

Before the
Federal Communications Commission
Washington, D.C. 20554

GEN. Docket No. 88-441

In the matter of

Technical compatibility protocol
standards for equipment operating
in the 800 MHz public safety bands.

MEMORANDUM OPINION AND ORDER

Adopted: February 22, 1989; Released: May 1, 1989

By the Commission: Commissioner Quello concurring and issuing a statement. Commissioner Dennis issuing a separate statement at a later date.

I. INTRODUCTION

1. On September 7, 1988, we released a *Notice of Inquiry* to explore the advantages and disadvantages of adopting a uniform trunking standard for radio equipment manufactured for trunked operation in the 821-824/866-869 MHz public safety spectrum.¹ In response to the *Notice* we received comments and reply comments from a variety of organizations and individuals representing public safety communications equipment manufacturers, the public safety community, and other interested organizations.

2. After careful consideration of the record developed herein, we have concluded that a Commission-mandated uniform trunking standard for analog communications is not necessary to achieve adequate interoperability among 800 MHz public safety entities. Our decision is not intended to prevent the industry from pursuing enhanced interoperability capabilities, either through the regional planning process established in the Public Safety National Plan proceeding,² or through the development of compatible trunked public safety communications systems. We conclude, however, that the steps we have taken to assure interoperability are adequate and that further federal intervention is not warranted at this time. We also conclude that the public interest will be served in this matter by the timely licensing of public safety communications systems. There is an immediate need for essential public safety systems in some areas of the country and the comments emphasize the importance of licensing these services without delay.

3. Our objective in this proceeding was to determine whether a trunked technology standard for analog communications³ should be developed to achieve enhanced interoperability among various trunked public safety radio systems. We conclude that it would be inappropriate to consider imposing standards utilizing this existing technology at this time. Rather, we believe the public safety community's interest in interoperability and our overriding objective of providing maximum spectrum efficiency will best be served by focusing on the development and

use of future technologies, *i.e.*, digital and other advanced communications technologies. Accordingly, we will initiate a further inquiry in this docket to explore the ways in which future radio communication technologies can be used to meet the evolving operational and spectrum needs of the public safety community.

II. BACKGROUND

4. On December 18, 1987, we released a *Report and Order* adopting policies, service rules, and technical standards to govern use of the 821-824/866-869 MHz public safety spectrum. Several petitions were filed asking reconsideration. On July 20, 1988, we adopted a *Memorandum Opinion and Order on Reconsideration*⁴ addressing four of these petitions, including one filed by General Electric Mobile Communications Business (General Electric) seeking reconsideration of our decision in the *Report and Order* regarding trunking standards for equipment operating in the 800 MHz public safety spectrum. We concluded that a further proceeding was necessary to explore fully the question of trunking standards. We therefore released a *Notice of Inquiry* on September 7, 1988, requesting public comment on issues relating to technical compatibility protocol standards⁵ for 800 MHz public safety equipment.

5. Although we received comments on General Electric's petition for reconsideration, the record was insufficient to support a conclusion regarding the trunking standards question. In particular, the comments did not fully discuss (1) the utility of standards or the time necessary to develop standards, (2) whether a trunking standard would result in interoperability, or (3) the effect trunking standards could have on the cost of radio equipment or on the evolution of trunking technology.⁶ Accordingly, the *Notice* sought information on four issues central to the trunking question:

- 1) the timeframe necessary to develop a standard and market equipment using the standard;
- 2) how the use of a common signalling standard could enable intercommunication among different trunking systems operating on different channels;
- 3) the effect a common standard might have on the cost of equipment; and
- 4) the possible effect a standard might have on the development of radio communication technologies.

6. We received comments from a variety of organizations and individuals representing the equipment industry and the public safety community. Most of the commenters addressed the primary concerns raised in the *Notice*, and a few offered various new suggestions and approaches to dealing with the trunking standards issue. There was, however, no consensus among the commenters on any of the major issues listed above, *i.e.*, interoperability, equipment cost, timing, and future technologies. There was, however, almost unanimous agreement that regardless of what we decide on the subject of trunking standards, licensing on the new 800 MHz public safety spectrum should not be delayed. In reaching our decision on whether to adopt uniform trunking standards, we gave great weight to this clear desire of the public safety community.

