LAW ENFORCEMENT ASSISTANCE ADMINISTRATION(LEAA)

POLICE TECHNICAL ASSISTANCE REPORT

SUBJECT	Radio Communications Assessment
REPORT NUMBER	77-096-179
FOR	Plano, Texas, Police Department

Population 26,000 (1973)
Police Strength (Sworn) 87
(Civilian) 31
Total 118

Square Mile Area 17.6

CONTRACTOR	Public Administration Service 1776 Massachusetts Avenue, N. W. Washington, D. C. 20036
CONSULTANT	R. James Evans
CONTRACT NUMBER	J-LEAA-002-76
DATE	January, 1978

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I. INTRODUCTION

This report was prepared in response to a request for technical assistance from the Plano, Texas, Police Department in the form of an assessment of police radio communications. The department specifically requested the consultant to address the following areas;

1. Type and number of additional frequencies needed, now and in the future.

2. Correct placement of transmitters and antennas to provide best possible coverage for service area and maintain emergency control.

3. Operating procedures for specific frequencies as applicable to units and divisions.

4. Coordination of frequencies to afford best possible utilization of existing equipment and any additions.

5. Appraisal of existing equipment in conjunction with its future use with new equipment.

The consultant assigned was Mr. R. James Evans, and those involved in processing the request included:

Requesting Agency:	Dwayne Kinsey Chief of Police Plano, Texas
State Planning Agency:	Frederic W. Keithly Director of Criminal Justice Arlington, Texas
Approving Agency:	Robert O. Heck Police Specialist LEAA Office of Regional Operations

Background

The City of Plano is just over 100 years old as an incorporated municipality, but nearly all of the city's growth has taken place during the past two decades. The original settlements in the Plano area date back to the 1840's and are related to the colonization efforts of the early days of the Republic of Texas.

The distance from Plano to Dallas, 18 miles, was originally sufficient to make Plano a separate trade center. The travel time

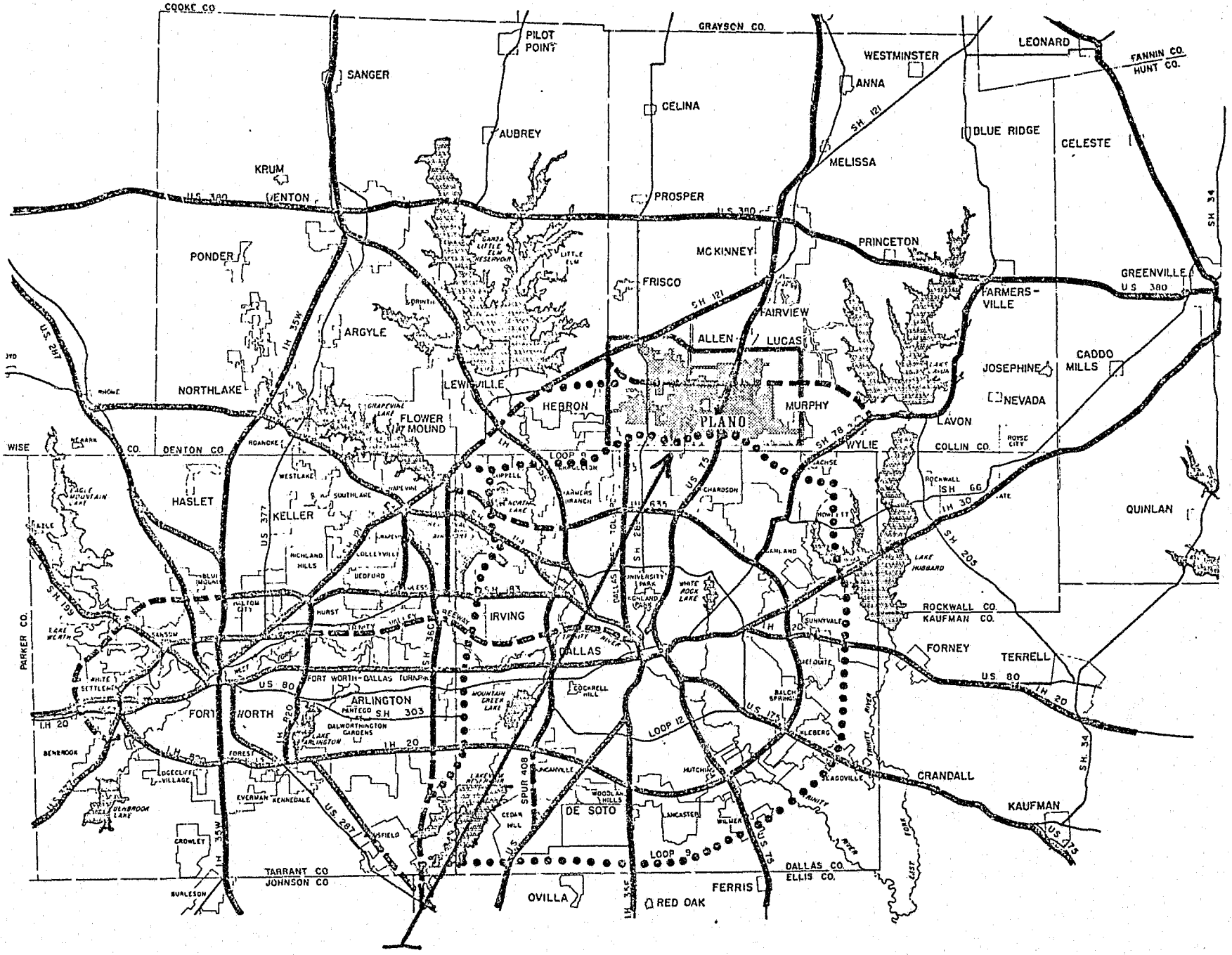
between the two cities has been reduced by the construction of highway U.S. 75 to about 20 minutes, thereby substantially changing in future potential of the community. Figure 1 shows the area's location.

The economic character of Dallas County began to change abruptly from agriculture to an urban industrial base in the 1930's. The World War II industries that are located in the Dallas area triggered a suburban expansion which is still in progress.

The interest in and the demand for housing in the Plano area has resulted in an aggressive development and home building industry that added approximately 2,500 new dwelling units to the city's housing inventory in 1976. Responding to the demand for developable land, the city has expanded its boundaries and is now considering expansion to approximately its ultimate boundaries, encompassing an area of approximately 72 square miles. When the entire area is annexed to Plano, the city's boundaries will be contiguous with those of Parker, Murphy, Richardson, Dallas, Hebron or Carrollton, Frisco, and Allen. The Plano municipal area will extend from Richardson and the Santa Fe Railroad on the south to State Highway 121 and Frisco on the North. The western boundary of the city will be along the Collin-Denton County Line. The eastern boundaries will touch Allen, Parker, and Murphy. These close geographic relationships which will exist between Plano and its neighboring municipalities will require increasing communication and coordination to assure orderly development of the entire urban area.

The 1973 median population estimate for Plano, based on the 1970 census was 26,000. Several factors have influenced the revision of population projections upward to an estimated 1975 population of 38,300, and it is expected that by 1985 the City of Plano will have a population of about 100,000 people. After 1985, growth will continue, but it is expected that the limits on availability of land and a general reduction in the growth rate will result in a slowing in the rate of population increase. The present growth rate is about 16% per year.

Figure 2 illustrates some physical and topographic characteristics of Plano's site, about two-thirds of which is drained by Rowlett Creek (eastern section of city). The western part of the community area lies in the White Rock Creek system that flows southward through northwest corner of the city planning area and along a ridge running parallel to Preston Road and separating the White Rock Creek system from the Rowlett Creek area. The higher elevations range upward to approximately 780 feet above sea level. The lowest terrain is found on the eastern part of the city. The elevation at the existing Plano Police Department radio tower is 650 feet above sea level. The western ridge running north and south as indicated in Figure 2 has caused some radio coverage problems for the department in the White Rock Creek area.



