IX- CONCLUSION

The further comments filed in this proceeding serve to confirm the utility of SBMS' allocation proposals. Accordingly, if the Commission is not willing to wait for the conclusion of the MPRG study, it should adopt permanent LMS licensing rules that are consistent with SBMS' instant comments and with its prior submissions in this proceeding.

Respectfully submitted,

SOUTHWESTERN BELL MOBILE SYSTEMS, INC.

By: Wayne Watts by
Wayne Watts
V.P. & General Attorney

Southwestern Bell Mobile
Mobile Systems, Inc.
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Its Attorneys

March 29, 1994

A

ANDREWS OFFICE PRODUCTS CAPITOL HEIGHTS, MD (K)

EXHIBIT A

Declaration of B. Keith Rainer

DECLARATION OF B. KEITH RAINER REGARDING
ADDITIONAL COMMENTS SUBMITTED TO
THE FEDERAL COMMUNICATIONS COMMISSION
IN PR DOCKET NO. 93-61

I, B. Keith Rainer hereby certify:

1. I am currently an employee of Southwestern Bell Technology Resources where I have been a Member of the Technical Staff since 1990. My full qualifications have already been provided in this proceeding, most recently in the Reply Comments of Southwestern Bell Mobile Systems, Inc. ("SBMS") filed on July 29, 1993.

2. The following comments are provided in response to several additional comments submitted to the Federal Communications Commission this month by parties participating in PR Docket No. 93-61.

3. In preparing these comments I reviewed the submissions of PacTel Teletrac ("Teletrac"), Pinpoint Communications, Inc. ("Pinpoint"), MobileVision, L.P. ("MobileVision"), AMTECH Corporation ("AMTECH") and the TIA Mobile & Personal Communications Consumer Radio Section of The Telecommunications Industry Association ("TIA") and other Part 15 advocates. I offer several observations regarding the various comments.

SBMS' Allocation Proposals:

4. A number of commenters have roundly criticized the alternative proposals presented by SBMS in this proceeding. In its original Comments in this proceeding SBMS advocated the licensing of wide band and narrow band carriers in separate spectrum. SBMS advocated the licensing of multiple wide band providers by proposing the assignment of at least four separate 4 MHz wide band allocations in each market area. The bands proposed by SBMS included 904-908 MHz (Wide Band A), 908-912 MHz (Wide Band B), 918-922 MHz (Wide Band C) and 922-926 MHz (Wide Band D). SBMS offered two alternatives to this approach. Under SBMS' preferred plan the forward links utilized by wide band providers would be located in separate spectrum assignments of 250 kHz each at the edges of the 902-928 MHz band to minimize interference. As an alternative, primarily to accommodate the interests of narrow band operators by freeing up an additional 1 MHz, SBMS offered to accept assignment of the forward links inside each 4 MHz wide band allocation. In its recent ex parte submission (see Letter from Robert L. Hoggarth to William F. Caton dated February 2, 1994 ("SBMS Ex Parte")) and its latest Comments filed March 15, 1994 (hereinafter "SBMS Comments"), SBMS proposed a "revised" allocation scheme. The revised proposal would accommodate existing wide band licensees by shifting the proposed wide band assignments by two MHz to 906-910 MHz (Wide Band A), 910-914 MHz (Wide Band B), 916-920 MHz (Wide Band C) and 920-924 MHz (Wide Band D). Throughout this process SBMS has attempted to accommodate the technical needs of other carriers not,

as some commenters have suggested, SBMS needs. SBMS' system will function well in any of its proposals.

5. After analyzing the proposals of the other parties, it is evident that the proposals offered by SBMS remain superior. The foundation of SBMS' proposals is the assignment of four 4 MHz wide channels approximately in the same band location as the current interim AVM allocations. This allocation scheme offers several benefits. First, it minimizes any dislocation effects and expenses on currently operating systems and subscribers to those systems. Second, although it accommodates the wide band signal portion of systems advocated by Teletrac, MobileVision, and SBMS,[1/] it would not necessarily prevent LMS system operators from obtaining additional licenses in more than one of the four proposed channels if the spectrum were available.

6. The SBMS proposals also allow wide band system operators to have a predictable radio environment in which to offer a quality radio service. The proposals foster a competitive service environment. The proposals are spectrally efficient and have received qualified support from representatives of independent organizations.[2/] They allow system operators the maximum freedom for system enhancements, and they provide spectrum to non-wide band operators like Part 15 devices and narrow band LMS systems that is clear from any potential wide band LMS system interference, thus preserving their use of the 902-928 MHz band.[3/]

[1/] All three parties have asserted the ability to operate location services in 4 MHz bandwidth.

