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December 18, 1996

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Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Room 222
Washington, D.C. 20554

Re: Ex Parte Meetings
ET Docket No. 95-183
RM-8811

Dear Mr. Caton:

Earlier today, representatives of WinStar Communications, Inc. ("WinStar") met with Julius Genachowski, Legal Advisor to Chairman Hundt, to discuss issues raised concerning band segmentation and spectrum sharing in the 37-40 GHz band. Representatives of WinStar included Joseph M. Sandri, Jr., Philip L. Verveer, Jack Dicks, and the undersigned. During the meeting, WinStar distributed a summary of its positions. A copy of the summary is attached.

Sincerely,

Michael F. Finn

Attachments

No. of Copies rec'd 0+2
List ABCDE

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WinStar Communications, Inc.

Presentation to the Commission

December 18, 1996

OVERVIEW

- Fixed Service (FS) operations in the 37-40.5 GHz band are substantial and growing rapidly.
- FS and Fixed Satellite Service (FSS) requirements must be addressed in a timely fashion.
  - Avoid dislocation of present FS implementation and business plans.
  - Create a unified international position.
- Both services seek to serve the same customer locations.
- Redesign of Fixed Service systems as proposed by Motorola is not acceptable to FS users, and does not solve the sharing problem.
  - The FSS receive earth stations will create large dead zones in the FS coverage areas.
  - The EIRP density limits of -22dBW are unacceptable.
  - The aggressive application of ATPC is an unproven technique.
- Band segmentation is the only viable solution.

TECHNICAL FACTORS (37-40.5 GHz FSS downlink)

- Co-frequency operation requires big separation between FS terminals and FSS receive stations. Sharing analysis shows:

  FS S/L to FSS M/B = 96.5 Km

  FS M/B to FSS S/L = 32.5 Km

  FS S/L to FSS S/L = 570 M

- Assumptions:

  FS e.i.r.p. >20dB below allowable limit of 55dBw

  Io/No = -13dB

  FSS sidelobe follow improved G = 29 - 25 log θ.

- Results in Interservice separation distances (protection zones) far exceeding average proposed FSS Interservice deployment objective of 2.62 earth stations per Km^2.

- Motorola proposes a major re-design of FS system. FS system parameters to operate with:
  - e.i.r.p. density limit of -22dBw/MHz
  - extensive use of ATPC (40 to 50 dB)

- Proposal is not acceptable to FS users because of unproven, risky, technical approach and significant adverse impact on:
  - performance
  - future growth capabilities

- **<u>METHOD OF SHARING PROPOSED BY MOTOROLA IS NOT ACCEPTABLE TO FIXED SERVICE USERS</u>**

(i) e.i.r.p. density limit of -22bBw\MHz is proposed

- This will prevent the introduction of new, spectrally efficient advanced modulation systems.
- This limit provides a clear sky received C/N ~ 14dB. 256 QAM systems require a clear sky C/N ~ 32dB.
- Would require FS systems to operate with a small margin making them more susceptible to adjacent channel interference and downlink satellite interference.

(ii) Extensive use of ATPC is proposed (40-50dB) to overcome rain attenuation.

- Motorola relies on TIA Bulletin TSB10-F data in support of its proposal. Section 4.3.2. (which contains most technical information was not discussed by Motorola, or included in its presentations) clearly states in its conclusion (Page 4-13) that data presented only applies to below 12 GHz, and more study is required for the use of ATPC above 12 GHz.
- No other supporting data is provided.
- The effects of non-correlated rain fades would have a significant adverse impact on the FS systems as well as interference into the FSS receive each stations.
- FS users have studied ATPC and have limited ATPC to between 10 and 15 dB maximum. <u>See</u> TIA

Bulletin TSB10-F and NSMA ATPC Recommendations (Relevant sections attached).

- NSMA "Operational Guidelines on ATPC" require that ATPC be used in a conservatice manner. Also Maximum Transmit Power is limited to a short time period (e.g. 5 minutes). Maximum fading at 40 GHz can extend over significantly longer time periods.

