Improving HSDPA Indoor Coverage and Throughput

Bibik Mikhail

Abstract - **The target of the paper is to provide guidelines for indoor planning and optimization using an outdoor-to-indoor repeater or a dedicated indoor system. The paper provides practical information for enhancing the performance of high-speed downlink packet access (HSDPA) in an indoor environment.**

Keywords – **HSDPA, WCDMA, Indoor Coverage, Indoor System, repeater.**

I. INTRODUCTION

The target of the paper is to discover the coverage requirements for different average and momentary HSDPA data rates, in the dedicated indoor system and outdoor-to-indoor repeater implementation. In addition, performances of indoor and repeater systems are compared.

II. INDOOR COVERAGE PROVIDERS

In the era of line telephones, wireless communication networks were mainly used for speech connections and out of office, thus requirements for indoor coverage and capacity were modest, and low service probabilities were accepted indoors.

Moderate indoor coverage can be provided as a side product of macro-/microcellular planning, as outdoor signal propagates inside buildings despite higher attenuation.

Dedicated indoor systems can be implemented using pico- or femto-cells, distributed antenna system (DAS), radiating cables, or optical solutions. In a distributed antenna system, one base station is used to provide service for large areas via multiple antennas. The base station is connected to the antennas via splitters, tappers, and coaxial cables. Since the coverage areas are rather scattered, and difficult to estimate accurately in indoors.

Repeaters can be considered as an alternative solution to the dedicated indoor systems. Outdoor-to-indoor (Fig. 1) repeating can be used to improve coverage in an indoor environment by exploiting the existing outdoor macrocellular network. The signal from the outdoor network can be captured using a rooftop antenna and forwarded inside the building using cables. Furthermore, the received signal can be amplified before retransmission and the building penetration loss can be avoided. Single antenna or DAS can be used indoors to provide the extension in signal coverage offered by the repeater. Repeaters in this paper stand for simple bidirectional linear amplifiers that can be installed in the cell area to provide an amplified replica of the received UMTS frequency bands.

Bibik Mikhail - National Technical University of Ukraine 'Kyiv Polytechnic Institute', Prospect Peremogy, 37, Kyiv, 03056, UKRAINE, E-mail: its@ntu-kpi.kiev.ua

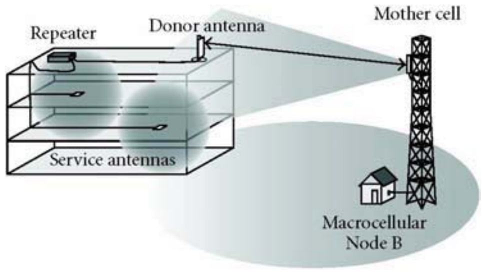

Fig.1 Outdoor-to-indoor repeating.

Measurements were performed in a UMTS system, based on 3GPP Release 5 specification. The network included a fully functional RNC connected to a core network. The measurements were performed with two different indoor systems: a dedicated indoor system, and an outdoor-to-indoor repeater.

Measurements for the dedicated indoor system show that with RSCP -110 dBm, average throughput is at a level from 1200 kbps to 1700 kbps, depending on the environment. Average throughput increases rather linearly with RSCP up to -90 dBm, where throughput between 2200 and 2500 kbps can be achieved.

Increasing the repeater gain improves downlink performance, but already the lowest measured repeater gain clearly provided improved indoor coverage and capacity. The best HSDPA indoor performance was achieved with the highest measured repeater gain, but a high rise in uplink interference level at the mother cell was caused. Thus, the optimal repeater gain is a compromise between repeater serving area performance and mother cell performance.

III. CONCLUSION

The measurements show that misorientation of the repeater donor antenna reduces HSDPA indoor performance significantly, and special attention should be paid to finding an optimal location and orientation for the repeater donor antenna. Finally, increasing the antenna density in the serving distributed antenna system has a clear positive impact on system coverage and HSDPA capacity.

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