III. SUMMARY OF COMMENTS

Interoperability

7. In developing the National Plan for Public Safety⁸ one of our primary objectives was to provide a mechanism that would enable different public safety entities to communicate with one another in emergencies. We concurred with the recommendation of the National Public Safety Planning Advisory Committee (NPSPAC)⁹ that interoperability should be achieved through the use of five "mutual aid" channels contained in the 821-824/866-869 MHz bands. We agreed with its recommendations that the mutual aid channels operate in the conventional mode and that all mobiles and portable radios operating in the new bands be equipped to operate on all five channels. In our *Report and Order*, we directed the various regions to explain in their regional plans how the interoperability channels are to be managed.¹⁰ In the *Report and Order*, we also gave regions, in the development of their plans, the freedom to provide for as many additional mutual aid channels as they deem necessary to satisfy their intercommunication needs. This type of flexibility was the cornerstone of the National Plan for Public Safety. Thus, in establishing the National Plan, we provided both the necessary spectrum as well as the various technical and operational rules to permit an organized and effective system for achieving regional interoperability.

8. Despite this effort, certain commenters believe that the mutual aid channel concept is inadequate to meet the needs for intercommunication among neighboring jurisdictions. For example, MX-COM, Inc. in its comments, feels that the mutual aid channels will "sit idle most of the time -- and are probably inadequate to the traffic demands of a major calamity." MX-COM, Inc. Comments at 9. On the other hand, Orange County, California believes that to attain interoperability with neighboring agencies planning to implement 800 MHz trunked radio systems, the use of the conventional five mutual aid channels, supplemented by the two statewide mutual aid channels currently proposed in the Southern California Regional Plan, is more than adequate to meet the county's interoperability requirements. Orange County Comments at 4.

9. Another concern raised by several commenters was that the conventional mutual aid network is operationally inferior to the more sophisticated trunked intercommunication system during emergency situations. They point out that a computer-controlled trunked system is capable of dynamic regrouping of callers¹¹, positive identification of callers,¹² and other capabilities not available to the dispatcher in a conventional system. Motorola, Inc. (Motorola) points out, however, that through the use of "gateways,"¹³ units of neighboring jurisdictions, whether transmitting on different bands or using different modes (trunked or conventional) of operation, can talk to each other efficiently. General Electric disputes the effectiveness of the gateway system, claiming that this procedure calls for units wanting to be patched through to another unit or group on a trunked system to "go through an elaborate process, which introduces delays and resulting inefficiencies that are virtually absent for calls that go from a caller directly into a trunked system." General Electric Reply Comments at 13.

10. In addition to the obvious disagreement among commenters concerning the technical and operational adequacy of the mutual aid network, there is also considerable disagreement over the more basic issue of whether the establishment of standard signalling protocols will, in fact, enable effective interoperability among trunked systems operating on different system protocols. The first and most obvious requirement necessary to permit communications between neighboring jurisdictions is that they be capable of operating on the same frequencies. Currently, frequency sharing arrangements exist among adjoining jurisdictions around the country, and these enable intercommunication during regional emergencies.¹⁴ The advocates of trunking standards argue that, given this existing practice of intercommunication among agencies with similar trunked system protocols, the existence of a common signalling protocol standard would allow the same intercommunication among agencies operating with different system designs. North American Philips Corporation (Philips) further argues that such an approach that simply addresses the standardization of the RF protocols that link mobile units and base stations would allow an equipment manufacturer to incorporate in the design of equipment the various features desired by its customers. Philips Comments at 5.

11. The major source of controversy on the use of "frequency-sharing" to enable interoperation among incompatible trunked systems is not whether it is technically achievable, but whether it is operationally feasible or advisable to permit "roaming" to occur in emergency situations. The California Public-Safety Radio Association, Inc. (CPRA), in its comments, asserts that most law enforcement agencies may not want other users to enter into their systems during a disaster when queueing within a system is at a maximum.¹⁵ CPRA states that the overload that would occur on a trunked system at this most critical time would be unacceptable. CPRA further points out that even if law enforcement agencies desired access by other selected users, the firmware and software changes in their control systems would be frequent and would require constant updates to all participating agencies' databases as units are added and deleted from the various forces or, as the Region 40 Public Safety Communications Planning Committee indicates, trunked systems are regrouped from time to time. Region 40 Comments at 1. While this would not be an insurmountable problem, CPRA expresses the concern that errors in the databases could create situations where appropriate personnel would not be able to access systems during emergencies. CPRA Comments at 4.

