Project: IEEE P802.15 Working Group for Wireless Personal Area Networks

Submission Title: [FCC’s Notice of Proposed Rule Making]
Date Submitted: [July 17, 2007]
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Re: []

Abstract: [Update on FCC’s NPRM to amend rules under Part 15.255]

Purpose: [Contribution to 802.15 SG3c at July 2007 plenary in San Francisco]

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What is NPRM?

- **Notice of Proposed Rule Making**
  - ET Docket No. 07-113

- **Created by the U.S. Congress under Administrative Procedure Act (APA)**

- **Forces Federal agencies to listen to comments and concerns of institutions and individuals affected by the rules**

- **Comment phase duration is 90 days from the date the NPRM appears in the Federal Register**
  - Published daily
  - Contain publications and notices of Federal agencies
  - NPRM (ET Docket No. 07-113) will tomorrow in Federal Register
  - Comments due on October 17
## Background

- **WCAI filed a petition to the FCC** for rule making on September 30, 2004

- **Presented [15-05-0054-00] at IEEE plenary** in Monterey, CA, on January 17, 2005

- **Industry position to the petition filed**
  - Against: IEEE, SiBEAM, Rory Van Tuyl
  - For: WCAI, Bridgewave, Proxim, CGI, Yipes

- **FCC just released NPRM** (see 2007-097) for comments from the industry
  - Agreed to all of WCAI’s petition
  - Requires comments from the industry before final rules are passed
Format of the Presentation

For each rule….

1) Existing rule
2) Proposed rules
3) Comments required
Rule #1

Existing Rules on Emission Limits

Current Rules

- Average power density $\leq 9 \, \mu W/cm^2$ at 3 m $\rightarrow 40 \, dBm$ EIRP
- Peak power density $\leq 18 \, \mu W/cm^2$ at 3 m $\rightarrow 43 \, dBm$ EIRP
- Peak power into antenna $\leq 500 \, mW$ (27 dBm)

Reason

- Prevent interference between unlicensed devices
- Put a limit on a device with low antenna gain (i.e. omni)
Rule #1
Proposed Rules on Emission Limits

Proposed Rules

- Average EIRP to “82 dBm less 2 dB for every dB that the systems’ antenna gain is below 51 dBi”
- Peak EIRP to “85 dBm less 2 dB for every dB that the systems’ antenna gain is below 51 dBi”
- Applicable for high gain outdoor or window link

Reason

- High gain antenna reduces probability of low power omni directional system located within its beam
- Emissions from high gain outdoor system attenuated by obstacles to affect indoor low gain system
- \(O_2\) absorption and rain attenuation further reduces emissions of outdoor system
Rule #1
Comments on Emission Limits

Comment on ....

- modifying the emission limit for very high gain antenna
- interference concerns along with methods that may be suitable for mitigating such concerns
- feasibility of using extremely high gain antenna ($\geq 51$ dBi)
Rule #2
Existing Rules on Emission Limits in EIRP

Current Rules

- Average and peak power density specified in $\mu$W/cm$^2$ at 3 m

Reason

- Prevent interference between unlicensed devices
- Put a cap on a device with low antenna gain (i.e. omni)
Rule #2
Proposed Rules on Emission Limits in EIRP

Proposed Rules

- Change specifications from $\mu W/cm^2$ at 3 m to EIRP for high gain antenna
- Existing rules apply for low gain antenna

Reason

- 3 m is in near field for high gain antenna and, thus, “difficulty in obtaining accurate power density measurement”
- Far field power density extrapolated to 3 m “may not approximate the actual power density at 3 m”
Rule #2
Comments on Emission Limits in EIRP

Comment on ….

- amount of antenna gain above which use of the EIRP limits would be mandatory
- an alternative (i.e. EIRP) to existing power density standards
- deleting power density in favor of EIRP
Rule #3
Existing Rules on Antenna Substitution

Current Rules

- Part 15.255 makes no reference to section 15.204(c)(4)
- 15.204(c)(4) allows “intentional radiators marketed and used with any antenna that is of the same type and of equal or less directional gain as the antenna authorized with the equipment”
- Part 15 can have broad interpretation