CITY OF PLANO, TEXAS

REGIONAL THOROUGHFARE RELATIONSHIP

Figure I- Plano Area

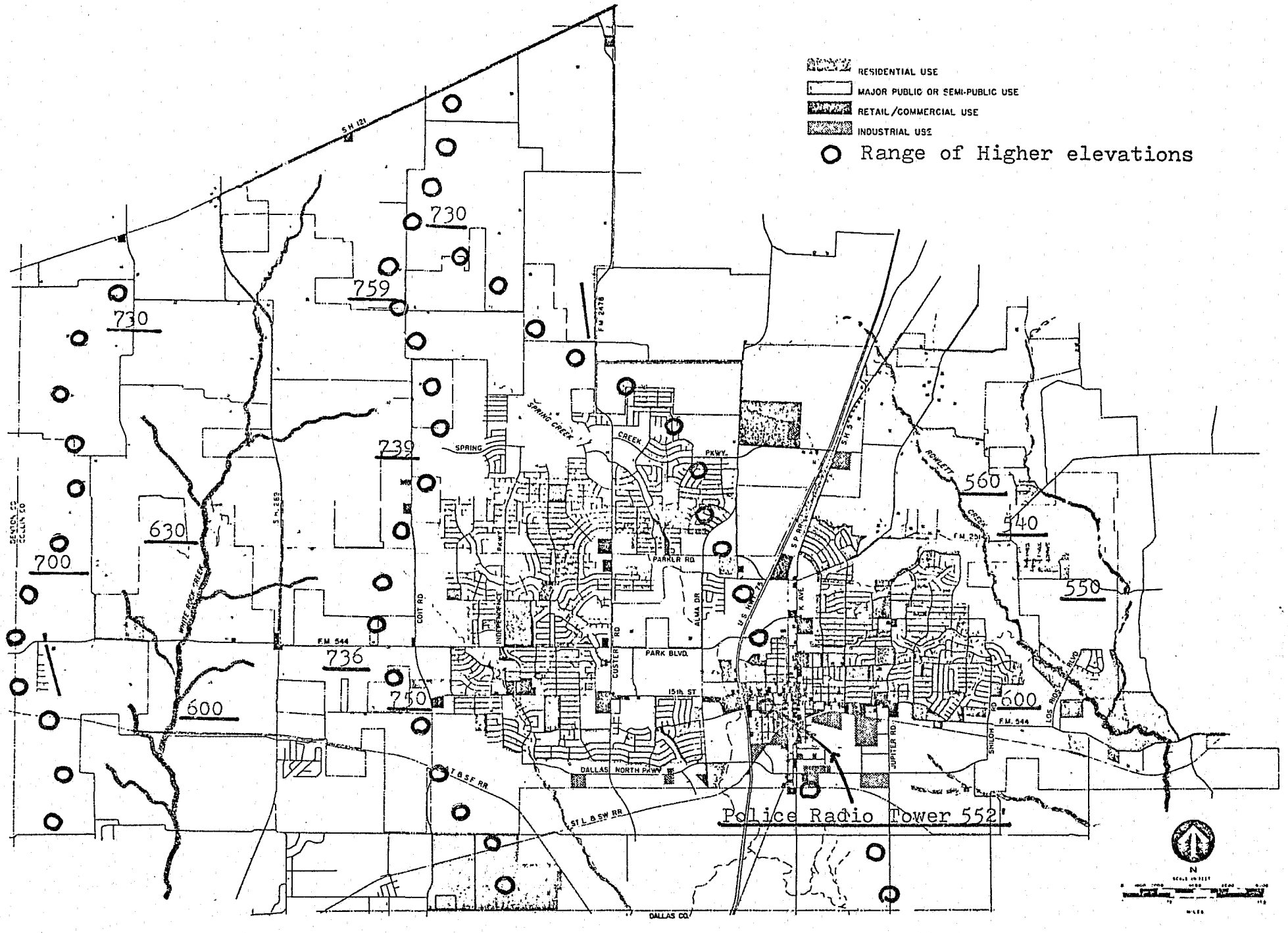


Figure 2 - Topographic characteristics

This rapid growth has created a need for immediate expansion of all city services and especially those involving public safety. A new police building was occupied about three years ago, but the department's expansion has created a space shortage in the new facilities. The communications dispatching area is presently being enlarged to make room for additional equipment and personnel.

The Plano Police Department presently has 87 sworn officers, 31 civilians, and 37 radio-equipped cars.

Methodology

The technical requirements of the task involved a number of meetings with city personnel as well as visits to existing city communications and areas that would impact future communications plans.

The State Frequency Coordinator at Austin, Texas, was contacted in an effort to determine if radio frequencies that are compatible with existing Plano assignments would be available in the future when they are required due to expansion.

Many communications problems, both present and future, were discussed with Chief Kinsey, Sgt. Payne, and James McCarley, who are directly responsible for the future expansion of technology within the department. The existing telephone, radio, and data facilities were observed and discussed with Sgt. Payne. Possible future technology and police communications expansion problems were discussed with the Assistant City Manager.

The Civil Defense (Emergency Services) Director for the City of Plano has a communications responsibility that includes many long-range plans for the improvement of city communications. The Civil Defense Director was in attendance at a meeting chaired by the Chief of Police at which all the city's existing and future communications were discussed. The Civil Defense Director has recently prepared some purchase specifications; these were reviewed and comments made to ensure that the police functions were properly considered.

Personnel interviewed during the on-site visit, January 2-5, 1978, included the following:

Dwayne Kinsey,
Chief of Police,
Plano Police Department

James McCarley,
Administrative Assistant,
Plano Police Department

Sgt. Lyndon Payne,
Plano Police Department

David A. Griffin,
City Manager,
Plano, Texas

Alan Ratliff,
Assistant City Manager,
Plano, Texas

Lee Mayfield,
Chief
Plano Fire Department

Ernest Reich,
Civil Defense Director,
Plano, Texas

Ben Montegue,
Frequency Coordinator,
State of Texas
Austin, Texas

II. ANALYSIS OF THE PROBLEM

The primary objective of this assignment was to conduct a survey of current communications systems and to project future needs for the next 10-15 years for the Plano Police Department. This objective is directly related to the currently high growth pattern that is expected to continue into the future. This growth over the past few years has demonstrated the need for careful technical planning in the area of public safety as well as other city services.

The several specific areas that were to be addressed by the consultant during his assignment included:

1. Type and number of additional frequencies needed currently and in the future.

2. Correct placement of transmitters and antennas to provide best possible coverage for the service area and to maintain emergency control.

3. Operating procedures for specific frequencies as applicable to units and divisions.

4. Coordination of frequencies to affort best possible utilization of existing equipment and any additions.

5. Appraisal of existing equipment in conjunction with with its future use with new equipment.

Frequency Needs

The number of frequencies required currently and in the future can best be determined by a review of the Plano Police Department's existing communications, followed by a discussion of immediately needed future improvements.

Figure 3, the Plano Police Department's basic communications, provides a graphic background that will be used as a building block diagram for future improvements to be discussed below. On the left hand side of the figure, event calls from the citizen are received at a telephone switchboard by one of three persons in the dispatch center. An event dispatch card is started by the operator receiving the call. The card is then given to the dispatcher if the call requires an officer at the scene (the complaint-taker and the dispatcher may be one and the same person on certain shifts). The dispatcher will give the event information to an officer in a patrol car for execution, completing further required information on the event card. After the officer has completed the assignment, he will notify the dispatcher by radio, and the event card will again be updated. The cards are taken daily to the records section where the officers' complete report will be combined with

