sharing would have on its ability to deploy a voice communications system in this band with *incidental* vehicle location.

Apart from the modifications required to calibrate one's system to a common time signal and the agreement necessary to accommodate time sharing, Pinpoint's proposal accommodates the plethora of current system designs:

- PacTel could use 8 MHz, including a 1.5 MHz forward link while it had access to the spectrum. Its mobiles could transmit ranging pulses using a CDMA protocol and/or rely on spatial diversity while it had access to the spectrum.

- MobileVision could utilize 8 MHz of spectrum and avoid the prospect of adjacent systems operating in its sidelobes, which seems to concern it greatly. Nor would Mobilevision have to forego voice operation in combination with its AVM operations, as it could always integrate cellular telephone, SMRS radio, or other voice capability with its 902-928 MHz radios.[37]

- Southwestern Bell could design its system to operate on 4 MHz. Indeed, Southwestern Bell conceivably could operate two or more 4 MHz systems (up to six in the band) simultaneously in those time increments in which it had access to the spectrum.

The band plan proposals of PacTel, MobileVision, and Southwestern Bell all involve exclusive licensing in each market, cut-off considerable flexibility in system design, and reduce the availability of the 902-928 MHz band for use by AVM as a

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[37] The comments in response to the Public Notice addressing MobileVision's and PacTel's bid to transform wide-area AVM into a voice service virtually unanimously reject the concept. *See e.g.*, Southwestern Bell Comments on Ex partes at 19-20; Comments of Ad Hoc Utilities Coalition at 9-10. *See also*, Comments of Pinpoint on Ex Partes at 32-35. While PacTel "voices" rejection of the notion as proposed by MobileVision, it proposes that voice communications be permitted for dispatch. Comments of PacTel on Ex Partes at 9. Pinpoint submits that this "loophole" would lead to the same result desired by MobileVision, which would disserve the public interest. As Pinpoint stated in its Comments on the Ex Partes, voice should be permitted, if at all, in a 250 kHz sub-band for emergency use only and be available on a trunked radio, shared basis to all wide-area AVM licensees.

whole. The band plans advocated by MobileVision[38] and the one preferred by PacTel[39] would be limited to the exclusive licensing in each market of two 8 MHz licenses. The plans presented by Southwestern Bell would accommodate four low-capacity 4 MHz systems per market licensed on spectrally distinct channels.[40]

In common, all of these proposals limit the number of AVM service providers per market to a very low number, reducing the potential for vibrant competition immeasurably. They would also foreclose or limit the likelihood of future developments in AVM technology by imposing technical barriers that would force others to prove they would not cause interference to inherently susceptible AVM system designs or deployment architectures. In addition, these proposals each arbitrarily limit the bandwidth that could be used by a wide-area system, thereby significantly compromising the throughput that could otherwise be achieved in this band, as Pinpoint has explained on many prior occasions. Moreover, each of these proposals leaves an amount of spectrum for local-area systems that is objectionably low

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[38] In its comments on the *ex partes* MobileVision moves the 8 MHz exclusive wide-area channels to the band edges, leaving 10 MHz in the center. MobileVision gratuitously suggests that wide-area systems not fortunate enough to obtain an exclusive license (due to lack of incumbency) could operate in this band on a "secondary basis," apparently to local-area AVM systems, and perhaps amateurs and Part 15 devices as well. MobileVision Comments on Ex Partes at 31. This facetious suggestion merely serves to underscore the anticompetitive nature of MobileVision's positions in this proceeding, and its "vigilan[ce] in [obtaining] and attempting to protect its licensed resources from being jeopardized by interference from other systems seeking authorizations in the same spectrum." Comments of MobileVision (June 1993) at 16.

[39] Comments of PacTel on Ex Partes at 2.

[40] Comments of SBMS on Ex Partes at 2-3. Southwestern Bell again demonstrates its misunderstanding of Pinpoint's ARRAY™ network by suggesting that its proposal will accommodate Pinpoint's contemplated system. *See id.* at 4. While under the current rules, Pinpoint must configure its system for a maximum of 8 MHz, it has always indicated in the proceeding its desire to deploy systems of much greater bandwidth.

to a number of commenters in this proceeding, including more than a few public users of such systems.[41]

In contrast, Pinpoint's modification of the PacTel proposal discussed in its comments on the *ex partes* would give local-area systems in excess of 16 MHz to operate, and the proposals in its original comments would provide for operation in up to all 26 MHz of the band.[42]

In short, the FCC should permit wide-area systems and local-area systems to operate throughout the 902-928 MHz band on a shared basis. Should the FCC determine that some segregation of the band into wide-area only spectrum is necessary to accommodate wide-area designs that are unable to share with local area systems, as required by the current rules, then the Commission should permit those wide-area systems that can share with local-area systems to do so without foreclosing their ability to use the wide-area only spectrum as well.

