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Associated Public-Safety Communications Officers, Inc.
Project 17
Task #7901401

Connecticut State Police Radio Communications System
Plan Advisory Recommendations
For Lt. Ron Mikulka, Commander, Communications Division

Conducted March 20 through March 24, 1979

Submitted March 27, 1979
Advisor
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Director, Communications Division, Michigan State Police

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Education:

- Western Michigan University, Kalamazoo - Electronics - 1955
- Motorola Training Institute - Schaumburg, Ill. - Motrac Radio Servicing 1963
- Motorola Training Institute - Schaumburg, Ill. - FM Communications System 1965
- General Electric Company - Lynchburg, Virginia - FM Communications System and Mastr Professional Radio Systems - 1966
- Federal Sign & Signal Corporation - Blue Island, Ill. - VASCAR Witness Program - 1972
- Michigan State University - East Lansing, Michigan - Executive Development Center - 1973
- Kustom Radar Company - Chanute, Kansas - Traffic Radar Theory - Servicing and Court Testimony - 1975
- Motorola Training Institute - Microwave Radio System Theory and Servicing - 1977
- Lansing Community College - Lansing, Michigan - Business Administration, Management Degree Option - 1979

Experience:

February 1978 to present - Director of the Communications Division, Michigan State Police - 36 employees, technical staff, statewide radio system, 1.6 million dollar budget, 120 base stations, 1700 mobiles, 800 handie talkies, 250 radars.

Experience (continued)

1972 - 1978: Chief Radio Technician & Supervisor of Communications Section, Michigan State Police.

This job included supervision, budgeting and planning for statewide communication system including 120 base stations, 1600 mobile units, 475 handie talkies, 150 radar units, etc., and 33 employees at 10 service shops.

1972 - present: Member Michigan Frequency Advisory Committee for Public Safety Radio Channels.

1962 - 1972: District Radio Technician, Michigan State Police at Traverse City, Michigan. Responsible for servicing and installation of all electronic equipment at 4 Michigan State Police Posts which included 12 base stations and 40 mobile units.

1957 - 1962: Radio Dispatcher, Michigan State Police, District Headquarters, Paw Paw, Michigan.

1955 - 1957: TV and Radio Service and Installation.

1962 - 1972: Equivalent of 2 years on part time basis at Motorola Service Company and nearly 2 years at a General Electric Service Center. Also equivalent of 18 months as Aviation Electronics Technician.

Licenses:

1st Class Radio Telephone License from Federal Communications Commission, #P1-19-26837, expires 5-9-80.

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Associated Public Safety Communications Officers, Inc., Michigan Chapter

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INTRODUCTION:

The Connecticut State Police have recognized problems with their communications system and have begun developing plans to revise and upgrade their radio system in an attempt to solve these problems. They have requested APCO advisor review of their plans and recommendations to insure that all problems have been recognized and addressed and that conclusions are sound. This review has been made and findings are reported herein.

Due to the extensive scope of the problem and time restraints placed on the advisors, some of the problem areas were not researched in depth and recommendations in these areas will take the form of action plans to conduct the needed research upon which management decisions may be based. These problem areas might be considered for future advisory studies on an individual basis.

Due to the complexity of the problem the analysis, conclusion and recommendation of each item will be addressed before proceeding to the next element of the problem. I believe this will give continuity to the report and make future reference easier.

Analysis and conclusions in this report are based on the advisor's observations and interviews with personnel of the CSP. The advisor visited the CSP headquarters service shops, message centers, and administrative officers; Troop Barracks H and K; Troop K Radio Tower; the Academy at Meriden and made a helicopter survey of "dead spot" areas in Troops A, F, G and I as well as the proposed new headquarters site at Meriden and associated alternate transmitting sites.

Extensive interviews were held with Communications Division administrative personnel. Lt. Ron Mikulka and Trooper Arthur VanHoltz, technical personnel Leonard McFarlan, Edward Baines and service and installation personnel. Lt. Perry of Troop K conducted a tour of his communication facility and answered questions regarding radio operations in a Troop operation.

Problem Addressed:

The Connecticut State Police Communications improvement plans have identified the following problems in their two-way radio system:

- A. Interference to base-mobile communication. (Pages 7 - 10)
- B. Multiple channel monitoring ability in patrol units. (Page 11)
- C. Inadequate communication between officers at Bradley Airport (Page 12) security force.
- D. Remote transmitting sites with no emergency power or site (Page 13-14) security.
- E. Geographical "dead spots" for patrol car communication. (Page 15-20)
- F. Radio towers in poor condition. (Page 20-21)
- G. Remote control lines unreliable and vulnerable. (Page 21-22)
- H. Poorly organized dispatch desk operations. (Page 23)
- I. Pending move of headquarters message center from Hartford to Meriden.(Pg24-25)
- J. Need for additional portable units. (Page 26)
- K. Inadequate paging facilities. (Page 26-27)
- L. Desire for statewide microwave planning. (Page 27-28)

