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Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
Amendment of the	)	
Commission's Rules to	)	Docket No. 90-314
Establish New Personal	)	
Communications Service	)	

REPLY OF AMERICAN TELEPHONE & TELEGRAPH COMPANY  
TO OPPOSITIONS TO PETITIONS FOR RECONSIDERATION

Pursuant to the Commission's Public Notice dated December 15, 1993, American Telephone and Telegraph Company ("AT&T") hereby replies to oppositions filed against several petitions for reconsideration or clarification of the Commission's Second Report and Order in GEN Docket 90-314, 8 FCC Rcd 7700 (1993) (the "PCS Order").<sup>1</sup>

Approximately forty commenters filed oppositions to the over sixty petitions for reconsideration filed in response to the Commission's PCS Order.<sup>2</sup> Although many issues were raised by these filings, AT&T replies only to those who: (1) seek an increase in base station power

<sup>1</sup> In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services, GEN Docket 90-314, Public Notice, 58 Fed. Reg. 65595, December 15, 1993. Order, DA 93-1575, released December 29, 1993, extended the time for filing oppositions to January 3, 1994 and replies to oppositions to January 13, 1994.

<sup>2</sup> See Attachment A for a list of the parties who filed petitions for reconsideration and oppositions.

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levels and do not provide for the development of requisite technical standards for PCS equipment by ANSI-accredited industry bodies,<sup>3</sup> and (2) oppose AT&T's proposal to develop measurement and certification procedures for unlicensed devices and to clarify that radio common carriers should be prohibited from providing services on the frequencies allocated for unlicensed products.<sup>4</sup>

A myriad of technical proposals were set forth in these numerous filings, which were made in response to the PCS Order issued in the spectrum allocation proceeding. This demonstrates that there are some important technical issues that should be addressed, not simply as a by-product of the spectrum allocation proceeding, but in a forum devoted purely to their resolution. Therefore, AT&T supports the numerous commenters that suggest that the

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<sup>3</sup> See, Oppositions of: APC, pp. 20-23; API, pp. 3, 5, and 9; MCI, pp. 18-22; Nextel, pp. 14-16; Bell Atlantic, p. 14; Citizens Utilities, pp. 12-13; GCI, pp. 2-3; GTE, pp. 11-12; Murray, pp. 6-7; Omnipoint, pp. 4, 13; Pacific Bell, pp. 1-3; and, Telocator, pp. 2-6; see also, Sprint, p. 7; cf., ANS, pp. 4-5 (does not oppose higher power limits, but is concerned about interference issues); AAR, pp. 5-7; Northern Telecom, pp. 6-9 (does not request power increase, but objects to imposition of ANSI standards); and, UTC, pp. 15-16.

<sup>4</sup> See generally, AT&T Petition For Reconsideration, filed December 8, 1993; see also, Oppositions filed by Bell Atlantic, p. 13; Pacific Bell, pp. 11-12; Northern Telecom, p. 16; Ericsson, p. A13 (believes testing problem is exaggerated); cf., GTE, p. 13 (seeks clarification of interoperability between licensed and unlicensed spectrum); accord, Omnipoint, p. 4, 12-13.

Commission require conformance to standards fully developed by an ANSI-accredited body as a precondition for type-acceptance of licensed PCS products.<sup>5</sup>

For example, TIA (p. 3) implores the Commission to develop standards, which are "absolutely essential to provide public PCS service at the most competitive costs to the user."<sup>6</sup> Similarly, Motorola (p. 3) demonstrates that official standards for PCS will increase the likelihood of United States standards evolving into de facto international standards.<sup>7</sup> In addition, as Qualcomm (pp. 2-

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<sup>5</sup> See, Petitions for Reconsideration of Ameritech, pp. 2-3; National, pp. 1-5 (the PCS Order fails to address interoperability and roaming standards); Motorola, pp. 3-5; TIA (fixed point-to-point), pp. 2, 7-10; TIA (mobile), p. 3; Telocator, p. 11; UTC, pp. 17-18; see also, Ericsson, pp. 4-5 (the Commission should reconsider its decision to refrain from adopting basic interference standards); and, Oppositions of API, p. 9 (supports TIA proposal for interference standards); Motorola, pp. 3-4; Qualcomm, p. 4; TIA, pp. 4-5; TDS, pp. 2-3 (all PCS equipment should meet type-acceptance criteria by an ANSI-accredited body); Telocator, pp. 7-9; and UTC, p. 17; accord, USTA, pp. 3-4 (interoperability facilitates competition).