III. PART 15 DEVICES SHOULD BE ALLOWED TO CONTINUE TO OPERATE THROUGHOUT THE 902-928 MHz BAND ON A NON-INTERFERING BASIS

Pinpoint has consistently recognized that the Commission should continue to permit users of Part 15 devices to operate in the 902-928 MHz band. However, as with all other users of the band, including wide-area and local-area AVM systems, the

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[41] *E.g.*, Comments of the Interagency Group, PR Docket No. 93-61 at 4-5 (filed June 29, 1993); Comments of the California Department of Transportation, PR Docket No. 93-61 at (6) (filed June 28, 1993).

[42] Pinpoint Comments (June 1993) at 32.

privilege to operate is subject to certain conditions. In the case of Part 15, the Commission has allowed the operation of these devices explicitly on a non-interfering basis with licensed users of the band. Although mindful of the real public interest benefits presented by the availability of Part 15 devices, Pinpoint notes that the proponents of Part 15 devices participating in this rulemaking would turn the condition of noninterfering operation inside out by having the FCC push those licensed services with which Part 15 devices may interfere out of the band. Ironically, therefore, while the Part 15 devices accuse, with some justification, PacTel of advocating a spectrum windfall for itself in this proceeding, the Part 15 industry, in effect, seeks no less.

As the Commission is well aware, Part 15 operation is authorized throughout large portions of the RF spectrum, including 40 MHz recently authorized solely for unlicensed PCS use once primary licensed services have made the transition to other bands. This allocation itself could accommodate most, if not all, of the operations that Part 15 proponents have described in this proceeding. In contrast, the 902-928 MHz band is the only suitable spectrum available for AVM services with the capacity for IVHS.[43] Moreover, many of the services contemplated by the Part 15 industry, such

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[43] As Pinpoint discussed in detail in the Technical Appendix to its Reply Comments, the vehicle location capacity required to perform IVHS in large metropolitan areas is significantly larger than the systems contemplated by PacTel, MobileVision, and Southwestern Bell. Pinpoint Reply Comments, Technical Appendix at 1-4. Indeed, the vehicle location capacity for traffic monitoring alone required in a city with a population of one million with modest market penetration is far greater than MobileVision has ever suggested it could achieve, with no capacity remaining for traveler information, commercial vehicle operations, and advanced public transportation systems, and other IVHS services. At bottom, MobileVision's claims in the first Annex to its Comments on the Ex Partes to be, in effect, all things to all people is just so much puffery.

as regional data distribution networks, can be supported by licensed microwave and land mobile channels -- both private and common carrier.

Pinpoint designed its system knowing that it, as an AVM licensee, would, as a practical matter, generally have to coexist with such devices. Pinpoint understands that the Commission required manufacturers of Part 15 devices to do the same with respect to licensed services, such as AVM, and a number of the comments from the Part 15 industry confidently refer to the robustness of Part 15 devices. As a result, Pinpoint believes that Part 15 devices will present a tolerable and manageable level of interference for the foreseeable future provided the Commission adopts the rules sought by Pinpoint in its earlier comments and as refined herein. Conversely, operation of Part 15 devices in the presence of AVM systems will remain viable.

However, in recognition of the need for wide-area AVM systems to possess a certain degree of interference tolerance, Pinpoint proposes an *objective* measure of harmful interference which will give Part 15 devices comfort that they generally will be able to operate in this band without fear of forced migration. Finally, Pinpoint has no objection if the Commission were to limit LMS systems in this band to the location of vehicles and equipment typically associated with transportation, such as freight containers and tractor trailers.

A. Part 15 Operation Should Continue Consistent with the Regulatory Balance Established in This Band in Prior Proceedings

Throughout this proceeding, commenters from the Part 15 industry have sought either the maintenance of the *status quo* (*i.e.*, continuation of the interim AVM rules in which the 903-912 and 918-927 MHz sub-bands are allocated to AVM) or the removal of wide-area AVM services from the 902-928 MHz band. Increasingly, the emphasis has been on the latter course of action without adequate justification. While Pinpoint believes that coexistence between well-designed wide-area AVM systems and soundly engineered Part 15 devices is readily achievable,[44] Pinpoint also believes it necessary to penetrate the attempts in the record at obfuscation of the Commission's orders in which the agency encouraged Part 15 operation in the 902-928 MHz band.