[2/] In comments regarding the Teletrac system, Dr. Jay Padgett of TIA has suggested that two 4 MHz bands would actually provide more capacity than one 8 MHz band. See Comments of TIA, Exhibit A (filed March 15, 1994). Dr. Brian Woerner of the Virginia Tech Mobile and Portable Radio Group ("MPRG") has also suggested that this would be a reasonable approach to spectrum sharing and preferable over time sharing. See report entitled "Capacity and Interference Resistance of Spread-Spectrum Automatic Vehicle Monitoring Systems in the 902-928 MHz ISM Band" prepared for SBMS by the Mobile and Portable Radio Research Group, Virginia Tech, and dated January 14, 1994 (hereinafter "MPRG Report").

[3/] Furthermore, the SBMS proposals establish bands for the narrow band forward links used by LMS systems which are currently deployed. The links, which would preferably be located at the band edges, could also be used to provide ancillary emergency voice services.

Pinpoint Communications, Inc. ("Pinpoint"):

A. Pinpoint's Time Sharing Scheme:

7. In its Comments, Pinpoint vigorously defends its own time sharing allocation plan. Pinpoint asserts that its plan for sharing the entire 902-928 MHz band by wide area and local area AVM systems is possible and practical. Pinpoint welcomes Teletrac's acknowledgement that sharing is possible. With certain modifications, Pinpoint believes that some of the elements of Teletrac's band plan, including a reserved 10 MHz sub-band, are worth considering.[4/]

8. Pinpoint incorrectly concludes that all wide area systems (LMS systems) are suited to time sharing.[5/] While a time sharing scheme could conceivably be developed which would be spectrally efficient for a limited number of systems with very similar technologies and network topologies, it is not a reality given the existing technologies of Teletrac, MobileVision, Pinpoint, and SBMS.

9. Pinpoint's discussion regarding the use of guard bands is particularly instructive on the issue of efficiency. Pinpoint asserts that under its time sharing scheme, time guard bands would be required to prevent interference between consecutive users of the band.

[4/] As part of its proposal, Pinpoint suggests that the Commission allocate the AVM band as follows:

- the 902 and 902.25 MHz band segment (250 kHz) would be allocated for emergency voice channels;
- the 902.25 to 902.5 MHz band segment (250kHz) would be set-aside for narrowband forward links or timing-system control channels;
- the 902.5 to 912 MHz band segment would be set-aside to be time-shared by as many qualified LMS providers as might apply; and
- the remaining 912 to 928 MHz band would be set-aside for sharing on a co-primary basis between wide area LMS systems and local area systems.

[5/] Pinpoint claims that vehicle location typically involves some sort of time sharing scheme among mobiles within an individual system. See Comments of Pinpoint at 5 (filed March 15, 1994)(hereinafter "Pinpoint Comments").

Pinpoint claims that this system would be efficient. It would in fact be wasteful because it assumes commonality of systems that does not exist. "Provided that all systems are coordinating with a common time standard to a certain degree of precision," Pinpoint claims "the size of such guard bands could be rather small."[6/] Pinpoint claims that practical mobile to base station communication range in the 900 MHz band is less than 20 miles, therefore, the maximum amount of guard band due to propagation time would be less than about 100 microseconds.[7/] Allowing for differences in GPS timing would add an additional 200 microseconds leaving the maximum amount of guard band needed at 300 microseconds.[8/]

10. Pinpoint's scheme appears to be based solely on its experience with its own particular technology. It reflects a misunderstanding of the 900 MHz radio environment and the LMS technologies of others. Pinpoint claims that each LMS system would have to make its own decision regarding the size of the guard band necessary for its operation to avoid interference. But in actuality the amount of time allocated to a guard band would largely be determined by the operating nature of the other systems in the band. Practical mobile to base station communication is determined by antenna heights and gains, transmitter power, receiver sensitivity, channel noise, and channel propagation characteristics. For example, SBMS's Chicago LMS System routinely experiences messaging and locating communication between mobile radio and base stations separated <u>by more than 30 miles</u> using mobile radios with a transmit power output 1/5 of that recommended by Pinpoint. Other technologies have other guard band requirements which would have to be adjusted by all operators. This time represents additional overhead and, therefore, spectral inefficiencies imposed by the sharing scheme. These inefficiencies would multiply as the plan sought to accommodate an increasing number of dissimilar technologies.[9/]

6/ Pinpoint Comments at 11.

