among themselves to avoid interference.[104] We also offered an alternative that systems be licensed on an exclusive basis for five years, after which licensing would be on a shared basis with any new licensees required to protect incumbents.[105]

44. Several multilateration parties oppose our proposal to license these systems on a shared basis, claiming that it is not technically or economically feasible to share spectrum on a co-equal basis with other multilateration licensees.[106] Two commenters that are developing multilateration systems, Pinpoint and Uniplex, support shared licensing, albeit on a limited basis.[107] SBMS, while opposing shared use of spectrum for multilateration systems, would divide the two 8-megahertz bands into four 4-megahertz bands licensed on an exclusive basis.[108] The commenters agree that sharing of spectrum among multilateration licensees would require the use of an interference avoidance measure, such as time sharing.[109] Time sharing would reduce system capacity since it requires the use of guard bands and other additional system overhead that represent additional uses of capacity that do not contribute to the content of the message.[110] With each addition of a new multilateration system, the quality of service provided by incumbent operators would diminish due to increases in system delays and time required for a subscriber to access the system.[111] In a shared environment, the multilateration interference tolerance threshold would be more likely to be violated, causing the time of arrival to be distorted for the return signal and therefore, not accurately providing location services.[112] Finally, if there is more than one multilateration system using the same frequency band, it would be extremely difficult to have adequate power control

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[104] Notice at para. 65, 8 FCC Rcd 2502, 2506 (1993).

[105] Id.

[106] Comments of Teletrac at 24-39; Comments of MobileVision at 33-36; Comments of Southwestern Bell Mobile Systems (SBMS) at 12-14; and Comments of Location Services at 4. We hereby grant SBMS's Motion to Accept Supplement to Reply Comments because it serves the public interest and best ensures the proper dispatch of Commission business to develop a full and complete record in this proceeding. See 47 U.S.C. § 154(j).

[107] See Comments of Pinpoint at 9-20; Ex Parte Comments of Pinpoint dated August 3, 1994; Ex Parte Comments of Uniplex dated September 30, 1994 (supporting Pinpoint's August 3, 1994 position).

[108] SBMS comments at 12-14.

[109] See Pinpoint comments at 17.

[110] See Ex Parte Comments of SBMS dated March 29, 1994, at 16-17.

[111] See Ex Parte Comments of Teletrac dated March 15, 1994, at 2, Ex Parte Comments of SBMS dated March 29, 1994, at 16-17.

[112] See Comments of MobileVision at 33-4, Reply Comments of MobileVision at 12-13.

among users from disparate systems. Without adequate power control, overall system capacity would suffer.[113] Sharing could also require the establishment of standards to which all of the systems would have to conform. With different technologies employed by the various systems being proposed, we are not in a position, nor are we inclined, to set such standards. For these reasons, we conclude that sharing in the multilateration segment of this service is neither practical nor desirable from either a technical or regulatory standpoint.

45. Some commenters also provided economic analyses of the impact of sharing on competition in the multilateration LMS market over the long-term.[114] Teletrac opposed sharing, pointing to various substantial fixed costs and technical difficulties to argue that a market with open entry to shared spectrum would not necessarily sustain more than two firms. Teletrac suggested that the close coordination among licensees needed to make sharing spectrum successful could inhibit vigorous competition. Teletrac also argued that exclusive licensing would not allow licensees to exercise market power because of the availability of alternative location services. SBMS, on the other hand, argues that sharing may be economically beneficial because it would encourage competition and technical innovation. SBMS also expressed concern that exclusive spectrum assignments would make the multilateration LMS market a natural monopoly.

46. We believe that both multilateration and non-multilateration systems will play an important role in achieving a nationwide ITS infrastructure and that a sufficient amount of spectrum must be available to enable both types of systems to develop.[115] We also agree with commenters that to enable both multilateration and non-multilateration systems to develop effectively, we should create separate allocations for the two types of systems to the extent possible.[116] Further, we believe that, for the most part, non-multilateration systems can share spectrum with one another if they are separated from multilateration operations (see paragraph 66, infra). Once separated, as discussed earlier, we believe that there are technical, operational and economic justifications supporting our decision to provide exclusive spectrum for exclusive assignments for multilateration systems.

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[113] See Ex Parte Comments of SBMS dated October 19, 1994, Final Report of the Mobile and Portable Radio Research Group at 35.

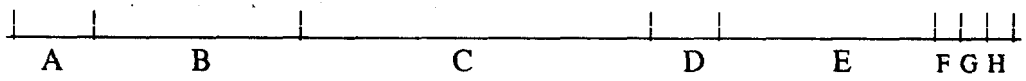
[114] See Comments of North American Teletrac and Location Technologies, Inc. (Teletrac), Reply comments of Mobilevision, L.P., Pinpoint Communications, Inc., and supplemental reply comments of SBMS.

[115] IVHS America comments at 13-15; DOT reply comments at 12-15.

[116] MFS/TI, in its August 12, 1994 comments suggests that multilateration use, ". . . even on a secondary basis [to non-multilateration use] would prove to be unworkable in day-to-day operations" and could ". . . present an untenable situation for non-multilateration systems with primary use over the band." Comments at 8 and 9.

47. Accordingly, we adopt a spectrum plan that: 1) allocates the entire 902-928 MHz frequency band for LMS systems, generally separating multilateration and non-multilateration operations; 2) allocates spectrum for non-multilateration systems licensed on a shared basis; and 3) allocates spectrum that may be authorized exclusively to a single multilateration licensee.

Spectrum Plan for the 902-928 MHz Band



A:	902.000 - 904.000	Non-Multilateration
B:	904.000 - 909.750	Multilateration
C:	909.750 - 919.750	Non-Multilateration
D:	919.750 - 921.750	Multilateration and Non-Multilateration
E:	921.750 - 927.250	Multilateration
F:	927.250 - 927.500	Narrow band associated with sub-band E
G:	927.500 - 927.750	Narrow band associated with sub-band D
H:	927.750 - 928.000	Narrow band associated with sub-band B

48. Bands B, D and E will be assigned on an exclusive basis to multilateration systems. Bands A, C and D will be licensed on a shared basis to non-multilateration systems. Licensees of Bands B, D and E will be assigned narrow bands H, G and F, respectively. We believe this allocation scheme will significantly increase the diversity of use in the entire 902-928 MHz band, as described below, in furtherance of the public interest. Specifically, the plan provides opportunities for implementation and operation of multiple multilateration technologies and service providers through the allocation of three blocks of spectrum (Bands B and H; E and F; and D and G).[117] The comments indicate that some multilateration systems can operate in roughly 2 MHz,[118] others require 4-6 MHz,[119] and still others need more spectrum[120] to provide effective LMS service. Through this licensing plan, it is our intent to provide a framework for each of these technologies to flourish. For example, systems requiring 2 MHz could be accommodated in Bands D and G, those requiring 4-6 MHz can be accommodated in Bands B and H or Bands E and F, and those requiring additional spectrum will be permitted to aggregate bands to obtain up to a total of 8 MHz in a given region through the aggregation of Bands D and G and Bands E and

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[117] Previously, two 8 megahertz bands had been available for use by multilateration systems. See 47 C.F.R. § 90.239(c).

[118] Ex Parte Comments of SBMS dated August 12, 1994, at 5.

[119] See, e.g., Comments of Teletrac and Mobile Vision.

[120] See, e.g., Ex Parte Comments of Pinpoint, June 27, 1994, at 4 and note 4.

