

### Interference Analysis Revisited

In its Comments on HP's Petition, AirTouch states that "AirTouch demonstrated in its Reply Comments that the operation of U-NII devices at 5.15-5.35 GHz [*sic*] will interfere with MSS feeder links . . . AirTouch estimated that such interference would reduce the capacity of its Globalstar satellite system in the United States by over 27.4%, resulting in significant and unacceptable service degradation."<sup>3</sup> However, that result was based on the assumption that 60% of the unlicensed devices operate outdoors, and that the average duty cycle is 50% (i.e., every device is always either transmitting or receiving). Also, it was assumed that there were a total of 50 million devices active in the 5150-5250 MHz band. Clearly, these assumptions are not realistic, in light of the facts that (1) devices in the 5150-5250 MHz band cannot operate outdoors; (2) two other 100-MHz bands are available for U-NII devices; and (3) only a small fraction of all deployed devices will be actually transmitting at any given time.

To provide an updated interference analysis, now that the FCC has issued the Report & Order, it will be assumed here that:

- All U-NII devices in the 5150-5250 MHz band operate indoors, as specified in the Report & Order. Consistent with the AirTouch analysis, the building loss is assumed to be 17 dB.
- The path loss is 193.9 dB, as in the original AirTouch analysis.
- The Globalstar subscriber terminal noise figure is 2 dB, as discussed above, so that the total aggregate noise floor at the subscriber unit, excluding any interference from U-NII devices, is  $I_t = -201.2$  dBW/Hz (this does not reflect the full 2 dB increase because the other components of  $I_t$  are unchanged).
- The polarization loss between the U-NII devices and the Globalstar satellite receiver is 2 dB.<sup>4</sup>
- The power spectral density per device is 11 dBm/MHz, or  $-79$  dBW/Hz, consistent with a power limit of  $11 \text{ dBm} + 10 \log B$ , where  $B$  is the bandwidth in MHz, up to a limit of 250 mW, with a dB-for-dB power backoff for antenna gains exceeding 6 dBi (this results in a *de facto* 1 W EIRP limit).
- A U-NII device channel bandwidth of 20 MHz (as assumed by AirTouch), and a uniform distribution of devices across the total available 300 MHz of spectrum, so the number of devices applying power within any 1-MHz band is 1/15 of the total number of devices deployed.

With these assumptions, the interference from the unlicensed devices is related to the "baseline" noise floor by  $i_{p15} = 5.67 \times 10^{-5} N_M d i_t$  watts/Hz, where  $N_M$  is the total number of U-NII devices (in millions) and  $d$  is the average transmit duty cycle per device. The capacity decrease in percent is

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<sup>3</sup> Opposition of AirTouch at p. 2.

<sup>4</sup> Per Exhibit 1 of the January 2 MSS letter.

$$\Delta_{\%} = 100(1 - \Delta C) = 100 \left( \frac{5.67 \times 10^{-5} N_M d}{1 + 5.67 \times 10^{-5} N_M d} \right) < 0.00567 N_M d. \quad (7)$$

Figure 2 shows the percentage capacity decrease according to (7) for a variety of duty cycles.

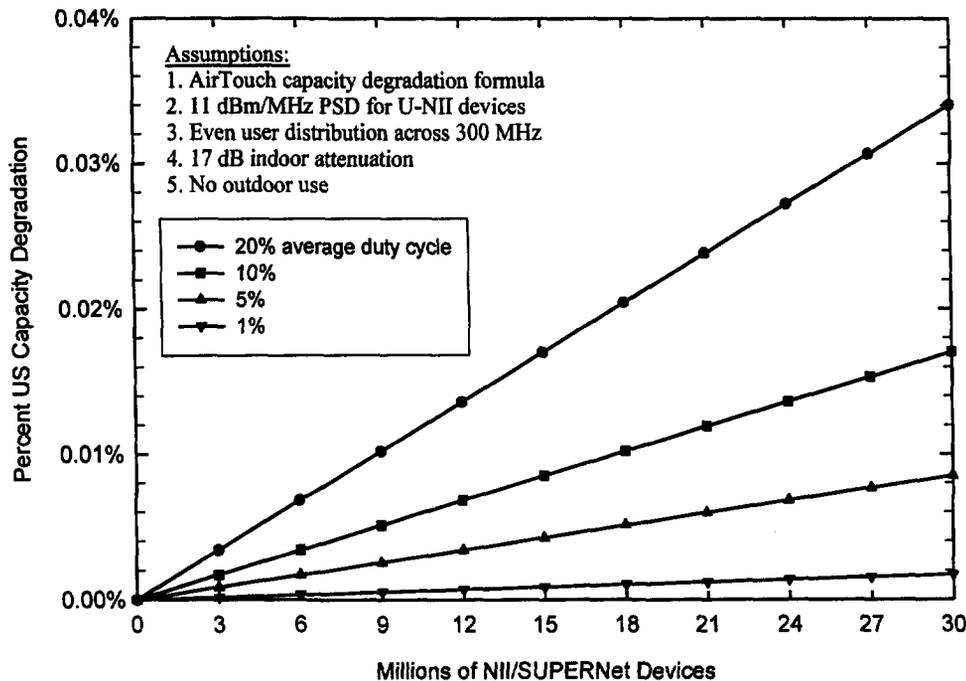


Figure 2: Globalstar capacity reduction due to U-NII devices.

