Wireless Sensor Network Topology Control

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Abstract - **topology control process for the wireless sensor network is considered. In this article the use of rule base for making decision on the search of optimum network topology is offered for the realization of different aims of network management.**

Keywords - **Wireless sensor network, Rule base, Network topology.**

I. INTRODUCTION

Wireless Sensor Networks (WSN) are the distributed networks, consisting of small sensor nodes (integrate the functions of environment monitoring, treatment, transmission and information retransmitting) and base stations which execute the functions of gateway on collected information passing and WSN management function [1].

Providing the effective WSN management in real time mode is impossible without the proper control system. One of the basic tasks of WSN operative management is a network topology management [2].

II. USING RULE BASE FOR TOPOLOGY SEARCHING PROCEDURE

The topology control is a control process U_T that changes WSN topology at the time of functioning process due to the nodes transmission power p_i redistribution with the aim Z_k, $k = \overline{1, K}$ of:

– system optimization: Z_1 – minimum transmission power of nodes ($\min p_i$) and total network power $P_{tot} = \sum_{i=1}^{N} p_i$ (on the routes of transmission); Z_2 – providing of network connectivity (connectivity between nodes i and u – $cv_{iu} = 1$); Z_3 – time of packages transmission delay minimizations ($\min t_d$); Z_4 – network carrying capacity maximizations ($\max S$);

– user optimization: Z_5 – execution of requirements for routing (for example, packets delivery immediacy between a pair sender-addressee) and other.

The WSN topology management cycle includes the next stages:

– the base station information acquisition about the network state (or its area) and network functioning parameters (information can be obtained during routing or network sounding process);

– calculation and estimation of network functioning parameters;

– finding of new network topology (in the case of deviation of network functioning parameters from admissible value), which will realize the network management purpose;

– final adjustment of the accepted decision to the nodes.

The receipt of exact decision for a network which counts ten (hundreds, thousands) of nodes is related to the considerable temporal costs (a task behaves to the NP-complete class). Therefore for reduction of network topology variation searching it is suggested to use a set of rules (structural, streaming, energy-saving), incorporated in a rule base, for changing of network connectivity.

Application of rule base includes an iterative procedure, consisting of the modules ANALYSIS, RULE BASE, MANAGEMENT (Fig. 1).
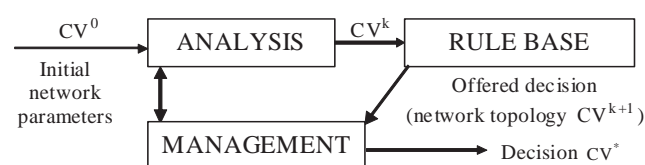

Fig.1 WSN topology searching procedure using rule base

The ANALYSIS module is intended for the WSN parameters calculation (nodes power, network carrying capacity, connectivity and etc) by analytical models.

The RULE BASE module contains rules, providing the directed search of network connectivity changing, using the parameters from the ANALYSIS module. The rules of three types are offered: structural rules – analyse the network graph structure and try to create a network structure which has the least of energy charges or the greatest productivity; streaming rules – find out the network overloaded area and try to send information by the routes with the least loading; energy-saving rules – try to build a network topology with the minimum expended power on the transmission routes.

The MANAGEMENT module determines the sequence of rules application (using metarules) and moment of completion of rules application.

III. CONCLUSION

Realization of proposed topology construction rule base allows to find suboptimum network topology at the real-time mode. In addition, realization of proposed rules in special software of the sensor allows to increase the effectiveness of WSN resources usage.

REFERENCES

[1] Міночкін А.І., Романюк В.А., Жук О.В. "Перспективи розвитку сенсорних мереж", *Зв'язок*. – 2008. – № 1. – С. 16 – 22.

[2] Романюк В.А., Жук О.В., Сова О.Я. "Система управління тактичними сенсорними мережами", *Збірник наукових праць ВІТІ НТУУ "КПІ"*. – 2008. – № 2. – С. 88 – 97.

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