12. General Electric, in its reply comments, addresses the various operational concerns presented by roaming and points out that roamers today "can and do move from one adjacent trunked system to another manufactured by the same firm, [and that] existing trunked systems already have the management tools to control those callers." General Electric Reply Comments at 20. It suggests that if roaming does not present any problems today, then it is extremely unlikely to do so in the future. General Electric Reply Comments at 22. Philips indicates further that in the United Kingdom and other countries, the necessary software protocols and hardware have been developed to allow roaming within and between systems and that similar results could be achieved in the United States. Philips Comments at 22.

13. In addition to the various methods and procedures for achieving interoperability discussed in the preceding paragraphs, a new approach was offered and debated in the comments. This was the use of "multi-mode" radios. Mobile radios designed with multi-mode capability would be able to operate with the signalling protocols of more than one trunking system and would thus be able to communicate with more than one manufacturer's system. General Electric, a strong advocate of this approach, states that from an engineering standpoint, "all that is required is for program memory capacity to be expanded to contain the software that would enable radios to recognize and emulate other protocols." General Electric Comments at 7. One of the primary advantages offered by multi-mode radios, according to General Electric, is that "the acquisition of new systems could continue without risk of obsolescence of embedded trunking equipment," and that this would create "backward compatibility" that would eliminate adverse impact on existing systems. General Electric Comments at 8. General Electric suggests that all that would be required to begin development of multi-mode radios would be to overcome existing patent barriers through the cross-licensing of manufacturers' protocols, and General Electric consequently urges the Commission to establish a "framework" for manufacturers producing equipment to APCO-16 standards to cross-license their protocols. General Electric Reply Comments at 3.

14. The Associated Public-Safety Communications Officers, Inc. (APCO) offers support to the multi-mode radio concept to the extent that multi-mode radios offer an "optional approach which will permit Public Safety agencies to procure radio equipment which would be interchangeable in a communication system from multiple manufacturers." APCO Comments at 36. APCO, however, believes that the development of multi-mode radios is no different than development of any other type of equipment and thus sees no need for Commission involvement. APCO Comments at 36. While Philips agrees that a multi-mode radio has certain advantages, such as backward compatibility, it feels that this approach would require substantial development costs for manufacturers, could increase the probability of equipment failure, and could complicate equipment repair. Philips Reply Comments at 34. According to Philips, however, the primary impediment to multi-mode radios is that development will be impossible unless all manufacturers are willing to disclose their proprietary protocols, and Philips appears to be unsure as to whether all the major players would be willing to do so on a voluntary basis. Philips Reply Comments at 35.

15. Motorola, in its reply comments, expresses a number of its concerns about the multi-mode radio concept. First, it raises the question of whether a multi-mode radio would be limited only to systems that meet APCO 16 requirements. (Motorola indicates that only its system and General Electric's currently comply.) Motorola believes that there would have to be agreed upon minimum criteria that a system would have to meet to qualify, and the issue of which manufacturers' protocols should be included on radios and which should be excluded would be likely to be controversial and could have antitrust implications. Motorola Reply Comments at 9 and 15. Motorola further points out that the multi-mode radio concept "spreads the responsibility [for system failure] among multiple vendors," which is contrary to its posi-

tion that public safety systems are best served by suppliers who take total responsibility for a complete communications system. Another drawback to use of multi-mode radios, according to Motorola, is that with the likelihood that manufacturers will enhance their systems periodically to bring new features to their customers, users of multi-mode radios will be required to upgrade their radios repeatedly to conform with the current state-of-the-art. Finally, Motorola agrees with Philips that multi-mode radios will be more expensive than today's single mode units, but perhaps equally as important, asserts that multi-mode radios (which contain the designs of different manufacturers) could cause operational difficulties for users and dispatchers. Motorola Reply Comments at 25-27.

