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Adjacent Channel Interference Analyses in TETRA Direct Mode Operation

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Abstract: - The present paper analyzes adjacent channel interference in TETRA Direct Mode Operation (DMO) for indoor and outdoor environments. To determine minimal stay-away distance and interference area propagation model is used. Thus, a brief overview of free space, Bacon and CEPT SE21 propagation models, mentioned in the TETRA DMO standard is given and two-ray and multi-wall models are described and evaluated by field measurements. We found out, that the two-ray model is suitable for fast estimation of the TETRA DMO signal coverage in open flat area while the multi-wall model, taking into account the attenuation of walls between transmitter and receiver, gives good estimate of the signal levels for indoor applications. Those two models were used for the interference analyses. According to the calculated results two-ray model gives rather pessimistic values of the stay-away distance and interference area in open flat areas while multi-wall model is appropriate for the interference calculation inside buildings that are not surrounded with the high structures causing additional ray reflections back into the interior of the analyzed building.

Key-Words: interference, propagation, path loss, TETRA Direct Mode Operation, two-ray model, multi-wall model, radio signal coverage, stay-away distance

1 Introduction

The analysis of adjacent channels interference strongly depends on the adequacy of the propagation model. In emergency situations reliable radio links between professional mobile users are essential for an efficient execution of rescue missions. Adequate frequency allocation to individual groups must be carefully planned; an appropriate radio signal coverage and sufficient system capacity must be provided to assure efficient communications [1].

The TETRA network usually operates in trunk mode. Since the emergency situations may happen in the areas where the signal strength is low or even in the places without radio signal coverage, an alternative communication mode can be provided, the so-called TETRA Direct Mode Operation (TETRA DMO) [2, 3].

The TETRA DMO enables communication between TETRA terminals without the support of network infrastructure. The DMO is particularly applicable in emergency situations where TETRA signal is not available and where effective local communication among members of rescue team on certain crisis locations is required.

The number of users increases significantly in emergency situations thus enlarging also the possibility of interference between individual users and groups, especially in DMO mode. Therefore, the interference analysis between adjacent channels in TETRA DMO mode has an extraordinary importance in providing reliable and undisturbed communication between professional users.

The propagation model applied for analysis has a fundamental impact on the predicted reliability and efficiency of the DMO communication. Propagation models are an important tool for wireless communication network design. They predict the path loss between the transmitter (Tx) and receiver (Rx), which is the most important information to determine the radio signal coverage and to estimate the interference between adjacent radio channels. Basically, the path loss depends on the carrier frequency, the height of transmit and receive antenna, the propagation environment and the distance between the transmitter and receiver.

The only alternative way to determine the radio signal coverage is field measurements, which are time-consuming and expensive.

The propagation of radio signal for TETRA trunked mode operation is covered in the literature relatively well. Numerous models exist for the calculation of radio signal coverage at 400 MHz frequency band [1]. However, detailed interference analysis and appertaining coverage studies for the TETRA Direct Mode Operation are not available yet. The TETRA standard proposes some short range models for open areas [4] but DMO