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August 26, 1994

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

Re: Ex Parte Submission
PR Docket No. 93-61

Dear Mr. Caton:

The attached statement of MobileVision, L.P. is respectfully submitted in response to materials previously placed on the record in the referenced docket. In addition, by telephone on August 22, 1994, Mr. Graham K. Smith of MobileVision spoke with Mr. Richard B. Engelman in the FCC Office of Engineering and Technology to advise him that the attached document was being prepared for submission.

Two copies of this notice are being submitted in accordance with Section 1.1206 of the Commission's rules.

Please associate this material with the record in this proceeding.

Sincerely,

REED SMITH SHAW & McCLAY

Marnie K. Sarver

Marnie K. Sarver

cc: Ruth Milkman, Office of the Chairman
Lauren J. Belvin, Office of Commissioner Quello
Byron Marchant, Office of Commissioner Barrett
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MobileVision's Comments to
Ex-Parte filing of Part 15 Manufacturers, Users and Associations,

(Reference letter from Henry M Rivera, filed August 12, 1994)

Summary

The Ex-Parte submission (the "Rivera letter") from the manufactures, users, and associations of manufacturers and users of Part 15 equipment contains several incorrect and misleading points. The same points are mirrored in virtually all of the other responses by companies manufacturing or using Part 15 devices. These points are in direct contradiction to the evidence that has been presented by MobileVision and other wide band LMS providers. Contrary to the points put forward by the Rivera letter and the Part 15 commenters, the facts are:

- Part 15 devices and LMS can exist in the same band.

  Analysis and practical evidence has shown that only in isolated cases will it be necessary to resolve an interference problem of a Part 15 device to an LMS site, and these cases are, in practice, limited to field disturbance sensor devices and outdoor, pole mounted, point to point links.

  The potential interference from LMS to Part 15 is very unlikely and limited to the outdoor Part 15 devices and the LMS high power forward links.

  The analyses produced by MobileVision are correct and the allegation that they are mathematically flawed is unfounded. In fact, the results are the same whether the Smith or the Padgett formula is used.

- No wide band high power LMS forward links should be permitted.

  MobileVision agrees that the interference potential of such links is sufficiently high that such high power wide band forward links should not be permitted.

- There is no fundamental reason why high power LMS narrow band forward links need be at the edge of the band

  Part 15 comments include many references that the devices are necessarily frequency agile in order to avoid blocked channels. Therefore, there is no reason to assume that the devices will be unable to avoid the LMS narrow band channels. It is very much preferable that the proposed 6 MHz LMS sub-bands are completely self contained.

- The wide band LMS providers have offered real compromise in creating a threshold for harmful interference.

  For example, attachment 1 to the Rivera letter concerns actual interference from Metricom devices to the Teletrac system. Under the proposed threshold, this interference would be below the threshold and hence not subject to dispute.

- The hierarchy rule must be maintained.

  The LMS system is constrained by frequency limits as well as physical site conditions. The closure or re-location of a site is costly and highly impractical. Metricom admit that their network "will cause catastrophic interference to wide band LMS systems". Without the hierarchy rule in place, the wide band LMS systems will be effectively eliminated from the band.

The Rivera letter, and all the Part 15 commenters, refer to an analysis performed by Dr. J Padgett on an interference paper submitted by G. Smith of MobileVision and state that Smith's interference analysis is "mathematically flawed" and thus is discredited. In fact, if the formula proposed by Dr. Padgett is used in place of Smith's formula, then *the results are the same*. The tables of results presented in Smith's paper are the same whichever formula is used.