Timing

16. In our *Notice of Inquiry*, we asked that commenters offer their estimates on how long it would take for the industry to develop a trunking standard and how long it would take before equipment built to that standard would be available on the market. There was no consensus among the equipment manufacturers on this question. There was general agreement, however, that if all or parts of existing standards were adopted, the process would proceed much more quickly than if a standard were developed from scratch. For example, Ericsson, Inc. believes that if a current, publicly-available¹⁶ standard were to be chosen, a number of manufacturers could begin delivering equipment as soon as the standard were set. Ericsson Comments at 6. Philips agrees, stating that with regulatory leadership and industry cooperation, and using the British standard as a starting point, the process could be completed in a matter of months. Philips Comments at 25. Regardless of which standard is adopted, King Radio Corporation believes that manufacturers should be able to respond very quickly because most of the developmental effort would be in software rather than circuit design. King Radio Comments at 6.

17. Motorola states, based on the recent history of the standards process, that it will take 3 to 5 years for the industry to develop and agree upon a single trunking standard. On the length of time required to achieve equipment availability, Motorola makes no definite prediction, but points out that it took them four years after the APCO 16 recommendations were issued to market equipment that complied with those recommendations. Motorola Comments at 60-61. On the use of the existing MPT 1327 standard, Motorola has serious reservations as to its adequacy to meet the unique operational requirements of public safety users.¹⁷ Thus, Motorola concludes that the suggested use of MPT 1327 as a starting point would provide little time advantage because the effort to adapt MPT 1327 for public safety use "would be akin to developing a brand new standard." Motorola Reply Comments at 30.

18. Philips, in its reply comments, disputes Motorola's claims of the inadequacy of MPT 1327. It specifically addresses a number of the "faults" in MPT 1327 identified by Motorola¹⁸, and provides various technical explanations to refute Motorola's criticisms. Philips concludes that while MPT 1327 is not perfectly suited in all respects to public safety needs, it could easily be adapted to the U.S. public safety market. Philips Reply Comments at 23-27.

19. Despite the obvious disagreement among industry commenters on the length of time it would take to adopt a trunking standard and market equipment, there was one matter on which there was almost unanimous agreement. Nearly all commenters believed that regardless of the ultimate decision reached by the Commission on the trunking standards issue, there should be no impediment to the licensing of the new 800 MHz public safety spectrum. See E.F. Johnson Comments at 7.

Equipment Cost

20. Another key question raised in our *Notice* was the effect that the establishment of a trunking standard might have on the price and availability of equipment. We are concerned with both the effect on the initial cost of a system purchased by a public safety user and the cost of add-on or replacement equipment purchased by the user during the life of his system. Besides the discussion of the possible increased cost for multi-mode radio equipment (see paras. 13 and 14, *supra*) there was little reference in the comments to potential increases that might occur in the price of equipment if equipment were to be built to a common standard. Various commenters, however, alluded to the additional R&D work that would be needed to develop new circuit hardware and protocol software, and it is possible that the costs incurred by manufacturers in these efforts could be passed on to the purchasers. One commenter, DuPage Public Safety Communications (DuComm), also indicated the belief that if standards are adopted and are licensable, then the costs of the licensing fees could be passed on to the purchaser. Du-Comm Comments at 4.

21. The discussion of possible reductions in equipment costs centered around two closely related issues: 1) the effect standards might have on the use of the "sole-source" approach by agencies in the initial purchase of their systems, and 2) the possible effect standards might have on the use of the "second-source" option when purchasing future, add-on or replacement equipment.

