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TECHNICAL REPORT

The Impact of Interference in the Reverse Link on Data Throughput, Minutes of Use and Capacity

November, 2008

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1. The Need for In-Band Interference Mitigation in a WCDMA System

1.1. Review of Multiple Access Schemes

In a Frequency Division Multiple Access (FDMA) system, a dedicated frequency channel is assigned to a single user for the duration of the link between the mobile unit and the base station, and hence the multiplicity of mobile units are distinguished by their unique frequency channel assignments. In a Time Division Multiple Access (TDMA) system, a frequency channel is shared by multiple mobile units. However, each mobile unit is assigned a different time slot within that frequency channel, and hence the multiple mobile units supported by a single frequency channel are distinguished by their unique time slots.

Unlike FDMA and TDMA systems in which only a single mobile unit is assigned to the frequency channel at any given instant in time, in a Wideband Code Division Multiple Access (WCDMA) system a number of mobile units utilize the same frequency channel simultaneously. Each mobile unit is assigned a different digital spreading code, and digital correlation is used at the receiver to extract the desired signal from the plethora of signals occupying the frequency channel. That is, the multiple mobile units supported by a single frequency channel are distinguished by their unique digital correlation codes.

1.2. Unique Problem of In-Band Interference in a WCDMA System

In an FDMA system, interference within a frequency channel will only affect the communication link for the single mobile unit using that frequency channel. In a TDMA system, while sustained interference will affect all mobile units being supported by that frequency channel, typically there are only between three and eight mobile units being supported by a single frequency channel. However, commercial spread-spectrum WCDMA systems utilize a wide-band frequency channel that supports a large number of mobile units simultaneously. Hence, a single in-band interferer will have substantially greater impact on a WCDMA system than on an FDMA or TDMA system, if for no other reason than substantially more subscribers are affected by a single in-band interferer.

For any multiple access system, in-band interference will effectively reduce the coverage area that can be supported by the affected channels. Beyond that, however, in-band interference will also reduce the capacity and data throughput that can be supported over a fixed coverage area for a WCDMA system due to the breathing-cell phenomenon associated with this access technology. This is best illustrated through coverage-throughput curves, wherein the relationship between coverage radius or coverage area and throughput is plotted. In Figure 1.1, a family of such coverage-throughput curves is plotted, with the total power level of the interference within the channel of interest as a parameter.