<sup>6</sup> E.g., TIA Petition for Reconsideration, p. 3 (the Commission should require all equipment be type-accepted for licensed PCS operation meet standards developed by an ANSI accredited standards body).

<sup>7</sup> This evolution is particularly relevant to the Commission's leadership within the ITU Task Group 8/1 working to develop plans for current global mobile systems to evolve to Future Public Land Mobile Telecommunications Systems ("FPLMTS"). The Commission could designate an ANSI-approved PCS standard as a pre-FPLMTS standard. See also, PCS Order, ¶ 5.

3) set forth, the rapid acceptance of industry standards will "encourage predictability and interoperability in a manner that will promote consumer acceptance of PCS."<sup>8</sup>

Moreover, economic growth of PCS also depends on improving the efficiency and price-performance of wireless telecommunications that would be ensured through standards that require PCS equipment to operate on all PCS allocations.<sup>9</sup> Without interoperability across bands A through G, PCS end-user's will be constrained in their ability to move between competing licensed service providers, which creates a greater likelihood of higher prices and less flexibility for PCS services.<sup>10</sup> However, interoperability with existing North American common carriers could be achieved by requiring compatible ANSI-accredited licensed PCS standards. This would also be

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<sup>8</sup> Furthermore, without the assurance of accessibility to a nationwide service that can only be given through agreed upon standards, the business risks associated with PCS licenses will discourage the entry of smaller businesses, particularly women and minority entrepreneurs, which the Commission would like to encourage as new entrants to the marketplace.

<sup>9</sup> Among such cellular standards are IS-41 (Intersystem Interoperability); IS-54 (TDMA Digital Interface); IS-93 (Interconnection with Wireless Networks); IS-95 (CDMA Digital Interface); IS-124 (Intersystem Operation for Call Data Records); and TSB-51 (Intersystem Support for Authentication and Voice Privacy).

<sup>10</sup> See also, e.g., USTA, pp. 3-4; and, Telocator, pp. 7-8 (failure to provide specific controls will greatly increase the potential for controversy and litigation).

consistent with the goal of the Commission to ensure that all mobile services are provided with the highest quality at reasonable rates to the greatest number of consumers.<sup>11</sup>

Those who argue against mandatory conformance to ANSI-approved standards for licensed PCS equipment do not oppose the proposal on its merit, but rather raise concerns that it will unduly delay deployment of PCS.<sup>12</sup> These commenters are wrong. Neither this spectrum allocation proceeding nor the auction process need be delayed by parallel industry standards proceedings, which no commenter seriously contends does not provide the best forum to properly consider and balance the concerns of all interested parties.

To assure the expeditious deployment of PCS, AT&T agrees with those commenters who propose that ANSI-accredited industry bodies be required to issue interim licensed PCS equipment standards prior to completion of network facilities.<sup>13</sup> AT&T also suggests that the Commission set forth guiding principles, which will further encourage rapid industry resolution on such issues as

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<sup>11</sup> See generally, PCS Order, ¶¶ 3-6.

<sup>12</sup> See, MCI, pp. 21-22; APC, pp. 15-17; GTE, pp. 12-13; Nextel, pp. 15-16; and, Northern Telecom, pp. 6-9.

<sup>13</sup> See, e.g., Motorola, pp. 3-4 (the Commission should direct ANSI-approved industry standards bodies to adopt interim PCS equipment standards no later than September of 1994).

handset interoperability, fraud control, and public interest concerns (such as 911 service).

