U.S. Department of Transportation
Urban Mass Transportation Administration

Bus Transit Fare Collection Equipment Overview

Office of Technical Assistance
Office of Bus and Paratransit Systems
Washington DC 20590

Prepared by:
Transportation Systems Center
Technology Sharing Office

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TECHNOLOGY SHARING A PROGRAM OF THE UNITED STATES DEPARTMENT OF TRANSPORTATION

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of Transportation
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*General Farebox Inc. (GFI), formerly Keene Corporation.

1. INTRODUCTION*

Between June 1980 and June 1981, the adult cash fare on U.S. transit systems increased by an average of 17 percent. The U.S. Department of Transportation's decision to phase out federal transit operating subsidies ensures that fares will continue to increase at an even faster pace in years to come.

The low fare philosophy of the 1970's is a thing of the past. Transit riders will be paying a higher share of their transportation cost in the future, and transit authorities will be handling much more money in both absolute and relative terms.

For example, in August 1981, the Massachusetts Bay Transportation Authority (MBTA) inaugurated a large and very comprehensive fare increase. This increase caused many bus and light rail trips to be priced at or above $1.00. A huge influx of dollar bills resulted which the MBTA was unable to handle with their limited fare box capacity. Their immediate response to this situation was to inform passengers that dollar bills would no longer be accepted on buses or light rail vehicles. Obviously, this is a temporary policy and they are in need of changing their fare collection system to eliminate this restriction.

As situations like this become more prevalent, revenue handling and security at all levels will become a matter of greater concern to transit management. As fares increase and become more complex, some degree of automation may be desirable to assist with the collection, recording, and handling of fares on bus transit systems.

This document is designed to give bus transit managers an up-to-date picture of fare collection equipment and systems which are designed with some degree of automation. It points out the problems and potentials of automating a bus transit fare collection system.

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*The information contained in this document was compiled during July and August, 1981.

2. AUTOMATIC FARE COLLECTION

2.1 SUMMARY

Automatic Fare Collection is a very general term which will be used to describe any form of fare collection apparatus or system which utilizes some form of automation in the fare collection, handling, and recording process. The highest form of automatic fare collection is employed on such properties as the Bay Area Rapid Transit District (BART) in San Francisco, Port Authority Transit Corporation (PATCO) in Philadelphia, and the Washington Metropolitan Transportation Authority (WMATA) in Washington, D.C. These systems all utilize a magnetically coded card for ingress and egress. This card automatically computes and deducts the fare for each trip based on a zone or graduated fare structure.

A lesser form of automatic fare collection is represented by coin- and token-operated gates which have been in use in such places as Boston, Chicago, and New York for over 50 years.

The economic viability of automatic fare collection on heavy rail rapid transit systems is well documented because of large numbers of people who enter the system through a limited number of stations.

The economic viability of automatic fare collection on bus transit systems is much less clear, however, because of the need for special equipment on each bus which must be designed to withstand the rigors of on-board operation. Also, when such devices fail, the bus must be taken out of service along with the fare equipment.

Since the beginning of urban bus transit, the bus operator has served very well as a fare collector and verifier. During the 1960's, most bus systems simplified the operator's role and improved security by adopting an exact fare policy. The 1970's saw the advent of vacuum collection systems and sealed vaults which provided further improvements in security.

Registering fare boxes were introduced in order to help the operator ensure that the proper amount of fare was being inserted by each customer. The registering fare box also gave the transit authorities a new capability for automatic data collection.

Implicit in all of these developments was the understanding that increased mechanical and electrical complexity would result in added maintenance requirements and possibly lower system reliability. It appears that improved productivity and security has more than offset reliability and maintainability problems, however.

The trend today seems clearly toward more automation in bus fare collection and revenue handling. This trend will continue as fares are increased and fare structures become more complex. Some benefits of bus transit automatic fare collection are:

- Increased overall security,
- Opportunity for automatic data collection,
- Reduction of manpower in the collection and counting function, and
- Simplification of fare verification, resulting in increased operator productivity and safety, and a higher percentage of full fares paid.

The principal problems with these new systems are:

- High capital cost,
- Increased mechanical and electrical complexity, and
- Potential for reduced equipment reliability.

2.2 AUTOMATIC FARE COLLECTION EQUIPMENT

For the purposes of this document, the definition of automatic fare collection equipment is any component of the fare collection system which includes any degree of automation. Thus, information has been included in this report on the following items.

- Registering Fare Boxes
- Transfer Issuing Machines

- Vacuum Collection Systems

Since most transit authorities use bus fare collection equipment which is manufactured in the United States, the following listing has been restricted to U.S. manufacturers.

2.2.1 Duncan Industries - Faretronic Mark IV

One of the most highly automated fare boxes on the market today is the Duncan Industries Faretronic Mark IV. This electronic fare box contains a microcomputer which records and stores revenue and passenger data and provides several features to help the bus driver ensure that he receives the correct fare from each passenger. These features include:

1. A coin-counting mechanism which accepts all U.S. coins and two types of tokens;
2. A paper currency mechanism which accepts and records one dollar bills and several sizes of tickets;
3. An audio transducer which signals the driver each time a "full fare" has been inserted in coins and/or dollar bills;
4. Two large display windows for visual inspection of coins and bills;
5. An LED display window which faces the driver and displays the fare as it is counted by the machine;
6. Six or twelve buttons which allow the driver to adjust the fare box for recording tokens, tickets, reduced fares, zone differentials, etc.; and
7. A locked container with separate compartments for bills and coins. (The fare box cash container must be manually emptied into a master collection vault.)

In addition to the standard features mentioned above, the Faretronic can also be equipped to read magnetically coded passes and tickets, as well as to record and store a wide range of ridership data.

Approximately 8500 Duncan Faretronic Mark IV fare boxes are in use in 35 U.S. transit properties including large systems such as the Southeastern Pennsylvania Transportation Authority (SEPTA) in Philadelphia and the Bi-State Development Agency in St. Louis, and smaller systems in cities such as Fort Worth, Tex., and Charlotte, N.C.

In St. Louis, the entire fleet of some 1000 buses is equipped with the Duncan Faretronic Mark IV. One hundred buses are equipped with a route/run segmenter which has the capability of providing statistical analysis of individual routes and runs in order to provide complete breakdowns by revenue and passenger types. This information is stored in the fare box for use with data transmission.

The Bi-State Development Agency's central data processing system is equipped for automatic acceptance of fare box transaction data from service island computers via communications lines to the central computer. Some of the reports which can be produced automatically from this system follow.

- Fare Box Trouble Report
- Vehicle Audit Reports
- Daily Revenue Summary
- Revenue Trend Analysis
- Revenue-To-Date Summary

This data-retrieval system is in the developmental state and is not yet fully operational.

2.2.2 GFI K-25 and K-50 Electrically Operated Registering Locked Fare Boxes and Automatic Revenue Retrieval System

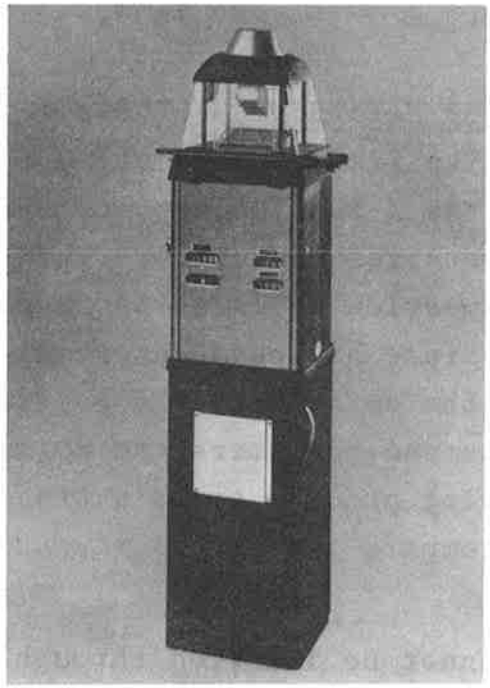
General Farebox Inc. (GFI) manufactures registering fare boxes that are widely used throughout the U.S. transit industry. More than 100 transit authorities use the GFI K-25 and K-50 fare boxes, and 21 of these also use the Automatic Revenue Retrieval System. The automatic retrieval system is utilized mostly by large properties, and a total of 13,315 buses and light rail vehicles are quipped.

