improves the quality of voice transmission. In the past generation telephone networks is used static routing, his based on general international telecommunication numbering plan. Routing takes place by a previously prepared table of numbers and directions- according to the recommendation E.164 of the Telecommunication Standardization Committee [2].

Each subscriber's number has corresponding a path throught certain ATS. This routing scheme is extremely difficult and costly to be scaled and optimized.

VOIP or IP-telephony, does not have a hard peg to routing ATS. Here applies packet switching. Here used IP-addressing with the advantages of this technology - packets can go through any available router to anywhere in the world, without taking up the entire communication channel, but with deficiencies - problems timely delivery of packages and their loss.

Companies, using their own ATS confronted with the task of optimizing traffic, because voice information is susceptible to delays and the percentage of lost packets has an important role in assessing quality of communication and subscriber satisfaction. In the event of packet loss by more than 5%, speech will become as a set of indecipherable sounds.

Packets are routed in the network according to certain algorithms. Therefore, the key point is choosing the right algorithm for routing packets, that provides the minimum of delay and loss, so the best voice quality, while not overburdening entire channel. There is not have its own protocol for VoIP, with taking into account the specifics of VoIP communication. Existing protocols have a number of advantages and disadvantages, but often one lack of overlaps all the advantages. Therefore, the task of improving the routing protocol is an urgent task in general and in particular for VOIP.

2 Formulation of the problem

The problem of today's networks with packet switching - it's optimizing the algorithm for packet routing protocols. Since IP-telephony also is technology with packet-switched, a task to select the best packet routing algorithm affects to it.

Also, IP-telephony as technology for transmitting media data in real time, in particular voice, quite sensitive to delay and packet loss, and this requires even more careful approach to the choice of routing protocol packets. Modification of existing protocols to VOIP specifics can solve this problem.

3 Theory aspect

3.1 STATIC ROUTING ALGORITHMS

Routing using static algorithms do not change with changes in topology and network status. Such algorithms will not be considered, because do not correspond to modern realities of building a corporate network [7-9].

3.2 DYNAMIC ROUTING

Adaptive algorithms require periodic measurement of channel characteristics, constant research of route topology and timely rebuilding routes for provide the most secure and timely delivery of packets.

For the analysis of the most popular protocols and for proposals to improve them, analysis was conducted and constructed a comparative table of the main characteristics of.

TABLE 1 Comparative table of routing protocols

Algorithm	RIP [3]	OSPF [4]	IGRP [5]	EIGRP [6]
Type of algorithm	distance vector	status channels of communication	distance vector	combined
Max number of routers in the network	15	65534	255	255
Load distribution	no possibility	equal distribution between channels with similar metrics	distribution by priority criteria metrics	distribution by priority criteria metrics
The number of channel characteristics in the overall route metric	one characteristic	three characteristics	combined metric	combined metric
Update routing information	dispatched entire table	transmits only changes	dispatched entire table	transmits only changes
Technical availability	open	open	only Cisco Systems	only Cisco Systems

4 Ways to improve the quality

As a basis we take the routing protocol OSFP. Change only the algorithm for calculating its metrics, through the introduction of the combined metrics, which takes into account all the characteristics of the channel, some of which must be maximized, and others - are minimized.

Multi-criteria optimization task is incorrect, since private quality criteria conflict with each other. Regularization of ill-posed problem of multi criteria optimization we perform by scalar convolution particular criteria of quality for nonlinear compromise scheme. In order to introduce the possibility administrator redirect traffic on certain criteria, we introduce weights for each private characteristic of channel – $\alpha_i \geq 0$ and $\sum_{i=1}^{n} \alpha_i = 1$. Then we get:

$$L = \sum_{i=1}^{n} \frac{\alpha_i}{1 - \frac{I_i}{I_{i\max}}}, \quad (1)$$

where (1) is weight of the edge based on the priority coefficients

$$\min L = \sum_{j=1}^{r} \sum_{i=1}^{n} \frac{\alpha_i}{1 - \frac{I_i}{I_{i\max}}}, \quad (2)$$

$$\alpha + \beta = \chi,$$

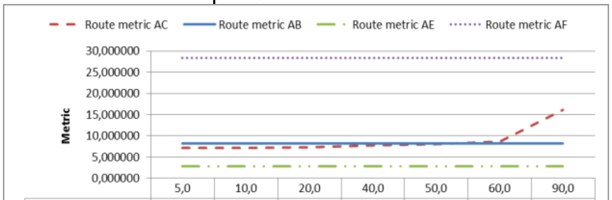
where (2) is all shortest path.