AT&T also supports those who believe ANSI-accredited standards bodies, such as IEEE, are the best qualified to determine the implications of power level limits as well.<sup>14</sup> For example, most commentators that seek reconsideration of base station power limits neglect to address the ensuing need to then raise the power of PCS handsets to enable them to benefit from the increased base station power.<sup>15</sup> A consequence of the power increase sought by these parties, however, would be a corresponding increase in the power of the handset, more expensive handsets that are heavier, have a shorter battery life, and have more potential to interfere with other electronic systems.<sup>16</sup> Indeed, the European Telecommunications Standards Institute ("ETSI") recently rejected a similar

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<sup>14</sup> See, API, p. 9; Motorola, pp. 3-4; Qualcomm, p. 4; TIA, pp. 4-5; TDS, pp. 2-3; Telocator, pp. 7-9; and UTC, p. 17.

<sup>15</sup> See, e.g., Citizens Utilities, pp. 12-13; GTE, pp. 11-12; MCI, pp. 18-19; and, Northern Telecom, pp. 3-6.

<sup>16</sup> See, e.g., API, p. 5 (higher base station power levels could increase interference); and Nextel, pp. 14-15 (the Commission has already considered and rejected such proposals because they are incompatible with the vision of PCS as low-power, microcellular systems serving local telecommunications needs).

proposal to increase power levels for its DCS1800 standard for these very reasons.<sup>17</sup>

Thus, rather than making decisions on such important technical issues in the context of a spectrum allocation proceeding, the Commission should, without any delay to the on-going allocation and auction proceedings, provide optimal opportunity for balancing the commenters' and Commission's (PCS Order, ¶ 5) "four objectives in providing spectrum and a regulatory structure for PCS: universality; speed of deployment; diversity of services; and competitive delivery." The Commission can achieve this by immediately severing the contested technical issues from this proceeding and opening a separate standards review.<sup>18</sup>

In its Petition for Reconsideration, AT&T sought clarification of that portion of the Commission's PCS Order that sets forth the technical standards and operational rules, and establishes who may use the band allocated for

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<sup>17</sup> ETSI did not raise, nor does it have any plans to raise, power levels for DCS 1800 hand-held devices from the presently available 1 watt maximum or the transmit power from DCS 1800 base transceiver stations beyond the current 40 watt maximum. Indeed, the only power level ETSI did increase was for vehicular-mounted applications (car boosters). See ETSI SMG Phase 2+ Work Program and ETSI GSM 05.05 Standard.

<sup>18</sup> AT&T also agrees with NENA (pp. 4-5) that the Commission should expeditiously initiate a proceeding to devise and impose a single uniform standard for delivery of location information intelligible to 911 systems by PCS and other mobile service providers.

unlicensed PCS devices.<sup>19</sup> Most commentators do not oppose this request. Bell Atlantic (p. 13), however, maintains that the spectrum allocated for unlicensed devices should be available to services whether they are associated with radio common carrier services or not.<sup>20</sup> In addition, Pacific Bell (pp. 11-12) opposed AT&T's proposal to clarify use of the spectrum allocated for unlicensed devices as anti-competitive.

These commenters are wrong. As demonstrated by MCI (p. 23), the potential for a PCS licensee to "poach" unlicensed spectrum is a very real concern and "adequate and enforceable safeguards must be adopted" to avoid interference with the Commission's spectrum allocation intentions. Similarly, GTE (p. 13) sets forth that "[l]icensed systems are obviously not contemplated in the unlicensed PCS band." Thus, while the Commission should not bar the licensed PCS services from using devices that allow interoperability with the unlicensed bands, (Omnipoint, pp. 12-13), the Commission should clarify that

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<sup>19</sup> See, AT&T Petition for Reconsideration, filed December 8, 1993.

