

An Inventory of Revenue Collection Equipment

Southern California Rapid Transit District
Operations General Department
October, 1982

Introduction

This is the third in a series of reports prepared by the Operations General Department on the issue of revenue collection. The first report entitled "An Analysis of Revenue Collection Costs" described the process involved in revenue collection and processing at the District. The second report, "Revenue Collection Alternatives for Cash Fare Payment and Monthly Passes", identified several issue areas related to revenue collection which required further study. The two primary issue areas identified as being of greatest concern to the District were the verification of full cash fare payments and the costs associated with the processing of currency fare payments.

Since the second report was written, a sales tax subsidy for transit was passed by the voters of Los Angeles County and later validated by the California Supreme Court. Under this initiative which was entitled Proposition A, the District bus fares are subsidized to a 50 cent base fare level for a three year period. After that time, the tax revenues will be transferred into rapid rail transit efforts. The fare subsidies will then be significantly reduced or eliminated. The current "Proposition A" 50 cent fare structure has helped to temporarily alleviate the problems of dollar bill processing and patron fare underpayment possible with large coin usage.

The District's drop-type farebox was designed to accommodate low cash fares, and it presently works well with the reduced fare structure. However, once the fare subsidy is discontinued in July of 1985, it will most likely be replaced with a base fare exceeding one dollar. At that time, the District will again face the enormous task and expense of processing large quantities of currency. District operators will also have the difficult task of verifying payment of large coin fares with fareboxes not designed for this situation.

I. Purpose of Study

This report attempts to define the District's revenue collection equipment needs for the next decade. It is the intent of the study to identify alternative revenue collection systems which may best meet the projected needs of the District under a variety of fare scenarios including the fare structure which will be implemented in July, 1985 to replace the Proposition A subsidy. This study also measures each available revenue collection system against the District's set of needs criteria. Finally, several systems which best meet the District's needs are identified.

These most promising systems will then be analyzed in a separate report. This following report will contain a benefit cost analysis of each of the systems recommended for further consideration, as well as of the current system. This next study will also describe how each of the systems under consideration would affect the various District functions linked to revenue collection if the systems were to be implemented.

II. Study Limitations

The evaluations of the revenue collection systems contained in this report are based on research by District staff, reports from other transit agencies, test results of equipment performance, and information provided by manufacturers. Historical data is limited, and almost non-existent, for certain types of revenue collection equipment due to their recent introduction into the transit marketplace and the lack of industry standards. For example, the life span of electronic registering fareboxes can only be speculated upon since the earliest installation of such equipment at any transit property was in 1974.

Also, the in-service data available from other transit agencies is limited. Certain areas of interest to the District, such as cost savings associated with various fareboxes and causes of road calls, have either not been monitored or unstable variables exist that prevent any significant measurements by the transit properties.

The marketplace for revenue collection systems is limited and highly competitive. In an effort to gain business, manufacturers appear to be eager to comply to the wishes of properties. However, their limited resources for research and development may prevent consideration or implementation of many suggestions and modifications.

III. Current Revenue Collection Problems and Proposed Alternatives

The District has less than three years to prepare for the fare structure that will displace the current 50-cent rate in July, 1985. Decision makers have three basic options concerning revenue collection equipment. These options are 1.) retaining, 2.) modifying, or 3.) replacing the existing system. If a new or a modified system is to be operational by July, 1985, a number of actions must be undertaken in a timely manner. These actions include selection of appropriate equipment type, specification preparation, bid processing, equipment testing and approval, as well as installation and training.

In order to reach a decision on whether or not the current equipment should be retained, replaced or modified, the limitations of the current equipment must be carefully evaluated. These limitations include the potential for fare underpayment and the high cost of currency processing. Consideration should also be given to the limitations of alternative types of equipment under consideration. These limitations include security, reliability and maintainability.

With the District's current drop-type fareboxes, operators have difficulty in visually validating correctness of payment involving a large number of coins. It is also difficult for operators to distinguish the difference between a partial or whole folded dollar bill, which allows for another common method of patron underpayment. The District's heavy passenger loading factors exacerbate this potential for underpayment.

