

Analysis the Results of Frequency Planning in Mesh Networking Standard IEEE 802.11

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Abstract – The paper analyzes the influence of territorial separation stations and technological characteristics of multiradio multichannel mesh networking the quality of the solution of the allocation of channels.

Keywords – Wireless Mesh Network, Mathematical Model, the distribution channels, transmission range, multiradio, multichannel.

I. INTRODUCTION

One of the main ways of increase productivity wireless mesh networks (WMN) is use a multiradio multichannel (MR-MC) operation with a corresponding distribution channels between radio network interface cards (NICs) stations. Today, there are wide enough range of approaches [1], allowing a distribution channels in multichannel mesh networking standard, IEEE 802.11. Thus it is necessary to note that adequacy and effectiveness of the solution of the distribution channels, using a particular method is often determined by a mathematical model, which it is based. It is also important to understand that the effectiveness of technological solutions of the problem of distribution channels in a multichannel mesh networks is largely determined by complete accounting requirements described mathematical model formulated in [1]. The most complete account of these requirements is to model the distribution channels, presented in [2-5]. However, the three-index nature of the mathematical models presented in [2-4] defines the high dimensionality of the problem on the distribution channels in the mesh network solution which is necessary to provide real-time. Compared with the model proposed in [2-4], in two-index of the mathematical model proposed in [4, 5] reduced the total number of control variables determining the order of distribution channels, which reduced the computational complexity of the problem distribution channels.

II. ANALYSIS THE RESULTS OF FREQUENCY PLANNING

In order to assess the quality of the solutions of the problem distribution channels, using a mathematical model of two-index introduced in [4] has been analyzed and its dependence on the following initial data:

- characteristics of mesh network;
- use of wireless technologies;
- geographically dispersed stations mesh network.

In the analysis as these initial data were as follows:

- number of usable channels;
- the total number of stations in the mesh network;
- the degree of overlapping of transmission range;
- heterogeneity topology mesh network;

- number of NICs on mesh network stations;
- dimension of transmission range.

In the result of analysis solutions the problem distribution channels between NICs mesh network by using different amounts of non-overlapping channels found that increasing the use of non-overlapping channels reduces the number of stations belonging to different collision domains. The number of mesh stations are part of a particular collision domains determines its bandwidth. The capacity of the collision domains, in turn, will affect the bandwidth of communication lines passing through it.

Herewith bandwidth the direction of communication will be determined by bandwidth of the low-speed collision domains, through which this line of communication. The bandwidth of the collision domains working for k -th channel ($\Pi_{c.d.}$) was determined using the following expression:

$$\Pi_{c.d.} = \Pi / \left(\sum_{n=1}^N x_{n,k} \right) \quad (k = \overline{1, K}; z = \overline{1, Z}; n \in G_z),$$

where Π – maximum transmission rate used technology wireless communication (Mbits/s); N – their total quantity of the stations in mesh network; K – the total number of non-overlapping channels used in wireless mesh network (in technology IEEE 802.11b/g is available 3÷4 non-overlapping channels, and technology IEEE 802.11a – 12 non-overlapping channels); $\{G_z, z = \overline{1, Z}\}$ set of areas of transmission range (TR), where Z – the total number of transmission range to wireless mesh network, $|G_z|$ – capacity of z -th subset, i.e. the number of mesh stations belonging to the z -th transmission range.

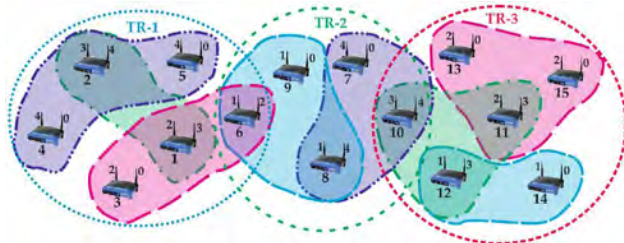
Also established that the use of each additional channel can increase the bandwidth of wireless mesh network by 20-25%.