PLANO POLICE DEPARTMENT
BASIC COMMUNICATIONS

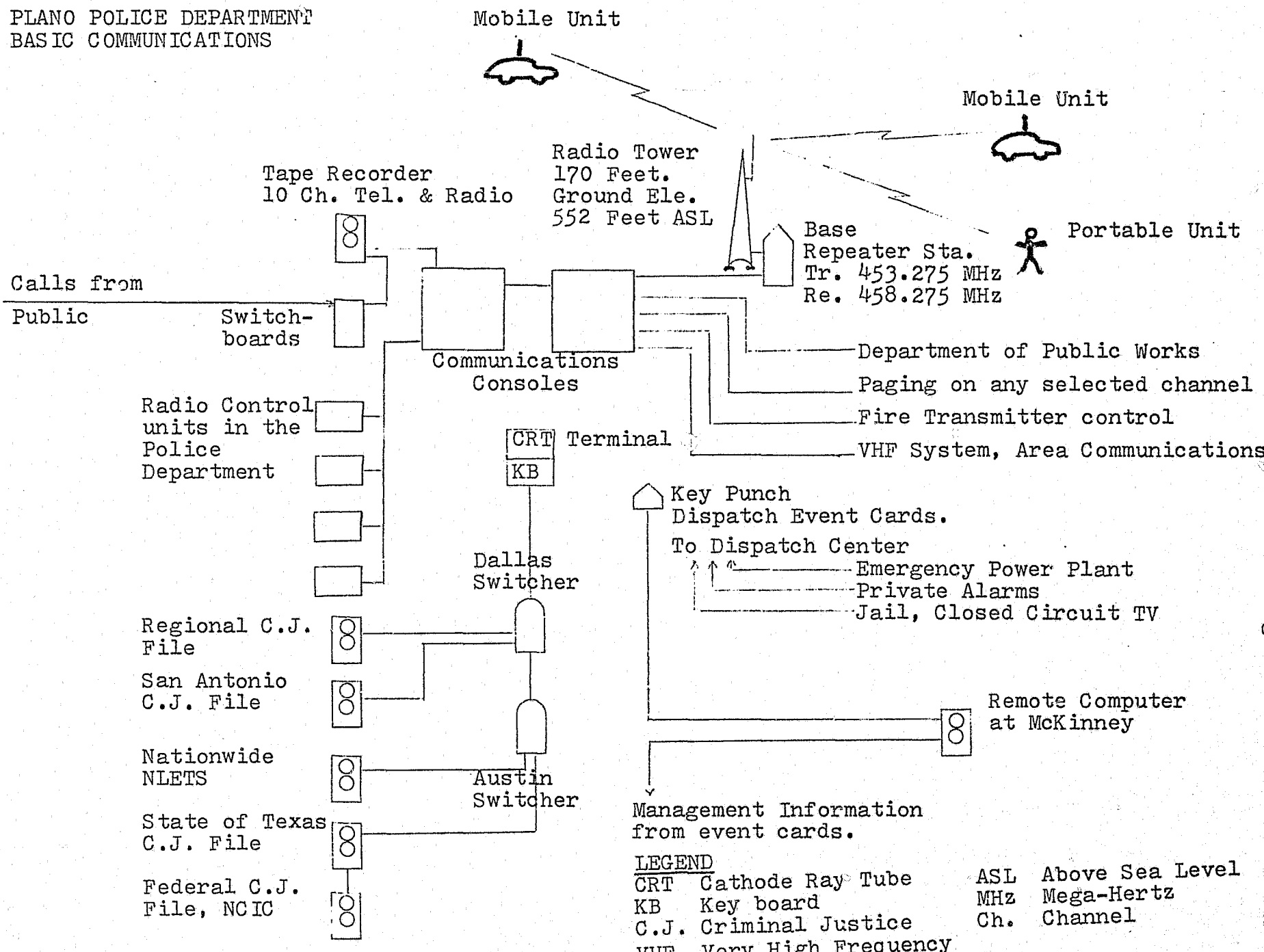


Figure 3 - Basic Communications

the card information and key-punched for computer entry. The record information from the computer is made avialable on a periodic basis fcr management decisions.

The tape logging recorder is physically located in the dispatch office and operates on a 24-hour basis. It has a 10-channel capability and can be modified for up to 40 channels when necessary. All emergency-type telephone calls are recorded as well as radio messages that are received or transmitted via the console dispatcher. This unit is becoming overloaded as radio channels are needed and extra telephone circuits are required.

The communications consoles located in the dispatch office are of the Motorola and General Electric design. The Motorola is approximately 3 years old, and the General Electric is 1 year old. The latter unit has a technical problem that has existed for some time. Technicians have attempted to correct the distortion during the transmit mode but to date have not succeeded. The two units are used to transmit and receive (functions of switching) to base stations and units in the following services:

1. Plano Police Department mobile and portable units via the UHF base station repeater.

2. Coordination with units of the Plano Fire Department on a low band frequency. The fire service has its own dispatch facilities.

3. Paging on any selected frequency to off-duty police officers or officials.

4. Areawide radio contact on a VHF radio system for communications with adjacent police departments.

5. Coordination with the Department of Public Works of Plano.

In addition to the main control consoles in the dispatch office, there are several remote desk-type consoles situated in offices in the department that allow divisions or officials to monitor the main radio channel and operate the transmitter should an extreme emergency occur. These are shown in Figure 3 as radio control units.

The base station repeater serves a dual function. It can be operated by the dispatchers to talk to the mobile and portable units, or in the repeat mode it will automatically repeat any received (tone-coded) signal from a mobile or portable radio so that it can be heard by all other units on the system. This repeat action greatly increases the unit-to-unit range. All mobile and portable sets are equipped with a second function switch termed "talk-around" which will allow unit-to-unit communications without using the base station repeater. This is a short-range function.

The base repeater is designed to operate at 250 watts output; however, due to an equipment malfunction, it only operates at 50 watts of power output. This has caused some communications problems when units are required to operate or work in the western part of the city. The service technicians are aware of the problem but have not been able to correct it.

The radio tower that supports the high gain antenna is located adjacent to Police Headquarters on 14th street. The ground elevation at the tower base is 552 feet, and the tower is 170 feet high. The location is towards the eastern section of the city, and difficulty in mobile and portable communications has occured in the western area near White Rock Creek. Figure 2 shows the range of hills between the radio tower and the Rock Creek area that creates these communications problem.

The mobile radio units presently in operation at the Plano Police Department vary in age and in the number of cha-nels available for transmitting and receiving. Of the radios, 28 have a 2-channel capability, and 10 have a 4-channel capability. These are on the UHF frequency range and operate at 40 watts output power. There are 5 radios on the VHF frequency range at 100 watts output power. The VHF radio sets are used in command cars for coordination with other department police officers during emergencies.

The portable radio units are used by officers while out of their patrol cars. There are 33 UHF hand-held units with 2 channels and 1-watt output. In addition to the UHF sets, there are 6 VHF portables with 5 operating channels and 2-watts output and 9 VHF sets with 4 channels and 1-watt output. The 1-watt portable radios have been satisfactory for communications in the present city area; however, they are not dependable in the western section of the area.

The dispatch center is provided with a computer terminal of the cathode ray tube (CRT) type. This terminal provides immediate access to the criminal justice computer files in Dallas, San Antonio, Dallas area regional file, state files, national files (NCIC), and the nationwide NLETS files. Use of this terminal is normally by a second dispatcher who will receive inquiries from officers in the field via voice radio. The request is entered and the return information is given to the requesting party by radio.

The center is equipped with an emergency power plant that is located adjacent to the operating room. This unit will furnish

primary power to the equipment during a commercial power failure. The unit engine operates on natural gas, which could be curtailed during an emergency. Plans are being made to change the fuel to an LP type of gas that would decrease the chance of failure during any emergencies. Additional ventilation is also required in the generator room due to the excessive heat produced while the engine is operating.

TV cameras and monitors are used in the jail and building door areas. The monitors are located in the communications operating room.

The dispatch personnel are also required to answer a number of private alarms that terminate in the communications room.

The electronic equipment owned by the Plano Police Department is maintained on a contract basis by a local firm. This maintenance arrangement is generally satisfactory, except for the two major problems described above. Since the city's growth has required additional electronic items, it may be wise for the City Manager's Office to determine at what point it becomes cost-effective to have a city-employed technician. Justification for this decision may be based upon a number of factors. Some of these are: a) review the cost of contract maintenance vs. the cost of an in-house technician; b) number of electronic units requiring service; c) projected population growth; and d) quality of the existing maintenance.

The specific area of concern relates to radio frequency usage, both for current and future requirements. The police department presently operates all field units on one pair of UHF radio channels, which are 453.275 MHz and 458.275 MHz. The normal usage is through the base station repeater, described above. This pair of frequencies is rapidly becoming overloaded with radio traffic. The department has recognized this problem and, in an attempt to keep response time at a minimum, has made operating adjustments. Currently, all computer checks requested by field units are answered by one dispatcher located near the CRT terminal, while the other dispatcher handles the voice radio traffic to and from the field units. Although this method of operation has kept response time at a minimum, further improvement is now necessary.

The department recently applied for and received from the FCC a second pair of UHF channels that are compatible with the existing pair. These are 453.100 MHz and 458.100 MHz. A new station is being purchased that will include both the old and the new channels. This unit will be located at the city hospital, in the western section of the city.

Placement of Transmitters and Antennas

The second specific area to be addressed in this technical assistance survey is the correct placement of transmitters and

antennas to provide the best possible coverage for service areas and maintaining emergency control.

Figure 4 is a chart of the improved communications design that will be purchased shortly. The existing base station at the police department is indicated on the right side of the chart and the new proposed base repeater is shown on the left side. The new repeater is a Civil Defense installation, and a control console will be installed in the basement of the hospital. This console will be used by police personnel during emergencies that prevent operation from the main dispatch office. The existing control consoles at the police department will be "hard wired" (no interrupt at the telephone central office) via telephone control circuits to the transmitter at the hospital. This method of control is recommended over the installation of a microwave radio system for two reasons: 1) The short distance between the two locations (3-1/2 miles), and 2) the small number of circuits to be used at this time. Microwave is ideal and very cost-effective where many circuits are required and long distances are involved or if telephone company circuits are not available or are undependable.

The control console switch network should be engineered to prevent accidental "turn-on" of the two repeaters on the same frequency. This error would result in a mixing of the two signals whereby a car or portable message would not be heard by the dispatcher. A normal operation would require the west repeater to operate on 453.100 MHz, while the east repeater is operating on 453.275 MHz. If the east repeater fails, then the west unit could be switched to operate on 453.275 MHz as a backup station.

