OPTIMIZATION OF ALGORITHMS OF ROUTING IN WIRELESS MOBILE NETWORKS

Belarusian state university of informatics and radio electronics
Minsk, Republic of Belarus

Goryacheva L. Ya.

Korolyev A.I. – c. t. s, assistant professor

Now wireless networks represent the best decision for the access organization on set of indicators of speed and deployment cost, simplicity of connection of users, degree of dependence on surrounding conditions. In this regard optimization of algorithms of routing takes place. In this work some existing methods of optimization and results of their work will be considered.

1) The algorithm uses principles of creation of the shortest ways which are used in Dijkstra and Bellmana-Ford's algorithms, and ways of definition of the average delay, traditional for networks with package switching.

Let us make an assessment of the optimality of functioning of the algorithm. Let us enter designations:

$$\lambda_i = \sum_{r=1}^{R} \lambda_{ir}, \Lambda = \sum_{r=1}^{R} \Lambda_r$$

where i - pair number knot addressee – knot recipient; the first formula – the stream of packages which arrive in i – channel suited; the second – a stream of the packages arriving from knot at a network.

Loading of i – channel with packages is counted on the following formula:

$$\rho_i = \frac{1}{\mu} \bullet \frac{\lambda_i}{D_i}$$

where – the average length of a package, Di – capacity of i - channel suited the first multiplier.

The average quantity of packages in i – channel makes:

$$L_i = \frac{p_i}{1 - p_i}$$

Considering total of knots in a network, the average quantity of packages at a network as a whole makes:

$$L = \sum_{i=1}^{N} \frac{p_i}{1 - p_i}$$

According to Littl's formula $L = \Lambda \bullet T$

where T – the average delay in a network. Thus, we receive Kleynrok's formula for the analysis of the average delay in a network:

$$T = \frac{1}{\Lambda} \cdot \sum_{i=1}^{N} \frac{\lambda_i}{\mu \cdot D_i - \lambda_i}$$

The received formula for the assessment of time of the delay is effectively used for the solution of various optimizing tasks. Among such tasks we can name optimization of capacity of channels and the choice of routes of transmission of messages.

2) The main differences of the offered algorithm from EXZRP (Extended Zone Routing Protocol) of routing is the changed algorithm of splitting into zones, definitions of an optimum way depending on requirements provided by traffic and support of plurality of interfaces and data transmission ways, both on user's knot, and on an access point. The process of splitting into zones consists of two stages: search of the head of a zone and determination of its radius. Zones can be crossed, unlike classical ZRP. When searching for the head of a zone some major factors are considered: – existence of wire infrastructure, usage of a wire point of access as the head of a zone increases stability of its structure; - stability of communication channels with neighbors and connectivity. In order to increase the reliability of a network at each domain there can be some heads. One of them is the main, the others are the reserves. After the head of a zone is identified we choose reserve heads. For the identification of reserve heads (TempHead) fully connected pairs of knots or three knots are chosen from the list of neighbors of the head zone. Such approach allows the change of position of the head of a zone or its exit from a zone served by it to continue to carry out intrazonal routing by means of the temporary heads. In the procedure of changing of the head of a zone the search of the new head is conducted only from the list of the reserve heads. One of additional benefits of such approach is a certain stability of the arrangement of the heads of zones after primary splitting of a network into zones. The radius of a network is chosen from radius of action of its heads and connectivity of a network. The second essential difference from the EXZRP protocol is the support of multiple ways of data transmission, both by means of different interfaces of transfer, and through various transit knots. Before the beginning of the priority interface of transfer is chosen and the required parameters of a way of transfer are formed depending on available interfaces and traffic requirements to the parameters of communication. Then the inquiry goes to the active head of a zone (if

certainly in the table of routing there is no created way within a zone or to a zone lock). When the head of a zone receives a message from a knot there is a check of the addressee's belonging to this zone, when it is packed the package goes to the addressee, and the optimum way to the addressee within a zone goes to the sender. If the addressee falls outside the limits the domain, the package goes to the next lock, and the address of this lock for the simplification of the subsequent exchanges is sent to the sender. In the course of passing the route, if there exist several ways to the addressee with various metrics in the current knot of routing, the knot with the best metric is chosen, if there are more than one the assessment of loading of channels is carried out and a package can be sent on several routes, and only a few packages can be marked as obligatory to deliver, the rest of packages are marked as desirable to deliver. The usage of special techniques of optimization of routing, rh-optimization and transfer on several ways with duplication and without duplication, allows not only to unload a network or to make a loading uniform, but also to raise its high-speed indicators.