- Motorola provides no technical information to back up their proposed unproven method.

(iii) Motorola argues that ATPC as suggested by them can be introduced with minimum system and manufacturing problems.

- Contrary to Motorola's claims, ATPC will not make FS equipment more reliable.

- ATPC will add more components and add failure points likely to reduce MTBF.

- Required use of ATPC will preclude one-way operation.

- Use of PIN diodes to implement ATPC also will require additional filtering, cost and complexity to avoid generating intermodulation and spurious interference.

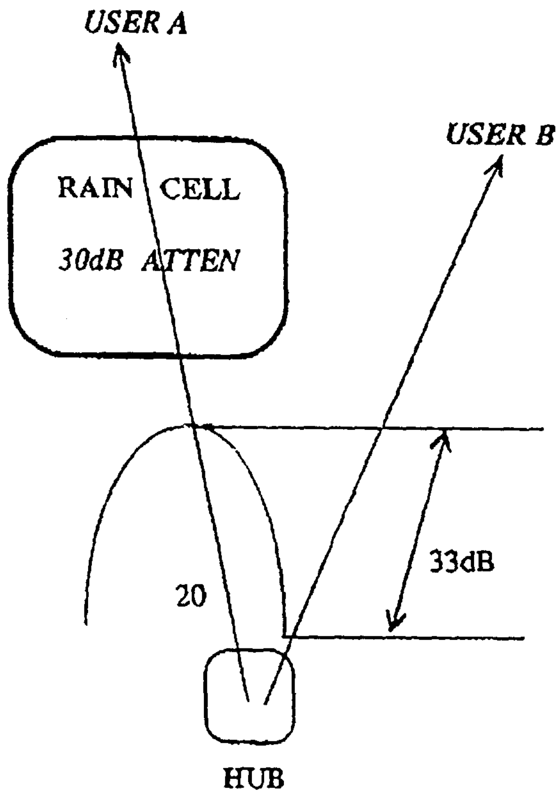
Attachments:

(1) Annex 1 Chart

(2) TIA Telecommunications System Bulletin TSB10-F (Section 4.3)

(3) NSMA ATPC Recommendations: Section 1 (Introduction) and Section VI (Operational Guidelines)

ANNEX 1



Under clear air conditions power to User A & User B is approximately equal. Sidelobe of the A link transmitter (FCC Class A antenna) is 33 dB down towards User B. If rain causes 30 dB of attention (and 30 dB of power increase on Link A) User B will experience 30 dB more interference - the C/I at B due to A will go from 33 dB to 3 dB. Clearly the power on the B link will also need to be increased, which will in turn effect links C, D, etc. Rain induced scattering of power from link A into receiver B will further increase the interference level seen at B.

TSB10-F

TIA/EIA TELECOMMUNICATIONS SYSTEMS BULLETIN

Interference Criteria for Microwave Systems

Excerpt from

TSB10-F
(Revision of TSB10-E)

JUNE 1994

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

Representing the telecommunications industry in association with the Electronic Industries Association consider the overall system noise objectives in parallel with the system reliability (outage) objectives. Most analog links require significant carrier level increases above threshold sensitivity just to achieve acceptable baseband signal-to-noise (*e.g.* >35 dB increase for 70 dB S/N in the worst message channel in an FM-FDM link).

4.3 Automatic Transmit Power Control in Digital Links

4.3.1 Introduction:

Automatic (or Adaptive) Transmit Power Control (ATPC) is a desirable feature of a digital microwave radio link that automatically adjusts transmitter output power based on path fading detected at the far-end receiver(s). ATPC allows the transmitter to operate at less than maximum power for most of the time. When fading conditions occur, transmit power will be increased as needed. ATPC is useful for extending the life of transmitter components, reducing power consumption, simplifying frequency coordination in congested areas, allowing additional up-fade protection, and (in some radios) increasing the maximum power output (improves system gain).