1. Although the Commission Has Authorized the Development of Spread Spectrum and Other Part 15 Devices in this Band, It Has Done So with the Explicit Understanding That Their Operation Would Be on a Non-Interfering Basis

In recognition of the fact that unlicensed devices operating in this band offer the public certain benefits and that such devices often could be engineered to provide acceptable levels of service without causing an interference threat to licensed radio systems in the band, the Commission authorized the operation of Part 15 devices in this band generally[45] and adopted specific provisions for the use of spread spectrum

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[44] *See* discussion below at pages in Section III.B.

[45] Revision of Part 15, First Report and Order, 4 FCC Rcd 3493, 3495 (1989).

devices in particular.[46] However, the Commission made it very clear that operation of Part 15 devices at 902-928 MHz, while not subject to restrictions on bandwidth, channelization, or type of operation, must be "consistent with the basic precept of the Part 15 rules that non-licensed operations are not to cause harmful interference to established services" and must accept harmful interference from licensed services and from Part 15 and ISM (Part 18) devices.[47] Every Part 15 recipient of a grant of equipment authorization from the Commission agrees to these conditions, and every Part 15 intentional radiator is required to be labeled with these two conditions.[48]

Accordingly, the Commission did not give the Part 15 industry any assurances that whatever they sought to do would be blessed and protected. In addition to the requirements of operations on a noninterfering basis, the Commission explained when revising its Part 15 rules in 1989 that certain types of operation were best accommodated in the licensed services. In response to a request by manufacturers of control and security alarm devices for permission to operate at even higher power levels in the 902-928 MHz band than currently permitted, the FCC noted that

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[46] Spread Spectrum Systems, First Report and Order, 101 FCC 2d 419 (1985); Amendment of Parts 2 and 15, Report and Order, 5 FCC Rcd 4123 (1990); 47 C.F.R. §§ 15.245 and 15.247.

[47] Amendment of Parts 2 and 15, Report and Order, 5 FCC Rcd at 4124; *see also* Revision of Part 15, First Report and Order, 4 FCC Rcd at 3494 (the FCC's accommodation of unlicensed operation is balanced by "the need to ensure that these devices do not cause harmful interference to licensed radio services"); Spread Spectrum Systems, First Report and Order, 101 FCC 2d at 426 (spread spectrum devices in the 902-928 MHz band "are allowed to operate . . . only on a noninterference basis to other operations that have been authorized the use of [this band] under other Parts of the Rules.").

[48] Indeed, for the Commission to authorize Part 15 devices on any other basis would call into question whether the agency was in compliance with the Communications Act of 1934, as amended, 47 U.S.C. § 307(e)(1) (1993), which requires, except in the citizens band service and radio control service, that no radio transmitter be operated without a license.

> in many instances, the need for higher emissions levels can be met through operation under one of the authorized services. In view of the absence of interference protection for Part 15 devices, it would appear that, wherever possible, operation under the authorized services would be preferable to operation under the Part 15 rules. We therefore encourage parties with need to operate RF equipment at higher emissions levels than those permitted herein to seek authorization under other provisions of our rules.[49]

In other words, the advice of the Commission to the Part 15 users is to obtain their services "wherever possible" through licensed operations rather than unlicensed operations if the conditions under which unlicensed devices may operate do not allow for satisfactory service.[50]

2. There Is Other Spectrum Already Allocated That Could Accommodate the Part 15 Uses in the 902-928 MHz Band on Both an Licensed and Unlicensed Basis

Many of the applications of Part 15 technology described in the comments could easily be accommodated within existing allocations for licensed services.[51] For

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[49] 4 FCC Rcd at 3502 ¶ 60.

[50] Certainly licensed operations, with the attendant protections from interference, are far more preferable than unlicensed devices, with no interference protection, for critical applications protecting the safety of life and property. Moreover, there are a variety of licensed services available for wireless data links and for tetherless access to wired and other wireless communication networks. Indeed, the Commission is currently considering allocation of 1000 MHz in the 28-29 GHz band for the Local Multipoint Distribution Service in CC Docket No. 92-297. Moreover, some 2 MHz of spectrum also has been allocated recently for narrowband PCS. *Amendment of the Commission's Rules to Establish New Narrowband Personal Communications Services*, First Report and Order, Gen. Docket No. 92-100, FCC 93-329 (released July 23, 1993).

