REPORT OF THE COMPTROLLER GENERAL OF THE UNITED STATES

Federal Funds Used In Chicago To Procure, And Later Replace, Unreliable Communication Equipment

Urban Mass Transportation Administration Department of Transportation

The Urban Mass Transportation Administration granted the Chicago Transit Authority about $6.1 million from 1968 through 1975 to acquire an advanced bus communication system.

The Feueral agency approved the purchase of 1,070 communication units even though the data transmission capabilities of this equipment were never proven reliable under a demonstration grant which provided for 500 units.

Partly because the system works poorly, the Authority requested about $3.8 million of additional capital assistance to replace the 1,570 units, some of which were less than 3 years old. The Federal agency approved this request but did not fully analyze alternative solutions to the replacement proposal until after approval.

CED-77-5

NOV. 22, 1976

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-180617

The Honorable Garner E. Shriver
House of Representatives

Dear Mr. Shriver:

Pursuant to your request of November 14, 1975, we reviewed the Federal financial assistance provided to the Chicago Transit Authority to procure bus communication equipment.

We have incorporated the comments on the proposed report of the Department of Transportation, the Authority, and the manufacturer of the radio equipment in this report.

This report contains recommendations to the Secretary of Transportation which are set forth on pages 15 and 36. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House and Senate Committees on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report. We will be in touch with your office in the near future to arrange for release of the report so that the requirements of section 236 can be set in motion.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

Contents

ABBREVIATIONS

AVM	automatic vehicle monitoring
CTA	Chicago Transit Authority
GAO	General Accounting Office
HUD	The Department of Housing and Urban Development
R&D	research and development
TSC	Transportation Systems Center
UMTA	Urban Mass Transportation Administration

REPORT OF THE
COMPTROLLER GENERAL
OF THE UNITED STATES

FEDERAL FUNDS USED IN CHICAGO TO PROCURE, AND LATER REPLACE, UNRELIABLE COMMUNICATION EQUIPMENT

Urban Mass Transportation
Administration
Department of Transportation

D I G E S T

The Urban Mass Transportation Administration granted the Chicago Transit Authority about $6.1 million from 1968 through 1975 to acquire an advanced bus communication system.

According to the Authority, the data transmission capability of the communication equipment has never been reliable, resulting in distorted data signals.

Partly because of this problem, the Authority requested about $3.8 million more to replace 1,570 of the 2,210 bus communication units procured primarily with Federal funds. Some units were less than 3 years old. (See pp. 2, 4, and 21.)

The Urban Mass Transportation Administration did not effectively manage the demonstration project and the capital grant projects which enabled the acquisitions to be made.

The Urban Mass Transportation Administration:

--Did not insure that the Authority took advantage of a clause in the demonstration project contract, allowing up to $1.3 million to be refunded for faulty equipment, even though extensive evidence showed the equipment continued to be unreliable.

--Approved the procurement, by the Authority, of more communication equipment costing about $5.9 million--$4.2 million Federal funds--even though the equipment was never proven reliable.

--Did not always provide adequate safeguards to insure that Federal funds were being used effectively in procuring this unproven equipment. (See pp. 2 and 4.)

GAO recommends that the Urban Mass Transportation Administration develop procedures to insure that:

--Equipment developed or tested under an Urban Mass Transportation Administration demonstration project not be approved for funding under the capital assistance program without its research and development office having been provided an opportunity to review, comment, and concur or not concur on the proposed project. If the research and development office does not concur and the capital assistance office determines project approval is warranted, then this determination should be fully justified and documented.

--Research and development and capital grant offices jointly monitor equipment purchased through capital assistance projects when the equipment reliability has not been demonstrated but the acquisition was justified because of immediate need.

--The Federal investment is protected when unproven equipment is procured through capital assistance projects on the basis of immediate need. Performance bonds and refund warranties should be considered. In addition, performance standards to measure the success of the equipment should be developed and made a part of the contract. The Urban Mass Transportation Administration should monitor these contract provisions. (See p. 15.)

The Urban Mass Transportation Administration approved an Authority request for replacement units, but did not fully analyze alternatives to replacement until after the request was approved. (See p. 21.)

The Urban Mass Transportation Administration was concerned that only one firm could supply communications equipment for the Authority and that other transit properties might encounter a similar problem. Consequently, the Urban Mass Transportation Administration requested the Transportation Systems Center, a branch of the Department of Transportation, to study this. As a result, the Center provided a relatively inexpensive technical solution to the problem. (See p. 29.)

GAO further recommends that the Urban Mass Transportation Administration:

--Determine the feasibility of the Transportation Systems Center's proposal and, if acceptable, inform the communication industry.

--Evaluate the Chicago Transit Authority's new system. This evaluation should include the system's reliability and its ability to meet its objectives.

--Require grantees to plan ahead for new or additional procurements to assure that several firms are able to compete for a contract.

--Advise grantees that procurement based on immediate need, after considering only one source, will be approved only in the most critical circumstances.

--Clarify the November 1975 directive on new technology by (1) establishing criteria to determine what constitutes new technology, (2) defining the responsibility and authority of the respective Urban Mass Transportation Administration offices, and (3) establishing a mechanism for resolving interoffice policy disagreements. (See p. 30.)

The Department of Transportation said that it basically agrees with the procedural recommendations contained in this report

and that the GAO recommendations are being implemented.

The Department, the Authority, and the communication equipment manufacturer disagreed with some of the findings and conclusions in the report. GAO considered these comments and incorporated them where appropriate.

The Department believes that the Urban Mass Transportation Administration acted properly and adequately protected the Federal investment in the procurement of communication equipment for the Authority. The Department stated that the Urban Mass Transportation Administration's actions to eliminate certain data functions from the communication equipment funded by capital grants and that the state of the art of the equipment justified the agency's actions. The Department also stated that the Urban Mass Transportation Administration's analysis, which GAO noted was completed after its decision to fund the replacement of the equipment, supported that decision.

The Authority stated that one of its overriding responsibilities was to provide secure and safe transportation to the public and its employees. The Authority stated that adequate protection was greatly complimented by the communication system, with both voice and data transmission. (See pp. 15 and 31.)

Insuring secure and safe transportation is important. However, the Urban Mass Transportation Administration's approval of the procurement of unproven communication equipment at least warranted greater protection and closer monitoring. Concerning the approval of the replacement of this equipment, GAO believes that analyses of alternative solutions should assist management in making decisions, rather than support managerial decisions already made.

CHAPTER 1

INTRODUCTION

The Congress passed the Urban Mass Transportation Act of 1964 (49 U.S.C. 1601 et. seq.) to provide Federal assistance for the development of comprehensive and coordinated mass transportation systems. The Department of Housing and Urban Development (HUD) originally was responsible for implementing the act. This responsibility was transferred to the Department of Transportation and its newly created Urban Mass Transportation Administration (UMTA) on July 1, 1968.

At the request of Congressman Garner E. Shriver, we have reviewed a $4.8 million Chicago Transit Authority (CTA) proposal to procure bus communication equipment with grant funds authorized under the act. We have also reviewed previous Federal assistance to CTA, which enabled CTA to procure the communication equipment it proposes to replace with the $4.8 million project.

Several programs were established to carry out the act. The largest is the capital facilities grant program, which enables State and local public bodies to acquire and improve existing transit systems or to build new transit systems. Capital facilities grants in fiscal year 1977 are estimated at $1.1 billion. Until July 1, 1973, maximum Federal assistance under this grant program was limited to two-thirds of the net project cost; that is, the cost which "cannot be reasonably financed from revenues." Capital grants approved on or after July 1, 1973, are funded by UMTA at a mandatory 80-percent level of net project cost. The balance of funds needed must be provided locally from non-Federal sources.

UMTA also sponsors research, development, and demonstration projects that concern all phases of urban mass transportation. Federal funds may cover the total cost of these projects. The estimated fiscal year 1977 funding for these programs is $67 million.

CHI TRANSIT AUTHORITY

CTA is a self-regulating municipal corporation, which was created by an act of the General Assembly of Illinois and an ordinance approved by local referendum in 1945. The ordinance gives CTA the exclusive right to operate a comprehensive unified local transportation system in Chicago.

CTA is the second largest public transit system in the United States, serving all sections of Chicago and its suburbs. CTA has over 2,300 buses and 1,100 rapid rail transit cars operating on 137 bus routes and 7 rapid transit routes.