The exact amount of lost revenue due to underpayment is, of course, unknown. However, Duncan Industries has estimated that revenue loss due to patron underpayment in a system using drop type fareboxes equates to approximately five percent of the total annual revenue which an agency should realize. Using this rate, uncollected revenues from underpayment of cash fares in FY 1980-81 can be estimated at \$4.7 million for the District. A farebox designed to verify individual fare payments in coins or bills or combinations thereof would ultimately help reduce revenue lost due to fare underpayment.

The second major weakness of the District's current equipment is inability to efficiently handle currency. The District's present single chamber vault mixes coins, tokens, tickets and bills. This necessitates the sorting of each vault at the Central Cash Counting Facility. Once the bills have been separated from the coins by hand, counting personnel can begin the tedious, manual task of unfolding, counting and stacking currency. Coins are placed into a sorting machine which mechanically separates the coins according to denomination and feeds the sorted coins into bags.

The most costly element in the counting and processing of farebox revenue is labor. In FY 1980-81, it cost the District over \$2.7 million to collect and process farebox revenue. Labor represents 69% or \$1.9 million of the total cost of collecting farebox revenue. A fare collection system capable of sorting coins and currency, and loosely stacking dollar bills would reduce the high labor costs now associated with processing currency collected in the District's present farebox equipment.

In order to reduce currency processing costs, the District has attempted via a publicity campaign to discourage dollar bill usage for fare payment. These efforts have not, to a large degree, been successful. The public appears to favor the convenience of dollar bills, and they have not been receptive to campaigns promoting the use of discounted tokens in lieu of currency. As long as fares equal or surpass one dollar, it is likely that riders will use dollar bills for payment. Provisions must, therefore, be made for the processing of this currency.

One approach to handling the currency problem would be to install fareboxes capable of accepting, counting and maintaining separation of coins and bills. Based on the conclusion of the District's January, 1982 report, "Revenue Collection Alternatives for Cash Fare Payment and Monthly Passes", by the Operations General Department, the registering farebox system was identified as having significant potential for recovering lost revenue, and for reducing labor costs associated with currency processing. This potential of the registering fareboxes to control patron fare underpayment and to reduce labor costs associated with counting currency makes it an attractive alternative. However, as the report noted, there are several limitations of the registering fareboxes in use today. These limitations include higher maintenance costs and lower service reliability than traditional fareboxes. These trade-offs will be explored in a benefit cost analysis contained in a report to follow.

Trade-offs will have to be made in the selection of any equipment. However, in making these trade-offs, it is important to be cognizant of the characteristics of an ideal revenue collection system. The purpose of presenting the following description of an ideal system is twofold. First it establishes grounds for comparing and measuring available systems against an ideal. Secondly, it provides manufacturers with a perspective of what the District desires from a revenue collection system.

Based on a combination of existing District farebox specifications and projected revenue collection needs, the following characteristics can be considered as an ideal revenue collection system. The first six characteristics are quantifiable. These are summarized

in Table 1. The table also measures each type of farebox listed in the inventory against each quantifiable characteristic. The remaining four characteristics of an ideal system are more subjective in nature and thus, more difficult to measure. These characteristics are outlined in the inventory itself.

1. A farebox capable of accepting, and registering all denominations of U.S. coins, dollar bills and District tokens in a timely and accurate manner.
2. Registration and display of individual fares should be presented clearly in view of both operators and patrons.
3. Unfolded, flat bills should be stacked and stored in a separate chamber in the cashbox.
4. A dual chamber cashbox with not less than 700 cubic inches, capable of holding \$500 in assorted coins, and a minimum of \$300 in dollar bills.
5. The option of equipping the farebox with data components capable of gathering information on fares and passengers.
6. Manufacturer product support in the form of service, training, and warranties.
7. A vault locking mechanism that has proven reliability and security features.
8. A fare removal system that does not expose the money until it reaches the counting facility. Security should be the utmost concern.
9. Readily available replacement parts for the projected life span of the product.
10. Operating costs that do not exceed those associated with the current District system taking into account justifiable savings which may be associated with the new equipment. Ability to meet operating performance standards must be demonstrated through in service testing.

IV. Current Fareboxes Available to the Transit Industry

The purpose of evaluating the various registering and non-registering fareboxes now available is to determine what types and models are most suitable for District specifications and needs. The evaluation is organized by farebox type, manufacturer, and level of farebox sophistication.