[51] In this regard, it is also worth noting that the Commission anticipated that Part 15 devices would be short range. *See e.g.* 101 FCC 2d at 420 ¶ 4; 5 FCC Rcd at 4124 ¶ 8. The long links used by such entities as Metricom may very well be inappropriate on a Part 15 basis given the conditions placed on (continued...)

example, the private fixed microwave services under Part 94 would be capable of supporting the regional data distribution networks described by some parties, such as Metricom and Spreadnet. That Part 15 services in the 902-928 MHz band are not a necessary element of some of the applications to which the band is being put is also suggested in the comments of Southern California Gas Company. Earlier in this proceeding, this utility suggested that it had begun a project utilizing radio-based systems for automatic meter reading and off-site meter reading which "*may* operate in part on the 902-928 MHz frequency band."[52] Apparently, this project could be implemented in other bands or using the licensed radio services.[53]

Moreover, the 902-928 MHz band is by no means the only band in which Part 15 operations are authorized. Part 15 devices have significant amounts of spectrum available for operations below 902 MHz.[54] In addition, specific provision has been made for relatively high powered Part 15 spread spectrum devices in the 2400-2483.5 MHz and 5725-5850 MHz bands.[55] Further, the Commission has recently allocated

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[51](...continued)
Part 15 operation and the availability of protected microwave point-to-point and point-to-multipoint channels. Certainly, under these circumstances, any inability of such long range Part 15 links to tolerate interference or to avoid interference should not be the basis for restrictions on licensed systems.

[52] Comments of Southern California Gas company, PR Docket No. 93-61 at 1 (filed June 29, 1993) (emphasis added).

[53] Southern California Gas notes that it is already a licensee under Parts 90 and 94 of the Commission's Rules. *Id.*

[54] 47 C.F.R. § 15.205 (1992).

[55] 47 C.F.R. § 15.247 (1992). The Commission also has before it a petition for rulemaking that seeks to eliminate the requirement that transmitter power for Part 15 systems operating in these two bands be reduced by an amount in dB that the directional gain of the antenna exceeds 6 dBi. *See* Petition for Rulemaking filed by Western Multiplex Corporation on January 5, 1994, RM-8435.

over 40 MHz of spectrum for unlicensed PCS operations that could accommodate many if not most of the operations currently existing in or contemplated for the 902-928 MHz band.[56] In contrast, the 902-928 MHz is the only band available that is appropriate for high capacity AVM systems in furtherance of the national goals for IVHS.[57]

3. The Commission Has Never Disavowed the Steps It Took to Encourage AVM Systems in This Band a Decade Before It Issued the Part 15 Orders

The comments of the Part 15 industry suggest that the Commission somehow disavowed its 1974 decision to authorize wide-area AVM systems in the 902-928 MHz band when it adopted orders in the 1980s that increased the flexibility of Part 15 operation on these frequencies. This construction of history is hard to square with the fact, as detailed earlier, that the Commission conditioned Part 15 operation on avoiding interference to licensed radio services, which throughout this period included wide-area AVM.

Nor is there any basis in the suggestion that, as a result of its earlier Part 15 decisions, the Commission is somehow prevented from expanding the AVM allocation to the entire AVM band, as proposed and supported by many comments in the record, including Pinpoint's. If that were the case, the Commission would be hard-pressed to carry out its congressional mandates to manage the spectrum in the public interest in

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[56] *Amendment of the Commission's Rules to Establish New Personal Communications Services*, Second Report and Order, 8 FCC Rcd 7700 (1993).

[57] *See* discussion at pp. 9-10, *supra*.

any frequency band in which Part 15 operation is authorized. In short, the principles that have guided the authorization of unlicensed devices would be turned on their head if the FCC were to permit the Part 15 industry to leverage the agency's encouragement of its operation on a non-interference basis into an FCC allocation decision protecting Part 15 operation because the unlicensed devices interfere with the operations of preexisting licensed services and/or suffer interference from them.[58]

B. Wide-Area AVM and Part 15 Operation Are Compatible

By the foregoing discussion, Pinpoint does not in any way intend to suggest that the Part 15 industry deserves the proverbial "short end of the stick" as the result of final AVM rules. To the contrary, Pinpoint is confident that, as a general matter, well-designed AVM systems will not have reason to complain about interference from Part 15 operations under Pinpoint's proposed band plan and power level rules. It has become clear, however, that this will impose an additional requirement on the design of AVM systems. They must be able to tolerate undesired signals below some specified level. Similarly, wide-area AVM systems will not present a threat to the viable operation of soundly engineered Part 15 devices.

