

APCO REPORTS



ASSOCIATED PUBLIC-SAFETY COMMUNICATIONS OFFICERS, INC.

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The following is a detailed issues statement of APCO's concerns regarding the FCC's spectrum "refarming" proposal in PR Docket No. 92-235, which was submitted to the Commission on December 15. The statement was prepared by an APCO Task Force on Spectrum Refarming consisting of APCO President John S. Powell, Executive Director Ronnie Rand, Second Vice President Ross A. Morris, Regulatory Review Committee Chairman Art McDole and APCO Counsel Robert Gurss.

The statement also reflects suggestions from APCO members and, on technical issues, from all of the major equipment manufacturers. The APCO Board of Officers is preparing an additional statement for presentation to the Commission recommending specific changes in the Commission's proposal that are necessary to alleviate the problems described below. Both documents will eventually become the basis of APCO's formal written comments in the Commission's proceeding.

APCO members are encouraged to submit their comments and suggestions regarding this Issues statement to members of the Task Force.

APCO Issues Statement - FCC Docket 92-235

I. SUMMARY

Public Safety Priority

Public safety communications priority ranks second only to national defense, as established both by statute and by court decision. APCO is concerned that the FCC's proposals in this proceeding are inconsistent with this statutory priority.

Specifically, refarming proposed for the 150-174 MHz band reduces public safety clock allocation bandwidth by .71 MHz, or by 23% of our current allocation. While the proposal would give public safety 464 "channels," the proposed 5 kHz bandwidth will not, in the foreseeable future, be capable of providing the quality of communications, and the features required, as discussed later.

In Docket 84-232, the FCC projected public safety spectrum requirements to the year 2000. In responding to the recent NTIA spectrum inquiry, APCO determined, using FCC formulas, that public safety spectrum use was 70% above that projected by Docket 84-232 for September 1992 (See Appendix A).

Section 88.429 proposes reduced transmitter output power that will cripple or destroy many existing systems, requiring the outlay of millions of dollars in public funds to add additional transmitters and sites to provide the same coverage and also requiring additional spectrum to link many of these new sites together. In many cases, the individual agencies will opt for additional frequencies to provide required coverage to avoid the expense of installing simulcast systems, thus requiring two or more times the initial number of channels.

Section 88.231 appears to prohibit mobile relay operation in the 150-174 MHz band for the Public Safety Service. Thousands of public safety systems (city, county, regional and state) now use mobile relays in this band. New allocations developed from splitting of current public safety channels in the 150-174 MHz band should be paired and assigned for exclusive public safety use.

The assignment of 5 kHz channels in the 150-174 MHz band appears to require equipment which will make state/local government incompatible with recently adopted 6.25 kHz federal government standards in the same band using the same equipment at reasonable cost. Local, state, federal interoperability, a major concern at all levels of government, will be lost.

Docket 92-235 envisions both state/local government and commercial users in the United States using the small "cellular" type of systems used in Europe. The major shortfalls of the "cellular" approach are what has caused active British participation in APCO Project 25 and a detailed inspection by their Home Office of larger coverage systems in the United States. Small, low-powered systems have specific applications, but do not fill the wide-area (state, regional, county) requirements of many of today's public safety and commercial systems.

II. MIGRATION

A. Time frames are unrealistic and, in some cases, undefined.

1. What are time frames for moving existing channel assignments to new channel assignments?
2. What are deadlines for these moves?

B. Section 88.413, Table C-1, Note 2, requires that new systems licensed after the effective date of the new rules must meet new narrowband requirements, even though equipment may not be available for these 5.0/6.25 kHz channels.

C. Section 88.245 is ambiguous. It discusses retention of frequencies after a system must meet the time requirements of 88.433 only in terms of "channel pairs."

1. No requirements on migration for simplex systems.
2. No rules on which portion of the old assignment is to be occupied by the existing licensee and which is available for new use.

D. While increases in spectrum efficiency are important, land mobile communications require a very high quality of service. This quality requirement is generally higher for public safety services and must not be compromised for the sake of spectrum efficiency.

Top engineers with leading United States public safety communications equipment manufacturers have provided the following information regarding proposed changes to existing equipment to support narrowband operation:

1. Reduced transmitter bandwidth will require a transmitter power increase of 20% to maintain equivalent range.

Reduction in transmitter bandwidth will have an adverse effect on receiver signal to noise by the ratio of 3/5 or 4.4 dB. Without corresponding improvement in receivers, performance will be degraded by a like amount. Adjacent channel protection interference ratio (ACPIR) is a function of both the transmitter and receiver, and must be calculated accordingly.