Southern California Rapid Transit District
Table 1
Quantifiable Characteristics of the Inventoried Fareboxes

Quantifiable Characteristics	Model: Acceptafare Mfr.: Duncan	Model: Farescan Mfr.: Duncan	Model: Farecount Mfr.: Duncan	Model: Keene System I Mfr.: Keene Corp.	Model: Cleveland-Johnson Mfr.: Keene Corp.	Model: Transview 100 Mfr.: GFI	Model: K-25 Mfr.: Keene	Model: K-50 Mfr.: Keene	Model: K-150 Mfr.: Keene	Model: Faretronic Mfr.: Duncan	Model: Cents-A-Bill Mfr.: GFI
1. Accepts all U.S. coins up to the size of a half dollar, dollar bills and District tokens.	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes
2. Registration and display of individual fares should be presented clearly in view of both operators and patrons.	Registers:-No Displays:-Yes	Registers - No Displays - Yes	Registers - Yes Displays - Yes	Registers - No Displays - Yes	Registers - No Displays - Yes	Registers - No Displays - Yes	Registers - No Displays - Yes	Registers - No Displays - Yes	Registers - No Displays - Yes	Yes	Yes
3. Unfolded, flat bills should be stacked and stored in a separate chamber in the cashbox.	No	Yes	Yes	No	No	Yes	No	No	No	Yes	Yes
4. A dual chamber cashbox, 700 cubic inch capacity; holds \$500 in coins; holds \$100 in bills;				No Vac/Dual Vault/Single Vit.	No	Yes	No	No	No	Yes	Yes
	No	Yes	Yes	Yes No No	No	Yes	No	No	No	Yes	Yes
	No	Yes	Yes	Yes-mix No	No	Yes	No	No	No	Yes	Yes
	No	Yes	Yes	Yes-mix No	No	Yes	No	No	No	Yes	Yes
5. The option of equipping the farebox with data components, capable of gathering information on fares and passengers:	No	Yes	Yes	Yes	No	Yes	No	No	No	N/A	N/A
6. Manufacturer product support in the form of service, training and warranties.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NON-REGISTERING FAREBOXES:

Non-registering fareboxes simply accept fares and hold them until removed from the bus.

1. Model: Acceptafare

Manufacturer: Duncan Industries

Transit Systems Currently Using This Equipment: Chicago Transit Authority, Golden Gate Transit.

Strengths: Acceptafare is considered a "proven" drop-type farebox. It accepts all denominations of coins, tickets and folded bills through a single slot.

Weaknesses: Offers no advantage over the District's current system. The compatible cashbox, Duncan's Securafare, is a drum-like single chamber container, with a capacity of only 360 cubic inches which would not meet the District's needs. Serious problems of cashbox jamming from dollar bills have been reported.

2. Model: Farescan

Manufacturer: Duncan Industries

Transit Systems Currently Using This Equipment: Santa Clara County Transit District, Sacramento Regional Transit District

Strengths: Farescan is designed to accept unfolded dollar bills, tickets, and all denominations of U.S. coins, keeping them separate throughout the entire collection process. A large vertical inspection plate clearly displays coins and unfolded currency. Dollar bills are loosely stacked and remain flat in the vault. Farescan's design allows it to be upgraded to a registering farebox. The registering component can be installed on the fareboxes in the field, in 20-25 minutes, at a cost of \$1,000 per unit. The accompanying cashbox, Duncan's Quantafare, has dual chambers to hold separated bills and coins, with a total capacity of 750 cubic inches.

Weaknesses: Properties that have monitored Farescan's performance, either on a test basis or while in service, report occasional jamming problems from dollar bills. The major cause of road calls is from the bill jamming problem. Santa Clara County has noted that spare parts are not readily available from the manufacturer.

3. Model: Farecount.

Manufacturer: Duncan Industries

Transit Systems Currently Using This Equipment: No transit system is currently using this farebox. C-Tran, in Vancouver, Washington just completed a two-week pre-award test on the Farecount. Based on their positive test results, C-Tran has ordered 60 Farecounts. Duncan will be delivering the fareboxes in late 1982. C-Tran will install the fareboxes under Duncan's direction.