In addition to the problems identified in the plan as stated above, the advisor suggests consideration of the following areas for attention:

- M. Additional vehicle repeater/handie talkie units for field operation.(Pg 28-29)
- N. Establishment of priorities for system improvement and commitment to these improvements by highest department administration. (Page 29-30)
- O. Reorganization of the service capability for more effective and efficient system servicing. (Page 30-31)
- P. Vigorous training of CSP personnel sworn and non-sworn who will be using the radio system. Especially those engaged in everyday dispatch duties. (Page 31-32)

Problem Analysis, Conclusion and Recommendations:

A. Interference to base-mobile communications.

Analysis: Interviews with patrol officers, technicians and monitoring of the dispatch channels indicates interference from adjoining CSP base and mobile stations and foreign stations during skip conditions. The basic CSP radio system at present is a simplex system ie all base and mobile units in a district transmit and receive on the same channel. Review of base transmitter ground elevations and topographic maps of the state show most base stations transmitting from excellent height advantages. Also many times mobile units will be at high elevation above average terrain. The entire state only covers an area approximately 85 miles wide and 55 miles deep which is divided into eleven troop dispatch areas for command and control. The problem is further complicated by extremely irregular troop patrol boundaries which can place a troop patrol unit closer to an adjoining troop base radio station than to his own station. All of these factors result in base and mobile stations covering each other up during normal dispatch work due to the capture effect of FM radio. In attempts to alleviate the problem, base station powers have been reduced, three separate dispatch channels have been used (still Simplex however) and limited geographical spacing of channels tried. Regardless of these attempts for improvement, the problem is still acute.

Conclusion: There is no question that the interference to communication is caused by co-channel interference from adjoining CSP mobile and base stations. While the attempts to improve the situation have been sound moves and must be continued, it is imperative that the system be converted to 2 frequency simplex (1/2 duplex) by the addition of mobile

only channels to be used with the existing base channels. This will eliminate competition between base and mobile stations on the same channel. Base over base and mobile over mobile interference will continue without further steps which will include geographic separation of base and mobile dispatch channels and the proper use of tone squelch.

Recommendations: In keeping with the above conclusions the following solution is recommended for consideration:

The most complete solution is to use four 2 frequency dispatch pairs, checkerboarded among the eleven troops for maximum geographic spacing (as indicated in attachment A) and the use of three separate tone frequencies as indicated in Attachment A. In order to keep statewide continuity of communication a fourth simplex channel, with tone squelch to eliminate skip interference, must be incorporated in all mobile units and base stations for use during activities that carry a patrol unit outside its normal troop area. It is also imperative that all mobile units have scanner capability on receive. Inasmuch as patrol vehicles are assigned to officers, this system will require the changing of frequency and tone in the mobile unit when an officer is permanently transferred to another troop area. This would not be a difficult procedure and should be accomplished by a technician in about one hour. If officers feel it is imperative to monitor the activity in a patrol area adjoining theirs, this can be accomplished by all patrol vehicles being equipped with a programmable type scanner which will allow monitoring of any troop communication system they may want, as well as monitoring local town police, fire and ambulance channels.

The CSP have already obtained three mobile only frequencies to pair with their existing base channels. It is recommended that the fourth channel pair of 42.580 MHz base and 42.680 MHz mobile be obtained. This was reviewed with radio supervisor Leonard McFarland and it would appear these channels could be obtained without any difficulty. A desire was expressed by CSP personnel to replace the statewide or tactical channel of 42.04 MHz with a channel that would be closer to the other channels in the system. The frequency 42.62 MHz is recommended for this change as it appears coordination would be obtained on this channel and this would reduce the frequency spread in patrol units from 640 KHz to 480 KHz. The BCI channel 42.18 MHz would be retained for its present use and would result in a maximum frequency spread in these units of 500 KHz. By properly tuning mobile and base units with a tuning crystal located in the center of the frequency spread the degradation resulting should not be objectionable. See Attachment B for recommended frequency pairing and assignment.

By using three tone squelch tones geographically separated in the system the problem of base stations interfering with one another from one side of the state to the other should be eliminated. Skip interference from foreign stations will not be heard either unless the tones picked are accidentally the same as might be used by the interfering station.

The actual layout of radio channels in the mobile units leaves some administrative flexibility. Those units that are equipped with 8 channels obviously can contain all channels for maximum flexibility. The existing four channel units will require a compromise and alternatives are suggested in Attachment C.

