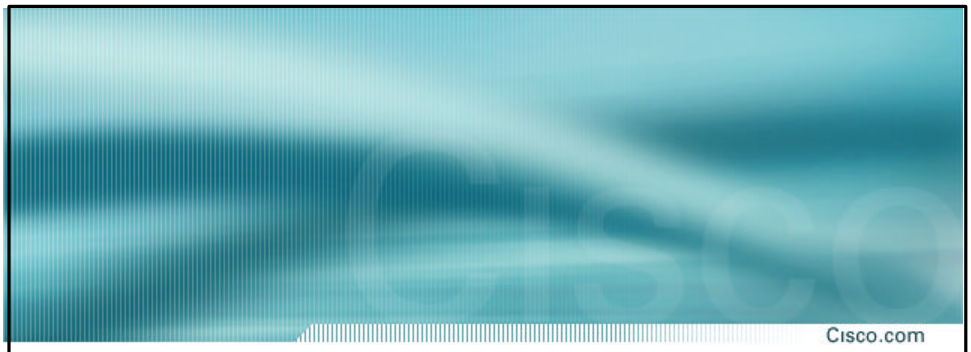


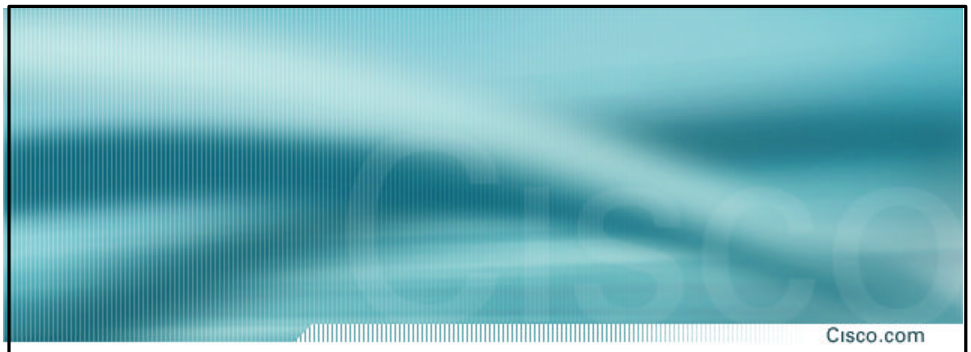
Discussion on 70/80 GHz Report & Order (FCC-03-248)

February 19, 2004

Wireless Communications Association International
Above 60 GHz Committee

Overview

- **The Report and Order got the big picture right, but important details seem to have been overlooked.**
- **Industry wants to emphasize the importance of the jointly developed technical rules – without which all the good work may be wasted.**
- **The Commission should shore up these areas:**
  - **The coordination/registration process**
  - **The interplay of channelization and loading requirements**
  - **Technical rules for (1) antenna gain, transmitter power, EIRP, and antenna RPE; (2) ATPC; and (3) power spectral density**
  - **Interference protection criteria**
  - **Conditional operating authority**



Streamlined coordination must be made more effective.

Path Coordination Should Be Required

- Path coordination identifies potential interference while it can still be prevented, rather than months later
  - In a registration-only regime, there may be a long delay between link registration and detection of interference.
    - A link can be installed up to 12 months after registration.
      - WCA members proposed 120 days; we would now like to see no more than 180
    - If the link is installed during dry season, there may be an additional 6 months where harmful interference is not detected because it may only occur during a heavy rain event.
  - Delay makes it more difficult to identify and correct the problem
- Path coordination promotes intelligent link design rather than completely random deployment, boosting link density

Path Coordination Improves Link Density

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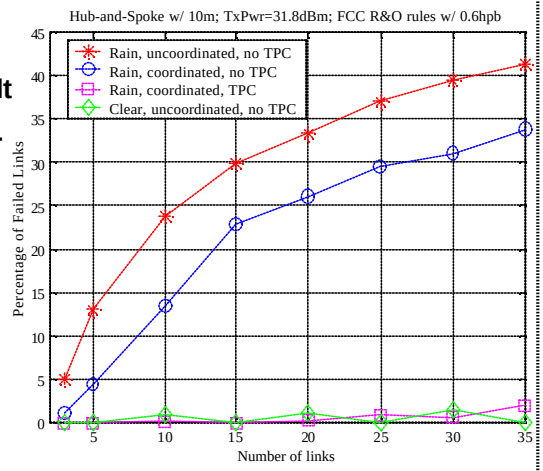
- **Monte Carlo simulation result showing probability of harmful interference for hub-and-spoke deployment in rain.**
  - **Assumes FCC R&O rules**
  - **Transmitter power = 32dBm**
- **The figure illustrates significant improvement in the link density in the rain between uncoordinated and coordinated hub-and-spoke deployments.**



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The segmentation and channel loading rules add needless complexity and uncertainty.

