



LAW ENFORCEMENT ASSISTANCE ADMINISTRATION (LEAA)
POLICE TECHNICAL ASSISTANCE REPORT

SUBJECT: Upgrading the Radio Communication System

REPORT NUMBER: 77-030-139

FOR: Denver, Colorado, Police Department

Population	516,000(1973)
Police Strength	
(Sworn)	1,380
(Civilian)	<u>280</u>
Total	1,670

Square Mile Area 112.8

CONTRACTOR: Public Administration Service
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Washington, D. C. 20036

CONSULTANT: James E. McCorkle, Jr.

NCJRS

CONTRACT NUMBER: J-LEAA-002-76

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DATE: June 24, 1977

ACQUISITIONS

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FOREWORD

This report was prepared in response to a request for technical assistance from the Denver, Colorado, Police Department in 1) performing a general communications needs assessment covering all public safety agencies in Denver, and 2) examining frequency availability and compatibility relationships with other agencies in close proximity as well as the existing systems within the police department.

The consultant assigned was Mr. James E. McCorkle, Jr., and other persons involved in processing the request included:

Requesting Agency:	Mr. Charles D. Weller Executive Director Denver Anti-Crime Council
State Planning Agency:	Ms. Nancy C. Maron Director of Planning Colorado Division of Criminal Justice
Approving Agency:	Mr. John R. Jones Systems Specialist LEAA Region VIII (Denver)
	Mr. Robert O. Heck Police Specialist LEAA Central Office of Regional Operations

I. INTRODUCTION

The Denver Police Department is experiencing severe inadequacies of the VHF radio frequencies that carry the bulk of law enforcement radio transmissions in that city. The problems facing the existing communication system include extreme transmission interference, the need to utilize complex multiplexing techniques, the likelihood the FCC will restrict the use of that one VHF channel for police use that is now being shared with maritime agencies (156.690 MHz) and that may be lost by 1980, the lack of present VHF channel back-up capacity, lack of communications interface between specialized units and patrol units, and the nonexistence of an expansion capability in the VHF spectrum. Each of these problems has been compounded by the extreme growth rate of citizens' request for police services in Denver and the corresponding increases in radio transmission. Over the past four years transmissions have increased by over 18%; nearly one-half of this increase occurred during 1976. The deficiencies, combined with the city's growth rate, the demands for a computer-assisted dispatch (CAD), and the non-availability of VHF frequencies appear to present very serious communications problems for the Denver Police Department.

In addressing the first task, "Perform a general communications needs assessment overview of all public safety agencies in Denver," past correspondence and studies prepared on this subject were reviewed, existing communications facilities of the public safety agencies were examined, and the existing problem areas were discussed with key personnel in order to identify the problems of the existing system and establish the parameters of the technical requirements of the task.

The second task, "Examine frequency availability and compatibility relationships with other agencies in close proximity and the existing system within the Denver Police Department", involved the examination of the operational procedures within the department and with the other city public safety agencies with whom they coordinate their activities and/or receive data pertinent to their operation. From this examination, the extent and kinds of communications capabilities that are required of the department were identified. The deficiencies of the existing communication system in meeting the established requirements were identified and correlated to specific tasks to be accomplished. These are two areas of a five-area requirement, the other areas of which are: 3) Assist in formulating an RFP for a planning and engineering consultant to refine and implement a communications system recommended through this technical assistance; 4) assist in the review of bids on the RFP and in the selection of a vendor; and 5) review the completed work of the vendor - consultant chosen. The first two areas, above, are the subject of this assignment, which also provides technical assistance in the communication system planning, interfacing, and design alternatives.

Personnel interviewed during the on-site phase of the assignment, May 3-20, 1977 were:

Mr. John Jones
Systems Specialist, LEAA
Region 8 Headquarters

Mr. Charles D. Weller
Executive Director
Denver Anti-Crime Council

Mr. William McNichols, Jr.
Mayor, City of Denver

Mr. Ed Sullivan
Assistant to the Mayor

Mr. Richard A. Clark
Budget and Management Office
City of Denver

Chief Arthur Dill
Denver Police Department

Capt. Doral E. Smith
Division Chief
Denver Police Department

Capt. William Maddock
Division Chief
Denver Police Department

Capt. Lester Gebhardt
Division Chief
Denver Police Department

Lt. Carroll E. Byrd
Superintendent
Communications Center
Denver Police Department