The hospital location appears to be the best selection for the new station, since the antenna height is great enough to allow the signal to cover the White Rock Creek area. Another significant factor in this location is the availability of antenna and equipment space at no charge to the city.

It is recommended that the antenna at the new location be oriented to the east to provide improved communications to portable units that may be working on the far eastern side of the city. The antenna on the tower at the police station should be oriented to the west or northwest to provide a more positive signal in that direction.

The new base station to be purchased for the western location should have two receivers (one on each frequency) to allow better signal control from the dispatch consoles. This addition will allow the dispatcher to monitor both channels if necessary during local equipment failures.

The addition of satellite receivers may be necessary in the future in the north, northwest, and east. Future tests will determine if these are required. Often tall buildings or metal buildings will shield the output from portable radio units and the police officer

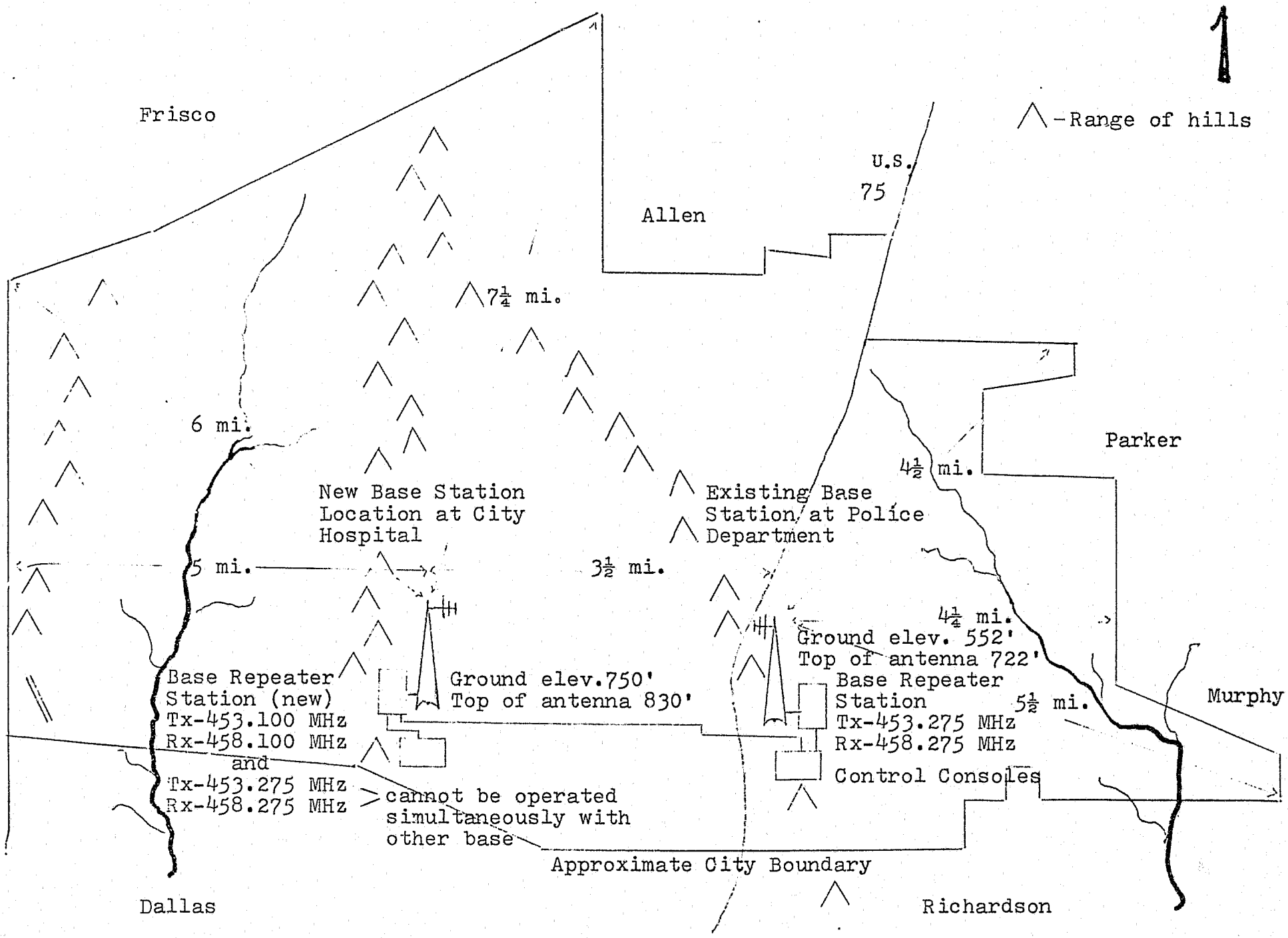


Figure 4 - Improved Communications Design

on patrol cannot pick an ideal location from which to transmit.

In order to maintain emergency control of the equipment in both locations, the dispatch consoles should be wired in a priority fashion with a switch that would allow complete control from the Civil Defense Center when required.

Operating Procedures for Specific Frequencies

The third specific area to be addressed involves operating procedures for specific frequencies as applicable to units and divisions.

There are several concepts of multi-frequency operation among police departments. One common method is to divide the city into districts or regions and to assign each of these areas a separate pair of frequencies. This concept works well in large metropolitan areas of several hundred thousand or more people; however, it is not recommended for Plano at this time. A second concept is to assign different frequencies to various types of activities requiring radio contact in the field. The second concept is recommended for this growing period in Plano. The two pairs of UHF frequencies now assigned tc the department can be split between the patrol operation and all other radio uses. The second pair of frequencies would provide radio operation to the administrators, C.I.D., traffic divisions, special operations, and computer checks. This arrangement would reduce the heavy load on the existing single pair of channels. When the two-frequency operation is started, it will be necessary to install scanners in all police vehicles to provide reception on both repeater channels.

The department should consider the addition of a third pair of radio channels after some experience is gained with the two-repeater system. The third channel could be justified either for data to and from the patrol cars or as the system becomes overloaded.

Coordination of Frequencies for Best Utilization

The fourth specific area to be addressed is the coordination of frequencies to afford the best possible utilization of existing equipment and any additions.

In order to plan for viable system expansion over a period of several years, the department must first determine if frequencies are available. The channels must be compatible with those presently in use, since radio transmitters and receivers used in police service do not have the capability of being changed from one band of frequencies to another, e.g., VHF to UHF.

The Plano Police Department was fortunate to obtain a second pair of UHF channels that are only 175 KHz removed from their original pair.

A third pair of compatible channels will be required as the department increases in size. The consultant discussed this with the State of Texas Frequency Coordinator, Mr. Ben Montegue, in an effort to determine the availability of UHF channels in the Dallas area. Mr. Montegue advised that at the present time there are no available UHF channels that would be compatible with the Plano Police Department's existing frequencies. However, the Dallas Police Department may eventually be required to move its system to the 800 MHz band for system expansion. If this move is made, some relief for the area could come about by the future assignment of the existing Dallas frequencies.

The existing Plano police radio equipment can be modified to accept the new channels now being planned. A certain amount of modification will be required in the control consoles and mobile and portable equipment; however, the modification cost is only a fraction of the cost of new units. The Plano Police Department's equipment is relatively new and has an expansion or modification capability.

Appraisal of Existing Equipment

The fifth specific area to be addressed by the consultant required an appraisal of existing equipment in conjunction with its future use with new equipment.

The existing communication control consoles will be compatible with the newly planned base repeater station to be located at the city hospital. The modification of the consoles will include new switches for channel selection, additional channel boards, and other minor changes. These control consoles if properly maintained should provide satisfactory operation for a number of years.

The mobile and portable radio units will require modification for the new radio channels. This consists of changing the frequency selector to one of greater range and adding channel frequency elements in the transmitters and receivers. Some units may require additional wiring from the selector switch to the oscillator section of the unit. All new frequencies added to units will require adjustment to proper tolerance, and a FCC report will have to be made. If some portable units are too costly to modify, new units should be purchased. It is recommended that 5-watt portable units be purchased in the future to provide a more useful range than that afforded by the 1-watt units.

The new base station being purchased on 453.100 MHz should have the same tone squelch frequency as the existing police system.

Review of Purchase Specifications

Purchase specifications for the procurement of new equipment for use with the Civil Defense Center were prepared by Ernest Reich, Civil Defense Director for the City of Plano. A review of these specifications was conducted by police department officials, Mr. Reich, and the consultant on January 4, 1978; the specification document was written or prepared in a professional manner, and only minor changes were recommended. A copy of the specifications is included as Appendix A.