It is recommended that this entire system change be accepted in order to completely solve the problem of co-channel interference. Certainly making some of the changes recommended will make an improvement over the existing system. As a bare minimum the 2 frequency per channel system with selectable scan heads must be adapted to make any significant improvement. Without the tone squelch addition, co-channel and skip interference will still be experienced. Financial and manpower restrictions may not allow rapid conversion of the radio system. In this case it is recommended that the conversion be phased in one troop at a time with the exception of the scanner heads which should be given immediate attention. Of course the conversion of the statewide base-mobile channel from 42.04 MHz to 42.620 MHz would have to be coordinated statewide in as short a span of time as possible. This could of course be one of the last items in the phase in procedure.

B. Multiple Channel Receive Monitoring in Mobile Units;

Analysis:

This problem refers to the need for selectable receive scanning in mobile units. In order to accomplish the CSP mission, several radio channels are required in the patrol and detective units. During various phases of patrol and investigative activities the officer will be required to operate on channels other than his main dispatch channel or the statewide channel. During this time the unit would lose contact with the dispatcher and be unable to receive emergency calls. In order to handle patrol and investigative activities outside his assigned troop area (such as high speed chases, etc.) the units must constantly monitor the statewide channel as well as their troop dispatch channel.

Conclusion and Recommendation:

The conclusion is unavoidable. All two-way radio units must be equipped with selectable receive scanning. The advisors recommendation is to equip all units with scan as soon as possible. The CSP has begun a conversion plan using on-staff personnel to design, construct and install the needed conversions on existing units. This unit was briefly reviewed and appears satisfactory to accomplish the task. This procedure will save the state considerable funds over the out right purchase of conversion units from commercial vendors. All new two-way radios purchased must include the scan receive option.

C. Inadequate Communications between officers on Bradley Airport Security Force.

Analysis:

The CSP maintains a security detail at the Bradley Airport. Ninety-five percent of the activity requires the officer to be on foot, mandating the use of personal portable 2-way radios. The personnel involved advise that they can always read their base station, however, they do not always have portable to portable communication due to the construction and size of the facility. Portable to portable communication is essential for this type of security activity. The CSP have already begun conversion of the system to a high band mobile relay (repeater).

Conclusion:

The conversion to mobile relay operation is essential to the operation of the security force. A satellite receiver/comparator system will probably not be needed as the portables have contact from all areas of the facility as reported at this writing.

Recommendation:

The CSP should conclude this conversion to repeater operation. Note should be made that tone squelch is highly desirable in this type of system to eliminate interference to the operation. Should dead spots appear later it may be necessary to add satellite receiver and a voting comparator to the system.

D. Remote Transmitter Sites Emergency Power and Security

Analysis: Interviews with technical personnel and visits to some transmitter sites revealed that there is no emergency power or site security at remote tower sites. This deficiency severely compromises the CSP communications systems, as failures due to power shortage generally occur in conjunction with some type of severe weather when emergency police services are very active. In addition the remote sites are vulnerable to sabotage and vandalism by criminal elements. Power lines and telephone lines strung through remote areas to these sites can be easily put out of service by accident or intent.

Conclusion: Immediate steps should be taken to equip each remote site with emergency power as indicated in the CSP communication plan. In addition, security fencing should be constructed around the remote tower and building to protect the tower, radio transmission lines and equipment. The addition of microwave radio control between the remote site and the troop barracks will eliminate the potential of system failure due to damage to the rented wire lines.

Recommendations: It is recommended that the remote sites be equipped with at least 3 KW motor generators with automatic transfer panels and exerciser. Preferably the engine should be operated on propane fuel with at least a two week supply of fuel. Normally this would mean a 500 gallon propane tank. For these units to be completely reliable and efficient at least one man should be factory trained in the service and repair of the units. This person should be given responsibility for

the proper operation and maintenance of the emergency power systems. The generators must be exercised for at least one hour per week. This can be handled automatically by control circuitry located in the automatic transfer panel. It is strongly recommended that an alarm system be devised by technical staff that will alert the troop barracks when the generator is running. This is necessary as power might fail due to a storm and the troop barracks might not be aware of the failure resulting in the generator running for several days without attention. The possible ramifications are that the generator would run dry of oil thereby ruining the engine. Of course in time the generator would run out of fuel.

Fencing recommended would be six foot cyclone fence with three strands of barb wire at the top. It is important that plenty of room is left around the tower for steeplejacks to work and that the gate is positioned for easy access to the equipment building door. The gate should be at least ten foot wide and split in two for ease of opening. In addition, one of the sides of the gate should be split horizontally as in a "dutch door" to allow access to the site during heavy snow conditions.

The microwave radio control systems will be treated in depth in a later portion of this report.

E. Communication "Dead Spots"

Analysis:

The CSP Communications personnel have questioned troopers in all of their Troops and from this information identified approximately 30 areas of allegedly bad communication. All troops except D and H are affected. The advisor consulted topographic maps of the areas, reviewed radio tower locations, antenna heights and effective radiated power. In addition, a helicopter survey was made of several of the more prominent bad areas. Time did not allow signal strength surveys in any of the areas.

