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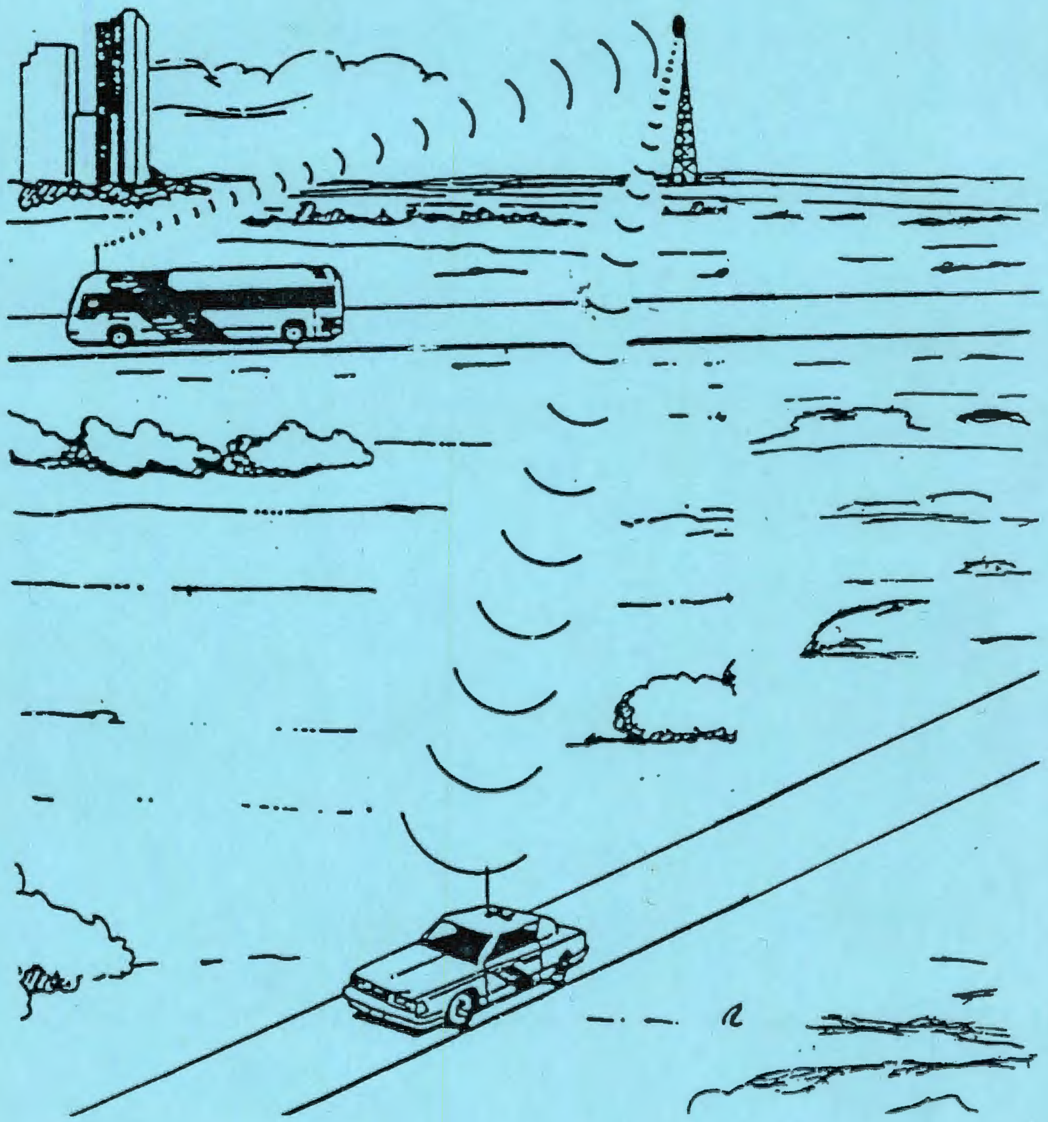
U.S. Department of Transportation

Urban Mass Transportation Administration

Emergency Alarm Systems:
Improved Emergency Alarm/Response System

Metropolitan Transit Authority
500 Jefferson
P.O. Box 61429
Houston, Texas

OCTOBER 1986



SAFETY AND SECURITY STAFF

UMTA Technical Assistance Program

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16. Abstract

This report examines transit security problems relating to emergency alarms, including false alarms, malfunctions, misuse of the alarm system and alarm system training. The report discusses the problem of alarms, their misuse and ways to countermand misuse.

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METRIC CONVERSION FACTORS

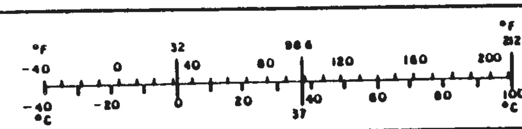
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE:

This report, prepared by the Metropolitan Transit Authority of Harris County, Texas, Transit Police Department between February 1984 and November 1985, provides a perspective on emergency alarms as used by transit authorities in general. It describes the range of problems involving the use of alarm systems. It further addresses the methods and forms of procedures to help remedy the problem of alarm misuse.

The authors wish to acknowledge the guidance and support for this work provided by Thomas C. Lambert, Chief of Transit Police, Edward Harris Jr., Assistant Chief of Transit Police, Captain Lewis Eakins, Security Operations, and Captain Frank Huerta, Field Operations. Thanks also go to Research and Planning Officers Mike Riggs and Harry Oliver for organizational assistance. The study was performed under the general direction of Thomas C. Lambert, Chief Of METRO Transit Police. The author is also grateful to Transit Police and Security Administrators of the Toronto Transportation Commission, Southern California Rapid Transit District, Metropolitan Atlanta Rapid Transit Authority, the Washington Metro Area Transit Authority and the Urban Mass Transportation Administration.

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1. EXECUTIVE SUMMARY

The effectiveness of emergency alarm systems linking buses to police and security support is seriously hampered by a high percentage of false or misused alarms. To illustrate this point, false and inappropriate alarms are received in Houston and Atlanta at an average rate of five to fifteen per day. These statistics are in line with alarm systems in general use in industry, business and residences indicating what appears to be a weakness inherent to alarm systems. Research done here and elsewhere indicates that human error and misunderstandings caused by a lack of training are the greatest problems in alarm misuse.

A safe transit system is essential to both provider and user. Alarm systems are time proven tools for both crime prevention and criminal apprehension but their misuse may cause more potential danger than they are worth. Each time an emergency alarm is activated the operator in effect is saying, "My life or the life of another is in danger." Due to the serious nature of this type of call, it is imperative that operators receive rigorous training in the use of emergency alarms and when to activate them.

To gain an overview on emergency alarm systems the Houston METRO System was evaluated and visits were made to four (4) Transit Authorities and nine (9) were contacted by telephone. Contacts were also made with several nontransit organizations, government and private firms to learn what percentage of the emergency alarms they deal with are false.

The first section of this study describes the principal study regarding emergency alarm systems and the problems encountered by METRO. The second section describes the ways in which each of the four systems visited deals with emergency alarms and identifies their strengths and weaknesses. The concluding section contains study findings and recommendations for improving emergency alarm systems.

1.1 Alarm System Problems:

1. Silent alarm systems, which are standard equipment on buses in many Metropolitan area systems, allow the drivers to signal trouble on a bus without alerting those on board. The simplest alarms activate flashing lights on the bus exterior. More complex alarms transmit a signal to the dispatcher indicating a problem on a specific bus. The operational efficiency of silent alarms, particularly the issuance of false alarms, is a major problem limiting their usefulness.

   Alarm system weaknesses can be divided into specific categories:

   a. Most false alarms can be attributed to misuse, either deliberate or uninformed, and can be rectified by proper training.

b. The balance of false alarms reported can be attributed to alarms activated by facility personnel when the bus is in for service, system design and system malfunction.

1.2 <u>Procedures for correction of misuse</u>:

1. All the authorities contacted reached the same conclusion that in order to reduce operator misuse of the alarm system an aggressive approach should be taken in training the operators in the use of alarms and when they should be activated. Some authorities have gone as far as documenting each misuse and disciplining the operator when he/she misuses the system three separate times.

2. Operator training at each Authority visited was intensive and comprehensive. The alarm system and its use is covered while the Operator trainees are also being instructed on everything from how to read a route schedule to how to set their air brakes. It is unrealistic to expect a high percentage of trainees to retain the information they are given on the alarm system while they are being exposed to all the training they will use daily.

   A separate handout that can be easily referred to at a later date should be provided and a training film showing alarm procedures should be incorporated into the training process.

Due to the infrequent need to use the alarm, retraining with the handout and film should be provided on a 12-18 month basis. A sample film script and handout may be found in Appendix G & H.

Equipment and procedures should be continually evaluated to keep pace with developing technology. Supporting hardware such as the Toronto Communications and Information System and the Loran Navigation System warrant further examination as they relate to alarm use and transit vehicle location. Simple protective measures such as SCRTD's switch cover could cut down on accidental alarm use. Toronto's "open mike" system of checking on an operators safety is another example of an innovative approach to alarm verification.

The sharing of information between transit authorities has helped to identify alarm system strengths and weaknesses. This sharing should be continued as we work toward a solution to the problem.

2. INTRODUCTION

This report, prepared for the Urban Mass Transportation Administration's (UMTA) Office of Technical Assistance, Office of Safety and Security, provides an overview and evaluation of the Emergency Alarm System used by many of North American Urban Mass Transit Systems. The focus of the report is the high percentage of false and inappropriate alarms activated on a daily basis. This problem is shared by most transit authorities identified in this study.

This study is an effort to understand the nature and extent of the problem and to develop a strategy to increase the efficiency of the Emergency Alarm System and thereby enhance the safety of mass transit employees and patrons.

2.1 Background

The general goal of transit police and security organizations is to provide for the security and safety of transit system employees and users. The most important aspect of safety and security is the freedom from life threatening situations. As a key tool being used in this effort, emergency alarm systems can be of great benefit. The problem being discussed here is the negative aspect of their use, the false and inappropriate use of the alarm system negatively impacts both security providers and users.

The alarms studied were generally activated by the operator by pushing, pulling or flipping a switch. Incidences of false alarms of over 90% are not uncommon. In each case of alarm activation, a message is being sent either through a computer readout, flashing lights on the bus destination signs or a combination thereof that there is an eminent threat to life on board the bus.

2.2 Study Methodology

In conducting this study, site visits were made to four large urban mass transit systems. A standard set of questions were asked and responses recorded based on common definitions developed from an evaluation at the Houston, Texas METRO system.

The four systems visited were:

1. Southern California Rapid Transit District [SCRTD], providing bus service to the Metropolitan Los Angeles, California area.

2. Metropolitan Atlanta Rapid Transit Authority [MARTA], provides bus and rail service to the Metropolitan Atlanta, Georgia area.

3. Washington Metropolitan Area Transit Authority [WMATA], providing bus and rail service in the Washington, D.C. region.

4. Toronto Transportation Commission [TTC], providing bus, rail and trolly service to Metropolitan Toronto, Ontario, Canada.

A telephone survey was made of nine additional transit properties to help establish the existence of a national problem. Precise data was not readily available in some areas and approximate numbers were accepted from first hand sources.

The authors gratefully acknowledge the cooperation of the nine systems contacted.

1. Cleveland, Ohio

2. Portland, Oregon

3. Boston, Massachusettes

4. Montreal, Quebec, Canada

5. Philadelphia, Pennsylvania

6. Orange County, California

7. New York, New York

8. Buffalo, New York

9. M.T.A., Maryland

3. METROPOLITAN TRANSIT AUTHORITY OF HARRIS COUNTY, TEXAS [METRO] EMERGENCY ALARM SYSTEM

3.1 Overview

The purpose of the Emergency Alarm System Study is to provide management and supervisory personnel with the background of the METRO bus emergency alarm system and problems associated with its use. METRO is used as the basis of this study as its system and problems are typical of many urban bus systems. During 1984, the Transportation and Transit Police Dispatch offices received 2,032 emergency alarms; 2,011 alarms were involved in alarms other than those authorized by the "Bus Operators' Radio Procedures" Manual.

Interviews conducted with first line supervisors and employees indicated the alarm system is adequate. The majority of the complaints concerned lack of training, improper usage, position of the alarm button, and response or lag time.

3.2 Definitions:

EA - an acronym for emergency alarm.

EAS - an acronym for emergency alarm system.

FALSE ALARM - an emergency alarm involving accidental activation during maintenance work, clean-up, or lack of knowledge of alarm purpose, identification, or operator misuse.

LAG TIME - the period between the time the alarm was activated and acknowledged until a police vehicle is dispatched.

MALFUNCTION - an emergency alarm that occurred due to a mechanical failure. Mechanical failures include electrical wiring shorts, radio failures and weather related activation.

RESPONSE TIME - the period between when action is initiated and arrival of Transit Police or Security to the bus in question.

UNAUTHORIZED ALARMS - an emergency alarm which does not meet the definition of an authorized alarm as outlined in the "Bus Operators' Radio Procedures" Manual. Unauthorized alarms are included as False Alarms for the purpose of this study.

VOICE SYSTEM COMMUNICATIONS NETWORK - a two-way radio system designed for communications between the bus operator and Transportation or Transit Police.

3.3 Emergency Alarm System:

The METRO Emergency Alarm System (EAS) is a silent alarm program designed to be used by bus operators in the event of life threatening situations on the bus. The EAS is comprised of the operator's EA button and sign flasher switch. The bus operator is authorized to use, in accordance with the radio procedures manual, the EAS in the following situations:

"This alarm is designed for the protection of the driver and should be used only for situations such as assault, robbery, rape, etc."

The EA button is normally a closed, push-button switch which is generally located on the bus operator's control panel, left of the steering wheel. The button is built into the panel, and generally not marked. In the older rehabilitated buses, the alarm may be marked SAS (silent alarm system). When the button is pushed, the EAS is activated causing a readout on the Transportation and Transit Police Dispatcher's consoles.

The sign flasher switch is an independent switch from the EA system and activates the destination sign to read "EMERGENCY CALL POLICE". This switch is located at the top left and is installed only on the RTS II buses (1700-1800 Series) and Grummans (1600 Series).

The EAS operation is initiated generally by a bus operator during a life threatening situation. The alarm is transmitted via the Voice System Communications Network (radio system) to the Dispatch Office where a readout will be displayed on all consoles. Once received on the console, a built in audible alarm sounds to alert the transit police dispatcher of the alarm. The dispatcher is responsible for clearing the EA by identifying the bus number, route, block, and approximate location. The transit police dispatcher will address the individual bus in accordance with radio procedures with the following statement:

"Thank you for riding METRO, the date is _________, and the time is ______." This statement is made over the public address system and indicates that an alarm has been received and acknowledged by Dispatch. A primary and support Transit Police unit will be dispatched to the nearest checkpoint for the appropriate action along with a transportation supervisor. Transit Police and the bus operator are required to file a report with their respective supervisors.

3.4 Voice System Communication Network:

The Voice System Communication Network (VSCN) is a two-way radio designed for communication between the bus operator and Transportation or Transit Police Dispatchers. The system is located on the left side of the steering column and resembles a telephone system. It is designed to transmit radio communication and emergency alarms as well as provide a sign-on system to identify the operator-by payroll number, bus number, block number, and route number. The bus operator is required to sign-on prior to beginning service and sign-off upon completion of the run.

3.5 Incident Reporting - 1984:

During 1984, Transit Police Crime Analysist's reports indicated the following statistics involving alarms and system checks:

Total Alarms Reported	2,032	
False/Malfunction Alarms Reported	1,830	(90%)
Subtotal	202	
Class I Alarms (Authorized)	21	(1%)
Other Alarms (Disorderly Conduct, Public Intoxication, Suspicious Persons, Sleepers, etc.)	181	(9%)
Reliability Check (every 90 days)	98% reliable	
Highest Month of Alarms (March to December 1984)*	August (252)	
Lowest Month of Alarms (March to December 1984)*	December (110)	
Hour with Highest Alarm Rate (Other Alarms classification)	4:00 to 5:00 pm (22)	
Hour with Lowest Alarm Rate (Other Alarms classification)	2:00 to 3:00 am (0)	
*Transit Police EA records began March 1984. Prior	3:00 to 4:00 am (0)	
maintained by Transportation Dispatch.	4:00 to 5:00 am (0)	

3.6 Positive Aspects:

As indicated above, reliability checks on the street and in the shop indicate a 98% reliability check. This reliability factor is based on tests of the system made whenever a bus has had a problem and needed its wiring checked out. The emergency alarm is tested from the data head to the switch. All buses are checked every six months on a routine basis.

The Transport Workers Union of America, Local 260, has a positive attitude toward the EA button on the buses, but is not satisfied with the Transit Police response time and circumstances under which the EA button can be used.

With regard to the response time issue, the average response time to system calls for service for METRO Transit Police units for 1985 was 14.6 minutes.

3.7 Problem Areas

Training:

Individual meetings were held with the Metropolitan Transit Authority Safety and Training Office, maintenance and transportation superintendents and supervisors, and maintenance personnel. During interviews, each person was provided with the above statistics and questioned concerning their knowledge of the system. All persons agreed that the system would operate properly if training was provided.

A 30 to 40 minute session on emergency procedures is provided to bus operator trainees during their first week of orientation. The Safety and Training Office provides the training and has placed into operation six radios (for training purposes only) connected with the Transportation Dispatch Office, to conduct mock exercises in radio usage and emergency alarm procedures. Some review is conducted on the Trainee's Review Day. During January 1985, Safety and Training had completed a refresher course on radio usage with some, but not all of the bus operators.

