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MULTICRITERION METHOD OF QUALITATIVE ASSESSMENT OF MODERN ROUTER COMPONENTS

Abstract. *Determination of effective models of many existing router today is an important task. We propose a multi-criteria method for qualitative assessment of the components of modern routers. In work and solved the problem by: systems analysis modern routers, developing a conceptual model of the modern wireless router, development of multi-component qualitative method router based on the theory of incomplete similarity, creating a landmark model dependencies technical parameters of wireless routers in dimensionless coordinates.*

Keywords: *router, classification, architecture, sign model, components, network, dimensionless coordinates.*

Urgency

With the development of information technologies the networks built on modern routers due to the integration of advanced applications in adaptive, full-function system become widespread. The improvement of productivity, security and mobility is the result of this approach.

A number of works of D. Hyukabi, S. Mac-Kveri, E. Whitaker, V. G. Zaytsev, O. M. Lysenko, Yu. N. Dobryshkin, O. A. Myasishchev, W. Dally, C. Seitz, G. Pankaj, R. Baumann, etc. are devoted to routers. However, not enough attention is paid to the problems of routers systematization and to multicriterion methods of formalization of components qualitative assessment at design stage. The choice of effective components takes long time at router design.

It is known that the classification facilitates the studying of an object of research, orders the terminology and reveals new dependences. The classification promotes science and engineering movement from the step of heuristic knowledge accumulation to the level of theoretical synthesis and system approach. The development of router classification schemes is a scientific and economically important problem.

The goal of the article

The determination of router effective model from a great number of models under consideration through the development of multicriterion method of qualitative as-

assessment of its components on the basis of their classification after the main characteristics is the purpose of this study.

Statement of the problem

To solve this purpose it is necessary:

- to develop conceptual model of modern wireless router;
- to develop multicriterion method of qualitative assessment of router components based on the theory of incomplete similarity;
- to build a sign model of dependences of technical parameters of wireless routers in dimensionless coordinates;
- to conduct a system analysis of modern routers.

Solution of the problem

Currently, there is quite a number of routers from various producers that support various standards and have individual characteristics. A router is a specialized network computer which makes decisions on delivery of data packets between various network segments, based on the information about network topology and predetermined rules [1].

Taking into account increasing use of wireless technologies, conceptual model of wireless uniprocessor router is offered (Fig. 1).

Network processor (on the core of ARM or MIPS which are based on Harvard architecture and RISC instruction set); switch, wireless module, memory, which is classified after functional characteristic on: read-only memory (ROM), flash memory, random access memory (RAM), nonvolatile memory (NV RAM), interfaces or ports of a router are the basic components of wireless router system which determine technical and economic specification.

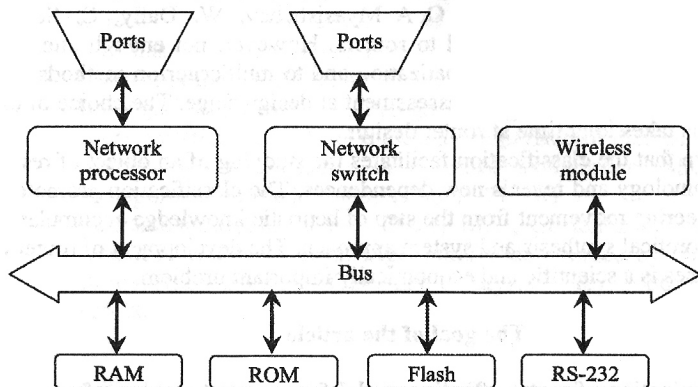


Fig. 1. Conceptual model of wireless uniprocessor router

In Table 1 manufacturers, routers models which support 802.11n standard and their main technical parameters are shown.