Conclusions:

With the information available it would appear that the "dead spots" are most likely caused by the rugged terrain. Terrain variations of 700 feet in the space of one mile were not unusual. However, the strong factors of co-channel interference and incomplete investigation of reported problem areas may contribute to the large number of reported "dead spots". In an attempt to alleviate co-channel interference base station powers have been reduced to 50 watts. While this is a valid move against co-channel interference it may have made some marginal areas unworkable. Also the CSP mobile fleet is comprised entirely of 50 watt mobiles. 100 watt units have not been tried for fear of contributing to the co-channel interference. This also is a valid argument, however, if the frequency plan with geographic spacing and tone squelch suggested in the recommendations for problem A are followed, both of these concerns would no longer be influential. It should not be considered that the advisor is advocating high power as

a solution to all problems. We are only suggesting that 100 watt base stations and 100 watt mobiles might significantly reduce the problem areas in some troops.

Recommendations:

It should be recognized that what may work as a solution to "dead spots" in one location may not be practical or work at all in other areas and alternate solutions must be tried. The following action plan is recommended to CSP Communications Division staff:

1. Administration must first review the dead spots that have been tentatively identified and label them. Each spot should be evaluated for its relative importance to the patrol activities of the department and placed on a priority list with the most damaging or important area at the top and progressing down to the spot that least effects department operation. In this way resources may be applied effectively by attempting to solve the problem areas in their order of importance.
2. Signal strength studies must be made in each problem area to define its exact boundaries and clarify what the problem is, ie mobiles can't reach the base but hear the base and vice versa or all contact is lost. This information will then point to the alternative solution available. The following procedures are recommended for conducting this survey.
 - a. A vehicle with properly operating radio and the type of antenna system normally installed on patrol units should be used. The vehicle should be equipped so that receiver meter readings can be recorded from the front seat.

- b. Tests should be conducted entirely by Communications Division staff with at least one person in the vehicle and one person at the radio tower in a position to monitor and record base station receiver readings as well as answer calls to the test vehicle from the base transmitter. This will eliminate the problem of missed calls by busy dispatchers as well as give receive signal strength readings from the mobile unit.
- c. The received signal strength and location of the mobile unit must be recorded both in the mobile and at the base. A signal strength level that is acceptable can be established and plotted on a map, thus defining the area of the problem. It is important to watch for interfering electrical noise readings in the mobile unit when traveling in industrial areas as these noise levels will block the radio signals if it is below the noise level. Therefore a stronger radio signal will be required in these than in other "quiet" areas.
- d. It is important to continue to check an area after the base station can no longer hear the mobile unit. This can be accomplished by predetermining that calls will be at certain time intervals. In this way the mobile can continue to measure signal strength from the base station after contact is lost.
- e. If technical staff personnel are available to assist in these surveys they should certainly be used as they can identify problems in the procedure, assure proper operation of the equipment, and help evaluate the results.

3. The map plots of dead spots and the data obtained can now be used to identify possibly why the problem exists and what alternative might be used to eliminate it.
Following are some suggestions of procedures that might be used to solve different types of poor communication areas.
 - a. A remote (satellite) receiver positioned in the problem area with its received audio returned to the dispatcher desk by rented phone line or microwave radio. It is not always necessary to have a voting comparator for these receivers. For instance, if there is only one in an area it may be simply run to a separate speaker at the dispatch desk. In addition if the problem area to be covered is small and free of intermodulation interference at the operating frequency an inexpensive receiver may be used.
 - b. Increasing base transmitter power may be a solution to some areas where mobiles have problems receiving the base. Before and after tests can be made in the problem area to evaluate the effectiveness of this procedure, I would suggest raising base station power to 100 watts and re-checking areas for signal strength. If this does not help the problem area, transmitter power should be reduced to only that required to cover the troop area.
 - c. If increasing base power does not solve the problem, the next alternative is to relocate the base station transmitter site. This may be of help in Troops A, F and G. Troop F is an excellent example of using this alternative, moving the transmitter site

to the Haddam area near the dead spot on Route 9 should clear up the dead spot and still cover the rest of the troop area.

In the particular case of Troop F I would also recommend changing the type of antenna used if the base is relocated. I would recommend changing to a shuntfed coaxial antenna similar to Krecko Model CO-41A as a coaxial antenna will give a lower angle of radiation than the ground plane antennas presently being used. The higher angles of radiation from the ground plane antennas may be sending the major portion of the radiated energy over the top of the dead spot. If the antenna cannot be top mounted and must be side mounted, I would recommend a DB product Model 212 mounted only as high as necessary to cover the area.