<sup>20</sup> Accord, Ericsson, Appendix, pp. 3-4; Apple, pp. 5-6 (questioning AT&T's channelization and power level clarifications). See also, Appendix attached hereto which addresses Ericsson's and Apple's technical concerns. Cf., GTE, p. 13 (seeks clarification of interoperability between licensed and unlicensed spectrum); accord, Omnipoint, p. 4, 12-13.

the unlicensed band is not available for services designated by the Commission to use auctioned spectrum.<sup>21</sup>

CONCLUSION

For the foregoing reasons, and for those set forth in AT&T's Petition for Reconsideration filed on December 8, 1993, the Commission should: (1) require industry standards bodies to adopt PCS equipment standards for base station power levels, interference, and interoperability issues,

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<sup>21</sup> See In the Matter of Implementation of Section 309(j) of the Communications Act Competitive Bidding, Order, PP Docket No. 93-253, ¶ 147, released October 12, 1993 ("Auction Order"). The following services are described in the Auction Order (¶¶ 148-166) as those to be subjected to auction procedures: Multipoint Distribution Service, Multichannel Multipoint Distribution Service, Local Multipoint Distribution Service, Fixed Satellite Services, Mobile Satellite Services, Point-to-Point Microwave Radio Service, Cellular Services, Public Paging Services, Air-Ground Services, Public Radiotelephone Services, Offshore Services, and Rural Radio Services.

and (2) clarify technical and operational rules for the use of the spectrum allocated for unlicensed devices.

Respectfully submitted,  
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Dated: January 13, 1994

OPPOSITIONS TO PETITIONS FOR RECONSIDERATION

Advanced Mobilecomm Technologies, Inc. ("AMT") and Digital Spread Spectrum Technologies, Inc. ("DSST")

Alcaltel Network Systems, Inc. ("Alcatel")

American Personal Communications ("APC")

American Petroleum Institute ("API")

Apple Computer, Inc. ("Apple")

Association Of American Railroads ("AAR")

Association Of Independent Designated Entities ("AIDE")

Bell Atlantic Personal Communications, Inc. ("Bell Atlantic")

Cablevision Systems Corporation ("Cablevision")

Cellular Information Systems, Inc. ("CIS")

Cellular Telecommunications Industry Association ("CTIA")

Citizens Utilities Company ("Citizens")

Ericsson Corporation ("Ericsson")

General Communication, Inc. ("GCI")

GTE Service Corporation ("GTE")

Interdigital Communications Corporation ("InterDigital")

KSI, Inc. ("KSI")

McCaw Cellular Communications, Inc. ("McCaw")

MCI Telecommunications Corporation ("MCI")

Motorola, Inc. ("Motorola")

National Emergency Number Association ("NENA")

Nextel Communications, Inc. ("Nextel")

Northern Telecom Inc. ("NTI")

Nynex Corporation ("Nynex")

Omnipoint Corporation, Inc. ("Omnipoint")

Pacific Bell And Nevada Bell ("PacBell")

PCS Action, Inc. ("PCS")

PMN, Inc. ("PMN")

Qualcomm Incorporated ("Qualcomm")

Rand McNally & Company ("Rand McNally")

ROLM ("ROLM")

Sprint Corporation ("Sprint")

Telecommunications Industry Association ("TIA")

Telephone And Data Systems, Inc. ("TDS")

Telocator, The Personal Communications Industry Association  
("Telocator")

Texas Advisory Commission On State Emergency Communications ("TX-  
ACSEC")

United States Telephone Association ("USTA")

Utam, Inc. ("UTAM")

Utilities Telecommunications Council ("UTC")

Wireless Information Networks Forum ("Winforum")

PETITIONS FOR RECONSIDERATION

Alcatel Network Systems, Inc. ("Alcatel")

Alliance of Rural Area Telephone and Cellular Service Providers ("ARATCSP")

American Personal Communications ("APC")

American Petroleum Institute ("API")

American Telephone & Telegraph Company ("AT&T")

Ameritech ("Ameritech")

AMSC Subsidiary Corporation ("AMSC")

Anchorage Telephone Utility ("ATU")

Apple Computer, Inc. ("Apple")

Association of Public-Safety Communications Officials-International, Inc. ("APCOI")

Bell Atlantic Personal Communications, Inc. ("Bell Atlantic")

BellSouth Corporation ("BellSouth")

Blooston, Mordkofsky, Jackson & Dickens

Cellular Telecommunications Industry Association ("CTIA")

Chickasaw Telephone Company, et al. ("Chickasaw")

Columbia Cellular Corporation ("Columbia")

Comsat Corporation ("Comsat")

Concord Telephone Company ("Concord")

Duncan, Weinberg, Miller & Pembroke, p.c.

