SIGNALING EFFICIENCY IN OFDM-BASED OVERLAY SYSTEMS

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Abstract[1] section: 6.5 Spectrum Management, Spectrum Allocation, Spectrum Interference Management

1. INTRODUCTION

Looking at today's frequency plans given by the regulatory bodies, it is obvious that there are nearly no unassigned frequency bands available any more which are appropriate for mobile communications. On the other hand, when taking a closer look at the real spectrum allocation, e.g. by taking measurements, one will see that the spectrum is not used very efficiently.

This discrepancy results from the static frequency assignment to dedicated licensees, not regarding their current communication demand. To overcome this "virtual" frequency shortage, one approach is to operate a secondary system as an overlay system in the same frequency band that has originally been assigned to a primary licensed system. This is also called spectrum pooling [1]. Here the overlay system dynamically adapts to the licensed system and only uses free time-frequency gaps, thus not degrading the performance of the licensed system.

2. OFDM-BASED OVERLAY SYSTEMS

Due to its flexibility OFDM (orthogonal frequency division multiplex) is a promising technology for designing overlay systems [2]. Depending on the current licensed system's allocation the overlay system can turn on or off each subcarrier individually, allowing for a minimization of interference and a maximization of spectral efficiency. For this purpose the overlay system has to periodically perform measurements of the spectral density, from which it generates an allocation vector. The allocation vector is a vector with the size of the applied FFT-length containing binary elements, whereas '1' indicates that the specific subcarrier may be used by the overlay system and '0' forbidding a usage. Figure 1 shows an example allocation vector, mapping four subcarriers on one channel of the licensed system.

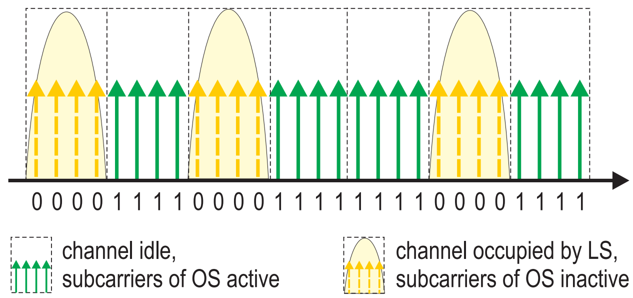

Figure 1: Coexistence of a licensed system (LS) and an OFDM-based overlay system (OS).

3. SIGNALING EFFICIENCY

In order to enable communication within the overlay system transmitter and receiver have to use an identical subset of subcarriers. Hence, the receiver has to know which subcarriers the transmitter is using and therefor regularly receive an update of the allocation vector. This results in a high signaling effort, since after every measurement in the transmitter the new subcarrier configuration has to be broadcasted. The signaling can be reduced by omitting an allocation vector update if the new allocation vector does not have significant changes compared to the previous one. This leads to an inaccurate allocation vector in the overlay system's receiver. Assuming that the transmitter always has a perfect allocation vector configuration, this inaccuracy only leads to additional interference in the overlay system, and thus affecting the achieved bit error rate. The licensed system's performance is not degraded, since the overlay transmitter still transmits on unused subcarriers only.

In [3] we investigated the performance degradation caused by an inaccurate allocation vector in an OFDM-CDMA (code division multiple access) overlay system. In the final paper simulation results for an OFDM system with channel coding are shown and compared to the already existing results from [3]. Furthermore, the licensed system is now modeled as a queuing system and the possible signaling reduction is shown depending on the arrival and service rate.

4. REFERENCES

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[3] U. Berthold, S. Brandes, M. Schnell and F. Jondral, "Performance of OFDM-CDMA Overlay Systems Considering Inaccurate Allocation Vectors", Proceedings of the InOWo'05, 10th International OFDM-Workshop, 31 August - 1 September 2005, Hamburg, Germany.

[1] The authors agree that the paper may be reviewed by the SDR Forum paper evaluation committee for purposes of inclusion in the conference. The authors allow the inclusion of the paper in SDR Forum conference publications, and other SDR Forum publications, if the paper is accepted.