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[58] The Part 15 industry justifiably talks of the attempts of PacTel to secure a spectrum windfall in this band. *See e.g.* Comments of the Part 15 Coalition at 4-5. Ironically, however, if the Part 15 industry were to succeed in moving AVM systems out of this band, as they demand, it is *they* who would receive a windfall of much greater proportion than the one sought by PacTel.

1. Pinpoint Anticipates That Most Part 15 Devices Will Not Be a Likely Source of Interference to Its Operations

The principal fear of the Part 15 industry, as expressed in the comments of its members, is that wide-area AVM systems are susceptible to interference from Part 15 devices and that such systems will seek the "shut down" of such devices on the basis of the fact that Part 15 devices are obligated not to interfere with licensed operations.[59] This argument is predicated on the simplistic and mistaken assumption that all wide-area system designs are as susceptible to interference from Part 15 devices as the Part 15 industry perceives the system of PacTel to be. *This is simply not the case.*

The Pinpoint ARRAY™ Network, for example, is unlike the PacTel system in terms of susceptibility to interference. This is true for a number of reasons. For one thing, the Pinpoint system will not rely on the bare minimum number of base stations, as PacTel's discussions suggest that it will. Not only will this improve the manageability of interference, but it will also greatly improve spectral efficiency.[60] Additionally, unlike the radios in the PacTel system, the base stations and mobiles in the ARRAY™ system are designed to utilize power levels that will be sufficient to

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[59] *See e.g.*, Comments of Metricom at 8-11; Comments of Symbol Technologies, Inc., PR Docket No. 93-61 at 7 (filed March 15, 1994). The arguments of some Part 15 proponents that they would soon be overcrowded by being forced into 16 MHz under the PacTel *ex parte* proposal underscores the industry's tendency to exaggeration shifting from a total of 26 MHz to 16 MHz would represent only a small gain in the noise level. However, as described herein, Pinpoint believes there are steps that should be taken that will significantly reduce the likelihood of AVM licensees seeking to have Part 15 devices cease operation.

[60] *See* Hatfield Response to MobileVision at 1-2.

compensate for most ambient noise levels[61] without rendering Part 15 operations inviable. In short, Pinpoint designed its system recognizing that when providing AVM in the real world, it would have to tolerate reasonable levels of Part 15 interference.[62]

2. The Part 15 Industry Technical Comments Regarding Interference to Wide-Area AVM Systems Are Based upon Unrealistic or Mistaken Assumptions

The studies that have been submitted in this proceeding that argue that Part 15 devices will represent an interference threat to wide-area AVM systems do not undermine Pinpoint's position on the ability of wide-area AVM systems to tolerate a substantial degree of potential interference from Part 15 devices. These efforts at modeling fail to deal adequately with the probabilistic nature of both Part 15 transmissions and AVM transmissions.

For destructive interference to be present a number of independent events must occur simultaneously. The desired and undesired signals must be present at the receiver's antenna at the same time. They must also occur in the same frequencies as used by the receiver. The overall probability that interference will occur at a particular receiver is the product of the probabilities of these events. Moreover, there may be a sufficient number of base stations not subject to the interference to still obtain an

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[61] Propagation and noise studies were carried out in 1991 and 1992 in an effort to ascertain the likely noise environments.

[62] Nonetheless, as discussed below, Pinpoint is not suggesting that licensed AVM systems should not have any regulatory protection from unlicensed devices. To minimize the potential for abuse of the primary status of AVM systems relative to Part 15 (and amateur radio) operation, Pinpoint proposes a minimum power level at the receiver of an AVM system that would define the lower boundary of "harmful interference." *See* discussion at Section III.C., *infra*.

accurate position fix. The studies in the record generally assume that all of the relevant events occur at the same time all of the time and that loss of one base station receiver to interference results in the loss of a position fix.

The significance or effect of the interference may also depend on ancillary factors, such as the time overlap with other events or the overlap of one set of frequencies with another. Additionally, the ability of the AVM system to deal with the interference will depend on the protocols employed for such features as automatic repeat and error correction. All of these factors should be considered in an overall evaluation of the potential for interaction between Part 15 transmissions and those of an AVM system.[63] When reasonable probabilities are assigned to these factors, the likelihood of interference diminishes substantially. This is not to say, however, that interference to AVM systems from Part 15 devices will never occur. In general, however, it will be manageable.