7/ Pinpoint Comments at 12, note 22.

8/ <u>Id</u>.

9/ Moreover, in addition to GPS timing adjustments (if GPS were used as a reference), SBMS would be required to resynchronize mobile radios to its own network timing standard in each time slice. This resynchronization time is an overhead that does not currently exist for the SBMS system and would constitute an additional loss in capacity due to time sharing. SBMS' system does not provide a timing reference standard in its forward control links.

11. Under Pinpoint's proposal, with the entry of each new wide band LMS system in a market, incumbent operators will experience a decrease in system capacity, an increase in system delays, and an increase in time required to respond to a subscriber's request for service. As a result, guaranteeing a specific grade of service to subscribers, who will frequently use LMS for personal and vehicular security will be impossible.[10/]

B. Pinpoint's spectrum requirements:

12. Although Pinpoint's system can operate in 8 MHz of spectrum,[11/] Pinpoint has routinely expressed a desire to share a continuous 16 MHz or 26 MHz band of spectrum for wide band systems.[12/] This proposal is simply contrived to provide Pinpoint with access to as much of the band as possible.[13/] All currently deployed AVM systems, including Pinpoint's proposed system, can be accommodated under SBMS' allocation proposal. By obtaining two 4 MHz contiguous licenses, Pinpoint could operate its system efficiently under the SBMS plan.

10/ SBMS's LMS system in Chicago offers subscribers to its network an emergency response feature (similar features are also provided by Teletrac's and MobileVision LMS systems) which is activated when the subscriber and/or the subscriber's vehicle experiences an emergency event related to personal and/or vehicular security. SBMS' network supports unsynchronized unscheduled access for emergency transmissions which occur unexpectedly and require immediate access to the network. The viability of such unscheduled transmissions would be seriously impaired in Pinpoint's time sharing scheme because they would prevent immediate access to the network. This is yet another example of Pinpoint's failure to understand SBMS' AVM technology and an illustration of how Pinpoint's time sharing proposal would create an environment where service quality for AVM/LMS systems could be seriously diminished.

11/ See Comments of Pinpoint Communications, Inc., P.R. Docket No. 93-61 at 8 (filed June 29, 1993).

12/ Pinpoint attempts to justify this "more is better" philosophy in its Comments on an erroneous understanding of the relationship of capacity to bandwidth.

13/ Pinpoint states that its has no objection to modification of its proposal as long as 16 MHz of continuous spectrum is provided. See Pinpoint Comments at 3, note 7. Oddly enough, this accommodation is required by no party except Pinpoint.

C. Location Capacity and Bandwidth:

13. Pinpoint states that SBMS' four 4 MHz assignments would rob the public of the capacity gains and efficient use of the spectrum resource achievable by wider-bandwidth operation. Pinpoint challenges the MPRG conclusion that there is merely a more-than-linear increase in vehicle location capacity as bandwidth increases, and that data throughput experiences a gain merely proportional to bandwidth increases. In practical designs and applications, according to Pinpoint, the maximum data throughput is not governed by theoretical limits but by design trade-offs and the non-ideal characteristics of the mobile environment. Pinpoint states that because the available design trade-off options grow rapidly with increasingly occupied bandwidth, design throughput will in fact increase supra-linearly with bandwidth without exceeding the theoretical limits.

14. Pinpoint provides a Technical Exhibit prepared by Louis H.M. Jandrell as Exhibit B to its comments. Jandrell observes that "[t]he principles of Shannon, Cramer-Rao and others set outside theoretical limits for system throughput." Pinpoint Comments, Exhibit B at 1-2. These theoretical limits, according to Jandrell, describe operation under only "idealized conditions that are rarely, if ever, realized." Id. The accuracy of Jandrell' first statement, is challenged by his subsequent representations. One paragraph later Jandrell claims that Pinpoint's technology is not limited by these universally accepted bounds. "In Pinpoint's ARRAY system, a supra-linear relationship between data throughput and bandwidth arises." Id. at 2.

15. Jandrell's second statement is not supported by theory or practice. With respect to data capacity in a channel, the best that can be accomplished is a linear increase in capacity with bandwidth. The data capacity for a channel is given by the well known Hartley-Shannon relationship $C=B \log_2 (1+S/N)$ bits/sec where C is capacity, B is bandwidth, and S/N is signal to noise. Note the linear relationship of capacity to bandwidth. This result is for a white noise band-limited Gaussian channel. The actual capacity for a mobile radio channel (due to multipath, noise, etc. as correctly observed by Pinpoint) would be reduced.