Table 1 The main technical parameters of wireless routers components

No	Router model	Processor frequency, f , MHz	RAM volume V_{RAM} , Mbit	ROM volume V_{Flash} , Mbit	Wireless interface velocity v , Mbit/s
1	Airlink101AR670W	266	256	32	150
2	Airlink101AR690W	266	256	32	300
3	AsusRT-N10	300	128	32	150
4	AsusRT-N12	300	256	32	300
5	AsusRT-N16	480	1024	256	300
6	CiscoLinksysE2000	354	256	64	300
7	CiscoLinksysE3000	480	512	64	300
8	CiscoLinksysWRT 150N	264	128	32	300
9	CiscoLinksysWRT 160N	266	128	32	300
10	CiscoLinksysWRT 300N	264	256	32	300
11	CiscoLinksysWRT 400N	680	256	64	300
12	D-LinkDIR-412	320	256	32	150
13	D-LinkDIR-825	680	512	64	300

As follows from the table, it is difficult to make qualitative assessment both after many parameters and various routers models to determine the best of them. Known multicriterion methods suffer from basic defects: subjectivity, time-consuming [2].

Multicriterion method of qualitative assessment of relevant routers models based on the theory of incomplete similarity and dimensions is offered, in so doing components technical parameters, shown in Table 1, are characteristic quantities.

The algorithm of the method includes the following [3]:

1. Listing of modern routers models.
2. Development of conceptual wireless router model.
3. Listing of the main technical parameters of wireless routers.
4. Creation of routers generalized mathematical model after characteristic quantities.
5. Identification of analytical dependences between these quantities. In their absence, on the basis of the theory of incomplete similarity and physical modeling, setting of characteristic quantities according to Table 1.
6. Formation of conditional similarity criteria based on the method of zero degrees and heuristics.
7. Creation of criterion equation.
8. Sign modeling in dimensionless coordinates after multicriterion conditional criteria.

Generalized mathematical description, which connects technical parameters of a subject of research, is of the form:

$$\Phi(f, v, V_{RAM}, V_{Flash}) = 0 \quad (1)$$

From (1) one can see that there is no analytical dependence between these quantities. Taking into account physical modeling, conditional similarity criteria are formed after characteristic quantities on the basis of heuristics. Their relevance is confirmed by the following physical interpretation:

$\left[\frac{v}{f \cdot V_{Flash}} \right]$ – quantity which characterizes the speed of relevant information processing;

$\left[\frac{V_{Flash}}{V_{RAM}} \right]$ – quantity which describes device capability.

Criterion equation is of the following form:

$$\Phi_1 \left(\frac{v}{f \cdot V_{Flash}}, \frac{V_{Flash}}{V_{RAM}} \right) = 0 \quad (2)$$

Sign model, shown in Fig. 2, is built in dimensionless coordinates on the basis of conditional similarity criteria, π theorem.

The analysis of the dependences between four technical parameters of wireless routers (Fig. 3) shows that Airlink101AR670W and Cisco Linksys WRT 160N routers are effective models. They have a high speed of relevant information processing and wider functional capabilities of the model in investigated set of models.

