RANDOM PHASE SPREAD CODING MULTIPLE ACCESS – THE NEW COMPETITOR OF CDMA IN THE BROADBAND WIRELESS NETWORKS

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Abstract

The Radio-communication Sector of ITU is now seeking submissions from industry and governments on various technical, regulatory and economic ideas in order to increase the efficient use of satellite orbits and frequencies. The proposed by the author a year before new mobile access to the satellite segment named RPSC-MA (Random Phase Spread Coding Multiple Access) is based on a reported previously RPSC technology property. It states that close situated RPSC subscriber terminals could communicate with terrestrial or satellite base stations, using the same frequency channel without interference. The isolation between the terminals is provided by their specific random phase spread coding, due to their specific antenna arrays random design. RPSC-MA will be a breakthrough technology, leading to unpredictable increase of the frequency reuse factor in satellite and terrestrial wideband networks, satisfying completely the ITU – R requirements.

Block-schemes of a RPSC-MA satellite system, as well as detailed system principles of operation are given in the report. A comparison of the multiple access properties and the advantages over popular CDMA approach are listed too.

The European Space Policy Institute [ESPI] is arguing for studies to introduce effective counter measures to protect satellites. The most vulnerable components of the space systems are the ground stations and communication links. The ESPI insists the policy makers to reconsider the satellite system architecture as a whole in order to improve the situation. The anti jam characteristics of RPSC-MA are considered in the report in order to satisfy the ESPI anti space terrorism activity. An analysis of up and down links protection principles are given in the report too.

1. INTRODUCTION

The Radio-communication Sector of ITU is now seeking submissions from industry and governments on various technical, regulatory and economic ideas [1,2,3,4] in order to increase the efficient use of satellite orbits and frequencies.

The developed by us SCP-RPSC [5,6,7,8,9] principles could be base of a new breakthrough technology, leading to unpredictable increase of the frequency reuse factor in the satellite and terrestrial wideband networks. This statement is based on the published previously RPSC property, that close situated subscriber terminals could communicate with terrestrial or satellite base stations, using the same frequency channel without interference. The isolation between the terminal up-links will be provided by their specific random phase spread coding, due to their specific random design. Thus, we can consider this way of operation as a new multiple access approach, named by us Random Phase Spread Coding - Multiple Access (RPSC-MA) [10].

2. RPSC MULTIPLE ACCESS TECHNIQUES – THE NEW WAY FOR EFFECTIVE ORBITAL-FREQUENCY REUSE OF THE SATELLITE SEGMENT

A block scheme of a possible RPSC-MA based satellite system is shown in Fig.1. Here $I_1, I_2 .....I_N$ are the incoming information streams, $C_1, C_2 .....C_N$ are the corresponding pseudo-noise codes, used for pilot access. $VMES_1, VMES_2 .....VMES_N$ - the different simultaneous transmitting Vehicle Mounted Earth Stations, equipped with Random Phased Radial Line Slot Antennas (RP-RLSA) with different random design.

In the receiver, equipped with a conventional high gain antenna, the information streams are recovered and separated in several SCP channels. Here $I_1, I_2 .....I_N$ are the out coming information streams This principle of operation is similar to the famous CDMA approach. The different RP-RLSA,s act as spatial coding devices. As it was shown in [7], the sum of several thousands random phased signals, transmitted by the different slots of the

each RP-RLSA, is Gaussian random process (equivalent to noise) The pilot and information signals, transmitted by same RP-RLSA, will have similar random phase spread in given direction and will correlate in the signal recovery units. The correlators outputs will contain the corresponding recovered information streams at base-band.

The isolation among the different channels of the proposed RPSC-MA system is based on the lack of correlation of the different random phase spread coded signals. The possible numbers of RP-RLSA with different random design and the corresponding frequency reuse factor improvement are not predictable at this stage of research. It is obvious, that similar RP-RLSA, oriented in random way in the space, could work without interference too. The intuitive approach to the problem shows that even similar RP-RLSA, oriented in similar way, could use the RPSC-MA approach. The isolation among them could be result of the random manufacturing and materials tolerances, due to the used cheap materials and technologies.

A block scheme of a RPSC-MA system with QPSK modulation is shown in fig.2. Here the *I* and *Q* streams of every single channel will need separate PN – codes for better isolation between them.