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- The segmentation of the band serves no useful purpose in the vast majority of cases, where no scarcity exists.
- Even in rare cases of conflict, segmentation boundaries will often be irrelevant to resolutions of the conflict, and may actually impede the optimum coordinated solution.
- Segmentation also complicates the channel loading calculation, since occupied bandwidth may not fit neatly into pre-determined segment boundaries.
- The Commission should license spatial pipes without regulating the number of bits passing through them.

The segmentation and channel loading rules add needless complexity and uncertainty.

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- A 1 bps/Hz loading requirement effectively prohibits binary modulation schemes
- A loading requirement is problematic when capacity needs do not fit “neatly” into 1.25 GHz segments
  - Is efficiency measured over the entire segment, or only over the occupied bandwidth?
  - Does interference protection extend to the entire segment, or only the occupied bandwidth?
- The Commission should license spatial pipes without regulating the number of bits per Hertz passing through them.

Spectral Efficiency

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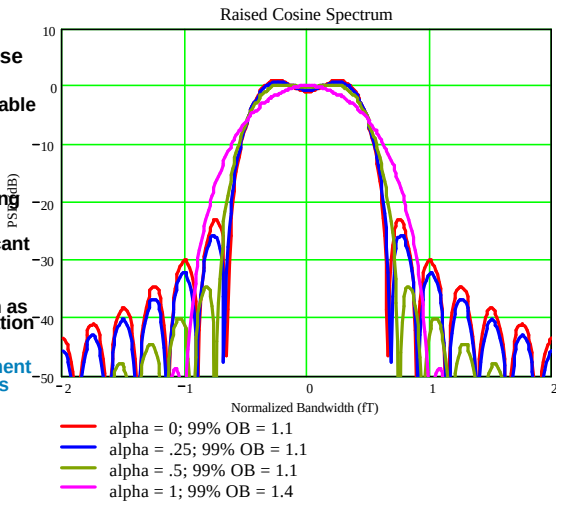
- The figure illustrates the spectral occupancy with raised cosine pulse shaping.
  - For low barrier to entry, it is desirable to implement simple modulation schemes.
  - The requirement of a minimum spectral efficiency of 1 bps/Hz *prohibits* the use of binary signaling such as OOK and BPSK.
  - Even QPSK would require significant pulse shaping to reduce the 99% occupied bandwidth.
  - If channel coding is desired, such as rate = 1/2, then high order modulation schemes would be required.
  - Conclusion: the 1bps/Hz requirement is onerous for radio manufacturers
- All simulation results presented herein assume completely co-channel and overlapping signals. Band segmentation has limited incremental value.



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The Commission Should Embrace the Industry's Power/Gain Tradeoff

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- The Commission is adopting a one-size-fits-all, 50dBi minimum antenna gain standard, which is typically met using a minimum 2-foot antenna dish.
- A 2-foot dish will be less marketable, more costly, and more sensitive to tower and building sway.
- The Joint Parties proposed to allow manufacturers to reduce the maximum authorized EIRP by a ratio of 2 dB of power per 1 dB of gain for lower gain antennas. This *added flexibility* would produce
  - Less interference; and
  - Lower barriers to entry for low-power products.
- The Commission should also adopt the Joint Parties proposal for antenna RPE requirements
  - The Joint Parties proposed RPE requirements between 1.2° to 5° off boresight as well as a cross-polarization requirement
  - The R&O defines a stricter antenna RPE which will necessitate more tapering to reduce antenna sidelobes.
  - The Commission cited manufacturing concerns, but the Joint Parties' proposal was vetted with antenna manufacturers and system suppliers for good balance between cost and performance.