- d. If the survey of the dead spots indicates that the majority of them are cases where the mobile can hear the base station in the problem area but cannot transmit out, I would recommend making additional studies with a 100 watt mobile unit to see if this significantly improves communications. If previous channel assignment and spacing recommendations are followed, I do not see any problem with conversion of the entire fleet to 100 watts if necessary.
- e. In severe cases it may be necessary to install a second complete base station in the problem area in order to get satisfactory communication. The dispatcher should have clear identification of signals being received from these base stations such as through separate speakers so that he can respond on the proper transmitter.

f. The lowest cost alternative that may be used in some cases is a reassignment of command and control over a problem area from one troop to another. This can be possible where the problem area lies on a troop boundary and on site surveys indicate the adjoining troop radio station satisfactorily covers the area that cannot be covered by its presently assigned troop.

- 4. Before permanent installation of satellite receivers are made or base stations are moved, surveys should be made with equipment temporarily placed at the site to confirm the operation. This can often be accomplished by using a temporary antenna and locally monitoring a receiver and/or transmitter connected to it.

F. Radio Towers in Poor Condition

Analysis:

This element of the plan was reviewed with Communications Division personnel and they indicate that towers are old and of tubular construction leaving some question of the integrity of the steel as rust working inside the tubing cannot be detected easily. They also indicate that little or no maintenance has been done on the towers in recent years. Advisor visited the troop K transmitting tower and found the paint in extremely poor condition. The tower was a uni-pole and large areas of rust were visible on the outside of the pole. It was also noted that at least four towers are close enough to Long Island Sound to be exposed to salt water corrosion under the right wind conditions.

Conclusions:

It is apparent that a routine inspection program should be set up on the towers. The paint conditions of the tower at Troop K are definitely in violation of Federal Aviation Agency and Federal Communications Commission regulations as well as jeopardizing the integrity of the steel by allowing rust and corrosion to develop on the unprotected surface. The loss of a tower during a storm would be especially crippling to any troops emergency response capability and jeopardize the safety of officers in that command.

Recommendations:

1. A survey of all towers should be made by a reputable tower construction and maintenance firm, and a careful evaluation made of their recommendations. Financial support of any emergency repairs or replacements required should be given highest priority.
 2. A yearly maintenance fund should be established as a permanent part of the CSP budget to finance the painting of at least three towers every year. This will insure that no tower goes more than four years without painting. Normally this is adequate if a proper job is done and there are no unusual conditions as might be experienced in the area of the Sound from blowing sand and salt water.
- G. Remote Control Lines Unreliable and Vulnerable.

Analysis:

The CSP communication plan shows a desire to replace all rented remote control lines to radio towers with microwave radio control systems. A review of the remote tower sites indicates that the majority of them are located in remote areas and are serviced by

control lines strung on poles through wooded areas. Technical staff of CSP indicates considerable problems in some areas with control lines that vary erratically causing problems keeping the communication system operating properly.

Conclusions:

The assumption in the CSP plan that rented wire line control circuits are a vulnerable point in the system is correct. The recommendation to use microwave radio control circuits is sound as they are reliable, not subject to damage from vandalism or windstorms and are under the maintenance control of CSP technical staff therefore assuring routine and emergency maintenance as might be required. The present state of the art has reduced costs of this type of equipment so that it is now cost effective for agencies such as CSP to take advantage of them. In addition, the capacity of such systems open the door to many added advantages to the total CSP communication system.

Recommendations:

1. The CSP Communication Division staff should review all remote installations and establish a priority list for sites to be improved with microwave control.
2. Equipment vendors should be contacted and asked to make proposals for the engineering and installations of systems at a couple of typical locations. This will furnish CSP with cost figures to work with in future planning.

H. Poorly Organized Dispatch Desk Operations.

Analysis:

A visit of the dispatch desks at Troop H and K, and the Headquarters message center was made. Time didn't allow visiting other troops however if these are typical examples of the system they indicate a very disorganized and unwieldy operation for the dispatchers. Several separate single channel radio consoles each with its own microphone were sitting on and about the dispatch desk making it difficult for dispatchers to operate the system.

Conclusions:

The CSP plan is correct in recognizing this problem. State of the art multi-channel remote control consoles should be purchased for all troops that have more than one radio transmitter to control. This will consolidate the communications dispatch facility and improve over all system operation.

Recommendation:

The CSP Communications Division should meet with console vendors to develop a standard set of specifications for their multi-channel consoles and get cost estimates for budgeting. A priority plan should be developed for the upgrading of all troops.

I. Pending Move of Headquarters Message Center to Meriden, Connecticut

Analysis:

The CSP plan addresses a need to move headquarters dispatch and message center facilities to new quarters at Meriden. Discussions indicate that it is desired to have microwave radio control of the new remote transmitter site which would allow expansion to a statewide data network over microwave. A problem was encountered with the site chosen for the remote radio tower as it appeared difficult to reach with a direct microwave link. The site was surveyed from the air by helicopter as well as on topographic maps.