F.[121]

49. The plan also accommodates the needs of non-multilateration systems by providing a total of 14 MHz for such systems rather than the 10 MHz of spectrum proposed in the Notice (see footnote 98, supra). Of this 14 MHz, 10 MHz is contiguous spectrum at 909.750-919.750 MHz that is not shared with multilateration systems, which should address the spectrum requirements of most non-multilateration systems.[122] In addition, non-multilateration systems may obtain up to a 12 MHz block of contiguous spectrum by also using the 2 MHz of spectrum at 919.750-921.750 MHz (Band D). Although this 2 MHz block will be shared on a co-equal basis with multilateration systems, it will nonetheless provide opportunities for non-multilateration systems that require additional spectrum to operate effectively.[123]

F. Geographic Areas for Exclusive Licenses

50. In the Notice, we sought comment on how to license spectrum to multilateration LMS systems.[124] In the Notice of Proposed Rulemaking in PP Docket No. 93-253, we asked for comment on the appropriateness of awarding LMS licenses through competitive bidding.[125] Finally, after adopting the Notice in this docket, we sought specific comment on certain alternative licensing aspects, such as the use of Basic Trading Areas (BTAs) in defining the license service area.[126]

51. Teletrac favors BTAs over MSAs/RSAs for multilateration LMS licensing "because the coverage area customers seek for tracking and emergency services extends

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[121] Licensees may not be authorized to operate on more than one of the multilateration bands in a given MTA, except that they will be permitted to aggregate Bands D and G and Bands E and F.

[122] Mark IV has indicated that its non-multilateration systems can operate in the 912-918 MHz range. Comments of Mark IV dated June 29, 1993, at 8-10. MFS/TI has indicated that "it may be possible for AVI (non-multilateration) technologies to operate in as little as 10 MHz of (contiguous) bandwidth." Comments of MFS/TI dated August 12, 1994, at 8.

[123] See Amtech comments at 9. Amtech states that two-way data transmission between a moving vehicle and a fixed location will require large bandwidths. See also TI/MFS ex parte comments filed December 2, 1993, at 5 and Hughes comments at 6.

[124] See Notice of Proposed Rule Making, PR Docket No. 93-61, 8 FCC Rcd 2502 (1993) at paragraph 21.

[125] See, Notice of Proposed Rule Making, PP Docket No. 93-253, 8 FCC Rcd 7635, para 145, n. 153 (1993).

[126] See Public Notice, DA 94-129, PR Docket No. 93-61, 59 Fed.Reg. 7239 (February 15, 1994).

beyond city limits to the broader metropolitan area where people are likely to commute, conduct business, or routinely drive."[127] SBMS favors MSAs/RSAs over BTAs because, it claims, (1) the Commission has had favorable experience with MSAs/RSAs in licensing cellular systems, (2) BTAs do not coincide with cellular service areas, to the detriment of cellular entities that are would-be LMS providers, (3) MSAs/RSAs are widely known and easily ascertainable, and (4) no private party or entity has ever attempted to control dissemination of maps or listings which depict or define these areas.[128] SBMS also argues that allowing existing licensees to expand to the borders of their BTAs could have anti-competitive implications.[129] Symbol Technologies believes that choosing BTAs for LMS would result in a congruency of service areas for LMS and PCS that would allow LMS providers to be de facto PCS providers and directly compete with PCS.[130]

52. We generally agree with Teletrac's view that the geographic scope of LMS systems logically correlates to areas in which there are centers of consumption of durable goods. We also find, however, that LMS has the potential to serve larger areas; vehicle location and monitoring will be useful for the individual motorist and for fleets of vehicles, and for short-range travel as well as long-range travel. For this reason, we conclude that Major Trading Areas (MTAs) as defined in the 1993 Rand McNally Commercial Atlas and Marketing Guide[131] and four additional MTA-like service areas,[132] unlike the smaller BTAs, provide a more suitable regulatory construct for multilateration licensing. While it is clear that multilateration systems will benefit from being centered upon areas of commerce and trade, use of MTAs will give systems greater capacity to accommodate large numbers of prospective users of location services. This will promote competition, encourage the advancement of new technologies, and result in better and speedier service to the public. We will thus provide for one exclusive multilateration system license in each MTA in the sub-bands identified for exclusive assignments (i.e., Bands B and H, D and G, and E and F). Multilateration licensees on these exclusive assignments will be allowed to construct stations anywhere within their MTAs, subject to technical and operational considerations discussed in paragraph 87-98, infra.

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[127] Comments of PacTel Teletrac dated March 15, 1994, at 8.

[128] Comments of SBMS dated March 15, 1994, at 5. SBMS makes reference to "PCIA, Rand McNally Settle Out-of-Court On Use of BTA/MTA Listings," Washington Telecom Week, February 18, 1994, at 2-3.

[129] Comments of SBMS dated March 15, 1994, at 14-16.

[130] Comments of Symbol Technologies, Inc. in Response to the Public Notice of February 9, 1994, at 7-8 (note 9).

[131] See footnote 23, supra.

[132] See footnote 24, supra.

G. Competitive Bidding for Exclusive Multilateration LMS Licenses

53. In response to the Notice of Proposed Rule Making in PP Docket No. 93-253, we received comment on the issue of whether mutually exclusive applications for AVM systems should be resolved by competitive bidding.[133] Teletrac and SBMS oppose use of competitive bidding to license in this service. These parties contend that the statutory requirement that auctionable spectrum be exclusively assigned and principally used to serve paying subscribers is not met because LMS operations are secondary to ISM and Federal Government use of the band. Amtech and Pinpoint, who oppose competitive bidding for LMS licenses for other reasons, argue that LMS's secondary status does not in and of itself statutorily preclude competitive bidding.

54. In the Second Report and Order in PP Docket No. 93-253, we concluded that it was premature to authorize competitive bidding for AVM systems during the pendency of PR Docket No. 93-61, because "the likelihood of mutually exclusive applications" was unknown or was debated by the commenters.[134] However, in light of our decision to grant exclusive multilateration LMS licenses within three sub-bands, and because they will be used to offer for-profit, subscriber-based services, we conclude that competitive bidding should be used to grant exclusive licenses where mutually exclusive applications are accepted for filing. Use of competitive bidding in such cases meets the general statutory criteria for auctioning licenses set forth in Section 309(j)(2) of the Act.[135] The statute permits auctions where: (1) mutually exclusive applications for initial licenses or construction permits are accepted for filing by the Commission; (2) the principal use of the spectrum will involve, or is reasonably likely to involve, the receipt by the licensee of compensation from subscribers in return for enabling those subscribers to receive or transmit communications signals utilizing the licensed frequencies; and (3) the public interest objectives of Section 309(j) would be served by subjecting mutually-exclusive applications in the service to competitive bidding.[136]

55. We conclude that the above requirements are satisfied, thus making competitive bidding available for licensing within certain band segments. First, in accordance with the statute, the licensing scheme we adopt herein allows for mutual exclusivity among applicants for initial licenses. Specifically, we have rejected the option of allowing multilateration LMS

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[133] Several commenters to that proceeding oppose grant of non-multilateration licenses by competitive bidding. See, e.g., Comments of Hughes Transportation Management, Interagency Group and Amtech.

[134] See Second Report and Order, PP Docket No. 93-253, 9 FCC Rcd 2348, 2351-2, (1994).

[135] See 47 U.S.C. § 309(j)(2). See also H.R. Rep. 111, 103d Cong. 1st Sess. 254 (1993).