2.2.2.1 K-25 and K-50 Fare Boxes - These two fare boxes are very similar in design. The K-25 accepts all U.S. coins up to a quarter-dollar, and the K-50 also accepts fifty-cent pieces. Both fare boxes accept two sizes of tokens. They are designed to provide easy visual inspection of fares by driver, passenger, or inspector. Once the fare has been inserted, the driver depresses a lever which dumps the coins into the registering mechanism. This mechanism counts and registers the coins on a visual display unit. This registering process gives a transit agency the opportunity to randomly compare the actual revenue against the recorded revenue.

Dollar bills cannot be inserted through the coin slot. They must be placed in an envelope by the driver and inserted in a separate slot on the fare box pedestal. They are retained in a separate part of the vault and are not recorded.

2.2.2.2 The GFI Revenue Collection and Processing System - The most important automated feature of the GFI System is the vacuum revenue retrieval system known as "GFI VAC". The GFI VAC features a large central island vacuum retrieval unit which can be located at an existing service island or at any suitable location in a garage or yard. To utilize this system, buses must be equipped with a special fare box vault which is designed to accept the vacuum probe. All GFI fare boxes are designed to readily accept the GFI VAC.

When a bus stops at the service island for normal servicing, the vacuum probe is inserted into the bottom of the fare box. All money, including bills which have been placed in small envelopes, is evacuated into a large vault in the central island unit. The system remains completely closed until sensors indicate that all revenues have been removed, sorted, and processed. A bus fare box can be completely evacuated in approximately 20 seconds.



K-25 ELECTRICALLY OPERATED, REGISTERING LOCKED FARE BOX

K-50 ELECTRICALLY OPERATED, REGISTERING LOCKED FARE BOX

Inside the central sorting and processing unit, a high speed sorter feeds the revenue into separate chambers in the master vault. If paper is part of the fare, it too is automatically separated and stored in an individual chamber. The chambers are color-coded to federal standards for different denominations and reinforced for extra protection.

The vault, with a $40,000. plus capacity, locks automatically when it is removed from the central processing unit for transfer to the counting facility or bank. Two different high security keys are required to unlock the door and remove the vault. The entire unit is protected by an audio/visual alarm system.

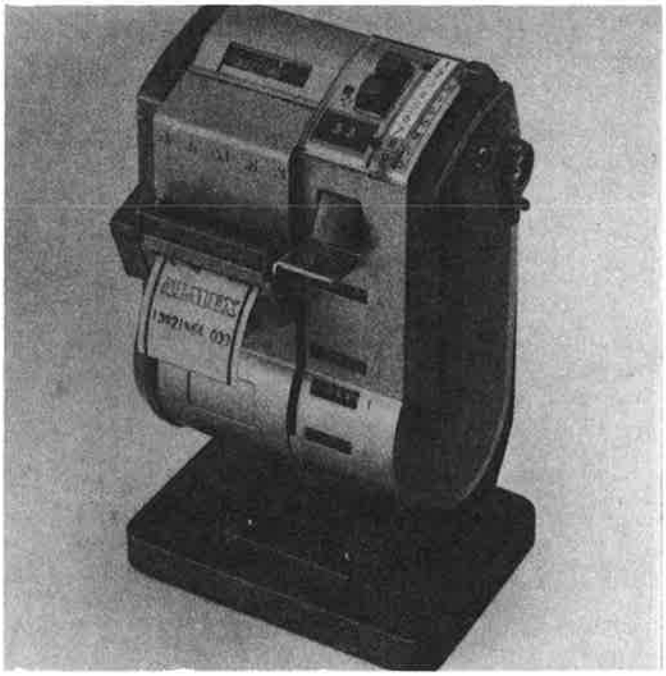
2.2.3 Vapor Almex Model E Transfer Issuing Machine

Another part of the fare collection process which can benefit from some form of automation is transfer issuing. Typically, transit authorities issue transfers to bus drivers each morning. These are one-day transfers which have nominal value, but most of them are not used and are thrown away at the end of the day. The total cost of printing, storing, and handling transfers can be quite high and the process is cumbersome.

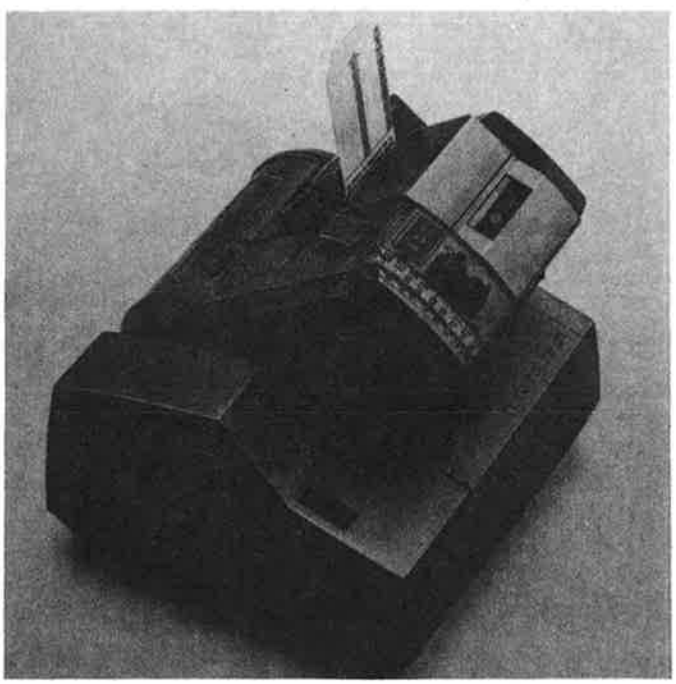
The Vapor/Almex Model E Transfer Issuing Machine prints transfers from a blank roll of paper at the time of issue. Each roll can print about 750 transfers. The transit authority logo, sequential serial number, machine number, date, time, route number, direction of travel, zone, and fare category can be printed on the transfer. The machine includes nonresetable counters which give data on total transfers issued and quantity of transfers issued by each type of up to nine different fare categories.

The Model E is easy for the driver to operate and is more convenient than issuing preprinted transfers. A cost savings is realized because the cost of a transfer from the Model E is less than the cost of a preprinted transfer. Also, with the Model E system, no transfers are wasted. Additional savings are realized by eliminating the cost of storing, processing, distributing, and accounting for preprinted tansfers.

There are approximately 30,000 Model E units in operation at transit properties in 25 countries throughout the world. San Mateo County Transit District has 283 units which have been in operation since late 1979. Long Beach Public Transportation has ordered 200 units which will be delivered in early 1982. Alameda-Contra Costa Transit District is bidding for 1000 units which have a delivery requirement of mid-1982.



ALMEX MODEL E TRANSFER ISSUING MACHINE (MANUAL)



ALMEX MODEL E TRANSFER ISSUING MACHINE (ELECTRIC)

3. SELF-SERVICE FARE COLLECTION

3.1 SUMMARY

A special variation of automatic fare collection is Self-Service Fare Collection (SSFC) which is very popular in Europe. SSFC is often referred to as an "honor" system, but all such systems employ ticket inspectors who ensure that people have purchased a valid ticket. Since some percentage of tickets are inspected every day, these systems cannot, in a strict sense, be referred to as "honor" systems.

SSFC is not a single method of fare collection, but rather a range of fare collection techniques based on the "proof of payment" concept. Under this concept, the passenger rather than the driver is responsible for fare payment and is required to have a valid ticket or pass while on the transit system. Random inspection is used to prevent widespread fare evasion. Similar concepts are used to control parking meters and various licenses (fishing, driving, etc.).