Strengths: Farecount is unique in that it is a non-registering farebox, which counts and displays individual fare payments on a digital read-out. Coins and flat bills are displayed on separate, vertical inspection plates. Farecount can be upgraded to a registering farebox, while on a bus, in approximately five minutes at a cost of \$500 per unit, according to Duncan Industries. The accompanying cashbox, Quantafare, has dual chambers for separate storage of coins and bills, with a total revenue capacity of 750 cubic inches.

Weaknesses: Farecount is not intended for data system application, unless it is modified to a registering farebox. There is a lack of historical or performance data due to the newness of the farebox. Maintenance is likely to be higher than with a drop type box.

4. Model: Keene System I

Manufacturer: Keene Corporation

Transit Properties Currently Using This Equipment: Washington Metropolitan Area Transit Authority (WMATA), Metropolitan Atlanta Rapid Transit Authority (MARTA).

The non-registering Keene System I Farebox is designed to be compatible with three different cashbox systems. The farebox has a single slot that accepts all forms of payment. The wrap-around, see-through panels surrounding the display plate enhances visual inspection of fares. A somewhat unique device filters and channels coins and bills into separate piles on the inspection plate to help operators verify fares. Bills and coins are routed together into the vault.

Strengths: Properties claim that the farebox is reliable, easy to maintain and cost effective. Three different cashbox systems or pedestals can be used with the farebox. The Vac Pedestal has a 1,000 cubic inch revenue capacity. Revenue is removed with a vacuum probe which transfers the revenue to a central processing unit.

The dual vault pedestal operates on a two cashbox box system, i.e. a full cashbox is pulled and replaced with an empty one. The single vault pedestal operates on the concept that the full cashbox is removed, and returned to the farebox in one operation. Both the dual and single vault cashboxes have a 400 cubic inch capacity.

Weaknesses: Properties have reported problems with bills jamming the fareboxes resulting in road calls. Bills are only accepted in a folded condition. Currency and coins are mixed together in the cashbox. The security of vacuum probe that is used with the Vac Pedestal can and has been defeated on a number of occasions. The 400 cubic inch cashboxes would not meet the District's vault capacity needs. The farebox would not be an improvement over the District's current farebox.

5. Model: Cleveland-Johnson

Manufacturer: Keene Corporation

Transit Systems Currently Using This Equipment: SCRTD, Central Ohio Transit Authority, Honolulu Bus System, Mass Transit ADM (Baltimore, MD.), Greater Bridgeport Transit District, Riverside Transit Agency, Montreal Urban Community Transportation Commission.

Strengths: This farebox is a well proven non-registering farebox. Maintenance is minimal. District patrons are accustomed to the fareboxes. It is simple and easy to operate.

Weaknesses: This farebox can only accept dollar bills in a folded condition. Coins and bills are routed together into the vault. Locks on cashboxes do not always secure in place as the cashbox is being removed from farebox, causing exposure of money and security problems. The vault has a total revenue capacity of only 297 cubic inches.

6. Model: Transview-100

Manufacturer: General Farebox Incorporated

Transit Systems Currently Using This Equipment: Windsor Transit, Windsor, Canada; Sarasota County Area Transit, Sunline Transit, (Palm Springs)

Strengths: Transview-100 accepts coins and tokens up to the size of a half-dollar. A separate slot accepts unfolded bills. The coin plate allows display of up to 20 coins, while the vertical bill area displays unfolded dollar bills. Transview-100 can be upgraded to a registering farebox, at an approximate cost of \$1,000 a

unit. Units need not be removed from buses to be upgraded. The accompanying cashbox, Dualport, has dual chambers capable of holding \$500 in coins and \$500 in dollar bills, with a total capacity of 765 cubic inches.

Weaknesses: Transview-100 is a relatively new farebox without performance documentation. The farebox was introduced in October, 1981. The first installation occurred in June, 1982 on Sunline Transit Agency's (Palm Springs) 31 buses.

7. Other Non-Registering Fareboxes: There are an assortment of non-registering fareboxes available and in use in the transit industry. These models include Diamond, Grant, and Main boxes. However, they do not offer any advantage over the District's current system. Security features on these fareboxes are also not as effective as those on the District's present equipment.