If the maximum transmit power in a ATPC link is needed for only a short period of time, a transmit power less than maximum may (if certain restrictions are met) be used when interference calculations are made into other systems. Many years of fading statistics have verified that fading on different physical paths is non-correlated, *i.e.* the likelihood of two paths in a given area being in a deep fade and thus sensitive to interference simultaneously is very small. Further, to allow for inevitable deep fading, microwave paths are designed with unfaded carrier-to-noise (C/N) and carrier-to-interference (C/I) ratios much greater than those required for high quality path performance. Since fading is non-correlated among paths, a short-term power increase by a path experiencing a deep fade will not reduce the C/I on other paths to an objectionable level. On a properly designed path, and one not affected by rain outage, ATPC-equipped transmitters will be at maximum power for a short period of time. However, because the maximum power is available when deep fades occur, CFM, threshold C/N, and C/I calculations into an ATPC link may assume the "Maximum Transmit Power" receive carrier level.

ATPC has been successfully implemented in FCC Part 21 common carrier bands for several years, and, under FCC *ET Docket 92-9*, is now permitted under Part 94. Currently, there are two types of ATPC available. The "ramping" type increases power dB for dB with a fade greater than a certain depth. The "stepped" type increases power in a single step to maximum power when a fade exceeds a certain depth. Besides significantly aiding the frequency coordination process, ATPC also provides receiver up-fade overload protection due to the backed-off transmit power under normal signal level conditions.

4.3.2 ATPC recommendations for frequency coordination

During the coordination process, the ATPC user must clearly state that ATPC will be used. The transmit powers associated with an ATPC system included on the coordination notice are defined as follows:

Maximum Transmit Power	That transmit power that will not be exceeded at any time, used for CFM and path reliability (outage) computations, and for calculating the C/I into an ATPC system.
Coordinated Transmit Power	That transmit power selected by the ATPC system licensee as the power to be used in calculating interference levels into victim receivers.
Nominal Transmit Power	That transmit power at or below the coordinated power at which the system will operate in normal, unfaded conditions.

The Coordinated Transmit Power is restricted to a 0 to 10 dB range below the Maximum Transmit Power. The Nominal Transmit Power must be less than or equal to the Coordinated Transmit Power, with typical values ranging from 6 to 15 dB below the Maximum Transmit Power. The receive level at which the system either steps up or begins to increase (ramp up) the far-end transmit power (depending on the type of ATPC) is referred to as the ATPC Trigger Level. Because shallow fading characteristics are path dependent and unpredictable, at least a 10 dB fade must occur before the Coordinated Transmit Power is exceeded.

In order to claim a Coordinated Transmit Power less than the Maximum Transmit Power (ATPC feature is used), certain restrictions on the time that this power is exceeded must be met. Below about 12 Ghz, the expected annual time percentages should not exceed the limits shown in Figure 4-4 and provided in Table 4-2. These time percentages can be calculated by the applicable reliability calculations as shown in Section 4.2.3. First, the fade depth that causes the transmit power to exceed the Coordinated Transmit Power by a certain number of dB must be calculated. This fade depth is then substituted for the CFM in the reliability calculation. For a ramping ATPC system that uses a step increase in transmit power, a single calculation of the time that the fade depth to the ATPC trigger level is exceeded is all that is required. For an ATPC system that increases (ramps up the) power in a linear dB for dB fashion, calculations of the time that the Coordinated Transmit Power is exceeded and the time that the Maximum Transmit Power is reached are sufficient. Future ATPC systems that boost transmit power in some other way may require time percentage calculations for the entire range of transmit power in excess of the Coordinated Transmit Power.

Note: There is no provision for greater than 12 GHz.