The basic conclusion of the Smith paper, namely that large numbers of Part 15 devices can co-exist with wide band LMS systems, and that the interference problem is restricted to the outdoor pole mounted type of device, is perfectly valid. The Rivera letter, and all the Part 15 comments appear to make no attempt to separate the different types of Part 15 devices, and it appears that, effectively, only the Metricom system has been considered. It is also interesting to note that no attempt has been made to evaluate the interference effect of a Metricom type system on other Part 15 devices. It has the potential of being a much higher interferer than the LMS systems in that it proposes to use 2 W pole mounted transmitters[1] on a half-mile grid, each transmitter occupying the entire 26 MHz band and based on using the ALOHA multiple access scheme which will ensure that there are many repeat transmissions and transmit duty cycles up to 50%. It is surprising that the other Part 15 manufacturers and users have not raised objections to this type of system which could conceivably cause a significant interference problem to the vast majority of Part 15 devices, including many consumer devices.

Each of the points raised in the Rivera letter, is discussed further:

[1] This appears to be in violation of section 15.247 which limits the transmit power to 1W if omni-directional antennas are used.

1. Interference from LMS to Part 15.

The Rivera letter claims that interference to Part 15 devices from LMS was not discussed by the LMS providers[2]. To the contrary, the MobileVision paper submitted March 15, 1994[3], contains analysis on:

> Near Far Ratio for LMS mobile blocking indoor Part 15, section 5.5.
> Near Far Ratio for LMS fixed site blocking indoor Part 15, section 5.6.
> Near Far Ratio for LMS mobile blocking outdoor Part 15, section 6.4.
> Near Far Ratio for LMS fixed site blocking indoor Part 15, section 6.5.

Tables 6, 7, 8, 13, 14 and 15 in the MobileVision paper refer to the above. Therefore comprehensive analysis has been provided together with summaries and discussions of the results. The results basically indicated that indoor Part 15 devices would not suffer interference but outdoor Part 15 devices could[4]. All the relevant information was given in the paper. Thus MobileVision has discussed interference from LMS to Part 15 and has produced extensive analysis so that individual Part 15 suppliers could apply the techniques to the design of their own devices/systems.

2. Interference Issues

The Rivera letter states that Part 15 devices and LMS cannot co-exist in the same band[5] in total disregard of the evidence advanced by the LMS providers which demonstrates that only in isolated cases will interference issues require resolution. The statement in the Rivera letter appears to be mainly based on the analysis of Dr. Padgett which was attached to the Rivera letter as Attachment 2, and is referred to in several places. A separate statement regarding this analysis is attached as Annex 1 hereto. Basically the formula derived by Dr. Padgett gives the identical results to those examples given in the MobileVision analysis[6]. The Tables of results given in the MobileVision paper are the same whether the Padgett formula or the Smith formula is used. The results and conclusions of the MobileVision paper are therefore totally valid in contradiction to the claims of the Part 15 commenters. The Smith paper calculated the number of devices that could operate within the LMS sub-bands and showed that large numbers of devices could co-exist[7].

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[2] Page 2, para 2.

[3] Annex 2 to "Further Comments by MobileVision, L.P.", "Interference Analysis of Part 15 devices and wide band LMS systems - Initial Calculations".

[4] "The outdoor Part 15 radios and the LMS system are liable to interfere with each other and therefore it is probable that the outdoor Part 15 devices will be set to the middle of the band", Section 6.6. Summary.

[5] Page 3.

[6] "Further Analysis of Interference of Part 15 devices and wide band LMS systems - probability of interference", G K Smith, Ex-Parte submission, June 23, 1994.

[7] Page 24, Section 10 "Discussion" - "The results show that devices that transmit on a low duty cycle, even if transmitting 1W, can be virtually ignored. Between 3000 and 10000 indoor 1W devices, transmitting 1% of the time, in the LMS sub-band (in a 4-8 mile radius), are required before the LMS system will experience a 10% probability of loss of location. The equivalent number for the outdoor

The point that has been made clearly, by analysis and by example[8], is that the vast majority of the Part 15 devices will not be affected by LMS but that certain devices, such as outdoor, pole mounted devices, operating within the LMS sub-bands, will. The attachments to the Rivera letter, in fact, support entirely the conclusions drawn by G. Smith's papers. The basic formula and results have been actually corroborated by Dr. Padgett, in that his independently derived analysis produces the same results.