Self-service systems all require some form of automatic equipment since the driver does not become involved in fare collection except perhaps only with a small percentage of passengers who purchase a one-ride ticket. These systems all utilize a ticket or pass which must be validated in order to prove that the passenger has paid the proper fare. Typically, validation machines are located on-board the bus and the operator's responsibility for fare collection is limited to adjusting zone settings on the validation equipment, announcing zone changes, and selling single-trip tickets. (Only about 15 percent of the riders purchase their tickets from the operator in most European systems.) Passengers holding tickets or passes usually enter and leave the bus through either door and validate their ticket on-board. Ticket vending machines are a vital part of these systems since every effort is made to encourage prepurchasing. Ticket vending can be totally automatic at bus stops or in the bus, or a semi-automatic ticket vendor can be used by the operator to issue a ticket.

A very thorough study of European Self-Service Fare Collection Systems has been performed by the MITRE Corporation under the sponsorship of the Urban Mass Transportation Administration (UMTA), and all volumes of the study are listed in the bibliography. This study concludes that more than a decade of development in Self-Service Fare Collection has enabled European Transit Systems:

a. To adopt flexible fare structures which allow for integration of transit modes and local operations into regional networks, more precise and attractive pricing of transit services, and greater recovery of costs.

b. To relieve vehicle drivers of responsibility for the administration of a wide range of fares and fare payment options, and for the verification and enforcement of fare payment.

c. To improve service productivity and facilitate the use of high capacity vehicles through the streamlining of passenger boarding and alighting.

The MITRE Study suggests that the SSFC concept has considerable potential for enhancing the quality and quantity of local public transportation in the United States by facilitating more flexible fare structures and through increasing service productivity. Most European properties which utilize SSFC have adopted very flexible fare structures and have realized an approximate 10 percent increase in service productivity. Some report this as a 10 percent decrease in trip time, some as a savings of one bus in ten, and some as a general comparison with operations prior to self-service. For example, Geneva, Switzerland, reported that by using unrestricted all doors access and by requiring passengers to have a prepaid fare to board the vehicle, dwell times at stops were reduced. The reduced dwell times led to savings of personnel and equipment — "one bus in ten".

The MITRE Corporation recommends a series of demonstrations at U.S. transit properties to provide operational examples of SSFC techniques and equipment in a variety of settings. Four such demonstrations are underway or being planned as of this writing. They are: Kalamazoo, Mich.; Portland, Oreg.; San Diego, Calif. (Light Rail Transit); and Santa Cruz, Calif. A description of these demonstrations is included in the next section.

Most SSFC equipment is manufactured in Europe, and since the variations are so numerous, only the equipment used in these four U.S. cities will be described. However, a comprehensive list of European manufacturers is included.

3.2 U.S. DEMONSTRATIONS OF SSFC

Four U.S. cities are presently in the process of experimenting with some form of self-service fare collection.

Kalamazoo, Michigan, has installed ticket cancellors on eight of its buses and has purchased three ticket vending machines for use in a demonstration at Michigan State University.

Portland, Oregon, has just awarded a contract for enough equipment to equip its entire bus fleet and is designing SSFC into its new light rail system.

San Diego, California, opened its new light rail system using the self-service concept.

Santa Cruz, California, has submitted a capital grant application to UMTA for expanding its program of direct billings to corporate customers whose employees are given special passes for transit use.

A more detailed description of each system follows.

3.2.1 Kalamazoo, Michigan - Metro Transit System

The Kalamazoo demonstration is not truly a Self-Service Fare Collection System. However, since it uses similar equipment and since it is directed toward simplifying the fare collection process, it is included here for information purposes.

The Kalamazoo Metro Transit System has ordered three ticket vending machines and eight cancellors for a demonstration which will be conducted on buses that are restricted to service on the campus of Western Michigan University. Four buses will be equipped with cancellors and the ticket vendors will be located at strategic places on campus. Four other buses will be equipped with cancellors, but will only be used if a university bus is unavailable for service.

This demonstration is being funded by the Michigan Department of Transportation and the main purpose is to simplify the fare collection process for both passenger and driver, and to reduce the amount of money collected on-board buses. Passengers will be encouraged to purchase multi-ride tickets which will cost $5.00 for two eight-ride tickets versus 40 cents per ride cash fare. This amounts to approximately a 22 percent discount in fare.

The passenger will show the ticket to the driver as he enters the bus and then cancel a portion of it in the cancellor. A similar multi-ride ticket system is in use today, except the driver punches the ticket by hand. Passengers who do not choose to purchase a multi-ride ticket will continue to pay the exact cash fare in the fare box.

This demonstration is scheduled to begin on August 31, 1981 and, if successful, will be expanded to the entire Kalamazoo Metro Transit System. The system utilizes two types of SSFC equipment, a Standard Change-Makers vending machine and a Vapor/Almex Cancellor.

3.2.1.1 <u>Standard Change-Makers Ticket Vending Machine</u> - Standard Change-Makers, Inc. is the largest U.S. manufacturer of dollar bill and coin changing equipment. They also manufacture token and ticket dispensing machines. While these machines utilize many standard components, they are "custom designed" in order to dispense the particular token or ticket of a specific transit authority.

The ticket vending machine for Kalamazoo was designed to dispense Almac tickets when a five dollar bill is inserted. From one to seven tickets can be vended for each five dollar deposit. To start, Kalamazoo intends to sell two eight-ride tickets for $5.00. When fares change in the future, the $5.00 charge will remain unchanged but the number of rides will be changed on each ticket.

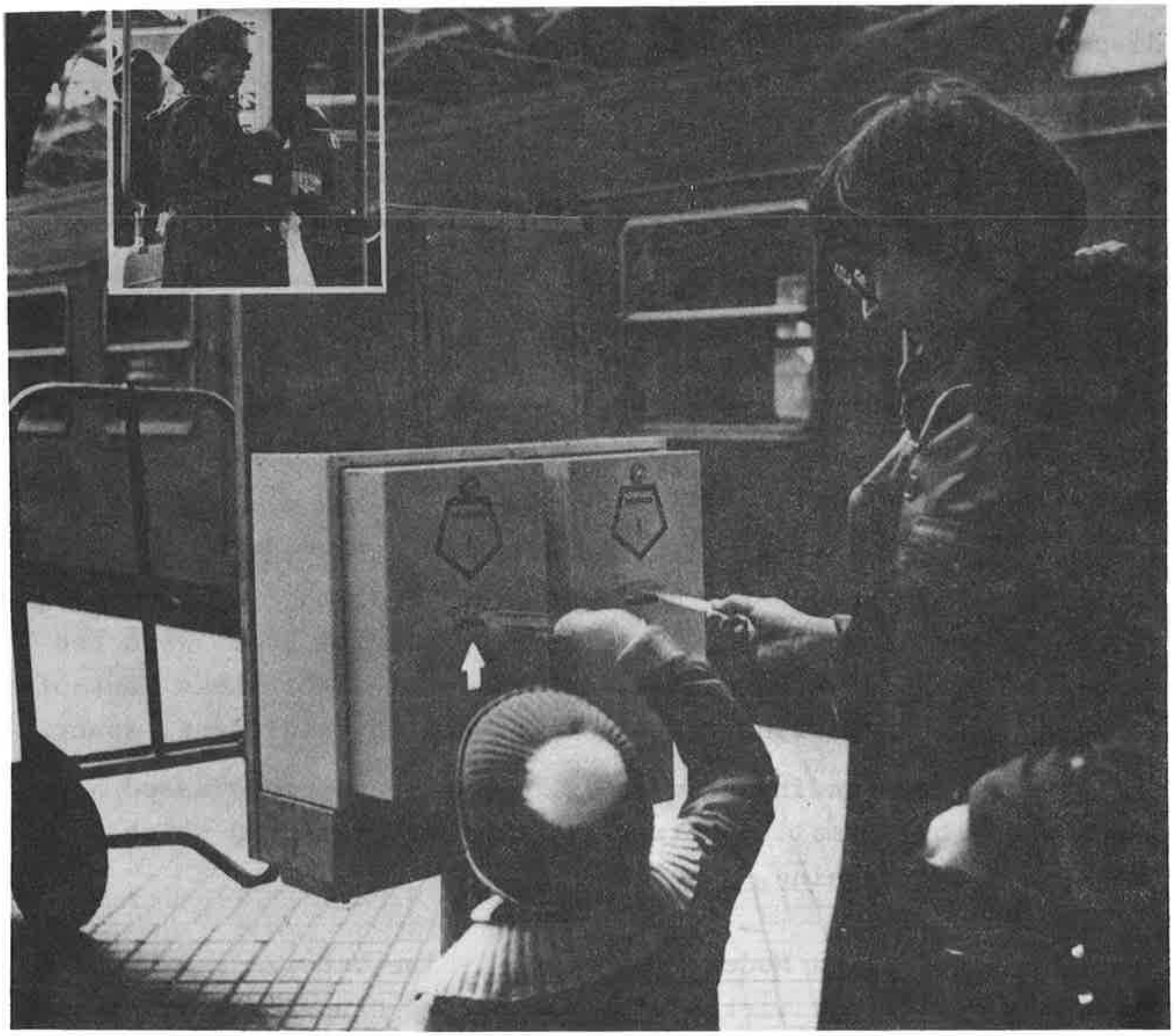
Since the machine only accepts five dollar bills and no change is given, the operation is quite simple. A five dollar bill is placed in the verifier tray and the tray is manually pushed into the machine. If the bill is accepted, the tickets are vended to the customer. The whole operation takes from 3 to 10 seconds depending on how many tickets are vended.