3) In reactive algorithms the route to concrete knot is looked for only if communication with this knot is really necessary. The main drawback of such algorithms is delays of communication installation between knots. Pro-active algorithms on each knot of a network constantly support the actual table of the shortest routes to all other knots of a network. It allows avoiding delays as it is not required to look for a route to appointment knot at the moment of communication installation. The main drawback of pro-active algorithms is the considerable volume of the office traffic necessary for maintenance of the urgency of route tables. Besides, such approach works not very well; if the topology of a network changes more often than on the knots, then the information on this topology is updated. In this case tables of the shortest route quickly become outdated, and routes in it become incorrect. The solution by reduction of an interval of updating will lead to a considerable overhead charge – the office traffic in a network will be more than the traffic of the user. For the solution of this problem we suggest using statistical information on changes in network topology for identification of the most probable shortest routes between knots. It is supposed that in a network many knots are connected among themselves, but communication is unsteady and can periodically be switched off. The switching off in communication in real networks can correspond to the removal of mobile devices from each other (out of limits of radius of action) or to switching off of touch sensors for the purpose of economy of charge of accumulators. More specifically, as model of functioning of communication we suggest using the stationary, markovsky process with two conditions: S0 – communication doesn't work, S1 – communication works. Intensity of transitions from S0 in S1 (λ01) and on the contrary (λ10) – are constant. The reciprocal values are average time of stay of communication in S0 and S1 conditions respectively. Let p1 (t) – probability of that at the moment of t communication was in a condition $S_1 (p_0(t)) = 1 - p_1(t)$ – probability of finding of communication in S0 condition at the moment of t). From Kolmogorov's equations we find

$$p_1(t) = (p_1(0) - \frac{T_1}{T_0 + T_1})e^{\frac{T_0 + T_1}{T_0 \cdot T_1}} + \frac{T_1}{T_0 + T_1}$$

The probabilistic approach allows to use possibilities of metric counts for needs of routing. The distance between hubs d (t) should be taken according to the formula:the higher is the probability, the less is the distance. We assume to use $d(t) = -\ln p_1(t)$ or $d(t) = \ln(1 + \frac{T_0}{T_1})$ ((limiting transition of d (t) at t →∞); other options are also possible.

Thus, unlike classical algorithms of routing in which it is supposed that all communications have identical length, in the offered approach each communication has its own length that depends on statistical behavior of communication. The shortest ways to all knots are calculated by taking into account the length of each communication. Results of experiments show that the table of the routes constructed with use of the offered approach, is much less subjected to destructive influence of changes in network topology in comparison with classical route tables. It allows to reduce considerably the frequency of updating of such table that brings to the corresponding decrease in the office traffic.

In this work 3 methods of optimization of algorithms were analysed, further they will be applied in our own development in a combination since each of these methods optimizes certain parameters.

References:

1. Ilchenko M. E., Bunin Of this year, Voyter A. Item. Cellular radio networks with switching of packages. - [Text]: Kiev «Naukova thought» 2003-266 стр.
2. Olifer V. G., Olifer N. A. Computer networks. Principles, technologies, protocols. - [Text]: SPb "St. Petersburg", 2006-960 p.
3. Nevdyaev L.M. Mobile communication of the 3rd generation. - [Text]: M. «What Trendz» 2001-208 p.
4. Nevdyaev L.M. Telecommunication technologies. English-Russian sensible dictionary reference. - [Text]: M. «Communication and business» 2002-592 p.
5. Kornyshev Yu. N, Pshenichnikov A. Item, Harkevich A. D. Teletraffic theory. - [Text]: M. «Radio and communication» 1996-272 p.
6. Barkun M. A., Khodasevich O. R. Digital systems of synchronous switching. - [Text]: M. «What Trendz» 2001-192 p.
7. A. V. Gramovsky Algorithm of routing of EXZRP in the integrated networks of new generation, 2007
8. R. A. Batayev, A. S. Golubev the Likelihood approach at creation of algorithms of routing in networks with changing topology. VGU