16. An analysis conducted by Dr. Jay Padgett (Chairman, TIA Mobile and Personal Communications) of the Teletrac system location capacity reveals the relationship of bandwidth and capacity in a practical radio system. In a report reproduced in Exhibit A of TIA's latest comments Dr. Padgett explains that doubling of the spectrum available to an AVM operator would result in a capacity improvement of only 40 per cent. See TIA Comments, Exhibit A at page ii. Dr. Padgett

suggests that location capacity could actually be doubled by having two 4 MHz bands instead of one 8 MHz band.[14/]

17. The MPRG Report concludes that data capacity in a channel has at most a linear relationship with bandwidth. The report determines that while radiolocation capacity may increase at a rate slightly greater than linear with respect to bandwidth, that relationship must be examined further with respect to a practical system design. Pinpoint claims that the MPRG Report recognizes that radiolocation capacity increases more rapidly with changes in bandwidth, but that the report tries to downplay the importance of its observations by arguing that the increase in data throughput is only proportional to bandwidth. According to Pinpoint, occupied bandwidth is determined principally by radiolocation requirements, not those of incidental data messaging. Pinpoint Comments at 8. Pinpoint argues that it is logical that wider bandwidths would yield greater location capacities than the same amount of spectrum divided into smaller sub bands. Pinpoint asserts that SBMS' argument that the increase in data throughput is only proportional to bandwidth is irrelevant, because "all parties other than Pinpoint use a separate channel or forward link for control and data than that used for radiolocation." Id. Pinpoint is incorrect. SBMS' statement regarding data throughput is completely relevant because data from the mobile radio to the base station is sent in the wide band channel. In fact, SBMS' system also has a wide band forward link in the same channel as its wide band reverse link.

18. Finally, Pinpoint claims that SBMS' 4 MHz band proposal would constrain system flexibility and location accuracy because narrower bandwidths lose multipath distortion resolving capability, thereby severely reducing a network's capacity and reducing overall bandwidth utilization. In challenging SBMS' argument that increases in bandwidth result in only modest improvements of location accuracy from 1 MHz to 10 MHz, Pinpoint claims that SBMS' conclusions are based on operations using a CW signal, such as those used by cellular telephones, and are not applicable to pulse-ranging AVM systems. Pinpoint is wrong. SBMS' conclusion is based on the delay spread found in the mobile radio multipath environment at around 900 MHz. The delay spread is measured by using wide bandwidth pulses of very short duration-- not CW signals. The results are applicable to radiolocation in an environment of a

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[14/] Dr. Padgett's conclusions with respect to the Teletrac system, suggest that SBMS's proposed allocation scheme is the solution that will most benefit the public.

of a mobile radio operating around 900 MHz and have been measured for urban and suburban environments by a numerous researchers.[15/]

D. Pinpoint Mobile Unit Power:

19. Along with supporting the allocation of all 26 MHz of the 902-928 MHz ISM band for use by wide band LMS service providers, Pinpoint advocates a permissible output power of up to 50 watts for the mobile radios used in LMS systems. Pinpoint even suggests that Teletrac's interference problems could be corrected if Teletrac's mobile radios had a higher transmit power.

20. Pinpoint's recommendation with respect to mobile transmit power is at odds with every other commercial land mobile radio system of which I am aware. SBMS, MobileVision, and Teletrac are all moving towards lower mobile power levels to minimize interference to co-channel users of the band and out-of-band system operators, reduce component costs, and mitigate any potential environmental effects. Pinpoint is adopting a completely contrary philosophy, one that advocates shouting louder instead of listening more carefully.

21. Since Pinpoint's direction seems to be contrary to that adopted by the wide band industry generally, its continued advocacy of high mobile power levels may reflect the need (1) to avoid interference (i.e., Pinpoint's radio system is highly susceptible to interference); (2) to maintain the bit error rate at an acceptable level (again indicating inefficient system design by Pinpoint); (3) to increase the signal-to-noise level to increase data capacity; and/or (4) to minimize the number of base stations in the system (at the expense of other co-channel users). In any case, this approach does not speak well for either Pinpoint's technology or its concern for other users of this band.

MobileVision, L.P. ("MobileVision"):

22. MobileVision is particularly critical of SBMS' filings and the MPRG Report. As one of five "technical" attachments to its comments, MobileVision includes a ten page paper evaluating the MPRG Report. MobileVision acknowledges that the MPRG Report substantiates its positions on interference and the lack of feasibility of direct overlay and time sharing proposals and also supports the need for wide band providers to maintain exclusive control of the frequencies on which they operate. But, regarding conclusions with which MobileVision disagrees, it asserts that the MPRG Report is based only on technical

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[15/] See William C.Y. Lee, Mobile Communications Engineering, McGraw Hill, 1982.

literature and lacks the benefit of empirical data and field experience. According to MobileVision, the report's conclusions with regard to necessary bandwidth (capacity), chipping rate (reliability and accuracy), and operation of adjacent systems in the same 8 MHz band (interference) are incorrect.