Chief James E. Garner
Denver Fire Department

Mr. Patrick H. Mahoney
Superintendent, Fire Alarm Division
Denver Fire Department

Mr. John G. Powell
Acting Director
Emergency Preparedness Office
City of Denver

Mr. H. James Copland
Supervisor, 911 Emergency Telephone
Service, City of Denver

Mr. John C. Kremer
Facility Chief, STRATCOM, Region 6
Denver Federal Center

II. UNDERSTANDING THE PROBLEM

In the consultant's initial meeting with Messrs. John Jones, Ed Sullivan, Charles Weller, and Richard Clark, the parameters of the problem areas that are the subject of this report were discussed. It was emphasized that the recommendations are to be confined to the communication system of the Denver Police Department, since this feasibility study is intended to provide the basis for contracting with an engineering firm to provide the contract negotiations for the services recommended.

On the basis of this assignment, the only limiting influence on accomplishing the recommendations appear to be budgetary. At this time, the final programming capabilities of the computer-aided dispatch system (CAD) being installed is unknown; therefore, the extent to which the CAD can be used as part of the communication system will have to be determined at a later date. The CAD is being programmed into existing hardware in the city's computer center and is using telephone lines for interface with the CRT terminals in the Police Department Dispatch Center.

III. ANALYSIS OF THE PROBLEM

Present Communications

The dispatch center in the Denver Police Department is located on the third floor of the Police Headquarters building in downtown Denver. The operating area consists of two adjacent rooms--one for the complaint clerks and one for dispatchers. A continuous belt system between the rooms is used to transport complaint record cards from the six clerks to the six dispatchers. Administrative offices are located on the periphery of the operating area.

Public telephone calls using the three-digit emergency number 911 are received in a secure area in the City and County Building and interfaced by telephone lines with the appropriate responding public safety agency. Seven-digit telephone calls are received directly by the agency being called. These mechanical methods are slow, and the procedures are scheduled to be updated by the installation of a computer-aided dispatch (CAD) system.

Radio communication from the dispatch center is by telephone leased lines to the repeater site at the City and County Building and by microwave to the Mt. Morrison repeater site located about 14 miles west of and about 3,000 feet higher elevation than the City and County Building. From this elevation, the VHF and UHF signals are transmitted to the base, mobile, and portable units in the Denver area.

The Mt. Morrison repeater station has been maximized to the point of inefficiency. As demands from the public safety agencies for more radio communication capabilities have increased, the additional facilities have resulted in intermodulation interference, competition for air time, and related problems.

A standby repeater site located at the Police Radio Maintenance Facility interfaces with the site at the City and County Building and is located east of the city and with about a 300-foot higher elevation. It is located adjacent to the Denver Fire Alarm Station. There are 42 pairs of telephone lines from this back-up repeater site that interfaces with the City and County Building repeater site. In the event of failure of the Mt. Morrison repeater site, the traffic is switched to the back-up repeater site. Antennas for the communication equipments are mounted on an unused Denver Public Works Department water tower located adjacent to the stand-by site. The tank is the property of the Water Board and could be removed, necessitating relocating the police department antennas.

IV. FINDINGS AND CONCLUSIONS

The Mt. Morrison repeater station provides a satisfactory coverage of the City. The voting system, with a receiver in each of the four quadrants of the city, adequately serves the portable radios. Exceptions are picked up by the back-up site and relayed.

Interagency communications are normally by telephone between base stations and by radio between mobiles. The timeliness of the interagency communication appears to be an administrative problem rather than a communication system problem. For example, the police department is advised of a fire department run and dispatches a vehicle; on site, the fire department reports a false alarm. If there is a delay in advising the police department of this fact, the police vehicle arrives at the site and finds no emergency. The addition of the CAD to these departments can keep them advised with timely information, providing, of course, the operating personnel make a timely recording into the computer. Because the computer entry is also the department record, communication by this method can be expected to improve.

The availability of the desired UHF channels has been confirmed by the Federal Communications Commission to the Superintendent of the Electronic Engineering Bureau, Denver Police Department, and the intermodulation characteristics have been determined by computer calculation and printout.

The plan to convert the present VHF channels to UHF channels must provide for the necessary interface with supporting departments still on VHF to retain interagency communication capability.

