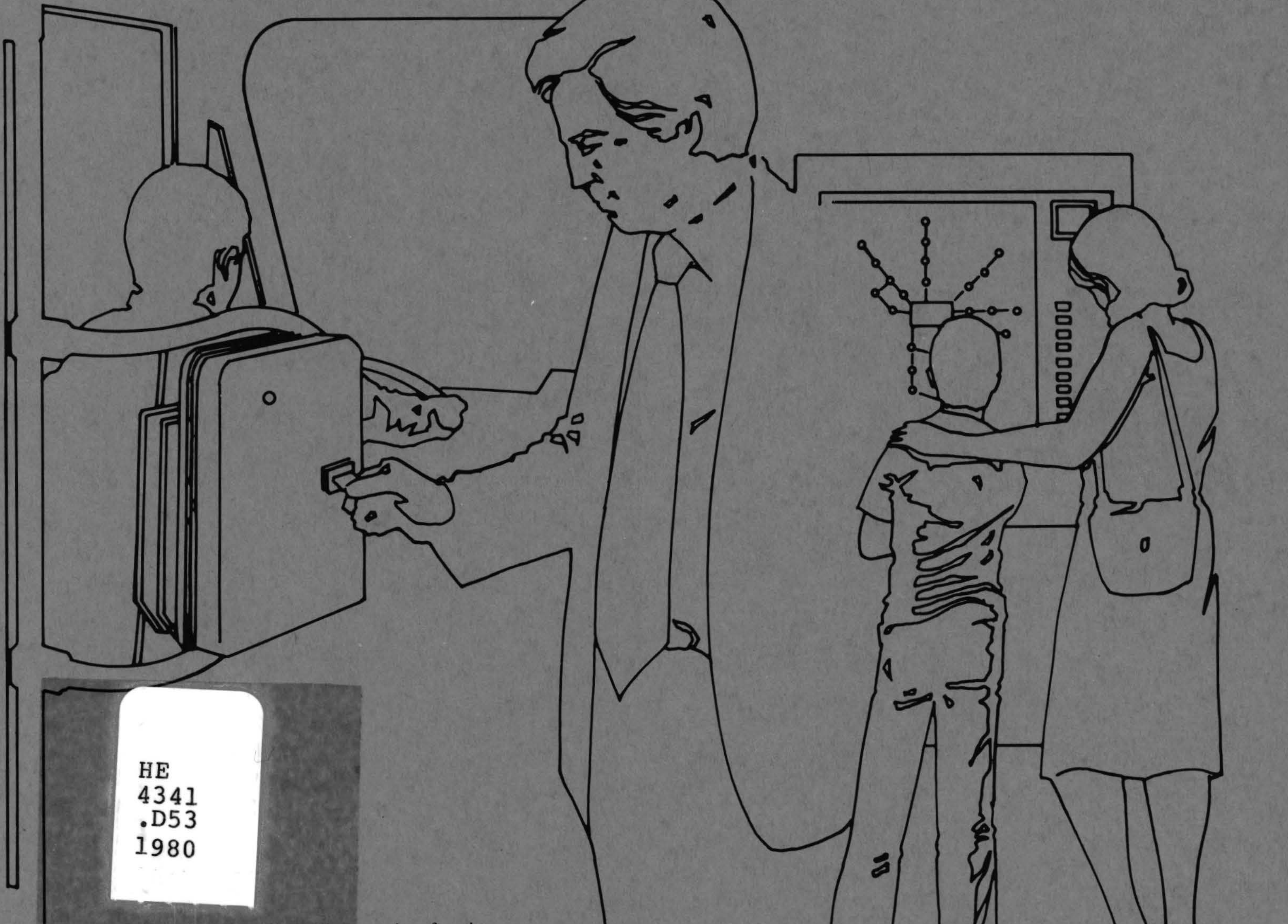
Self-Service Fare Collection

Ticketing Procedures in Self-Service Systems



Prepared by the Mitre Corporation for the

U.S. Department of Transportation
Urban Mass Transportation Administration
Office of Service and Methods Demonstrations
Washington, D.C. 20590

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-VA-06-0049-80-1		

4. Title and Subtitle	5. Report Date
TICKETING PROCEDURES IN SELF-SERVICE SYSTEMS	FEBRUARY 1980
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
LAWRENCE E. DEIBEL	MTR 79W00451
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
The MITRE Corporation, Metrek Division 1820 Dolley Madison Boulevard McLean, Virginia 22102	11. Contract or Grant No. DOT-UT-80047
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	
U.S. Department of Transportation Urban Mass Transportation Administration Office of Service and Methods Demonstration Washington, D.C. 20590	14. Sponsoring Agency Code

15. Supplementary Notes

Urban Systems Department
Project Number: 1239B

16. Abstract

Self-Service Fare Collection is common practice in most European cities and is beginning to be considered by a number of U.S. transit operators. In most self-service systems, the driver is relieved of most of the responsibility for fare collection and of all the responsibility for the monitoring of fare payment. Instead, the passenger is responsible for the payment of the proper fare and this payment is randomly enforced by special transit personnel. Several demonstrations of this fare collection technique are being planned and supported by the Office of Service and Methods Demonstration, Urban Mass Transportation Administration.