The capacity of the ticket machine is 1500 tickets. Since two tickets are vended for every five dollars, the ticket capacity is roughly equal to the bill stacker capacity of 800. When the supply of tickets is exhausted, an indicator light shows "Out-of-Tickets" and the machine refuses to accept any additional money.

The ticket vending process is pneumatic and compressed air is provided by a small electrically operated air pump which is built into the machine.

3.2.1.2 Vapor/Almex Model M Cancellor - The Vapor/Almex Model M Cancellor electronic ticket recognition and cancellation unit is designed for use with prepaid multi-ride tickets. When a ticket is inserted in the Model M, the cancellor checks the validity of the code and, if valid, a numbered square representing a ride is removed from the ticket. Preset information is then printed on the ticket and a nonresetable counter in the cancellor is advanced by one. The printed information can include time, date, route number, direction of travel, zone, and can be easily set by the driver. In the case of a free transfer system, the printed information can be used for a transfer.

The cancellor can be equipped with a bell to indicate a valid ticket and a buzzer to indicate an invalid ticket. The cancellor



ALMEX MODEL M CANCELLOR

can also be equipped with a crystal clock which automatically advances the time that is printed.

There are approximately 20,000 Model M Cancellors in operation at transit properties throughout the world. Most of these are used in conjunction with SSFC systems, but many are used to supplement exact fare collection systems such as in Kalamazoo. The use of multi-ride tickets and cancellors provides many advantages. On-board cash transactions are reduced, thus saving wear and tear on fare boxes and revenue sorting and counting equipment. Personnel expenses should also be reduced through reduction in equipment maintenance, vault pulling, revenue sorting, counting, bagging, record keeping, and transportation of funds. These savings will be offset somewhat by the increased cost of maintenance on the cancellors and ticket vendors.

With the prepaid tickets, transit authorities have the advantage of receiving payment in advance. Driver safety is enhanced by reducing the cash on the bus and the possibility of pilferage is reduced. The ticket is very flexible for fare changes, is convenient for passengers to use, and reduces boarding time.

In concept, the multi-ride ticket has similar advantages to the weekly or monthly pass. But, the ticket is good only for a limited number of rides and a pass is usually unlimited.

For more information on the Kalamazoo demonstration project, please contact:

Mr. Terry O. Cooper, Director
Metro Transit System
530 North Rose Street
Kalamazoo, Michigan 49007
(616) 385-8201

3.2.2 Portland, Oregon TRIMET

The Tri-County Metropolitan Transportation District (TRIMET) of Portland, Oregon, has embarked upon the first large scale self-service fare collection program in the United States. This is a phased program which will start with their entire fleet of buses

(601 standard and 95 articulated) in 1982 and will be expanded to the new light rail transit (LRT) system when it opens in 1985. This program is being financed, in part, under a grant from UMTA.

TRIMET's decision to adopt SSFC was motivated by a Fare Policy Study in 1979 which concluded that SSFC would be the only method of fare collection that would enable them to operate two-car light rail trains with a single operator, loading from stations in street right-of-way through all doors, and without any other access restrictions. However, the system also promises to achieve a number of other improvements in transit operations and a decision was made to adopt it on buses as well as the LRT system.

Some of the benefits, such as tighter control of fare evasion, driver support, and security, will be realized immediately. Others will not be fully realized in the initial period of SSFC operation until, for instance, new generations of buses are purchased that facilitate multi-door loading and larger vehicles make up a higher proportion of the TRIMET fleet.

The goals of the self-service project include the following:

- Permitting the efficient use of larger transit vehicles;
- Improving driver work conditions by lessening duties and reducing the opportunity for friction with passengers;
- Improving system equity by better relating fare to trip length;
- Providing a means for positive control of zone fares and general fare evasion;
- Improving system security as a spinoff of the improved communications and fare inspection process;
- Demonstrating TRIMET's commitment to maximizing user revenue and minimizing overall collection costs;
- Greatest possible simplicity of fare rules for passengers; and
- Minimizing risk of adverse public reactions by developing a phased implementation plan that avoids traumatic changes.

Prior to implementing SSFC, a "Proof-of-Payment Ordinance" will be enacted by the TRIMET Board of Directors. In essence, this ordinance will require all riders on the transit system to possess a valid ticket or pass showing that they have paid their fare, and to show this ticket or pass to TRIMET Agents upon request.

One of the primary benefits of SSFC will be to speed-up service. In order to achieve this goal, it is essential to reduce fare box use to a level below 20 percent. This will be achieved by increasing the cash fare relative to the pass and introducing a new discounted multi-ride ticket that is validated before each trip by a machine that does not require driver participation. Under the SSFC System, fare payment would be as follows:

- By pass, as today;
- By fare box, as today except that a receipt similar to a transfer will always be issued; and
- By multi-ride tickets which will be sold by TRIMET ticket outlets and by simple vending machines. Multi-ride tickets will require "validation" before each trip using an on-board validation machine.

Fare collection rules will be enforced by fare inspectors who will board buses on a random basis and check ticket validity. Passengers travelling without proof-of-payment will be liable to penalty.

To provide a smooth transition from today's fare collection to self-service, and to minimize TRIMET's exposure to potential revenue loss, a three-phase program has been adopted.

Phase One - Planning and Preparation

Phase One has been underway for approximately one year and includes all planning activities as well as hardware procurement and installation, employee training, and documentation.

Phase Two - Driver Monitored SSFC

Phase Two will be inaugurated in 1982. The new system will feature:

- All passengers enter front door and exit rear door(s);
- Proof of payment required; and
- Driver's role reduced to monitoring (but not enforcing) fare payment.

The purpose of Phase Two is to minimize change from present conditions, and to set in place the proof-of-payment requirement that is the foundation of SSFC. During this phase, passengers will continue to enter the bus through the front door only and will indicate fare payment to the driver; pass holders will flash their passess; fare box payment will continue, except that the driver will activate a ticket printer to give passengers a receipt; and multi-ride ticket users will validate their tickets in the validator behind the driver. Because the validator emits an audible tone on validation, the driver will be aware of payment. Transferring passengers will offer their valid receipts or multi-ride tickets for inspection just as transfers are offered today.

In the event a passenger boards without any evidence of fare payment, the driver will ask, "Do you have a pass?" If the answer is yes, the driver says, "Please show it when you get on a bus." If the answer is no, the driver says, "You owe me a fare." If the passenger refuses, the driver may, at his discretion, radio a complaint to the dispatcher who will notify the inspectors. No other action is required of the driver. Drivers will be expected to relax their level of monitoring during peak period.