The further discussions, in attachments 2 and 3 to the Rivera letter, merely consider special cases, whereas the Smith paper clearly used a worst case analysis and clearly stated all the assumptions. For example, Zavrel's analysis (Metricom), submitted as attachment 3 to the Rivera letter, only considers its own system, and does not consider other, non-co-operative, outdoor Part 15 devices. Although Metricom use the ALOHA principle, with only 18% throughput (or 82% effective blocking), this may not be acceptable to other Part 15 devices which are trying to use the same band. Although there is a case to be made that the MobileVision paper was pessimistic in assuming 1 in 10^3 blocking, it is simple to apply different criteria. The MobileVision paper clearly stated the conditions and assumptions upon which it was based, so as to allow others to further apply the techniques. As has been stated before, the formula used in the MobileVision paper have been proved to be correct because the Padgett formula, independently derived, gives the same results as the Smith formula.

Also attached to the Rivera letter, as attachment 1, are a series of letters from Airtouch Teletrac (then Pactel Teletrac) to Metricom concerning interference experienced by the Teletrac system from the Metricom system. A degradation of 4-8 dB was reported by Teletrac. It should be noted that this level of degradation is less than the 10 dB level which the wide band LMS providers proposed as the threshold of acceptable interference. The comments made in attachment 1 of the Rivera letter do not make any reference to this or note that under the proposed interference threshold the reported degradation of 4-8 dB would *not* be considered as harmful interference. Instead, the Rivera letter proceeds to label the proposals from the wide band LMS providers "the so-called compromise", and in doing so blithely ignores the fact that the proposals would have *prevented* any complaint from Teletrac to Metricom. Thus, it is clearly shown that the proposals from the wide band LMS providers is a true compromise.

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devices is between 170 and 540."
"From these results it is clear that the effect of the LMS systems will not cause a dramatic decrease in the number of Part 15 devices in the field and similarly the number of cases where the LMS system operators will require the co-operation of a Part 15 user/supplier in order to resolve any harmful interference will be very limited."

[8] LMS Consensus paper on Part 15 interference, ex-parte submission, June 13, 1994.

3. The "Compromise"

The Rivera letter states that the LMS providers have offered a compromise on the resolution of interference which will "force Part 15 devices off the air"[9]. It further states that "no real compromise" has been offered. It has been clearly established that certain Part 15 devices have the potential to cause significant interference to an LMS system. The LMS system is constrained by frequency band limits as well as physical fixed site conditions. The Part 15 devices, on the other hand, usually have frequency agility, as has been clearly pointed out in the attachments to the Rivera letter, and because of their size are not so constrained to a particular location. The LMS providers have made a clear attempt at a compromise and have offered interference tolerance limits as well as a procedure designed to prevent any frivolous actions by the LMS provider. In fact, the 4-8 dB degradation from Metricom devices, as reported by Teletrac and the subject of attachment 1 of the Rivera letter, would fall below the LMS proposed interference tolerance threshold and therefore would not be considered harmful. A clear compromise on the part of the wide band LMS providers since such degradation effectively halves the range of the affected LMS site.