System Performance with Relaxed Antenna Requirements

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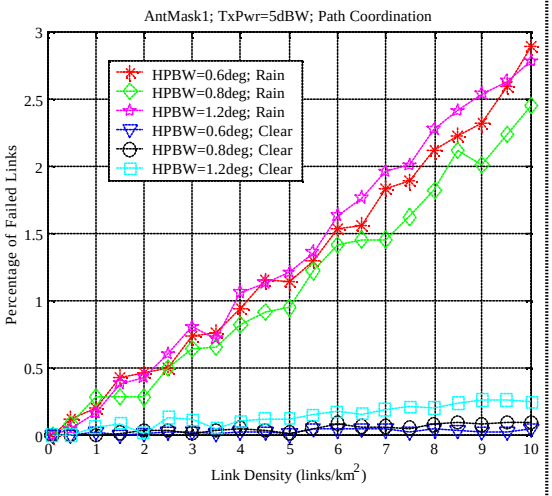
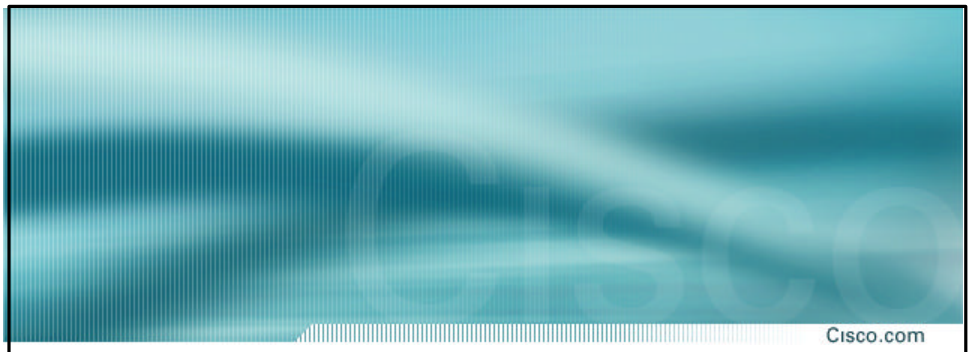
- This figure compares system performance with 0.6, 0.8, and 1.2 degree half power beamwidth for random deployments.
- System performance is comparable indicating that larger, higher gain antennas are not critical to high link density.
- Link ranges based on 99.99% availability, transmitter power identical for all cases





The Commission should require ATPC for links with EIRP > 23 dBW

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- ATPC is critical to permit dense hub-and-spoke deployments; it also increases link density in random deployments.
- Industry proposal for ATPC permits low-cost, low-power transmitters because no ATPC is required below 23 dBW
- Under industry proposal, ATPC dynamic range increases as the radio's maximum EIRP increases.
  - ATPC range (dB) = max (0, $EIRP_{dBW}$-23)
  - E-band radios manufactured in the near future will have lower EIRPs and consequently low ATPC range—within the capability of near-term devices
  - Future high-performance radios will have increased EIRP and ATPC range as technology improves

ATPC Hub-and-Spoke Simulation Results

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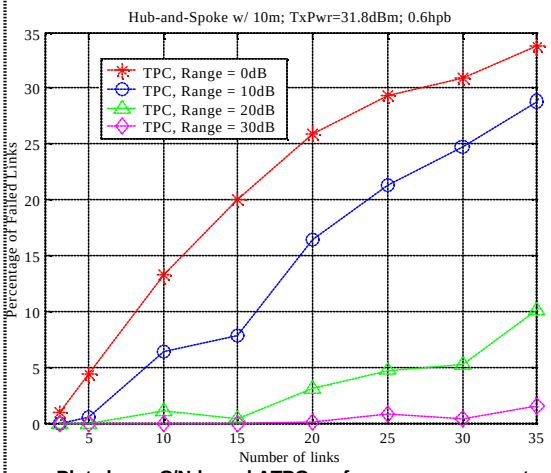

Plot shows C/N-based ATPC performance per ex parte filing (not PFD based)