Also, during this second phase, fare inspectors will be deployed to make fare inspections on a random basis on the buses. Because of the driver monitoring process, the temptation for fare evasion will be less, and the inspectors will provide both a new deterrant and general driver support. Fare inspection will be targeted at responding to driver complaints about fare evasion, pass fraud, and zone overriding. TRIMET will gain experience in conducting on-board ticket inspections and processing persons cited for violations. Experiments may be made with various levels of penalty.

During Phase Two, it will be possible to revert to conventional fare collection overnight without severe impact on operations, should adverse legal or political actions mandate this course.

Phase Three - Full Self-Service

Phase Three will feature:

- Entry or exit through any vehicle door;
- Proof of payment required; and
- Driver's role further reduced to assistance, but not monitoring conformance to fare collection.

Phase Three will commence once the proof-of-payment concept and fare inspection procedure have become established. A transition period will feature full self-service on part of all of the system. Under full self-service, passengers will be permitted to enter or exit all doors of vehicles. Drivers will no longer monitor fare payment. Fare evasion potential, and hence the inspection rate, will be higher. Since there will be consistency between the rules for driver monitored and full self-service, both methods of fare collection may be operated simultaneously on the system during the third phase. Mixing driver monitored and full SSFC may prove attractive since it would permit TRIMET to minimize inspector man-hours on lightly used lines and at low traffic periods of the day while deriving the benefits of full self-service on those vehicles and during those periods of the day when substantial benefits can be realized. Full self-service will be expanded into the new light rail system when inaugurated in 1985.

TRIMET has awarded a contract to Camp/Vultron, a joint venture, for supply of 746 controllers, 956 validators, 766 printers, test equipment, installation hardware, training, documentation, and a one-year maintenance contract. Vultron is a subsidiary of Trans Industries, located in Waterford, Michigan, and CAMP is a French firm with extensive experience in supplying similar equipment to the European market.

3.2.2.1 <u>Camp-Vultron SSFC System</u> - The Camp-Vultron SSFC System, which is to be used by TRIMET, consists of three units: the controller, the printer, and the validator. All three units are located on-board the vehicle and work together to perform the ticketing process.

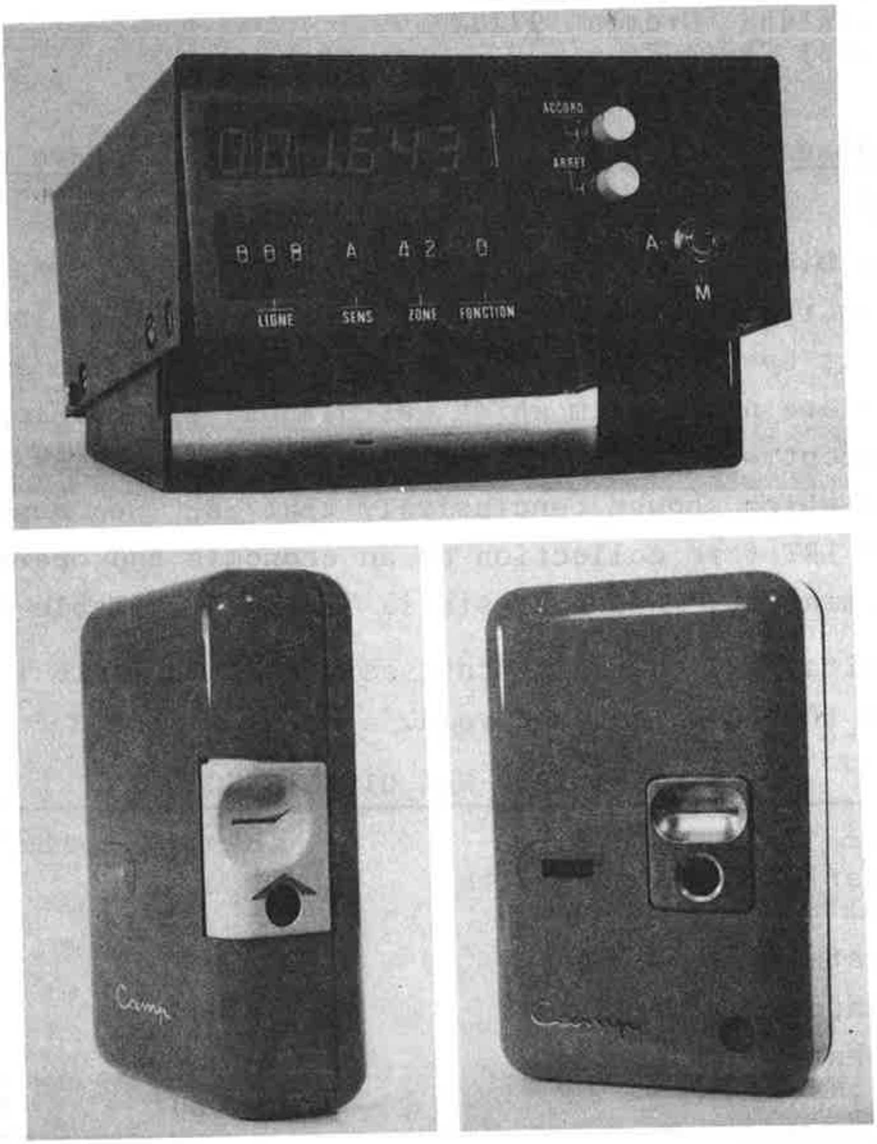
The controller is programmed to control the ticketing and validation process. It contains data including date, time, zone, and a keyboard which the operator uses to issue single trip ticket The controller tells the printer and the validator what to print when a ticket is issued or validated. It also serves as a monitoring device which continuously checks for system malfunctions.

When a ticket inspection is made, the controller is switched off by the inspector thus preventing passengers from validating their tickets after they have entered the bus. Also, the controller is used to store all ticketing and validation information for statistical uses.

The printer's function in the Camp-Vultron SSFC System is to issue single ride tickets to customers who board the vehicle without a ticket. The passenger places the exact fare in the fare box and the operator punches the proper button on the controller (i.e. regular fare, student, senior citizen, etc.). The ticket is issued in a prevalidated format showing time, date, and zone. The passenger must keep this ticket to prove that the proper fare has been paid.

The validator is used by a passenger holding a multi-ride ticket. Upon entering the vehicle, the passenger inserts his ticket into the validator and the machine determines whether the ticket is valid. If valid, the validator prints the date, time, and zone on the ticket and the passenger removes it. The machine also emits an audible signal so the driver is aware that the ticket has been validated.

The Camp-Vultron System is similar in design and function to Camp SSFC equipment which is presently being used in several European cities.



CAMP-VULTRON SYSTEM - CONTROLLER AND VALIDATING MACHINES

For additional information on the TRIMET SSFC System, please contact:

Mr. Gerald Fox
Fare Collection Project Manager
TRIMET
4012 S. E. 17th Avenue
Portland, Oregon 97202
(503) 238-4974

3.2.3 San Diego, California, Metropolitan Transit Development Board

The San Diego Light Rail Transit System or "Tijuana Trolley" was the first transit system to adopt full scale SSFC in the United States when it opened in July 1981. San Diego had the advantage of being a complete new system which was planned and developed around the SSFC concept. A thorough analysis was performed by Bechtel Incorporated which showed conclusively that SSFC was superior to conventional LRT fare collection on an economic and operational basis. A summary of this analysis is included in Table 1.

The capital and operating cost estimates in Table 1 were derived from the following analysis.