23. MobileVision's criticisms are unfounded. First, the conclusion in the MPRG Report regarding bandwidth is accurate. The bandwidth of a spread spectrum system is normally measured null-to-null (twice the chipping rate) or from the 3 dB point to the 3 dB point of the main lobe of the direct sequence signal. For the wide band portion of AVM systems the null-to-null bandwidth is also the necessary bandwidth because readily available pulse shaping techniques allow the signal to be contained within this band. In this respect, MPRG is correct and was simply stating what is generally accepted.[16/]

24. MPRG's conclusion regarding the operation of adjacent systems in the same 8 MHz of bandwidth is also correct. Through the use of pulse shaping techniques, adjacent carriers can operate in the side lobes of another AVM carrier.[17/] The difficulty lies in MobileVision's purported systems operations, not in MPRG's analysis with respect to the wide band signal portion of the system.[18/]

25. Ironically, MobileVision's own system design decision supports MPRG's conclusion that operating systems in adjacent 4 MHz bands in each other's side lobes is reasonable. MobileVision's system design now calls for narrowband voice channels <u>in the side lobes of its wide band signal</u>. That design proves that interference is manageable. With respect to its side lobes, MobileVision is designing its system to do exactly what SBMS proposes can be achieved by adjacent license allocations.

26. Like Pinpoint, MobileVision also raises the issue of bandwidth versus capacity. As explained above, channel data capacity

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[16/] The MPRG Report does not advocate a reduction in chipping rate. MPRG does plan, however, to explore the relation of location capacity to bandwidth in more detail.

[17/] If pulse shaping techniques are not used to attenuate emissions outside of the null-to-null bandwidth, some adjacent channel interference will occur. But through proper system design this interference is readily manageable.

[18/] The plan cannot work if adjacent carriers are conducting voice and data transmissions in their side lobes.

has a linear relationship to bandwidth.[19] Within the limits of this relationship, no channel data capacity is lost by licensing two 4 MHz channels instead of one 8 MHz channel. With respect to location capacity, for a practical radio system location capacity (with respect to bandwidth) can actually be increased by dividing an 8 MHz channel into two 4 MHz channels. See TIA Comments, Exhibit A at page ii.

Pactel Teletrac ("Teletrac"):

27. Teletrac also criticizes certain aspects of the MPRG Report, particularly the conclusion that direct overlay of CDMA systems will be "problematic" if there are differences in system operating parameters. Teletrac claims that MPRG's conclusion is not applicable to its revised proposal because MPRG associates single receiver reserve link reception with the expected near/far problems. Teletrac claims that its proposal takes into account the multiple receiver reverse link associated with wide band LMS systems. Because it advocates sharing of the wide band return link, Teletrac also claims that its shared spectrum proposal can be effectuated with a minimum of service degradation.

28. Teletrac's contention is incorrect and is not supported by its previous comments in this proceeding. Moreover, having discarded its previous criticism of direct overlay, Teletrac never explains why that criticism was wrong or misguided. Throughout this proceeding, MobileVision and SBMS have cautioned that in the same geographic area, direct overlay of dissimilar direct sequence AVM/LMS systems is impractical.

Part 15 Advocates:

29. Part 15 commenters nearly unanimously claim that wide band systems and Part 15 devices will not be able to share spectrum with LMS providers without experiencing harmful interference. SBMS believes that those fears are unfounded.[20]

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[19] The data capacity for a channel is given by the well known Hartley-Shannon relationship $C = B \log_2 (1 + S/N)$ bits/sec, where C is capacity, B is bandwidth, and S/N is signal to noise. Note the linear relationship of capacity to bandwidth. This result is for a white noise band-limited Gaussian channel.

[20] SBMS acknowledges that MPRG anticipates that some interference between LMS systems and certain types of Part 15 devices may occur. MPRG intends to investigate the extent of any potential interference and the methods by which those interference concerns can be minimized or eliminated. Recognizing that MPRG's

(continued...)

30. SBMS proposes no change in the current status of Part 15 operators in the 902-928 MHz band. Part 15 devices and operators will continue to enjoy the same design freedom and the same degree of protection with which they are currently provided in the band.