It should be noted that the average duty cycle  $d$ , for all deployed devices, is actually the product of the "activity factor" (the fraction of devices that are powered-up at a given time), and the actual duty cycle while powered up. WINForum estimates that  $d \leq 0.01$  (1%).<sup>5</sup>

As in the December 11 Apple/WINForum analysis, it is also possible to calculate the reduction in  $E_b/N_0$  at the subscriber unit, where  $E_b$  is the energy/bit and  $N_0$  is the total noise (thermal plus interference) power spectral density. This reduction (in dB) is given by:

$$\Delta(E_b/N_0) = 10 \log \left( \frac{E_b / (i_{p15} + i_t)}{E_b / i_t} \right) = 10 \log \left( \frac{i_t}{i_{p15} + i_t} \right) \approx -\frac{10}{\ln 10} \left( \frac{i_{p15}}{i_t} \right) \text{ dB}, \quad (8)$$

<sup>5</sup>See Exhibit A of WINForum's September 12, 1996 letter to Warren Richards, Chair, U.S. National Committee, International Communications and Information Policy, U.S. Department of State, filed as *ex parte* in ET Docket 96-102 on October 21, 1996.

where the approximation uses the first term in the Taylor series for the natural logarithm. Fig. 3 shows  $\Delta(E_b/N_0)$  vs.  $N_M$  for the same range of  $d$  as Fig. 2 (computed using the exact expression in (8), not the approximation).

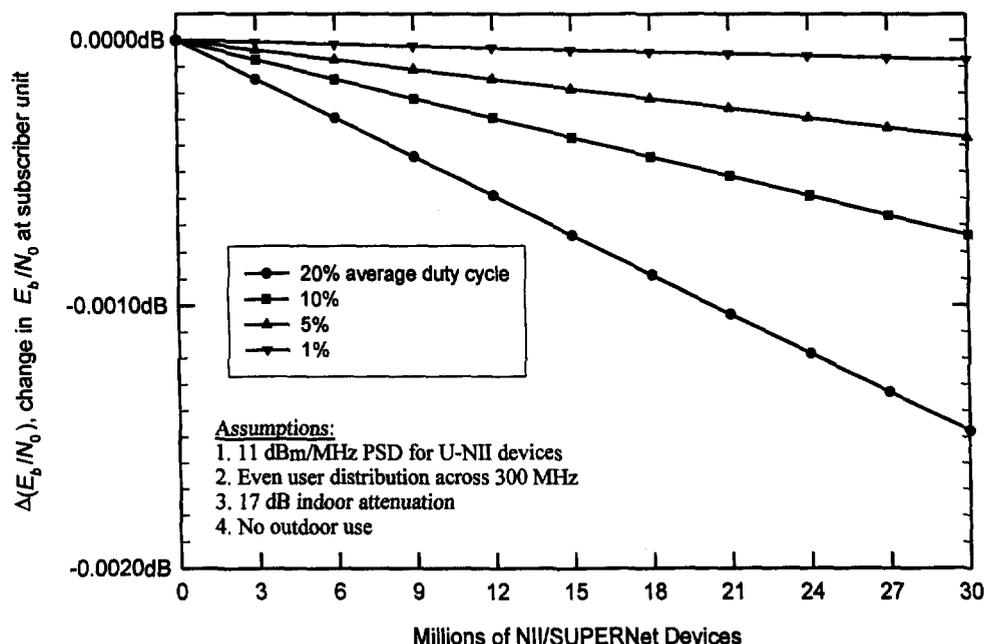


Figure 3: Reduction in  $E_b/N_0$  at the Globalstar subscriber unit due to U-NII devices

### Conclusion

It is clear from the results presented here that the even if a large number of U-NII devices on the MSS forward link will be insignificant, even if U-NII devices in the 5150-5250 MHz band are allowed to operate with up to 250 mW and 6 dBi of antenna gain, for a maximum of 1 watt EIRP. The restriction to indoor operation is more than adequate to protect Mobile Satellite Services from any noticeable interference. For example, with a deployment of 30 million U-NII devices and an overall average duty cycle of 10% (which is much higher than it is expected to be), the reduction in  $E_b/N_0$  will be less than 0.0008 dB (i.e., a noise floor increase of  $\Delta T/T < 0.018\%$ ).

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EX PARTE OR LATE FILED

December 2, 1996

**EX PARTE**

Mr. William F. Caton  
Acting Secretary  
Federal Communications Commission  
1919 M Street, NW, Room 222  
Washington, DC 20554

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DEC 2 - 1996

Federal Communications Commission  
Office of Secretary

RE: Amendment of the Commission's Rules to Provide for Unlicensed  
NI/SUPERNet Operations in the 5 GHz Frequency Range  
(ET Docket No. 96-102)

Dear Mr. Caton:

On Wednesday, November 27, 1996, I, on behalf of AirTouch Communications, spoke with Harry Ng to discuss issues relating to this proceeding and he requested the attached. Please associate the attached material with the above-referenced proceeding.