No training is provided to mechanics, starters, cleaners, or maintenance supervisors concerning the alarm system or radio usage. All persons interviewed indicated that the alarms classified as malfunctions and false alarms which occurred on maintenance facilities were either caused by a mechanical failure or carelessness by cleaners or mechanics. As the alarm system consistently tests out with a 98% reliability, most of the blame must be placed on human error. Each mechanic interviewed was unable to identify the EA button, unaware of the EA address statement's purpose, or unable to provide the proper procedure in reporting an alarm.

Improper Usage:

As indicated in the 1984 statistics, only 21 emergency alarms were classified as authorized alarms in accordance with the Radio Procedures Manual. There were 181 emergency alarms involving incidents ranging from Disorderly Conduct, Suspicious Persons, Simple Assaults, to operators trying to override their radio priority system. In meetings with Transit Police, an Operator chosen to represent operators in working toward system improvement explained that some operators were using the emergency alarm because of overcrowding on the radio channel. He stated that an operator may try the radio and upon getting no immediate response use the alarm system to get through not realizing that he will then be unable to receive on his radio.

A total of 1,830 alarms were classified as either false or malfunctions. This figure cannot be broken down to separate the two catagories but the 98% reliability rate upon checking the equipment would indicate a high percentage of the 1,830 alarms are due to human error or lack of training. Many operators indicated they were unaware of the meaning of the public address or fail to return a radio call if the situation is brought under control or the suspect leaves the bus.

EA Button Location:

Operators and mechanics interviewed advised that the EA button is positioned in a location where an accidental activation of the system could occur during early morning sign-out/late night sign-in (dark hours, no internal lights) and during period of cleaning or maintenance. Activation of the system can occur when mistaking the button for the starter button.

Lag Time:

With the METRO Transit Police Department's response time in 1985 averaging 14.6 minutes to any call on the system, the time it takes to acknowledge the alarm and give the alarm announcement should be almost simultaneous. Some problems encountered in responding to an alarm are (1) operator's failure to sign-on/sign-off, (2) incorrect data entered into the operator's radio, (3) bus change-outs without notification, (4) bus delays or incorrect route information, (5) incorrect destination sign and block sign information, (6) dispatcher check of bus location (i.e., bus barn, street, stand-by, etc.), and (7) incorrect procedures being followed by the operator or maintenance employee.

3.8 Recommendations

Training:

The Safety and Training Office has installed six "working" radios for radio and emergency alarm mock exercises. Training in these areas is conducted for approximately 30 to 40 minutes during the first week of Operator's School. Training time should be increased to 1 (one) hour per week and radio usage should be included in on-the-road training. Coordination with the Authority's Training Section should be made to involve a mock exercise on emergency alarm situations and procedures. Additionally, refresher training should be conducted at least once a year for all bus operators, and this should include a question and answer program. The present practice of voluntary attendance at safety meetings is inadequate as an inservice training practice.

The cleaners, bus mechanics and maintenance supervisors receive no training in radio procedures unless they are classified as road testers or radio repair. Much of the problem in false alarms can be eliminated through a training program for mechanics and supervisors through their orientation classes, annual training and refresher courses, and discussion during "tool box" sessions. Recommendations from interviewed mechanics and supervisors were in line with the aforementioned recommendations and provided training through:

a. Video tape produced by the Transit Police and Training Office concerning the emergency alarm system and radio procedures.

b. Certifying supervisors who will in turn provide training to their personnel.

c. Required annual training by the Training Office.

All interviewed personnel indicated that the training would be beneficial in understanding the system and reporting in the event of a malfunction or false alarm.

Improper Usage:

Annual refresher training for operators is seldom used. Transit Police Officers have indicated that many operators had informed them that they (operators) were not trained and did not know how the alarm system procedures worked. Of the operators who indicated they understood the system, many have used the alarm system in situations other than authorized by policy and procedure. In instances wherein the alarm was intentionally used for a situation not consistant with policy, disciplinary action or retraining should be implemented. Continuous misuse - which places the public, operators, supervisors and transit police in unsafe conditions - should be considered for severe disciplinary action.

Although not documented, dispatchers indicate that of the 1,830 false/malfunction alarms in 1984, the majority of the alarms occurred at a maintenance facility and according to those personnel interviewed, the majority of the alarms were caused by carelessness or lack of training (i.e., curiosity on what the button was, mistaken for the starter button, operator sign-out/sign-on, etc.). Training in these areas would significantly reduce the number of facility-based bus alarms. Also, the addition of a switch cover as discussed in the following section would be useful.

<u>EA Button Location</u>:

The location of the button on the buses could easily cause an alarm to be activated by a cleaner working on the bus or a mechanic/operator misjudging the location of the alarm button. Recommendations indicated that the button either be covered by a cap or placed on the left side of the driver's seat. Other recommendations were to place the button on the floor near the accelerator pedal, on the floor under the driver's seat, on the floor beside the fare box, or on the right panel.

<u>Lag Time</u>:

Lag Time has been a problem and will continue to be a problem but can be minimized through joint efforts and upgraded equipment. Consideration was given to reconnecting the flasher sign to the alarm button with the interior destination sign indicating route information and exterior sign providing alarm activation information. Past studies indicated that the offender may cause more problems if the flasher sign was seen. These recommendations could lower lag time by the bus data being flashed with the alarm information. A tracking system has also been discussed and should be taken into consideration. Such a system would eliminate the considerable time wasted while the dispatcher is determining if the bus is in or out of service and where it is located.

Transit Police response time can be improved with additional officers, coordination between all involved parties, and the reduction of false alarms that tax scarse manpower resources.

Technical Services:

The Authority's Training Office should establish a training and refresher training program for all bus operators and maintenance personnel to provide certification in the Alarm System and Radio Procedures.

The Transit Police Department should develop a video tape concerning the Alarm System and provide mock exercises to include a discussion at the scenes. The Department should consider providing one officer to a training day for an on-the-street training session. An officer should be dedicated to speak before the Operators Union and other seminars to provide a question and answer session.

The Planning Department and Transportation Communications Department should develop a program to integrate bus data into the alarm system.

3.9 Conclusion:

METRO's emergency alarm system has the potential of being an excellent system if proper use and training requirements are met. The equipment is in good working condition but could be upgraded to work faster and integrated with a bus locator system presently being procured for testing.

4. SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT EMERGENCY ALARM SYSTEM

4.1 Overview

The purpose of this study is to compare the SCRTD EAS, its outstanding features as well as problems, to the current METRO EAS. Emphasis was placed on the location of alarm, sequence of events after the alarm is set off, and any problems faced presently under this system.

4.2 Emergency Alarm System:

The SCRTD Emergency Alarm System (EAS) is a silent alarm program devised to be used in life threatening and serious bodily injury situations faced by the bus operators. These emergency circumstances would normally occur on the bus, however they may be occurring within eyesight of the operator. The EAS is comprised of the operators EA switch. The operator is authorized to use the EAS in circumstances that constitute a felony crime in progress, serious bodily injury to operator or patrons, and/or life threatening situations.

The EA switch is a toggle flip switch with a safety cover. The safety cover must be flipped into an open position before the toggle switch can be moved to the on position. The EA switch is normally located on the control panel to the left of the operator. When the EA switch is activated, there is an immediate readout on the Transportation Dispatchers console. Additionally, the sign flasher is activated resulting in the destination sign reading, "EMERGENCY CALL POLICE". The two-way radio on the bus is inactivated, prohibiting radio communication with or by the operator. Finally, on approximately two hundred (200) buses presently equipped, the EA will also trip a security camera that films the interior of the bus from over the operators right shoulder.

When the EAS is activated the alarm is transmitted via the Voice Communications System to the Transportation Dispatch Center. The transportation dispatchers assigned to work the police console are then responsible for handling and clearing the alarm. It should be noted that there is no means to verify the alarm at this point and a transit police unit or a local jurisdiction police unit must be dispatched and make contact with the bus in order to clear the alarm. As mentioned previously, the EA automatically disables the two-way radio on board the bus. Due to the large service area, outside police agencies are used regularly to clear the EA's.

4.3 Voice Communication System:

All the buses are equipped with RCA two-way radios that have ten (10) channel capability. The operators are under the control of a specific dispatcher in the Communications Center. The operators are required to sign on and off using the two-way radio. However, there is no capability for bus operators to talk directly to police units in the field. This configuration is typical of communications used by the systems visited.

4.4 Incident Reporting - 1st Quarter 1985:

The SCRTD Police Department is not responsible for keeping, nor does it presently keep any statistics on the EAS program as it may involve their department. However, the Chief Dispatcher in the Transportation Division maintains a quarterly alarm report on certain divisions. This report breaks down the number of alarms per division and shows which were considered actual alarms and which were false alarms. The grand totals for the first quarter of 1985 are as follows:

Grand Totals for First Quarter 1985

Division	Actual Alarms	False Alarms	Total Alarms	% False
1	19	8	27	30%
2	25	15	40	37%
3	13	5	18	28%
5	45	18	63	29%
6	4	9	13	69%
7	17	12	29	41%
8	10	9	19	47%
9	12	7	19	37%
10	28	11	39	28%
12	8	9	17	53%
15	10	6	16	37%
16	3	3	6	50%
18	43	15	58	26%
Totals	235	127	364	35%

The most significant item is the 35% of the total being listed as false alarms. The SCRTD Police Department indicated that this percent was not acceptable. Compared to the METRO EAS program, running around 90% false alarms, this percent is relatively low. There is however an inconsistancy in statistics that make this an unfair comparison. The alarms reported as false under the SCRTD system did not include situations where there was trouble on the bus that was determined not to have been life threatening.

4.5 Problem Areas

Training:

The training of new employees falls upon the Transportation Division regarding the use of the communication system, including the EAS. The training and follow-up procedures for operators are very limited. The operators are given approximately fifteen (15) to twenty (20) minutes using mock situations on a radio and EA alarm set up in the communications center. There are no provisions being enforced to discipline operators who misuse the EAS.

No training is provided to the mechanics, cleaners or maintenance supervisors concerning the proper use of the EAS. However, due to the design of the switch, there are few incidents in which purely accidental contact will set off a false alarm. According to a cursory look at the false alarms, the majority of these are activated while the bus is out of service at one of the facilities. Again, there were no statistics available to show the exact number or the probable cause of these false alarms. Overall, it is the belief of the police department that a well constructed and dedicated training program will reduce the number of false alarms to an acceptable level.

As mentioned earlier, the activation of the alarm automatically deactivates the Voice Communication System, leaving no way to contact the operator. This item is to prevent the endangerment of the operator if a serious situation is in progress. However, this also precludes any contact from the operator to disregard police units if the alarm is a malfunction or accidentally set off. Therefore, presently a Police Unit or possibly two Units are tied up running this alarm until the bus is contacted. Presently, there is consideration being given to creating a system where verification can be obtained regarding the validity of an alarm. The SCRTD Transportation Communication System does not have the capability to address an individual bus at this time, so a similar system as METRO uses is not possible now.

Lag Time:

Again, it was found that the police department did not maintain records or statistics regarding the response time to an EA. However, the average response time to a call for service is approximately eleven (11) minutes. Since a large number of EA's are handled by outside agencies there is no record of the response time when such agency is involved. Units are dispatched immediately to the alarm as there is no wait for verification of the alarm. The Dispatcher will work to determine if the bus is on a route or out of service during the response, and will disregard if it is found to be at a facility.

4.6 Telecamera:

In 1981 the SCRTD Police Department started a program of installing ten (10) super 8 mm cameras on designated buses traveling on troubled routes. This program has continued and presently there are approximately two hundred (200) buses with the telecameras installed and operational. These cameras are loaded with a four minute film cartridge that is easily changed. The camera is activated by the EA and will run until the four minute film strip is completely expended. Other features are a continually visible red light on the front of the camera, supposedly indicating that the camera is filming. This is to advise the patrons that they are under continual observation. The following is printed across the front of the camera in red letters, visible to the patrons:

FOR YOUR PROTECTION
CONTINUOUS PICTURE RECORDING
ON BOARD THIS VEHICLE

There is a second red light to the rear of the camera that only comes on after the camera has been activated and the film used up. This is to be used by police officers and street supervisors in determining if the film has been exposed.

The cameras are made by a company in California, TRANSIT CAMERAS OF AMERICA. This particular model is referred to as the Mobile Transcender. The camera weighs approximately eight (8) pounds and is relatively small in size. The cost of the cameras installed per unit is $800.00.

There have been several problem areas regarding these telecameras. First, when an alarm is tripped on a bus equipped with a camera, an Officer must make contact with the bus to change the film cartridge. What makes this a problem is the fact that most of the alarms set off in outlying areas are run by and cleared by outside agencies. Because of the camera, a transit officer must still make contact with the bus even though the incident may have been cleared already. There is no way to reuse film exposed on a false alarm or to record a situation that takes place outside the view of the camera. Therefore, there has been a large amount of film exposed that is not usable.

There are no statistics available through the police department to indicate if the camera program has been beneficial in reducing reported crimes on the buses having them. Such statistics are presently being collected. When the system is fully operational, 900 cameras will be in place.

4.7 <u>Conclusion</u>:

There is presently a definite lack of usable statistics presently being recorded by the SCRTD Police Department regarding all phases of their EAS. With the exception of the transportation dispatchers records, most of the items obtained for this study were in the form of interviews and first hand knowledge of the police, communications and transportation Staff. One item of the EAS bears closer examination. The use of a toggle flip switch with a safety cover does seem to eliminate many of the accidental alarms. Overall, METRO and SCRDT are having a similar number of alarms per quarter. The big contrast is in the lower number of false alarms experienced by the SCRDT System. This low percentage of false alarms experienced in the maintenance facility must be attributed to the safety switch as that is the principal differance in the two systems.

5. METROPOLITAN ATLANTA RAPID TRANSIT AUTHORITY EMERGENCY ALARM STUDY

5.1 Overview

This segment of the EAS study compares the Metropolitan Atlanta Rapid Transit Authority (MARTA) EAS to the Current METRO EAS. The study centered around the location of the alarm button and the sequence of events that take place after the alarm is set off. Due to different radio systems the two properties handle the alarms differently.

5.2 Emergency Alarm System

The MARTA alarm system is a silent alarm to be activated in life or death and serious bodily injury situations by the bus operators. The EAS is activated by the operator and is authorized only in circumstances which constitute a felony in progress, serious bodily injury to operator or patrons, and/or life threatening situations.

The EA switch is a push button switch with no cover protection located on the driver's side floor board. The switch is positioned so that the operator activates the alarm by moving his left heel to the rear. When the EA is activated, an immediate readout appears on the bus dispatcher's radio console and the sign flashers are activated resulting in the destination sign reading "EMERGENCY, CALL POLICE."

After receiving the EA, the bus dispatchers are responsible for handling and clearing the alarm. It is at this point that the EAS procedures differ greatly from the METRO EAS. Upon receiving the alarm, the bus dispatcher immediately calls the bus and inquires as to his problem. If the bus dispatcher gets a response from the operator, he either clears the EA as being accidental, or determines the nature of the problem on the bus. If the dispatcher receives no response from the operator then it is assumed that a true emergency exists. If a transit police response is necessary the bus dispatcher switches over to the police channel and dispatches the call directly to the transit police units. If the dispatcher was able to talk with the operator, he dispatches the nature of the call as advised by the operator. If the operator did not respond to the radio call, the call is then dispatched as an alarm and the approximate time points are given. In a true alarm, the exact location of the bus is not known. If a bus on any system is taken off route, then it becomes difficult, if not impossible to find.

5.3 Incident Reporting

MARTA does not keep statistics on the number of emergency alarms received in the dispatch center or the number of actual alarms dispatched to transit police units. The Chief Dispatcher advised that they receive approximately 12-15 alarms per day, but after calling the bus back to see what the problem is, most, if not all, of the alarms are cleared as accidental. The MARTA Transit Police does not keep any records of emergency alarms. After talking with transit police officials involved, they advised that they are only dispatched to approximately two EA's a month.

5.4 Training

Bus operators receive initial training on bus operation and are familiarized with the use of the radio and emergency alarm. During this instruction period operators are taught to use the alarm only in life threatening situations or other felonies in which the operator cannot talk on the radio. It is stressed to operators that unauthorized use of the EA will result in disciplinary action. If an operator uses the EA to summon the MARTA Transit Police for any unauthorized reason, the occurrence will be documented and, after three unauthorized uses, the operator is disciplined. This disciplinary policy has reduced the number of unauthorized EA's (fare disputes, disturbances, passengers fighting).

There is no training provided to maintenance personnel to limit the number of EA's occurring on buses in the facilities. Again, there are no statistics kept on EA's originating from out of service buses at facilities. EA's originating from out of service buses are never dispatched to transit police units, but are cleared by bus dispatchers as accidental. The police department is not aware of these accidental alarms and, thus, they do not feel that they have a problem with the emergency alarm system.

5.5 Lag Time

The police department does not keep records of their response time to an EA. Even though the police response time is not known, the method used to handle the alarms by the dispatcher would seem to be a more efficient procedure than is presently used by METRO. The MARTA bus dispatchers handle all EA's and then switch to the police channel to dispatch them, rather than calling the police dispatcher over the phone to have her dispatch the call.

5.6 Conclusion

The MARTA Transit Police Department reports little or no problems with false or malfunctioning emergency alarms. After talking with the bus dispatchers, it was learned that they clear 12-15 false EA's a day. Due to the manner in which EA's are handled by bus dispatchers, the alarms are very seldom assigned to transit police units. MARTA's present practice of calling a bus after receiving an EA has been debated at METRO but it has not been adopted as it could place an operator in more danger during a real emergency. One item used at MARTA which would help eliminate misuse of the EA's is the timely disciplinary action of operators for unauthorized use of the EA.