The Rivera letter states that a "significant proportion of Part 15 equipment" will be eliminated from the band"[10]. This must refer to those devices which exceed the thresholds as put forward by the LMS providers. Attachment 3 to the Rivera letter provides some characteristics of the Metricom system; 162 hopping channels, each 160 kHz wide occupying the entire 26 MHz band with a transmit duty cycle of up to 0.5. In each proposed LMS sub-band, a Metricom device would therefore, on average be present a maximum of 11.5% (6/26 x 0.5) of the time and in practice less than this. The LMS providers proposed an interference threshold that included a relaxation for duty cycles less than 10%, but this point has been totally ignored in the Rivera letter and by Metricom. In short, Metricom wants the whole 26 MHz, for a fixed outdoor network with universal coverage[11]. In clear contrast to the work and evidence put forward by MobileVision and other LMS providers, Metricom, or other Part 15 users have produced no analysis as to their effect from or to other Part 15 devices. In addition they have not considered or commented on the effect on the LMS systems of the less than 10% duty factor , which was clearly analyzed in the MobileVision paper and a major part of the proposed harmful interference definition. They merely state that they will cause "catastrophic interference to wide-band LMS systems", and, as later discussed, simply propose to eliminate the hierarchy rule in order to resolve the problem. This would, in practice, permit the Metricom system to be free to interfere with the wide band LMS systems and not allow any recourse by the wide band LMS provider. Furthermore we are led to believe that this system is a "significant proportion of Part 15 devices"[12], ignoring completely the very

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[9] Page 5, para 1.

[10] Page 5, para 2.

[11] Such a system, in fact, seems to be against the general intentions of the Part 15 band.

[12] In reading the response by Robert J Zavrel, of Metricom (attachment 3 of the Rivera letter), other Part 15 suppliers should note that the Metricom system deploys 2W transmitters on a half mile grid. In addition there are portable units. The throughput is governed by the ALOHA scheme and as such achieves about 18% throughput (i.e. 82% blocking) for a maximum presented traffic load of 0.5, thus

large numbers of Part 15 devices that can operate without harmful interference to wide band LMS systems.

4. Co-Existence

The Rivera letter advances the notion that exemption from the hierarchy rules enables co-existence[13] on the supposed basis that "the wide band LMS proponents really believe that Part 15 will not cause any significant interference to LMS providers". How can this statement possibly be made? The analyses and the field experience summaries that have been produced by the LMS providers have made the problem very clear, and the reality of that problem has been fully recognized by the Part 15 community. For example Attachment 3 to the Rivera letter, states in its conclusion "a fully operational Metricom MCDN network will cause catastrophic interference to wide-band LMS systems based on Smith's interference threshold".

In paragraph 4 of page 6, the Rivera letter concedes that "Part 15 devices are likely to cause interference to the reception of the (LMS) mobile signal"[14]. The Rivera letter then proposes that if both services were subject to section 15.5 then they would be "force(d) to use the best technology possible in order to co-exist in the band....". This is an amazing assertion, and is nothing short of an unfounded attempt to effectively change the status of the Part 15 devices (the Metricom system in particular) in a proceeding whose purpose is to define AVM/LMS parameters. If accepted, it would enable Part 15 systems to operate without restrictions and effectively block LMS sites at will. This would turn the regulatory framework on its head. If the existing hierarchy is not kept in place then the wide band LMS systems will effectively be eliminated from the band.

An additional point is that systems such as the one Metricom wishes to deploy, will normally have 26 MHz available, and, only in the case when the devices are less than a mile away from an LMS site [15], is it possibly reduced to 20 or 14 MHz. It is inconceivable that the capacity of the Metricom system will be dramatically reduced by this. This allocation represents significantly more bandwidth than the 6 MHz required by the LMS provider.

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there are many re-tries to be expected as the system load increases. As rightly pointed out by Mr. Zavrel, the use of pole mounted antennas means that the signal propagation is good and each antenna capable of producing significant signal strength for 32 miles! One questions and wonders if such a system should have the support of the Part 15 community as it represents a massive source of interference to the band for any Part 15 user, including indoor voice devices and especially any other outdoor Part 15 device.

[13] Page 6, para 2.

[14] A contradiction to the previous point of the letter.

[15] With 10% duty factor, the distance from an LMS in order to be below the proposed threshold is about 1 mile. See Annex 1 to Ex-Parte Statement of MobileVision, submitted August 12, 1994.