III. FINDINGS AND CONCLUSIONS

The following findings and conclusions were derived from the preceding analysis of the Plano Police Department communications system. The findings cover areas for immediate improvement as well as long-range considerations.

1. FINDING

Future updating of the communications system will be needed.

CONCLUSION

One aspect of this technical assistance task was to conduct a survey of the existing system and to project future needs for the next 10 to 15 years. Today's law enforcement agencies are forced to consider new communications concepts and innovative designs for a number of reasons. As personnel costs have soared upward, it has become necessary to automate many manual functions in an effort to provide fast and efficient telephone and dispatch functions. By reducing the manual workload of the operating personnel, response time is reduced. This reduced response time is important to the citizen who requires police, fire, or ambulance assistance in the fastest manner possible. The automation of any system must be cost-effective to the agency, whether it is a town of 500 or a city of 500,000. That the Plano Police Department is a very active and efficient agency is exemplified by its Communications Division. Its officers are cognizant of the citizen response time factor, and the immediate technical improvements include a further reduction in response time by giving the field officers more "air time." The consultant recommends that future needs for the next 10 to 15 years be studied carefully and that plans to update and automate be scheduled in several phases in order to keep implementation costs within reason and to minimize the obsolescence of usable equipment items. The police department should consider the use of a staff assistant who is a qualified telecommunications expert who could be responsible for all present and future data, radio and telephone planning. This person might also be used by the city for advising other departments on communications needs, thereby justifing the additional personnel cost.

The major improvements or revisions in the communications area recommended by the consultant are:

1. Car status via data input.
2. Future satellite receiver installations.
3. Computer-assisted dispatch.
4. 911 common telephone number implementation.
5. Consolidation of city dispatch functions.

The status of police vehicles is presently handled on a manual basis by the dispatcher. This function can be automated directly from the police vehicle by the installation of a status data head and equipment interface to the mobile radio unit. The officer in the car, by the use of preprogrammed push buttons, can automatically update his status. This action by the officer shows up on the status screen in the dispatch office. The data transmission from the vehicle takes only a fraction of the time of a voice transmission and saves valuable "air time" (see Figure 5, an event flow chart).

The satellite receiver implementation should be investigated as the department grows to determine if there are "dead communications areas" that cannot be serviced by an officer using a portable radio. This concept can be added to an existing system at any time in the future.

A computer-assisted dispatch system should be considered in the future for further reducing the normal workload in the dispatch center. At some point in time, a decision can be made whether to add more dispatchers or to automate the functions. The CAD system has a number of added advantantages such as a switching of terminal use from CAD to regional, state, and Federal files, coordinating event information for other emergency departments, and furnishing management information. A CAD concept is shown in Figure 6. Management information collection is indicated in Figure 5.

The 911 common telephone number should be considered as a future improvement to reduce the citizen's response time. This item should be considered simultaneously in conjunction with the surrounding communities such as Dallas and should provide selective routing of calls, coin-free pay phones, automatic number identification, and automatic street location. Plano presently uses several seven-digit numbers for emergency services. Figure 7 indicates a reduced emergency response cycle when 911 is used in comparison to a seven-digit number. The consolidation of city dispatch services should be evaluated at some future period to determine if there could be any savings in personnel cost for the city while still maintaining efficient service to the public. The present fire and ambulance dispatch center was visited by the consultant, who found it to be very up-to-date and efficient in operation.

The consultant's concept of message flow from the event call from the citizen to the final recorded event and management information is shown in Figure 5.