Since 1964 CTA has received 11 UMTA capital grants totaling $372 million and 4 UMTA demonstration grants totaling about $2.5 million.

Of UMTA's total grant assistance to CTA, one demonstration grant and two capital grants provided CTA with Federal funds to help purchase communication equipment. This grant assistance began with a $1.6 million demonstration grant which was later increased to about $1.9 million. CTA has also obtained communication equipment through funds made available under UMTA's capital grant program. The following table shows UMTA's grant assistance to CTA for communication equipment.

Project description	Communication equipment: Radio and data units	Net project costs	Federal share
		(millions)	
UMTA demonstration project IL-06-0010 (note a)	500	$2.0	$1.6
Amendment #1		.2	.2
Amendment #2		.1	.1
UMTA capital assistance project IL-03-0024 (note b)	525	1.8	1.2
Amendment #1	545	1.9	1.2
UMTA capital assistance project IL-03-0040 (note b)	640	2.2	1.8
Total	2,210	$8.2	$6.1

a/Cost includes auxiliary equipment and funds for testing and evaluating the system.

b/The exact equipment price was not available. We derived an estimate by multiplying the number of units procured by a unit cost of $3,404 and the appropriate Federal share. The unit cost of $3,404 is based on a spare unit price on the equipment obtained under IL-03-0040. The communication equipment manufacturer disagreed with this unit cost estimate, but would not provide us with a more accurate unit cost.

COMMUNICATION TECHNOLOGY FOR THE TRANSIT INDUSTRY

Since the 1940s two-way radios have been used in some bus operations. However, it was not until after passage of the Urban Mass Transportation Act of 1964 and the resultant availability of Federal funds that more advanced communication equipment for bus operations has been used. In 1968 UMTA awarded a demonstration grant to CTA to develop an advanced communication system. The system consists of four basic components--roadside sign-post transmitters that notify buses of their location, mobile units on buses, control consoles in the dispatchers office, and a computer at CTA headquarters. The system was designed to permit voice communication between the bus operator and the console operator and data transmission between the buses and the console. Data transmission capability was to permit use of a silent alarm on the buses and automatic vehicle monitoring (AVM).

The silent alarm feature enables the bus operator in an emergency to press a button which sends a signal to the console operator identifying the bus. If the silent alarm has locator capability, the console operator is also provided with the bus' location. Without locator capability, the console operator must check the schedule to determine probable location of the bus at the time the silent alarm was activated. In either case, the dispatcher can notify authorities to assist the bus operator.

The second feature permitted by the data transmission capabilities when used in conjunction with computer support is AVM. AVM constantly monitors the location of each bus, compares actual location with scheduled location, and reports schedule deviations to the console operator. The dispatcher can then direct the bus driver to take corrective action.

CHAPTER 2

CHICAGO TRANSIT AUTHORITY PROCUREMENT OF TROUBLESOME COMMUNICATION EQUIPMENT

Between 1968 and 1975, CTA used UMTA, State, and CTA funds to acquire an advanced bus communication system, including 2,210 two-way radios with voice and data transmission capabilities and support equipment, under a demonstration grant (one procurement) and two capital grants (three procurements). Data transmission capabilities considered most important to CTA were AVM and silent alarm.

UMTA did not effectively manage the demonstration project and capital grant projects which enabled the acquisitions. As a result

--a demonstration project refund clause valued at about $1.3 million was neither exercised nor extended even though extensive evidence existed as to continuous unreliability of the equipment and

--capital grant funds were approved for several additional procurements of communication equipment for CTA even though the equipment was never proven reliable.

Also, UMTA did not always provide adequate safeguards to insure that Federal funds were being effectively and efficiently used in procuring this unproven equipment. For example, UMTA's research and development (R&D) office, which had responsibility for the demonstration project, did not monitor the capital grant procurements to help insure identification and correction of system problems. Also, warranties for the capital grant procurements were weaker than the warranty for the demonstration project procurement, as there was no refund clause and the guarantee on parts and labor was for a shorter period of time. System performance standards and associated penalties for unsatisfactory performance were not included in the contracts.

CTA believed that equipment obtained under the capital grant procurements had functioned better than the demonstration project equipment. However, as discussed in chapter 3, CTA is replacing most of the system, some components of which are less than 3 years old, partly because CTA believes it has not functioned properly.

THE DEMONSTRATION PROJECT

In March 1968 HUD approved a $1,549,000 demonstration grant to CTA for a two-way voice and data communication system to be installed in 500 existing CTA buses. CTA's project justification highlighted two features made possible by data transmission--AVM and silent alarm--because CTA wanted more management control over bus operations and greater safety for drivers and passengers.

In June 1968 CTA advertised for bids and issued detailed specifications for procurement of 500 radios with data transmission capabilities, 2 control consoles, and support equipment. The specifications contained a 2-year parts and labor guarantee and the following refund clause:

> "* * * In case the units fail to meet the requirements for performance, (and require more than normal expense or routine maintenance correction) during the guarantee period of two (2) years, and the basic failure condition is not promptly (within 30 days) rectified by the contractor at his expense, the entire system will be returned to the contractor and the contract price shall be refunded to Chicago Transit Authority. It is the intention of this paragraph to protect the purchaser against equipment which does not function correctly, and the correction and repair of which is beyond normal expense and maintenance as determined by Chicago Transit Authority Engineer or his chosen representative."

The specifications also required the bidders to furnish a complete operating system. Although certain functional requirements were contained in the specifications, no performance standards were provided to determine when the system operated satisfactorily.

In July 1968 the following bids were submitted to CTA:

Company	Total bid
Raytheon	$3,277,985
Hazeltine	2,527,627
Motorola	1,339,350
Motorola (alternate)	1,239,350

CTA approved the higher Motorola bid. It rejected the lower Motorola bid, since the proposed system did not meet the

specifications. In August 1968 UMTA, which by this time had assumed responsibility for administering the Urban Mass Transportation Act of 1964, approved the $1,339,350 CTA-Motorola fixed price contract.

CTA officials told us installation of the 500 Mark XIIA radios with data capabilities was completed in July 1970, which was about 9 months after the end of the contractual delivery period. UMTA's R&D office monitored the project through field visits and CTA's quarterly progress reports, which are required by UMTA procedures.

CTA's July 1970 progress report stated that data transmission did not initially function because of signal interference and inadequate telephone lines connecting CTA's control consoles with its fixed antennas. CTA also stated that these problems were corrected sufficiently for some silent alarms to work. But many false alarms were triggered by other electrical equipment on the buses. However, CTA reported it had solved this latter problem by July 1970.

An UMTA project manager reported after a visit to CTA in April 1971 that equipment failures had been numerous and continual and that new difficulties arose as soon as problems were solved. He said that the new problems had always been present, but their existence was obscured by more obvious malfunctions. He found that the new problems were more subtle, more sophisticated, and more troublesome to deal with.

Thereafter, CTA and UMTA continued to report problems with CTA's communication equipment. For example:

--In June 1971 CTA noted in its quarterly progress report that much time during the period was devoted to continued system debugging.

--In October 1971 an UMTA R&D official noted in his trip report that persistent hardware problems had caused the demonstration project to fall behind schedule. This official said that in his opinion the effect of these problems had been somewhat magnified by inaction and a seeming lack of technical expertise on the part of the contractor (Motorola) and the failure of the grantee (CTA) to (1) hold Motorola to its obligations and (2) keep UMTA fully apprised of the actual system status.

In the fall of 1971, however, Motorola officials believed that they had met the demonstration grant objectives as the

Motorola/CTA contract provided for final payment (15 percent) to Motorola upon system acceptance and CTA made this final payment at that time.

We believe UMTA and CTA had enough information on system deficiencies and questions about the system's performance to withhold final payment to Motorola until the system was determined to be acceptable.

Also, during that same time (October 1971), UMTA approved an additional CTA procurement of similar communication equipment as part of a bus contract although no objective criteria for evaluating the progress of the demonstration project had yet been developed. However, in November 1971, UMTA provided CTA with criteria consisting of six measures for determining when the system could be adjudged to be fully operational. On January 31, 1972, CTA responded and essentially agreed to each measure except one, which related to a valid system response rate. CTA suggested that system response rate be lower.

In June 1972 UMTA requested the Transportation Systems Center (TSC), a branch of the Department of Transportation which provides the Department with technical assistance, to evaluate CTA's communication system to determine (1) the technical validity of the system and (2) whether UMTA would be justified in spending capital grant funds to complete CTA's communication system.