[136] A comprehensive discussion of these principles for determining whether licenses may be auctioned is set forth in the Second Report and Order in PP Docket No. 93-253, 9 FCC Rcd 2398 (1994) at paras. 11-67.

systems to operate in an unlimited shared use environment and have instead decided to grant only one licensee the use of each of three sub-bands for multilateration LMS in each MTA. (see paragraphs 44-46, supra) We do not believe that the likely existence of some grandfathered AVM multilateration operations alters this conclusion. See para. 61, infra. Because no more than one multilateration licensee will be permitted in any single sub-band in an MTA (hereinafter "MTA licensee"), we anticipate that mutually exclusive applications will be filed. We also conclude that the use of the spectrum by other services does not preclude the applicability of the competitive bidding process. Shared spectrum for which we exclude competitive bidding is "where mutual exclusivity between applications cannot exist because channels must be shared by multiple licensees.... [W]e proposed to exclude these services from competitive bidding because there can be no mutual exclusivity."[137] That is not the case here, where in all likelihood there will be mutually exclusive applications for each exclusive MTA license. The relevant statutory prerequisite, as set forth in Section 309(j) of the Budget Act, is that "mutually exclusive applications are accepted for filing." This standard does not require that the relevant spectrum be completely unoccupied by other services.

56. Second, as the statute requires, the "principal use" of the spectrum is reasonably likely to involve MTA licensees receiving compensation from subscribers in return for those subscribers receiving or transmitting signals. We have concluded that this requirement allows us to evaluate classes of licenses, rather than individual licenses, in determining the "principal use" of spectrum.[138] Thus, while MTA licensees may be secondary in the band to government and ISM operations, the "principal use" test, as we have interpreted it, permits us to conclude that the principal uses of multilateration LMS are primarily subscriber-based offerings.[139]

57. In addition, we believe that use of a competitive bidding procedure for the licensing of these services satisfies the public interest objectives for auctioning set forth in Section 309(j)(3)of the Act. Specifically, use of competitive bidding to award MTA licenses, as compared to other licensing methods, will speed the development and deployment of new services to the public with minimal administrative or judicial delays, and encourages efficient use of the spectrum as required by Section 309(j)(A) and (D). Furthermore, in accordance with Section 309(j)(3)(B), we believe that competitive bidding will promote access to multilateration services and technologies and disseminate licenses among a wide variety of applicants by encouraging participation by all interested or qualified bidders. Finally, we conclude that competitive bidding will recover for the public a portion of the value of the

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[137] In the Matter of Implementation of Section 309(j) of the Communications Act -- Competitive Bidding, Second Report and Order, PP Docket No. 93-253, 9 FCC Rcd 2348 at para. 13 (1994).

[138] See Second Report and Order in PP Docket N. 93-253, FCC 94-61, 9 FCC Rcd 2348 at para. 34 (1994).

[139] Comments of Pinpoint at 5; Comments of SBMS at 4.

spectrum, as envisioned in Section 309(j)(3)(C). Specific rules and procedures for competitive bidding for this spectrum, including rules and procedures for designated entities, will be established in a separate proceeding. We will not accept applications for multilateration LMS licenses until after these rules and procedures have been established.

H. Construction Period for LMS Systems

58. In the Notice, we proposed that LMS systems be constructed and placed in operation within eight months of the date a license is granted, which is the current standard for AVM licensees under Part 90.[140] The majority of commenters that addressed this issue support our proposal so long as provision is made for extended implementation periods for local governments or especially large and complex systems.[141] MobileVision supports a five-year construction period with construction benchmarks for multilateration systems but states that eight months is appropriate for non-multilateration systems.[142] SBMS supports a 12-month construction period.[143]

59. Most non-multilateration installations use relatively few transmitters in a limited number of locations. Accordingly, we shall retain the current requirement that these systems be constructed and placed in operation within eight months. We will consider a non-multilateration LMS system to be constructed and placed in operation if at least one base station has been constructed and the system is providing service to at least one mobile radio unit. As they may do currently, a local government entity requiring more than eight months to construct a non-multilateration LMS system because of the system's size and complexity can request extended implementation in accordance with Section 90.155(b) of our Rules.

60. We recognize that multilateration LMS systems, because they will be licensed on an MTA basis, will likely be larger and more complex than non-multilateration LMS systems. Rather than imposing benchmarks and reporting requirements on these systems for all or part of their license term, we will require a multilateration LMS licensee authorized to operate throughout an MTA to construct a sufficient number of base stations that utilize multilateration technology to provide multilateration location service to a substantial portion of at least one BTA in that MTA within twelve months after initial authorization.[144] LMS

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[140] Notice at para. 26, 8 FCC Rcd. 2502, 2507 (1993). See 47 C.F.R. § 90.155.

[141] Hughes comments at 15; Amtech comments at 35-36; Mark IV comments at 14; IVHS America comments at 19; Interagency Group comments at 10.

[142] MobileVision comments at 46-49.

[143] SBMS comments at 22.

[144] This requirement is comparable to the substantial service requirement for 10 MHz PCS licensees set forth in Memorandum Opinion and Order, GEN Docket No. 90-314, 9 FCC Rcd 5108,

systems not constructed and placed in operation in a timely fashion (i.e., within 8 months for non-multilateration systems and within twelve months, as described above, for multilateration systems) will cancel automatically.

I. Grandfathering Provisions for Existing Multilateration AVM Licensees

61. As of February 3, 1995, we will no longer accept applications for the operation of multilateration LMS systems in the 904-912 and 918-926 MHz bands under our current rules. To ensure that our new licensing scheme does not impose undue hardship on existing, operating multilateration AVM systems, we will adopt certain grandfathering provisions which will allow them to continue to operate their systems under the current rules. We will also confer grandfathering provisions on multilateration AVM licensees who have not yet constructed their systems so that such licensees may construct and operate their licensed stations under our newly adopted rules.

62. A grandfathered multilateration AVM station will be considered constructed and placed in operation if it is built in accordance with its authorized parameters and is regularly interacting with one or more other stations to provide location service, using multilateration technology, to one or more mobile units. See 47 C.F.R. § 90.155. Specifically, LMS multilateration stations will only be considered constructed and placed in operation if they are part of a system that can interrogate a mobile, receive the response at 3 or more sites, compute the location from the time of arrival of the responses and transmit the location either back to the mobile or to a subscriber's fixed site. A grandfathered multilateration AVM station will receive no protection or exclusivity based upon mileage separation or service area criteria, but instead will operate on a co-equal shared basis with stations of any other grandfathered licensee or the exclusive MTA licensee operating in the same sub-band. We have concluded that sharing of spectrum among unlimited numbers of multilateration licensees is not technically feasible (see paragraph 44, supra), and thus we have not adopted rules that would permit the sharing of spectrum among multiple multilateration systems over an entire MTA. However, given the very small number of multilateration licensees currently authorized, in any given MTA there will ultimately be, at most, one or two grandfathered licensees operating in the same spectrum as the eventual MTA licensee. In such limited cases, we expect cooperative arrangements for sharing among these licensees to be reached. Where this is not possible or achieved, MTA licensees may build their systems in areas geographically removed from grandfathered stations, or may attempt to acquire existing systems from the grandfathered licensee(s) in their licensed area.

63. To attain grandfathered status, existing multilateration AVM licensees must file, within thirty days of the effective date of the rules adopted in this Report and Order, applications to modify their licenses to comply with the new band plan. These applications to modify must identify which new sub-band or sub-bands (i.e., Band B and H, Band D and

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¶ 155 (1994).