5. High Power Forward Links

The Rivera letter, and all the Part 15 commenters, have proposed that spread spectrum, high power forward links should not be used by LMS providers, since such transmissions could indeed present a devastating interference threat to Part 15 devices. They have also proposed that the LMS high power forward links be located in separate bands at 927.5 MHz. This common theme has obviously been circulated throughout the Part 15 community and appears in Dr. Padgett's paper on AVM/LMS design tradeoffs[16], attachment 3 to the Rivera letter. The only reason given is that the " necessarily high-power, narrow band forward links located near the band edges would be relatively easy for frequency-agile systems to avoid"[17]. Attachment 2 to the Rivera letter states that frequency agile Part 15 devices avoid interference by "dynamically replacing frequencies on which collisions occur"[18]. Similarly, when discussing direct sequence devices , Dr. Padgett points out that "As with FH devices, robustness in the 902-928 MHz band requires the capability to avoid interference, and a DS system should be able to access multiple frequency bands"[19]. This is done to avoid interference from all sources, <u>therefore a device would soon learn to avoid narrow band frequencies such as the LMS forward links, wherever they are.</u> Therefore, there is no compelling reason to position the forward links at the top of the band. Moreover, MobileVision supports that the proposed LMS 6 MHz sub-band allocation should not require any further out-of-band allocations[20].

Basically there is no reason why moving the high power links to the edge of the band should make any practical difference with respect to Part 15 interference, and hence MobileVision maintains that it is preferable to make the proposed 6 MHz wide band LMS allocation completely self contained [21].

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[16] "Wide area pulse ranging AVM/LMS: Messaging/locating system design tradeoffs and Part 15 interference." Dr. Jay E Padgett, Ex-parte submission August 12,1994.

[17] Page 33 of "Wide area pulse ranging AVM/LMS: Messaging/locating system design tradeoffs and Part 15 interference." Dr. Jay E Padgett, Ex-parte submission August 12,1994.

[18] Page 11.

[19] Page 12.

[20] See also page 4, Ex-Parte Statement of MobileVision, submitted August 12, 1994. If the Commission did wish to allocate further bands outside the 6 MHz allocation for the forward links, then MobileVision would possibly not object to this allocation, provided it is clear that it refers only to the high power narrow band forward link channels and that no emission designator restrictions would apply within the 6 MHz wide band LMS allocations.

[21] This is also strongly supported by the "Ad Hoc Gas Distribution Utilities Coalition", page 6, footnote 7.

Annex 1
Reference to Dr. J Padgett's
Comments on MobileVision's
"Further Analysis of Part 15 Devices and LMS Wideband Systems
Probability of Interference"

Summary

Dr. Padgett's comments state that the MobileVision blocking probability formula is mathematically flawed and thus Dr. Padgett derives his own formula. Unfortunately, Dr. Padgett did not apply his formula to any of the examples given in the MobileVision paper. If Dr. Padgett's formula is used in place of the MobileVision formula, to Tables 1 to 7 in the MobileVision paper[1], then it is found that ***the results are the same***.

The MobileVision formula, allegedly derived with "mathematical errors", provides the same results to those using the formula derived by Dr. Padgett. Thus it is clear that Dr. Padgett has actually confirmed the MobileVision results. Dr. Padgett appears to have committed a fundamental error in not applying his formula to any of the examples given in the original MobileVision paper

Those representing Part 15 equipment manufacturers have used Dr. Padgett's paper to make statements that Smith's paper "suffers from fundamental mathematical flaws" and is therefore invalid. Not one of them applied the formula to the examples in order to draw these conclusions and observations. If they had done so they would have quickly found that the results were the same. One can only assume that such acts are the result of either incompetence or are a deliberate act to mislead the Commission.

1. Introduction

Dr. J. Padgett has submitted Comments[2] on the MobileVision paper[3] on the probability of interference. In these comments Dr. Padgett states "MobileVision's analysis suffers from a number of faulty assumptions, as well as mathematical errors in the blocking probability derivation upon which the entire analysis is based"[4]. In fact, references to "mathematical errors" by MobileVision frequently occur[5]. In his paper, Dr. Padgett proceeds to derive his own version of the blocking formula and in so doing points out the "error(s)" in the MobileVision derivation.