In August 1972 UMTA extended the demonstration project by 4 months and increased the grant by $110,860 to cover operating costs and to collect information during the TSC evaluation. One reason cited for the extension was an urgent need to obtain an evaluation of the system because CTA had applied for a capital grant to extend the system throughout its entire bus fleet.

TSC completed its draft report on CTA's communication system in September 1972 and forwarded it to UMTA. Among other things, TSC reported that CTA's data clearly indicated a high failure rate of the radio equipment was occuring. The data gathered by TSC showed actual mean time between failures to be 80 days, whereas TSC estimated that the mean time between failures for this equipment should be 1 year. TSC also reported several problems with data accuracy.

Also, an UMTA official told us that the TSC draft report disclosed that the goals for considering the system operational were not met according to either UMTA's or CTA's criteria.

The warranty on this equipment was originally scheduled to expire in July 1972 but an agreement was reached between Motorola and CTA whereby the warranty was to run to October 1972. There is no correspondence between UMTA and CTA recommending that the warranty refund provision contained in the demonstration project be exercised or further extended. However, UMTA officials said Motorola continued to work on the system in an attempt to make it work correctly. An UMTA official said that both UMTA and CTA considered this preferable to removing the system and returning it to Motorola, because the equipment did provide voice communication. CTA said the equipment provided voice communication as well as some silent alarms.

Also in May 1975 an UMTA R&D official requested a legal opinion on whether the warranty refund clause could still be exercised. UMTA's legal office told him in December 1975 that the warranty refund clause, valued at about $1.3 million, could not be exercised due to the time that had elapsed.

A CTA official said that as of September 1976 about 470 demonstration radios were stored in a warehouse. This official told us the radios were in storage either because they chronically malfunctioned or because the bus on which they were installed was scrapped. Also the remaining 30 demonstration radios still in service are not reliable.

THREE CAPITAL PROCUREMENTS OF COMMUNICATION EQUIPMENT

UMTA approved a capital grant for two CTA procurements of advanced communication equipment similar to that used in the demonstration project, even though the equipment was never proven reliable in the demonstration project. Many problems encountered with the demonstration equipment occurred in the two subsequent capital grant procurements. For instance, CTA had experienced problems in the demonstration project with data signals being distorted in the telephone lines connecting its receivers with its control consoles. A CTA official said that this problem is caused by the mobile data equipment transmitting data too fast for the telephone lines to retransmit accurately. Although CTA attempted many mechanical corrections in both the mobile data equipment and the telephone lines, some signals, including silent alarms, continued to be distorted.

According to CTA officials, its engineers always knew the communication equipment purchased under the first two capital grants had problems, but it was not until early 1975 that CTA realized it had a basic data system problem. By this time, CTA had already procured 1,070 additional radios with this type of data equipment.

There was also a third CTA capital grant procurement of communication equipment. However, communication equipment purchased under this procurement was different from the equipment purchase under the previous procurements.

All CTA communication equipment purchased subsequent to the demonstration equipment was approved and monitored through the UMTA capital grant office. UMTA's R&D office, which was responsible for monitoring the demonstration project, was not involved in subsequent communication equipment procurements. UMTA has no requirement that its R&D office

--certify that any equipment tested in a demonstration project is adequately developed, before capital grants are authorized for additional equipment and

--monitor capital grant projects, where unproven equipment is purchased because of an urgent need.

UMTA's external operating procedures require the grantee to maintain a contract administration system to assure contractor conformance with terms, conditions, and specifications of the contract, but, according to an UMTA official, UMTA does not have the necessary staff to assure compliance with this requirement. Furthermore, two UMTA officials told us that they were unaware of any UMTA procedures concerning contracts for the procurement of unproven equipment.

First capital procurement of communication equipment

In July 1971 CTA developed specifications for a proposed order of 500 (later increased to 525) buses with communication equipment similiar to that tested in the demonstration project. In September 1971, UMTA's Assistant Administrator in the office of capital assistance, in a memorandum to its R&D office, stated that CTA was proposing to equip 1,000 new buses with "the data retrieval package ('CTA-Monitor')" developed under the R&D grant. Although not required by UMTA procedures in effect at that time, the Assistant Administrator in his memorandum to UMTA's R&D office asked whether this system was sufficiently developed and/or proven to continue with capital grant assistance.

In October 1971 the Assistant Administrator in the office of R&D responded that the "CTA-Monitor System" cannot be considered as sufficiently developed to warrant funding through the capital grant program. He also stated that persistent, complex problems in the system hardware have

permitted only a functionally degraded mode of operation. The Associate Administrator for R&D expressed confidence in the system concept, but he did not believe that Federal participation was appropriate until the system was demonstrated to be capable of full operation.

CTA documentation shows that the system described by the term "CTA-Monitor System" consists of:

1. A computerized vehicle location and identification element (AVM).

2. A silent alarm radio element.

3. A two-way radio element.

The first two elements represent the system's basic data transmission capabilities. Information was not available to clarify whether the R&D office's response was limited to AVM or was addressing all the radio/data transmission capabilities of CTA's communication system.

On October 29, 1971, UMTA concurred in the bid documents and specifications for 500 50-passenger, radio-equipped diesel buses. Although UMTA's concurrence was subject to certain conditions, none of the conditions reduced the scope of the CTA communication equipment request. However, CTA records indicated that an agreement was reached with UMTA, on December 9, 1971, to reduce the scope of the communication equipment proposal. Subsequently, on December 22, 1971, CTA issued an addendum to the specifications for 500 radio-equipped buses (later increased to 525), which removed the location data capability requirement, including the AVM capability on the communication equipment.

Notwithstanding the removal of this location data capability requirement, the approved specifications required a data transmission system which had not been fully developed or tested but was needed for silent alarms. By requiring that the mobile equipment transmit data into the demonstration project control consoles, the specifications provided for an expansion of the same basic type of data system used in the demonstration project. Despite some mechanical improvements in the mobile equipment, CTA was thus committed to a data system which had not been proven reliable.

Although the data system was unproven, the specifications included fewer safeguards than the specifications for the demonstration project equipment. The communication equipment manufacturer was required to certify that the complete device furnished would perform all the functions stated in

the specifications. But no provisions for refunds or other penalties were provided if the devices did not perform all functions, nor were performance criteria provided. Also, the warranty on this equipment was the standard industry warranty of 1 year for parts and labor, compared to 2 years for the demonstration project equipment.

General Motors Corporation was low bidder on the buses. CTA and General Motors signed a contract for 525 buses at a cost of $21,926,604 in March 1972. General Motors subcontracted with Motorola for the communication equipment but did not separate the communication equipment price from the bus price. Therefore, UMTA and CTA do not know the total cost of the communication equipment.

Under this contract, CTA obtained 525 Motorola Mark XII radios with data capabilities. As discussed in chapter 3, CTA became dissatisfied with the equipment and proposed replacing it less than 3 years after installation.

Second capital procurement of communication equipment

In August 1972 CTA developed specifications for a proposed order of 500 (later increased to 545) buses with communication equipment similar to that obtained through the demonstration project and the first capital procurement of communication equipment. As in the first capital procurement, UMTA approved the requirement for data transmission capabilities, even though the system remained unproven. UMTA officials said they approved data transmission capabilities because it was required for silent alarms needed for bus safety. For this procurement, however, UMTA again disallowed the AVM data capability but allowed the location data capability for silent alarms, because at the time of approving the specifications, UMTA officials did not realize that location data capability was included.

Other similarities with the previous procurement are:

--The specifications did not include performance criteria, refund provisions, or other penalties for inadequate performance, and the parts and labor warranty was for 1 year, despite the unproven data system.

--CTA signed a contract with General Motors 1/ for buses. General Motors subcontracted for the communication

1/CTA signed a contract with General Motors in April 1973 for 545 buses at a cost of $22,719,137.

equipment but did not separate the communication equipment price from the bus price. Therefore, UMTA and CTA do not know the total cost of the equipment.

Although UMTA had disallowed the AVM data capability for this procurement, CTA obtained 545 Motorola Mark XII radios which were combined with data equipment capable of transmitting AVM data. CTA officials said that Motorola added this AVM capability at no extra charge to CTA. CTA engineers said that when data equipment can transmit location data in silent alarms, it takes only minor changes to the equipment to add AVM capability.