To analyze the quality of the solutions of the distribution of channels, was examined their dependence on the number of stations used in WMN. Feature of the examples used in the analysis is that the network stations are divided into transmission range an equal number of mesh stations. This eliminated the dependence of the solutions obtained on the number of mesh stations in transmission range. The analysis revealed that the analyzed mesh network was divided into connecting collision domains, the maximum dimension for all cases was the same. From the obtained results we can conclude that the solution formed task allocation of channel does not depend on the size of mesh network, on condition of formation of transmission range with an equal number of stations.

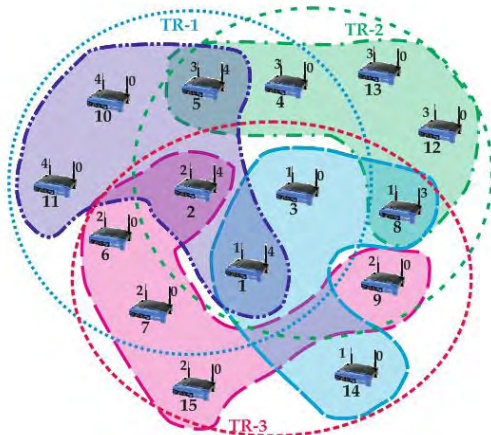
Also analyzed the dependence of the quality problem distribution channels on the degree of transmission range of mesh network (Fig. 1). In this case, the degree of overlapping of transmission range by the number of mesh stations located at their intersection, i.e. stations are part of several transmission range. The analysis found that increasing the degree of

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overlapping transmission range leads to an increase in the dimension of collision domains created by working in channel and thus reduces the performance of mesh network. Reduce the degree of overlapping transmission range can be achieved by controlling the low power mesh network stations. However, the management of low power beyond the scope of the studies.



a) low degree of overlapping transmission range



b) high degree of overlapping transmission range

Fig.1 An example of solving the problem of distribution channel in mesh networks with varying degrees of overlapping transmission range

Also analyzed the influence of heterogeneity of topology WMN on the quality of the solutions of the channel, the distribution between the NIC stations. Under the heterogeneity mesh network topology, we mean the difference in the dimension of transmission range which is mesh network. Thus, if the mesh network consists of transmission range with different number of station, then the topology of a mesh network is heterogeneous, and conversely, if the transmission range are the same dimension - homogeneous. In the analysis found that in a heterogeneous mesh network maximum collision domain will be determined by taking transmission range of a largest dimension. As a result, there is no possibility of minimizing the dimension of the generated domains collisions in transmission range of a smaller dimension. Therefore, a mesh networks with heterogeneous topology the solution of distribution channels, does not guarantee to ensure maximum throughput across the mesh network.

Also analyzed solutions the problem of the distribution channels, using a different number of stations supported by the NICs mesh network. During the analysis of found that the result of solving the problem of distribution channels in no way depends on the number of NIC included, using the number of

non-overlapping channels does not exceed the total number of stations. In the case where the number of non-overlapping channels than the total number of mesh stations network, increasing the number used by the NIC increases the number of domains formed by collisions. Thus dimensions produced by collisions domains are minimal and consist of two mesh stations. In such networks increases used in the NIC does not increase the bandwidth within the domains created by collisions, however, provides a better structure of the WMN solution the problem for multipath routing.

III. CONCLUSION

In the paper analyzed of solutions obtained by performing a mathematical model proposed in [5]. A result of analysis found that the quality of the obtained solutions to a large extent influenced by parameters such mesh network, the number of non-overlapping channels are used, the degree of overlapping transmission range, the heterogeneity of the topology of the mesh network, dimension of the transmission range, the number of stations using NICs on the mesh network. Reducing the dimension of the transmission range allows increasing the quality of the solutions, as well as reduce the number of used channels. The use of each additional channel can increase the bandwidth of wireless mesh network by 20-25%.

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