G, or Band E and F) they intend to operate their licensed multilateration AVM stations in, once their applications to modify have been authorized. We will not restrict multilateration AVM licensees to selecting a particular sub-band or sub-bands for their modified authorization, but will permit these licensees to choose the spectrum band(s) -- not to exceed a total of 8 MHz -- that best meets with their future LMS requirements. The application to modify a license to comply with the new band plan may also include a modification to specify an alternate site, so long as the alternate site is 2 kilometers or less from the site specified in the original license.[145] Further, at the time that existing multilateration AVM licensees file these applications to modify, they must certify that either (1) their multilateration AVM system has been constructed and is operational as of February 3, 1995, or (2) that it is not constructed at that time. Multilateration AVM systems that are constructed and operational as described above will be given until April 1, 1998 to convert to the spectrum identified in their modified LMS system license. Such licensees may continue to operate their multilateration AVM systems under either the old rules or the new rules during the process of converting their systems during this period. Licensees of constructed and operational multilateration AVM systems that do not file applications to modify within this 30-day period will be permitted to continue operations under the provisions of Section 90.239 until April 1, 1998 or the end of their original license term, whichever occurs first, at which time such licenses will cancel automatically and will not be renewed.

64. Multilateration AVM licensees for stations not constructed as of February 3, 1995 must construct and operate their modified LMS systems on the spectrum identified in their modified LMS system license by April 1, 1996. These licensees will not be allotted the lengthy transition period that licensees of constructed and operational systems are provided (i.e., until April 1, 1998) because they do not have an existing, operating infrastructure that will require this additional time for conversion. Licenses for stations not constructed under the old rules as of February 3, 1995 will terminate 30 days after the effective date of the new rules unless timely applications to modify are filed. Parties may file applications to modify those licenses that they plan to construct by April 1, 1996.[146] We have provided a transition period that we believe is appropriate for construction and operation for current licensees to attain grandfathered status. Because this spectrum will be subject to competitive bidding, we must balance our wish to accommodate the desired construction schedules of existing multilateration AVM licensees against the need for prospective bidders to be able to evaluate the likely value of the spectrum upon which they will be bidding.

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[145] See generally Implementation of Sections 3(n) and 332 of the Communications Act, Regulatory Treatment of Mobile Services, GN Docket No. 93-252, PR Docket No. 93-144, PR Docket No. 89-553, Third Report and Order, FCC 94-212, released Sept. 23, 1994, at para. 356.

[146] We note that Airtouch and Mobilevision have offered to limit the number of licenses they construct to 20 percent of the unbuilt licenses they hold. While we are not adopting this 20 percent limit, we expect all licensees to file modification applications only for those unbuilt licenses that realistically can be constructed by April 1, 1996. If the number of modification applications submitted significantly varies from the number built, we will consider appropriate measures.

J. Licensing of Non-Multilateration Systems

65. We proposed that non-multilateration systems be licensed in the 902-904, 912-918, and 926-928 MHz bands.[147] Mark IV believes that 6 MHz of contiguous spectrum at 912-918 MHz is sufficient for its type of system.[148] MFS Network Technologies/Texas Instruments recommend 12 or 14 MHz of contiguous spectrum for non-multilateration systems, but indicate that 10 MHz may be sufficient.[149] Amtech states that a minimum of 12 MHz of contiguous spectrum is required for non-multilateration systems, because these systems need 6 MHz wide channels and two such channels are necessary for high-speed operation at most toll booth locations.[150]

66. We also proposed that non-multilateration systems be licensed on a shared basis with licensees responsible for coordinating use to avoid interference.[151] Lockheed proposes licensing of non-multilateration systems based on a fixed mileage separation.[152] Mark IV supports the use of frequency coordinators to coordinate the assignment of spectrum.[153] NABER proposes that it be designated as the frequency coordinator for non-multilateration LMS systems.[154] We are adopting our proposal to license non-multilateration LMS systems on a shared basis because these systems generally cover relatively short distances, and licensing based on a fixed mileage separation would limit re-use of spectrum and thereby limit the potential uses of these systems. We also decline to designate a frequency coordinator for this service. Many non-multilateration licenses have been issued and many stations have been placed in operation without such a formal coordination process and there appear to be no negative consequences. Considering the limited coverage of these systems and the expanded amount of spectrum available under the allocation plan we have adopted, it should not be difficult for non-multilateration systems to share their sub-bands.

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[147] Notice at para. 25, 8 FCC Rcd. 2502, 2507 (1993).

[148] Comments of Mark IV IVHS Division dated June 29, 1993, at 8.

[149] Ex Parte Comments of MFS Network Technologies/Texas Instruments dated August 12, 1994.

[150] Ex Parte Comments of Amtech dated August 12, 1994.

[151] Notice at para. 25, 8 FCC Rcd. 2502, 2507 (1993).

[152] Lockheed comments at 4. Mark IV supported a fixed milage separation in its comments but modified its support in reply comments. Mark IV comments at 8-9, reply comments at 8.

[153] Mark IV reply comments 8-10.

[154] NABER comments at 6-7.

67. The Interagency Group, with the support of Mark IV, proposes that local governments be able to obtain blanket licenses for non-multilateration systems.[155] We decline to adopt a blanket licensing scheme for non-multilateration systems. In a shared use environment, it is important that applicants and other co-channel users know exactly where systems are located if they are to avoid interference. If we issue blanket licenses, it will be difficult for the Commission or the public to ascertain the exact location of LMS transmitters.

68. Finally, we proposed that existing non-multilateration systems licensed to operate in spectrum allocated for use by multilateration systems be required to move their operations within three years of the effective date of any new rules.[156] SBMS and Location Services support this proposal.[157] Both Teletrac and Amtech favor grandfathering existing non-multilateration systems, although Teletrac would only do so for systems licensed prior to the initiation of this proceeding.[158]

69. As discussed earlier, we have modified our proposal to provide for shared use of the 902.000-904.000 and 909.750-921.750 MHz bands by non-multilateration LMS systems, thus allocating a total of 14 MHz that will be available for non-multilateration operations. Although a non-multilateration licensee could be required to share 2 MHz of this spectrum (at 919.750-921.750 MHz) with an MTA multilateration licensee, we believe that the benefit to those non-multilateration systems requiring a minimum of 12 MHz of contiguous spectrum to operate remains substantial and warrants this overlap.

70. In addition, because we have concluded that sharing between multilateration and non-multilateration systems is technically inadvisable (see paragraph 46, supra), we are requiring that non-multilateration systems currently licensed to operate in spectrum other than the 902.000-904.000 and 909.750-921.750 MHz bands must apply to modify their licenses by April 1, 1998, to specify operation solely in those bands and to operate their systems consistently with the rules we are adopting by this Report and Order. This is consistent with our decision to require multilateration systems to relocate their operations within the same time period. Similarly, authorizations not so modified within this period will cancel automatically.

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[155] Comments of Interagency Group at 12; Reply Comments of Mark IV at 6-8.

[156] Notice at para. 16, 8 FCC Rcd. (1993).

[157] SBMS comments at 12; Location Services at 5.

[158] Teletrac comments at 22-23; Amtech comments at 36-38.