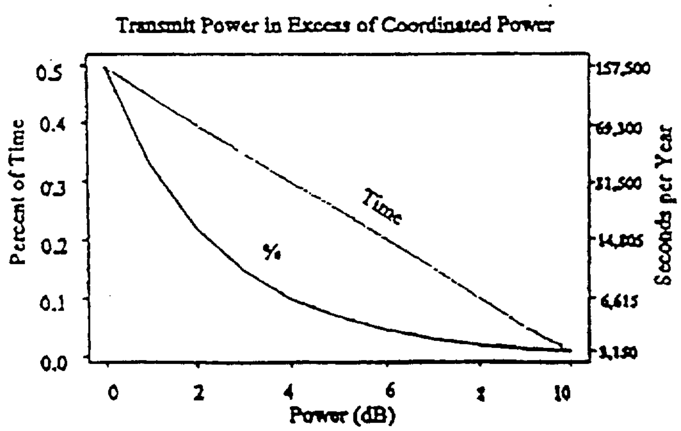


Figure 4-4 — Permitted Time Above Coordinated Transmit Power

In dB steps above the selected Coordinated Transmit Power for ramping-type ATPC systems, the permitted time percentages (and annual transmit power boost times) are shown in the following table. Only one single value (+6, +10 dB, *etc.*) need be considered in step-type ATPC systems (see examples in Section 4.3.3).

Power above Coordinated Transmit Power (dB)	Permitted time (annual)	
	Percentage of time	Seconds per year
0.0	0.50	157,500
1.0	0.33	103,950
2.0	0.22	69,300
3.0	0.15	47,250
4.0	0.10	31,500
5.0	0.07	22,050
6.0	0.047	14,805
7.0	0.032	10,080
8.0	0.021	6,615
9.0	0.014	4,410
10.0	0.010	3,150

Table 4-2 — Time Permitted Above the Coordinated Transmit Power in an ATPC Link

$$Time = 100 \left(\frac{Time\text{, sec}}{31.5 \times 10^6} \right) \% \qquad (4.3\text{-}1)$$

ATPC-equipped transmitters that claim a Coordinated Transmit Power less than the Maximum Transmit Power must base transmit power increases on path fading. In those cases, interference or error correcting information alone is not sufficient for increasing transmit power, but either or both may be used as an additional criterion. For systems with space diversity, ATPC must be controlled by the stronger signal from the two antenna system. In calculating the time percentages above Coordinated Transmit Power, the space diversity improvement factor may be found to be less than one if the fade depth is small. In these instances, a space diversity improvement factor of one may be assumed (no improvement or penalty from using space diversity).

ATPC-equipped transmitters must not be allowed to stay in the Maximum Transmit Power mode for more than any five minute duration. This event should result in an alarm condition which returns the transmit power to the Normal Transmit Power. ATPC should then not be re-enabled until a determination has been made that this long-term anomaly has been corrected and normal operation can be resumed. This criterion will prevent a long-term degradation, such as a down-stream receiver or control channel failure falsely implying a deep fade, from causing a transmitter to be in the Maximum Transmit Power mode for an extended period of time.

If the above restrictions are met, interference calculations from an ATPC system may assume the lower Coordinated Transmit Power level. Interference and CFM calculations into the receiver of an ATPC-equipped system can then assume that the Maximum Transmit Power is in use. Thus, in calculating performance (outage, etc.) and a C/I for comparison to the objectives, the "C" is then based on the Maximum Transmit Power.

When a Coordinated Transmit Power less than Maximum Transmit Power is claimed for an ATPC system, documentation that the system will meet these recommendations should be supplied during the coordination process. Because rain fading, obstruction fading, or surface duct fading could cause an ATPC system to increase power for a much longer time, additional justification for claiming a Coordinated Transmit Power less than the Maximum Transmit Power may have to be provided for paths with inadequate clearance or long paths above about 10 GHz. Paths that do not meet the restrictions may still use ATPC, but a Coordinated Transmit Power equal to the Maximum Transmit Power must be used in the coordination process.

The cumulative yearly time at maximum transmit power and the maximum transmit power single duration event time of five minutes may not be appropriate for radios operating above about 12 GHz due to the impact of rain rates and duration on interference cases. Further study in this area is needed.

In order to best reflect ATPC operation in the licensing process, the transmit power shown in the FCC filing should be the Maximum Transmit Power of the station. The station EIRP corresponding to the Maximum Transmit Power must meet FCC EIRP requirements.