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[63] The TIA Comments also suggest that the AVM interests have miscalculated the effects of bandwidth on vehicle location capacity. Comments of TIA, Exhibit A. The TIA analysis mistakenly posits a system operating near threshold levels. Practical AVM systems would not be designed to operate at or near the threshold because variances in propagation path loss are so large that if a system were designed to run at the threshold level, it would be operating below the threshold level most of the time. It is practical to operate at or near the threshold only if the path link conditions are very stable as in a fixed satellite receiver used to downlink a television signal from a geosynchronous satellite.

3. The Operation of Wide-Area Systems Pursuant to the Rules Proposed by Pinpoint Will Not Undermine the Viability of Part 15 Operations

While many Part 15 commenters are concerned that their devices may cause interference to certain wide-area AVM systems, only a very few suggest that wide-area AVM systems will cause a significant interference problem for them. Indeed, most of those that address the interference issue note that their Part 15 systems are robust and that interference from wide-area AVM systems is little cause for concern.[64] Those that do suggest there may be a potential interference problem do not substantiate why.

Pinpoint submits that the possibility of interference to Part 15 devices from its operations should be minimal, for many of the probabilistic reasons that relate to the potential for Part 15 interference to wide-area systems, as discussed above.

4. Just as Pinpoint Designed Its System with the Need to Coexist with Part 15 Devices in Mind, Part 15 Devices Should and *Do* Have Reciprocal Obligations

As described above, Pinpoint designed its system recognizing that, as a practical matter, it would have to tolerate a relatively high level of noise from Part 15 devices. Moreover, in its earlier pleadings, Pinpoint has explained in detail how its design also reflects the need for wide-area AVM systems to operate on a co-equal basis with local-area AVM systems. Just as Pinpoint has incorporated these sharing concepts into its system design, Pinpoint submits that manufacturers and users of Part 15 devices should

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[64] *See, e.g.*, Comments of Metricom at 4; Comments of TIA at 5.

be required to do the same. The non-interference obligation of Section 15.5 of the Commission's rules requires no less.

The regional data distribution networks of several of the commenters are a case in point. The threat of interference to AVM systems could be reduced by changing the geometry of the radio links to avoid illuminating a wide-area base station, for example. Similarly, the height of transmitters could be reduced when possible to minimize the potential for interference, even if that means installing additional radio link nodes because of reduced range.

With respect to protection from interference from wide-area AVM systems, these data distribution networks could make more use of path diversity and reduce the length of some radio links. Most notably, the option of operating in other frequency bands as a licensed service or on a Part 15 basis should not be ignored, particularly for point-to-point operations that require continuous operation.

C. Pinpoint Has No Objection to the Establishment of an Objective Definition of Harmful Interference

While Pinpoint believes that its ARRAY™ system will be largely tolerant of Part 15 interference, it submits that wide-area AVM systems that operate in this band should exhibit a certain degree of robustness given the myriad uses of this spectrum. Accordingly, Pinpoint proposes that the FCC adopt a quantitative, objective measure of "harmful interference" to give Part 15 devices "protection" from wide-area AVM systems that unreasonably intend to rely on an overly pristine radio environment.

Specifically, Pinpoint suggests that the Commission consider "harmful interference" to a wide-area AVM base station from a Part 15 device to be defined as follows:

(1) Any interference level would be measured at the receiver of the higher priority (AVM) system;

(2) Any interference level less that -90 dBm will be tolerated indefinitely;

(3) Any interference level higher than -70 dBm need not be tolerated;

(4) Any interference level between -70 dBm and -90 dBm (Level) would be tolerated (-70 dBm - Level)/(0.2 dBm) percent of the time. (Thus, for example, a level of -85 dBm would be tolerated 75% of the time.);

(5) Occupancy would be averaged over an interval such as 10 seconds;

(6) Once an intolerable level is reached, the Part 15 operator would have an obligation to correct the problem or otherwise comply with the obligations of Section 15.5(b).

At an interference level suggested by the above proposal, the desired signal levels would then need to be in relationship to the -70 dBm jammer to ensure non-jamming (per the rule) near 100% of the time. Processing gains available in the spread spectrum communication link would allow the locating signals to be detected at between -15 dB and -20 dB s/j ratio at the base station's receiver antenna. Therefore the desired signal levels would need to be above -70 dBm (jammer level) minus 20 dB receiver margin, or -90 dBm. With a 40 Watt mobile power at 6' height communicating with a typically 200' height base station, using Lee's 90% log-normal probability curve yields a communication range of about 7.5 miles. This is more than adequate for a multilateration systems with a 7-mile base station spacing.