COST ANALYSIS-SAN DIEGO SSFC

Capital Items	SSFC	Conventional
16 Nonregistering fare boxes with spare vaults	---	$16,000
35 Coin-operated ticket vendors	$280,000	
60 Ticket cancellors/validators	30,000	
35 percent contingency	110,000	
Total Capital Cost	$420,000	$16,000

OPERATING PERSONNEL	LABOR YEARS SSFC	LABOR YEARS Conventional
Revenue collectors	2	2
Extra operator on each Two-car train		20
Fare machine maintenance personnel	3	---
Transit supervisors/ticket inspectors	1	---
Senior transit supervisors	1	---
Salesman/bookkeeper for ticket sales outlets	1	---
Total Labor Years	9	22

TABLE 1. A COMPARISON OF FARE SYSTEMS FOR THE SAN DIEGO LRT

	Conventional Manual Operation Of Exact Cash Fare	Self-Service Barrier-Free
Capital Cost Annualized at 10 percent	$ 1,600	$ 42,000
Operating Costs	$500,000	$175,000
Collection Costs based on two man-years; may be reduced by integrating with bus collection	$ 50,000	$ 50,000
Paper Costs	$ 4,500	$ 9,000
Total Costs not including Head Office Accounting and Supervision	$556,100	$276,000
Cost Per Passenger 15,000/day x 300	12 cents Will remain much the same at higher passenger volumes	6 cents Will reduce moderately as passenger volume grows
Collection Security	Very good	Very good
Evasion Security	Very good. Typical losses 0.5 percent - 4 percent	Very good. Typical losses 0.5 percent - 3 percent
System Security and Passenger Information	Very good, employee on each car	Good, employee on each train plus roving supervisors
Passenger Convenience	Moderate, requires exact cash for each ride	Moderate, as may still require exact cash fare but more adaptable to multi-ride options
Passenger Education	None, as identical to existing bus system	Requires information program to familiarize users with new system
Transfers	Requires manual issue of date and time coded	Ticketed as issued or cancelled automatically becomes date and time coded transfer

TABLE 1. A COMPARISON OF FARE SYSTEMS FOR THE SAN DIEGO LRT (CONTINUED)

	Conventional Manual Operation Of Exact Cash Fare	Self-Service Barrier-Free
Flexibility of Fare Option		
Concession fares	Readily offered	Readily offered
Passes	Readily offered	Readily offered
Prepurchased tickets/tokens	Readily offered	Readily offered
Time variable fares	Possible	Readily offered
Zone fares	Possible but cumbersome	Readily offered
Operator Convenience	Very simple system	Requires more effort for fare inspection and machine maintenance
Station Design	Not restrictive	Not restrictive
Compatible with Barrier Collection at Major Stations?	Yes	Yes
Boarding Times	2-4 seconds per passenger	1/2 - 2 seconds per passenger through use of multiple doors
Reliability	Excellent	Moderate to good. On-board coin-operated machines have moderate mean time between failures. Some redundancy provided by two machines per car. Validators have high reliability

SOURCE: MTDB Fare Collection System, Bechtel Incorporated, January 8, 1979.

Each labor year is valued at $25,000., thus resulting in the estimates shown in Table 1.

The favorable economics of SSFC result entirely from the savings of one operator on each two-car LRT train. Since this type of saving is not applicable to a bus system, it appears that SSFC will be more expensive for bus operators in a direct economic comparison with conventional fare collection systems. This is especially true for an operator who already owns a large number of fare boxes and related equipment.

From this analysis, it appears that the economics of converting to an SSFC system would be negative for most bus transit systems, and it is recommended that a thorough analysis be performed prior to adopting SSFC.

The principal benefits of SSFC for an all bus property are as follows:

1. Reduces amount of money collected on the bus;
2. Reduces drivers' responsibility for fare verification;
3. Facilitates the adoption of zone fare structures to maximize revenue;
4. Reduces loading and unloading times; and
5. In a multi-modal property, SSFC also allows for the development of a very simple and cost effective intermodal transfer policy.

However, all of these benefits can be realized to some degree through the adoption of an aggressive pass and/or multi-ticket program without the cost of SSFC equipment.

The San Diego trolley system should be watched closely by interested properties. If the LRT system has good results, local bus companies which intersect with it may adopt a similar policy. If this happens, San Diego may be the first city in the United States to adopt a multi-modal SSFC system.

As of this writing, the San Diego Trolley has been in operation for only two months. However, the service is carrying an average of 13,000 people on week days and 18,000 to 20,000 on weekends on one line running between downtown San Diego and the Mexican border at Tijuana. This is approximately 30 percent more ridership than the Metropolitan Transit Development Board had anticipated prior to inauguration. Thus far, San Diego has encountered a very small percentage of attempted fare evasion incidents and the equipment is performing well.

The self-service equipment consists of 28 AUTELCA BE-20 ticket vendomats, with at least one located at every station and street stop. The vendomats sell a single ride ticket for $1.00 and the ticket is prevalidated when it is sold. The vendomat also contains a built-in validator which is used to validate multi-trip tickets which are sold over-the-counter in various locations. The "Ready 10" multi-trip ticket costs $7.50 for 10 rides. No vendomats are located on the trolleys, and the entire ticketing and validation process takes place on the wayside.

3.2.3.1 AUTELCA BE-20 Ticket Vendomat - AUTELCA AG is a Swiss manufacturer of self-service fare collection equipment, represented in North America by Shepard Transition, Inc. During the past ten years, AUTELCA has supplied approximately 6000 ticket vendomats to almost all European countries.

The BE-20 model provided to San Diego accepts all U.S. coins ranging from a nickel to the Susan B. Anthony dollar in a single slot coin acceptor. When the passenger inserts the proper fare, a ticket is issued with the time, date, and station location printed on it. The tickets issued in this manner are valid for two hours.

The machine contains a large coin storage capacity and provides continuous accounting and cost control by electronic voucher printed on ticket paper itemizing all cash receipts and statistical data. The BE-20 can be equipped with up to 20 different ticket options to accommodate a very complex fare structure. The operation is controlled by a microcomputer which includes an electronic data memory.

The unit is encased in a rugged all-weather steel housing which provides space for a transit system map and other information such as simple instructions for machine use. The machine also contains a validator which passengers use for validating multi-ride tickets. The validator clips off part of the ticket and prints time, date, and location.

For security purposes, a TV camera is located opposite each vendomat, and monitors are located in central control. Each vendomat is wired into central control and breakdowns are monitored on a real time basis. Thus far, there has been no vandalism damage to any vendomats.

For more information on the San Diego Trolley SSFC system, please contact:

Mr. Maurice Carter
Director of Planning and Operations
Metropolitan Transit Development Board
620 C Street, Suite 400
San Diego, California 92101-5368
(714) 231-1466

3.2.4 Santa Cruz Metropolitan Transit District, California

The Santa Cruz Metropolitan Transit District (SCMTD) currently operates, on a manual basis, an Aggregate Contract Billing System allowing passengers possessing a special pass to board and ride all SCMTD vehicles at no cost to the passenger. Passengers receive the special passes from their employer who has contracted with SCMTD to pay for rides taken by their employees. The rides are paid for under a special contracted rate arranged between SCMTD and employers.

This is not a Self-Service Fare Collection System. However, SCMTD has filed a federal grant application to automate the system. Since this automated system would simplify the work of the bus driver and the accounting department, a description is provided on information for other transit properties. Furthermore, it is anticipated that the equipment to be used in this system will be similar to existing SSFC equipment.

Under the current system, an employer contracts with SCMTD for transit service billing based on average daily ridership of its employees. Employees purchase a pass from their employer at a reduced rate or, as in most cases, they receive the pass free as a fringe benefit. To use the pass, employees simply board an SCMTD vehicle and show their pass to the driver. The driver then manually records the type being used onto a tally device (color-coded keys corresponding to particular employers). At the end of the day, all individual tally data are collected and totaled. Some employers, through special agreement with the SCMTD, will not pay for transit trips made on certain days, at certain times, or on specific routes. Therefore, these ineligible trips must be subtracted from the total for a specific contracted employer before billing takes place.

Because SCMTD wishes to receive payment for each legitimate transit trip and employers wish to pay only for legitimate trips, it is necessary for all pass contract data such as <u>type</u> and <u>date</u> to be recorded and billed properly.

Due to all of the manual operations associated with the billing system, but mostly due to the human limitations of the driver, the number of contracts must be kept to less than seven. If the number of contracts is increased beyond the current number, the work load on the driver increases to such a degree that the driver can no longer keep track of the contract types. This increases the number of billing errors, which increases the costs to SCMTD and the contracted employer. To keep the number of contracts low, SCMTD has grouped several employers under one contract. However, this is only a temporary solution.