K. Multilateration System Operations

71. From review of the lengthy record in this proceeding, we have determined that multilateration systems have two distinct methods of operation. One type of multilateration system utilizes a low power, wideband location pulse originating from the mobile units and a high powered, narrowband interrogation and control signal emanating from the fixed/base stations. These systems also utilize narrowband transmissions, within the band that is used for the location pulse, for two-way voice and data communications between fixed/base stations and mobile units. Another kind of multilateration system operates in a different manner, utilizing wideband transmissions for: the location pulse from the mobiles, the interrogation and control signal from the fixed/base stations and the two-way messaging between the fixed/base stations and the mobile units. As we understand these two types of multilateration systems, there are three basic elements used to accomplish location and monitoring functions: forward links, reverse links and communication links. Forward links originate at the fixed/base site and are used to control and interrogate mobile units. In contrast, reverse links are signals transmitted from the mobile units or fixed station to fixed/base stations to determine the location of the mobiles or from fixed stations to other fixed/base stations for system synchronization and testing purposes. Communication links connect fixed/base stations and mobile units and are utilized for two-way messaging related to the location or monitoring functions of the system. In addition, multilateration systems use these three basic elements either in what we will refer to as the "narrowband" or the "broadband" portion of the LMS band. The narrowband portion we will define as the 250 kHz sub-bands (i.e., the sub-bands 927.250-927.500, 927.500-927.750 and 927.750-928.000 MHz) and we will define the broadband portion as the sub-bands 904.000-909.750, 919.750-921.750 and 921.750-927.250 MHz. Each of the three basic elements are discussed below in accordance with their location in the narrowband or broadband portion of the LMS band, along with how they are considered in our overall regulation of multilateration systems.

Narrowband Segment

a) Narrowband Forward Links

72. In the Notice, we observed that many multilateration systems are designed using forward links to contact units to be located.[159] Consistent with existing systems, we proposed that multilateration licensees authorized to operate in the 904-912 MHz sub-band be licensed to operate their forward links in the 250 kHz of spectrum between 924.890 and 925.140 MHz and that multilateration licensees authorized to operate in the 918-926 MHz sub-band be licensed to operate their forward links in the 250 kHz of spectrum between 904.375 and 904.625 MHz.[160]

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[159] Notice at para. 19, 8 FCC Rcd 2502, 2405 (1993).

[160] Notice at para. 19, 8 FCC Rcd 2502, 2505 (1993).

73. Teletrac is the only commenter that supports the proposed location of the forward links, claiming that it will be adversely affected otherwise because its systems now employ forward links in the manner proposed in the Notice.[161] MobileVision favors placing the forward links within a licensee's authorized sub-band rather than in the other multilateration LMS sub-band as proposed.[162] Location Services proposes keeping the forward links in the opposite sub-band but would move the links to the edges of each sub-band.[163] SBMS prefers that the forward links be placed as far from wideband frequencies as practical and assigned exclusively.[164] Pinpoint prefers a wideband forward link that operates over an entire multilateration system sub-band.[165] Amtech recommends placement of the forward links at the edges of the 902-928 MHz band or make licensees use alternative spectrum for forward links, such as common carrier or private carrier paging spectrum.[166] Symbol, ITRON and TIA urge that multilateration LMS forward links be placed at the upper edge of the 902-928 MHz band if Part 15 devices are to be accommodated.[167] Other Part 15 commenters expressed fear of being "drowned out" by high powered forward links, particularly wideband forward links.[168]

74. Although there is no identification of forward links in our current rules, we will define a forward link as any signal transmitted to a mobile unit to be located by a multilateration LMS system."[169] We will also dedicate a portion of spectrum in the 902-928 MHz band where narrowband forward links may be used by the multilateration systems that require them for their operations. Thus, in accordance with our band plan for multilateration systems, multilateration licensees will be authorized to use only the following spectrum for narrowband forward links:

The 904.000-909.750 MHz band narrowband forward link is 927.750-928.000 MHz
The 919.750-921.750 MHz band narrowband forward link is 927.500-927.750 MHz

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[161] Teletrac Comments at 51, Reply Comments at 33-35.

[162] MobileVision Comments at 43-44.

[163] Location Services Comments at 5-6.

[164] Ex Parte Comments of SBMS, dated August 12, 1994.

[165] Ex Parte Comments of Pinpoint dated September 19, 1994, Ex Parte Comments of Pinpoint dated September 15, 1994.

[166] Amtech Comments at 31-32.

[167] Further Comments of ITRON, Symbol and TIA dated August 12, 1994.

[168] See Itron comments, dated August 12, 1994.

[169] See Section 90.7 of our rules.

The 921.750-927.250 MHz band narrowband forward link is 927.250-927.500 MHz

The placement of narrowband forward links at the upper edge of the 902 to 928 MHz band meets the requirements of the majority of the multilateration industry and also accommodates the needs of Part 15 interests.[170] We have provided the flexibility requested by these various commenters, with two of the narrowband forward links placed in spectrum apart from the licensee's multilateration sub-band (e.g., the 927.50-927.75 and 927.75-928 MHz forward links) and the third forward link (927.25-927.50 MHz) placed adjacent to its related multilateration sub-band.

75. Based upon comments from entities that employ narrowband forward links, we believe that 250 kHz for each multilateration system is a suitable amount of spectrum for narrowband forward links.[171] Furthermore, because narrowband forward link transmissions will be situated in the uppermost portion of the 902-928 MHz band -- and thus somewhat removed from the operations of other licensed and unlicensed services in the band -- a relatively greater power level for this use should be permitted. We therefore will allow narrowband forward links to operate with a maximum power of 300 watts ERP.

Broadband Segment

a) Wideband Forward Links

76. Pinpoint and Uniplex have expressed interest in employing a wideband forward link, which, like the narrowband forward link, would be used to communicate with mobile units. However, unlike the narrowband forward link, a wideband forward link could operate over a multilateration system's entire authorized sub-band.[172] Part 15 users uniformly oppose this request on the grounds that such transmissions are likely to cause interference to Part 15 devices. Itron, for example, points out that the high powered wideband forward link could adversely affect the operations of Part 15 devices because it would "present an essentially constant signal at any particular geographic location."[173] Pinpoint, however, asserts that its

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[170] Ex Parte Comments of Teletrac dated August 12, 1994; Mobilevision Comments at 43-44; Location Services Comments at 5-6; Ex Parte Comments of Southwestern Bell dated August 12, 1994; Amtech Comments at 31-32; Further Comments of ITRON, Symbol and TIA dated August 12, 1994.

[171] Ex Parte Comments of SBMS dated August 12, 1994, Ex Parte Comments of Teletrac dated August 12, 1994, Ex Parte Comments of MobileVision dated August 12, 1994.

[172] Ex Parte Comments of Pinpoint dated September 19, 1994, Ex Parte Comments of Uniplex dated September 30, 1994.

[173] See e.g., Ex Parte Comments of ITRON Inc. at p. 3, dated August 12, 1994 and Symbol Technologies, dated August 12, 1994.

system, which is based on the use of the wideband forward link, would pose far less of an interference threat to users of the 902-928 MHz band than that caused by a certain, currently deployed Part 15 data distribution system.[174] We will permit the authorization of wideband forward links, but note that multilateration operations are conditioned on further testing as described in paragraphs 81-82, infra.

b) Reverse Links

77. As discussed above, a multilateration signal transmitted to the fixed/base stations will be referred to as a "reverse link" and is utilized by both types of multilateration systems. These signals are contained within the broadband segment of the multilateration allotment and are primarily location pulses originating from mobile units and used for determination of the position of mobile units. Such transmissions may also originate from other fixed/base stations for the purpose of system synchronization or testing. These transmissions are likely to occur less frequently and more randomly than the above-mentioned forward links and are therefore less likely to cause interference to Part 15 operations. However, as pointed out by one commenter, reverse link transmissions could present significant problems to Part 15 operations depending on the power levels, duty cycles and density of mobile units.[175] Reverse links are an essential part of any multilateration LMS system and therefore must be accommodated. However, in order to limit the potential for interference from such transmissions, we will limit the maximum power level of reverse links to 30 watts ERP. This is a sufficient amount of power to enable mobile units to provide an adequate signal to fixed sites for location, synchronization and testing purposes.

c) Communication Links

78. As noted by multilateration service providers,[176] there is an additional transmission that multilateration systems utilize for two-way messaging that we will refer to as a "communication link." The communication link emanates from the fixed/base stations and mobile units ancillary to the location and monitoring function of the multilateration system and provides status and instructional information relating to the vehicle being located or the occupant(s) of the vehicle. Additionally, these links may be interconnected with the PSN to enable emergency communications.[177] Moreover, the method of transmission of the communication link differs between multilateration systems, the differences centering on the

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[174] See comments filed by Pinpoint Communications, Inc., dated September 19, 1994.