As discussed in chapter 3, CTA proposed replacing the communication equipment less than 2 years after installation, partly because CTA became dissatisfied with the equipment.

Third capital procurement of communication equipment

In January 1974 CTA outlined to UMTA a proposal to expand its communication system. The proposal included purchasing 500 (later increased to 600) new buses with communication equipment.

In September 1974 CTA issued specifications for radio-equipped buses. The specifications were for Mark XII radios and a new Motorola data system called Metrocom, or equivalent equipment. Metrocom is advanced electronic equipment used to code and decode data messages. Motorola and CTA believed the new data packages would avoid the data transmission problems associated with the previously procured data system. CTA officials said that they intended to replace CTA's entire data system with a Metrocom system.

UMTA approved the specifications for communication equipment in September 1974. UMTA capital grant officials who approved the specifications told us they were unaware CTA was changing its data system under this contract. The communication equipment warranty, approved as part of these specifications, was virtually identical to that in the specifications for the previous two procurements of MARK XII radios, that is, 1 year for labor and parts and no performance standards or refund clause.

General Motors again was low bidder on the buses. However, to insure competition for the communication equipment, UMTA required CTA to inform other radio manufacturers of the procurement. CTA told the Radio Corporation of America, General Electric, and Motorola of the pending procurement,

but only Motorola supplied General Motors with a price for the communication equipment.

For the first time, the specifications required complete spare mobile units. General Motors bid separately on the spares, thus giving CTA and UMTA some idea of what they paid for the 600 bus radios and data packages.

In January 1975 CTA signed a contract with General Motors for 600 radio-equipped buses at a cost of $38,860,800 and 40 communication spare units at a cost of $3,404 each. Although the radio specifications required the Motorola Mark XII or its equivalent, Motorola later proposed and CTA authorized the substitution of a more advanced Motorola radio model--Mocom 70--for the 640 Mark XII radios at no additional cost to CTA since the Mark XII was being phased out of production. The new equipment provided both AVM and silent alarms with location data capabilities.

CTA started receiving the Mocom 70 Metrocom equipped buses late in 1975. Because Metrocom data messages are different from data messages generated by the previously procured equipment, CTA's existing control consoles could not decode Metrocom data messages. However, CTA obtained a temporary control console and other fixed equipment from Motorola, but this fixed equipment is not adequate to permit AVM testing, because new computer and auxiliary equipment are needed.

In February 1976 CTA engineers told us that the Metrocom data equipment appears to avoid the major data transmission problems associated with the data equipment included in the Mark XII radios. In addition, CTA engineers said that location data has been reliably transmitted, but no statistically controlled tests have been conducted to demonstrate this function.

CONCLUSIONS

UMTA has acted primarily as a financial source for CTA's communication system acquisitions. It did not effectively manage the demonstration project and capital assistance projects which enabled the acquisitions. As a result, UMTA did not always require adequate safeguards to insure that Federal funds were being effectively used.

Specifications under the demonstration contract between the manufacturer of the communication equipment and CTA contained a comprehensive parts and labor guarantee which provided for a refund of the contract price if the equipment failed to meet the performance requirements. However, in

October 1972, 1 month after TSC's draft report disclosed that the goals for considering the system operational were not met under either UMTA or CTA's criteria, the refund clause, valued at $1.3 million, lapsed. UMTA officials said that Motorola continued to work on the system in an attempt to make it work correctly. UMTA said that they and CTA considered this preferable to removing the system and returning it to Motorola, since the equipment did provide voice communication. However, there is no evidence that any attempt was made to extend the warranty beyond October.

UMTA also approved several capital grant procurements of communication equipment costing about $5.9 million even though the equipment had not been fully developed and tested. Although UMTA required CTA to remove the AVM capabilities from the equipment, unproven data transmission capabilities were approved. From a procurement management point of view, the inclusion of unproven equipment in these procurements does not, in our opinion, represent a prudent use of Federal funds.

UMTA capital assistance officials said that they disallowed funding for the AVM capabilities in response to an opinion from UMTA's R&D office that the system was not sufficiently developed to warrant capital grants funding. Information is not available to clarify whether the R&D office's response was limited to AVM or was addressing all the radio/data transmission capabilities of CTA's communication system.

UMTA approved the capital grant communication equipment procurements with unproven data transmission capabilities because it was considered necessary for silent alarms, which CTA believed were urgently needed to offer drivers and passengers protection from murder, robbery, rape, and vandalism while riding on the buses. However, with the known data transmission problems, UMTA did not take adequate measures to protect the Federal investment. For example, UMTA's R&D office, which monitored the demonstration project, was not involved in monitoring capital procurements to help insure identification and correction of problems with the equipment. Also, warranties under the capital procurements were weaker than the warranty for the demonstration project. Although the communication equipment manufacturer was required to certify that the equipment would perform all the required functions, no performance penalties were provided for, and no performance standards were established.

RECOMMENDATIONS

We recommend that the Secretary of Transportation require the Administrator of UMTA to develop procedures to insure that:

--Equipment developed or tested under an UMTA demonstration project not be approved for funding under the capital assistance program without its R&D office having been provided an opportunity to review, comment, and concur or not concur on the proposed project. If the R&D office does not concur and the capital assistance office determines project approval is warranted, then this determination should be fully justified and documented.

--Its R&D and capital grant offices jointly monitor technical performance of equipment purchased through capital assistance projects when the equipment has not been demonstrated to be reliable, but when the acquisition was justified because of immediate need.

--The Federal investment is protected when a capital assistance procurement of unproven equipment is justified on the basis of immediate need. These procedures should consider such areas as performance bonds and refund warranties. In addition, performance standards to measure the success of the equipment should be developed and made part of the contract. UMTA should monitor these contract provisions to assure that they are exercised, when warranted.

AGENCY COMMENTS AND OUR EVALUATION

The Department of Transportation said that it was in basic agreement with the procedural recommendations contained in this chapter. The Department said that UMTA has long been concerned with the areas highlighted by us and that our recommendations are currently being implemented.

Although UMTA stated that it is taking corrective actions to implement our recommendations, these actions relating to two of the three recommendations in this chapter are not reflected in UMTA's written procedures for ready reference by all officials who must implement them. We believe that unless policies reflecting these recommendations are clearly set forth in UMTA procedures, policies may be overlooked or carried out incorrectly. As discussed further in chapter 3, UMTA's policy for involving the R&D office in new technology funded under the capital grant program had not been clearly set forth and, in our opinion, was a factor in the R&D office

not becoming involved in CTA's most recent procurements of communication equipment until after conditional approval was given to the capital grant procurement.

We believe that the new procedures UMTA issued in May 1976, after our audit work, basically address the issues in our recommendation concerning coordination between capital assistance officials and R&D officials before approving capital grant funds for new equipment developed under UMTA demonstration projects. The Department stated that these procedures were currently being implemented. We believe it is important that the records clearly set forth the rationale for any actions taken in funding new technology under the capital grant program, particularly when agreement is not reached between capital assistance and R&D officials.

UMTA has stated that our recommendation relating to capital assistance and R&D offices jointly monitoring the technical performance of unproven equipment purchased through capital grant projects is currently being implemented. UMTA, however, has not developed any specific procedures to clarify what would constitute adequate joint monitoring. We believe that without such procedures the roles to be played by capital assistance and R&D offices will be left to chance and UMTA management may not have the benefits of a systematic evaluation by these two offices of the effectiveness of such equipment and its potential for further funding.

With respect to our recommendation relating to protecting the Federal investment when the procurement of unproven equipment is justified under the capital assistance program, the Department has stated that UMTA has developed and is implementing a suggested Communication Acceptance Test Index for use by grantees in developing acceptance tests. The Department also noted that the recently approved CTA procurement (discussed in ch. 3) did contain greater protection for the Federal investment. These actions are limited to communication equipment; we believe that the principal of our recommendation is applicable to all types of equipment, and that UMTA's procedures should address other types of equipment as well.

The Department said that UMTA's financial participation in CTA's procurement of communication equipment was based on the pressing needs for more effective management, better scheduling, emergency maintenance and security, and that the need for security has become especially crucial in recent years. It stated that the concern for the safety of CTA passengers, employees, and equipment has become the number one priority of CTA management, employee groups, and passengers. The Department stated that it believed that UMTA

acted in a justified and appropriate manner and adequately protected the Federal interest in the procurement of communication equipment for CTA.

