Routing in Mobile Ad Hoc Networks Using Fuzzy Neural Networks

Oleg Sova, Valeriy Romanjuk, Dmytro Minochkin

Abstract – **In this article the use of fuzzy neural networks is offered for the construction of management routing subsystem in Mobile Ad Hoc Networks.**

Keywords – **Mobile Ad Hoc Networks (MANET), dynamic topology, Routing, Fuzzy Neural Networks.**

I. INTRODUCTION

In recent years, wireless local area networks (LANs) have received significant attention due to their attractive properties, such as high throughput, easy deployability with or without any infrastructure, and self configurability, etc. The example of wireless LANs is Mobile Ad hoc Networks (MANETs). A MANET consists of a collection of mobile nodes with wireless communication device. In MANETs, due to the limited communication range of wireless interface, a data packet has to be transferred via several intermediate nodes. Thus, the routing problem is one of the most fundamental problems in MANETs and development of new RP able to correct the failings of existent RP, is an actual task for today [1].

II. USING FUZZY NEURAL NETWORKS FOR ROUTING DECISION-MAKING PROCEDURE

Development of any RP must include the synthesis of the followings basic functions: collection and delivery of information about node and network state, routes information storage, routes searching and other [1]. In addition, RP functioning has to satisfy custom optimization Eq. (1):

$$U_{\rho}^{a\text{-}b}(t) = \arg\max_{U_{\rho}(t)\in\Omega} \min C^{a\text{-}b}(X^{a\text{-}b}(t), U_{\rho}^{a\text{-}b}(t)), \quad (1)$$

$$C^{a\text{-}b} = \{S^{a\text{-}b}(X), t_d^{a\text{-}b}(X), p^{a\text{-}b}(X), E_b^{a\text{-}b}(X), V_{st}^{a\text{-}b}(X)\}, \quad (2)$$

taking into account resources limits and requirements to quality of service ξ- traffic types

$$\Omega = \{p_{ij} \leqslant p_{ij\max}, s_{ij} \leqslant s_{ij\max}, t_d^{\xi} \leqslant t_{d\max}^{\xi}, \omega^{a\text{-}b} \leqslant \omega_{\max}^{a\text{-}b}, e_{bi} \leqslant e_{b\max}\},$$

where $C^{a\text{-}b}$ – a network control purpose on direction between nodes **a** and **b**; $X^{a\text{-}b} = \{x_i(t)\}$, $i = \overline{1,7}$ – ensemble of the route state parameters: x_1 – traffic type, x_2 – information volume which have to be passed, x_3 – remaining batteries capacity, x_4 – intensity of streams ξ-type, x_5 – network mobility, x_6 – information safety providing, x_7 – amount of destination nodes; $U_{\rho}^{a\text{-}b}(t)$ – a result of routing method application; $S^{a\text{-}b}$ – network carrying capacity; $t_d^{a\text{-}b}$ – middle time of packages transmission delay; $p^{a\text{-}b}$ – transmission power; $E_b^{a\text{-}b}$ – nodes battery capacity on direction between nodes a and b; $V_{st}^{a\text{-}b}$ – service traffic volumes; $\omega^{a\text{-}b}(t)$ – intensity of network topology change; p_{ij} – transmission power in a channel ij; e_{bi} – i-nodes battery capacity.

It is offered the dynamic ranging of criteria (Eq. 2) with the purpose of providing quality of service routing of ξ- traffic types under various conditions of network functioning. In [2] the hierarchy of route searching decision-making procedure has been offered. The hierarchy includes following stages and is presented in (Fig. 1).

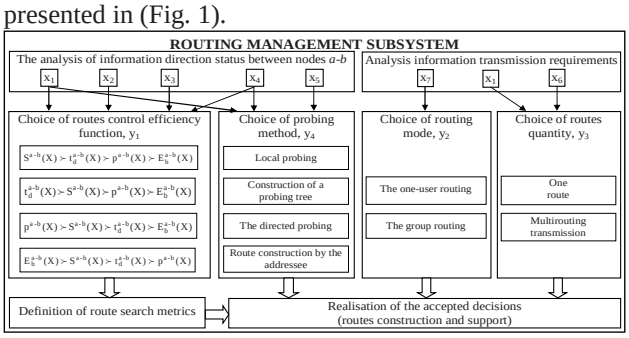

Fig.1 Route searching decision making procedure hierarchy

Because of dynamic character of MANET, incompleteness and unauthenticity of checking information it is offered to describe a routing management subsystem as heuristic advantages, using the rules of type „If <condition> – Then <Action>". For the decision of such tasks the special mathematical apparatus, named Fuzzy Neural Networks, is developed. From one side the Fuzzy Neural Networks allow to develop and present the models of the different systems in the form of fuzzy rules set, which are well evident and are easily interpreted. From other side, for the construction of fuzzy rules set the neural networks methods, which are a less labour intensive process, are used.

III. CONCLUSION

In this paper the use of fuzzy neural networks is offered for the construction of routing management subsystem in MANETs. It will allow to make the QoS-routing decision and to reduce the service traffic volumes circulating in a network.

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Valeriy Romanjuk, Oleg Sova – Military Institute of Telecommunication and Information Technology, Moskovska Str., 45/1, Kyiv, 01011, UKRAINE, E-mail: soy135@ukr.net, romanjuk@i.com.ua;

Dmitro Minochkin – National Technical University of Ukraine "Kyiv Polytechnic Institute", Peremogy Prosp., 37, Kyiv, 03056, UKRAINE, E-mail: Dminochkin@mail.ru.