Note: ATPC is not recommended for use with analog radios because of the signal-to-noise degradation with the increase in thermal noise proportional to the normal transmitter back-off.

4.3.3 ATPC time above Coordinated Transmit Power sample calculations

In order to best reflect ATPC operation in the licensing process, the transmit power shown in the FCC filing should be the Maximum Transmit Power of the station. The following examples illustrate typical ATPC computations:

Example 1: Ramping-type ATPC is to be used on a 40 km (25 mile) 6.7 GHz path without space diversity. The ATPC trigger level is -55 dbm. Once this trigger level is reached, the system will increase transmit power one dB for every additional dB of fade. The Nominal Transmit Power of the equipment is +14 dBm with a Maximum Transmit Power of +29 dBm. Average climate, terrain, and temperature conditions exist on the path. The path is designed for a receive level, with Nominal Transmit Power, of -43 dBm. The designer wishes to check if a Coordinated Transmit Power of +19 dBm, 10 dB below the Maximum Transmit Power, can be specified under the recommendations:

A fade depth of 12 dB from -43 to -55 dBm causes the trigger level to be reached. An additional 5 dB of fade boosts the power from +14 dBm to the +19 dBm Coordinated Transmit Power. The time that the fade depth exceeds 12+5=17 dB is computed to be:

$$T = 20\,(6.7)\,(25)^3\,10^{-\left(\frac{17}{10}\right)} = 41{,}776 \text{ seconds} \qquad (4.3\text{-}2)$$

or 0.1326 percent of the time, which meets the 0.5 percent requirement.

An additional 10 dB of fade will cause the transmitter to reach its +29 dBm Maximum Transmit Power. The time that the fade depth exceeds 17+10 = 27 dB is computed to be:

$$T = 20\,(6.7)(25)^3\,10^{-\left(\frac{27}{10}\right)} = 4{,}178 \text{ seconds} \tag{4.3-3}$$

or 0.0133 percent of the time. This does not meet the requirement of 0.01 percent of the time for 10 dB above the Coordinated Transmit Power.

Since the power is allowed to exceed the Coordinated Transmit Power by as much as 9 dB for 0.014 percent of the time, a Coordinated Transmit Power of +20 dBm (9 dB below the Maximum Transmit Power) may thus be specified.

<u>Example 2</u>: ATPC equipment that increases power in a single step to Maximum Transmit Power is to be considered on the non-diversity path in the previous example. The Nominal Transmit Power is +24 dBm for a receive level of -33 dBm. The Maximum Transmit Power is +30 dBm and the ATPC trigger level is 10 dB above the 10^{-3} BER outage threshold of -74 dBm. The designer wants to check if a Coordinated Transmit Power equal to the Nominal Transmit Power can be specified under these rules:

The ATPC trigger level is -64 dBm (10 dB above the 10^{-3} BER threshold) and a fade depth of 31 dB from the nominal power receive level will cause this trigger level to be reached. The time that the fade depth exceeds 31 dB is computed to be:

$$T_{SD} = 20\,(6.7)(25)^3\,10^{-\left(\frac{31}{10}\right)} = 1{,}663 \text{ seconds} \tag{4.3-4}$$

or 0.0053 percent of the time. Since a path is permitted to be 6 dB above the Coordinated Transmit Power (+24 boosted to +30 dBm) for 0.047 percent of the time, this path meets the requirement.

<u>Example 3</u>: A single-step ATPC'd transmitter is considered for a 48 km (30 mi) 6.7 GHz space diversity path with 9 m (30 ft) dish spacing. Average climate terrain and temperature conditions are present on the path. The Nominal (and Coordinated) Transmit Power is +20 dBm (+30 dBm maximum) for a -42 dBm nominal receive level. The ATPC trigger level is 10 dB above the -77 dBm 10^{-3} BER outage threshold, or -67 dBm.