The Department agreed with our finding that the possibilities for extension of the warranty in the demonstration project had not been fully explored. However, they also said that the combined efforts of UMTA, CTA, and Motorola had been able to rectify technological problems as they had occurred, thus there was no reason to assume that continued efforts could not make the system operational.

Therefore, according to the Department, rather than exercise the refund provision or extend the warranty, an arrangement was made with Motorola to continue their efforts to make the system fully operational. However, as discussed throughout the report, the system never became fully operational.

The Department did not agree with our findings that UMTA approved capital procurements despite a recommendation from its R&D office against capital funding of a CTA Monitor System. The Department believes that the recommendation was adopted in that the scope of the CTA communication equipment was reduced to eliminate the location data capability requirement which included the AVM capability on the communication equipment.

We have recognized in the report that the UMTA Office of Capital Assistance responded to its R&D office's recommendation that the "CTA Monitor System" did not warrant funding through the capital grant program by eliminating the AVM portion of the system. However, the documentation is not clear, and information was not available to clarify whether the R&D office's response was limited to AVM or was addressing all of the radio/data transmission capabilities of CTA's system. Therefore, we were not able to confirm that the recommendation against funding the "CTA Monitor System" was limited to only AVM, as the Department has stated, and did not include the system's other data capabilities, which did not function adequately in the subsequent procurements funded through the capital grant program. Further, there is no evidence that R&D officials were asked to concur in the grant approval actions taken by capital grant officials.

We believe that, in the future, the records should be made clear as to whether R&D concurs with the action proposed by capital grant officials as a result of R&D recommendations. If the R&D office does not concur and the capital assistance office determines that project approval

is warranted, this determination should be fully justified and documented.

Also, the Department has suggested that once the AVM aspect of the system was eliminated, the remaining parts of the communication system had similar features to systems which were in successful use at other transit properties around the country and were considered to be state of the art and eligible for capital funding. It should be noted, however, that at the time of the first capital grant approval in October 1971 for CTA communication equipment, none of the transit properties referred to in the Department's response had operational communication systems with features similar to CTA. At the time of the second capital grant approval in January 1973, installation was either underway or had not begun on four of the seven systems mentioned by UMTA officials as having similar communication equipment in successful use at the time of this CTA approval. None of the properties in question were using the Mark XII radios with data capabilities that were being used by CTA. Five of the properties were using the Mocom 70 radios with Metrocom data packages.

Also, our review indicated that a Motorola task force was formed in October 1974 at UMTA's request to investigate communication equipment problems being encountered by three of the five users of the Mocom-70 radio with Metrocom data packages which UMTA identified as successful systems. As a result, in January 1975 a retrofit of the equipment was begun, at Motorola's expense, on these three UMTA-funded systems that were using the Mocom-70 radio with Metrocom data package. The Motorola retrofits were not completed until late 1975.

It is important to note that this Motorola task force was formed at UMTA's request, only 1 month after UMTA approved CTA's specifications for Mark XII radios with Metrocom data packages. Although the original CTA specifications for radios differed from those being used by other transit properties, the Metrocom data system was the same as that of the properties that were experiencing problems with data transmission capabilities. Therefore, we do not believe that the communication equipment being used by other transit properties supports the Department's statement that UMTA was approving the procurement of state-of-the-art equipment with capital grant funds. Instead, the equipment approved for capital grant funding provided data transmission systems which had not been proven reliable.

The Department also defended the subsequent approvals of capital grant procurements on the basis that they had no

indication that the first capital grant procurement of communication equipment was exhibiting major problems for CTA. However, UMTA did not determine the reliability of this unproven equipment. Further, there are some indications in UMTA correspondence after the approval of these procurements that there were known problems with the equipment purchased through capital grant funds. For example, an August 1975 memorandum from the UMTA Project Management Division Director to the Associate Administrator for Capital Assistance, stated, in part:

> "Some damaging arguments can be made against CTA such as the add-on purchases of equipment at the time that CTA knew the equipment was failing at unacceptable rates. The arguments, however, probably cannot support a case of gross mismanagement. CTA argues that UMTA and CTA recognized that the equipment was in a developmental stage during these purchases and even with its problems it is still worth its cost."

With respect to providing adequate safeguards on the communication equipment purchased through the capital grant program, the Department points out that the warranty provisions contained in the procurement contracts were the standard industry warranties of 1 year for parts and labor. The Department stated that given the state-of-the-art nature of the equipment procured, UMTA had no reason to assume that the Federal investment was not adequately protected.

As pointed out above, the equipment procured by other transit authorities was not the same as the Mark XII radios with data capability procured by CTA. Also, at the time of the various capital procurement approvals, many of the authorities that did have advanced communication systems were experiencing problems with the systems' data transmission capabilities. In conclusion, UMTA approved the procurement of unproven communication equipment, which we believe, as a minimum, warranted greater protection and closer monitoring as outlined in our recommendations.

CTA AND MOTOROLA COMMENTS AND OUR EVALUATION

In commenting on our report, the General Manager of CTA stated that one of his overriding responsibilities is to maximize the security and safety of the riding public and the CTA employees. He emphasized that efforts to provide adequate protection were greatly supplemented by a communication system with both voice and data transmission

capabilities. He further stated that the voice and emergency alarm was producing real, though difficult to quantify, savings through avoiding personal injury and property loss or damage. He added that although the project emphasis has turned from AVM to concentrate on voice and emergency silent alarm problems, CTA remains convinced that the productivity of a transit system's largest investment--its men and equipment--will be considerably increased when the development of AVM is carried through.

CTA also provided specific comments on the content of the report. We have considered these comments and, incorporated them where appropriate.

In commenting on the report, the vice president and area manager for Motorola generally agreed with the factual content but disagreed with some of the conclusions. Throughout the report we have considered his comments and where appropriate have attempted to clarify the report.

Both Motorola and CTA have disagreed with our statement that communication equipment obtained under the capital grant program was similar to the demonstration project equipment. These officials have noted that some data capabilities were deleted and hardware improvements were made in the equipment funded under the capital grant program in comparison to the demonstration equipment. We have recognized throughout the report that differences exist in each procurement. However, as stated by an UMTA engineer after a trip to CTA in 1974 "It should be noted that 1,500 existing units [500 demonstration units and 1,000 capital grant units] have approximately the same engineering design techniques * * *."

CHAPTER 3

URBAN MASS TRANSPORTATION ADMINISTRATION APPROVAL OF REPLACING CHICAGO TRANSIT AUTHORITY COMMUNICATION EQUIPMENT

In March 1975 CTA requested UMTA approval of a $4.8 million proposal to replace most of CTA's communication system which was purchased with assistance from previous UMTA grants. CTA wanted to replace the 500 Mark XIIA demonstration radios and the 1,070 Mark XII radios with Mocom 70 radios and the Metrocom data package. However, CTA did not provide UMTA with detailed information of an alternative proposal from Motorala to retrofit the existing communication system because CTA rejected the retrofit proposal. CTA wanted additional communication capabilities which were not possible with a system retrofit.

While UMTA has attempted to protect the proposed Federal investment of about $3.8 million--80 percent of the $4.8 million replacement proposal--by establishing certain safeguards, such as a refund clause for unsatisfactory performance, it approved the replacement procurement without assuring itself that the increased benefits resulting from replacing rather than retrofitting the equipment warrant the additional Federal expenditures. Subsequently, UMTA did conduct an analysis and concluded that replacing the equipment was warranted.

CTA COMMUNICATION SYSTEM PROBLEMS

As noted in chapter 2, CTA's existing communications system has had major operational deficiencies. According to CTA, voice communication has generally been reliable, but the data transmission capability has never functioned at a reliable level.

CTA recognized that its communication system was not working adequately and requested Motorola to participate in a task force to determine what was necessary to make the system work. Consequently in January 1975, a CTA/Motorola task force was formed and charged with investigating CTA's communication system. Three months later, the task force reported eight major problems with CTA's existing communication system.

--Original specifications were prepared in 1968 for an experiental two-way voice, alarm, and location communication system for 500 mobile radios.

--Data transmission problems have resulted in garbled data signals.

--Three different combinations of radios and data equipment are in use--500 Mark XIIAs with location capability, 525 improved Mark XIIs without location capability, and 545 improved Mark XIIs with location capability.

--There has been no expansion of fixed equipment--control consoles and related equipment.

--There is channel congestion since CTA can use only one voice channel and one data channel.

--Location as a tool had not functioned properly, so schedule adherence has never been demonstrated.