31. Interference will exist within the band much as it exists currently. New and emerging devices will migrate into the band, providing their own contribution to the noise level of the environment, and other devices will migrate out of the band, eliminating their noise contributions. Selective location of devices operating within the band, as already demonstrated by many developers (such as those of cordless telephones), will minimize interference.[21/]

32. Several Part 15 commenters advocate relocation of wide band AVM/LMS systems to another band. Relocation would be inappropriate and unfair. Under the existing Interim Rules both AVM/LMS and Part 15 providers must share this spectrum. The Part 15 devices in operation today presumably are, and certainly should have been designed to operate in this shared environment. None of SBMS' proposals alter this sharing requirement. The only spectrum presently allocated

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[20/](...continued)
conclusions will be independent and objective, SBMS is willing to work under any conditions that MPRG's study reveals to be necessary to permit efficient use of the 902-928 MHz band provided that all band users also comply with those conditions.

[21/] Graham Smith, of MobileVision, has provided an excellent introductory interference analysis of Part 15 devices and wide band LMS systems. See Comments of MobileVision, Annex 2 (filed March 15, 1994). Dr. Brian Woerner of MPRG is also examining this issue as well as techniques to avoid interference in the independent study on LMS radio issues he is currently pursuing with support from Rutgers University's WINLAB organization. SBMS also plans to conduct a limited range of interference testing on its operational LMS system in Chicago. As evidenced in the attached September 20, 1993 Letter From C.C. Bailey of Southwestern Bell Technology Resources to Eric Schimmel of TIA, SBMS is willing to participate in the examination of these issues within the TIA standards organization.

for AVM service is in the 900 MHz band and it is to the requirements of this band that wide band systems have been developed and implemented. Part 15 entities have never enjoyed any priority rights in the band. In fact they have a large amount of other spectrum available for their use including (but not limited to) 100 MHz in the 2.4 to 2.5 GHz band and 150 MHz in the 5.725 to 5.875 GHz band. They can even target products for the new unlicensed PCS band which provides 20 MHz for voice based systems and 20 MHz for data.

I hereby certify under penalty of perjury that the above statements are true and correct to the best of my knowledge, information and belief.

Signed and dated this 28 day of March, 1994.

B. Keith Rainer

B. KEITH RAINER

Southwestern Bell
Technology Resources

September 20, 1993

Mr. Eric Schimmel
Vice President
Telecommunications Industry Association
2001 Pennsylvania Avenue NW, Suite 800
Washington, DC 20006-1813

Dear Eric:

Attached please find Southwestern Bell's response to your recent questionnaire regarding technical issues associated with docket 93-61. We regret that this response missed your requested September 10 deadline, but we trust that it will still be of value to you.

As you see from our response, Southwestern Bell would expect to participate in the technical meetings related to docket 93-61. However, there is one area of concern about the meetings that we feel should merit your careful attention. Our support would be based on TIA ensuring that the resources devoted to this effort would not divert support from the critical standards work that is currently taking place in the TR45 standards body. This group is currently developing a number of standards that will enable new capabilities and services to be offered by cellular carriers to their customers. Any diversion of TIA resources from support of those efforts could affect the agreed-upon schedules for these standards. Southwestern Bell would view such a situation as unacceptable.

550 Maryville Centre Drive
St. Louis, Missouri 63141

We look forward to working with you on this project. If you have any questions about our survey response, or our concern about resources and schedule, please do not hesitate to call me (314-529-7538) or Keith Rainer (314-529-7778) who is our technical expert on these issues.

Sincerely,

Chuck Bailey

C. C. Bailey
Director - Standards

Attachment

CC: Keith Rainer
John Stupka

DOCKET 93-61 AD-HOC QUESTIONNAIRE

1. Can we expect technical participation from your organization?
   ____X____Yes or _____No

2. If yes, will you be willing to make a nominal prorated contribution to cover the material expenses of the meetings?
   ____X____Yes or _____No

3. In what part of the country would you prefer one of more of the meetings to be held?
   Midwest (St. Louis, Dallas, Chicago) or Washington, D.C.

4. List in order of priority the issues which this effort should address.

   A. What are the relationships between noise, capacity, power and bandwidth for wideband LMS systems?

   B. What are the effects of narrow and wideband interference on LMS systems and what techniques can be used to mitigate these effects?

   C. Can wideband LMS systems co-exist on the same spectrum in the same geographic area and what are the system impacts? Also, what are the effects of interference due to part 15 devices operating in the same spectrum?