The ATPC is thus triggered with <u>both</u> space diversity receivers faded from -42 dBm to -67 dBm, or 25 dB. The time that the fade depths both exceed 25 dB is computed to be:

$$T_{SD} = \frac{3 \times 10^5\,(30)^4\,10^{-\left(\frac{25}{5}\right)}}{30^2} = 2{,}700 \text{ sec} \tag{4.3-5}$$

or 0.0086 percent of the time. Since a path is permitted to be 10 dB above the Coordinated Transmit Power 0.01% of the time, this space diversity link meets the requirement.

NSMA ATPC RECOMMENDATION

OUTLINE

File: WG18.91.032

Approved: *4-27-92

To Membership: 9-27-93

Notes: *Approved by BOD 4-27-92 with minor modifications.

Final copy to membership 9-27-93.

NSMA ATPC Recommendation

I. Introduction

Automatic Transmit Power Control (ATPC) is a feature of a digital microwave radio link that adjusts transmitter output power based on the varying signal level at the receiver. ATPC allows the transmitter to operate at less than maximum power for most of the time; when fading conditions occur, transmit power will be increased as needed until the maximum is reached. An ATPC equipped system has several potential advantages over a fixed transmit power system, including less transmitter power consumption, longer amplifier component life, and reduced interference into other microwave systems.

If the maximum transmit power in a ATPC system is needed for only a short period of time, a transmit power less than maximum may (if certain requirements are met) be used when interference calculations are made into other systems. On the other hand, because the maximum power is available when deep fades occur, C/I interference calculations into the ATPC system may assume the "maximum power" carrier level. Thus, ATPC usage may offer an advantage in the resolution of low level interference cases without compromise to the fade margin of the ATPC equipped system.

This Recommendation defines terminology, sets restrictions, specifies how ATPC systems will be coordinated, and establishes some ATPC operating guidelines.

II. Definitions

y :The difference in an instantaneous transmit power and the selected Coordinated Transmit Power (defined below) in dB.

Tc(y) :The calculated annual percentage of time that the ATPC system transmit power will exceed the selected Coordinated Transmit Power by y dB.

Tp(y) :The maximum annual percentage of time yearly that the ATPC system transmit power is allowed to exceed the selected Coordinated Transmit Power (defined below) plus y dB. Calculated time percentages, Tc(y), should be less than Tp(y) for all values of transmit power.

4. If the restrictions in this Recommendation have been met, interference from an ATPC equipped transmitter should be calculated using the Coordinated Transmit Power (not the Maximum Transmit Power).

5. Just as questions related to an OH Loss calculation may lead to a request for blockage verification or an interference measurement, the coordination of an ATPC equipped system may require follow-up. In some cases, verification of "worst-month" fading characteristics of the ATPC equipped path may be needed.

VI. Operational Guidelines

1. Continuous operation at Maximum Transmit Power for a 5 minute period may imply an equipment failure. This situation should result in an alarm condition which returns the transmit power to (or below) the coordinated power.

2. When practical, ATPC should be used in a conservative manner. For example, selection of the Nominal Transmit Power below the Coordinated Transmit Power will help offset the increase in interference as the transmit power increases above the Coordinated Transmit Power.

VII. Examples of ATPC Application

The following examples illustrate valid application of ATPC systems according to the restrictions above:

1. A path designer wishes to apply ATPC (instead of changing-out existing antennas) in order to reduce intrasystem interference at a junction station. The 6 GHz path being added from the junction will be 16 miles in length with space diversity separation of 35 feet; the path is in a difficult propagation area (climate = 2), with average terrain roughness (w = 70 ft).

   Standard flat fading calculations show a combined (main and diversity) fade depth of 8 dB or greater will occur for 0.50% of the time and a combined fade depth of 20 dB or greater will occur for 0.01% of the time. This Recommendation requires that at least a 10 dB fade must occur before Coordinated Power is exceeded. (Note that no space diversity improvement is assumed at such shallow fades.) Thus, for this path, the minimum fade parameters that could be chosen would be:

   $F(P > Pc) = 10$ dB
   $F(Pmax) = 20$ dB.

(Continued on next page)