Such a system would typically be implemented as a high-spectral-efficienct system, i.e. a frequency re-use system, in some ways similar to the cellular telephone system. The relatively short communication range accomplishes two important objectives: the path loss between mobile and base station is reduced over that experienced by long-range multilateration systems, and consequently, the tolerance of interference can be proportionately higher and multilateration accuracy increases due to the higher density of base stations.

The short range propagation models described in the TIA Comments show that the worst case signal levels for free-space propagation between half wave dipoles occur at about 200 ft range, and equal about -40 dBm from a one watt transmitter. Typical AVM systems use antennas with significantly higher gains, typically 12 to 15 dB, which portray a very narrow vertical beam aimed at the horizon. Such antennas suppress the jammer signals near the base station by between 15 and 30 dB, while increasing the desired mobile signals. The net result is that the "free space" jammers reach somewhere within 15 dB of the proposed limits.

Since the majority of Part 15 jamming sources would be indoors, or only incidentally outdoors (e.g. cordless phones), there is an additional 10 to 30 dB margin due to non-line of sight or wall penetration attenuation, making such devices fall well below the 100% (non) interference threshold.

Point-to-point outdoor systems typically use narrow bean antennas (e.g. Yagis). Interference from such systems can be ameliorated by judicious pointing of the beam path in relation to the AVM system's base station sites.

The only remaining sources of interference left unresolved are those of outdoor deployed Part 15 networks that rely on network radio nodes mounted at significant elevations in comparison to the AVM system's mobiles. Ameliorating the interference from such systems would require some other forms of coordination such as minimum-link-power control by the Part 15 system operators.

A criterion such as that proposed above has greater practical utility than that proposed by PacTel in its comments on the *ex partes*. The PacTel definition is relative to the "average interference and noise floor" at the AVM receiver.[65] This is an undefined level of interference that will correspond to greater and greater power levels in the AVM receiver as the band becomes increasingly populated with both licensed and unlicensed radios. Concomitantly, developers of Part 15 devices will not have an objective criterion by which to assess the likelihood of their equipment operating on a non-interference basis.

D. Pinpoint Supports a Definition of AVM Limited to Vehicular and Transportation Applications

As Pinpoint explained earlier in these comments, the 902-928 MHz band is unique in its ability to support high-capacity wide-area AVM operations in furtherance of national objectives for IVHS. There is no strong showing in this record that the permitted applications of AVM should extend beyond the location of vehicles, and equipment involved in vehicular transportation, such as intermodal cargo containers,

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[65] Comments of PacTel Teletrac, PR Docket No. 93-61 at 10 (filed March 15, 1994).

rail cars, tractor trailers, and the like.[66] Not only will such a definition preserve this band for its best use, it will also alleviate the concerns of the Part 15 industry about a host of LMS services unrelated to the location and management of vehicles and transportation being introduced into this band.[67]

IV. MOBILEVISION'S CRITIQUE OF THE PINPOINT SYSTEM REVEALS A POOR GRASP OF SPECTRALLY-EFFICIENT RADIO DESIGN AND MISCONSTRUES THE HATFIELD REPORT

MobileVision, in Annex 5 to its Comments on the Ex Partes, criticizes the design and operation of the Pinpoint system, as reported by Hatfield Associates, Inc.[68] MobileVision's Annex comments on the system's range and receiver sensitivity, its location accuracy, and the ARRAY™ network's susceptibility to interference from local-area systems. As described in the "Response to MobileVision's 'Technical Review'" ("Hatfield Response to MobileVision") prepared by Hatfield Associates, Inc. attached hereto MobileVision has misinterpreted and distorted the Hatfield Report and has committed fundamental engineering mistakes to reach its conclusions.

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[66] For example, Southwestern Bell has suggested the use of wide-area LMS to monitor the status of stationary vending machines.

[67] This position is largely supported, for example, by the U.S. Department of Transportation and others. *See, e.g.*, Reply Comments of the U.S. Department of Transportation, PR Docket No. 93-61 at 15 (filed July 29, 1993); Comments of IVHS America, PR Docket No. 93-61, at 16-17 (filed June 29, 1993); Reply Comments of AMTECH Corporation, PR Docket No. 93-61 at 32 (filed July 29, 1993).

[68] Hatfield Associates, Inc., "Review and Discussion of the Pinpoint ARRAY™ Network and Its Performance," dated January 20, 1994, ("Hatfield Report") filed as an *ex parte* presentation in PR Docket No. 93-61 by Pinpoint on January 26, 1994.