MECHANICALLY OPERATED REGISTERING FAREBOXES

8. Models: K-25, K-50, K-150

Manufacturer: Keene Corporation

Transit Properties Currently Using This Equipment:
Massachusetts Bay Transportation Authority, The Metropolitan Transportation Authority (New York), Metropolitan Transit Commission (St. Paul, MN.), Southwest Ohio Regional Transit Authority (Cincinnati, Ohio), Metropolitan Dade County Transportation Administration, Santa Monica Municipal Lines, Orange County Transit Authority.

All three K-Series models operate on the same principle, but they differ in the maximum denomination of coins that are accepted. The K-25 accepts nothing larger than a quarter; the K-50 accepts nothing larger than a half-dollar; the K-150 accepts all denominations of U.S. coins including the Susan B. Anthony dollar.

Coins and tokens are inserted through a single slot onto an inclined inspection plate. Dollar bills and tickets cannot be used as they will cause the registering mechanics to jam. After inspecting the fares, the operator depresses a bar which advances the fares to the registering mechanism. Coins and two sizes of tokens are recorded on separate registers. Individual fare verification is not possible as cumulative, rather than individual fares, are registered. The accompanying cashbox has a 360 cubic inch revenue capacity. The K-Series farebox is also available with a vacuum vaulting system.

Strengths: The K-Series is a good, proven farebox for properties with an exact fare policy and with fares under one dollar. Current satisfied users facing a fare increase over the dollar mark reportedly are investigating alternative systems that can accommodate dollar bills.

Weaknesses: The K-25, and K-50 do not accept all denominations of coins. None of the fareboxes are capable of accepting dollar bills without first being folded, placed in an envelope, and inserted through a separate slot located in the farebox pedestal. Currency enclosed in an envelope only adds to the cost of revenue processing as it must then be removed as well as unfolded, flattened and stacked. It could also slow the boarding of patrons at busy locations. Heavy coin usage has caused register mechanism jams at New York City. The problem became so severe that they removed the registering element from the boxes in order to make them straight drop boxes. The cashbox revenue capacity also falls below District requirements. The registering device cannot verify individual fare drops. Therefore, patron underpayment cannot be determined and prevented.

District staff have observed the K-Series fareboxes in operation at local properties. Performance measurements indicated that it takes fifteen seconds for processing of any three denominations of coins, and 36 seconds to count \$2.25 in quarters, dimes and nickels. With District boarding conditions, these processing time requirements are far too excessive.

ELECTRONIC REGISTERING FAREBOXES

This type of farebox is designed to count and verify individual, and cumulative fare payments.

9. Model: Faretronic

Manufacturer: Duncan Industries

Transit Systems Currently Using This Equipment: A.C. Transit, (Oakland), Bi-State, (St. Louis), Indianapolis, MSBA, (Suburban New York) New Orleans, Norfolk, VA., PAT, (Pittsburgh), R.T.A., (Suburban Chicago), SEPTA, (Philadelphia), and Westchester County.

Faretronic is designed to count all denominations of U.S. coins at the rate of twenty coins per second, and to accept unfolded dollar bills. After fares are displayed on separate, vertical inspection plates, they are routed to the dual chamber Quantafare cashbox. Bills and coins remain separate throughout the collection process.

Individual fare payments are displayed on a bright, digital read-out. The farebox is equipped with a micro-computer to record and store revenue and passenger data, and a L.E.D. data register which displays totals. A control panel with twelve passenger classification push buttons allow operators to record types of fares received.

Strengths: The Faretronic is the earlier, and more widely used of the two electronic registering fareboxes in the United States transit industry. It is designed to handle bills, count individual fares, and maintain separation of bills and coins throughout the collection process. This separation of coins and currency significantly reduces the cost of processing revenue. Faretronic is also designed to gather passenger and revenue data. This information is currently being gathered manually at the District. Ability to count individual fares means elimination of patron fare underpayment. The first Faretronic, Model 1, was installed in September, 1974.

Weaknesses: Current transit agency users complain of occasional miscounting of cumulative fares or inaccurate registration of individual fare drops. Users accept the error variance from miscounting as inevitable and consider it small enough not to distort the overall data. Properties that have switched from non-registering fareboxes to Faretronic report a significant increase in farebox related road calls. Jamming of boxes from bills is the most frequent cause of road calls. The sophistication of the equipment produces a greater need for preventative maintenance, and care in handling the equipment. These factors result in an increase in maintenance costs over those associated with the drop-type box. Dust particles from vacuum cleaning of the bus can cause problems in the fareboxes. Some properties cover the fareboxes during the vacuuming process. The security of the vault system may not be up to the District's desired standards.