Two copies of this notice are being submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's Rules.

Please stamp and return the provided copy to confirm your receipt. Please contact me at 202-293-4957 should you have any questions or require additional information concerning this matter.

Sincerely,

Donna L. Bethes

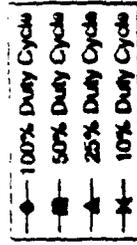
Attachment

cc: Harry Ng

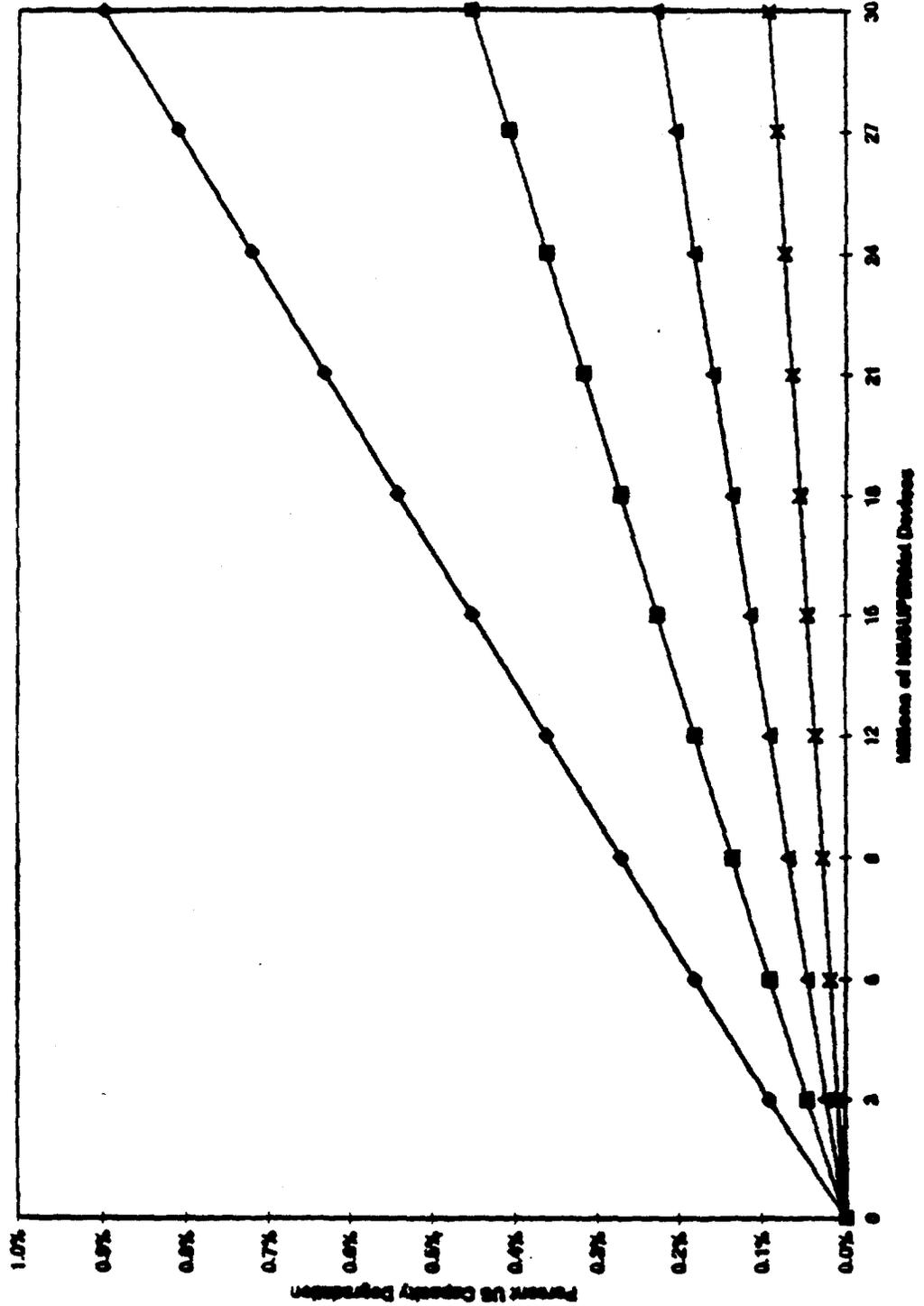
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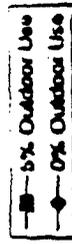
Globalstar US Capacity Degradation from NISUPERNet Devices



NISUPERNet Device Assumptions:  
 1. 200 MHz/20 MHz NISUP.  
 2. Even user distribution across 100 MHz.  
 3. 17 dB indoor attenuation.  
 \* Note that each 1 dB of indoor attenuation assumed improves capacity degradation by 1 dB (for indoors-only use).



### GlobeStar US Capacity Degradation from NBSUPERNet Devices



- NBSUPERNet Device Assumptions:**
1. 200 MHz/20 MHz ESUP.
  2. Even user distribution across 100 MHz.
  3. 17 dB indoor attenuation.
  4. 100% duty cycle.