6. WASHINGTON METRO AREA TRANSIT AUTHORITY

6.1 Emergency Alarm System

The Washington METRO Area Transit Authority Emergency Alarm System (EAS.) is a silent alarm system designed to be used by bus operators in the event of life threatening situations. The bus operator is authorized to use the EAS in accordance with the radio procedures manual during the following situations:

A. Life Threatening Situations

1. Operator's Life is threatened

2. Another individual's life is threatened

The EAS button is normally a closed, push button switch which is built into the bus control panel, left of the steering wheel. Activating the EAS button causes a readout on the Transportation console.

The sign flasher switch is an independent button that reads "EMERGENCY, CALL POLICE" when activated. This printout appears on the destination sign.

6.2 Voice System Communication Network

The alarm is transmitted via the Voice System Communications Network (radio system) to the Transportation Dispatch Center where a readout will be displayed on all consoles. Once received on the console, a built in audible alarm sounds to alert all the dispatchers of the alarm. An assigned dispatcher is responsible for clearing the EAS by identifying the pertinent information to be passed on to the transit police dispatcher. Information appearing on the console is bus number, route, block, and time. The dispatcher will find the approximate location in the route book.

The transit police dispatcher will assign a scout car to follow up on the EA's. A Transportation Supervisor is not assigned and no report is required by the officer if there was no activity.

6.3 Incident Reporting

The chief transportation dispatcher of Washington Metropolitan Transit Authority advised that they had a 90% false alarm rate. The transit police analyst does not keep statistics on the EAS. The chief transportation dispatcher indicated that the problems they experience with the EAS are similar to those of METRO.

6.4 Problem Area - Training

The bus operators are familiarized with the EAS during their Operator Training classes. The operators have no specialized or refresher training on the EAS.

No training on the EAS is provided for the mechanics, starters, or maintenance supervisors. Also, there is no available literature on the EAS. There was no information available on improper usage or response time.

6.5 CONCLUSION:

The problems experienced from Emergency Alarm Systems and the Flashing Emergency Sign are similar to problems experienced throughout the transit properties. One of the time saving features is the capability of the console to give complete bus information. The transit police dispatchers have no involvement in obtaining the information from the console when the emergency alarm is first activated; their role is to dispatch and coordinate assigned Transit Police units.

7. TORONTO TRANSPORTATION COMMISSION

7.1 Overview

The purpose of the Toronto Alarm System evaluation is to provide management with the background of the Toronto Transportation Commission's emergency alarm system and its effectiveness.

The TTC operates both the most sophisticated alarm system and the most elementary of all sites visited. Those buses that do not have the system as described in Section 7.2 have a switch, that when activated, causes the horn to blow and bus lights to flash. Buses with this elementary system are not equipped with radios of any kind.

7.2 Emergency Alarm System

The Toronto Transportation Commission does not have a system wide emergency alarm program as of 1985. However, the Toronto Transportation Commission implemented a pilot program called "Communications and Information System" (CIS) on Surface Transit vehicles from their Wilson Operating Facility. This facility services the suburban corridors of Toronto with approximately 260 Surface vehicles.

The concept of CIS, or automatic vehicle monitoring, involves a microprocessor radio package on board each vehicle which collects data from various fixed post sensors and transmits real - time information to a central facility. The information is manipulated by the central computer and displayed in an appropriate format which allows a supervisor to visualize location and schedule adherence of vehicles on the route. The ability to monitor actual vehicle location is crucial from a security perspective since it allows a supervisor to locate a vehicle even if the driver is unable to respond. This is a key advantage of CIS in comparison to two-way radios.

The CIS unit is capable of voice and digital communication. The voice transmission capability allows a central control facility to communicate to each individual driver and the patrons of a vehicle. This capability has proven to be useful, especially in dealing with fare disputes between patrons and operators which can be resolved by a CIS supervisor immediately. The supervisor addresses the bus over a public address system from the communications center. The passenger is able to converse with the supervisor and resolve conflicts without having to dispatch personnel to the scene.

7.2a Configuration of the keyboard and key functions

The digital transmission of data includes the capability to transmit "pre-packaged" information to the Central Center at the touch of a single button on it's keyboard. The keyboard is a 16 button panel arranged in 4 rows of 4 keys. Ten of the keys are numbered from 0-9, and are used to enter numerical information, such as badge, route, and run numbers for log on. The 1, 2, 4, 5, 8, and 9 keys are dual purpose and labelled as follows:

a) Vehicle Traffic Key: The #2 key is labelled "VEH TRAF". It is used to advise the Control Center of heavy vehicular traffic.

b) Overtax Key: The #4 key is labelled "OVERTAX". It is used to advise the Control Center that he cannot accommodate all potential passengers.

c) Mechanical Trouble Key: The #5 key is labelled with a graphic of a wrench. It is used to advise the Control Center of mechanical trouble.

d) Fare Dispute Key: The #8 key is labelled "FARE-DISP". It is used to advise the Control Center of a fare dispute which the operator cannot resolve. This is displayed on the central controllers screen and remains until the central computer acknowledges the message. (Note: Supervisory personnel will respond to this key message as soon as possible and in order of priority for all remaining keys.)

e) Talk Key: The #9 key is labelled "TALK". It is used to advise the Control Center that the operator requires voice communication.

f) Security Keys: Which are single function message keys. The emergency key is yellow in color, and is labeled "EMERG". It is used to report any serious emergency such as collision, fire or any other emergency not covered by a predetermined message key. This key is only pressed when voice communication is possible.

g) Silent Alarm Key: The Silent Alarm key is red and is not labelled. This is only used to report that criminal action is taking place on or near the vehicle and the operator is not in a position to communicate. This key discreetly advises the Control Center of a police emergency situation.

Acknowledgement by the central computer is the appearance of a single asterisk (*) displayed in the leftmost character position.

NOTE: A Silent Alarm message receives a top priority response from supervisory personnel. The police will be dispatched immediately to the location of the vehicle. No conversation with the vehicle will take place. There is no means of cancelling a Silent Alarm once it is initiated. Supervisory personnel have the option only under the Silent Alarm conditions of activating a boom microphone to listen without indication on the bus, or to send a text message which will display in the usual manner.

(Additional Keys)

a) Yes Key: The "YES" key is orange in color, and labelled "YES". It is used to acknowledge receipt of a text message. Pressing the "YES" key clears the operator's display to restore normal operations.

b) No Key: The "NO" key is orange and is labelled "NO". It is used to acknowledge receipt of a text message, if appropriate. Pressing the "No" key clears the operator's display to restore operations.

The two remaining keys are for local control of the P.A. System. They are as follows:

External P. A. Key: The External P. A. key is labelled "OUT" with a graphic of a speaker. This key is presently non-functional.

Internal P. A. Key: The Internal P. A. key is labelled "IN" with a graphic of a speaker. This key activates the P. A. mode to internal, for use inside the vehicle. No indication that this key has been pressed is sent to the central computer.

Operations Controls

i) Keyboard

Installation - a sixteen button keyboard assembly arranged in four rows of four keys.

ii) Display Screen

Installation - thirty-two (32) character alpha-numeric display in the upper section of the TRUMP front panel

Purpose - to present data to the Operator, such as:

- schedule information
- instructions from supervisory personnel
- feedback on message key pushes

- radio mode
- time from Transit Control Master Clock

Text Messages

Text messages are normally initiated by supervisory personnel and replace any existing display on the operator's screen (including schedule deviation and time display.) Messages can be up to thirty-two (32) characters in length and are accompanied by a "beep" every second until acknowledged.

CIS Control Center

The Wilson Garage has three full inspector's consoles. Each console has three CRT displays for monitoring routes and dialogue with the computers. The left and right screens are used for detailed displays selected by the Inspector. The center screen shows an updated list of problem areas, as well as written reminders for the inspector. The console keyboard has a number of specially coded buttons specific to CIS operations, plus a typewriter keyboard for sending text messages to the vehicle or for filing forms. In addition, the Inspector has full control of voice channels from the console.

How Transmissions Are Received

Development of the concept and related computer, electronic and radio components were carried out during 1974 and 1975 by T.T.C. staff. The system, which included automatic tracking/vehicle location, two-way data and voice radio communication, driver keyboard, display units, (allowing transmission of pre-coded messages), was successfully demonstrated on test routes.

Forty sign post microwave transmitters, are located at strategic locations along CIS routes and at terminal points to determine vehicle position. Each transmitter beams a unique identification code which is picked up by the microwave receiver on the vehicle and fed to the on-board TRUMP unit which in turn transmits the information to the central computer, on the next polling cycle. The polling cycle works on the same principle as the state and Federal teletype communications system polling cycles.

Additional Function of CIS

Another very important part of CIS is the use of passenger counters. They are located at each of the three (3) stairwells on each vehicle. Infa-red passenger counters provide an accurate account of system ridership.

Use of CIS Security Features

As part of the on-going evaluation of CIS, data on the use of the aforementioned keys was collected over the period September, 1983 to October 1984.

1. Fare Dispute: The average percentage of fare dispute keys pushed per month was 36.2%. Of this total, 92% were resolved immediately upon voice communications being established by the Control Center. The remaining 8% includes keys pushed in error as well as those which required further intervention by appropriate authorities.

2. Yellow Emergency: This key was used, on average, 35 times each month. Of this total, 43.6% were incidents observed by operators and reported by them via CIS, but not involving the Toronto Transportation Commission.

TTC Not Involved (General Public)

The following breakdown is for incidents witnessed, and reported by operators of CIS - equipped vehicles, but not involving the Commission.

Medical Problem	22.8%
Accidents	12.2%
Assaults	2.2%
Other	6.4%

Commission Involved

The remaining 56.4% of the total incidents involving the Commission are broken down as follows:

Medical Problem (Of Patrons On Vehicle)	14.0%
Accidents (Involving Commission Vehicles)	14.6%
Assaults (On Commission Vehicles)	3.6%
Disturbance (On Board Vehicle)	11.6%
Other	12.6%

The "Accidents" category does not include those accidents which resulted in personal injury. These appear in the "Medical Problem" category.

Real Emergency

The average percentage of use of this key was 4.8% for a month. Of this total, the key was used justifiably 45% of the time, the operator felt his, or his passenger's safety could be endangered. The other 55% of the cases are accounted for mostly by use of the key during emergency where the Yellow Emergency Key would have been more appropriate.

7.3 Incident Reporting

As the Commission does not have its own police force, when an Emergency alarm is received the Inspector at the CIS control console calls the Metro Toronto Police Department advising them of the location of the bus, the bus number, and the condition on-board the bus, via audio mike communication which allows the Inspector to listen to all voice activity on the vehicle.

Metro Toronto Police responds to all Transit System related incidents as well as various other duties in the Metropolitan Toronto area. The Toronto Transportation Commission has a 21 man force of investigators who ride the system in plain clothes, unarmed to monitor the system. These investigators do not have power of arrest. However, as agents of the Commission, they may tell patrons to disembark get off the system if they (patrons) are causing problems and they may issue a summons for minor violations.

These investigators are also responsible for follow-up investigations relating to system complaints. As a part of general policy of Toronto Transportation Commission, all employees are instructed to take progressive action in the event they witness a crime being committed on the system or in their view off the transit system.

Since there is no conflict with dual jurisdiction, the response time by the Toronto Police relating to emergency alarms is approximately 3 to 4 minutes. This is due to their large force (appx. 3500 Officers) in a service area of 240 square miles. They also incorporate high visibility and a 6 district breakdown of their manpower deployment.

Additional Emergency Alarm System For Surface Vehicles

As this study mentioned earlier, the CIS System is used on a limited number of Surface vehicles. The remainder of the system must rely on the old emergency alarm system.

This system on Surface vehicles, when activated, causes the horn to sound and emergency flashers to operate on the buses; the stoplights to flash and the gong to sound on streetcars; the lights to flash and a pulsating electronic-tone alarm to sound on the CLRV's (Canadian Light Rail Vehicle.) The Commission has asked that the public assist them if they hear this alarm by notifying the proper authorities and also to remain at the scene to provide information to Police or Commission personnel. Contacting the proper authorities is done by using a Bell Telephone and dialing 911.

7.4 Security System Training

The Transportation and Operations Division of the Toronto Transportation Commission is responsible for training on all available security systems, currently in use at the Toronto Transportation Commission. Prior to comprehensive training on the CIS system, the false alarm rate was approx. 93%. The majority of these false alarms were attributed to operator error. Shortly after improving the training program, a false alarm rate of approximately 55% overall was recorded. These statistics indicate that the false alarm rate could be greatly reduced through a more aggressive program relating to operator familiarization with existing emergency alarms.

7.5 Conclusion

Expanded use of the CIS on subway and all surface vehicles could further improve the Toronto Transit Commissions handling of system emergency alarms. Continuation of public cooperaion and assistance can only serve to enhance immediate resolution of system emergencies.

8. RECOMMENDATIONS

8.1 System Hardware

The Toronto Transportation Commission had both the most and least sophisticated emergency alarm system of those sites visited. The automated vehicle tracking system in use throughout one of the districts is good but is limited to tracking a bus while it is on route. Once taken off route the bus, as on all other systems is "lost".

A similar system under consideration by some transportation and law enforcement agencies provides the same type of route information but also follows the designated vehicle wherever it goes throughout the service area. This system uses the Loran Satellite Navigation system that now tracks ships at sea and aircraft equipped with a small transmitter. The signal being beamed by the ground vehicle is picked up by the satellite and beamed to a ground receiver connected to a computer with map and route information. The ground station is then not limited to fixed post signal devices such as those used in Toronto. If a vehicle is taken off route the monitor will follow it.

The system using an open microphone to check on the status of a bus that is in alarm status would be an efficient way to check on the safety of the operator. This method is preferable to sending out officers on all calls. It is also safer than calling the operator to see what the problem is or risking startling a potentially armed suspect with an address over the P.A. system.

Flashing lights on the bus exterior, especially those reading "Emergency, Call Police" are not recommended as the frequency of false alarms would cause undue public attention to question the safety of the bus system when there is no real problem. The lights have been disconnected in some jurisdictions because of the possibility of the person causing the trouble seeing the flashing lights reflected in store windows.

The alarm switch itself should be out of the way of accidental activation. The placement of the switch on the left side of the drivers console away from the radio is a good location. The switch or button itself should have a cover to prevent an accidental contact.

The radio system must provide the operator with reasonable access to the dispatcher without lengthy delays for priority calls. This will take away the temptation of using the alarm to get around a backlog of calls waiting to be answered. An additional set of automated signals such as the TTC's Fare Dispute key and mechanical trouble key may serve to lessen the burden on some voice systems.

8.2 Procedures

Procedural documents must clearly specify the reasons for utilizing the emergency alarm. Disciplinary action is a necessary part of the procedures if the integrity of the system is to be protected. Operating manuals must present the procedures and be enforced.

8.3 Training

Emergency Alarm Procedures are too much a part of the overall new operator training program. These procedures should be broken out of the radio procedures manual and presented separately to reinforce their importance. Handout material and a training film dealing specifically with the system and how it is responded to should be developed.

APPENDIX

Original Grant Work Program

Appendix A

APPENDIX A - PROJECT DESCRIPTION AND WORK PROGRAM

IMPROVED EMERGENCY ALARM/RESPONSE SYSTEM

BACKGROUND

Many transit vehicles have radio communications with their central dispatcher as well as some sort of silent alarm. Silent alarms are hidden switches which can be tripped by bus operators under emergency circumstances. Activation of the alarm causes a signal (bus identification number) to be transmitted to the central dispatcher. After determining the approximately location of the vehicles, appropriate security personnel are notified by the dispatcher.

Effectiveness of the alarm system depends directly on the dispatcher's ability to predict the location of the bus from route and schedule information and quick response to the call for assistance. Because the alarm is covert, bus drivers can get assistance without the source of the problem (e.g. an assailant) knowing that any alarm has been tripped. The alarm system thus provides bus operators with a meaure of security especially during late night hours.

Some transit systems have experienced a high rate of false alarms. This can cause the security personnel to question whether repeated calls for assistance were warranted and thus potentially undermine the intended security of the system.

To minimize the rate of false alarms the switch can be installed in a location where the driver or mechanic is much less likely to trip it accidentally. With these precautions a high percentage of false alarms may still be an operating necessity. In order to keep the alarm switch convenient enough to the driver so that it can be activated covertly, a certain level of false alarms may have to be tolerated.

Currently the Houston METRO is experiencing a high (90% or more) false alarm rate. This is considered excessive and has led to the need for a study to address the false alarms associated with their silent alarm system. The objective of this work is to investigate the nature of false alarms, compare these with alarm systems and experiences at other selected transit systems and make recommendations for an improved emergency alarm/response system. Specific areas to be included in the investigation are types of alarm systems, operation, effectiveness and training. <u>METRO</u> shall perform the following tasks:

<u>Task 1 - Review of Houston METRO Alarm System</u>

This task will involve an in depth investigation of the existing alarm system, including such areas as the following:

- Hardware
  - type of switch, location, inc.
  - sign flashers

- voice system communications network
  1. phone, radio
  2. driver, motorist alarm initiated
  3. central control, dispatcher, transit police, city police response system
- installation
- quality/reliability of equipment

° Operation

- driver/dispatcher/police responsibilities
- emergency definition - when to use alarm
- when to use flashers, voice systems
- union involvement, attitude
- incident reporting
- maintenance program
- misuse/incidents-(e.g. inadvertently tripped by moisture, feet, lunch pail)
- procedures for alarm/response
- communication paths - driver, central control, dispatcher, transit/city police

° Effectiveness

- frequency of alarm usage by hour of day
- ratio of false alarms to actual emergency activations
- response times to emergency alarms both by the bus dispatcher and police

- Training
  - driver/dispatcher/central control/police procedures
  - system description, description of on-board
  - equipment, handouts on operations
  - "hands-on" experience using mock-up version
  - integration with overall vehicle training program
  - material/times

Task 2 - Review of Alarm Systems at Selected Transit Systems

This task will involve an in-depth investigation of existing alarm systems at other transit systems. Four systems have been selected:

1. Southern California Rapid Transit District - Los Angeles, California;
2. Metropolitan Atlanta Rapid Transit Authority - Atlanta, Georgia;
3. Washington METRO Area Transit Authority - Washington, D.C.; and
4. Toronto Area Transit Operating Authority - Ontario, Canada

The investigation may be based on on-site review or available documentation (TSC has an unpublished report entitled "Evaluation of the Chicago Transit Authority (CTA) Bus Communications and Control System"). The elements of this investigation will be the same as those in Task 1, i.e., hardware, operation etc.