   D. How should the two 8 MHz AVM bands in the 902-928 MHz ISM be allocated? That is, should they remain as 8 MHz bands or be divided into 4 4 MHz bands?

NAME C. C. Bailey
COMPANY Southwestern Bell Technology Resources
ADDRESS 550 Maryville Centre Drive, Suite 300, St. Louis, MO 63141
PHONE & FAX 314-529-7538; 314-529-7674 (fax)

EXHIBIT B

Initial Review of Harmful Interference Between Locate One and Part 15 Devices

INITIAL REVIEW INDICATES NO HARMFUL INTERFERENCE BETWEEN LOCATE ONE AND PART 15 DEVICES

by Jonathan P. Riso, Director-Specialized Applications, Southwestern Bell Mobile Systems

In preparation of these reply comments, SBMS wanted to include information concerning the interaction between SBMS' Locate One system and Part 15 devices. Since the Locate One network is still being installed, only limited time was available for testing. The information in this section is preliminary only and will be supported by more extensive, quantitative testing on a wider variety of Part 15 devices. SBMS believes that the detailed analysis will support the initial conclusions contained here.

TESTED DEVICES

Four major categories of Part 15 devices have been targeted for interference testing.

- 900 MHz Cordless Telephones
- 900 MHz Wireless LAN systems
- 900 MHz Wireless Security Devices
- 900 MHz Wireless Point-to-Point Systems

At this time, however, only 900 MHz Cordless Telephones have been tested. The other types will be tested in the near future. The results of these tests will also be submitted to the Commission as soon as possible.

In addition to the targeted devices, SBMS will also be confronted with other users' signals in-band with Locate One's wideband signal. This will present other opportunities to verify that wideband AVM systems and other users can coexist. In fact, this has already occurred. While testing a Locate One receive site, a railroad tag reader was discovered nearby producing significant power in our wideband signal. Results of the preliminary testing of interactions with this narrowband AVM device is included below.

900 MHz CORDLESS TELEPHONES

A survey of 900 MHz cordless telephones was conducted. These devices have consumer interest because they extend the range of conventional cordless phones by 5 to 10 times. Now cordless phone users will be able to venture outside their homes and still use their "home" phones. In a recent test

conducted at the Consumer Electronics Show in Las Vegas, a reporter was able to travel seven-and-one-half miles from the phone base and conduct static free conversations using a 900 MHz cordless landline phone.

A survey of available models in the Locate One coverage area revealed the following information from the Owner's Manuals.

			Frequency Ranges (MHz)	
Mfr	**Model**	**#Channels**	**From Base**	**From Handset**
ATT	3900	10	902.300-905.000	925.070-927.750
NW Bell	900 MHz	60	902.120-903.890	926.120-927.890
Sony	ER1	40	902.050-904.000<*>	926.000-927.950
Uniden	EXP 9100	23	903.087-925.615	903.087-925.615
VTech	Tropez 900DL	20	905.600-907.500	925.500-927.400

* Direction of frequency use is not known for the Sony ER1

This survey shows readily that only one of these 900 MHz cordless phones uses frequencies in-band with Locate One's wideband signal, 918 to 920 MHz. The majority of phones are not in-band with Locate One, so they will not interfere with Locate One operation, nor will Locate One interfere with them.

The Uniden EXP 9100 uses a spread spectrum that occupies approximately 2 MHz bandwidth. When the phone establishes a link between the handset and the base, it appears to randomly choose one of 23 channels to occupy. Once a channel is chosen, it stays on that channel unless the signal degrades, in which case it hops to other channels, apparently randomly, until a satisfactory channel is found. Within that one channel, it appears that Time Division Duplex with 5 millisecond timeslots is used to provide two-way communications.

Cordless phone's impact on Locate One

To test the impact of the Uniden phone on Locate One, many attempts were made to get the phone to hop into the Locate One wideband signal, 918 to 920 MHz. The closest obtainable bands were roughly 916-918 MHz and 921-923 MHz. No configuration was found in which the phone caused any detectable interference with the operation of Locate One.

The majority of 900 MHz cordless phones in the survey do not use any frequencies in-band with Locate One's wideband

signal. Therefore, these phones could not interfere with Locate One's ability to determine vehicle positions.

Locate One's impact on the Cordless phone

Again, SBMS was unable to get the Uniden phone to be in-band with our wideband signal. However, we could get it to hop to an adjacent band. While in that position, if the phone's base station was placed within 10 feet of a Locate One transmitter, when the transmitter gave a location burst, there was a drop in the signal to and from the handset for approximately one-quarter of a second. There were no pops or hisses, just a drop in the signal. This drop will be quantified for the Commission as soon as testing can be completed. However, the perception to the user is of a minor interruption, one that is substantially less noticeable than interference experienced on conventional cordless phones.

