Project	IEEE P802.16 Broadband Wireless Access Working Group
Title	Proposed Draft Text for the Coexistence Practice Document on Mitigation Techniques
Date Submitted	7 September, 1999
Source	Rebecca Chan Industry Canada 300 Slater Street Ottawa, Ontario K1A 0C8 Canada Voice: +1 613 993 8516 Fax: +1 613 952 5108 E-mail: chan.rebecca@ic.gc.ca Keith Doucet Newbridge Networks Corporation 600 March Road Kanata, Ontario K2K 2E6 Canada Voice: +1 613 599 3600 ext 4409 Fax: +1 613 599 3686 E-mail: kdoucet@newbridge.com
Re:	Call for Contribution on the Coexistence Practice Document
Abstract	The document outlines some of the mitigation techniques that can be used to mitigate interference from systems operating in adjacent-areas.
Purpose	To propose draft text for the Coexistence Practice Document, specifically dealing with mitigation techniques.
Notice	
Release	

Proposed Draft Text for the Coexistence Practice Document – Mitigation Techniques

Mitigation Techniques

1. General

This paper describes some of the mitigation techniques that could be employed in case of co-channel interference between systems operating in adjacent areas. As each situation may be unique, no single technique can be effective for all cases, and in certain circumstances, the application of more than one mitigation technique may be more effective.

In general, analyses to evaluate the potential for interference as well as any possible mitigation solution should be performed prior to systems implementation. Coordination with adjacent operators could significantly lower the potential for interference.

2. Separation distance/Power

One of the most effective mitigation technique that can be employed is to increase the distance between the interfering transmitter and the victim receiver, thus lowering the interfering effect to an acceptable level. If the distance between the interferer and the victim cannot be increased, then the transmitter power can be lowered to achieve the same effect. However, both options are not always viable due to local terrain, intended coverage, network design, or other factors.

Another possible, but less desirable, option is to increase the transmit power levels of the customer premise equipment (CPEs) within a cell or sector in a given service area to improve the signal to interference level into the base station receiver. Operating the CPEs ‘hot’ at all times may help to address the adjacent area interference, however, it may introduce other interference scenarios that are equally undesirable, therefore, caution should be exercised if this approach is taken.

3. Antenna

3.1 Orientation

In certain system deployments, sectorized antennae will be used. A slight change in antenna orientation by the interfering transmitter or victim receiver can help to minimize interference. This technique is especially effective in the case of interference arising from main-beam coupling. However, as before with separation distance, although to a lesser degree, this mitigation technique may not be practical in certain deployment scenarios.

3.2 Tilting

Similar to changing the main-beam orientation, the downtilt of either the transmitting antenna or receiving antenna can also minimize the interfering effect. A small change in downtilt could significantly change the coverage of a transmitter, hence reducing interference to the victim receiver. However, in some systems, the downtilt range could be quite limited either due to technical reasons, or economic reasons, rendering this technique impractical.

3.3 Directivity

In problematic areas near the service area boundaries where interference is of concern, consideration can be given to using high performance antenna with high directivity as opposed to a broader range sectorized antenna or omni-directional antenna.

Another possible option is to place the base station at the edge of the service area or boundary, and deploy sectors facing away from the adjacent licensed area. Interference is then avoided through the front to back lobe isolation of the base station antennas, which can exceed 30 dB, to accommodate QPSK and 16 QAM modulation.

3.4 Antenna Heights

In circumstances where adjacent licensed base stations are relatively close to each other, another possible technique to avoid interference is to place the base station antennae at lower heights to indirectly create LOS blockages to neighboring base stations. This solution will not be practical in many cases, as it will significantly cause a reduction in coverage area (i.e. mini-cell), however, under certain conditions, it may be the best option available for addressing the interference issue.

3.5 Future Schemes

Future schemes may be available such as adaptive arrays or beam-steering antennas which focus a narrow beam towards individual users throughout the service area in real-time to avoid or minimize coupling with interfering signals. Beam shaping arrays which create a null in the main beam towards the interfering source represents another possible approach towards addressing interference.

4. Polarization

Cross polarization can be effective in mitigating interference between adjacent systems. A typical cross-polarization isolation of 25-30 dB can be achieved with most antennas today, which is sufficient to counter co-channel interference for QPSK and 16 QAM modulation schemes. As with other mitigation techniques, cross polarization is most effective when coordination is carried out prior to implementation of networks to accommodate all possible affected systems.

5. Blockage

Natural shielding, such as high ground terrain between boundaries, should be used to mitigate interference where possible. When natural shielding is not available, the use of artificial shielding, such as screens, can be considered.

6. Frequency plan

A similar frequency plan for the up- and down-link could help to reduce interference for FDD systems. The most problematic interference occurs between base stations primarily for the following reasons:

i) Base stations are typically located on high buildings/structures, therefore, they tend to have good clear line of sight (LOS) with neighboring base stations,
ii) Base stations typically operate over 360 degrees, and
iii) Base stations are always transmitting.

By transmitting at the same frequencies, co-channel interference between base stations is completely avoided.

Frequency exclusion provides another, albeit very undesirable, approach for avoiding interference. This involves dividing or segregating the spectrum so that neighboring licensees operate in exclusive frequencies, thus avoiding any possibility for interference. This should and must be considered an absolute last resort, where all other remedial opportunities have been completely exhausted between the licensed operators.

7. Modulation and Encoding

Using more robust modulation and encoding schemes can help in deployment scenarios where the potential for interference is high. Future schemes being considered to help overcome cellular interference are spread spectrum and COFDM.