2. Received audio volume will also be reduced 40% to 60% requiring audio gain (amplification) to be increased. Increased amplification also increases noise which may effect intelligibility. Many

public safety agencies scan a number of frequencies, often from other local agencies. This is an issue of officer safety for many police agencies, especially those with overlapping jurisdiction. If all agencies being scanned do not reduce deviation simultaneously, output volume will vary greatly between channels making this feature unusable.

Available audio recovery power available in portable and mobile units used in high-noise environments (police crowd control, fire apparatus, etc.) may not be sufficient to allow radios transmitting with reduced deviation to be heard by the user.

Most current receivers do not use the concentrated or "lumped" circuit designs that allowed earlier receiver IF bandwidths to be easily reduced when channel widths were reduced in the past. Additionally, these integrated designs have been optimized for several characteristics, including selectivity, sensitivity, desensitization, and IM rejection. Changing one part of a design impacts all other characteristics. It is, therefore, impractical, if not impossible, to reduce the bandwidth of today's receivers.

Reduced deviation will remove approximately 50% of tone squelch decoder margin above threshold of detection. This will lead to system failure.

3. It may be possible to reduce deviation on some older transmitters by a field adjustment. Equipment manufactured since the early 1980s utilizes different technology; some will not have sufficient adjustment capability for deviation reduction to required levels. This limitation is equipment-specific and must be determined by each manufacturer.

4. Many of today's transmitters are type-accepted by the FCC for a single (or defined range of) power output(s). Attempts to reduce output power below these levels to comply with Section 88.429 will most likely result in spurious emissions.

5. There is no assurance that late-model equipment using synthesized frequency control can shift to the offset frequencies required in the new table of allocations. Much, if not most, of the newer equipment will not be capable of shifting.

6. Digital encryption will not work with reduced deviation.

7. Reduced deviation at the initial stage of implementation will render public safety paging receivers unreliable, if not inoperative, as they are designed to operate at the full 5 kHz.

Commercial paging frequencies are grandfathered at 5 kHz, necessitating development of a special product for public safety paging for the vital purpose of alerting emergency police, medical and especially fire personnel.

8. New offset frequency requirements and more stringent frequency tolerances will render obsolete most current test equipment.

E. There is no apparent graceful migration path or means for old equipment to communicate with new 5.0/6.25 kHz equipment, thus necessitating complete change out of systems.

1. There is no interoperability during changeover period (which could be several years) as different agencies change on different schedules. Project 25 spent extensive resources to research migration schemes and provide both backward/forward interoperability which is negated by this proposal.

2. The interoperability impact will, in most cases, render mutual aid plans unusable throughout the changeover period. In states that are large both geographically and by population (California, Florida, Texas, etc.) statewide mutual aid communications will be impacted throughout the transition period as metro areas change early, followed by rural areas many years later.

F. Section 88.231, as written, precludes mobile relay operation as it presently exists in the 150-174 MHz band for Public Safety Services.

1. Thousands of public safety systems (city, county, regional and state) now use mobile relays. How can they continue to operate? When must they reduce bandwidth? Vacate current channels? Where can they go?
2. Designating many new channels as "mobile only" or "low power" has the same effect; 150-174 MHz systems as we know them today will vanish or must undergo dramatic change.
3. NEW ALLOCATIONS developed from splitting of current public safety channels in the 150-174 MHz band should be paired and assigned for exclusive public safety use.

III. FREQUENCY COORDINATION

A. The proposal does not include criteria for mileage separation, except on exclusive use channels.

B. Methods/criteria for coordination vary greatly among current coordinators, even within the consolidated services specified in the new proposed rules.

C. Coordinators do not share a common data base.

1. Without a single common data base, critical coordination information is not available real-time:
 - Applications in process by another coordinator for the same frequencies;
 - Date and time application received by coordinator;
 - Detailed technical parameters on transmitter, such as antenna characteristics, CTCSS, etc.

D. Vertical vs. horizontal channel loading will not work for public safety.

1. Life-threatening situations need a clear channel.
2. For operational and political reasons, stacking of dissimilar public safety services onto a common conventional channel where signals overlap is ill-advised.
3. The only time different public safety services have been able to successfully share systems is when priorities can be automatically established by the equipment being used. This application is currently limited to public safety trunking systems.

E. Third-part providers must not be allowed to hold licenses in the public safety services; only government should be eligible for public safety blocks.

1. Public safety users need to control their own systems; they can not be dependent on a third-party who could fail to provide required services, leaving an agency without public safety communications until its contract could be litigated.
2. Labor disputes impacting the third-party leave public safety with little control, whereas government employees are usually prohibited from striking.
3. Licensees have always been able to contract with a third-party to provide communications; with the current method, public safety retains control of licenses and, thus, always has frequencies available.