Task 3 - Assessment of Alarm Systems and Recommendations to Improve the Houston Metro Alarm System

This task will assess the information gathered in the first two tasks and make specific recommendations to improve the Houston METRO alarm system. The output of this task will be a final report. Recommendations may be made in the following areas:

- design (e.g. hermetically sealed thumb switch detent)
- location (e.g. on or near door opener)
- construction/installation
- maintenance
- operation (e.g. when alarm should be activated, when to use voice system automatic central control polling
- to check operational status, maintenance reporting system
- training (e.g. improved manuals, importance of alarm system, seriousness of alarm system infractions, cooperation of unions, false alarm acceptance level.

SCHEDULES

Task I	METRO Review	1 month
Task II	Other Systems Review	2 months
Task III	Assessment & Recommendations	3 months

DELIVERABLES

Assessment & Recommendations Report	3 months
Test & Evaluation Report	8 months

Alarm System Telephone Survey

Appendix B

8.2 Emergency Alarm System Telephone Survey

Property	Alarm System? Yes	Alarm System? No	On All Fleet? Yes	On All Fleet? No	If No, What %	Silent? Yes	Silent? No	Lights Flash? Yes	Lights Flash? No	If Not Silent What?	Where Does Signal terminate?	% of False Alarms	Discipline Yes	Discipline No	1984 Data True Alarm	1984 Data False Alarm
Cleveland, OH	X		X		NA	X		X		NA	Transportation/ Transit Police	40%	X		1 per day	2 per day
Portland, OR	X		X		NA	X			X	NA	Transit Police	90%	Unk		2 per day	28 per day
Boston, MA	X		X		NA		X	X		Lights only	NA	Unk	Unk		Unk	Unk
Montreal, Queb.		X	NA		NA	NA		NA		NA	NA	NA	NA		NA	
Philadelphia, PA	X		X		NA	X		X		NA	Transportation	99.9%	Unk		1 per day	19 per day
Orange County, CA	X		X		NA	X			X	NA	Transportation	50%	X		Unk	
New York, NY	X		X		NA	X		X		Lights only	Transportation	Unk	Unk		Unk	
Buffalo, NY	X		X		NA	X			X	NA	Transportation	90%	X		15 mo.	135 mo.
MTA, Maryland	X		X		NA	X			X	NA	Transportation	90%			10 mo.	90 mo.

EMERGENCY ALARM SYSTEM

Telephone Study:

The purpose of this study was to contact nine other Transit Authorities to compare their systems outstanding features as well as their problems. A series of ten (10) questions were asked to the representative of each transit authority contacted. The questions are as follows:

1. Alarm system on bus fleet?
2. If yes. On all fleet?
3. If no. What %:
4. Silent Alarm?
5. Lights flash on bus?
6. If not silent what does it do?
7. If silent where does signal go?
8. Off the cuff comment on effectiveness of the alarm. % False.
9. Any action taken on operators for misuse?
10. Any data on the number of alarms in 1984 and the number of false versus good.

    If yes; total
    good
    bad

The phone study was conducted to get more information on the systems presently in use, that METRO was not able to visit in person.

Systems Contacted:

Cleveland, Ohio:

Answers:

1. Yes
2. Yes, on all fleet
3. N/A
4. Yes
5. Yes
6. The operator can activate all top clearance lights to a flashing mode if an emergency occurs.
7. Transit Police, Transportation, City Police Department
8. 40% False
9. Disciplinary action can be taken against an operator for wrongful use of the emergency alarm system.
10. Total 3 per day: Good - 1 Bad - 2

Person contacted: Charles Sullivan
Asst. Director of Transportation
(216) 566-5167

Portland, Oregon:

Answers:

1. Yes
2. Yes. On all fleet
3. N/A
4. Yes
5. No
6. No answer
7. Transit Police
8. 90% False
9. No answer
10. Total 30 per month: Good - 2 Bad - 28

Person contacted: Charles Hill
Chief of Transit Police
(503) 238-4860

Boston, Massachusettes

Answers:

1. Yes
2. Yes
3. 100%
4. No
5. Yes
6. There is a system of green lights mounted on the top front and rear of each vehicle. The operator can activate the signal in case of an emergency.
7. No answer
8. No answer
9. No answer
10. No answer

Person contacted: Lt. O. Laughlin
Field Operations Transit Police
(617) 722-5000

Montreal, Quebec

Answers:

1. No

2-10. No answers

NOTE: Bus operators are instructed to contact the Transit Police from a pay telephone if they have any problems.

Phone: (514) 280-4500

Philadelphia, Pennsylvania

Answers:

1. Yes
2. Yes
3. N/A
4. Yes
5. Yes
6. The entire fleet also has yellow flashing lights mounted on top of each vehicle. The operator can activate to alert police of any emergencies.
7. Transportation
8. 99.9%

9. No answer

10. Total 20 per day: Good - 1 Bad - 19

Person contacted: Ken Korach
Transportation Division
(215) 456-4000

Orange County Transit, California

Answers:

1. Yes
2. Yes
3. No answer
4. Yes
5. No
6. No alternate systems
7. Transportation
8. 50%
9. Disciplinary action can be taken against an operator for wrongful use of the emergency alarm system.
10. No answer

Person contacted: Dick Ingwerson
Asst. Superintendent of Bus Operations
(714) 971-6200

New York City, New York

Answers

1. Yes
2. Yes
3. No answer
4. No
5. No
6. The operator can activate his destination sign to read "CALL POLICE". All buses are also equipped with radios and operators use a special code if there is an emergency.
7. No answer
8. No answer
9. No answer
10. No answer

Person contacted: Detective McHugh
New York City Transit Police
(718) 330-4908
Det. McHugh is also a Crime
Prevention Specialist

Buffalo, New York

Answers:

1. Yes
2. Yes
3. No answer
4. Yes
5. No
6. No answer
7. Transportation
8. 90%
9. Disciplinary action can be taken against an operator for wrongful use of the alarm system
10. Total 150 per month: Good - 15 Bad - 135

Person contacted: Norm Birner (716) 855-7660
Chief of Transit Police

Jack Heien (716) 855-7323
V.P. of Bus Operation

Curt Barber (716) 855-7624
V.P. of Transportation

Mass Transit Administration of Maryland

Answers:

1. Yes
2. Yes
3. No answer
4. Yes
5. No
6. No answer
7. Transportation
8. 90%
9. There is no present policy for disciplinary action to be taken against operators who misuse the alarm system.
10. Total 100 per month: Good - 10 Bad - 90

Person contacted: Ardel Hoverskeland
Director of Systems
(301) 659-3430

Neel Williams
Chief of Transit Police
(301) 659-3550

Southern California Rapid Transit District

Alarm Data

Appendix C

REV 5/82

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

DO NOT INCLUDE MORE THAN ONE SUBJECT IN THIS COMMUNICATION

DATE: February 4, 1985

TO: S. Singer

FROM: D. Ibarra

SUBJECT: Maintenance Department Alarms for January 1985

	DIV. YARDS	ALARMS ACTIVATED	POLICE DISPATCHED
	1	4	0
	2	1	0
	3	0	0
	5	3	0
	6	4	0
	7	3	0
	8	4	0
	9	7	0
	10	4	0
	12	1	0
	15	5	0
	16	3	0
	18	0	0
TOTAL		39	0

D. Ibarra

D. Ibarra
Radio Dispatch Manager

D.I.:rm

cc: G. L. Diehl

10.1.6

REV 5/82

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

DO NOT INCLUDE MORE THAN ONE SUBJECT IN THIS COMMUNICATION

DATE: March 1, 1985

TO: S. Singer

FROM: D. Ibarra

SUBJECT: Maintenance Department Alarms for February 1985

	DIV. YARDS	ALARMS ACTIVATED	POLICE DISPATCHED
	1	1	0
	2	4	0
	3	2	0
	5	5	0
	6	5	0
	7	1	0
	8	3	0
	9	3	0
	10	4	0
	12	1	0
	15	3	0
	16	1	0
	18	4	0
TOTAL		37	0

D. Ibarra

D. Ibarra
Radio Dispatch Manager

D.I.:rm

cc: G. L. Diehl

10.1.6

RTD 37-11
REV 5/82

DEPARTMENTAL

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

DO NOT INCLUDE MORE THAN ONE SUBJECT IN THIS COMMUNICATION

DATE: April 1, 1985

TO: S. Singer

FROM: L. Stevenson

SUBJECT: Maintenance Department Alarms for March 1985

	DIV. YARDS	ALARMS ACTIVATED	POLICE DISPATCHED
	1	1	0
	2	3	0
	3	1	0
	5	4	0
	6	3	0
	7	3	0
	8	3	0
	9	5	0
	10	4	0
	12	2	0
	15	4	0
	16	6	0
	18	3	0
TOTAL		42	0

L. Stevenson
L. Stevenson
Acting Radio Dispatch Manager

LS:aw

cc: G. L. Diehl

10.1.6

TORONTO TRANSIT COMMISSION

OPERATOR'S INSTRUCTION MANUAL

ABSTRACT

Appendix D

D-2

Toronto Transit Commission

Communications & Information System. C.I.S.

Operator's Instruction Manual

January, 1983

YOUR C.I.S. SYSTEM

When you start your C.I.S. equipped vehicle, you become part of the most sophisticated transit communications system in the world. The system has been designed to be as automatic as possible to eliminate annoying distractions while you are driving. Assistance is as near as the TRUMP keyboard whether it is the Police you require, service for your vehicle or help with a fare dispute which you cannot resolve.

How you use the system is important. It is designed to provide high speed data transmission. Excessive use of the voice radio will reduce the efficiency of the system. The voice radio function is for problems you cannot handle yourself. You should not hesitate to use it when you need it, but should not use it unnecessarily.

The C.I.S. system is working to make things easier for YOU and our passengers.

JANUARY, 1983

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Table of Contents (Cont'd)

Table of Contents (Cont'd)

SECTION I

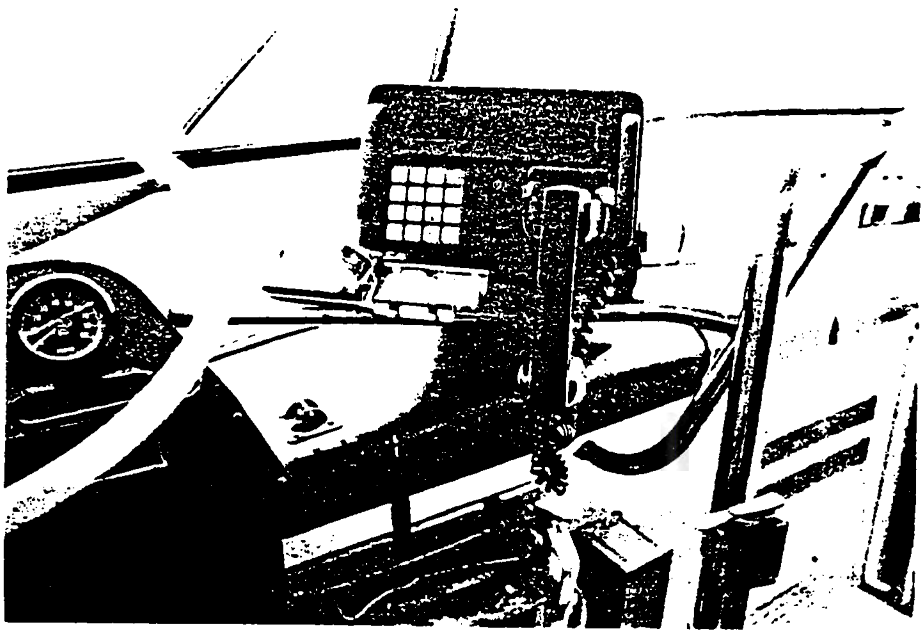
Vehicle Equipment

1. THE TRUMP UNIT

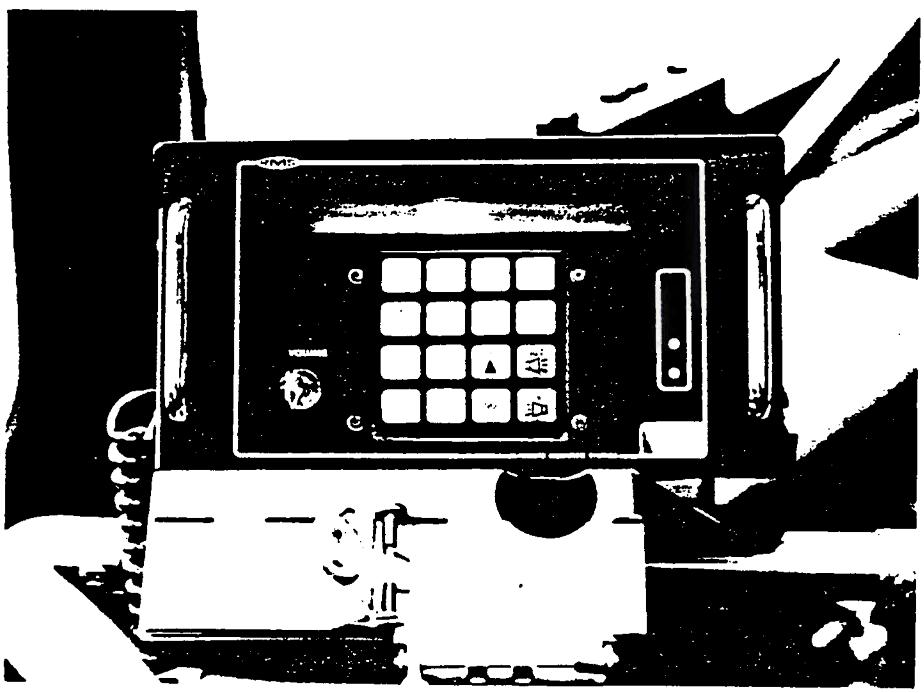
The Transit Universal Micro-Processor, or TRUMP, is the heart of the vehicle system and is the focal point for the various sensors, the radio and public address systems on the vehicle. There are two models of TRUMP unit. They operate and look the same but the new style has the handset mounted separately from the main unit (See page 1-1A for the old model and page 1-1B for the new model). TRUMP incorporates a micro-processor, radio, speaker, handset (early model), pushbutton keyboard and display area. It is designed to provide communications for monitoring and control of C.I.S. equipped vehicles.

A. Installation - the TRUMP unit is mounted on the dash of the vehicle to the right of the Operator. It is angled for ease of operation and direct viewing of the visual display. The unit is secured to a permanently installed rack which facilitates easy removal for maintenance. A multipinned block connector attached to the rear of the unit supplies power and connects the other devices of the on board system to TRUMP. Vehicle identification is also coded into this connector. The antenna is connected separately on the left side and is protected by a key lock.

B. Purpose
- control communications between vehicle and Control Centre.
- generate automatic messages from sensors on vehicle.
- transmit messages from Operator.
- provide visual display to Operator.
- control voice communication with Control Centre.
- control public address system for passengers.