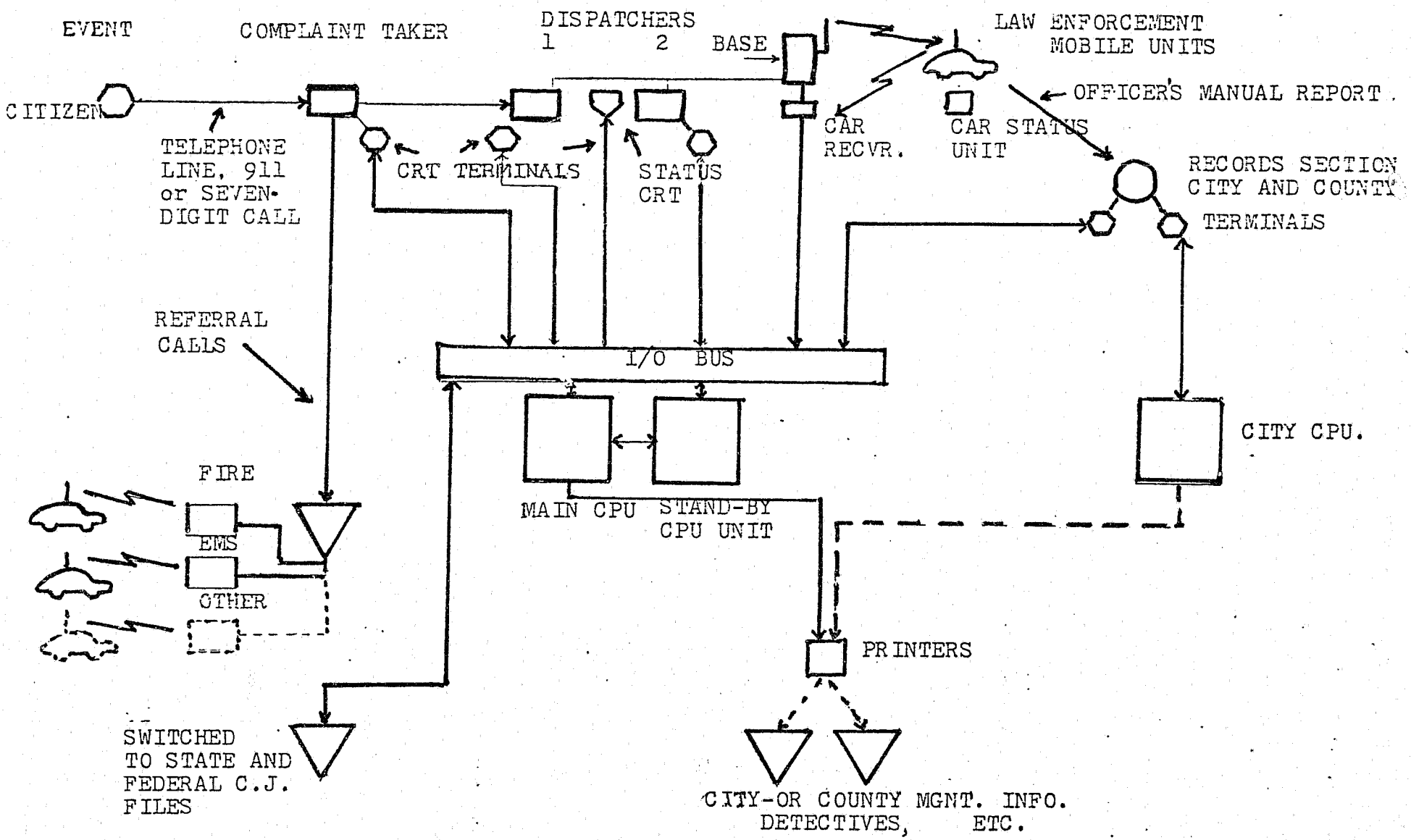


Figure 5 - Event Flow Chart

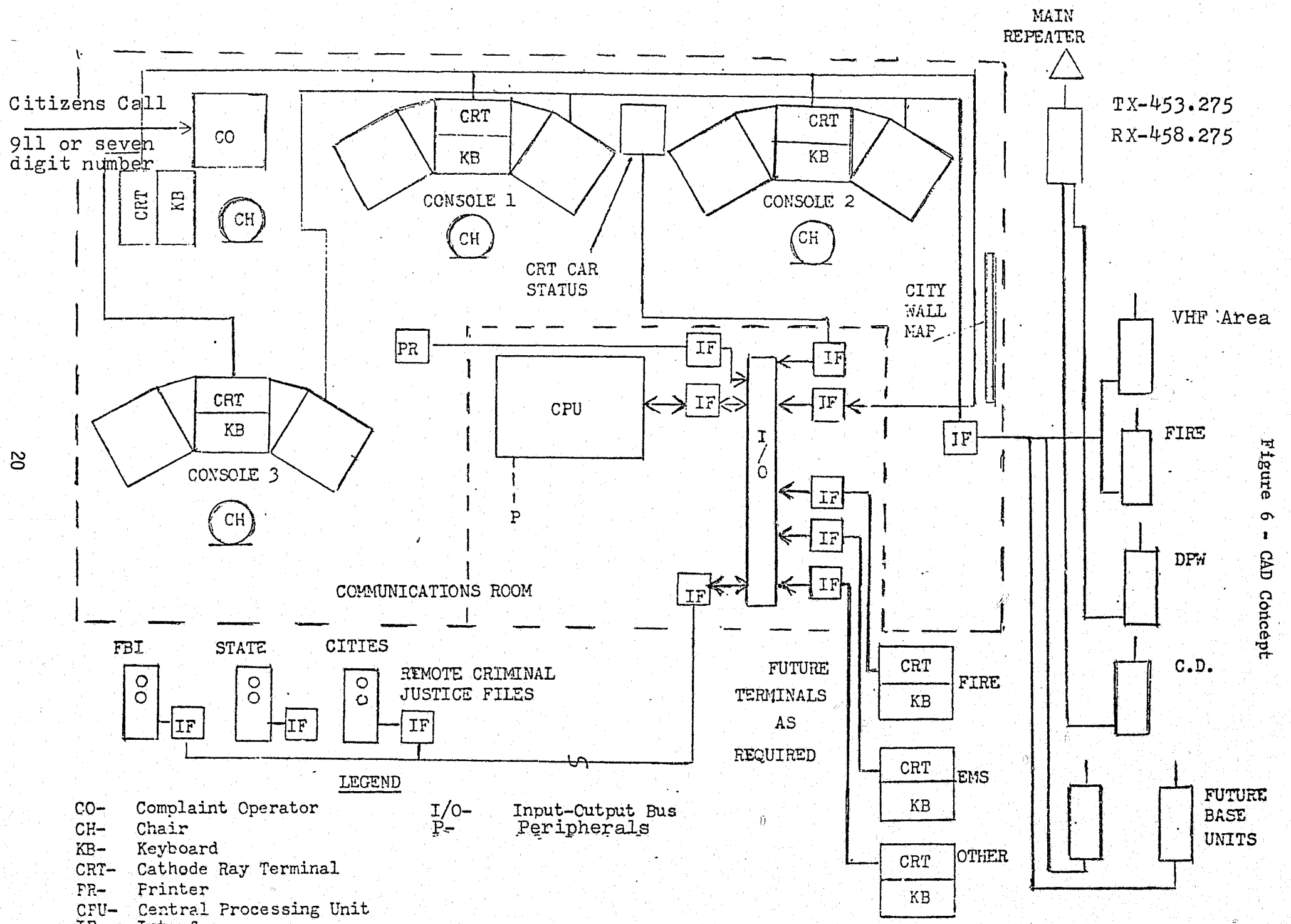
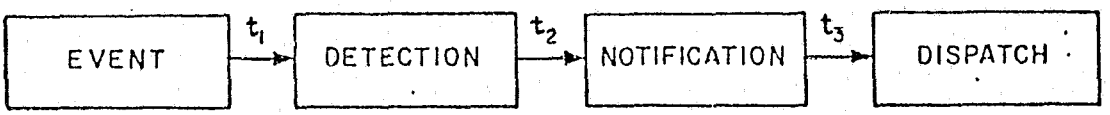
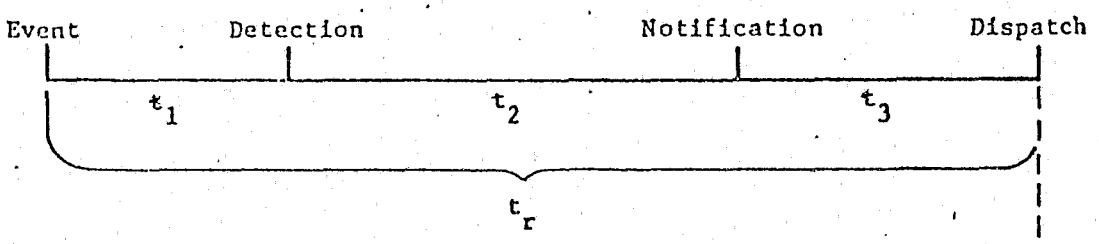


Figure 6 - CAD Concept

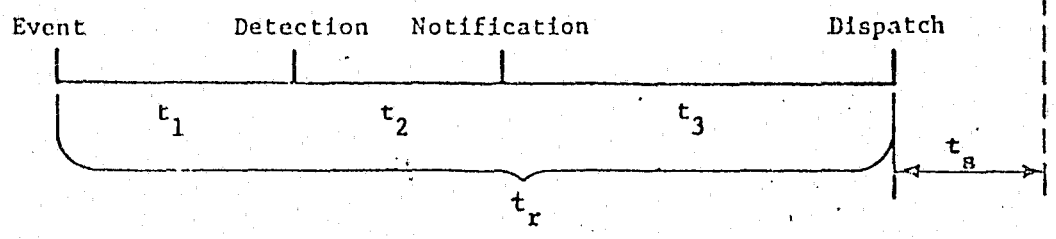
Figure 7 - The Emergency Response Cycle



RESPONSE CYCLE DEFINITION



RESPONSE CYCLE TIMING WITHOUT 911



TIMING WITH CENTRAL DISPATCH AND 911

Note: From report of Franklin Institute Research Laboratories on Single Emergency Telephone Number, March 1970.

2. FINDING

The portable radio units lack sufficient power.

CONCLUSION

With the rapidly expanding land area use in the City of Plano, the 1-watt portable radios lack sufficient power for good communications. A 5-or 6-watt unit would give more dependable use, especially within buildings.

3. FINDING

Additional radio frequencies will be needed.

CONCLUSION

The projected growth of the city's population supports the view that a third pair of UHF channels will be needed by the early 1980's.

4. FINDING

Additional technical personnel may be required.

CONCLUSION

In order to successfully plan for communications update over the next 10 years, the department should consider hiring a telecommunications expert. The city should periodically review the cost-effectiveness of contract electronic maintenance to determine if the city should hire a technician.

5. FINDING

Radio coverage is poor in the western section of the city, and distortion from the General Electric console makes messages hard to understand.

CONCLUSION

The poor radio coverage appears to be caused by a shading effect of a range of hills running north and south through the western part of the city and by a malfunction of the base station transmitter that was operating at only one-fifth of its rated output of 250 watts.

The reorientation of the base antenna to provide more gain to the northwest could improve the signal. The distorted audio signals are created by a malfunction in the General Electric console. This problem has caused messages to the police vehicles to be misunderstood and perhaps missed entirely.

IV. RECOMMENDATIONS

The consultant's recommendations will be of a specific nature and will be divided into two sections -- immediate improvement and future or long-range plans.

Immediate Communications Improvement

1. The department should implement an improved method for the use of the headset microphone and ear piece. Manual operation of the telephone and radio could be improved by a switching network that allows the operator to switch the headset from telephone to radio.

2. The new base station repeater at the hospital location should be purchased with a tone squelch frequency compatible with the existing system and remote panel with the existing system and remote panel facilities to accept future input satellite receivers.

3. Reorient the existing base station antenna towards the northwest for improved coverage and install the new antenna at the hospital with the major gain favoring the east.

4. Ask the General Electric Company to have engineers from the factory repair the base station and the control console to factory specifications.

5. Provide intercom facilities on the new console being purchased for the Civil Defense center.

6. Improve the emergency power equipment with the addition of LP gas and improved room ventilation.

Future Or Long-Range Communications

1. Request an additional pair of UHF radio frequencies that are compatible with the existing police channels.

2. Purchase higher power portable radios when the existing units become obsolete. The transmitter power should be 5 or 6 watts.

3. Investigate the use of satellite receivers and a signal comparator if future "dead areas" occur in the expanding city.

4. Consider employing a telecommunications expert for future planning.

5. Review periodically the cost-effectiveness of contract type of electronic maintenance.

6. Plan the implementation of a mobile "status" system.

7. Plan to automate the dispatch functions of the Plano Police Department (CAD implementation).

8. Plan to implement the 911 common telephone number to improve citizen response time.

9. Consider the cost-effectiveness of a city-coordinated dispatch center.

APPENDIX A - EQUIPMENT PURCHASE SPECIFICATIONS

SPECIFICATION

RADIO EQUIPMENT

1.0 PURPOSE

The purpose of this specification is to detail technical and performance requirements for radio equipment and interface equipment for the City of Plano Emergency Operations Center, located in the basement of Plano General Hospital and modification of existing equipment for use in the Emergency Medical System, Basic Life Support Services.

2.0 BID AND/OR PROPOSAL REQUIREMENTS

All bids and/or proposals submitted, in order to be considered responsive, must reference paragraph numbers of this specification with pricing of each item. Exceptions, if any, to any part of this specification or alternate proposals must delineate deviations from these specifications on a paragraph by paragraph basis.