**Reason (example)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Antenna gain, dBi</td>
<td>42.9</td>
<td>40.3</td>
</tr>
<tr>
<td>3</td>
<td>HPBW, degrees</td>
<td>1.2</td>
<td>1.6</td>
</tr>
<tr>
<td>4</td>
<td>EIRP, dBm</td>
<td>48.2</td>
<td>43.5</td>
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<tr>
<td>5</td>
<td>Maximum P_{IN}, dBm</td>
<td>5.3</td>
<td>3.2</td>
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<tr>
<td>6</td>
<td>R_{NF}, cm</td>
<td>484.5</td>
<td>266.7</td>
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<tr>
<td>7</td>
<td>R_{FF}, cm</td>
<td>1,162.8</td>
<td>640.1</td>
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</tbody>
</table>
Rule #3

Proposed Rules on Antenna Substitution

Proposed Rules

- 15.204(c)(4) will not apply to “60 GHz transmission systems operating under the proposed higher EIRP limits”

Reason

- 3 m is in near field for high gain antenna and, thus, “difficulty in obtaining accurate power density measurement”
- Far field power density extrapolated to 3 m “may not approximate the actual power density at 3 m”
Rule #3

Comments on Antenna Substitution

Comment on FCC proposed rule
Rule #4
Existing Rules on Transmitter ID

Current Rules

- Applies only to emissions originating from inside a building, not outside a building
- “Within any one second interval of signal transmission, each transmitter with a peak output power equal to or greater than 0.1 mW or a peak power density equal to or greater than 3 nW/cm², as measured 3 meters from the radiating structure, must transmit a transmitter identification at least once”
- “….which shall be field programmable”

Reason

- A mechanism to identify an interferer
Rule #4
Proposed Rules on Transmitter ID

Proposed Rules

- Transmitter ID not required from window link

Reason

- “…reflected from the glass in a window link will be attenuated by the walls and other surrounding objects…”
- “In most cases, all equipment within the same room will be under the control of the same user”
Rule #4
Comment on Transmitter ID

Comment on ..

- the proposed rule
- eliminating transmitter ID completely
# Thoughts

<table>
<thead>
<tr>
<th>#</th>
<th>Proposed Rule</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emission Limits</td>
<td>- Concerned of window links - should abide by indoor low power device</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Concerned of high power outdoor link in close proximity to low power indoor device</td>
</tr>
<tr>
<td>2</td>
<td>Emission Limits in EIRP</td>
<td>Agree with FCC - migrate from power density to EIRP - but need to understand implication of this decision</td>
</tr>
<tr>
<td>3</td>
<td>Antenna Substitute</td>
<td>Agree with FCC</td>
</tr>
<tr>
<td>4</td>
<td>Transmitter ID</td>
<td>Remove transmitter ID requirement</td>
</tr>
</tbody>
</table>
Proposed Actions

1) Review FCC’s NPRM
   - Download from FCC web site (ET Docket No. 07-113)

2) Identify areas of concern

3) Make a technical case

4) Post concern and analysis to FCC’s web site on or before October 17
Back Up Materials
**WCAI’s Proposed Emission Limits**

- **EIRP = 82 dBm** for Gain > 51 dBi
- **EIRP = \((2 \times \text{Gain}) - 20\) dBm** for Gain ≤ 51 dBi

Note:
51 dBi => HPWB ~0.5°, ~79 cm aperture Ø [~31.1 inches Ø]
# Near & Far Fields

<table>
<thead>
<tr>
<th>Aperture $\phi$, cm</th>
<th>$\sim$ Gain, dBi</th>
<th>$\sim \Theta_{3dB}$</th>
<th>Near Field, cm</th>
<th>Far Field, cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>19.0</td>
<td>18.3°</td>
<td>2.0</td>
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<td>5.2°</td>
<td>24.7</td>
<td>59.3</td>
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<td>4.6°</td>
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<td>2.4°</td>
<td>113.4</td>
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<td>1.5°</td>
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<tr>
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<td>1.5°</td>
<td>315.1</td>
<td>756.3</td>
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<td>61</td>
<td>48.7</td>
<td>0.6°</td>
<td>1,876.0</td>
<td>4,502.4</td>
</tr>
</tbody>
</table>

Frequency = 60.5 GHz, Aperture Efficiency = 50%

\[ R_{NF} = \frac{D^2}{4\lambda} \]
\[ R_{FF} = 0.6 \frac{D^2}{\lambda} \]
Far Field & Gain Plots

- Aperture Diameter, cm
- Far Field, cm
- Gain, dBi

15.7 cm
Window Link

Indoor

Window Link

Outdoor