Fixed Beam Antenna Effectiveness Study in Remote Control Radio Systems

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***Abstract* - The paper describes fixed beam antenna effectiveness at a remote control system base station. Data acquisition time and message missing probability at different beam numbers and terminal dislocations are being analyzed.**

***Keywords* - antenna array, remote control systems**.

I. INTRODUCTION

One of the main restriction factors for communications is interference. It could be caused by different reflected signals, as well as by simultaneous function of more than one transceiver at the same frequency. It could cause radio link disturbances at a wireless system and severely decrease its functionality. As a result adaptive antenna array are being widely applied in the last years. They are mainly used at mobile communications systems [1,2].

The paper analyses fixed direction beam antenna array at remote control systems.

II. THE PROBLEM

The system described herein comprises a base station (BS), which acquires dislocated objects information, the latter being also stationary, equipped with radio-terminals each of them, used for parameters estimation. Some of the terminals are at objects with mains power supply and are permanently switched on (RT – P). Data is acquired from them upon a request from the base station, and subsequently all radio-terminals send the appropriate information in a sequence. If a given parameter is not within the predefined boundaries, messages are being transmitted upon a request from the radio-terminal. The rest (RT – A) are dislocated at objects without a mains power supply and are supplied by means of batteries. They send the measurements data upon an individual initiative at a given time interval.

The base station antenna is not directed towards a horizontal plane and radio link is achieved by means of a single radio channel. The latter leads often to noise occurrences, as a result of a simultaneous transmit of more than one radio-terminal, as well as loss of information.

The article proposes a method for noise reduction, by means of base station antenna pattern division into a given number of beams, thus allowing parallel exchange with the terminals.

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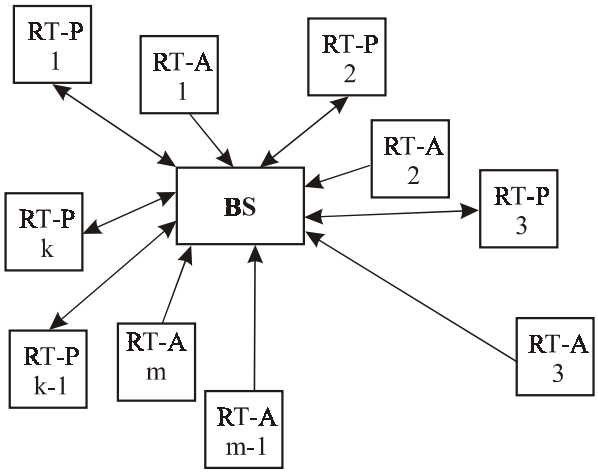
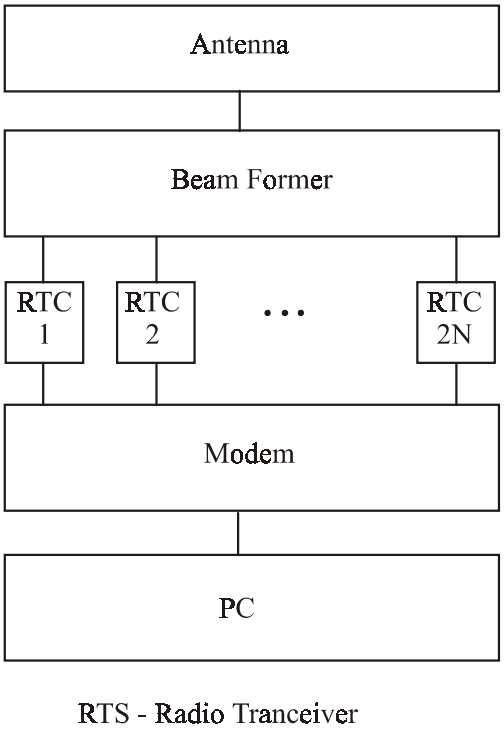


fig. 1



RTS - Radio Tranceiver

fig. 2

2N beams are being formed by means of a Beam Former (fig.2), consisting of phase–shift circuits. 2N transceivers, receiving and transmitting the corresponding beam signals are

connected to it. By means of a modem data is being send to a personal computer (PC) for processing and storage.

Antenna system is being realised by means of one or more antenna arrays. As a result the following diagram is being achieved (fig.3).

