Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Interim Considerations arising from Simulations, revision 1**
Date Submitted	**2002-05-23**
Source(s)	Philip Whitehead Radiant Networks Plc The Mansion, Chesterford Park Little Chesterford, Essex CB10 1XL UK Voice: +44 1799 533600 Fax: +44 1799 533601 mailto:pw@radiantnetworks.co.uk
Re:	Coexistence task group activities up to session # 19
Abstract	This document summarizes the status of the 42 identified simulation tasks
Purpose	To assist in producing a new draft coexistence recommended practice.
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures (Version 1.0) <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:r.b.marks@ieee.org > as early as possible, in written or electronic form, of any patents (granted or under application) that may cover technology that is under consideration by or has been approved by IEEE 802.16. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Interim Considerations from Simulations, revision 1

The following table summarizes the results from the various simulations carried out by TG2.

Input contribution	Scenario	Frequency	Area/ channel	Conclusion/ notes	Methodology
C802.16.2a-02/21	PMP BS to PP	Range 2 [2]	Adjacent area, same channel	The PP link must be over the horizon or at least 180km from BS. If antenna offset is possible this can be reduced to approximately 20km. RABC [1] proposes a pfd limit at the service area boundary of -125dBW/m^2/MHz, as a trigger, to protect the PP links in the 38GHz band.	Worst case analysis
C802.16.2a-02/21	PMP SS to PP	Range 2	Adjacent area, same channel	PP link must be over the horizon and/ or have a significant pointing offset from the SS direction(s). RABC [1] proposes a pfd limit at the service area boundary of -125dBW/m^2/MHz, as a trigger, to protect the PP links in the 38GHz band.	Worst case analysis
C802.16.2a-02/22	PP to PMP BS	Range 2	Adjacent area, same channel	PP link must be at least 10km from BS. For longer links (>5km) additional isolation is needed (greater spacing or antenna pointing offset required).	Worst case analysis
C802.16.2a-02/22	PP to PMP SS	Range 2	Adjacent area, same channel	50-80km spacing required (may be shorter if the SS antennas are lower than typical and horizon is relatively close).	Worst case analysis/ Monte Carlo analysis
C802.16.2a-02/20, 02/25 and 02/26	PMP BS to PP	Range 2	Same area, adjacent channel	Rigorous coordination is always required. Adjacent channel operation imposes very severe constraints on the location and pointing direction of the PP link(s). A single guard channel [3] significantly reduces but does not eliminate these constraints.	Worst case analysis
C802.16.2a-02/20, 02/25 and 02/26	PMP SS to PP	Range 2	Same area, adjacent channel	Rigorous coordination is always required. Adjacent channel operation imposes very severe constraints on the location and pointing direction of the PP link(s). Even with a single guard channel [3] there remains a significant range of pointing directions that must be avoided.	Worst case analysis

C802 .16.2a-02/19, 02/25 and 02/26	PP to PMP BS	Range 2	Same area, adjacent channel	Coordination is usually required. Adjacent channel operation imposes severe constraints on the location and pointing direction of the PP link(s). A single guard channel [3] significantly reduces but does not eliminate these constraints. The reciprocal direction of interference will usually dominate	Worst case analysis
C802 .16.2a-02/19, 02/25 and 02/26	PP to PMP SS	Range 2	Same area, adjacent channel	Coordination is usually required. Adjacent channel operation imposes very severe constraints on the location and pointing direction of the PP link(s). Even with a single guard channel [3] there remains a significant range of pointing directions that must be avoided. The reciprocal direction of interference will usually dominate.	Worst case analysis
C802.16.2a-02/18	PMP BS to PP multi link	Range 2	Adjacent area, same channel	Over the horizon or at least 80km spacing required. Shorter distances possible when the BS antenna is lower than typical.	Worst case analysis
C802.16.2a-02/18	PMP SS to PP multi link	Range 2	Adjacent area, same channel	BS case usually dominates, so that over the horizon (at least 80km) spacing is required. Where SS antennas are unusually high, specific coordination may be needed .	Worst case analysis
C802.16.2a-02/10	PP multi link to PMP BS	Range 2	Adjacent area, same channel	Spacing of 20 – 24 km is typically required, in the absence of co-ordination	Monte Carlo simulation
C802.16.2a-02/10	PP multi link to PMP SS	Range 2	Adjacent area, same channel	Spacing is usually controlled by BS interference (see 11) unless the SS antennas are on unusually high structures, in which case, spacing may have to increase to 40 – 50km	Monte Carlo simulation
C802.16.2a-02/10	PMP BS to PP multi link	Range 2	Same area, adjacent channel	2 channel guard band is generally required	Worst case analysis
C802.16.2a-02/10	PMP SS to PP multi link	Range 2	Same area, adjacent channel	2 channel guard band is generally required	Worst case analysis
C802.16.2a-02/10	PP multi link to PMP BS	Range 2	Same area, adjacent channel	1 channel guard band is generally required	Monte Carlo simulation
C802.16.2a-02/10	PP multi link to PMP SS	Range 2	Same area, adjacent channel	1 channel guard band is generally required	Monte Carlo simulation
None	BS – BS	2.5 GHz	Adjacent area, same channel	No contributions	