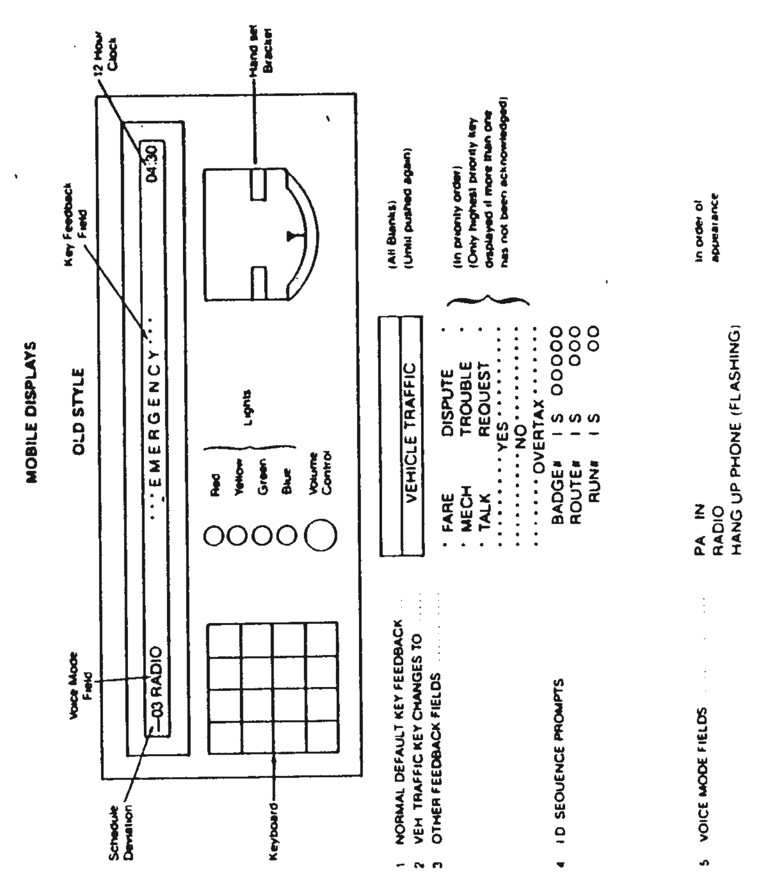


1-1A

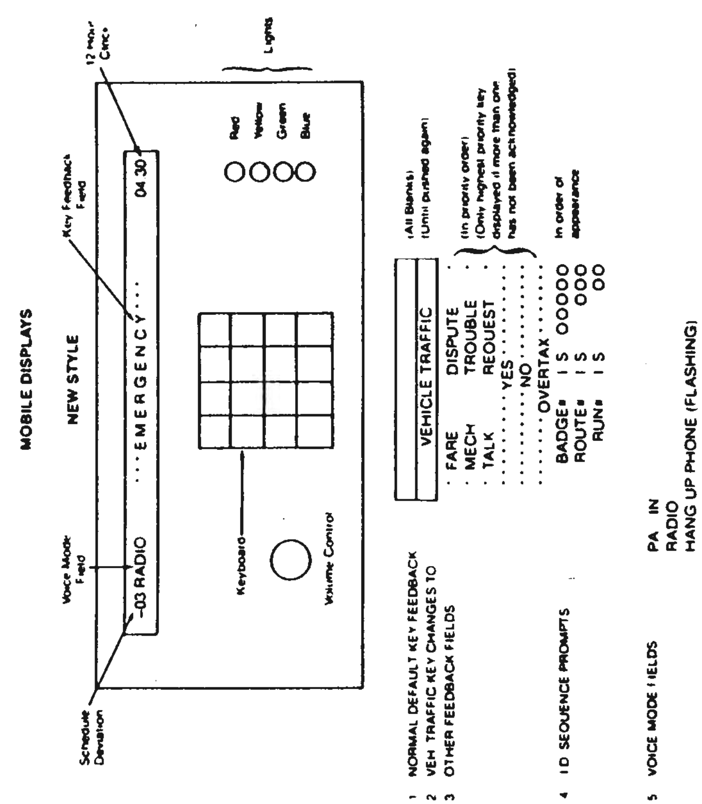


1 - 1B

C. Operation - the operating controls for the TRUMP Unit are located on the front panel facing the Operator. They consist of a pushbutton keyboard, display screen and volume control, a handset is also provided (see page I-2A and I-2B). An emergency reset button is located at the rear of the unit under the power connector. The unit has no on/off switch. It is turned on whenever the alternator on the vehicle is operating. The unit remains on for thirty minutes after the engine is shut off. Disconnecting the power connector is the only way of turning the unit off.



I–2B



D. Operations Controls

i) Keyboard

Installation - a sixteen button keyboard assembly arranged in four rows of four keys as seen below.

MOBILE KEYBOARD

ii) Display Screen

Installation - thirty-two (32) character alpha-numeric display in the upper section of the TRUMP front panel.

Purpose - to present data to the Operator, such as:

- schedule information
- instructions from supervisory personnel
- feedback on message key pushes
- radio mode
- time from Transit Control Master Clock

D. Operations Controls (Cont'd)

iii) Handset

Installation - the handset rests in a special bracket. The bracket is designed to prevent the set from being accidentally dislodged. A push to talk button is in the handle to switch on the microphone.

Purpose - for private voice communications with the Control Centre and for internal P.A. announcements.

iv) Volume Control

Installation - the volume control is a rotary knob located in the lower centre of the front panel.

Purpose - to allow the Operator to adjust the volume of the TRUMP speaker. The volume cannot be turned entirely off.

v) Indicator Lights

Installation - four (4) indicator lights (red, green, yellow and blue) are mounted to the right of the keyboard on the front panel.

Purpose - the blue light flashes each time the TRUMP unit transmits a message. The red, yellow and green lights are for future applications.

E. Auxiliary Hardware

i) Boom Microphone

Installation - an omni-directional microphone is attached to the dashboard to the left of or in front of the Operator's position (see page I-5A and I-5B).

Purpose

- to permit hands free voice communication with the Control Centre.
- to allow the supervisory personnel to monitor conversation on the vehicle during a SILENT ALARM ONLY.

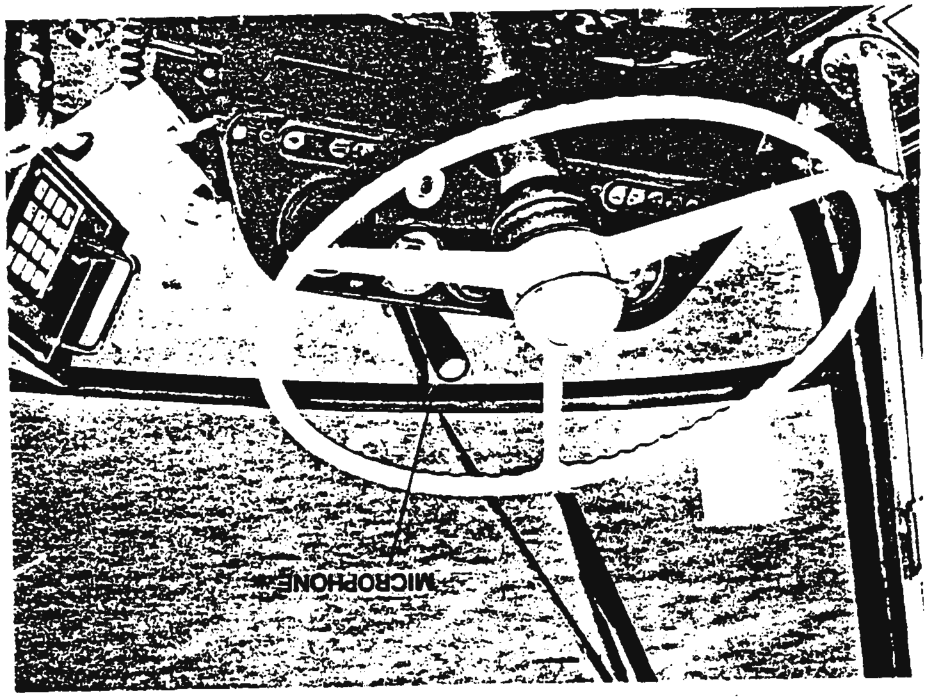
The boom microphone is only used when the Control Centre requires an individual vehicle be put in radio mode. It cannot be used for internal P.A. announcements nor can it be used for two-way radio communication between the Control Centre and a group of C.I.S. vehicles. The handset must be used for this group communication.

ii) Internal Public Address System

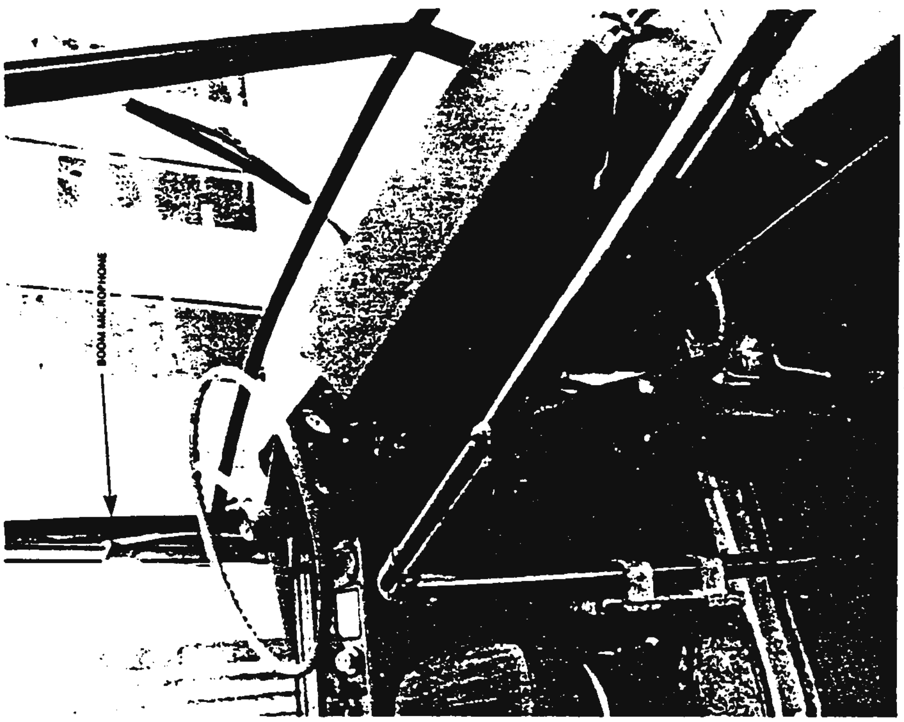
Installation - the system uses two speakers mounted flush to the ceiling of the vehicle.

Purpose - for the Operator or the Control Centre to make announcements to passengers. The Operator's use is restricted to the handset. It is controlled by a push-button on the keyboard.

I - 5B



I-5A



E. Auxiliary Hardware (Cont'd)

iii) Radio Antenna

Installation - a small, durable cast metal antenna mounted on the centre roof line near the front of the vehicle (see page I-6A).

Purpose - to receive and transmit digital and voice radio messages.

F. Vehicle Sensors

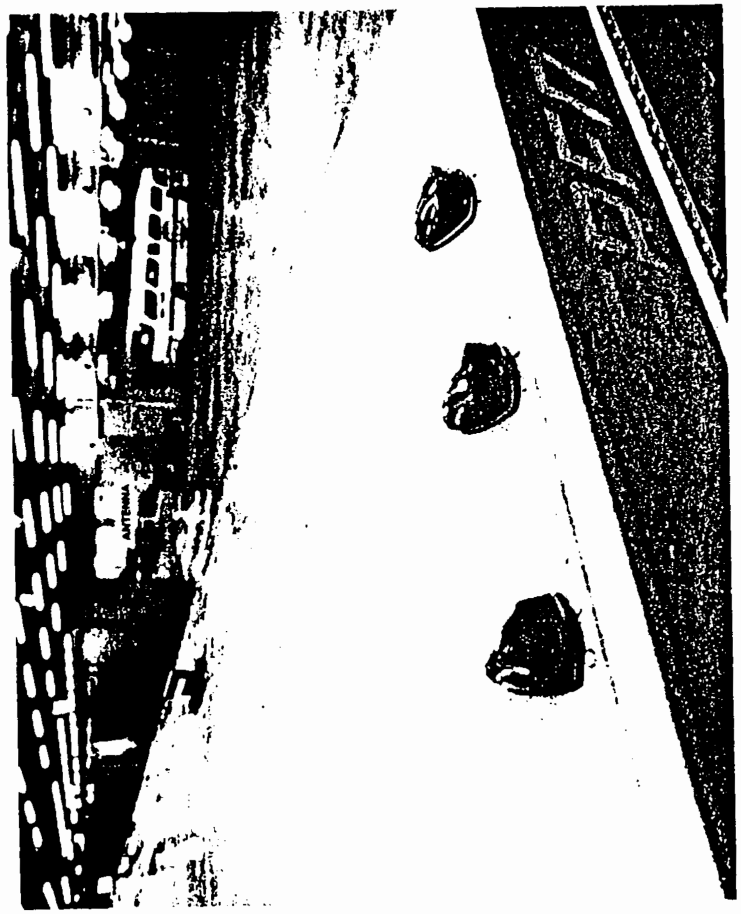
i) Passenger Counters

Installation (On some vehicles) - An assembly of two (2) infrared light transmitters and associated receivers in one housing plus accompanying reflectors. Dual horizontal light beams are transmitted across each door opening and are returned by opposing reflectors. The sequence by which the beams are broken determines whether a passenger is entering or leaving the vehicle. A complete installation (3 assemblies) is mounted adjacent to both the entrance door and each of the exit doors (see pages I-6B and I-6C).

Purpose - to count the number of patrons, entering and leaving vehicle. These counts are used for management reports and to indicate current vehicle loads to Supervisory Personnel.

ii) Microwave Sensor

Installation - a microwave receiver and bi-directional antenna mounted on the open side roof of bus, just behind the exit doors. The unit is enclosed in a weatherproof plastic dome.



F. Vehicle Sensor (Cont'd)

Purpose - to receive microwave signals from a fixed transmitter known as a sign post. When the vehicle passes the transmitter, the signal is a reference point for establishing the exact location of the vehicle and to correct information from the odometer sensor if necessary.

iii) Odometer Sensor

Installation - a magnetic switch that closes in response to the passage of 2 magnets installed 180° apart on the right front wheel. Each switch closure is monitored by the micro-processor.

Purpose - to count wheel revolutions. These are then converted into distance travelled.

iv) Door Sensor

Installation - a switch assembly installed in the door mechanism at the entrance and exit doors of the vehicle.

Purpose - to detect whether doors are open or closed. Door openings and closings are used to mark the start and finish of a passenger counting cycle and to update the Inspector's display.

v) Engine Sensor

Installation - a sensor switch installed in the alternator circuit of the vehicle.

Purpose - to detect if the vehicle is running. This data is used to automatically start up the TRUMP unit and to update the Inspector's display.

Section II

SECTION II

Vehicle Equipment - Operating Instructions

1. **START UP**

Starting up of the bus engine will also start up the TRUMP Unit.
TRUMP Unit will run for 30 minutes after bus engine is switched off.

2. **LOG ON**

Log on is the procedure whereby the Operator advises the central computer of his badge, route and run number (vehicle number is automatic).

Log on procedure will be carried out under the following conditions:

- prior to entering service from Garage
- when taking over bus on street
- when requested by the Control Centre
- when TRUMP unit has been reset

Note: The Silent Alarm and Yellow Emergency keys are the only keys which maintain their normal function during the log on procedure.

Log on requires the Operator to enter data in the following sequence.

a) Press "ID" (1) key on the keyboard to start the identity prompt sequence.

Press "NO" key
Display reads - "Badge is 00000"

Log On (Cont'd)

Enter the badge number by pressing appropriate numeric keys. The numbers will enter from the right of the five digit display. (Example - Operator enters badge #234, Display will read 00234).

If a wrong number is entered, press the "NO" key to restore the display to "00000". Re-enter the proper number. Press the "YES" key to acknowledge a correct entry.

TRUMP will ignore any badge number over 65530. Therefore, if a previous entry is displayed and a badge number change is necessary, or a wrong number is entered, press the "NO" key and the display will be restored to "00000".

b) Display now reads - "Route is 000" (or previous entry)

If display reads route number desired, press the "YES" key to acknowledge a correct entry.

If display reads "000", enter route number desired by pressing the proper numeric keys. Numbers will enter the three digit display from the right. (Example - Operator enters route #29, Display will read 029)

TRUMP will ignore any route number higher than 199. Therefore, if a previous entry is displayed and a route number change is necessary, or a wrong number is entered - press the "NO" key to restore display to "000". Enter route desired. Press "YES key to acknowledge a correct entry.

c) Display now reads - "Run is - "00" (or previous entry)

If display reads run number desired, press the "YES" key to acknowledge a correct entry.

If display reads "00" enter run number desired by pressing the proper numeric keys. Numbers will enter the two digit display from the right. (Example - Operator enters run #6, Display will read 06)

Log On (Cont'd)

TRUMP will ignore any run number higher than 99. Therefore, if a previous entry is displayed and a run number change is necessary, or a wrong number is entered, press the "NO" key to restore display to "00".

Enter run number desired. Press "YES" key to acknowledge a correct entry. This terminates the ID sequence and clears the keyboard and display for normal operations.

Completion of the ID sequence causes log on information to be transmitted to the central computer by TRUMP. Log on may be checked or corrected at any time by repeating the ID sequence.

3. LOG OFF

To log off, an Operator is required to restore badge, route and run numbers to zero. This is achieved by repeating the log on identity prompt sequence.

This log off information is transmitted to the central computer by the TRUMP unit on completion of sequence.

Log off procedure will only be carried out after the bus is parked in the Garage or Yard area.

4. DISPLAY SCREEN

The display is divided into five primary functions, as follows:

a) Schedule Deviation

Schedule deviation information is automatically displayed (in minutes) at the extreme left of the screen and is indicated by means of a plus (+) or minus (-) sign within a thirty-nine (39) minute range.

D-15

Display Screen (Cont'd)

b) Audio Mode

There are 3 modes which the TRUMP will operate in; RADIO, P.A. IN or HANGUP PHONE. These messages are displayed in a field to the right of the schedule deviation as follows:

"RADIO"
"P.A. IN"
or
"HANGUP PHONE"

The "HANGUP PHONE" will flash when Handset is off cradle and the push-to-talk button is not depressed for 3 minutes. A beep every second will warn the Operator of this condition. Returning the handset to its proper position will cancel this mode. The handset must be in the cradle when not in use, otherwise supervisory personnel will not be able to monitor a Silent Alarm condition.

c) Key Feed Back

Verification of the message key pressed is displayed in the central portion of the screen. The message displayed is a text representation of the key's legend. It will remain visible until the message displayed has been acknowledged by the central computer. (Exceptions are as explained in individual key descriptions.)

d) Time

Time is continuously displayed at the extreme right of the screen by a twelve (12) hour clock. The central computer sends time update messages automatically.

Note: In the event of loss of communication with the system for one minute or more, the time information display will disappear until communication is re-established.

Time (Cont'd)

e) Text Messages

Text messages use the entire screen for display purposes and can be up to thirty-two (32) characters long and will replace any existing display. When this occurs a beep is sounded every second until the message is acknowledged. Pushing the "YES" or "NO" key is the only procedure for acknowledging the text message and restoring the previous display.

5. THE KEYBOARD

The keyboard is a 16 button panel arranged in 4 rows of 4 keys. Ten of the keys are numbered from 0 to 9 and are used to enter numerical information, such as badge, route, and run numbers for log on.

The 1, 2, 4, 5, 8 and 9 keys are dual purpose and labelled as follows.

a) ID Key (Identification)

The #1 key is labelled "ID". It is used to initiate the identification prompt sequence. (See log on instructions, page 1, Section II)

b) Vehicle Traffic Key

The #2 key is labelled "VEH TRAFF". It is used to advise the Control Centre of heavy vehicular traffic. Verification of this message is displayed until the Operator cancels the message by pressing the "VEH TRAFF" button a second time.