10. Model: Cents-A-Bill

Manufacturer: General Farebox Incorporated (GFI)

Transit Systems Currently Using This Equipment: (On a pre-award or pilot test basis) Dallas Transit System, Utica, New York, MARTA (Atlanta, GA.) and Washington Metropolitan Area Transit Authority (Washington, D.C.).

Cents-A-Bill operates very much like Duncan's Faretronic system, except that the GFI method of verifying coins operates on a light-sensitive plate. Cents-A-Bill is a new product, and was recently (July-August 1982) tested

by Dallas Transit System. GFI was awarded a contract from Dallas, and will be installing 550 units starting in November, 1982.

Strengths: Cents-A-Bill accepts and counts all denominations of coins, as well as tokens and dollar bills. Fares are displayed on vertical inspection plates and fare amounts are registered on a digital read-out, alleviating the problem of patron fare underpayment. Cents-A-Bill is designed to keep currency and coins separate in a 765 cubic inch dual chamber cashbox called Dualport. Separation of fares significantly reduces the cost of processing revenue. There are twelve passenger classification buttons for operators to record types of fares paid. The farebox also has built-in provisions for the transmission of passenger and revenue data. Gathering of this data is currently done manually at the District.

Weaknesses: This is yet to be a proven product. Properties have begun testing the farebox, but no systemwide installation has yet been implemented. District staff observed the farebox during the Dallas test and noted that the design of the coin receiving cup required coins to be dropped singly and with care into the farebox. District boarding conditions necessitate a farebox capable of handling large sums of coins in a timely and accurate manner. Bouncing or stacked coins, combined with a moving vehicle, can cause an inaccurate registration of coins. The dollar bill transport operated quite well when crisp unfolded bills were inserted. However, very worn or rumpled bills were not always accepted by the mechanism. Currency jams that occurred appeared to clear with the insertion of the next bill. A strong preventative maintenance program is needed with the Cents-A-Bill farebox. Maintenance costs for these boxes would probably exceed current maintenance costs for the District's drop type boxes.

V. Conclusion

The trend and acceptance of dollar bills as fare payment has been acknowledged by manufacturers incorporating bill recovery and display plates in their farebox product line. Specifications for registering fareboxes appear to technically meet the District needs. However, documentation and observations of in-service performance of this equipment illustrate the need for continued product improvements. High District standards and the necessity for a product with proven durability may rule out the registering fareboxes currently available.

In reality, there is no farebox currently on the market that completely meets District needs. However, the necessity to prepare for anticipated post-Proposition A fare changes and the need to control costs suggest that a decision on this matter should be reached soon. Given what equipment is available in light of the limited time frame available for decision makers, the following options should be considered:

- A. Purchase non-registering fareboxes that accept unfolded currency, count individual fare drops, and are designed to be capable of upgrading to a registering farebox. Manufacturers may improve the registering components to a level of performance acceptable to District standards over a period of time.
- B. Purchase registering fareboxes, making any modifications deemed necessary after testing, and accepting any operational weaknesses that may exist, including a much heavier maintenance effort than that which is required for the District's present system.
- C. Outfit the majority of the bus fleet with non-registering fareboxes that accept dollar bills, with an upgradable option. Install registering fareboxes on the balance of the fleet with the intent of utilizing these buses equipped with registering fareboxes for data collection. Buses could be assigned to lines needing passenger or fare data on a rotational, on-going or as-needed basis. Currently this type of passenger data collection revenue is done on an annual basis, so its timeliness and accuracy cannot be assured.

Each of the above three options, as well as the option of retaining the present revenue collection system, will be examined in greater detail in a report to follow. This next study will attempt to quantify the costs and the benefits associated with each option. Whichever option is selected, the purchase of any new farebox should be preceded by preliminary equipment tests conducted by the District. Once the fareboxes are tested in the District's own operating environment, positive and/or negative variances may surface that were not detected or present in previous tests by other agencies.