Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**2-11 GHz mesh coexistence material**
Date Submitted	**2002-09-11**
Source(s)	Nico van Waes Nokia Wireless Routers
Re:	Re: Ballot 8
Abstract	2-11 GHz mesh co-existance material accompanying comments
Purpose	Discussion and adoption
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2-11 GHz mesh coexistence material

Nico van Waes
Nokia Wireless Routers

Note to editor: Frame maker source available for inclusion in case of adoption.

5.3.1.3.3 Victim omni-directional mesh node

The potential interference sources for omni-directional mesh nodes is shown in Figure 5a. As this type of mesh deployment tend to have a relatively small footprint (a few kilometers) and is only feasible on frequencies below 11 GHz, the negative impact of rain cells will be minimal (less than 1 dB). Apart from the omni-directional interference cases shown in Figure 5a, mesh nodes may also employ sector (typically at the mesh BS) and highly directional antennas (possible at the edge of the coverage area), in which case the interference scenarios (particularly E and F) as specified for the BS (see [REF 5.3.1.3.1]) and all interference scenarios as defined for the SU (see [REF 5.3.1.3.2]) apply respectively.

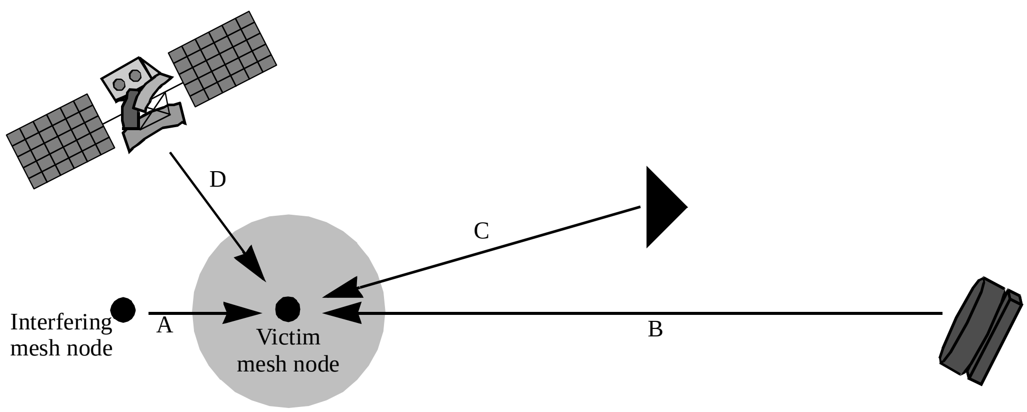

Figure 5a—Interference sources to omni-directional mesh node (mesh BSU and mesh SU)

Case A shows mesh node to mesh node interference. This type of interference may occur in multi-cell deployments with low spectral re-use and on the boundary of provider coverage areas. In these cases, the victim node could tend to see the aggregate power of several interfering nodes. Compared to the BS-to-BS scenario as outlined in [REF 5.3.1.3.1], this scenario would tend to be less severe due to the typical low elevation above clutter of this type of deployment, which results in significant NLOS attenuation.

Case B covers interference from a highly directional antenna system into the victim mesh node. The antenna system could be a PMP SU, part of a PTP link, or a mesh node in another cell or from another provider area. Interference energy could be mainly from the main lobe or from a sidelobe. LOS between the interfering and victim antenna is however relatively unlikely.

Case C covers interference from a PMP BS into the victim mesh node. This interference may occur on the boundary of coverage areas (same or different provider). The victim node could tend to see the aggregate power of several interfering PMP BSs. Due to the elevation of PMP BSs, LOS may exist. Similar to BS-to-BS interference, this source of interference tends to be most severe for mesh systems.

Case D covers interference from a satellite downlink or stratospheric downlink. This case is not included in this Recommended Practice.

Table 31a—Parameters for 3.5 GHz mesh deployments

	Charactistics	Typical values
Deployment	Layout of system(s) including diagrams	Multi–cell (uniformly distributed)
	Typical sector arrangements and frequencies	Typically 4-sectors per cell, 4 frequencies. Vertical polarization only. Systems may use adaptive antennas.
	Propagation	Partially obstructed paths allowed. For co-existence purpose LOS assumed over first 50 m and $d^{2.3}$ for the rest of a link. Non-link attenuation is assumed to be LOS over the first 50 m and d^3 for the following 500 m and d^4 for any subsequent distance.
	Cell radius	2 km
	Link distances	Lognormal propagation distribution [H3.25] with $\sigma_{PD} = 5$dB (mean according to link budget). Typically between 50 and 500 m.
	Availability	99.9% of time for 90% cell area coverage
	Number of nodes per sector	Up to 100.
	Distribution of terminal stations	Uniform per unit area
	Frequency of operation	2-6 GHz. 3.6 GHz is used for co-existence calculations
	Duplex method	TDD
	Channel bandwidths	6, 7, 12, 14 MHz. 7 MHz is used for co-existence calculations
	Antenna gain	9 dBi
	Backhaul links	Seperate assignment in block or out of block
Receiver	filter response and rejection	See [REF C802.16a-02/84] [N.B. depending on whether this makes it into the .16a spec, reference the spec instead. Editor please check.] Same PHY rejection values are (from [REF 802.16a-2002]): Adjacent (16 QAM-3/4): 11 dB Non-adjacent (16 QAM-3/4): 30 dB
	noise floor	5 dB
	Acceptable level of co-channel interference	I/N = -6 dB (aggregate over all interferers)
Transmitter	Emission mask	See [REF ETSI EN 301 021]
	Transmit power (at antenna port)	Mean: -12 dBW Peak: -6 dBW
	use of ATPC, steps and range	2 dB steps, 25 dB range

20.1.1 Methodology

Coordination is recommended between licensed service areas where both systems are operating co-channel, i.e., over the same fixed BWA frequencies, and where the service areas are in close proximity, e.g., the shortest distance between the respective service boundaries is less than ~~80km~~ the coordination trigger. The operators are encouraged to arrive at mutually acceptable sharing agreements that would allow for the provision of service by each licensee within its service area to the maximum extent possible. Under the circumstances where a sharing agreement between operators does not exist or has not been concluded, and where service areas are in close proximity, a coordination process should be employed.