3.2.4.1 <u>Proposed Automated System</u> - In response to the potential for human error, the need for accurate billing, and the limited number of contracts possible under the manual system, the SCMTD has proposed an Automated Aggregate Contract Billing System. The major benefits of the automated system follow.

- Increased potential for contracts with employers or consortiums of employers (i.e. groups of employers under the same contract – for example the members of a merchant's association) from the current limit of 6 to a new limit of up to 115 employers/employee consortiums.
- Dependable user data collections and aggregate billing techniques providing incentive to major employers to enroll employees.
- Higher transit utilization and fare box revenue as a result of the above.
- Decreased driver workload related to fare control and data collection.
- Miscellaneous nontransit spin-off benefits, which, although difficult to quantify, include the potential for reducing demand for employment-area parking spaces (e.g. in downtown Santa Cruz), and the general benefit to the environment resulting from increased use of transit.

3.2.4.2 Operational Concepts of the Automated System - The overall operational concept of the Automated Aggregate Contract Billing System is the same as the current manual system. The major differences is that a machine, instead of the driver, will be used to verify and count contract passes. To perform this function automatically requires the following system changes:

1. A machine, which can recognize the various contract passes, on every bus.
2. A machine which can store data on contract pass usage for subsequent readout.
3. A contract pass that is machine readable.

Once these changes have been completed, automated operations can begin.

The machine that will be used to perform the data and fare collection functions will be similar to currently available on-board validators.

The system will operate as follows:

1. SCMTD will distribute special encoded passes to each of its contracted employers. The passes will be encoded such that each employer has a unique code number that is machine readable.
2. The employer will distribute the passes, one to each employee, either free of charge or at a low cost.
3. An employee, when boarding the vehicle, will insert his/her pass into the validator.
4. The validator will scan the pass, determine validity, and, if valid, will store data concerning pass usage in an internal memory. Also, the validator will indicate to the driver and passenger that a valid pass has been accepted. If the pass is invalid, the validator will indicate to the driver and passenger that the pass is invalid and the validator will not store data.
5. The employees will then remove their pass and take a seat on the vehicle.
6. Later, after the vehicle has returned to the garage, a maintenance technician will board the vehicle and extract the data from the memory of the validator.
7. The data will be transported to a data processing facility where it will be sorted and totaled according to pre-determined fare collection rules.
8. SCMTD will then bill the employers based on negotiated rates for all the eligible trips made by their employees.

A Section 3 Capital Grant Application has been submitted to UMTA requesting capital funds to install the automated system in Santa Cruz. A Section 6 Application which would provide federal funding for system evaluation has also been submitted. For more information please contact:

Mr. Ed van der Zand
Chief of Planning and Engineering
Santa Cruz Metropolitan Transit District
230 Walnut Avenue
Santa Cruz, CA 95060
(408) 426-6080

4. ANNOTATED BIBLIOGRAPHY

4.1 NATIONAL TECHNICAL INFORMATION SERVICE

Some reports on UMTA research and development described in this volume are available to the public through the National Technical Information Service (NTIS). NTIS is the principal repository and disseminating agency for all reports issued in conjunction with federal research and development activities. To order reports from NTIS use the order numbers ("PB" numbers) listed after each report citation in the bibliography. The lack of an order number following the citation may mean that the report has not yet been entered into the NTIS system when the publication went to press. Some reports may not be entered into the NTIS system and should be obtained directly from the publisher.

Inquiries about the availability or price of reports should be addressed to NTIS, rather than UMTA. The NTIS Order Desk telephone number is (703) 557-4650. Payment must accompany orders; cash, check, postal money order, GPO coupons, or American Express are acceptable. It is possible to establish an account at NTIS from which payments are withdrawn when documents are ordered.

The NTIS purchase price includes postage at the fourth class rate. Three to five weeks must be allowed for delivery. Faster delivery is provided by the NTIS Telephone Rush Order Service (703) 557-4700, for an additional charge of $10.00 per document if mailed or $6.00 if picked up at NTIS offices in Springfield, Va., or downtown Washington, D.C.

4.2 AUTOMATIC FARE COLLECTION

1. Automatic Fare Collection: System Definition, P. Wood, The MITRE Corporation, Report No. M-71-35, McLean, Va., July 1971 (not approved for public release).

The MITRE Corporation, under contract to UMTA, is responsible for developing the requirements for an automatic fare collection (AFC) system, and for demonstrating such a system under operational conditions. This paper, which is intended for circulation to transit system and equipment manufacturers, contains a description of the requirements for AFC equipment and a set of preliminary specifications for two alternative approaches.

2. Automatic Fare Collection, P. Wood, The MITRE Corporation, Technical Report No. MTR-369, McLean, Va., May 1972.

The continuing search for increased efficiency in transit operations is resulting in the gradual elimination of manual tasks which can be performed with equal facility by automatic equipment. Revenue collection is receiving increased attention as a potential area for automation. Automatic fare collection systems are becoming common in rapid transit but have had a much slower rate of acceptance for bus systems. Systems currently in use or to be introduced in the near future are described, and there is a discussion of the future trends in cashless systems.

3. Automatic Fare Collection, D.F. O'Sullivan, W.B. Stevens, and P. Wood, The MITRE Corporation, Technical Report No. MTR-7186, McLean, Va., June 1976.

Automatic fare collection (AFC) systems vary from simple coin-operated turnstiles to complex electronic systems using magnetically coded tickets. While most AFC equipment has been installed on rail systems, attention is being directed towards similar applications for buses. Developments that have taken place in the three years since an earlier report are described in detail.

4. Demonstration Plan for an Intermodal Automatic Fare Collection System, W.B. Stevens, The MITRE Corporation, Technical Report No. MTR-7009, McLean, Va., August 1975 (not approved for public release).

The automatic fare collection techniques that have been successful in rapid transit systems have not been extended to buses. This demonstration plan defines a program to design and develop prototype Intermodal Automatic Fare Collection equipment, and measure its impact in an operational demonstration.

The program, which would be carried out in cooperation with a major transit property, would be accomplished in four steps — Contractor and Site Selection, Prototype Procurement, Prototype Evaluation, and Operational Demonstration.

5. Evaluation of a Registering Fare Box, B. Devine, The MITRE Corporation, Technical Report No. MTR-7133 (Controlled Distribution), McLean, Va., December 1975.

A registering fare box capable of providing revenue data in electrical form is an essential subsystem in the Operational Data Collection System (ODCS) being developed by The MITRE Corporation for UMTA's Office of Transit Management. One such fare box, the FR 10,000 Fare Box manufactured by Duncan Industries, was tested in the laboratory and on a GM5301 transit bus, and was found suitable for ODCS operation.

Laboratory investigations concentrated on the relative merits of the major functions and subsystems of the fare box, while tests on the transit bus were conducted to verify the unit's performance in the transit bus environment.

6. Impact of Fare Collection on Bus Design, H. Holcombe, W. Magro, and J. Mateyka, Booz, Allen and Hamilton, Inc., Bethesda, Md., Report No. IT-06-0132-79-1, PB 300-663, April 1979.

This report examines the potential impact on transit bus design of freeing the bus designer from the constraint that fares must be collected and/or monitored on-board the bus by the driver. Conceptual transit bus designs are developed which offer the potential for operating cost reductions and substantial improvements in passenger service characteristics. Current U.S. fare collection costs and total bus operating costs are assessed and compared to those possible with new buses and compatible off-board fare collection systems. The report contains considerable information on both bus design and fare collection system trends in the United States and Western Europe.

7. Impact of Fare Collection on Bus Design (Appendices A through G), W. Magro, J. Mateyka, and S. Mundle, Booz, Allen and Hamilton, Inc., Bethesda, Md., Report No. UMTA-IT-06-0132-79-2, PB 300-664, April 1979.

These appendices contain detailed information on transit bus fare collection systems operations and costs in the United States. Also included is an examination of Swiss experience with total off-board fare collection systems. European transit bus design trends and fare collection systems are surveyed. Drawings of a number of new bus design concepts compatible with off-board fare collection systems are presented. A discussion of technical, design, and operating cost issues related to bus design and off-board fare collection is presented. A very extensive bibliography on fare collection and transit bus design trends is included.