Note: This information is displayed at the Control Centre only when requested by supervisory personnel.

c) Overtax Key

The #4 key is labelled "OVER TAX". It is used to advise the Control Centre that he cannot accommodate all potential passengers. This is displayed on TRUMP and remains until the central computer acknowledges the message

The Keyboard (Cont'd)

d) Mechanical Trouble Key

The #5 key is labelled with a graphic of a wrench. It is used to advise the Control Centre of mechanical trouble. This is displayed on TRUMP and remains until the central computer acknowledges the message.

Note: Supervisory personnel will respond to this key message as soon as possible and in order of priority.

e) Fare Dispute Key

The #8 key is labelled "FARE DISP." It is used to advise the Control Centre of a fare dispute which the Operator cannot resolve. This is displayed on TRUMP and remains until the central computer acknowledges the message.

Note: Supervisory personnel will respond to this key message as soon as possible and in order of priority.

f) Talk Key

The #9 key is labelled "TALK". It is used to advise the Control Centre that the Operator requires voice communication. This is displayed on TRUMP and remains until the central computer acknowledges the message.

Note: Supervisory personnel will respond to this key message as soon as possible and in order of priority.

There are four single function message keys as follows:

i) Yellow Emergency

The Yellow Emergency key is yellow and is labelled "EMERG". It is used to report any serious emergency such as collision, fire or any other emergency not covered by a predetermined message key. This key is only pressed when voice communication is possible. This is displayed on TRUMP and remains until the message is acknowledged by the central computer.

Keyboard (Cont'd)

Note: A Yellow Emergency message will receive a high priority response from supervisory personnel.

ii) Silent Alarm Key

The Silent Alarm Key is red and is not labelled. This key is only used to report that criminal action is taking place on or near the vehicle and the Operator is not in a position to communicate. This key discreetly advises the Control

Centre of a Police Emergency situation. Acknowledgement by the central computer is the appearance of a single asterisk (*) displayed in the leftmost character position.

Note: A Silent Alarm message receives a top priority response from supervisory personnel. The Police will be despatched immediately to the location of the vehicle. No conversation with the vehicle will take place. There is no means of cancelling a Silent Alarm once it is initiated. Supervisory personnel have the option (only under the Silent Alarm condition) of activating the boom mike to listen in without indication on the bus, or to send a text message which will be displayed in the usual manner.

iii) Yes Key

The "YES" key is orange and is labelled "YES". It is used to acknowledge receipt of a text message, if appropriate. Pressing the "YES" key clears the Operator's display to restore normal operations. This is displayed on TRUMP and remains until acknowledged by the central computer. The "YES" key is also used in the Log On sequence.

Note: This information is displayed at the Control Centre only when requested by supervisory personnel.

Keyboard (Cont'd)

iv) No Key

The "NO" key is orange and is labelled "NO". It is used to acknowledge receipt of a text message, if appropriate. Pressing the "NO" key clears the Operator's display to restore normal operations. This is displayed on TRUMP and remains until acknowledged by the central computer. The "NO" is also used in the Log On sequence.

Note: This information is displayed at the Control Centre only when requested by supervisory personnel.

The two remaining keys are for local control of the P.A. system as follows:

a) External P.A. Key

The External P.A. key is labelled "OUT" with a graphic of a speaker. This key is presently non-functional.

b) Internal P.A. Key

The Internal P.A. key is labelled "IN" with a graphic of a speaker. This key activates the P.A. mode to internal for use inside the vehicle. No indication that this key has been pressed is sent to the central computer.

6. THE RADIO

The radio permits voice communication between the vehicle (Operator) and the Control Centre. The Operator can only request radio communication. The radio can only be switched on by supervisory personnel in the Control Centre.

The Radio (Cont'd)

Radio mode is initiated by supervisory personnel and activates a boom microphone close to the Operator. This permits hands-free voice communication. The selected mode is verified on the Operator's display by the word "Radio". The boom microphone cannot be used for internal P.A. announcements or for Radio communication between supervisory personnel and a group of vehicles.

The Operator has the option of using the handset. The boom microphone and the TRUMP Unit speaker are automatically disconnected when the handset is removed from the bracket.

7. P.A. MODE

Internal P.A. Modes

To activate the Internal P.A. system:

a) Remove the handset from bracket.
b) Press the "P.A. IN" key.
c) Depress and hold the push-to-talk button until the P.A. announcement has been completed. It is important to speak slowly and clearly when using the P.A. mode.

Note: While P.T.T. button is depressed, "P.A. IN" will be displayed on TRUMP.

d) Replacing the handset in the bracket when finished cancels the P.A. Mode.

The internal P.A. system is also available to the supervisory personnel at the Control Centre.

Note: It is essential that the Operator replace the handset in the bracket in its normal fashion. If not, supervisory personnel will be unable to monitor a Silent Alarm condition. To ensure Operator security, the TRUMP will beep every second if the handset is not seated properly for periods longer than 3 minutes.

8. TEXT MESSAGES

Text messages are normally initiated by supervisory personnel and replace any existing display on the Operator's screen (including schedule deviation and time display). Messages can be up to thirty-two (32) characters in length and are accompanied by a beep every second until acknowledged. The Operator responds to a text message as follows:

a) If the message is in the form of a query the Operator will acknowledge by pushing the appropriate "YES" or "NO" key.

b) If the message provides information only, a "YES" key push should be used to acknowledge receipt.

Note: "YES" or "NO" key pushes are the only keys that will clear the display, silence the beeping and restore normal operations.

9. VOLUME CONTROL

The volume control knob is located on the front panel of the TRUMP Unit. It adjusts the volume of the TRUMP speaker only. A minimum volume level is predetermined, therefore, the volume cannot be turned entirely off.

10. RESET BUTTON

A reset button is located at the rear of the TRUMP Unit under the power supply connector. The reset button is only to be used when:

- there has been an apparent loss of data communication for more than five (5) minutes
- when unit is producing annoying noises
- or on instruction from supervisory personnel.

Using the reset button will require the Operator to repeat the log on procedure when communication is re-established.

Section III

SECTION III

Messages To/From Vehicle

1. TRUMP AUTOMATIC MESSAGES

TRUMP automatic messages are the result of data produced by sensors on the vehicle. The sensors are continually monitored by TRUMP which processes and automatically transmits the information to the central computer.

Information for TRUMP automatic messages is obtained from five sensors as follows:

a) The odometer sensor generates magnetic impulses which are produced by two magnets mounted on the right front wheel of the vehicle. TRUMP automatically sends this data to the central computer on every poll.

b) The passenger count sensor reads the number of passengers entering and leaving the vehicle as they pass through two infrared light beams. These counts are stored in TRUMP and automatically transmitted to the central computer on the next poll after the doors are closed.

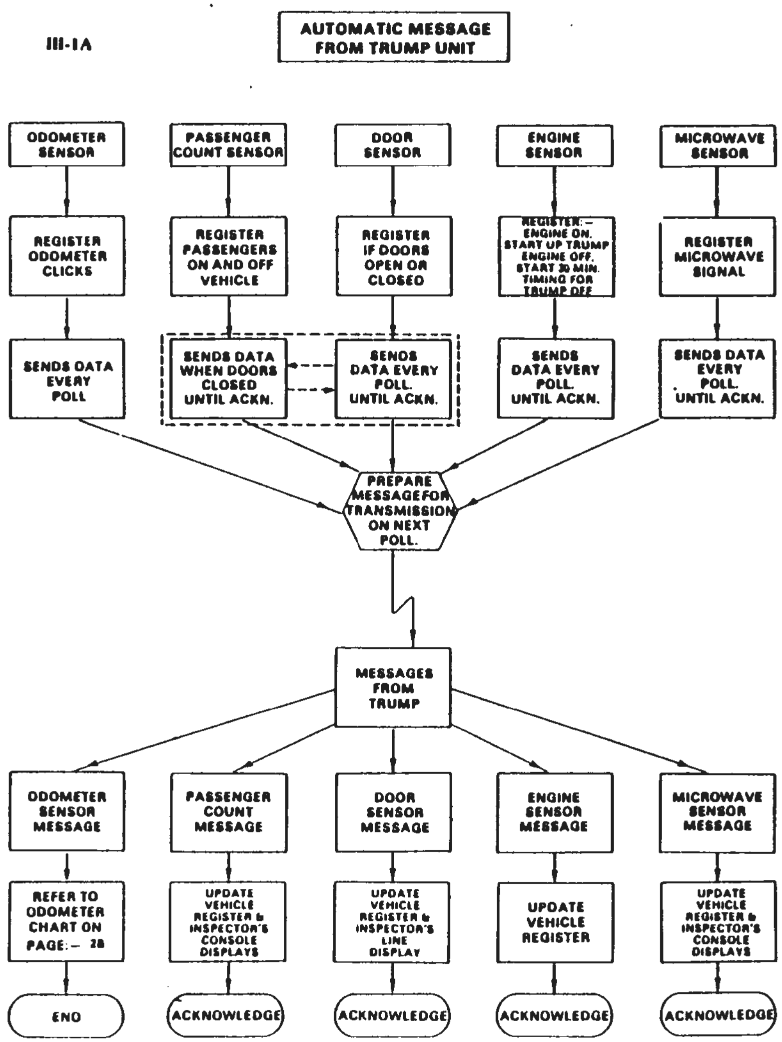
c) The door sensor detects whether doors are open or closed. This data is stored in the TRUMP and automatically transmitted to the central computer on every poll.

d) The engine sensor reads whether the engine is on or off. If the engine is on, the TRUMP Unit is started up. If the engine is turned off, the TRUMP Unit shuts off after 30 minutes. This data is stored in TRUMP for automatic transmission to the central computer on every poll.

e) The microwave sensor reads a microwave signal from a fixed signpost. The data is stored in TRUMP and automatically transmitted to the central computer until acknowledged. This data is used by the central computer for position reference.

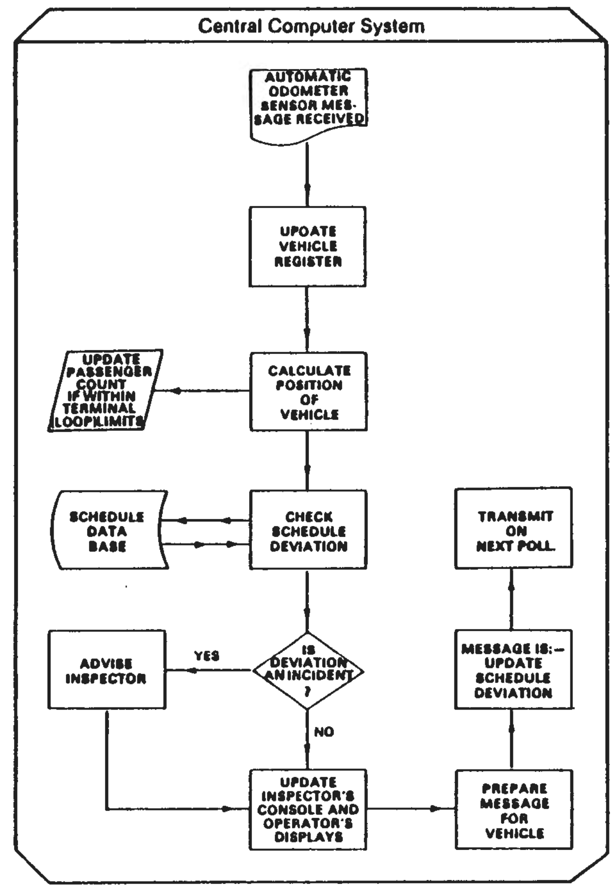
See flow chart of Automatic Message from TRUMP Unit on pages III-1A and III-1B.

III-1A



III-1B

ODOMETER SENSOR MESSAGE



2. DRIVER ORIGINATED MESSAGES

Driver originated messages are keyboard messages transmitted by TRUMP to the central computer.

When a message key is pushed, TRUMP determines the type of message (there are four types) and proceeds as follows:

a) Message Type #1 - Silent Alarm

TRUMP immediately prepares a message for transmission to the central computer on the next poll. On receipt of the message, the central computer updates the vehicle register and Inspector's console displays. An automatic acknowledgment from the central computer is displayed as an asterisk on TRUMP and the radio speaker is turned off.

b) Message Type #2 - Incident

TRUMP generates a beep signal and produces a verification message on the Operator's display. A message is also sent to the central computer on the next poll. The central computer uses the data to update the vehicle register and Inspector's console display. An automatic acknowledgment is generated, which in this instance cancels the Operator's display.

c) Message Type #3 - Status - Vehicle Traffic

The TRUMP Unit first determines if the Veh Traff condition is already in effect. If it is, a beep tone is generated and the Operator's display is cancelled. If it is not, a beep tone is generated and the verification message "VEH TRAFF" is displayed on TRUMP. In both instances a low priority message is sent to the central computer. The central computer uses the data to update the vehicle register and the vehicle display.

d) Message Type #4 - Log On

On completion of the ID sequence, log on data is transmitted to the central computer. Data is used to update vehicle register and Inspector's console display. There is no response to correct data. Incorrect route data will generate a text message to Operator - "PLEASE CHECK LOG ON".

See flow charts on pages III-3A and III-3B.

3. SYSTEM AUTOMATIC MESSAGES

System automatic messages are generated within the central computer system. The primary message is the Vehicle Interrogation Poll which is sent to each vehicle approximately every six seconds. The internal message structure of the poll can, in addition, contain a number of messages or instructions as follows:

a) Acknowledgment messages in response to TRUMP Automatic Messages.

b) Schedule Deviation messages in response to data received from the Odometer and Microwave sensors, after comparison with schedule data base.

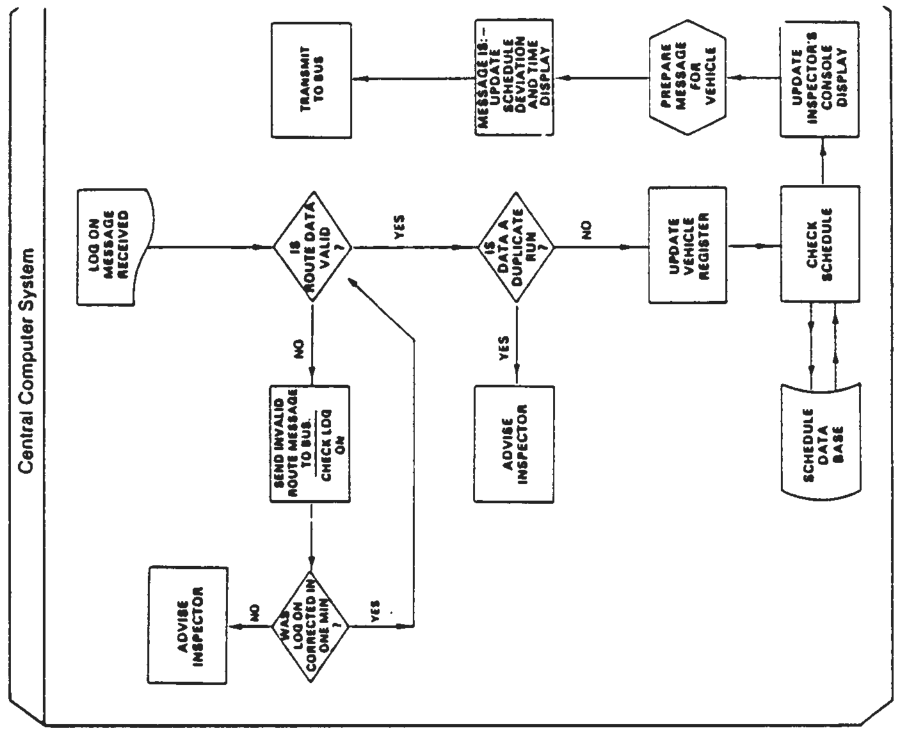
c) Acknowledgment of Driver Originated Messages, including appropriate instructions.

d) Time Display message which is transmitted approximately every 5 minutes to ensure that TRUMP time is synchronized with the Transit Control master clock.

e) Invalid Log On message is a text message generated in response to any Log On which includes an invalid route number. The text message reads, "Please Check Log On".