Conclusions:

The desire to use microwave control at this new facility is good and based on sound planning. The particular site chosen for the remote radio tower does definitely create several problems. The site was chosen because state land was available and it has excellent height advantage with commercial power available. It appears however that a direct microwave path could not be established direct to the site however I would not say that it could not be done without first making a path survey. It may very well be that with the remote microwave antenna placed on a 200 or 300 foot tower the obstacles would be cleared. However an additional problem of possible inter-modulation interference from other transmitters at the site affecting the 42 MHz patrol channels and 155 MHz intersystem channels should be carefully researched before proceeding. There appears to be other possible choices of transmitter sites in the area. One in

particular that bears investigation is the ridge behind the CSP Academy. This ridge appears to have a road access to the top with power available at the bottom of the cliff on the academy side. It appears to provide a clear path to the new headquarters for a microwave link and is free from other transmitters.

Recommendations:

1. A path study should be made from the new headquarters site to both suggested remote tower sites so that exact requirements for a clear microwave path will be known in both cases. This might be the subject of a future advisor task as it would give CSP personnel experience to be able to conduct future studies on their own.
2. The West Peak Mountain site should be carefully reviewed for interference that might be received if CSP receivers are placed there as well as what interference might be created to existing receivers at the site by CSP transmitters. It would very likely fall upon CSP to move or make correction if they create harmful interference by placing transmitters at this site.
3. An investigation of the possibility of leasing a tower site at the Academy location should be investigated as well as obtaining cost estimates for supplying power to the top of the ridge.
4. Inasmuch as this will be the central point of the CSP Communication System, microwave equipment capable of at least 48 channels (2 GHz narrow band) should be considered minimum acceptable.

J. Need for Additional Portable Units

Analysis:

The CSP plan calls for equipping each troop with 10 portable radios (110 for entire system) for use by officers in times of emergency and whenever activities require coordination of men on foot as well as routine activities. It is understood these would be low band units capable of communicating with patrol units on the statewide channel.

Conclusion:

This is a sound investment as these type units have been proven to be indispensable for police activities and the present supply is inadequate.

Recommendation:

This purchase should be coordinated with plans to change frequency and possible use of tone squelch so that conversion is not required at a later time.

K. Inadequate Paging Capability:

Analysis:

The CSP operates a limited paging systems in the Hartford area and desires to expand and improve the system to include more emergency personnel and provide statewide coverage.

Conclusion:

Radio paging is a proven time saver and is cost effective when compared to the cost of keeping emergency personnel on duty or paying for them to stay by a telephone. CSP has eleven 24 hour dispatch sites all with common radio channels which would allow expansion to statewide coverage.

Recommendation:

A 900 call paging system be developed that would equip each troop dispatch desk with a 900 call encoder. The pagers could operate either on the low band statewide channel or the 154.665 MHz point to point channel. Paging codes should be assigned only once in the system thereby allowing the flexibility of being paged anywhere in the state by the local troop. Some advantage may be seen by using the low band statewide channel for this purpose due to the rugged terrain.

L. Desire for Statewide Microwave System.

Analysis:

The CSP plan expresses a desire to develop a statewide microwave plan and begin developing microwave links that can form a part of a complete system. Some microwave paths already exist and are operated by the DOT and EMS people. The CSP technical staff at this point have had no training in installation or repair of such systems and are inexperienced in system planning.

Conclusion:

The desire for a statewide microwave system is justifiable for data transmissions, statewide command and control and many other uses. It may be entirely possible to incorporate the other state agencies in such a system to improve cost effectiveness of the plan. Time didn't allow a complete review of possibilities in this area. However, it could possibly be the subject of a future advisory task by APCO Project 17. The development of a statewide microwave plan will require a great deal of work by personnel experienced with microwave systems.

Recommendations:

1. CSP staff should contact microwave radio system vendors such as Lenkurt, Farinon, Motorola and Collins for a review of their needs in Connecticut and the vendors could begin to supply information and proposals for the development of a system. If funds are available a consulting firm could be hired to engineer and plan the entire system.
2. It is recommended that when a plan is developed and funds become available to purchase all or any part of a system that the vendor selected be required to do all path studies, frequency coordination, assist in FCC licensing, complete the entire installation and train CSP technical staff in maintenance of the equipment.

In addition to the above problems addressed in the CSP plan the advisor would like to comment on other problem areas discussed with CSP personnel.

M. Additional Vehicle Repeater Units.

Analysis:

The CSP already have many of these units operating successfully in their system. However, the communication plan does not include any additional units.