3. RPSC TECHNOLOGY – A NEW APPROACH TO PROTECT SATELLITE COMMUNICATIONS FROM SPACE TERRORISM

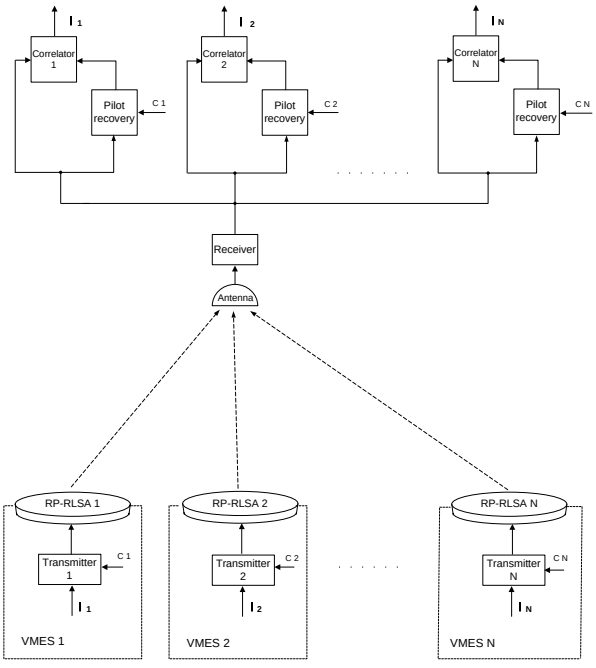

Fig. 1. Block scheme of a RPSC-MA system

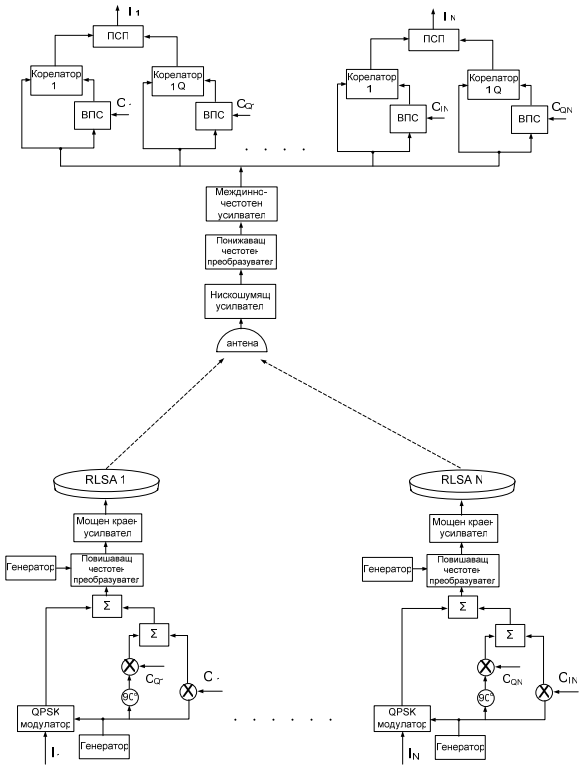

Fig. 2. Block scheme of a RPSC-MA system with QPSK modulation

The European Space Policy Institute [ESPI] issued an article in January, titled "The Need to Counter Space Terrorism - a European Perspective", arguing for studies to introduce effective counter measures to protect satellites [11].The article lists several examples of jamming and piracy events that occurred in the commercial satellite sector. One of the conclusions is that the most vulnerable components space systems are the ground stations and communication links. These components are susceptible to attack from widely accessible weapons and technologies. The ESPI agrees with this and says policy makers must consider the system architecture as a whole.

SCP-RPSC technology is one the best technologies, satisfying the above mentioned requirements, as follows:

- *SCP in down-links*

In this particular case the down-links are well protected from jamming, coming from the side-lobes of the Spatial Cross-Correlation Function (SCCF). As it was shown in [6], the level of the side-lobes is very low (in order of -25, -30 dB). It leads to good protection rations of SCP down-links against ground based terrorist jamming.

- *RPSC in up-links*

In this particular case up-links are protected against jamming, coming even from points, close situated to the earth stations – in the main lobe of the satellite up-link receiving antenna. The receiving SCP units will not recovery the jamming signals because of the lack of correlation between the jamming signals, transmitted by conventional high gain antennas, and the recovered random phase spread pilot signals. Situation is similar to the case of CDMA protection against narrowband interference.

4. CONCLUSION

The practical SCP-RPSC principles implementations in transmit and receive mode will drastically change the existing paradigm in the satellite communication business in general. Many of the existing problems of the proposed LEO, MEO and GEO satellite systems, dealing with frequency and orbital resource sharing, beam pointing, beam shadowing, terrorist jamming etc., will be solved successfully.

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