--The system is almost impossible to maintain at an acceptable performance level.

--Radios in CTA mobile supervisors' automobiles are in a separate system not linked to the bus radio system.

In commenting on our proposed report, Motorola referred to two problems--channel congestion and no expansion of fixed equipment--identified by the task force and said that in each of the three procurements under UMTA's capital grant program CTA requested additional equipment over and above the mobile units, such as base stations, control consoles, and auxiliary items, required to expand the system in an orderly manner. Motorola said these items of fixed equipment, however, were removed from the specifications at UMTA's request, thus forcing all units to operate on the one data and one voice channel of the original system. Motorola said the deletion of this fixed equipment was made against its engineering recommendations and in its opinion the severe congestion represented one of the system's major problems. However, UMTA officials told us that they were never made aware that any problems existed in this area.

To correct these system deficiencies the task force presented two proposals--a Motorola retrofit proposal and a CTA replacement proposal.

MOTOROLA'S RETROFIT AND CTA's REPLACEMENT PROPOSALS

Motorola proposed that CTA retain the 1,070 Mark XII radio/data units obtained through UMTA's capital grant

program and retrofit these units with a Metrocom modem, which would make Mark XII data messages compatible with Metrocom data messages. In addition, Motorola's proposal provided for replacing the 500 radios obtained under UMTA's demonstration project. MOCOM 70 radios with Metrocom data packages were to be provided as replacement units. The cost of equipment and labor directly related to the radio/data units was $739,400. Also, under this proposal CTA would receive eight control consoles and other fixed equipment costing $746,500, which brings the total proposal to $1,485,900.

The Motorola/CTA task force reported that Motorola guaranteed that after installation, training, and optimization of this proposed system, it would perform at a 97 percent reliability level based on hours of service availability. If this reliability level was not met, Motorola agreed to convert the system to voice only at its own expense, if CTA requested.

However, this retrofit proposal was rejected by CTA since (1) the Mark XII radio unit was being phased out of production, (2) maintenance, storage, and operations of the communication system would be simplified by use of only one system, and (3) additional features and functions, which CTA desired, would not be possible through system retrofit. The additional capabilities included

--allowing voice communications over data frequencies when problems exist with the voice frequencies;

--allowing bus drivers and mobile supervisors to hear other mobile unit transmissions so that they will not interrupt ongoing communications;

--providing uniform voice radios; and

--allowing for future on-bus sensor data, such as a passenger counter, to be added to the transmitted information.

To obtain these additional features, CTA proposed to the Motorola/CTA task force that its existing radios (1,570) be replaced by Mocom 70 radios with Metrocom data packages at a cost of $2,654,000. This CTA replacement proposal also provided for fixed equipment, control room architectural costs, communication equipment for supervisory, maintenance and emergency vehicles, and labor at a cost of $1,470,200, which brings the total proposal to $4,124,200.

Our analysis showed that the Motorola proposal of about $1.5 million is not exactly comparable to the CTA proposal of about $4.1 million. When both proposals are equated with like items, except for the Mark XII radios under the retrofit proposal and the Mocom 70 radios under the replacement proposal, the retrofit proposal would have cost about $2.2 million.

CTA's REQUEST FOR COMMUNICATION EQUIPMENT REPLACEMENT

In March 1975 CTA presented UMTA officials with the communication equipment replacement proposal through a sole-source procurement from Motorola. Although there is no documentation that Motorola's retrofit proposal was presented to UMTA, a CTA official told us the proposal may have been presented to UMTA officials orally in March.

In June 1975 UMTA officials requested information from CTA on why it could not continue to use the Mark XII radios obtained under UTMA's capital grant program, or have them retrofitted. CTA said that its existing communication equipment was transmitting distorted data messages, was permitting bus drivers to interrupt each other, and sometimes was being interrupted by nearby radio systems. CTA also reported that the cost of retrofitting the 1,070 radio/data units obtained under UMTA's capital grant program would cost from $750,000 to $1 million. This retrofit estimate did not address disposing of the 500 radio/data units obtained under UMTA's demonstration program, nor did it recognize the Motorola retrofit proposal. As previously mentioned, the Motorola retrofit proposal provided for replacing 500 radio/data units and retrofitting 1,070 radio/data units at a cost of $739,400. A CTA official said that this difference was due to CTA presenting UMTA with undiscounted costs. CTA also presented UMTA with a communication equipment replacement proposal of $4.8 million. 1/

UMTA did not technically evaluate CTA's analysis of system deficiencies. An UMTA technical official read CTA's description of the deficiencies in light of his past visits to CTA and accepted CTA's statement that retrofitting would not be cost effective. He recommended that UMTA approve CTA's proposal.

1/The $700,000 CTA replacement cost increase over the proposal presented to the CTA/Motorola task force is due to additional engineering and system design costs which CTA believed were necessary.

In August 1975 UMTA capital assistance officials told CTA that UMTA agreed in principle with CTA's replacement proposal. However, CTA was also told that before UMTA's approval of the $4.8 million budget, CTA must submit a copy of the proposed contract, a certification that the prices charged are those charged to the firm's most favored customers, and a detailed sole-source justification.

CTA made several attempts to comply with UMTA's pricing analysis requirement, but UMTA officials concluded that the analyses were inadequate. Consequently, UMTA's procurement office requested an UMTA auditor to review the cost/pricing data in CTA's possession and determine if CTA had sufficient information to support its position that the price was fair and reasonable. The auditor's report stated that CTA had adequate cost/pricing data to conclude that the negotiated price was fair and reasonable. However, the UMTA auditor qualified his opinion because a technical evaluation of the components included in the Motorola proposal had not been performed by CTA. As a result, in November 1975, CTA sent UMTA a technical evaluation letter, which said that Motorola's communication equipment was technically acceptable. UMTA capital assistance officials reviewed the letter and concluded that the equipment was acceptable .

CTA's sole-source justification submitted to UMTA stated in part that

--the system CTA desired was not available through the competitive process, nor would it be within any foreseeable time;

--only Motorola had a commercially available radio package with location capability, and any other potential vendor would require at least 1 year to design and produce a system to reliably meet this need.

--a reliable silent alarm must be provided, as soon as possible, to protect passengers and operators;

--malfunction of the Mark XII radio alarm system has made it impossible to provide reliable protection but this situation can be rapidly corrected by replacing the unreliable equipment with the only commercially available system which can perform the required functions; and

--the radio-data system must be composed of indentical equipment to insure the reliability needed and the ease of maintaining interchangeable equipment.

Under UMTA directives, which conform with the intent of Federal administrative requirements, for grants to State and local governments as set forth in General Services Administration Federal Management Circular 74-7, UMTA's contract review board conduct preaward reviews of proposed contracts to be awarded on a sole-source basis when the contract amount exceeds $5,000.

In December 1975 UMTA's contract review board reviewed the sole-source justification and concluded that it was not feasible to competitively solicit for the equipment. Also, in December 1975 UMTA's Office of Capital Assistance concurred in the proposed contract subject to several changes. Three main changes UMTA wanted were

--if the system did not meet the stated performance level, Motorola would have to reimburse CTA at least $2 million;

--the warranty period would not begin until the system had passed all phases of the system acceptance test; and

--the contract would include a clause to allow the Department of Transportation and the General Accounting Office to inspect and audit all relevant data and records of the equipment contractor.

In response to the contract changes required by UMTA, CTA submitted several documents, including Motorola's statement that if the required performance level defined in the specifications was not demonstrated in a mutually agreed test period, Motorola would, at CTA's request, remove the data portion of the sytem at its own expense and reimburse the project $500,000. In addition, a performance bond would be furnished to CTA for $1.5 million to cover the data cost of the system. CTA agreed to accept UMTA's recommendation that the warranty period not begin until the system passes all phases of the system acceptance test. Motorola agreed to extend the warranty for an additional $280,849, because they considered it a change in the contract scope. Also, CTA revised the specifications to include UMTA's suggested audit clause.

Although UMTA's Office of Capital Assistance conditionally concurred in the proposed contract, UMTA's R&D office was not given the opportunity to concur on CTA's project. A November 1975 UMTA directive calls for cooperation on new technology between UMTA's R&D and capital assistance offices. This directive states

"Prior to approval or issuance of a denial to capital grant applicants proposing uses of new technology, [UMTA's R&D office] must be consulted and given an opportunity to concur or not concur in the proposed action."