F. Dual rules apply for low-power channels. Section 88.909 specifies 2-watt transmitter output provided the antenna does not exceed 20 feet above ground. This could, and does, result in 20 or more watts of ERP (effective radiated power) with an HAAT (height above average terrain) of several thousand feet. Section 88.429 limits power to 5 watts ERP if located in excess of 590 feet above HAAT. The potential for interference from "low-powered stations" can be as much as 10 dB greater than from a conventional station when located at high HAAT.

G. Although it might be contended that public safety gains additional channels by making them eligible in the General Category pool, examination of licenses will show that historically, in instances such as the 150-800 MHz General Access and the TV-shared 470-512 MHz pooled frequencies, public safety accounts for less than 1% of all licenses. Public safety cannot successfully compete for channels on an even basis with non-public safety entities due to widely differing channel requirements and funding cycles.

IV. CHANNEL ASSIGNMENT PROPOSAL

A. The proposal provides no discrete public safety service blocks (PF, PL, PP, etc.). This has been the subject of APCO's comments in response to the spectrum refarming Notice of Inquiry.

1. All public safety services do not have equal priority. For example, Local Government Radio Service users are not currently afforded, nor do they require, the same quasi-exclusive use protection given to Police/Fire Radio Service licensees.

B. Interspersing of SMR channels into public safety blocks is not a workable solution.

1. One of public safety's largest current problems is adjacent channel coordination, even with other public safety service coordinators.

2. Public safety users tend to operate in defined geographic areas, while commercial users operate in wide and often undefined areas (any place their equipment will work). SMR mobiles on adjacent channels drifting into range of a public safety system could render public safety receivers inoperable.

3. Public safety often co-locates its sites with other commercial users; adjacent channels cannot be co-sited, especially with reduced bandwidth and adjacent channel interference protection ratios inherent in these designs. Within the public safety services such conditions can be controlled; this is impossible with commercial licensees.

4. EIA has made comparisons between a 25 kHz FM channel and a 5 kHz Side Band system for constant interference (each with equal adjacent channel interference). The study showed that the geographic separation for the Side Band interfering signal could come from up to 2.7 times greater distance than that of the reference 25 kHz FM system. This is demonstrated in Attachment B.

5. THERE IS NO POSSIBILITY of developing wider bandwidth systems (e.g., high-speed data for photos and fingerprints, and TDMA), by combining adjacent channels in the 150-174 MHz band because the proposed non-public safety assignments will preclude combining more than two channels (10 kHz).

C. The lack of statewide exclusive channels will virtually eliminate the possibility of any wide-area government systems. It will not be possible for states, especially large states like those previously listed, to secure a statewide assignment due to competition for spectrum from other users in the major metropolitan areas.

D. Assigning two channels to an entity that has met the time requirements for narrowband

changeover proposed in Section 88.245 will not necessarily provide a usable system unless the entity can make wideband use of both frequencies. Adjacent channel interference could make either or both assignments unusable as individual channels.

V. EFFECTIVE RADIATED POWER BASED ON HEIGHT ABOVE TERRAIN (Section 88.429)

A. THE EARTH IS NOT FLAT. With the proliferation of quality personal computer-based spectrum engineering programs, propagation prediction is both available and affordable. The FCC needs to establish a procedure to accept coverage prediction models to service Part 88 licensees. Applicants would be required to file coverage report(s) with each application showing that coverage did not exceed service area. Such services could be performed by the coordinator for a fee, by a consultant, or by the licensee if they chose to purchase the program. For users of shared systems (or add-ons to SMRs), it would only be necessary to demonstrate that a system with coverage limited to the user's service area was being proposed. It would be up to the service coordinators to make this decision. This method is now used by most NPSPAC Regional Plan Committees to maximize spectrum reuse. As part of the coordination process, good RF engineering practices (directional antennas, downtilt, reduced power, etc.) are ensured.

B. The proposed requirement will limit the use of antenna downtilt as an effective method of limiting coverage. The only practical method of developing downtilt is to start with a medium to high-gain antenna. Because antenna gain increases ERP, the situation becomes self-limiting.

C. The proposed requirement is a disincentive to use antennas with patterns tailored to coverage area. ERP calculations do not take into account the directional pattern of an antenna. In fact, highly directional antennas with limited coverage can have higher ERPs than non-gain omni-directional antennas which have a much larger coverage area.