[175] See letter from Metricom, Inc., Alarm Industry Communications Committee, Electronic Industries Association, Itron, Inc., Part 15 Coalition, Sensormatic Electronics Corporation, Southern California Edison, and Telecommunications Industry Association., dated August 12, 1994.

[176] See e.g., Ex Parte Comments of MobileVision dated December 14, 1994, at 1-2.

[177] See paragraphs 26 and 27, supra.

size of the channel(s) being used.

i) Narrowband Communication Links

79. Narrowband communication links are used in certain multilateration systems to provide voice and data communications within the broadband portion of their allocation of spectrum. Additionally, the narrowband communication link differs from a wideband communication link in that it uses small (e.g., 25 kHz) channels to accomplish its messaging functions. These narrowband transmissions are a valuable asset and are may enhance the economic viability and flexibility of these particular multilateration systems.[178] However, as we did for reverse links in order to limit their interference potential, we will also limit the maximum power of narrowband communication links to 30 watts ERP. This limitation encompasses communication links that originate at fixed/base stations as well as mobiles. Due to the fact that these transmissions should only occur sporadically or in the event of an emergency, we believe that this power level should serve to limit interference to Part 15 operations. However, we note that multilateration licenses are conditioned on additional testing as discussed in paragraphs 81-82.

ii) Wideband Communication Links

80. Certain multilateration systems use wideband communication links, integrated with accompanying wideband forward links, to provide messaging within the broadband segment. This wideband link differs from narrowband communication links because it transmits a direct sequence spread spectrum signal across the entire sub-band (e.g. all of the 904.000-909.750 MHz sub-band) instead of signals on small channels within the sub-band. Although these links are perceived to represent greater interference potential to Part 15 devices,[179] we conclude that these wideband links should be authorized. As noted earlier, however, multilateration system licenses are conditioned on additional testing as discussed in paragraphs 81-82.

Testing of Multilateration Systems

81. In comments, a number of parties to this proceeding have expressed the desire and need for additional testing to demonstrate the feasibility of multiple services coexisting in the 902-928 MHz band, in particular the multilateration LMS users and the operators of Part 15 devices. Our record contains a significant amount of information on the issue of mutual coexistence between these parties, which was submitted in the form of theoretical analyses, demonstrations and testing (See Appendix B). This record shows that certain aspects and elements of these various systems and services create a greater potential for interference than

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[178] See Ex Parte Comments of Mobilevision dated December 14, 1994, at 5.

[179] See e.g., Ex Parte Comments of Cellnet and KNOGO dated August 19, 1994, at 4.

others.[180] The band plan adopted in this item was crafted on the basis of this extensive record. In addition, these submissions were used to establish technical limitations or criteria on the operations of the various systems, to minimize the potential for interference and provide a more conducive environment for sharing of the band by the disparate services.

82. The record of this proceeding contains substantial technical analysis supporting the band plan we now adopt. We are persuaded, however, that additional testing could provide users of the band with data that could contribute to "fine-tuning" system operations. Therefore, to ensure that the coexistence of the various services in the band is as successful as possible and to identify whether further refinements in our rules are necessary, we will condition grant of each MTA multilateration license on the licensee's ability to demonstrate through actual field tests that their systems do not cause unacceptable levels of interference to Part 15 devices. To provide such protection and to facilitate band sharing and minimize interference to Part 15 operations, multilateration licensees may employ any one of a number of technical refinements, i.e., limiting duty cycle, pulse duration power, etc. It is our expectation that such testing be accomplished through close cooperation between multilateration systems users and operators of Part 15 systems.

L. LMS Below 512 MHz

83. In the Notice, we proposed that the expanded definition of LMS would apply to below 512 MHz systems, but that licensees of such systems would not be permitted to provide service to individuals or to provide service on a private carrier basis. NABER is the only commenter that addressed LMS operation below 512 MHz. NABER requests clarification of several points pertaining to these systems, including coordination requirements and co-channel separation requirements between LMS systems and non-LMS systems used for voice operations.[181] NABER also notes that proposed Section 90.105(b)(3)(i) discusses loading criteria for systems operating with single frequencies, two-frequency mode, and pairs of frequencies, but that Section 90.105(b)(3)(ii) only discusses separation criteria for operations using single frequencies or two frequencies. NABER suggests that because the loading criteria are the same, we apply the same separation criteria for single frequency operations to operations using pairs of frequencies.

84. Section 90.175 of our Rules provides that applicants for frequencies below 512 MHz must generally obtain a frequency recommendation from a frequency coordinator. We

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[180] Many of these submissions have focused on concerns regarding the use of wideband forward links for multilateration systems, the location of such links in the band, and the appropriate power levels for both forward and reverse link transmissions.

[181] NABER comments. NABER also requests clarification as to the effect our "Refarming" proceeding (PR Docket 92-235, Notice of Proposed Rule Making, 7 FCC Rcd 8105 (1992) will have on LMS systems. No final action has yet been taken in the Refarming proceeding. Ultimately, LMS systems below 512 MHz will have to adhere to any decisions reached in that proceeding.

conclude that LMS applicants should be subject to these same coordination requirements when applying for these frequencies. Accordingly, applicants for LMS systems below 512 MHz must meet the coordination requirement of Section 90.175(a) of our Rules, 47 C.F.R. § 90.175(a). Applicants will use the frequency coordinator for the radio service in which they have established their eligibility. We will also require LMS systems authorized below 512 MHz to modify their licenses under the same conditions as other land mobile licensees. This means that a modification application will have to be filed for changes in the number of base, fixed, control, or mobile transmitters.[182]

85. Section 90.105(b)(3)(i) only discusses using pairs of frequencies in the 470-512 MHz band. Because these frequencies are only available within 80 km (50 miles) of 13 major urban areas, applying a 120 km (75 miles) separation between non-LMS voice systems and LMS systems would severely restrict LMS use of this spectrum. Pairs of frequencies in the 470-512 MHZ band will be assigned in accordance with the allocation plan for the band as described in Subpart L, 47 C.F.R. Part 90, Subpart L, except that the 200 mobile unit loading criteria will apply and an LMS system will not be authorized to share a channel utilized by a non-LMS licensee operating a voice system unless an agreement with the licensee is reached. Accordingly, the co-channel separation between LMS systems and co-channel non-LMS voice systems in the 470-512 MHz band will be 64 km (40 miles), except on Channel 15 in Chicago, Channel 20 in Philadelphia, and Channel 17 in Washington where the minimum co-channel separation is 32 km (20 miles). See 47 C.F.R. § 90.313.

86. We also adopt our proposal to extend the definition of LMS to below-512 MHz systems. We are not, however, expanding uses of LMS systems below 512 MHz to provide service to individuals or to provide service on a commercial basis. Such commercial uses of LMS would be inconsistent with the nature of the spectrum below 512 MHz, which is intended primarily for the use of private land mobile radio (PLMR) communications to enable private land mobile eligibles to provide for their own internal communications needs. Moreover, the frequency bands below 512 MHz on which LMS systems are licensed are shared PLMR frequencies. Many of these channels are already unacceptably crowded. We are currently considering rule changes to increase channel capacity and promote more efficient use of PLMS frequencies below 512 MHz.[183] Permitting LMS systems authorized below 512 MHz to provide service on a commercial basis, or to provide service to individuals, would only exacerbate this spectrum congestion.