The site for the radio communications back-up equipment at the Police Radio Maintenance Facility is satisfactory. The conversion to UHF, or higher frequencies, will replace older equipment at this site. This older equipment is no longer economical to maintain, since maintenance costs over the past 8 years have increased from about \$8,000 per year to \$45,000 per year.

There are presently 42 pairs of telephone lines that interface the back-up communication equipment with the relay point in the City and County Building, and these can be replaced with a microwave link. The link will carry present services and provide a needed expansion capability. The line-of-sight path between the two relay points has been assured by city building regulations.

V. RECOMMENDATIONS

General Recommendations

It is now urgent that the Denver Police Department communications systems convert from a part VHF, part UHF system to a complete Ultra High Frequency system. The VHF portion of the system is ineffective to meet program requirements and excessively expensive to maintain. There are now very few UHF channels available in the Denver area; therefore, consideration should be given to converting the present police VHF and UHF channels to the 450,800 or 900 MHz systems in the field, in comparing the conversion to these frequencies of the UHF band.

With the move of the Communication Dispatch Center to the new Police Headquarters building, consideration should be given to consolidating the back-up systems for all of the public safety agencies at the Police Radio Maintenance Facility. This expansion of the communication facilities would be engineered for frequency compatibility, use of multiplexing techniques, and related design characteristics that would provide the major services normally provided by the Mt. Morrison site.

A microwave link, in lieu of the present 42 telephone lines, between the back-up repeater site and the City and County Building repeater site is desirable for its reliability and capacity for handling large volumes of traffic. The interface between the two sites can only increase; microwave transmission can be readily expanded and represents a one-time cost, and it would replace all leased telephone lines between police and fire department repeater services at the Police Radio Maintenance Facility and the co-located Fire Alarm Station, as well as the repeater services at the City and County Building. The procurement and installation of this system is interrelated to the proposed expansion of the radio back-up capabilities of the police department's facilities at its Radio Maintenance Facility. The site elevation of the police facility makes it ideal for this necessary service; it is an answer to the problem of intra-city communication interference by the ever-increasing building density in the city area.

Specific Recommendations

It is recommended that:

1. The four VHF repeater pairs be replaced with UHF channels. The selection of the most desirable frequencies will be determined by the intermodulation characteristics when combined with the presently assigned UHF frequencies. This conversion would involve changing equipment at the Mt. Morrison site, the five voting stations, back-up base stations, mobile and portable radios, for a total of 16 base stations, 642 mobile/portable radios, and 642 vehicular chargers.

2. Equipment specifications and requests for proposals (RFP) from the vendors be prepared for the new UHF system equipments, expansion of the standby services to be provided the city's public safety agencies, and the extension of the Fire Alarm Station radio tower.
3. When planning for relocation of the antennas from the water tank, consideration be given to extending the existing tower on the adjacent Fire Alarm Station building to 350 feet. This will provide space on the tower without interference with existing antenna systems on the tower. The extension would be accomplished by the addition of a base section, either by lowering the tower or raising it with cranes.
4. The installation of a microwave system from the repeater station at the Police Radio Maintenance Facility to interface with the repeater station at the City and County Building to be in the 12 GHz band, two-way link, with a hot standby. One hundred of the channels of multiplex would serve the immediate needs of the city's public safety agencies, replacing the present expense of 42 leased telephone lines and providing high reliability.

Action Plan

1. The application to the FCC for this conversion to UHF channels should be made without delay.
2. The change of VHF to UHF is an action independent of facility location for the Police Department Communication facilities. Based on an estimate of one vendor, costs are an estimated \$1.4 million for hardware items. An expenditure of an additional \$50,000 to the vendor for the hardware installation can be saved by using a force account for this work.
3. The cost estimate for a 12 GHz microwave link between the Police Radio Maintenance Facility and the City and County Building is \$125,000.
4. The inclusion of providing all back-up facilities at the Police Radio Maintenance Facility will cost an estimated \$100,000.00, including the moving of the stations antennas from the water tower. These actions do not require additional floor space, personnel, or permanent test equipment.
5. The total costs of developing the projects identified in this study are estimated at \$1.625 million. These costs

can be phased; however, the major cost, \$1.4 million for conversion from VHF to UHF, may be a turn key type of operation, making maximum use of city force accounts.

- 6: When the RFP's are completed and cost estimates refined, the availability of Federal funds should be investigated thru the Joint Federal Regional Council for multiple Federal Agency participation, or by application to the individual agency, including LEAA, DCPA, HEW, and DOT.



END