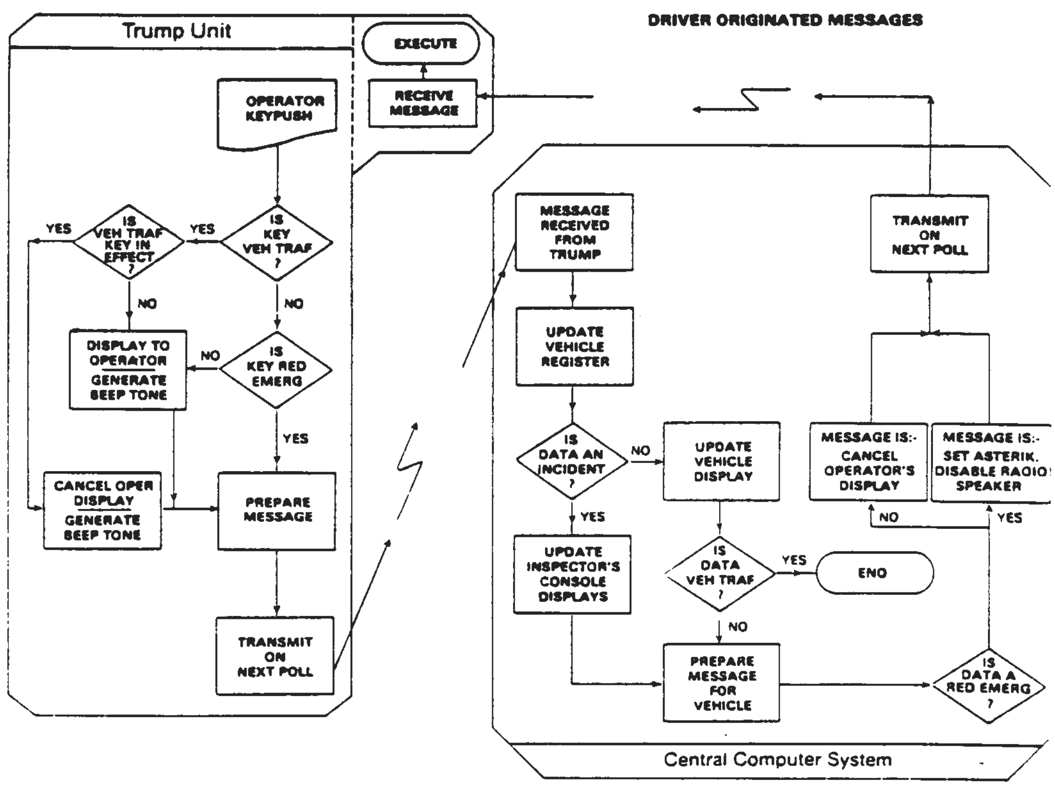
III-3B

LOG ON MESSAGE



III-3A

DRIVER ORIGINATED MESSAGES



4. INSTRUCTIONS FROM SUPERVISORY PERSONNEL

When necessary, supervisory personnel will send instructions in the form of text messages to a vehicle or vehicles. The TRUMP display screen is limited to thirty-two (32) character positions and therefore, abbreviations may be used.

The most frequently used messages are listed below as they appear on the TRUMP display, with accompanying explanations.

1) SHORT-TURN MESSAGES

Example (1a)

TURN AT EGLINTON OUT AT 11:45

Explanation:
Short-turn on arrival at Eglinton Avenue via the usual short-turn routing. Proceed in the reverse direction at 11:45.

Example (1b)

TURN AT EGLINTON OUT AT NOTICE

Explanation:
Short-turn on arrival at Eglinton Avenue via the usual short-turn routing. Do not proceed in reverse direction until further notice from supervisory personnel.

2) HOLD MESSAGES

Example (2a)

HOLD AT EGLINTON MEET 7744

Explanation:
On arrival at Eglinton Avenue, hold until you have connected with Bus #7744. Route and run number or just route number may be used instead of the vehicle number.

Example (2b)

HOLD AT EGLINTON UNTIL NOTICE

Explanation:
Hold on arrival at Eglinton Avenue. Do not proceed until further notice from Wilson Base Inspector.

Example (2c)

HOLD AT EGLINTON UNTIL 09:30

Explanation:
Hold on arrival at Eglinton Avenue. Do not proceed until 09:30.

3) RUN SHARP MESSAGE - RUN LATE MESSAGE

To space service, it will sometimes be necessary for the Inspector to instruct a vehicle to run sharp or late. The following examples are self explanatory.

Example (3a)

RUN SHARP BY 03 MINUTES

Example (3b)

RUN LATE BY 03 MINUTES

4) RUN EXPRESS MESSAGE

Example

EXPRESS FINCH TO SHEPPARD

Explanation:
Change destination sign to Garage and operate express (non passenger carrying) from Finch Terminal to Sheppard.

D-24

5) CHANGEOVER MESSAGE

Example

RUNS 14:19 CHANGEOVER LAWRENCE

Explanation:
Runs 14 and 19 will meet at Lawrence (approximately) and Operators will changeover their vehicles. This procedure is used to place runs on time and in place without having to short-turn vehicles. Operators must log on and change run numbers on the new vehicles.

C.I.S. GLOSSARY

CONTROL CENTRE	- Divisional C.I.S. Control Centre or Transit Control Centre depending on time of day.
HARDWARE	- Physical equipment as opposed to the program or method of use (e.g. an electronic device).
HOLD	- Stay.
INSPECTOR'S DISPLAY	- Data which is displayed on the screen(s) of the Inspector's Console.
LOG ON	- To enter Badge No., Route No., Run No. (i.e. identity) into TRUMP Unit.
LOG OFF	- To delete identity from TRUMP unit by setting Badge No., Route No. and Run No. to zero.
MONITOR	- Software or hardware that observes, supervises, controls or verifies the operaton of a system.
MODE	- Method of doing e.g.:
DATA MODE	- Digital Information Transmission.
VOICE MODE	- Voice Transmission.
I.D. MODE	- For entering numeric data into TRUMP Unit.
P.A. MODE	- By public address.
RADIO MODE	- Pubic radio mode using vehicle boom microphone, private radio mode using vehicle handset.

C.I.S. Glossary (Cont'd)

OPERATORS' DISPLAY	- Data displayed on screen of TRUMP Unit.
POLL	- A computer command to communicate between the base system and a (C.I.S.) vehicle.
P.T.T.	- Push to talk button on vehicle radio handset.
REGISTER	- (Record) a section in the computer memory capable of storing a specified amount of data.
SIGNPOST	- Fixed microwave transmitter sending a continuous signal picked up by a vehicle sensor for position purposes.
SOFTWARE	- A set of programs, rules and procedures used for the operation of a data processing system.

TORONTO TRANSIT COMMISSION

COMMUNICATIONS AND INFORMATION SYSTEM

Appendix E

COMMUNICATIONS AND INFORMATION SYSTEM

A JOINT PROJECT OF
THE TORONTO TRANSIT COMMISSION
AND THE PROVINCE OF ONTARIO.

Ontario

TORONTO TRANSIT COMMISSION COMMUNICATIONS AND INFORMATION SYSTEM (C.I.S.)

The Communications and Information System project concept and its design specifications are the result of a study approved by the Toronto Transit Commission in 1973 and carried out by a special study team of TTC staff, consultants and representatives of the Ontario Ministry of Transportation and Communications and the Municipality of Metropolitan Toronto during 1973 and 1974.

C.I.S. is a joint project of the TTC and the Province of Ontario. Provincial participation and funding is part of the government's program to assist public transit.

BACKGROUND

Following an analysis of existing TTC methods of communications and control and a selective study of several TTC surface routes, the study team made world-wide inspection trips to cities which are involved in the development and use of various types of automatic vehicle communication systems. After evaluating all aspects of each system, the study team concluded that if the TTC is to maintain and improve transit service in the future and effectively anticipate and respond to the increasing demands being placed on its services, the existing communications and information system should be improved to more effectively carry out the following control strategies:

Route Supervision — early detection of variations from schedules and effective implementation of corrective action to lessen the bunching and overloading of vehicles as well as more reliable and consistent schedule adherence;

Emergency Handling — immediate notification of emergencies, ready dispatch of assistance and effective restoration of service;

Dynamic Scheduling — collecting and processing of continuous data on passenger movements on each surface vehicle for faster and more responsive scheduling as well as more effective allocation of vehicles and manpower;

Management Reporting — automatic recording of events and preparation of management reports;

Passenger Information — processing of real-time service information for the benefits of passengers who phone in who are waiting at major bus stops as well as provision of more effective ticketing and marketing information;

Traffic Signal Priority — transmission of transit vehicle locations, running times and passenger loadings to provide both on-line and off-line interfaces with the Metropolitan Toronto Traffic Signal Computer Control System, allowing the eventual provision of signal priority for transit vehicles.

DEVELOPMENT

The study team reviewed in detail the types and costs of equipment available for the recommended system and concluded that if the features of the planned TTC system were to be achieved in the most cost-effective manner, improvements were required in available hardware and technology. Based on the consultants' recommendations, it was decided to use the most advanced computing and communications elements for the on-vehicle and control station installations. This approach resulted in the combination of all on-vehicle data handling and logic functions into a single and compact unit called TRUMP — TRANSIT UNIVERSAL MICRO-PROCESSOR.

Development of the TRUMP concept and related computer, electronic and radio components was carried out during 1974 and 1975 by TTC staff and its consultants. The system, which included automatic tracking/vehicle location, two-way data and voice radio communications and driver keyboard/display units allowing transmission of pre-coded messages, was successfully demonstrated on a test route. Work was also carried out on the development of on-board, automatic passenger counters which record the number of boarding and alighting passengers.

Based on the success of these tests, approval was given by the Commission for a pilot project based at TTC's Wilson Division. This phase of the project involved the establishment of a C.I.S. Control Centre at Wilson and equipping 100 surface vehicles for operation on six routes; Dufferin, Sheppard West, Finch West, Wilson Heights, Faywood and Senlac. C.I.S. equipment was also installed in one supervisory cab. The pilot project was completed in the early part of 1980.

In order to gain additional experience in the operation of this system, it was decided to equip all Wilson Division routes — over 260 vehicles (Phase VI). This system became operational in the fall of 1984. Work is now being carried out to determine how the balance of the Commission's surface fleet should be equipped with C.I.S.

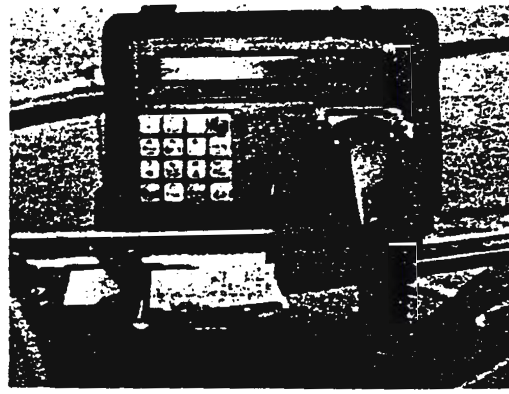
MARK I — TRUMP

The very first prototype of vehicle equipment for the C.I.S. Project was handbuilt and very large. This was necessary to facilitate testing and debugging. The large open box contained the microcomputer (TRUMP), power supplies, est switches and cable terminations. The two-way UHF radio is seen at the top left corner. Also included was an 8-light display unit (on he dash), a 16-button keyboard unit (in front of he Operator's knee) and a hand-held nicrophone.

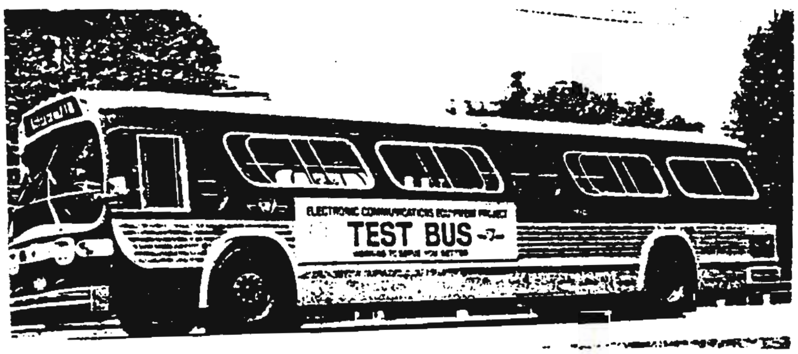
MARK II — TRUMP

The vehicle equipment used for the ten-vehicle test was much more compact. The radio, power supply, TRUMP and cable terminations were all mounted above and behind the Operator's area. This section was closed in with a moulded cover to blend in with the decor of the vehicle. The 16-button keyboard and console is shown to the right of the Operator's area. This particular installation tested a handset (similar to that on a telephone) instead of a hand microphone and speaker.

MARK III — TRUMP

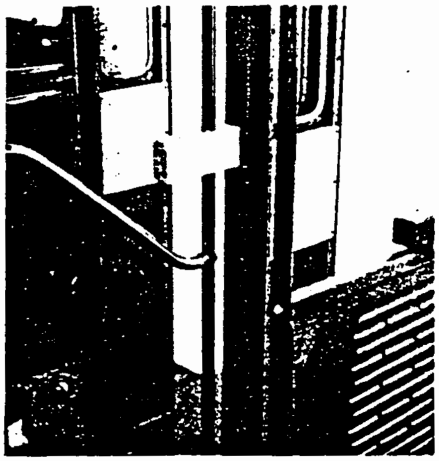


The vehicle equipment used for Phase V (the 100 bus test) greatly reduced in size. This one package contains the m computer (TRUMP), the two-way radio, power supplies, a character alpha/numeric display, the driver's keyboard and a phone type handset. This compact approach greatly reduced the of packaging and installation. Also included on the vehicle a boom microphone (for hands-free operation), internal and exte P.A. systems, a passenger counter at each stairwell, an odom sensor for continual location information and a signpost receive exact "location fixes". Phase VI TRUMPS, although functionally ic tical, are slightly smaller.



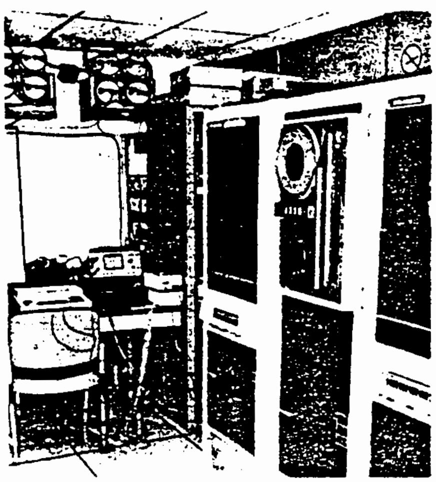
is Test Bus was the TTC's mobile laboratory for developing reliable and economical components r the Communications and Information System. A micro-computer on board connects passenger unters, driver console and location device to a radio system to provide continuous information of hicle location and status to the control centre and to provide the driver with special messages. vo-way voice radio communication between the control centre and the bus driver is provided. owever, well over 90% of all radio transmission is digital.

A typically congested Toronto street, one of the reasons for C.I.S.

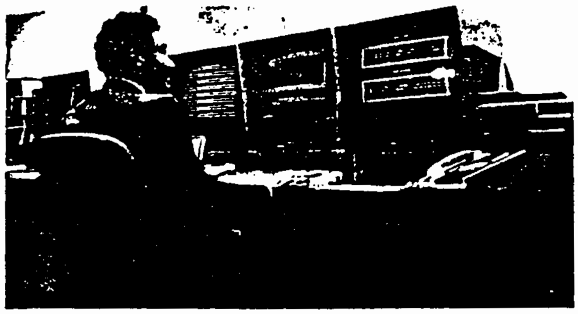


Another very important part of C.I.S. is the use of passenger counters, one at each of the three stairwells on each vehicle. Infra-red passenger counters, as shown, were used in phase V. Treadle mat type counters are presently being tested.

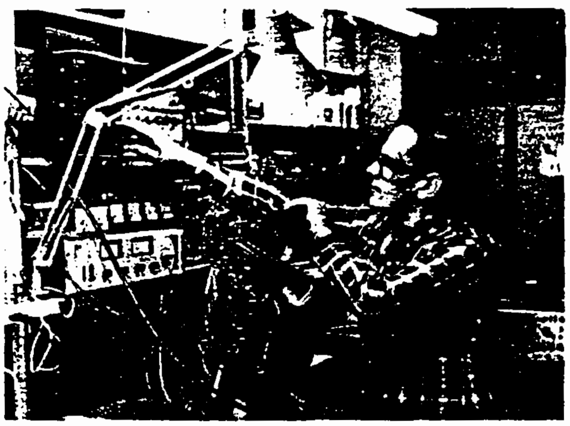
Passenger loading is essential information for the Inspector to make real-time decisions.



he C.I.S. computers are housed in a room adjacent) the control centre Two Data General Nova 3D omputers are currently in use Part of the radio base tation equipment can be seen in the top background

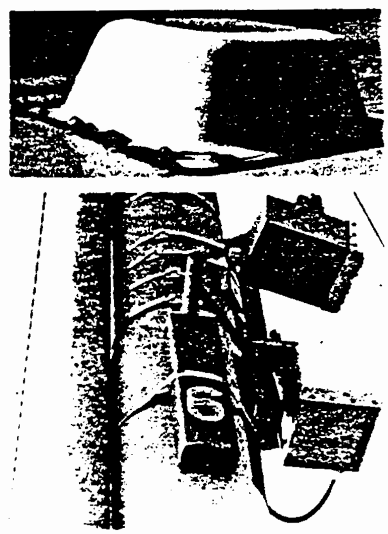


C.I.S. Control Centre at the Wilson Garage has three full inspector's consoles. Each console has three C.R.T. displays for monitoring routes and for dialogue with the computers. The left and right screens are used for detailed displays selected by the Inspector and the centre screen shows an updated list of problem areas as well as written reminders for the inspector. The console keyboard has a number of specially coded buttons specific to C.I.S. operations plus a typewriter keyboard for sending text messages to the vehicle or for filling out forms. In addition, the Inspector has full control of voice channels from the console.



The C.I.S. radio room is also located near the control centre. Since the Operator's console has a self-diagnostic capability, it is expected on-board repairs will be minimal. The mechanic simply unplugs the unit, replacing it with a spare unit. The defective console then comes to this room for repair.

Many low powered communications sites chosen rather than one high-powered one : localized coverage eliminates poor reception Low power enables the same frequencies to b a short distance away. This radio antenna is i at Wilson Division, the site of C.I.S.



About 40 sign posts (microwave transmitter located at strategic locations along C.I.S. route at terminal points to determine vehicle position transmitter transmits a unique identification which is picked up by the microwave receiver (vehicle and fed to the on-board TRUMP unit wh turn transmits this information to the central ce ter on the next polling cycle. The top picture s the receiver in its plastic bubble on top of the :

Vehicle Tracking System Specifications

Appendix F

AE. VEHICLE TRACKING, STATUS, AND OPERATOR SAFETY SYSTEM

AE.1 General

It is the intent of these specifications to describe a Vehicle Tracking System (VTS) with additions to improve operator safety and to show vehicle status. The details included herein define the minimum acceptable performance levels necessary to assure dependability, longevity, and the functional characteristics required of a VTS.