Moreover, the majority of 900 MHz cordless phones in the survey do not use any spectrum in Locate One's wideband signal. Therefore, they are not impacted at all by Locate One's ranging signal.

RAILROAD TAG READER LOCATED NEAR RECEIVE SITE

While installing and testing the Locate One system, a power source was discovered close to one of our receive antennas. SBMS traced this signal and discovered a pair of railroad car tag readers within a mile of a Locate One receive antenna. These narrowband AVM devices are located across the train tracks from one another, separated by approximately 35 feet. As shown by spectrum analysis, these tag readers emit a continuous signal within the Locate One wideband signal. The tag reader signal is an unmodulated carrier centered near 919 MHz. The signal is sent continuously, whether a train is present or not. When a train is present, the distance between the reader and the train is estimated to be approximately four feet.

Tag Reader's impact on Locate One

The strong in-band signal power of the tag reader near the Locate One receive site causes a reduction in the sensitivity of the Locate One receiver. The impact of this upon the operation of the Locate One system is a reduction of the effective radius of the site. This less-than-optimal allocation of site assets is normal and expected in any land-based system design and therefore is allowed for in the

overlap of other receive sites. The decision whether the system can operate with this interference source becomes one of whether the site is participating in locating vehicles within the intended operating area.

A vehicle was equipped with Locate One equipment in the standard configuration, in which the effective radiated power from the mobile transmitter is 0 dBW. The vehicle was driven within the expected radius of operation of the site of concern. Even though some other Locate One sites in the area were not yet operational, the test vehicle was consistently and effectively located. Of greatest interest, the site of concern did participate in the location of the vehicle.

Locate One's impact on the Tag Reader

The Locate One site near the tag reader is a receive-only site. As such, it does not produce any interference with the railroad tag readers at all. Also, there are no Locate One transmit towers in the area of the railroad tag readers to produce interference.

If a Locate One-equipped vehicle were present near the tag readers, the readers may receive signal from the vehicle. The likelihood of Locate One causing interference, however, is slim for two reasons: timing and proximity.

Since actual details were not available in time for these reply comments, certain assumptions must be made about the operation of the tag readers. Assuming the tag readers can read a tag on a train approximately 20 feet away, that the distance to the train at its nearest point is 4 feet, and that trains can travel up to 30 miles per hour on this stretch of track, the tag reader has nearly a second to read a tag, only a portion of which is required. By comparison, the location burst of Locate One lasts approximately one-quarter of a second. Moreover, this would only become a consideration if there were a vehicle at that position on that road, and that vehicle was being located at that time, and there was a train on that part of that track, and that train's tag was being queried at that time.

The other reason Locate One will not interfere with the operation of the railroad tag readers is the distance signals from train tags must travel compared to the distance unwanted signals from vehicles must travel, and the correspondingly lower power of the interfering signals. The nearest road to the tag readers is about 400 feet away. A car on the road would be approximately 100 times farther

away from the readers than a train on the track. Since, in a typical mobile environment, power from a transmitter falls to the fourth power as the distance from it increases, a Locate One signal from a vehicle on the road would be received at only 10 one-billionths the strength of an equal signal from the train. Moreover, with the hidden antenna in a Locate One-equipped vehicle, the effective radiated power is 0 dBW.

INITIAL CONCLUSIONS

SBMS recognizes that these tests are merely anecdotal and realizes more quantitative information is needed to assist the Commission in evaluating the interaction of wide-band AVM/LMS systems with Part 15 users. It is SBMS' intent to do detailed analysis of the impact of Part 15 devices on Locate One, and vice versa, and to share the results of our studies with the Commission. At this preliminary point in testing, however, SBMS sees no indication of devastating interference from or to representative Part 15 devices. Further, no situation has yet been encountered that would require SBMS to request a change in operation, much less the termination of operation, of any Part 15 user. Similar conclusions are supported in initial testing with at least one narrowband AVM device.

It is important to stress that these conclusions are not to praise the unique design of Locate One and the Quiktrak technology. Rather, SBMS presents this information using Locate One as only one example of a modern radio design that allows successful cooperation of AVM/LMS band users. The Commission should make permanent rules based on technology that is available today and will be used into the future. It would be shortsighted to make suboptimal use of scarce spectrum by penalizing sophisticated system design to favor flawed, archaic AVM systems.