Although other transit systems around the country have purchased Mocom 70 radios with the Metrocom data package, UMTA had no objective evidence of how reliable this relatively new technology was. An UMTA R&D official considered CTA's proposed communication system to be new technology; however, UMTA capital assistance officials did not. UMTA R&D officials were not given an opportunity to agree before conditional approval in December 1975.

Additionally, in March 1976 there still remained unresolved questions--such as, what evidence was provided to UMTA to support the CTA statement that only Motorola has a commercially available radio data package with location capability. However, UMTA established a special evaluation team--consisting of officials of UMTA's R&D and capital assistance offices and Department of Transportation's Transportation System Center (TSC)--to investigate the CTA communication equipment situation. The purpose of this investigation was to answer questions regarding the lowest-cost off-the-shelf reliable communication system that embodies both two-way voice and emergency response capability. The UMTA and TSC officials visited other radio manufacturers to determine if they could meet CTA's communication equipment requirements.

These officials selected General Electric and the Radio Corporation of America as the manufacturers to be contacted because these two companies manufactured their own land mobile radios and both companies were interested in supplying communication equipment to other transit properties.

Results of UMTA and TSC's assessment of CTA's communication system

Results of the UMTA and TSC assessment of CTA's communication system were presented to the Associate Administrator of the office of research and development in May 1976. Some pertinent findings were:

--System reliability records for CTA until recently have not been systematically kept or analyzed.

--Motorola believes CTA's primary communication problem with the demonstration radios was a power supply failure. Another difficulty was that the first two procurements under the capital grant program (1,070 units) had poor data transmission. As mentioned on page 13, CTA's most recent communication equipment procurement (640 Mocom radios with Metrocom data packages) appears to work well.

--Motorola showed reliable data for transit properties using Mocom/Metrocom; however, more data in this area was required to fully assess reliability.

--Some prices of Motorola components were difficult to assess and Motorola was reluctant to reveal breakout of component and assembly costs.

In April 1976 TSC and UMTA officials visited the Radio Corporation of America and General Electric and found that these two firms were unable to meet CTA's specifications at that time. Because of this inability, the urgency of CTA's needs, and other factors, these officials recommended Motorola sole-source procurement. They also recommended to the Associate Administrator of Research and Development that UMTA capital assistance and research and development offices jointly develop a program to monitor and evaluate the new CTA communication system for 1 year after equipment installation. This joint program was recommended to obtain much needed information which would enhance the Federal decision-making process concerning future capital grant applications for communication systems, as well as assist UMTA's R&D efforts. Some of the areas to be covered in such a program are

--the overall reliability of the equipment,

--the effect of silent alarm with location capability on the level of transit crime, and

--the system's technical capability.

Two primary courses of action concerning CTA's communication system were recommended. The first alternative was for UMTA to approve CTA's request to replace 1,570 radio/data units with Mocom/Metrocom units. The second alternative was for UMTA to approve a plan to replace the 500 demonstration units and retrofit of 1,070 radio/data units. This retrofit would require replacing the old data package with Metrocom data packages on the 1,070 Mark XII units.

The UMTA R&D official advised the Associate Administrator of research and development that although the first alternative of replacing the 1,570 radio/d ta units would give CTA the easiest and quickest solution to their commuications problem, the other alternative of replacing 500 radio/data units and retrofitting 1,070 units could cost considerably less, but possibly at the expense of reliablility. However, this UMTA R&D official said he, as well as TSC and a capital assistance technical official, believed there was no valid technical reason why the second alternative would not be successful.

The TSC and R&D officials suggested that CTA obtain a current cost quote from Motorola to retrofit 1,070 radio/data units. These officials further recommended that the cost of retrofitting the 1,070 units be audited for reasonableness by UMTA capital assistance officials, who should then be in a position to decide the potential of the second alternative.

The TSC and R&D officials also recommended that UMTA's capital grant office encourage

--transit properties to allow adequate time for preparing competitive bids, particularly in add-on and retrofit situations and

--all qualified suppliers to bid on add-on and retrofit jobs.

We noted that UMTA capital grant officials were concerned that for compatibility reasons Motorola was the only feasible supplier for CTA and there was a potential problem of other transit properties being locked into one manufacturer's communication equipment.

As a result, in early 1976 UMTA capital grant officials consulted with TSC, which in turn proposed a relatively inexpensive technical solution to the communication equipment compatibility problem. TSC presented this technical solution to Motorola, General Electric, and the Radio Corporation of America and they concurred that such a solution would be feasible. In May 1976 this TSC solution was formally presented to UMTA in the form of an appendix to technical specifications for bus mobile radios and related equipment. The stated purpose of this appendix was "to define the interfaces and modifications required to ensure compatibility between two or more different types of mobile bus radio equipment and the central station controllers and displays with which they must communicate."

In June 1976, an UMTA official told us that TSC's solution appeared to resolve the transit communication compatibility problem but UMTA was still considering the proposed solution. On August 30, 1976, the Department said that UMTA was still performing a technical analysis of the TSC recommendation.

CONCLUSIONS

TSC's technical proposal is designed to insure compatibility between two or more different manufacturers' communication equipment as a potential means to promote competition for proposed communication systems and insure a more competitive transit communication market. UMTA should complete its evaluation of this proposal and, if determined feasible, UMTA should provide this information to the communication industry.

We concur with the TSC and R&D officials' recommendation that capital grant and R&D officials jointly develop a program to monitor and evaluate CTA's communication system performance. We also concur with the TSC and R&D officials' recommendation that UMTA's capital grant office encourage transit properties to allow adequate time for preparing competitive bids. We believe that UMTA should tell CTA and other transit authorities that for new or follow-on procurements, adequate leadtime must be given to encourage more competition and that sole-source justifications based on immediate need will be approved only in the most critical circumstances.

We recognize UMTA and TSC's involvement in assessing CTA's communication system and the November 1975 policy directive as positive measures to promote interoffice coordination on new technology. However, we believe there is an inherent weakness in the directive because it does not state what constitutes new technology or provide a means through which a determination can be made. The fact that UMTA's R&D office considered CTA's proposed communication system as new technology, while UMTA's capital assistance office did not, illustrates this point. This policy should be clarified on these points and also provide a mechanism for resolving any interoffice disagreements relating to the new technology.

RECOMMENDATIONS

The Secretary of Transportation should require the Administrator of UMTA to:

--Determine the feasibility of the Transportation System Center's equipment compatibility proposal and, if acceptable, inform the communication industry.

--Evaluate the Chicago Transit Authority's new system. This evaluation should include the system's realiability and its ability to meet its objectives.

--Require grantees to allow adequate leadtime for new or follow-on procurements to assure competition to the maximum extent feasible.

--Advise grantees that sole-source procurements based on immediate need will be approved only in the most critical circumstances.

--Clarify the November 1975 policy on new technology by (1) establishing criteria to determine what constitutes new technology, (2) defining the responsibility and authority of the respective UMTA offices, and (3) establishing a mechanism for resolving interoffice disagreements concerning the policy.

AGENCY COMMENTS AND OUR EVALUATION

The Department of Transportation said that it was in basic agreement with the procedural recommendations contained in this chapter and that procedures implementing our recommendations have previously been developed and are currently being implemented.

The Department stated that UMTA was making a technical analysis of the Transportation System Center's equipment compatibility recommendation. If acceptable, the Department said it will be made known to the communications industry and utilized in all add-on communication equipment procurements.

The Department also stated that UMTA's capital assistance and R&D offices have agreed to and will be jointly monitoring and evaluating the CTA communications system.

With respect to our recommendations that UMTA require grantees to allow adequate leadtime for new or follow-on procurements to allow for maximum competition, and advise grantees that sole-source procurements based on immediate need will be approved only in the most critical circumstance, the Department stated that both matters are considered current UMTA policy. Although we recognize that

current UMTA policy allows for sole-source procurement on the basis of urgent public need, we believe that UMTA needs to clarify its policy so that potential grantees are made aware that they will have to plan for adequate leadtime for their procurements because sole-source procurements justified by urgent public need will be approved only in critial circumstances.

The Department also stated that UMTA has clarified its November 1975 policy on new technology and recognizes the need for and is developing a clearer and more precise definition of new technology.

In our draft report sent to the Department, we proposed that the Administrator of UMTA make a cost-benefit analysis of retrofitting or replacing CTA's communication equipment based on current information before any final decision is made on the procurement of communication equipment, and evaluate the merits of a competitive procurement.