22. Currently, some agencies choose the sole-source method when purchasing land mobile radio systems. In using this approach, they forego the possible cost advantages of competitive bidding for several possible reasons: 1) in order to take advantage of the unique system features offered by a particular manufacturer, 2) to use a manufacturer that can provide a turn-key system (to avoid expending funds to conduct detailed analyses and write specifications for proposals from several bidding manufacturers), or 3) the desire to have interoperability with a neighboring jurisdiction using a particular trunking system. The advent of a common trunking standard would probably not cause purchasers desiring the sole-source option for the first two reasons to change their decision to use this approach. Those who use sole-source to achieve interoperability, however, could prefer the multi-source option if that were to become available to them under a "trunking standards" environment. Electrocom, Inc. offered evidence of such a scenario in the State of Louisiana where the purchase of a particular manufacturer's trunked system by the State Police apparently forced a local jurisdiction within the state, desiring interoperability with the State Police network, to go "sole-source" and thus, in Electrocom's words "deny the public the benefits of competitive bidding." Electrocom Comments at 4.

23. It is argued by a number of commenters that beyond the lack of competition that can occur in the initial purchase of equipment when purchasers go "sole-source" because of the absence of compatibility among different systems, there also exists a more serious lack of competition that can occur when users cannot choose from a variety of vendors in the purchase of add-on and replacement equipment due to the incompatibility of different manufacturers' systems. These commenters state that public safety agencies would like to have the flexibility to obtain add-on and replacement equipment from more than one source and not be "locked-in" to the manufacturer that provided their basic system. They feel that if equipment can be acquired from a second source and there is competition from various manufacturers for the sale of this equipment, then the costs will be lower than if the buyer must, for system compatibility reasons, deal with the original vendor.

24. These users believe that the adoption of a common trunking standard will permit competition to occur by enabling different manufacturers to produce compatible equipment. For example, CPRA states that the present requirement that an agency purchase additional equipment from the same vendor may present some cost disadvantages. CPRA Comments at 2. Similarly, the Port Authority of New York and New Jersey points out that compatibility will enable the benefits of competition among manufacturers of public safety radio equipment to become available to public safety users and that the advent of competitive bidding among vendors "can only result in lower costs for public safety agencies and a greater spur to improvements in equipment itself among manufacturers and vendors." Port Authority Comments at 1 and 2. Spectrum Resources, Inc. (SRI) offers evidence in support of competition, stating that from its experience in assisting the purchase of equipment for governmental agencies, when a vendor is the sole source for equipment they have no reason to supply equipment at other than list price, while when these vendors are put in a competitive situation they almost always take a different position on pricing. SRI further indicates that in such a competitive environment "it is not unusual to see discounts from list price in the twenty-five to fifty percent range." SRI Comments at 3.

25. Other commenters suggest that there are better ways of approaching the "lock-in" problem than through federal intervention in the form of trunking standards. APCO, for example, states that agencies could include in their initial solicitation and contracting documents provisions designed to accommodate future system expansion. APCO further believes that there is sufficient competition in the radio communications market to enable buyers to establish reasonable terms for the equipment they are purchasing. APCO Comments at 11. The State of Florida Division of Communications (Florida) presents a different side to this argument, disputing claims that users may avoid monopoly pricing difficulties by sufficiently clever procurement and long-term contractual strategies. They note that equipment models and features often change over time, and that a change or discontinuance of a particular model generally negates existing contract terms. This, according to Florida, voids previously agreed-upon prices, necessitates contract re-negotiation, and almost always results in higher equipment costs to the purchaser. Florida Comments at 7. Philips, in its reply comment adds that merely knowing the price to be charged by an

original equipment supplier for future equipment add-ons and system enhancements is not the same as having the ability to choose from among multiple suppliers at the time the add-ons or enhancements are needed. Philips also points out that years after a system is installed, the manufacturer offering the best equipment at the best price "may be some relatively recent entrant into the marketplace, and the original system supplier may no longer be at all competitive in terms of quality or features or price." Philips Reply Comments at 20 and 21.

26. Ted Vratny, representing Du-Comm, supports the APCO position and similarly believes that the concern of pricing for add-on and replacement equipment is a contractual and administrative problem that can be dealt with effectively without the need for technical standards. From his experience as director of a large intergovernmental emergency communications agency, he has observed that it is more advantageous for an agency to make a careful initial decision that it can live with for several years. According to Vratny, this requires that administrators prepare adequate specifications and make every effort to implement long term solutions. In the final analysis, he points out, an agency does have the choice not to purchase equipment or delay projects that are not cost effective. Du-Comm Comments at 2-3.