Fixed BWA operators should calculate the power spectral flux density (psfd) at their own service area boundary. Power spectral flux density should be calculated using good engineering practices, taking into account such factors as propagation loss, atmospheric loss, antenna directivity toward the service area boundary, and the curvature of Earth. The psfd level at the service area boundary should be evaluated for heights up to which reasonably interference to potential devices located within the radio horizon could be expected. ~~the maximum value for elevation point up to 500 m above local terrain elevation~~.

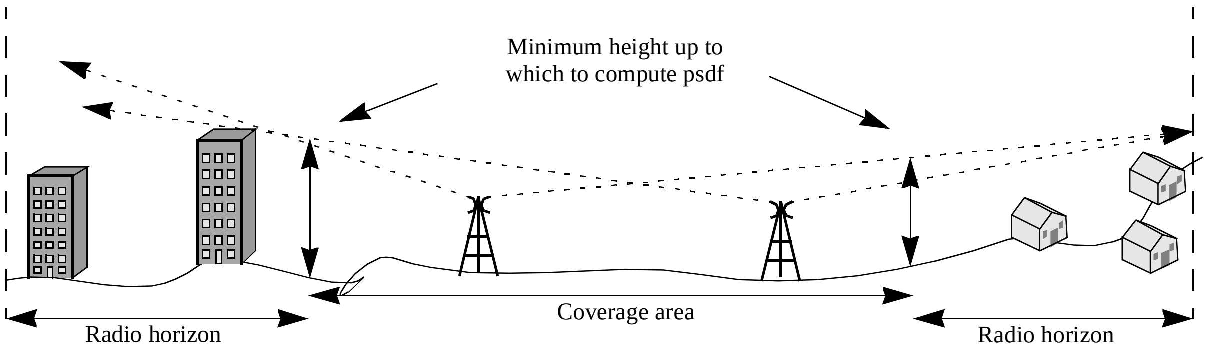

Figure 31a—Illustration of appropriate heigh for psdf computation at service area boundary

~~No aggregation is needed because principal interference processes are direct main beam to main beam coupling.~~ Aggregation may in some cases be needed if the flux contributed by potential interference sources differs less than 3 dB (which generally indicates possible joint direct main beam to main beam coupling between those interference sources and the potential victim system).

20.1.2.2 MP

For MP deployments, generally no LOS exists over the service area boundary. The PMP trigger defined in [REF 20.1.2.1] hence needs to be refined for MP deployments. Observing that the tolerated psdf at the receiver should exceed the aggregate psdf produced by all transmitters (including unspecified pathlosses), and assuming for simplicity that all nodes contribute equally to the interference, provides the worst case relation:

$$pathloss > P_{\mathrm{Tx}} - 10\log(BW) + G_{\mathrm{Tx}} + G_{\mathrm{Rx}} - 10\log(kT_0) + N_{\mathrm{F}} + (I/N) + \log(Nodes) \qquad dB \tag{1}$$

where:

kT_0 = -144 dBW/MHz = Equipartition Law

N_{F} = Receiver noise figure

P_{Tx} = Mean power at the antenna port

BW = Occupied bandwidth

$G_{\mathrm{Tx}} = G_{R\mathrm{x}}$ = Antenna gain (Tx/Rx)

I/N = Tolerated Interference to Noise ratio

$Nodes$ = Nodes served on this channel (near this service area boundary)

The mean *pathloss* is composed of several components. The first component is the reference pathloss which is defined as $20\log(4\pi/\lambda)$ dB, where λ is the wavelength. The remaining components follow the propagation model. In the mesh case, Table 31a specifies the first 50 m LOS, followed by d^3 for the next 500 m, followed by d^4 for any excess distance. Hence:

$$\begin{aligned} pathloss(d) &= 20\log(4\pi/0.09) + 20\log(50) + 30\log(500/50) + 40\log(d/500) \\ &= 40\log(d) - 1 \end{aligned} \qquad dB \qquad \forall d > 500m \qquad (2)$$

Combining Eq.1 and Eq.2, using the parameters listed in Table 31a, hence results in a coordination trigger of 6 km (in comparison, using this analysis for PMP would result in a coordination trigger of 80 km for a single BS, similar to the radio horizon [Note to editor: this 80 km is based on 3W peak power, since Table 30 is not clear on mean or peak. If that value is mean, then replace 80 with 125 km. Also, this is based on 7km LOS and the rest d^4]). However, should a mesh deployment be installed substantially above the clutter (which is not recommended), then the coordination trigger as specified for PMP should be applied.

[H3.25] G. Durgin, T.S. Rappaport and Hao Xu "Measurements and Models for Radio Path Loss and Penetration Loss In and Around Homes and Trees at 5.85 GHz