Ericsson Corporation ("Ericsson")

Florida Cellular RSA Limited Partnership ("Florida Cellular")

General Communication, Inc. ("GCI")

GTE Service Corporation "GTE")

Iowa Network Services, Inc. ("INS")

Killen & Associates, Inc.

LACE, Inc./Chandos A. Rypinski ("Lace")

McCaw Cellular Communications, Inc. ("McCaw")

MCI Telecommunications Corporation ("MCI")

MEBTEL, Inc. ("Mebtel")

Metricom, Inc. ("Metricom")

Motorola, Inc. ("Motorola")

Murray, George E.

National Communications System ("NCS")

National Telephone Cooperative Association ("NTCA")

Nextel Communications, Inc. ("Nextel")

Northern Telecom, Inc. ("NTI")

NYNEX Corporation ("NYNEX")

Organization for the Protection and Advancement of Small  
Telephone Companies ("OPASTCO")

Pacific Bell and Nevada Bell ("PacBell")

Pacific Telecom Cellular, Inc. ("PTC")

PacTel Corporation ("PacTel")

PCS Action, Inc. ("PCS")

Pegasus Communications, Inc. ("Pegasus")

Personal Network Services Corp. ("PNS")

PMN, Inc. ("PMN")

Point Communications Company ("Point")

Radiofone, Inc. ("Radiofone")

Rand-McNally ("Rand-McNally")

Rockwell International Corporation "RIC")

Rural Cellular Association ("RCC")

Southwestern Bell Corporation ("SWBT")

Spectralink Corporation ("Spectralink")

Sprint Corporation

Telecommunications Industry Association Fixed Point-to-Point  
Communications Section Network Equipment Division ("TIAMCD")

Telecommunications Industry Association Mobile and Personal  
Communications Division ("TIAMPCD")

Telephone & Data Systems, Inc. ("TDS")

Telocator ("Telocator")

Texas Advisory Commission on Emergency Communications  
("TX-ACSEC")

Time Warner Telecommunications ("TWT")

TRW, Inc. ("TRW")

U.S. Intelco Networks, Inc. ("Intelco")

U S West, Inc. ("U S West")

UTAM, Inc. ("UTAM")

Utilities Telecommunications Council ("UTC")

Wireless Information Networks Forum ("WINForum")

## APPENDIX ON UPCS RULES

### 1.0 MIXED CHANNELIZATION IN THE ASYNCHRONOUS SUB-BAND

Apple Computer requested that section 15.323 (b), which they called "packing rules imposed on the asynchronous sub-band", be removed<sup>1</sup>. AT&T strongly disagrees with this request. The section 15.323 (b) rules are very critical for insuring coexistence in the asynchronous sub-band.

The rules of section 15.323 (b) were established to counter a potential condition that occurs with the LBT channel access rules of the asynchronous sub-band when systems of wide bandwidth disparity operate in the same physical region. Multiple narrow channels of one system operating in a common location with a wideband channel of another system, with both systems operating in the same frequency range, can effectively block the wideband channel from operation. If multiple narrow frequency channels operate in an area, each can have a carrier on most of the time (packet bursts of up to 10 ms followed by quiet periods of 50 to 350 microseconds). A wideband system, the pass band of which includes that of the multiple narrowband systems, will sense the carriers of each narrow channel. The wideband transmitter will not get a chance to send unless all narrow channels in its vicinity are quiet simultaneously. The multiple narrowband systems will operate independently and may seldom have their carriers off simultaneously. Thus, the rules for the asynchronous sub-band need special provisions to assure that the wideband channel can operate fairly.

Section 15.323 (b) greatly alleviates this problem by encouraging the narrowband channels to first occupy the outer edges of the 10 MHz segments. The outer edges of these segments are relatively less occupied by a wide channel because of the need for the wide channel to meet the out of sub-band emission requirements. Thus, this is an equitable and efficient way to provide coexistence.