8. Intermodal Automatic Fare Collection System Phase II Final Report, P. Wood, The MITRE Corporation, Technical Report No. MTR-7141, McLean, Va., December 1975.

This report covers the second phase of the UMTA sponsored Intermodal Automatic Fare Collection Program which includes the development of system specifications, testing of critical sub-systems, and carrying out a detailed cost analysis. It has been established that it is technically feasible to install a complete automatic fare collection system on a bus. Estimated costs are approximately 13 percent higher than the target figure, but a system would still be cost effective in many applications.

9. Passenger Admission Processing Systems, Lea Transit Compendium, Volume III-Special Issue, 1976-77, N.D. Lea Transportation Research Corporation, Huntsville, Ala.

The N.D. Lea Transportation Research Corporation is using the forum of the Lea Transit Compendium to introduce the broader and more generic term, Passenger Admission Processing (PAP), defined as:

All procedures and devices used by transit system operators to provide orderly, lawful passage of passengers through the transit system from point of entry to point of exit. This includes all equipment and procedures, such as fare computation, fare collection, ticket issuing, cancellation and validation, admission and exit control, passenger flow control, revenue control (i.e., any incorporated revenue and/or passenger accounting process), revenue collection (i.e., retrieval), etc.

This issue is supplementary to the previous edition, Vol. III-Special Issue, 1976-77, titled Passenger Admission Processing Equipment and contains descriptions of PAP systems. Data used in this issue are based on information submitted by transit system operators/authorities throughout the world resulting from a world-wide survey.

4.3 SELF-SERVICE FARE COLLECTION

1. Self-Service Fare Collection - Volume I: Review and Summary, L. Diebel, S. Stern, L.R. Strickland, and J. Sulek, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-79-2, PB 80-132-251, August 1979.

European transit properties have widely adopted a method of fare collection known as self-service. Instead of being monitored and controlled by vehicle drivers and station attendants, passengers are allowed virtually unrestricted access to transit service and are responsible for determining and paying the fare themselves; special inspectors are used to check compliance and to penalize passengers who have not paid the correct fare.

This report describes the European approach to, and rationale for, self-service fare collection; documents the experience European transit systems have had with using and enforcing these procedures; and discusses the relative merits of the alternative approaches to self-service with respect to their application in the United States.

2. Self-Service Fare Collection - Volume II: Survey of European Transit Properties, L.R. Strickland, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-79-3, PB 80-132-269, May 1979.

Self-service fare collection is a system of fare collection that makes the passenger responsible for establishing and paying the correct fare. Passengers who fail to pay the correct fare are subject to penalty.

Transit properties in Europe have been using self-service fare collection, in several different forms, since the late 1960's. The potential advantages of self-service fare collection have lead to UMTA's Office of Service and Methods Demonstrations to sponsor a demonstration program in the United States. As part of the project effort, a survey of self-service operations was conducted. This report summarizes the information collected during visits to the transit properties using self-service fare collection. Information contained in this report includes network operating statistics, fare structure data, fraud statistics, maintenance data, and descriptions of self-service operations in each city.

3. Self-Service Fare Collection - Volume III: Hardware Considerations, L.E. Diebel, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-79-4, PB 80-132-277, September 1979.

European applications of self-service fare collection are typically supported by a variety of automated equipment to facilitate ticket purchase and validation by passengers and ticket sales by drivers and station attendants. This report describes the common hardware features employed by these ticket vending and validation devices and examines the general policy and hardware design trade-offs which need to be addressed by properties contemplating self-service implementation.

4. Self-Service Fare Collection - Volume III: Legal and Labor Issues, G.G. Eiseman, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-79-5, PB 80-132-285, August 1979.

Self-service fare collection makes the passenger responsible for determining and paying the proper fare prior to taking a trip. Complete monitoring or control of the payment of the proper fare is not performed by vehicle drivers, station attendants, or automatic equipment; all or nearly all responsibility for fare enforcement falls to special personnel who randomly check compliance. This method of fare collection is frequently referred to as an "honor" system. However, self-service does not completely transfer responsibility to the passenger since random inspection by roving checkers is a necessary feature of self-service.

The typical features of self-service represent substantial departures from the current operating procedures and existing legal powers of U.S. transit systems. This paper summarizes the legal issues of self-service operations in the U.S. transit environment. Also addressed are labor, economic, liability, and accessibility issues of self-service in U.S. applications.

5. <u>Self-Service Fare Collection - Functional Specifications</u>, L.R. Strickland, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-79-6, November 1979.

Self-service fare collection (SSFC), used very successfully in Europe, is a fare collection system that makes the passenger responsible for establishing and paying the correct fare. To demonstrate potential advantages of self-service fare collection in the United States, UMTA's Office of Service and Methods Demonstrations has decided to implement a SSFC demonstration at several U.S. transit properties.

This specification provides the general guidelines for the functional, environmental, and performance requirements for SSFC hardware that would be required for a successful SSFC operation.

6. <u>Self-Service Fare Collection System Requirements</u>, J.D. Sulek, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-79-7, November 1979.

This document highlights and discusses the critical, nonhardware requirements for self-service fare collection and provides guidelines outlining the actions, procedures, policies, and arrangements necessary to achieve a workable and efficient system. General requirements applicable across a range of specific system configurations are discussed in terms of the four major requirement areas identified - access, enforcement, information, and support services. In addition, specific requirements associated with five variant SSFC system configurations are examined. These general and specific system requirements have been developed as a part of, and are intended to support, the ongoing study and demonstration of self-service fare collection sponsored by UMTA's Office of Service and Methods Demonstration.

7. Self-Service Fare Collection Ticketing Procedures in Self-Service Systems, L.E. Diebel, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-80-1, Febraury 1980.

Self-service fare collection systems are characteristically ticket-oriented systems. Nearly all self-service systems use special devices which passengers can use directly to "validate" these tickets for trips in the transit system. However, self-service systems represent a broad range of ticket types from which to choose. The common approaches to self-service ticketing are reviewed and the relative merits of different ticket types and ticketing approaches are discussed.

8. Implementation Requirements for Self-Service Fare Collection Systems, L.R. Strickland, The MITRE Corporation, McLean, Va., Report No. UMTA-VA-06-0049-80-3, February 1980.

The Pricing Policy Division of UMTA's Office of Service and Methods Demonstrations is planning to demonstrate several alternative configurations of self-service fare collection.

This implementation plan describes the predemonstration implementation processes for the alternative configurations being considered for demonstration.

5. EQUIPMENT SUPPLIERS

5.1 U.S. SUPPLIERS OF AUTOMATIC AND SELF-SERVICE FARE COLLECTION EQUIPMENT FOR BUSES

Duncan Industries
Mass Transit Division
751 Pratt Boulevard
Elk Grove Village, Illinois 60007
(312) 593-8855

General Farebox Incorporated
4619 North Ravenswood Avenue
Chicago, Illinois 60640
(312) 561-8700

Shepard Transitron, Inc.
608 Fifth Avenue, Suite 802
New York, N.Y. 10020
(212) 582-9280

Standard Change-Makers, Inc.
422 East New York Street
Indianapolis, Indiana 46202
(317) 639-3423

Vapor Transportation Systems
6420 West Howard Street
Chicago, Illinois 60648
(312) 631-9200

Vultron, Inc.
Subsidiary of Trans Industries
6145 Delfield Industrial Drive
Waterford, Michigan
(313) 623-1626

5.2 EUROPEAN SUPPLIERS OF SELF-SERVICE FARE COLLECTION EQUIPMENT

AEG Telefunken
Nachrichten - und Verkehrstechnik
Fachbereich Fahrgastabfertigung,
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8 Rue de Torcy
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Control Systems Limited
(also known as Bell Punch Co., Ltd.)
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La Chau-de-Fonds,
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Cirencester GL71UF
England

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Birchstrasse, 210
8050 Zurich
Switzerland

Zawadil
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Austria

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