- **This figure illustrates the effect of ATPC range on the control of harmful interference**
  - **Interference is problem when a short-range link is on adjacent "spoke" to long-range link**
  - **Rain fading severely attenuates long-range link's signal**
  - **ATPC keeps short-range link transmitter's at lowest possible level, mitigating interference**
- **The percentage of failed links dramatically decreases as the ATPC dynamic range increases**
  - **JRC proposed max ATPC range of 32dB corres-ponding to 55-dBW EIRP transmitter**

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The Commission Should Adopt Power Spectral Density Limits

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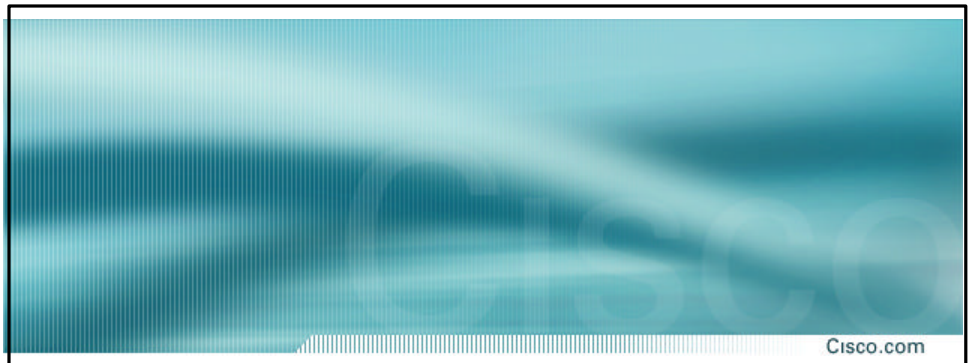
- The 70/80GHz bands should be preserved for high bandwidth radios as a wireless alternative for fiber-rate services. Spectrum exists at lower frequencies for narrow band services.
- Currently there are no regulations restricting a device from transmitting an EIRP of 55dBW in an arbitrary small bandwidth (*e.g.,* 1MHz).
- Such devices would have significantly different spectral and spatial properties.
  - Interference between narrow band and wide band devices would be difficult to predict with respect to measurement and calculation of C/I.
  - Narrow band devices will have much longer ranges, and would have wide exclusion zones, significantly reducing the deployment of wide band devices.
- As a compromise, the JRC proposal allows for narrowband devices but restricts the spectral density to a maximum of 150mW/100MHz.



The Commission should adopt the WCA text for interference protection criteria.

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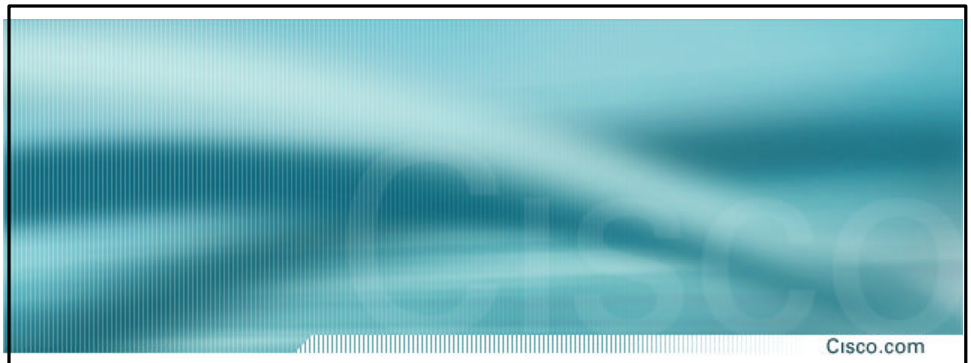
- 36 dB should be the *maximum* C/I protection, not the minimum.
  - Unduly high C/I objectives will limit deployable link density.
  - While analog modulation typically requires 55dB C/I or greater, the difference reflects the expectation of filtering on the analog receiver relative to wideband digital modulation.
- Rain fading will be highly correlated in these frequencies.
- Both carrier and the interference will fade during precipitation and C/I protection is necessary at all received carrier levels (clear air to fully faded)
  - There will be more than 1dB degradation to the static threshold during clear air operation
  - C/I protection provides for un-impaired operation



The Commission should permit 70/80 GHz applicants to obtain conditional operating authority.

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- WCA assumes this was purely an oversight.
- Section 101.31 must be amended to include new frequency bands.
- Reference must be made to coordination under new section 101.1523 as well as 101.103