MobileVision's claims that the Pinpoint system has limited range and poor mobile receiver sensitivity.[69] However, spectrally-efficient systems such as Pinpoint's are interference-limited, not noise-limited, and the range of their base stations is deliberately restricted to permit frequency use in a local market.[70] In fact, when the true jamming margin of the Pinpoint system, 23.1 dB, as opposed to the 5 dB asserted by MobileVision in its Annex 3, is utilized to assess the range of the Pinpoint system, it is found to actually be 10 to 20 percent greater than that of the MobileVision system if operating with the same power levels.[71]

Similarly, MobileVision's criticism of the Pinpoint system's receiver sensitivity misconstrues the Hatfield Report and misses the point. Because the Pinpoint ARRAY™ network, as any AVM system operating in the 902-928 MHz band, will be interference limited, the "nominal" receiver sensitivity will be based on the expected interference environment. The Pinpoint TransModem sensitivity cited in the Hatfield Report, -85 dBm, is representative of these operating conditions.[72] It should be noted, however, that laboratory measurements show that the actual receiver sensitivity of the Transmodems is -100 dBm or lower.[73]

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[69] MobileVision Comments on Ex Partes, Annex 5, Summary.

[70] Hatfield Response to MobileVision at 1.

[71] The Hatfield Response to MobileVision explains that the low jamming margin arrived at by MobileVision was a product of MobileVision's misunderstanding of the processing gain in the Pinpoint and the fact that sixteen sequences contribute to a position fix. *Id.* at 3.

[72] *Id.* at 2.

[73] *Id.*

MobileVision goes on to assert that the accuracy of the Pinpoint system is subpar, basing the claim on quoting the first half of a statement in the Hatfield Report: "the points are scattered over a range of about two hundred feet *at a few of the locations along the test route*."[74] In fact, Hatfield Associates explain that

> about ninety-five percent of the sample points were within about thirty feet of the measurement path, even though the data were not processed or corrected and were produced by a minimum configuration of four receive sites.[75]

In a commercial operation, several more than the four receive sites used in the experimental system typically will be involved to make each position fix, and the data will benefit from error correction, so that this already high degree of accuracy will be improved further.[76]

Finally, to suggest that Pinpoint is highly prone to interference from local-area systems, MobileVision makes a fundamental error in misconstruing the interference test results conducted by Pinpoint and AMTECH Corporation. As Hatfield Associates explain, MobileVision confuses "the mere detection of the presence of another system's signal with destructive-interference."[77] As a result, MobileVision grossly overstates the zone of potential interference. Moreover, the interference test was designed to present a worst-case scenario, and does not reflect the probabilistic nature of interaction

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[74] Hatfield Report at 5-7 (emphasis added); *see* MobileVision Comments on Ex Partes, Annex 5 § 1.2.

[75] Hatfield Response to MobileVision at 5-6.

[76] Pinpoint would also point out, as MobileVision carefully ignores, the accuracy of the Pinpoint system will be coupled with a radiolocation capacity 75 to 150 times that of MobileVision.

[77] Hatfield Response to MobileVision at 6.

between two low duty-cycle systems, such as Pinpoints and AMTECH's.[78] Contrary to MobileVision's self-serving interpretation of these results, therefore, the test showed that Pinpoint's operations are highly compatible with local-area systems.

In short, MobileVision's misguided critique of the Pinpoint system only underscores the soundness of the ARRAY™ network, the accuracy of its radiolocation function, and its ability to operate in the shared 902-928 MHz band.

V. CONCLUSION

This proceeding will be pivotal to the success of the Intelligent Vehicle Highway System. Both wide-area and local-area AVM have key roles to play in IVHS. The Commission should move forward to adopt rules that provide a solid foundation for AVM in support of IVHS. These regulations should accord technically and financially qualified wide-area AVM system proponents the opportunity to be licensed in the 902 - 928 MHz band on a time shared basis with sufficient bandwidth to provide high speed wide-area AVM services. The recommendations of Pinpoint Communications, Inc.,

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[78] *Id.* at 7. For the reasons discussed above, MobileVision also misstates the low susceptibility of AMTECH's system to interference from wide-area systems. In addition, as explained in the Hatfield Report, at 6-1, the AMTECH system also has a built in redundancy that overcomes the occasional frame of data that may be lost.

provide the basis for a sound regulatory framework that will make possible a wide variety of competitive AVM services for the benefit of the public.

Respectfully submitted,

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