AE.2 Purpose

The system described in these specifications will (1) provide continuous vehicle tracking, (2) enable each operator to send a silent alarm to headquarters, (3) show unit status. These added capabilities will provide the ability to coordinate the movement of all on-duty vehicles. To achieve these results the system must provide a graphic display of a variety of user-selected maps which will show a symbol for each unit selected for tracking at its actual locations. It must also indicate the status of each unit on the same display, i.e., in service, busy, out-of-service, etc.

AE.3 System Requirements

A.E.3.1 Fixed End Equipment

The system shall include fixed end equipment capable of supporting multiple dispatch positions.

A.E.3.2 Mobile Units

The system shall include fixed end and mobile equipment compatible with existing radio.

A.E.3.3 Base Stations

The system shall include equipment capable of interfacing with existing base stations. Base station VTS equipment should be capable of 12 VDC operation in the event mobile operation is required.

SPECIFICATIONS

Vehicle Transponder (Model VTS 202):

Power Input: 6.5 to 48 VDC (10 watts nominal).

Size: Height 2", Width 6 3/8", Depth 10 1/4".

Weight: 4 Pounds.

Time to Track: 2 Minutes Nominal.

Track Speed: 600 Knots.

Position Update: 0.5 Seconds

Position Repeatability: .01 Nautical Mile (60 Feet).

Operating Temperature: -15°C to +55°C.

Operating Humidity: 95% at 50°C.

Data Output: FSK Data Format at 300 Baud.

Control Console (Model VTS 204):

Power Input: 117VAC (130 watts nominal) 12V DC Optional.

Outputs: RGB Video for High Resolution Monitor.

RS-232 for Printer 9600 Baud.

Communication Link Input/Output:

FSK Data Format at 300 Baud Poled Sequence (Selectable from Front Panel)

Hold to 1 Second

Custom Map:

Typically may exceed 4,000 Streets Area Covered 360 Miles x 360 Miles.

Up to 64 Landmarks may be included.

Size: Height 5 3/4", Width 17·1/8", Depth 20".

Weight: 12 Pounds.

High Resolution Color Monitor, 19" (Model VTS 208-19):

Power Input: 117VAC (200 watts nominal).

Input: R.G.B. Video.

Size: Height 15", Width 19", Depth 21".

Weight: 88 Pounds.

Resolution: .31mm Dot Triad Pitch (Dots - 1,280 x 1,024).

Video Bandwidth: 40 Mhz.

High Resolution Color Monitor, 14: (Model VTS 208-14):

Power Input: 117VAC (130 watts nominal).

Input: R.G.B. Video.

Size: Height 11", Width 13 3/4", Depth 18".

Weight: 39.6 Pounds.

Resolution: .31mm Dot Triad Pitch (Dots - 1,280 x 1,024).

Video Bandwidth: 40 Mhz.

A.E.3.4 Silent Alarm

Each mobile unit is to be supplied with an emergency alarm switch that, when activated, sends the units ID number and the closest units available to respond, the assistance of the involved unit will be shown on the video map display. There is

to be no audible or visual indication within the
that the emergency switch has been activated. Cap
exist to activate the emergency alarm switch even
mobile radio is turned off.

A.E.3.5 Display Terminal

Each dispatch position is to be supplied with a high resolution video screen capable of displaying the vehicle location and status information. Provisions are to be included that will enable the dispatcher to select any map and any unit to be tracked on a given video, regardless of which RF channel the units are assigned to. Each video display is to be available in at least 4 different colors. Information such as status, emergency, signal, viability, and other customer selected concerns is to be utilized as criteria for color of display.

A.E.3.6 Power Requirements

The VTS mobile unit must draw no more than 10 milliamps from a vehicular 12V DC system when the unit is turned off.

AE.4 Service Manuals

A minimum of 3 printed service manuals must be provided for the complete system. This will include all circuit boards, mechanical drawings of parts and interconnections that will be required for service or replacement parts that may be required for future service.

AE.5 Warranty - Maintenance

All components of the Vehicle Tracking System shall be warranted for one year of normal use. Exchange program shall be available for mobile units and maintenance of fixed end equipment shall be done at the factory or site by contractor technicians. Contract maintenance will be available after warranty expiration.

A.E.5.1 Data Tones

Provisions must be made to assure that all non-VTS equipped mobiles, portables, and all dispatch consoles operating on the same RF channels do not hear the VTS data bursts. Non-VTS units must have tone squelch control.

A.E.5.2 Map Displays

Maps will be made from city provided surveyed sources, or from USGS maps. Exact map requirements will be defined by the customer, but a menu of no more than 25 maps of ever-increasing detail will be required beginning with an area approximately 20 to 60 miles showing principal roadways in the city and in adjacent cities, graduated down to some areas of 8 square miles or less. Map selection will be available at the option of the dispatcher and "zoom-in" (magnification) of desired section of any map is required. In addition to map display, units being tracked should be listed in a track table showing distance North/South East/West from certain major landmarks.

A.E.5.3 Data Port

The VTS fixed end computer is to be equipped with an RS-232 port to be utilized by the customer. This data port will provide real time vehicle location and status information that can be used for further processing or displaying of available data.

A.E.5.4 Unit ID

Each unit must have its own code designator so that separate identification is accomplished on the map display. A minimum of 150 unit ID's is required.

A.E.5.5. Polling Times

The VTS is to utilize existing voice radio channels. It is therefore essential that the amount of air time utilized for polling be limited. The amount of air time utilized for polling is to be adjustable from 10% to 80% of channel time. A typical poll should require less than 1.5 seconds of air time to poll a unit and receive a response.

A.E.5.6 Status Message

Each mobile unit shall have the capability of transmitting 8 user defined status messages at the driver's discretion. The status messages are to be shown to the dispatcher on the same video map display as the VTS information.

DATA GROUP: LATITUDE/LONGITUDE

Character	Definition	Value
1	Start Character	"#"
2	Lat/Long Char.	'L'
3	Space	20H
4	Hemisphere	'N'
5	LAT. DEG. MSD	3-
6	" " LSD	3-
7	LAT. MIN. MSD	3-
8	" " "	3-
9	" " "	3-
10	" " LSD	3-
11	Space	20H
12	Hemisphere	'W'
13	LONG. DEG. MSD	3-
14	" " "	3-
15	" " "	3-
16	LON. MIN. MSD	3-
17	" " "	3-
18	" " "	3-
19	" " LSD	3-
20	(CR)	ØDH

II MORROW, INC.

APOLLO Serial Data Output Speceification

PRELIMINARY

Electrical Format:

RS-232C

Logic 1 = 0 VOLTS

Logic 0 = +5 VOLTS

Data Format:

Asynchronous, 1200 Baud

1 Start Bit

7 Data Bits

1 Parity Bit - ODD

1 Stop Bit

Conforms to Standard UART Data Format

(INTEL 8251, MOTOROLA MC6850)

Data is formatted into various groups (e.g., Lat/Lon, SNR). Each data group is formatted by a control character followed by the data. Data is generally transmitted in ASCII format.

DATA GROUP: SNR VALUES

Character	Definition	Value
1	Start Character	"#"
2	SNR Character	'S'
3	Space	20H
4	Master Identifier	'M'
5	Master SNR MSD	3-
6	" " "	3-
7	" " LSD	3-
8	Space	20H
9	Slave Identifier	'A'
10	Slave SNR MSD	3-
11	" " "	3-
12	" " LSD	3-
13	Space	20H
14	Slave Identifier	'B'
15	Slave SNR MSD	3-
16	" " "	3-
17	" " LSD	3-
18	(CR)	ØDH

DATA GROUP: SIGNAL TRACKING STATUS

Character	Definition	Value
1	Start Character	"#"
2	Status Character	'C'
3	Space	20H
4	Status Word	(D7: Ø
		(D6: Ø
		(D5: Ø
		(D4: M
		(D3: W
		(D2: X
		(D1: Y
		(D0: Z
		ØDH

NOTE: M, W, X, Y, Z, Bits are set according to tracking status for the selected triad. If the MWX triad is selected, then only M. W, and X status bits are defined. For the bits used, "Ø" implies tracking status, "1" implies non-tracking status.

Emergency Alarm

Draft Training Film Script

Appendix G

DRAFT SCRIPT

Transit Operator-Officer Relations #2

"Calls for Police Assistance"

Voice Over	"Trouble; it comes in all sizes and forms, ranging from a passenger who has fallen into a deep sleep on your bus to violence directed against another passenger or against you".
Scene	Operator noticing a sleeper, METRO Officer awakens sleeper, sees that everything is alright... scene fades out.
Scene	Shot opens with 2 passengers having a heated argument with violent threats being exchanged. One of the passengers tells the operator to keep away from his radio and not get involved. Operator shown sending alarm... scene fades to shot of show host.

Training Officer

(Standing between bus and patrol car facing camera) Hello, I am ______________ Training Officer for your METRO Transit Police Department. We are going to take a few minutes of your time to examine the relationship of METRO Police Officers and Operators in dealing with troublesome transit users.

*METRO takes the safety of its personnel and patrons seriously. The Transit Police Department is dedicated to the safety and security of the system. Utilizing a modern communications system the METRO team works together to insure your safety while on the job. One of the key elements in the safety network is the Emergency Alarm System installed throughout our bus fleet.

*Each time an emergency alarm is activated on a METRO bus the operator is saying "My life or the life of another is in danger."!
For the emergency alarm system to be effective it must be taken seriously by both bus operator and police officer. False and inappropriate alarms increase the risk to both operator and police officer in the same manner as the story of the boy who cried "Wolf!" when there was no wolf.

In a typical year transportation dispatchers have to deal with over 2000 emergency alarms, 90% of which are either false or malfunctions. With a 98% reliability factor for the alarm hardware, human error accounts for the majority of the alarm system problems.

*Activate the Emergency Alarm System ONLY when you are in an emergency situation and cannot safely use your radio to talk to the dispatcher and explain your problem. The alarm is designed for the protection of the operator and should be used only for such situations as assault, robbery, rape and other serious crimes which cannot be communicated by the normal radio system.

*Using the Emergency Alarm System renders you "deaf and dumb" for radio communications.

When the system is activated the transportation dispatcher will respond by announcing the following on your bus only:

1. Time of day
2. Day and date

Example: "Good morning, thank you for riding METRO. The time is now 9:35 a.m. Thursday, March 18th".

When you hear this announcement you will know that YOUR emergency has been received.

*If you do not have an emergency or if the emergency has changed and you can now use your radio you should immediately do the following:

1. Push "Priority" button.
2. Notify the dispatcher of your situation.

By using the Emergency Alarm System responsibly you can help keep the METRO system safe for all.

*Misuse of the system can cause delays in addressing your problem and may result in disciplinary action being taken.

Thankfully, most problems are minor and are dealt with quickly with a minimum of inconvenience to all concerned. Let's take a look at two trouble calls from our case files and see how Operators and Officers interact and clear up some misunderstandings.

Scene	Bus interior, host standing beside the drivers seat.
Training Officer	A call for assistance will originate here. The Operator will determine if the call is life threatening, in which case the emergency alarm will be activated. If the incident is of a lesser nature then the operator will use his request to talk procedures on his radio. Let's go along as a typical call for service unfolds.

Scene	Bus driving along a route. Exterior
Scene	Interior of bus as passenger in the rear is lighting a cigarette. Operator advises the passenger of no smoking rules, but gets no response. Operator calls for assistance through the Communications Center (shot moves to the dispatcher's console as call comes on screen).
Dispatcher	Observes trouble call, answers call and passes information to Police Dispatcher. Police Department puts call out to zone officer.
Scene	METRO Police car parked along route. Officer is standing beside car with a bus pulling away in the background. Officer seen receiving the call indicating nature of call and location to intercept the bus. Car pulls away. Cut to car arriving at bus stop and awaiting arrival of bus. As bus arrives officer greets the operator and get a rundown on the complaint. Officer addresses subject of the call and escorts offenders from the bus. After stating that the bus would be normally allowed to leave at this time the officer then explains to the camera how some offenders are given transfers or transportation when deemed

necessary. Officer explains what he needs from an Operator when making such a call and explains what will happen after a citation is written.

Training Officer (Walk on)	Now that we have looked at a typical call, let's look at the thankfully less frequent call involving serious trouble.
Scene	Bus interior as two intoxicated passengers begin to argue. Driver notices possible trouble developing. As the argument escalates, a voice over says that the driver uses his judgement as to disposition. Does it look like the verbal exchange is brief and soon ended? Does it seem that assistance is needed but the situation is not life threatening? Is there an indication that there is a serious threat to passengers and operator safety and the radio cannot be used. When the answer to the last question is yes the emergency alarm is the answer. Alarm is sent. (Close up of signal being sent) Shot of alarm coming into communications and call giving out. (Dispatchers explaining radio procedures).
Scene	Call being received by the primary police unit and second unit being sent to back up. 1st. police unit arrives, followed shortly by second. Officers enter bus with fight in progress. One officer

advances from the front, the other from the rear. Combatants are separated and handcuffed. Officers remove subjects from the bus, get witnesses names and turn to camera and state that the bus would now be freed to continue its route. Officers and Operators visit over what elements must be present to make an arrest? What happens in the case now? Why do the officers need the operator's name? Officers and Operators part company and camera watches as offenders are driven away in the patrol car.

Training Officer — (Walk on) We have seen how METRO Officers and Operators work together to keep our system the best in the Nation. Remember, the emergency alarm is a vital communications link. Your safety depends upon its proper use.

Sample Emergency

Alarm Handout Material

Appendix H

METRO Transit Police Department

The METRO Transit Police Department was formed under the authority of Article 1118X, Vernon's Civil Statutes in 1982 with the expressed purpose of providing law enforcement and police services for the Transit Authority's property, personnel and partrons.

The operation of the Department is like that of most local police agencies. METRO Police have the same powers of arrest as city police officers operating within their jurisdiction.

METRO Police are responsible for the investigation of all crimes occuring on METRO property, including buses and right-of-ways.

The majority of the officers are assigned to the 24-hour uniformed patrol division. Uniformed officers patrol facilities, make bus security checks and are equipped with marked police cars for a quick response to emergency situations.

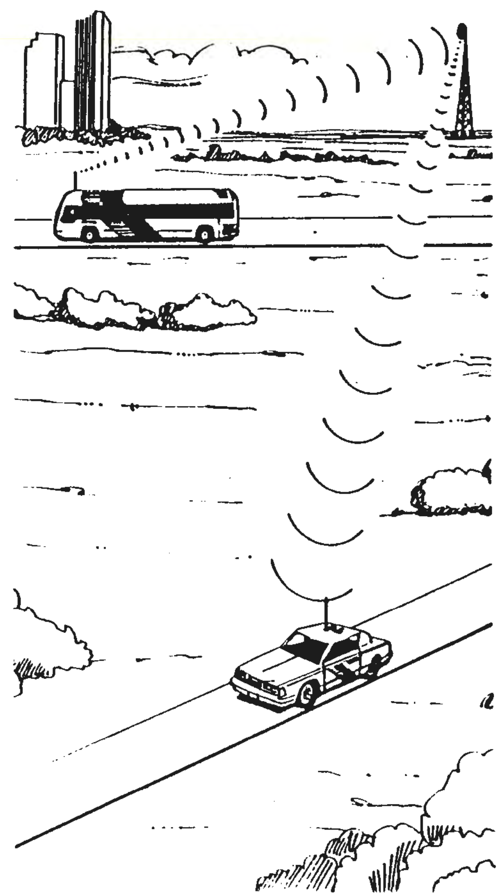
Plain clothes officers ride buses, utilize unmarked patrol cars and respond to special crime problems. An investigation unit is responsible for the follow-up investigation of serious offenses.

For further information or additional copies of this brochure, contact:

METRO Transit Police
P.O. Box 61429
Houston, Texas 77208-1429
713/739-6800

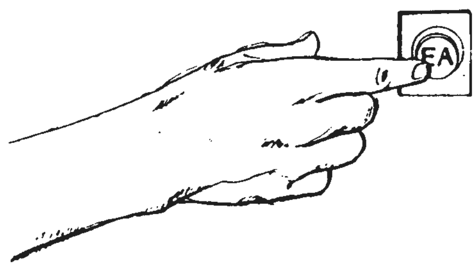
Bus Operators

Emergency Alarm Procedures



Each time an emergency alarm is activated on a METRO bus the operator is saying "My life or the life of another is in danger!" For the emergency alarm system to be effective it must be taken seriously by both bus operator and police officer. False and inappropriate alarms increase the risk to both operator and police officer in the same manner as the parable of the boy who cried "Wolf" when there was no wolf.

In a typical year dispatchers have to deal with over 2000 emergency alarms, 90% of which are either false or malfunctions. With a 98% reliability factor for the alarm hardware, human error accounts for the majority of the alarm system problems.



Activate the Emergency Alarm System **Only** when you are in an emergency situation and cannot safely use your radio to talk to the dispatcher and explain your problem. The alarm is designed for the protection of the operator, and should be used only for such situations as assault, robbery, rape and other serious crimes which cannot be communicated by the normal radio system.

Using the Emergency Alarm System renders you "deaf and dumb" for radio communications. When the system is activated the transporations dispatcher will respond by announcing the following on your bus only:

1. Time of day
2. Day and date

Example: "Good morning, thank you for riding METRO. The time is now 9:35 a.m., Thursday, March 18th." When you hear this announcement you will know that **Your** emergency has been received.

If you do not have an emergency or if the emergency has changed and you can now use your radio you should immediately do the following:

1. Push "Priority" button.
2. Notify the dispatcher of your situation.

By using the Emergency Alarm System responsibly you can help keep the METRO system safe for all.

*Misuse of the system can cause delays in addressing your problem and may result in diciplinary action being taken.