In commenting on our report, the Department said that UMTA did institute a thorough analysis of retrofit alternatives, which demonstrated that no feasible or cost effective retrofit alternatives were or are available. Therefore, the Department's position is that decisions made and actions taken by UMTA were justified, appropriate, and adequately protected the Federal investment.

This analysis, which was completed by UMTA's Office of Capital Assistance in August 1976--2 months after UMTA had approved CTA's communication equipment replacement contract on June 11, 1976--consisted of five different proposals.

According to the Department, the first proposal to obtain the equipment through a competitive procurement was not feasible because none of the major manufacturers contacted by UMTA or CTA officials could provide a demonstrated location capability to meet the CTA specification and bid on the contract.

The second proposal referred to as the Motorola retrofit alternative, discussed on page 22, consisted of retaining the original Mark XII radio and data package and retrofitting it with a Metrocom modem. The Department's analysis disclosed that the Motorola proposal was not an official corporate proposal and CTA had rejected it for several technical and operational reasons. The reasons mentioned were that (1) the retrofit would require retention of the Motorola Mark XII radio units which are obsolete compared to Motorola's Mocom 70 units, (2) the Mark XII radio

data package has pronounced and inherent reliability, electrical and mechanical problems and disadvantages, (3) several practical operating features which CTA wanted could not be realized through this retrofit, and (4) no additional features or technological innovations could be added to the Mark XII data package. The Department agreed with CTA's rationale, thus despite the proposal's low cost compared to the other proposals, it believes the Motorola retrofit could not have been accepted.

Under the third proposal the original Mark XII radio would be retained, but the old data package would be disconnected and the radio would be retrofitted with an entirely new data package. The Department said this proposal would eliminate the inherent reliability problems associated with the old Mark XII data package, provide all necessary technical and operational features, and provide the flexibility to incorporate future technology. However, since UMTA's analysis showed this type of retrofit would cost $4,865,269 compared to CTA's replacement proposal of $3.7 million, the Department concluded that this proposal would not be cost effective. This conclusion was also based on a CTA analysis of retrofitting the first 1,070 capital grant radio/data units. According to an UMTA official, this analysis was also completed after UMTA had approved CTA's communication equipment replacement contract.

A fourth proposal UMTA considered was similar to the third proposal in that it involved retrofitting the radios obtained under the capital grant program with a new data package, but included Motorola replacing the 500 demonstration radio/data units at no charge. However, according to UMTA analysis, this retrofit alternative would cost $4,042,671 while the fifth proposal--CTA's replacement proposal would cost $3.7 million.

We found certain weaknesses in the analysis. An UMTA official said that in the first four proposals the common equipment and other improvements was held constant for comparative purpose, thus the only costs which varied in these proposals were those relating to retrofitting or replacing the radio/data units. This official told us UMTA did not make a detailed analysis of the CTA replacement proposal, since UMTA officials considered the total CTA replacement costs, which included the radio/data units, common equipment and other improvements, to be fair and reasonable. This official also said that those items that UMTA classified as common equipment and other improvements totaled about $600,000 in the CTA replacement proposal, but for its analysis in the first four proposals, UMTA used a cost of about

$1.3 million for common equipment and other improvements. This official said that the discrepancy is accounted for in part because, due to an oversight in the analysis, the control room architectural costs of $500,000 were not considered in the CTA replacement analysis. If the architectual costs included in the first four proposals had been included in UMTA's analysis of the replacement proposal, it would have been $157,000 more expensive than the fourth retrofit proposal, which, according to the Department comments, would also eliminate the reliability problems associated with the old Mark XII data package, provide all necessary technical and operational features, and provide the flexibility to incorporate future technology.

Although only the first four proposals UMTA analyzed included the $500,000 in architectural costs, an UMTA official said all five proposals UMTA considered excluded $600,000 in system engineering and design costs which were included in CTA's July 1975 replacement request of $4.8 million.

Because this procurement was approved prior to the analysis, such shortcomings become academic. In addition, we recognize that in this retrofit or replacement situation, arguments can be made for the advantages of procuring new equipment over a less expensive retrofitting of existing equipment. However, we believe that in the future, UMTA management decisions would be better supported if a consistent methodology is employed in UMTA's analysis of such alternative proposals and if such analysis is completed before making a decision.

CHAPTER 4

SCOPE OF REVIEW

We reviewed CTA's advanced communication equipment procurement through Federal grant assistance.

We made the review primarily at UMTA headquarters in Washington, D.C., and its regional office in Chicago, Illinois; the Chicago Transit Authority, Chicago, Illinois; and Motorola Communications and Electronics, Inc., Schaumburg, Illinois. We reviewed applicable legislation, UMTA policies and procedures, and the project records and reports relating to the Federal grants. We interviewed officials and examined records of the above-mentioned organizations. We also interviewed General Motors Corporation officials.

APPENDIX I

GARNER E. SHRIVER
4TH DISTRICT, KANSAS

ROOM 2209
RAYBURN HOUSE OFFICE BUILDING

LESTER ROSEN
ADMINISTRATIVE ASSISTANT

MEMBER:
COMMITTEE ON APPROPRIATIONS
BUDGET

SUBCOMMITTEES:
LABOR—HEALTH, EDUCATION, AND WELFARE
FOREIGN OPERATIONS

Congress of the United States
House of Representatives
Washington, D.C. 20515

November 14, 1975

Honorable Elmer B. Staats
Comptroller General
General Accounting Office
441 G Street
Washington, D. C. 20548

Dear Elmer:

I wish to request that a GAO inquiry be made concerning a planned procurement of two-way radios for the Chicago Transit Authority by the Urban Mass Transit Administration, Department of Transportation.

According to information which has come to me, there have been four procurements of approximately 2,000 each of these radios and there is a possibility that the warranty provisions have not been exercised by the appropriate officials.

I would appreciate having your report on the procurement of these radios by UMTA.

With kind regards, I am

Sincerely,

Garner E. Shriver

Garner E. Shriver
Member of Congress

GES:clf

OTHER GAO REPORTS RELATING TO UMTA'S ROLE DURING THE APPROVAL PROCESS OF CAPITAL FACILITIES GRANTS

Opportunities for Improving the Effectiveness of Rapid Transit Grants, CED-76-75, Mar. 10, 1976

New York City's rapid transit system has received $573 million in Federal assistance but has experienced problems with the reliability of its new railcars. UMTA approved a grant of $142 million for new cars for New York's system without sufficient information on the reliability of that equipment. This grant included funds for equipment not planned for use in the immediate future.

GAO recommended that UMTA require grantees to provide evidence that new equipment meets specific reliability requirements before committing funds to assist in the purchase of the equipment. GAO also recommended that UMTA require potential grantees to justify the need for, and use to be made of, technology new to a transit system and not to be used in the immediate future.

Increased Cost of Implementing Commuter Ferry System On San Francisco Bay, RED-76-40, Nov. 11, 1975

UMTA has awarded nearly $25 million in Federal funds to the Golden Gate Bridge, Highway and Transportation District to assist in developing and implementing a commuter ferry system for the San Francisco Bay. The cost of the system has more than doubled since initial estimates were made in 1970.

GAO recommended that UMTA develop criteria to assist in evaluating the cost-benefit aspects of the alternatives available within individual projects, improve the extent of written justification for management decisions, and insure that maximum competition is obtained for construction contracts awarded by grantees.

Procurement of Rail Passenger Cars for the New Haven Railroad, RED-76-15, Sept. 17, 1975

UMTA granted Connecticut $49.6 million to assist in purchasing 100 passenger cars from

General Electric for $63.9 million. The procurement contract did not adequately protect Federal interests and the Government probably will incur interest costs of about $2 million by funding the contractor in advance.

Although UMTA acted to protect the Government, GAO believes that the agency's interpretation of its directives, patterned after the Federal procurement standards for grantees, resulted in limiting the direction the agency provided in this grant. Federal agencies currently are reviewing these standards. GAO recommended that more specific grantee contracting procedures be developed.

Problems with the Procurement and Reliability of Small Buses, RED-75-391, July 2, 1975

UMTA has provided Federal assistance to transit system grantees for procuring capital equipment. Many of these grantees were having problems and delays procuring small (30-foot) buses and many small buses purchased with Federal funds were not reliable and have been or will be replaced after a few years' use. GAO recommended the adoption of standard specifications and the early development and implementation of reliability requirements for UMTA-funded buses.