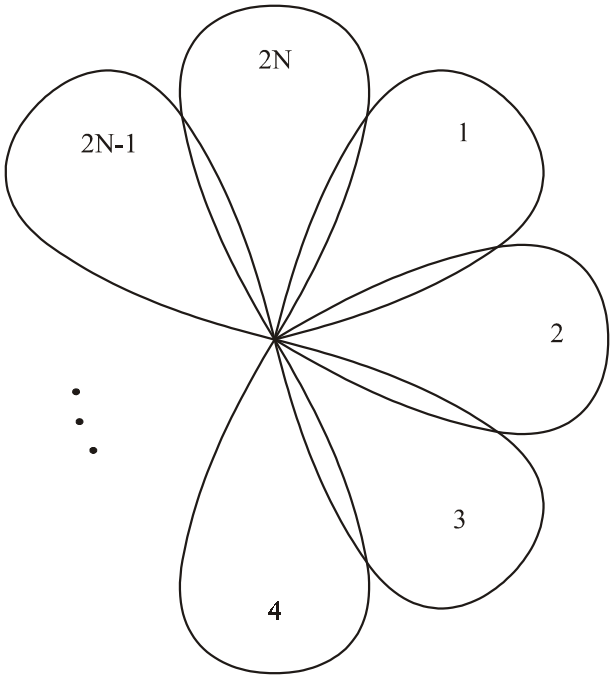


fig. 3

In this case the base station acquires first of all data from all radio terminals, situated at beam zones with an odd number, thereafter from those with an even number. Simultaneous service of odd and even number beam zones leads to noise occurrences between adjacent zones and will not allow the desired effect to take place.

III. INVESTIGATION RESULTS

Antenna pattern division into beams aims data acquisition time reduction at radio terminals, as well as missing message probability reduction at stations with a battery power supply.

By means of a computer simulation based on real data, terminals data acquisition time dependence in cases of equal and real radio-terminals dislocation is being derived. The latter is shown in fig. 4.

In case of an equal distribution, data exchange time is proportional to 1/N. In case of a real nonequal distribution, it decreases with beam number increase as well, but is greater, as a result of radio – terminals concentration at given beams. In cases of antennas with 10 and more beams, data exchange time does not decrease considerably with beam number increase. Additional complication and price rise of the appropriate hardware are to be expected in this case.

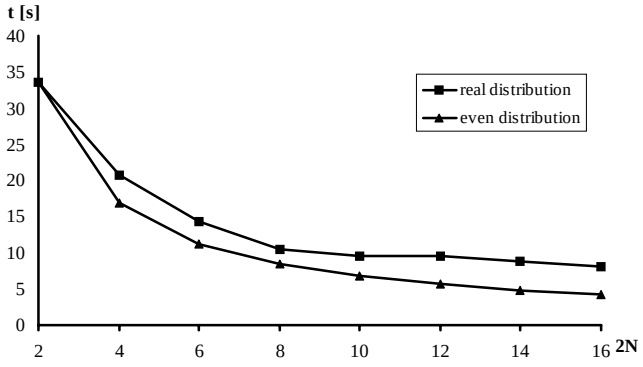


fig. 4

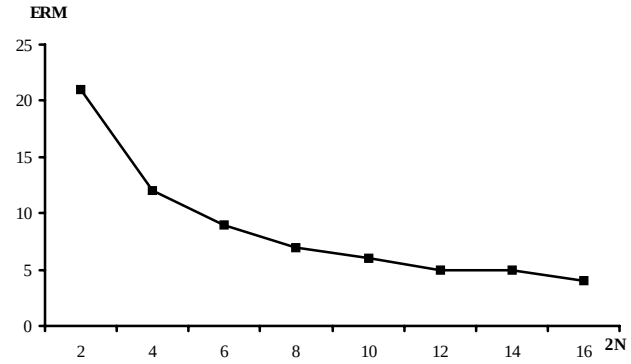


fig. 5

Besides of data exchange time decrease, fixed – beam antenna application leads to missing messages number reduction at radio – terminals upon a corresponding self-initiative. Fig. 5 represents missing messages number dependency in twenty - four hours.

IV. CONCLUSIONS

As a result of the analysis, it could be concluded that fixed beam antenna application at base station leads to a significant data exchange time and missing messages number reduction. Besides of that, the above mentioned parameters decrease with the increase of beam number, considerably for antennas with 8 – 10 beams. Usage of a greater number of beams is not justifiable from a technical and economical point of view, due to transceivers number increase and complications in single beam signals processing.

REFERENCES

[1] M. L. Dukić, M. L. Janković, B. L. Odadžić, “Analysis of SDMA&Smart Antenna Techniques for Existing and New Mobile Communication Systems”, Telfor’2001, Belgrade.

[2] M. A. Halim, “Adaptive Array measurment in communications”, Artech house, 2001,Boston - London.