M. Technical Issues

87. In the Notice, we proposed a number of technical requirements for LMS systems to minimize the possibility of both co-channel and adjacent-channel interference and we proposed that equipment be type accepted to ensure compliance with these standards. The

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[182] See 47 C.F.R. § 90.135(a).

[183] See Notice of Proposed Rule Making, PR Docket No. 92-235, 7 FCC Rcd 8105 (1992).

following technical criteria will be applied to licensees of LMS systems. Our proposals, commenters' responses, and our decisions are discussed below.

88. Type Acceptance. We proposed that LMS equipment be required to be type accepted.[184] This proposal was supported by Teletrac, MobileVision, SBMS, Mark IV, and Location Services.[185] Teletrac proposes that we require the equipment to be authorized through the notification process one-year from the adoption date of this Report and Order, while SBMS suggests type acceptance after 18-months.[186] Location Services suggests that licensees be permitted to operate new equipment on a commercial basis for 18 months before such equipment must be type accepted.[187] We are adopting our proposal to require type acceptance. We decline to adopt Teletrac's proposal that we only require equipment "notification."[188] Considering the mobile nature of most LMS transmitters and that new, advanced technologies will be employed in this equipment, we find that the stricter regulatory oversight of having equipment type accepted rather than "notified" is justified. Accordingly, all LMS equipment imported or marketed after April 1, 1996, must be type accepted for use under Part 90 of our Rules, 47 C.F.R. Part 90. This includes the "transmitting tags" used in certain non-multilateration systems. If, however, these units meet the requirements of Part 15 of our Rules, 47 C.F.R. Part 15, they may be authorized under that Part. By delaying the requirement for type acceptance, we effectively adopt Location Services' proposal for a grace period in which to operate LMS equipment without authorization, albeit for a lesser period than 18 months. As discussed in the Notice,[189] licensees still in the developmental stages that do not wish to seek type acceptance may be licensed on a developmental basis in accordance with Subpart Q of Part 90.[190]

89. Emissions. We proposed that no restriction be placed on the type of emission that may be authorized for LMS operation in the 902-928 MHz band.[191] MobileVision and

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[184] Notice at para. 29, 8 FCC Rcd 2502, 2507 (1993).

[185] Teletrac comments at 48; MobileVision comments at 50; SBMS comments 23; Mark IV comments at 13; and Location Services comments at 3.

[186] Teletrac comments at 48; SBMS comments at 23.

[187] Location Services comments at 3.

[188] Teletrac comments at 48.

[189] Notice at para. 29, 8 FCC Rcd. 2502, 2507 (1993).

[190] 47 C.F.R. Part 90 Subpart Q.

[191] Notice at para. 30, 8 FCC Rcd 2502, 2507 (1993). See Section 2.201 of the Rules, 47 C.F.R. § 2.201, for a description of emission designators.

SBMS support this proposal.[192] Teletrac supports this proposal only if multilateration systems are required to be physically separated.[193] Teletrac claims that, in the absence of geographic separation, stricter limits on emissions are required to prevent interference between multilateration systems.[194] We are adopting our proposal to place no limits on the type of emission that can be authorized for LMS systems. Allowing any types of emissions will enable any type of location or monitoring technology or ancillary service to develop without restrictions. We will limit the likelihood of interference through appropriate power, frequency tolerance and emission mask limitations. Moreover, exclusive licensing of multilateration systems in MTAs in each of the three respective sub-bands should ameliorate concerns of co-channel multilateration LMS interference.

90. Bandwidth. We proposed to limit the bandwidth of LMS systems as follows:

for 904-912 and 918-926 MHz -- maximum 8 MHz
for 902-904 and 926-928 MHz -- maximum 2 MHz
for 912-918 MHz -- maximum 6 MHz[195]

MobileVision supports the maximum bandwidths proposed while Pinpoint opposes limiting the maximum permissible bandwidth within the 902-928 MHz band.[196] In conformance with the band plan we have adopted, we are adopting maximum permissible bandwidths as follows:

For Multilateration systems:

for 904.000-909.750 MHz -- maximum 5.750 MHz
for 919.750-921.750 MHz -- maximum 2.000 MHz
for 921.750-927.500 MHz -- maximum 5.750 MHz[197]
for 919.750-927.750 MHz -- maximum 8.000 MHz[198]

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[192] MobileVision comments at 50; SBMS comments at 24.

[193] Teletrac comments at 49.

[194] Id.

[195] Notice at para. 30, 8 FCC Rcd. 2502, 2507 (1993).

[196] MobileVision Comments at 49; Pinpoint Comments at 23-26.

[197] This includes 5.5 MHz multilateration bandwidth and adjoining, associated 0.25 MHz forward link.

[198] This bandwidth capability only exists for licensees aggregating the adjacent 2 MHz and 5.5 MHz multilateration bands and includes the adjoining, associated forward link bands.

For Narrow Band Links:

for 927.250-927.500 MHz -- maximum 250 kHz
for 927.500-927.750 MHz -- maximum 250 kHz
for 927.750-928.000 MHz -- maximum 250 kHz

For Non-multilateration systems:

for 902.000-904.000 MHz -- maximum 2.000 MHz
for 909.750-921.750 MHz -- maximum 12.000 MHz

While we establish these maximum permissible bandwidths, applicants for non-multilateration LMS systems should request only the minimum amount of bandwidth necessary to meet their operational needs.

91. Frequency Tolerance. We proposed a frequency tolerance for transmitters in the 904-912 and 918-926 MHz bands of 0.0005 percent and proposed that no minimum frequency tolerance be established for transmitters in the 902-904, 912-918, and 926-928 MHz bands.[199] The frequency tolerance for these systems would be specified on the station's authorization. MobileVision, SBMS, Mark IV, and Hughes support the proposed frequency tolerance of 0.0005 percent for multilateration systems and support having no specific frequency tolerance for non-multilateration systems.[200] Teletrac argues that tighter frequency tolerances are required and recommends a tolerance of 0.00025 percent for both multilateration and non-multilateration systems.[201] We agree with Teletrac that tighter frequency tolerances are justified to help reduce the potential for interference to systems operating on adjacent frequencies and that this argument extends to non-multilateration as well as multilateration systems. Additionally, as Teletrac points out, the frequency tolerance it has proposed is more liberal than that required for other services in the 900 MHz band. Accordingly, we are adopting a frequency tolerance of 0.00025 percent for both multilateration and non-multilateration systems.

92. Effective Radiated Power. We proposed a maximum peak effective radiated power (ERP) for any LMS systems operating in the 902-928 MHz band of 300 watts.[202]

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[199] Notice at para. 30, 8 FCC Rcd. 2502, 2507 (1993).

[200] MobileVision comments at 49; SBMS comments at 24; Mark IV comments at 13; Hughes comments at 13.

[201] Teletrac comments at 49.

[202] Notice at para. 30, 8 FCC Rcd 2502, 2507 (1993). The current maximum power for multilateration systems is 1 kW peak envelope power (PEP) transmitter output power. See existing 47 C.F.R. § 90.239(e)(2)(i).