2.1 Intent of Specifications

It is the intent of these specifications to take advantage of the latest advances in the field of 2-way radio communications, particularly with regard to reliable operation throughout the wide range of voltage, temperature, and vibrations extremes, which are encountered in vehicular and fixed installations operating from emergency power sources. Since communications with equipment specified herein involves the protection of property, and frequently concern for life itself, continuity of communications is of prime importance. It is the intent to specify equipment which is representative of the most modern industrial design - equipment that is durable, rugged and easily interchangeable.

All equipment supplied must meet or exceed current standards of the Electronic Industries Association and the regulations of the Federal Communications, in addition to the specifications herein.

The absence of specifications regarding details implies that the best general practice will prevail and that first quality material and workmanship will be applied.

2.2 Evaluation of Equipment

Evaluation of the equipment offered will be made on the following basis, but not necessarily in the order listed:

1. Whether or not equipment meets specifications.
2. Quality of workmanship and materials.
3. Equipment performance and reliability.
4. Superior design features, advantages to the user.

5. Freedom from pre-mature obsolescence.
6. Ease of installation and removal.
7. Ease of servicing, tuning and adjustment.
8. Equipment interchangeability.
9. Environmental and electrical tolerance.
10. Safety and Security provisions.
11. Clarity and completeness of Instruction Manuals.
12. Warranties.
13. Cost.

2.3 Current production equipment

Only new, unused equipment in current production by manufacturers with at least ten years experience in this field will be considered. The equipment offered shall be of the latest design in current production. Each proposal shall include a complete description of each item to be furnished, including manufacturer, model number, or other specific identification, descriptive literature and specification sheets.

2.4 Compatibility

Equipment offered must be operationally compatible with current production equipment of leading manufacturers in the field.

2.5 Sample equipment

A working sample of the exact equipment offered shall be made available upon request to the buyer for the purpose of making such examinations and performance tests are deemed necessary by the buyer to determine compliance with the requirements set forth herein.

2.6 Instruction manuals

Instruction manuals are to be written so that a qualified radio technician can read and interpret effectively the contents. These manuals shall be complete and will include the following information:

a. Complete description of operation.
b. Theory of operation.
c. Complete schematic diagrams.
d. Interconnection diagrams.
e. Complete tuning and alignment instructions.
f. Trouble-shooting information including chassis operating voltages.
g. List of replacement parts.
h. Installation instructions.

2.7 Replacement parts

Replacement parts for the equipment proposed shall be available for a period of at least five years from the date of purchase.

2.8 Warranty

The bidder shall warrant that all equipment shall conform to its published specifications, proposed specifications, or specifications herein and be free from defects in material, workmanship and title.

The minimum warranty period shall be as follows: Oscillator crystals - life of equipment; crystal filter assemblies containing no active elements- life of equipment; frequency control modules containing quartz crystals and active elements - five years; all semi-conductors including diodes and transistors - three years; all other items, excluding batteries, pilot lamps, and fuses, one year.

If it appears that whithin one year from date of delivery by the seller that the equipment does not meet the warranty specified above and that the purchaser notities the seller promptly, the seller shall thereupon correct any defect, including non-conformance with this specification or bid award terms, whichever is applicable, and at its option, either repair any defective part, or parts, or make available at the purchasers plant, a repaired or replacement part.

2.9 Patents

The seller shall indemnify the purchaser and shall defend any suit or proceeding brought against the purchaser arising out of the use or patent claims involving the equipment supplied. In the event the equipment is judged to infringe on patents of others the seller at its option shall pay all royalties or supply non-infringing equipment.

2.10 Delivery

Unless otherwise specified, purchaser will accept delivery of the equipment hereunder F.O.B. destination. The seller shall notify purchaser promptly of any delays in delivery above deliveries quoted stating a firm new delivery date and the reason for the delay. Excessive delays in delivery and/or repeated delays will be justification for termination for any purchase order.

3.0 RADIO EQUIPMENT

3.1 General Requirements

Each base station radio, unless specified otherwise, will be supplied with local control with the use of an operators headset (Bidder to supply descriptive literature) and a standard desk microphone and loud speaker.

Each radio will be installed by the successful bidder and connected to its respective antenna. (Antenna, feedline and respective installation is a separate item of this

specification.) Factory test data must be supplied with each radio along with a certificate of compliance indicating at a minimum transmitter power output (maximum and minimum), transmitter frequency, receiver frequency, receiver sensitivity in microvolts for 20db quieting at minimum and maximum input voltages. In addition, at time of installation, proof of conformance to F.C.C. specifications must be supplied for the purchasers log.

Each base station radio and all related accessory items must be equipped with lightning protection circuitry to prevent damage to equipment due to line surges and transients generated by a lightning strike to a pole transformer primary equiped with power transmission industry accepted means of protection.

Each radio located at the Emergency Operations Center shall operate without interference or degradation of performance to other equipment specified herein.

3.2 Fire Radio Receive and Transmit 46.340MHz

Desktop base station to be used with local control and D.C. remote to be specified later.
Specifications:

General
Input voltage 100 to 132VAC 50-65Hz or 12VDC
Antenna impedance 50 ohms
Local control with desk microphone and speaker contained in desk top unit and with operator type headset.
Size- 6" high max. X 20.375" wide X 13.75" Deep max.

Transmitter
Power - adjustable 15 to 50 watts
Spurious and Harmonic Emission -85db
Modulation Deviation - 0 to ±5KHz
Frequency Stability - ±0.0005% from -30°C to +60°C
FM Noise - -55db
Audio Response - Within +1 and -3db of 6db/octave pre-emphasis, 300 to 3000Hz per EIA
Audio Distortion - Less than 3% from 300 to 3000 Hz

Receiver
Sensitivity - EIA 12db SINAD 0.25microvolts
20db quieting 0.35 microvolts
Selectivity - EIA 2 signal (20KHz channels) -95db
Frequency Stability - Same as transmitter
Modulation Acceptance - ±6.5KHz
Intermodulation - -80db
Spurious and Image Rejection - -100db
Audio Response - Within +1 and -8db of 6db/octave de-emphases, 300 to 3000Hz per EIA
Audio Output - 5 watts, 5% max. distortion at 1000Hz

Remote Control
To be located in the Emergency room of Plano General Hospital approximately 200 feet from the base station. The remote will be either a desktop unit or wall mounted and will

contain a two tone sequential decoder to activate a loud speaker to alert emergency room personnel. Emergency room personnel will communicate through the use of a push to talk telephone type handset. When the handset is removed from its cradle the loud speaker will be muted and the two tone decoder will be reset. The unit will also be equipped with a monitor switch that will allow continuous monitoring through the loud speaker, if desired. (Loud speaker to be contained within the remote unit) A volume control will be provided for the speaker with provision to prevent personnel from turning the speaker completely off. Tone #1 358.6Hz, Tone #2 378.6Hz.

Audio response characteristics of the remote control are to be the same as receiver and transmitter requirements specified above. Installation of the remote and control cables are to be included in this item by the bidder.

3.3 County Fire Frequency and Sanitation Radio

Desktop base station to be used with local control. Two frequency 37.100MHz transmit and receive or 37.180MHz transmit and receive. Specifications identical to Fire Radio in paragraph 3.2 excluding remote control. Channel one to be 37.180MHz and Channel two to be 37.100MHz.

3.4 Public Works Radio

Desktop base station to be used with local control. Single frequency 45.52MHz. Specifications identical to Fire Radio in paragraph 3.2 excluding remote control.

3.5 Intercity Base Station

Single frequency transmitter 155.370MHz and two receivers. Receiver 1 on 155.370MHz. and Receiver 2 on 154.950MHz. This unit may be a desktop unit with the options listed below or a separate unit with desktop control.

General Same as paragraph 3.2 except size to be specified.

Transmitter

Power - Adjustable 10 to 35 watts
Spurious and harmonic emission - -80db
Modulation deviation - 0 to ±5KHz
Frequency Stability - ±0.0005% from -30°C to +60°C
FM Noise - -55db
Audio Response - Within +1 and -3db of 6db/octave pre-emphasis, 300 to 3000Hz EIA
Audio Distortion - Less than 3%

Receivers

Sensitivity
EIA 12db SINAD 0.35 microvolts minimum
20db quieting 0.50 microvolts minimum

Selectivity EIA 2-signal - -90db

Frequency Stability - ±0.0005% from -30°C to +60°C
Modulation acceptance - ±7KHz
Intermodulation - -85db
Spurious and image rejection - -100db
Audio response and audio output - Same as paragraph 3.2

Tone Encoder

The transmitter shall be provided with a 12 key tone encoder compatible with the intercity law enforcement network. The encoder shall be internal to the desktop unit.