27. Another consideration on the issue of "second-sourcing", as discussed by several commenters, is that some agencies may prefer to use one particular manufacturer's equipment for operational and technical reasons. As Orange County indicated, the locations of controls and displays can vary from vendor to vendor on otherwise compatible equipment, and that a radio system containing equipment built by several different manufacturers can create operational and training problems. Orange County Comments at 3. They further point out that for agencies that service their own equipment, having multiple equipment suppliers requires stocking of parts from different manufacturers and in some cases additional specialized test equipment. Orange County also emphasizes that due to the nature of the competitive process a trunking standard could force agencies to accept equipment from undesired vendors. Orange County Comments at 3. The Lenexa, Kansas Police Department makes the point that, at least from its perspective, it is desirable to have a single point of service contact for a complicated radio system, especially one involving trunking technology. They also indicate that, in a mixed "network" of equipment from several makers, a problem with any of the equipment could affect all users on the network. Lenexa Comments at 3. Ted Vratny (Du-Comm) concurs with this position, stating that it is extremely costly to "play mix and match" with radios and fixed-end equipment. When this occurs, Vratny claims, service times and costs often increase because technicians must be trained to repair different types of equipment. Vratny indicates further that to accommodate different systems one must maintain a larger inventory of parts for different manufacturer's equipment and that "this is taxpayer money sitting on the shelf." Du-Comm Comments at 3.

Future Technologies

28. An important consideration in analyzing the arguments for and against trunking standards is the concern that the adoption of a standard could retard or stifle future technological innovation in the field of trunking technology and in land mobile radio in general.

29. On the first point, the County of Los Angeles Facilities Management Department fears that because standards take a long time to develop they would be difficult to modify rapidly as new technologies become available. It further believes that a standard trunking system could have a stifling effect on creativity "as new technical improvements [could not] be implemented without obtaining agreement to change the standard, therefore limiting solutions to communications problems." County of Los Angeles Comments at 4. Motorola expresses a related concern that a trunking standard developed by a number of manufacturers could represent a compromise, or "common denominator" standard that would not be equal to the level of the more advanced systems. Such a scenario would be even more likely, according to Motorola, if industry representatives were ordered by the FCC to mandate a standard "or else" and if the overriding priority became to complete the task as quickly as possible. Motorola Comments at 18-19. Motorola states unequivocally that a standard mandated by the Commission will retard technology because new public safety systems from both Motorola and its competitors "will dry up as soon as an FCC proceeding to launch a standard is initiated." Motorola Reply Comments at 2. APCO agrees with this opinion, stating that if a standard were to be adopted "manufacturers would have little incentive to develop advanced products of any type, including digital, since they would then become non-standard." APCO Comments at 13. Philips does not share APCO's opinion that advanced technology would be retarded if a standard were to be adopted. They point to the current development underway to adopt a digital standard to supplement the current cellular analog standard, and indicate that adoption of a digital standard would not render analog radios obsolete. Philips Comments at 15. They further suggest that, over time, certain advances, such as digitization of voice communications, will occur in land mobile communications technology regardless of whether there is a trunking standard. Philips Comments at 15-16.

30. Dr. Michael Trahos, commenting for the Jefferson Hospital, Alexandria, Virginia, adopts a different argument for developing a uniform standard signalling protocol. He strongly advocates an eventual transition from present-day analog trunking systems to a standard digital trunking format, and suggests that only through the establishment of a uniform standard trunking protocol, preferably digital Time Division Multiple Access (TDMA),¹⁹ will "an orderly transfer to an advanced technology more 'spectrum efficient' than our current analog FM" be realized. Jefferson Hospital Comments at 3. Corwin Moore, representing the Personal Radio Steering Group, Inc. (PRSG) takes a similar, long-term approach to the technology issue in his comments. He suggests that those seeking interoperability among radios operating with different 800 MHz trunked systems should recognize that the future radio is likely to become increasingly software-dependent (perhaps becoming, as he puts it, "a computer with an RF front end"), and that issues raised in the NOI (such as interoperability), should be addressed in the context of future directions in equipment technology. PRSG Comments at opening summary and 5-6.

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