Where L - the weight of the arc, n - the number of partial criteria, r - number of ribs on the fast track, I_i - particular quality criterion of specific edges of the graph, $I_{i\max}$ maximum permissible value, which is given by technical characteristics of the channel.

5 The discussion of the results

The proposed formula for calculating metrics allows you to increase the number of defining criteria, that will optimize the routing for existing equipment and existing requirements [9-10].

The inclusion of priority criteria will enable system administrators to simply and clearly manage the redirection of traffic. Thus, when the load increases to channel, flow can be routed to another path.

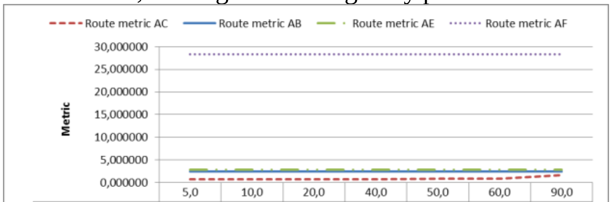


	5,0	10,0	20,0	40,0	50,0	60,0	90,0
Route metric AC	7,144312	7,202792	7,341681	7,758347	8,091681	8,591681	16,091681
Route metric AB	8,220333	8,220333	8,220333	8,220333	8,220333	8,220333	8,220333
Route metric AE	2,776667	2,776667	2,776667	2,776667	2,776667	2,776667	2,776667
Route metric AF	28,350000	28,350000	28,350000	28,350000	28,350000	28,350000	28,350000

Functioning capacity

FIGURE 1 Metrics of node A channel without taking into account the priority criteria

Route AC, with increasing load on it, acquires almost worst metrics, although it was originally preferred route.



	5,0	10,0	20,0	40,0	50,0	60,0	90,0
Route metric AC	0,714431	0,720279	0,734168	0,775835	0,809168	0,859168	1,609168
Route metric AB	2,466100	2,466100	2,466100	2,466100	2,466100	2,466100	2,466100
Route metric AE	2,776667	2,776667	2,776667	2,776667	2,776667	2,776667	2,776667
Route metric AF	28,350000	28,350000	28,350000	28,350000	28,350000	28,350000	28,350000

Functioning capacity

FIGURE 2 Metrics of node channel A with priority criteria

Due to the influence of priority criterion metric of route AC is smaller than any other metric, even when heavily loaded channel.

6 Conclusion

The analysis showed that the choice of dynamic routing protocol depends on the size and requirements of a specific corporate network, depends from the installed equipment and depends of need for a detailed configuration of routing traffic by system administrator.

The organization of VoIP in the enterprise network, EIGRP can be selected if all routers are presented by Cisco (but it's expensive equipment) and network administrator can to configure routing without the appearance of a loop (which is not trivial task). Or use the OSPF protocol, as the most universal and having a sufficient number of advantages, but with a one-criterion metric. But the best solution is to use an advanced algorithm above, which based on the OSPF protocol, using multicriteria metrics and the obvious setting via the priority criteria.

References

[1] Goldstein A B, Goldstein B S 2006 *Softswitch* 368

[2] ITU-T Recommendation E.164 (02/2005) *The international public telecommunication numbering plan*

[3] Hedrick C L 1988 *Routing Information Protocol* 1058

[4] OSPF Cisco Systems Inc, https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/iproute_ospf/command/iro-cr-book/ospf-a1.html accessed 06.04.2016

[5] An Introduction to IGRP Cisco Systems Inc https://www.cisco.com/c/en/us/support/docs/ip/interior-gateway-routing-protocol-igrp/26825-5.html accessed 07.04.2016

[6] Enhanced Interior Gateway Routing Protocol Cisco Systems Inc https://www.cisco.com/c/en/us/support/docs/ip/enhanced-interior-gateway-routing-protocol-eigrp/16406-eigrp-toc.html accessed 07.04.2016

[7] Chernyi S 2016 Use of Information Intelligent Components for the Analysis of Complex Processes of Marine Energy Systems *Transport and Telecommunication Journal* **17**

[8] Chernyi S 2016 Techniques for selecting topology and implementing the distributed control system network *IOP Conf. Series: Materials Science and Engineering* **124**(012048)

[9] Boriev Z, Nyrkov A, Sokolov S, Chernyi S 2016 Software and hardware user authentication methods in the information and control systems based on biometrics *IOP Conf. Series: Materials Science and Engineering* **124(**012006)

[10] Chernyi S, Zhilenkov A 2015 Modeling of Complex Structures for the Ship's Power Complex Using Xilinx System *Transport and Telecommunication Journal* **16**(1)

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