Apple also requests the rules of section 15.321 (b) (for the isochronous sub-band) be removed and claims that the arguments concerning the two sets of rules are equivalent. AT&T agrees that the rules concerning the isochronous sub-band [15.321 (b)] should be removed, but disagrees that the arguments are equivalent. The isochronous sub-band rules now require isochronous devices to first occupy the sub-band region where asynchronous device generated inter sub-band interference is worst. Thus, these isochronous sub-band rules harm isochronous/asynchronous coexistence. Asynchronous devices are relatively more immune to adjacent sub-band isochronous device interference than are isochronous devices to asynchronous interference. In addition, the narrowband asynchronous devices, even near the band edge, create no more interference in the adjacent sub-band than does wideband devices.

Apple and LACE requested that the asynchronous sub-band emission bandwidth limitation of 10 MHz be relaxed to the full 20 MHz<sup>2</sup>. AT&T disagrees with the need to allow the wider bandwidth, but does not oppose the bandwidth increase so long as the provisions of 15.323 (b) for the 10 MHz segments are retained. It must be noted however, that in this instance the protection of 15.323 (b) would not assist devices using the wider bandwidth.

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<sup>1</sup>Apple comments, section I, page 2.

<sup>2</sup>Reconsideration petition of Apple, section V, page 7, and LACE, page 2.

## APPENDIX ON UPCS RULES

### 2. THE POWER LEVEL SPECIFICATION

The current rules establish the power level requirements based on the peak envelope power. This has the effect of encouraging constant envelope modulation techniques. WINForum reiterated its support for the average power definition of the WINForum proposed etiquette<sup>3</sup>. AT&T supports the position of WINForum as submitted in the etiquette that the transmitted power should be defined as the mean power over any interval of continuous transmission with an allowable peak-to-average power ratio (crest factor) of 10 dB. AT&T again requests that the WINTech defined approach be adopted.

The effect of the peak power limit is to encourage constant envelope modulation techniques and render more advanced techniques impractical. Yet advanced techniques with varying envelope power can provide up to 2 times the data throughput density of conventional constant envelopes techniques. Table 1 compares the computed throughput density and crest factor for some common and advanced modulation techniques. The throughput density is proportional to the actual efficiency achievable in terms of information flow per MHz per cell in a self interference limited small cell environment. The advanced techniques with high peak-to-average ratio are 50% to 60% more efficient than the techniques providing more constant envelopes.

In addition, the peak-to-average ratios for the BPSK and QPSK techniques are higher as a result of the limited RF emission bandwidth. This narrow bandwidth is sufficient to allow optimum signaling speed with minimum spectrum occupancy. In this case also, limiting the peak envelope power would tend to encourage less than optimum signaling speeds in a given amount of spectrum.

The potential for high throughput density and spectrum efficiency should be encouraged, while the specification based on controlling the peak envelope power virtually rules out this potential.

Historically, peak power has been limited to control interference. Ericsson<sup>4</sup> opposes the average power approach on this basis. However, in the case of high signaling rate digital data signals, the interference potential is almost totally independent of the envelope variation at the source because:

- Multipath reflections convert a wide bandwidth signal with constant envelope to a varying envelope signal at any receiver not equalized to the signal.
- Operation in dense throughput locations where optimum coexistence efficiency is important is self interference limited and composite interference levels are due to a large number of signal sources. Such interference has a high crest factor.
- A wideband signal intercepted by a narrowband receiver has high peak envelope variations at the receiver output decision point.
- Interference in adjacent or nearby channels due to spurious emissions normally has a high crest factor regardless of the form of the source.

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<sup>3</sup>WINForum comments, page 2.

<sup>4</sup>Ericsson reconsideration petition, page 8.

## APPENDIX ON UPCS RULES

The only case where the source crest factor is of significance concerning interference potential is when the interfering signal is an isolated source and the receiver with which it interferes has equal or greater bandwidth than the source emission.