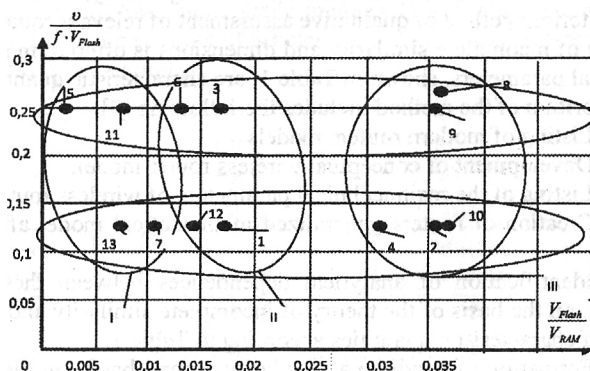
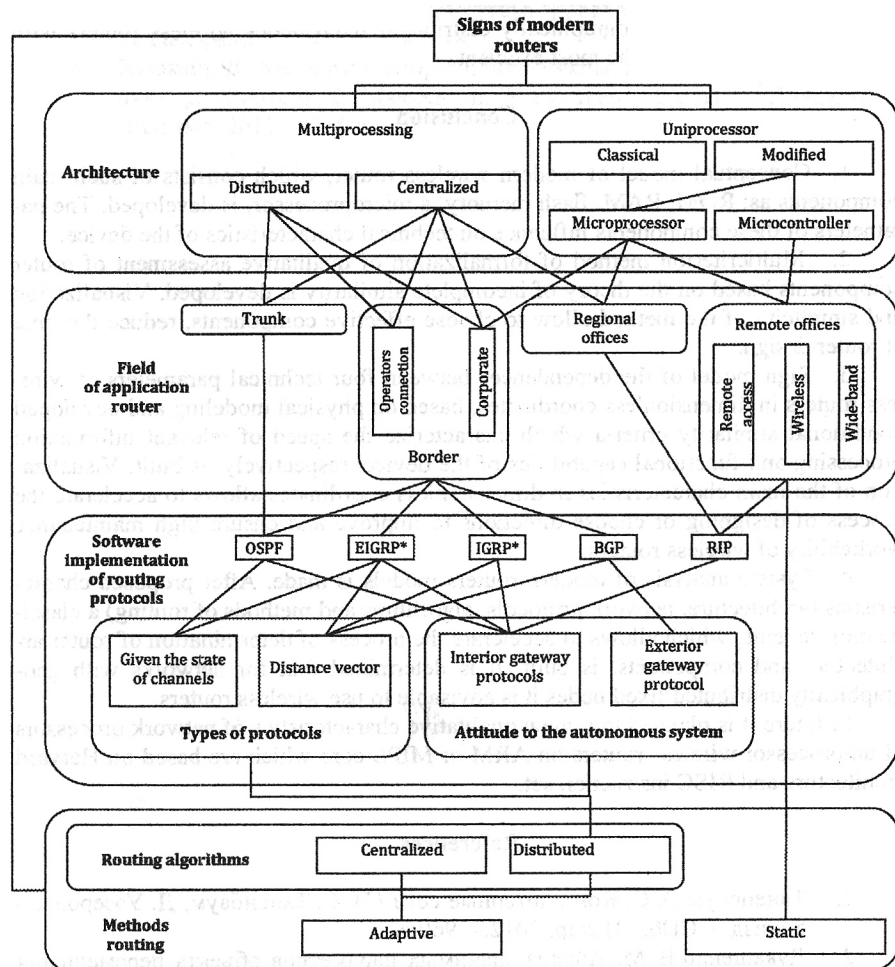


Fig. 2. Sign model of the dependences of wireless routers technical parameters in dimensionless coordinates

Note: numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 correspond to those in Table 1.

It is offered to classify modern routers on the basis of heuristic method. Classification scheme of modern routers, which provides scientific basis and allows to clearly identify wireless routers location in their general system after the following characteristics: architecture, field of application, protocols, algorithms and methods of routing, is developed (Fig. 3).



* – internal standard equipment from CISCO

Fig. 3 – Classification scheme modern routers

The architecture – multiprocessor (distributed, centralized) and uniprocessor one – is fundamental characteristic of productivity, reliability and cost of a router. All architectures are designed to meet the requirements of high-critical applications support [4].

Characteristics (algorithms, techniques and protocols of routing) mainly determine a range of routers application (functionality) in modern dial-up networks.

It is revealed that for building of networks with flexible topology it is expedient to use the hardware which supports adaptive routing methods, namely – RIP protocol, and for networks with geographically distributed fixed nodes wireless routers with static routing method are the most efficient.

Conclusion

1. Conceptual model of modern wireless router, which consists of such main components as: ROM, RAM, flash memory, a microprocessor, is developed. The parameters of these components influence on technical characteristics of the device.

2. Multicriterion method of formalization of qualitative assessment of router components based on the theory of incomplete similarity is developed. Visualization and simplicity of the method allow to choose effective components, reduce the time at router design.

3. Sign model of the dependences between four technical parameters of wireless routers in dimensionless coordinates, based on physical modeling and developed conditional similarity criteria which characterize the speed of relevant information processing and functional capabilities of the device, respectively, is built. Visualization of the main characteristics in dimensionless coordinates allows to accelerate the process of designing or choose directions to improve and ensure high maintenance workability of wireless routers;

4. System analysis of modern routers models is made. After proposed characteristics (architecture, network protocols, algorithms and methods of routing) a classification scheme, which allows to accelerate the process of determination of router architecture and components, is built. It is determined that for networks with geographically distributed fixed nodes it is advisable to use wireless routers.

In future it is planned to review qualitative characteristics of network processors of uniprocessor wireless routers on ARM or MIPS core which are based on Harvard architecture and RISC instruction set.

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