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[1] "Further Analysis of Interference of Part 15 devices and wide band LMS systems - probability of interference", G K Smith, Ex-Parte submission, June 23, 1994.
[2] Ex-Parte submitted August 12, 1994.
[3] Ex-Parte submitted June 23, 1994.
[4] Page 1.
[5] Pages 1 (twice), 2, 6, 7, 9, 10, and 14.

2. Application of Dr. Padgett's Formula

Formulas (5) and (11) in the Comments, are identical and give the probability, *Pc*, of a clear channel as:

$$Pc = \frac{(NFR)^2}{N}\left[1 - e^{-N/(NFR)^2}\right] \qquad (1)$$

The MobileVision paper used a duty factor *Ft* which Dr. Padgett subsumed into *N* [6], the number of unwanted transmitters. Thus, the formula can be re-written

$$Pc = \frac{(NFR)^2}{F_t N}\left[1 - e^{-NF_t/(NFR)^2}\right] \qquad (2)$$

The condition of 10% probability of loss of location was used in the MobileVision paper. This corresponds to a blocking probability of 20% at one site (as per Table 1A in the MobileVision paper) i.e. $Pc = 0.8$.

Using, as example, figures from Tables 2, 4 and 6 of the MobileVision paper,

a) NFR = 13.3,	Ft = 0.1,	N = 800,	from (2),	Pc = 0.80
b) NFR = 3.4,	Ft = 0.5,	N = 10.8,	from (2),	Pc = 0.80
c) NFR = 23.7,	Ft = 0.25,	N = 920,	from (2),	Pc = 0.82

These are the effectively the identical results to those calculated using the MobileVision formula.

In fact, Tables 1 to 7 of the MobileVision paper have been re-calculated using formula (2), and the results are the same as those given in the MobileVision paper with the exception that for high values of NFR (Tables 3 and 6, which use NFR values of 42.2 and 23.7 respectively) the Padgett formula actually predicts slightly <u>higher</u> numbers of Part 15 devices can be tolerated. It is clear that the two formulas yield virtually identical results, and therefore MobileVision's results and conclusions have been validated.

3. NFR Value

Smith's probability formula has been criticized[7] because it can yield results "outside 0 to1 for various values of NFR". This is true only if a value for NFR less than unity is assumed. Technically, that limit should have been stated against the Smith formula but an NFR of less than unity means that interferers from outside the propagation area must be included and as such the basic concept of the derivation[8] is changed. The omission is an insignificant one as in no case was an NFR of less than unity considered in Smith's paper.

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[6] Page 6.

[7] Both Dr. Padgett and R. Zavrel (Metricom) stated that the formula was incorrect because it could yield results outside 0 to 1.

[8] i.e. the concept of the unit radius circle representing the propagation area.

4. Conclusion

In all the examples used in the MobileVision paper, the same results are obtained whether the Padgett or the Smith formula is used. The results are the same, hence the conclusions drawn from the results are totally valid. If the results are the same then it is inconceivable that the Smith formula is totally wrong. The conclusion is that Dr. Padgett has, in fact, totally supported all the results in the MobileVision paper by independently deriving a probability formula that gives the same results.

It is a pity that Dr. Padgett (and others) decided it was more productive to criticize the derivation by G. Smith rather than simply apply his formula to the examples in order to determine the results. Had he done so, he would have observed that the results were the same. Dr. Padgett's paper has been cited by all the Part 15 commenters in an attempt to show that the MobileVision paper was incorrect and mathematically flawed. It is astounding that not one of them applied the formula to the examples in order to see if it produced any differences vis a vis the MobileVision results. One can only assume that it was either incompetence or a deliberate act to mislead the Commission.

G K Smith
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