Interference envelopes from high signaling rate digital data signals will have envelope variations approaching that of random noise regardless of the envelope variations of the source. Thus, potential interference is not a legitimate reason to discourage variations in the envelope power at the source at the expense of achieving optimally efficient use of the spectrum.

WINTECH set a 10 dB peak to mean power ratio as a value which would permit the advanced modulation techniques that are envisaged for legitimate advanced technology. This ratio was felt to be sufficient to prevent insidious attempts at gaining advantage at the expense of coexistence while still allowing promising advanced modulation techniques.

### 3. OTHER MATTERS

AT&T asked that the LBT monitoring bandwidth specification be clarified<sup>5</sup> and Ericsson<sup>6</sup> requests that the LBT monitoring bandwidth be permitted to be as little as 80% of the emission bandwidth. The Ericsson proposal would further help alleviate the mixed channel width problem described in section 1 of this appendix and AT&T supports this request. However, the term "monitoring bandwidth" needs further definition and that this question should be further investigated and clarified in the testing and measurement procedures.

Apple Computer noted that a number of petitioners have requested an increase in the power levels for licensed-PCS and described a number of potential instances where such licensed-PCS stations can cause interference to unlicensed devices<sup>7</sup>. AT&T agrees with the Apple position and reiterates our request that unlicensed devices be afforded the protection of Part 15.209 and the licensed device emissions in the unlicensed band should not exceed the out-of-band emissions already self-imposed on unlicensed devices.

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<sup>5</sup>AT&T reconsideration petition, Attachment B.

<sup>6</sup>Ericsson reconsideration petition, page 12, section 6.

<sup>7</sup>Apple comments, section III, page 4.

## APPENDIX ON UPCS RULES

TABLE 1. MODULATION STRUCTURES COMPARISON

Modulation	Peak/ Average Power (dB)	Signaling Rate /B (99%)	Medium Reuse Factor ( $\eta$ in %) <sup>1</sup>	Throughput Density Mb/s/MHz/ cell
BPSK <sup>2</sup>	3.4	0.67	6.6	0.0442
MSK	0	0.87	6.6	0.0574
QPSK <sup>2</sup>	3.0	1.33	5.5	0.0731
8PSK <sup>2</sup>	3.0	2.00	3.8	0.076
16 QAM <sup>2</sup>	4.8	2.67	3.4	0.0908
4 Tone/ 16 QAM <sup>2</sup>	10.8 <sup>3</sup>	2.67	3.4	0.0908

## Notes:

- 1.0 The medium reuse factor gives an estimate of the throughput density in a 2 dimensional, small cell deployment area. It is the percentage of cells that can have simultaneous transmissions without destructive interference in a homogeneous propagation environment limited by cochannel interference. The propagation index is assumed to be 3.5 (-10.5 dB for each doubling of range). It is given by the following:

$$\eta = [2 + SIR^{1/n}]^{-2}$$

SIR is the Signal to Interference power ratio necessary to meet the error rate ( $10^{-6}$ ) and  $n$  is the propagation index (3.5).

This relationship is derived in the paper distributed to WINTECH in September, 1992, "Tradeoff Between Modulation Bandwidth Efficiency and Medium Reuse Efficiency", IEEE P802.11/91-22, by Kiwi Smit of NCR. It is based on the article "Universal Digital Communications" by Donald C. Cox, Proceedings of the IEEE, Vol. 75, No. 4, April 1987.

- 2.0 The peak/average factor in all cases except MSK is that which results with raised cosine filtering with a total (rf) bandwidth of  $1.5/T$ , where  $T$  is the symbol time.
- 3.0 Multi-tone adds  $10 \log_{10} n$  dB to the peak/average crest factor, where  $n$  is the number of tones. This type of operation can provide high signaling speed in Local Area Network data applications by the use of long symbol times to counter delay spread.

CERTIFICATE OF SERVICE

I, Janice Knapp, hereby certify that copies of the "Reply of American Telephone & Telegraph Company To Oppositions To Petitions For Reconsideration" have been sent by United States First Class Mail, postage prepaid, this 13th day of January, 1994, to the companies on the attached list.

  
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