SBMS supports our proposed 300 watt peak ERP.[203] MobileVision opposes any reduction in permissible power. AT&T and Hughes support a 30 watt ERP power limit for non-multilateration systems with 10 meter and 15 meter antenna height restrictions respectively.[204] Amtech and Pinpoint support various power limits for different systems based a shared use of the entire band.[205] Mark IV supports a field strength limit of 1 mV/m at 3000 meters with a maximum antenna height of 10 meters for non-multilateration systems rather than a limit on peak ERP.[206]

93. As discussed earlier,[207] we will limit the maximum ERP of multilateration LMS system narrowband forward links, which operate between 927.250-928.000 MHz, to 300 watts. However, we will limit maximum power for transmissions of multilateration system base and mobile stations outside the 927.250-928.000 MHz sub-band to 30 watts maximum ERP. Limiting base and mobile stations power levels will reduce the potential for interference between co-channel multilateration systems [208] and will reduce the likelihood of interference to any other operations in the 902-928 MHz band. In addition, we are limiting the peak ERP of non-multilateration systems to 30 watts over the licensee's authorized bandwidth and limiting the antenna height above ground of these systems to 10 meters. Reducing the maximum power and antenna height of non-multilateration systems will allow non-multilateration systems to share spectrum more easily with other non-multilateration systems and with users of Part 15 devices and will permit greater frequency reuse for these systems.

94. Currently, facilities authorized in the private radio services are categorically excluded from our rules requiring an environmental assessment to demonstrate that a facility complies with standards concerning human exposure to radiofrequency radiation. (See Second Report and Order, in Gen. Docket No. 79-144, 2 FCC Rcd 2064 (1987); and Erratum, 2 FCC Rcd 2526 (1987). The guidelines used for evaluating the environmental effects of radiofrequency radiation, however, are currently under review in ET Docket No. 93-62 (See Notice of Proposed Rule Making, ET Docket No. 93-62, 8 FCC Rcd. No. 93-62 (1993)). In that proceeding we note that some of the current categorical exclusions may be inconsistent with the new guidelines being considered. We wish to emphasize here that LMS systems will be required to comply with any requirements adopted in ET Docket No. 93-62.

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[203] SBMS comments at 24.

[204] AT&T comments at 7-8; Hughes comments at 7-9.

[205] Amtech comments at 33-35; Pinpoint comments at 31-34.

[206] Mark IV comments at 13.

[207] See discussion of Forward Links, paragraphs 73-76.

[208] We contemplate that this issue will have significance in MTAs where exclusive LMS licensees must co-exist with grandfathered LMS licensees.

95. Interference Criteria for Co-Channel Multilateration Licensees. Exclusive MTA multilateration LMS licensees and co-channel grandfathered multilateration LMS licensees must not interfere with one another. Similarly, exclusive MTA multilateration LMS licensees must also ensure that they do not cause interference to exclusive co-channel MTA licensees in adjacent MTAs. To help reduce the likelihood for interference between adjacent MTA licensees, we will impose a 47 dBuV/m field strength limit at the MTA boundary on signals transmitted from the base stations of MTA licensees.[209] If differences arise over whether interference has been caused, we will expect the particular licensees to cooperate with one another to resolve these disputes. Should the Commission have to become involved in any disagreements among licensees, we may employ a wide variety of tools to resolve such disputes.[210] These tools could include, but are not limited to, requiring use of a common controller or mandating a particular time sharing arrangement. If, however, we determine that an LMS licensee has not cooperated in developing a suitable mechanism to minimize harmful interference, or that a licensee's system design renders it extraordinarily sensitive to interference, we may authorize the other licensee to operate its LMS system regardless of interference caused to the LMS system that failed to cooperate or that has a system design highly susceptible to interference.

96. Emission Mask. We proposed that emissions anywhere within a licensee's authorized bandwidth not be required to be attenuated but that any emissions outside of the authorized bandwidth be attenuated by at least 55 + 10log(P) dB where P is the highest emission (in watts) of the transmitter inside the authorized bandwidth.[211] This requirement applies to both multilateration and non-multilateration systems. We also requested comment on whether multilateration systems should be required to distribute power evenly throughout

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[209] We note that in adopting this 47 dBuV/m limit, we are not determining that this field strength will necessarily result in reliable service for all multilateration systems. It is merely a level that may not be exceeded by MTA licensees and is thus established for interference planning purposes only. (see Second Report and Order, Amendment of the Commission's Rules to Establish New Personal Communications Services, GEN Docket No. 90-314, FCC 93-451, released October 22, 1993 at paragraph 177).

[210] Disputes over harmful interference (as described in Section 90.173(b) of our Rules) are typically resolved on a case-by-case basis. For these services, while absolute blocking of a licensee's transmissions throughout a large region would constitute the only clear-cut case of harmful interference (see Section 90.7 for definition of harmful interference under 47 C.F.R. Part 90), it is possible that lesser degrees of interference could diminish the accuracy or reliability of certain multilateration systems in a limited portion of a system's area of operation. The degree to which such lesser amounts of interference would be considered harmful cannot be determined in advance, and there can be no guarantee that licensees will be unconditionally protected from interference of this type. Because of these unique characteristics of multilateration systems, we decline to specify what will be considered to constitute harmful interference to such systems.

[211] Notice at para. 30, 8 FCC Rcd. 2507 (1993).

their authorized band.[212]

97. Mark IV IVHS was the only commenter that supports a requirement that power be evenly distributed across a licensee's authorized bandwidth. Both Mark IV IVHS and Teletrac believe that only emissions outside of the 902-928 MHz band (rather than any emissions outside of a licensee's authorized bandwidth) should be attenuated by 55 + 10log(P) dB. Mark IV IVHS would require that frequencies outside of the licensee's authorized bandwidth only be attenuated by 30 + 10log(P) dB, while Teletrac would just require that 99 percent of the power be within the licensee's authorized bandwidth. MobileVision would require that spurious spread spectrum emission should not exceed 100 + 10logP dBW/Hz and the level of any spurious discrete emission could not exceed 55 + 10logP dBW. SBMS would merely require that the first side-lobe be 20 dB below main lobe and each following side-lobe be progressively reduced by 10 dB out to the third lobe. Amtech and Pinpoint provide recommendations for various power, height and emissions limits for different systems and supports establishment of robustness and sharing requirements.

98. We will require licensees to attenuate their emissions by 55 + 10log(P) dB at the edges of the specified LMS subbands. The licensed frequency band edges for multilateration systems for which emissions must be attentuated are 904, 909.75, 919.75, 921.75, 927.50, 927.75 and 928 MHz. If the 919.75-921.75 and 921.75-927.25 MHz subbands are aggregated by a single licensee, the emission mask limitations at the band edges at 921.75 and 927.50 MHz may be ignored. The licensed frequency band edges for non-multilateration systems for which emissions must be attenuated are 902, 904, 909.75 and 921.75 MHz. These emission limitations will assure that multilateration and non-multilateration systems will not interfere with each other and that operations below 902 MHz and above 928 MHz are protected.

IV. CONCLUSION

99. Given the plethora of diverse users that share the 902-928 MHz band, this has been an especially difficult proceeding. While we strongly support and wish to encourage the continued development and deployment of an LMS industry, we also recognize the valuable services being provided by other users of this spectrum. We believe that the rules we have adopted herein fairly balance these diverse interests. While we have not been able to satisfy all of the concerns of all of the parties in this proceeding, we reviewed extensive comments and replies to the Notice as well as a very large number of ex parte filings in this docket and serious consideration was given to each position. Given the diverse and often mutually exclusive interests of the many parties that participated, our decisions were the best that could be achieved. The rules will allow for the continued growth of LMS services and

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[212] Id.