Tone Decoder

The 155.370MHz receiver shall be equipped with a tone decoder compatible with the intercity law enforcement network. The decoder shall be factory set to activate the speaker on receipt of the sequence *04306 or a continuous 10 second *. The speaker may also be activated by the use of a monitor switch. Separate volume controls shall be provided for each receiver.

3.6 Two-Frequency Police Repeater

General - This repeater will provide a second operating frequency for the Plano Police Department and will also serve as a backup unit to the existing police repeater. The repeater will be controlled locally from the emergency operating center or remotely via telephone line tone control. Tone squelch (sub audible) will be provided on both transmitter and receiver at 75.7Hz.

Frequencies -

Channel	Receive	Transmit
1	458.110MHz	453.110MHz
2	458.250MHz	453.275MHz

Remote Control - The remote control shall provide the capabilities to disable the repeat function and to disable the receiver tone squelch to permit monitoring.

Bidders shall provide detailed information regarding installation of equipment into the two control consoles at the police and courts building. Cross muting between the two consoles at the police and courts building must be provided. Equipment supplied shall be free from audio distortion over the normal compression range.

Size - Repeater (Indoor cabinet) 69¼" High max.X 23¼" Wide max. X 25½" Deep.

Service Items- A local speaker and microphone shall be provided in the repeater cabinet for service purposes. An extender card shall be provided.

Transmitter

Duty Cycle - Continuous
Power output - 200 watts (Adjustable 100 to 200 Watts)
Spurious Emission Conducted - -70db
Spurious Emission Radiated - -70db

Modulation Deviation - 0 to ±5KHz
FM Noise - -55db
Audio Response - EIA RS152B Within +1 and -3db of 6db/octave pre-emphasis 300to 3000Hz.
Audio Distortion - Less than 2% at 1000Hz
Frequency Stability - ±0.0002% -30°C to + 60°C

Receiver -

Sensitivity	
EIA 12db SINAD	0.20 microvolts
20 db quieting	0.25 microvolts
Noise squelch	0.10 microvolts
Tone squelch	6db SINAD

Frequency Stability ±0.0002% -30°C to + 60°C
Selectivity EIA SINAD at ±25KHz -90db
Intermodulation - -75db
Spurious and image rejection - -90db
Modulation acceptance - ±7KHz
Audio distortion - Less than 3%
Audio Response - Within +1 and -8db of 6db/octave de-emphasis 300 to 3000Hz per EIA
Audio Output - 5 watts minimum into 8 ohm load.

Cooling - Cabinet cooling shall be provided and in addition, a protection circuit shall be provided to disable the transmitter if the temperature becomes excessive.

Tone Remote Control
Line terminating impedance - 600 ohms
Line level (adjustable) -20dbm to +11dbm
Permissible control line loss 30db
Output level to line +11dbm (adjustable)
Hum and Noise -55db (ref 11dbm)

Duplexer - D.B. Products DB4071 or equal duplexer to be included.

3.8 UHF Portable

Eight channel 4 watt portable with carrying case, quarter wave antenna, and desktop charger.

Channel	Receive	Transmit
1	453.275MHz	458.275MHz
2.	453.275HMz	453.275MHz
3	453.100MHz	458.100MHz
4	453.100MHz	453.100MHz
5	453.775MHz	-0-

Tone squelch at 75.7Hz on receiver and transmitter.

Battery Life - 8 hours with 5% transmit, 5% receive, and 90 % standby duty cycle. Battery capable of being completely recharged in desktop charger in three hours or less.

Battery Charger - must completely recharge battery pack within three hour period. The charger must be capable of recharging the battery when it is detached from the radio.

Size - 8.15" high max. X 2.62" wide max. X 1.58" deep max.

Transmitter

Power Output - 4 watts minimum
Spurious and Harmonic emmission - -50db
Modulation Deviation - 0 to 5KHz
Frequency Stability - ±0.0002% 0°C to +55°C
±0.0005% -30°C to +60°C
FM Noise - -50db
Audio Response - Within +1 and -3db of 6db/octave pre-emphasis, 300 to 3000Hz per EIA
Audio Distortion - Less than 8%

Receiver

Sensitivity	
EIA 12db SINAD	0.35 microvolts
20db quieting	0.50 microvolts
Noise squelch	0.20 microvolts
Tone squelch	6db SINAD
Selectivity	
EIA 2 signal	-65db
20 db quieting	-90db

Frequency Stability - Same as transmitter
Modulation acceptance - ±7KHz
Spurious Response - -60db
Image rejection - -60db
Intermodulation --60db
Audio Output - 500 milliwatts at less than 5% Distortion
Audio Response - Within +2 and -10db of 6db/octave de-emphases 300 to 3000Hz.

3.9 Spare Battery for UHF Portable in Paragraph 3.8

3.10 UHF Portable same as paragraph 3.8 except with dual front end receiver to receive on channel 6 at 155.61MHz.

4.0 ANTENNAS, FEEDLINE, AND INSTALLATION

Antennas for the operation of the above radio equipment will be mounted on top of the north elevator shaft of Plano General Hospital. Equipment is to be located in the basement of P.G.H. The sight may be inspected by contacting Ernest C. Reich, Civil Defense Director, at 423-8144.

Lo Band (30-50MHz) feed lines shall be of the RG/213 type while VHF shall be ½" hardline and UHF feedlines shall be minimum 7/8" hardline. Pig-tails sufficient to permit service of the radio equipment shall be provided.

4.1 37.180MHz and 37.100MHz Antenna

D.B. Products DB201 or equivalent antenna to be mounted on roof of hospital. Installation may require support for antenna to be installed on roof.

4.2 46.34MHz Antenna

Same as in 4.1 except frequency.

4.3 45.52MHz Antenna

Same as in 4.1 except frequency. Note alternate proposals will be considered to use a single antenna for both 46.34MHz and 45.52MHz with a suitable isolator to prevent interference and spurious signals.

4.4 155.37MHz Antenna

D.B. Products DB304 or equivalent. 6.1db gain. D.B. Products DB5001 side mount. Survival without ice 100 MPH wind. With ½" radial ice 74 MPH wind. Lateral thrust at 100 MPH 194 pounds. 21' 8" maximum length.

This antenna is to be mounted on the side of a minimum of 25' of tower to be mounted on the roof of the hospital.

4.5 Tower

25 feet minimum of tower to have a life of 20 years minimum. Tower must withstand a bending moment load of 916 foot pounds at the top while in 100 MPH winds and a lateral thrust of 194 pounds distributed along its length. 155MHz antenna mounted on side and 450MHz antenna mounted on top. Tower to include mast for mounting 450MHz antenna. This item includes installation on the hospital roof.

4.6 453.1 MHz and 458.25 MHz antenna

DB410 or equivalent. Survival with-out ice 100 MPH. With ½" radial ice 70 MPH. 18'1" length. Lateral thrust at 100 MPH wind 133 pounds. 9.2 db gain.

5.0 MODIFICATION TO G.E. MOBILE UNITS IN AMBULANCE (3 UNITS)

The existing radio equipment consists of 3 each G.E. Model MC76KFU66A High Band MASTR II Mobile units, 8 channels. Channel 1; Tx 154.83 MHz, Rx 155.61 MHz: Channel 2; Rx and Tx 155.61 MHz; Channel 3; Rx and Tx 154.95 MHz: Channel 4; Tx 154.95 MHz, Rx 155.37 MHz: Channel 5 Tx and Rx 158.745 MHz.

CONTINUED

5.1 Additional channels

This includes adding channel elements to permit transmission and receiving on Channel 6 at 155.28MHz and Channel 7 at 155.34MHz.

5.2 Additional control head and necessary control circuits and DTMF encoder.

An additional control head is to be installed in the attendant area of the ambulance. The DTMF encoder is to be installed adjacent to the new control head. Circuit modifications will be provided to the radio to permit channel selection by either control head. Means must be provided to prevent transmitting on a channel not indicated on the channel selector of the control head if the other control head has selected another channel. All cables and installation are to be provided as part of this item.

6.0 RECORDER

This item includes a recorder to be installed at the Plano central fire station to record all radio traffic on the main fire frequency (46.34MHz) and provide a method of time correlation. Alternate proposals are desired to modify at a later date to include up to four additional channels of audio information. The recorder will be of current manufacture and will operate unattended a minimum of 24 hours. A separate playback device will be provided to allow playback of one tape while still recording. (Uninterrupted recording even if immediate playback is desired.) Compression amplifiers are to be provided to compensate for a minimum of 10db variation in input audio signal with a maximum of 5% distortion. The recorder and playback will have a response within ±2db over the range of 300 to 3000 Hz. Detailed data sheets must be provided with proposal.

END