Conclusions:

The vehicle repeater/handie talkies have proven to be valuable tools for patrol activity and officer safety. They allow the officer to be in constant contact with the dispatcher and fellow officers when he is out of his patrol car. They improve response time to emergencies and allow officers to call for help when they cannot readily return to their cars such as injury accident scenes and cases where firearms are involved.

Recommendation:

That all CSP patrol vehicles be equipped with these units to improve patrol efficiency and officer safety.

N. Establishment of Priorities for System Improvement.

Analysis:

The CSP communication plan covers a wide area of communications needs and desires for the overall State Police communication system.

Conclusions:

A definite set of priorities must be established to insure that resources are expended on the most pressing needs.

Recommendations:

Recognizing that alterations must be made due to available financing such as LEAA funding and the individual judgements of higher administration, the following priority list is suggested based on the premise that communication for and service to the patrol officer are the number one department priority. Notes elaborating on why certain selections are made have been included in some cases.

1. Radio Tower Repair/Replacement:

If the towers fail the entire system in a troop is wiped out and lengthy delays will be encountered attempting to get the systems back to normal.

2. Emergency Power At Tower Sites:

Again when power fails at the transmitter site the entire system at a troop is disabled.

3. Interference to base-mobile communications and scan capability on mobile receivers: These items are grouped together, as the solution to one requires the other for proper operation.
4. Eliminating dead spots.
5. Additional vehicle repeaters.
6. New multi-channel consoles for dispatch desks.
7. Additional portable units: These might not be needed if vehicle repeaters are used throughout the system as each officer would already have a portable.
8. Microwave radio control links for remote transmitters.
9. Dispatcher training.
10. Headquarters move to Meriden:

This item's priority will of course be controlled by the planned time for the move. This information was not given to the advisor and might easily move this item to the top of the priority list.
11. Improved paging facilities.
12. Statewide microwave system:

Number 11 and 12 are placed last as they are viewed as added advantages to the overall system. Whereby previous items are viewed as necessities for the efficient operation of the base-mobile communication system.

O. Review of Radio Service Capability:

Analysis:

CSP maintains a staff of 10 technicians at headquarters radio shop in Hartford. All radio work is done from this shop for the entire state.

Recommendation:

Consideration should be given to spreading these people out and establishing at least three separate facilities, one in each geographical division. This should reduce travel time tremendously thereby increasing response time. Technicians assigned to an area would be held responsible for equipment in their area thereby improving accountability. More preventative maintenance could be accomplished, technicians would be in closer contact with troopers and in a better position to recognize department needs and respond to them. In such a situation technical staff should remain under the Communications Division organizationally but be responsible to the local troop commander for attendance, conduct and general administrative supervision. They would be responsible to the Communications Division commander for all technical work and performance.

P. Dispatcher Training:

Analysis:

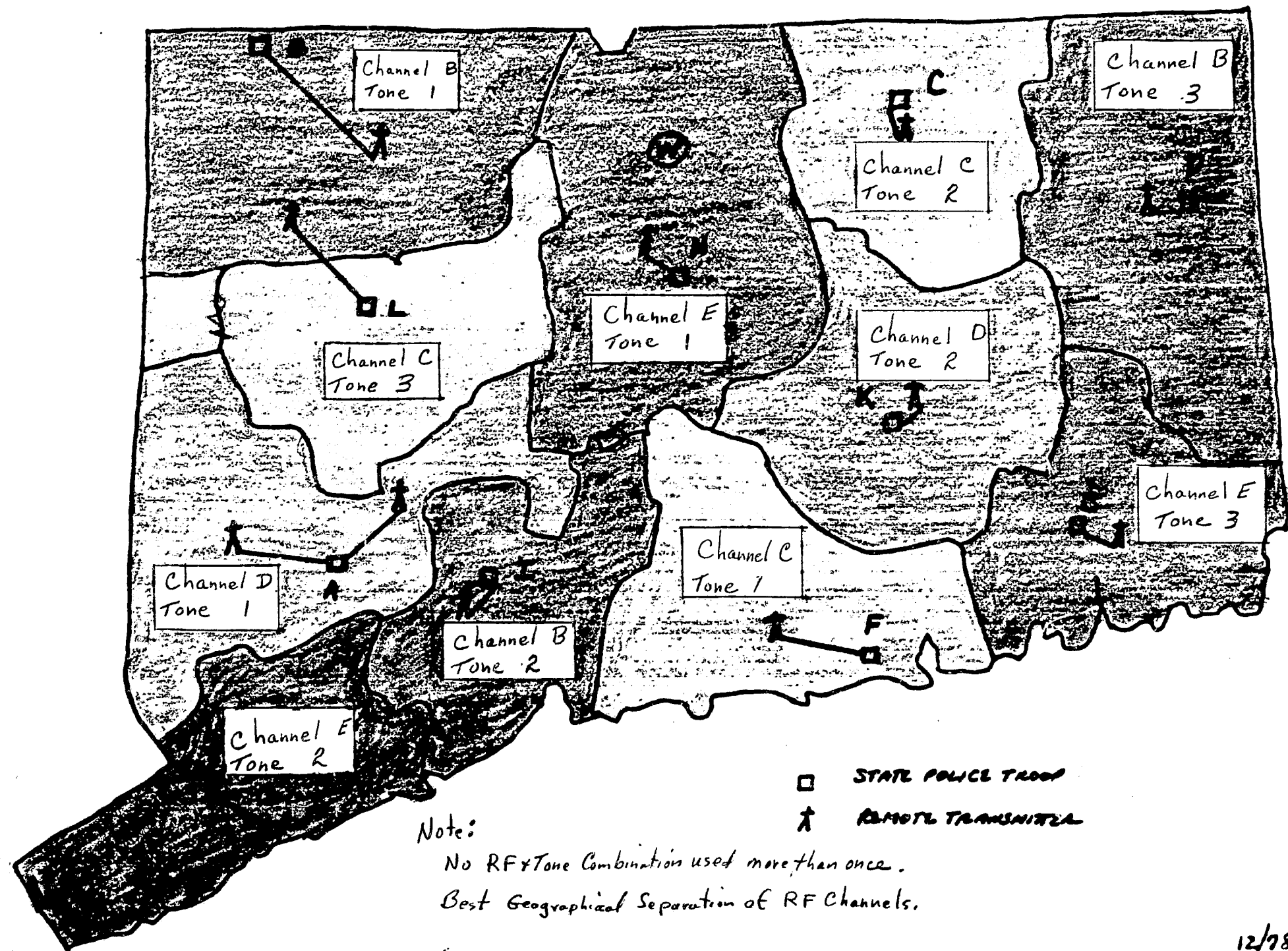
CSP personnel advise that dispatchers at troop barracks are usually drawn from the trooper staff and do not consistently operate the dispatch desk. In addition some non-sworn dispatchers are used. Little or no organized training takes place for these people.