D. The current ERP/HAAT proposal would devastate existing systems at all levels of government, but especially regional and statewide systems. The reduction in coverage is clearly shown in a series of coverage maps from around the United States included as Appendix C.

E. Coordination must be based on service area and field strength contours, as used in NPSPAC Regional Plans. Service area coverage is required; therefore, spectrum will be used whether from one or from 10 transmitters.

F. Current proposal would actually require more spectrum to provide coverage. Coverage is required, so users will have to add more transmitter sites to cover current area, plus use additional spectrum (microwave or fixed links) to interconnect these sites. In many cases, the individual agencies will opt for additional frequencies to provide required coverage to avoid the expense of installing simulcast systems, thus requiring two or more times the initial number of channels.

G. Firm ERP rules can apply at most on a local or regional basis and vary dramatically between regions, especially when topography is considered.

VI. TECHNICAL ISSUES REGARDING NEW EQUIPMENT

A. While increases in spectrum efficiency are important, public safety communications requires a very high quality of service. As previously stated, the high standard of service required for public safety communications mandates an appropriate balance between spectrum efficiency and quality of service. For two years, APCO Project 25 has considered this balance and has arrived at the conclusion that the smallest practical channel bandwidth for public safety systems at the present time is 12.5 kHz, with an ultimate goal of 6.25 kHz. There is general concurrence between equipment suppliers and users that

bandwidths below 6.25 kHz will not support critical features such as public safety trunking, voice recognition, and encryption that is essential to public safety operations. The proposed Project 25 standards have been demonstrated to provide these features throughout the user's service area with sufficient overhead for additional features as technology develops. No other system has demonstrated even similar capabilities.

1. In defining the parameters for Project 25, consideration was given as to when key components (such as linear amplifiers) would be available for mass production. A stepped conversion to 12.5 kHz and finally to 6.25 kHz bandwidth, using an interim compatible digital modulation scheme (QPSKC) for forward and backward compatibility, has been selected as the best alternative.
2. Even so, Project 25 is not sure when 6.25 kHz equipment will be available. APCO strongly recommends that final narrowband specifications be reviewed several years after the interim move to 12.5 kHz bandwidths is completed.
3. Cellular and Personal Communications Services are based on quality of service. There are no channel loading requirements for these services.

B. Proposed frequency stability (Section 88.425).

1. The proposed .1 ppm for base stations operating above 174 MHz is not economically feasible. Such highly stable oscillators will approach the cost of the entire base station.
2. Amplitude types of modulation can experience as much as 10-14 dB more degradation due to impulse noise than frequency modulation for a given frequency error.

C. Availability of highly linear amplifiers is an absolute requirement for the narrow bandwidths (5 or 6.25 kHz) being proposed. The question is: When will these be commercially available in a usable size at an affordable price within the required frequency bands?

1. Amplifier power consumption must be considered; linear amplifiers are not power-efficient. While this is critical for portable equipment (due to battery service per charge), it is important for environmental and economical reasons in all equipment.

D. Use of Amplitude Modulation Technology

Many of today's sites, both commercial and public safety, are located in congested areas near or on private residence buildings. The use of high-power, non-constant carrier methods of modulation will result in audio frequency rectification in many types of household and commercial entertainment equipment. Likewise, communications receivers for these same modulation schemes will be susceptible to interference from household and commercial appliances.

E. Narrowband equipment needs to support trunking and encryption.

1. Public safety encryption and trunking both require transmission of a digital signal on each voice channel. A digital modem would have to be applied for any analog modulation scheme such as ACSSB or SSB-TTIB (SSB-Transparent Tone In-Band).
2. The data rate of encryption and, thus, the quality of encryption, and the features supported on a trunking system, will be limited by the narrow channel.

F. Time frame to implement new equipment.

1. Technology that will be available in the time limits imposed by Docket 92-235 will not meet the requirements of the public safety services.

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VII. MUTUAL AID AND INTEROPERABILITY

- A. Insufficient and undefined mutual aid exclusive channels by service.**
- B. Disaster cache radios (example: 8000+ at Boise Interagency Fire Cache) will be obsolete.**
- C. State Mutual Aid communications plans will be eliminated for lack of channel assignments.**
- D. No compatibility with federal government in the 150-174 MHz band.**
 - 1. VHF high band is the most popular for local/state and federal interoperability. The federal government has selected channel widths of 12.5 and 6.25 as their standard.
 - 2. The assignment of 5 kHz channels in the 150-174 MHz band appears to require equipment which will make state/local government incompatible with recently adopted NTIA 6.25 kHz federal government standards using the same equipment at reasonable cost. Local, state, federal interoperability, a major concern at all levels of government, will be lost.

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