None	BS – SS	2.5 GHz	Adjacent area, same channel	No contributions	
None	SS – BS	2.5 GHz	Adjacent area, same channel	No contributions	
None	SS – SS	2.5 GHz	Adjacent area, same channel	No contributions	
None	BS – BS	2.5 GHz	Same area, adjacent channel	No contributions	
None	BS – SS	2.5 GHz	Same area, adjacent channel	No contributions	
None	SS – BS	2.5 GHz	Same area, adjacent channel	No contributions	
None	SS – SS	2.5 GHz	Same area, adjacent channel	No contributions	
C802.16.2a -02/12	BS – BS	3.5 GHz	Adjacent area, same channel	With LOS paths, the distance has to be at least the horizon distance (approx 80km). With the two slope path loss model, 80km is sufficient. Unless BS antennas are very high above surrounding terrain, a reasonable guideline spacing is 80km. At 20km BS to BS spacing, additional path attenuation of approx. 30dB is needed, since the interference level is otherwise unworkable.	Monte Carlo simulation
C802.16.2a -02/13	BS – SS	3.5 GHz	Adjacent area, same channel	As for the BS case, a reasonable guideline coordination spacing is 80km (at least horizon distance), but the probability of the worst case is lower due to narrower beam antenna. BS to BS is likely to be the dominant case, as the SS antenna is usually lower than the BS antenna.	Monte Carlo simulation
Ref!	SS – BS	3.5 GHz	Adjacent area, same channel	Typically 60 – 80 km spacing needed	Monte Carlo analysis
Not required	SS– SS	3.5 GHz	Adjacent area, same channel	Low probability. Coordination needed for the rarely occurring bad cases.	Worst case analysis
Ref!	BS – BS	3.5 GHz	Same area, adjacent channel	Combination of isolation (NFD etc) and physical spacing is required (typically 0.1 – 2km, dependent on available isolation)	Monte Carlo analysis

Ref!	BS – SS	3.5 GHz	Same area, adjacent channel	Isolation needed (NFD etc) depends on modulation. In some cases it may be possible to operate in the adjacent channel.	Monte Carlo analysis
Ref!	SS – BS	3.5 GHz	Same area, adjacent channel	Isolation needed (NFD etc) depends on modulation. In some cases it may be possible to operate in the adjacent channel.	Monte Carlo analysis
Not required	SS – SS	3.5 GHz	Same area, adjacent channel	Low probability. Worst cases require coordination. Direct alignment would place one BS in the path of the SS to SS interference. Also, timing of transmissions on interference and victim links has low probability of coincidence. It is concluded that a simulation is not necessary.	None required due to low probability
TBA (formal paper not yet uploaded)	BS – BS	10.5 GHz	Adjacent area, same channel	With LOS paths (single slope path loss model), the distance has to be at least the horizon distance (approx 80km). With the two slope path loss model, 80km is sufficient. Unless BS antennas are very high above surrounding terrain, a reasonable guideline spacing is 80km.	Monte Carlo simulation
TBA (formal paper not yet uploaded)	BS– SS	10.5 GHz	Adjacent area, same channel	Over the horizon or very long distances are required (much greater than 80km). In practice, expect to make use of significant diffraction loss.	Monte Carlo simulation
02/01r1	SS – BS	10.5 GHz	Adjacent area, same channel	Typically 60 – 80 km spacing required	Monte Carlo analysis
Not required	SS – SS	10.5 GHz	Adjacent area, same channel	Low probability. Coordination needed for the rarely occurring bad cases. BS to BS interference usually dominates the required spacing because SSs are usually lower than BSs.	Worst case analysis
02/23	BS – BS	10.5 GHz	Same area, adjacent	Combination of guard frequency and physical spacing is needed. Typical result for rain region K is 1 guard channel plus 350m spacing. For more severe rain fading environments, additional isolation is needed (e.g. through use of ultra linear PA)	Monte Carlo simulation

02/16	BS – SS	10.5 GHz	Same area, adjacent channel	A single channel guard band with typical NFD will be sufficient in most cases, even when differential rain fading is severe. Adjacent channel operation may be possible when equipment has better than typical NFD (5-10dB better than the 27dB assumed figure). Care needs to be taken to have adequate BS to BS physical spacing (typically 300-500m).	Monte Carlo simulation
TBA (to be uploaded)	SS – BS	10.5 GHz	Same area, adjacent channel	In rain region K, this scenario is workable in the adjacent channel. In severe rain environments (such as P), at least 10dB additional isolation is needed. This can be obtained from better NFD than "typical" or by use of additional guard channel(s)	Monte Carlo simulation
Not required	SS – SS	10.5 GHz	Same area, adjacent channel	Low probability. Worst cases require coordination. Direct alignment would place one BS in the path of the SS to SS interference. Also, timing of transmissions on interference and victim links has low probability of coincidence. It is concluded that a simulation is not necessary.	Not required due to very low probability

The following additional simulations are being carried out to assess the affect of mitigation techniques Scenarios 41 and 42 are illustrations of methods by which interference may be reduced, rather than new scenarios

02/24	SS – BS, using adaptive BS antenna	3.5 GHz	Adjacent area same channel	BS to BS spacing can be reduced to approximately 20km, provided 1% of interference cases can be tolerated/ mitigated. If not, horizon distance is required (approx. 60-80km).	Monte Carlo simulation
TBA	BS – BS using adaptive antennas	3.5 GHz	Adjacent area same channel	Reza Arefi to review whether this or paper 02/24 describes the dominant case. Conclusions for the SS-BS case can not be validated until the BS-BS, potentially worse, case has been evaluated.	TBA

Notes
[1] The RABC paper is RABC 99.2 (coordination process for PMP fixed Wireless Access)
[2] Frequency range 2 is 23.5 – 43.5 GHz
[3] The guard channel width should be that of the system using the whannels

End of document