Conclusions:

There is no assurance that the person operating the dispatcher desk is completely familiar with the entire radio system and data system.

Recommendations:

1. A training program be developed to train all personnel who will be operating the radio system. This program should include: how the system works, what CSP radio procedures are, FCC Regulations, blockade information and others. Assistance may be obtained from APCO in this regard.



Note:

No RF & Tone Combination used more than once.
 Best Geographical Separation of RF Channels.

- STATE POLICE TROOP
- ▲ REMOTE TRANSMITTER

12/78

D. Held 3-25-79

ATTACHMENT B

Suggested frequency pairing, tone and use assignments.

<u>Channel</u>	<u>Base</u>	<u>Mobile</u>	<u>Use</u>
A	None	42.180 MHz	BCI
B	42.360 MHz	42.680 MHz	Troops B, I, D
C	42.480 MHz	42.200 MHz	Troops L, F, C
D	42.580 MHz	42.300 MHz	Troops A, K
E	42.520 MHz	42.240 MHz	Troops G, E, H
F	42.620 MHz	42.620 MHz	Statewide B-M & M-M

<u>Tone</u>	<u>Frequency</u>	<u>Use</u>
1	71.9 hz	Troop A, B, F, H
2	88.5 hz	Troop C, G, I, K
3	103.5 hz	Troop D, E, L

<u>Troop</u>	<u>RF Frequency - Tone Frequency</u>
A	D - 1
B	B - 1
C	C - 2
D	B - 3
E	E - 3
F	C - 1
G	E - 2
H	E - 1
I	B - 2
K	D - 2
L	C - 3

ATTACHMENT C

Alternative for Mobile Radio Channel Positioning.

(Selectable Receive Scan is Assumed on all Units)

4 Channel Patrol:

1	2	3	4
Statewide (1 Frequency Simplex)	Troop Dispatch (2 frequency Simplex)	Troop Car-Car (1 frequency Simplex)	Tactical Car-Car (1 frequency Simplex)
Base-Car Car-Car Tone Optional 42.62 (42.04)	Base-Car Tone Squelch As Assigned	Mobile frequency of Dispatch Pair Tone Same as Pos. 2 As Assigned	No Tone 42.580

This positioning provides:

1. Base to/from mobile statewide - (position 1)
2. Mobile to mobile statewide - (position 1)
3. Private dispatch channel for troop (position 2)
4. Private mobile to mobile within troop (position 3)
5. Mobile will hear other mobiles call troop (position 3)
6. Tactical channel for additional car to car and emergency use statewide (position 4)

NOTE: (1) Position 4 is also the base transmit channel for troops A & K. Used with no tone and on a secondary basis harmful interference should be slight.

(2) If trooper wishes to monitor adjoining troop traffic, an additional scanner receiver is recommended.

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END