Self-service 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.

17. Key Words	18. Distribution Statement
Self-Service Fare Prepayment Multi-Trip Tickets European Transit Fare Collection	Available to the Public through the National Technical Information Service Springfield, VA. 22161

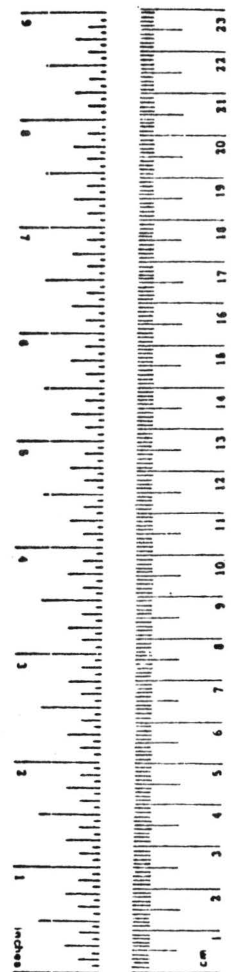
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	40	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

METRIC CONVERSION FACTORS

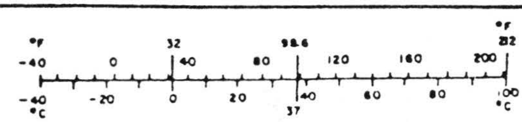
Approximate Conversions to Metric Measures

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



Approximate Conversions from Metric Measures

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



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1. INTRODUCTION

The Office of Service and Methods Demonstration, Urban Mass Transportation Administration, is planning to support several demonstrations of the European fare collection technique known as self-service fare collection. Part of this effort has included a survey of European self-service practices and the preparation of several documents describing the European experience and discussing the application of such techniques in the U.S.[1,2,3,4] In addition, documents covering the functional specifications for system hardware and general system requirements have been prepared.[5,6]

Self-service systems are highly ticket-oriented. Special devices, called validators, are used to "validate" these tickets (cf. Volume I, p.6). These validators permit extensive use of multi-trip ticketing; in many European systems multi-trip tickets account for greater than 50 percent of all trips. Individual trips in self-service systems are also ticket-oriented; even when cash is paid for an individual trip, a ticket, i.e. a receipt, is necessary to provide the passenger with sufficient proof-of-payment in the event of an inspection.

European systems provide a variety of examples of the use of different approaches to both single-trip and multi-trip ticketing and also of the use of radically different types of tickets--all with apparent success. It is difficult, therefore, to ascertain which of the many options represents the best approach for a new implementation of self-service, particularly for the introduction of self-service in the U.S., since very few of the alternatives are either wholly impractical or unadvisable. Various trade-offs involving factors such as equipment cost, passenger convenience, propensity for fraud, fare pricing flexibility, and user equity enter into this decision process.

Subsequent sections discuss these various trade-off decisions. Section 2 compares the basic alternatives to multi-trip ticketing and Section 3 reviews the options within single-trip ticketing. Recommendations relative to the proposed implementations in the U.S. are presented in Section 4.

2. MULTI-TRIP TICKETING IN SELF-SERVICE

The multi-trip ticket is not unique to self-service systems. A number of U.S. transit properties offer a multi-trip ticket as a convenience because of the exact-change requirements of the cash fare system. Although some properties sell a punch-style of multi-trip ticket which is valid for a specified number of rides, the majority of the multi-trip tickets being used in the U.S. are tear-off tickets. Having the physical appearance of a single ticket, these tear-off tickets are actually strips of individual single-ride tickets; they are the ticket-equivalent of tokens.

Overall, the use of multi-trip tickets in the U.S. is very low because they are cumbersome for the operator to handle and because they typically are marketed solely for passenger convenience and without discounts. The tear-off tickets introduce a significant amount of paper into the system and thus complicate the farebox collection of fares and the handling and accounting of revenue. The punch-style ticket is impractical for most properties because of the additional activity required by the driver; for many properties, the extensive use of punch tickets on high volume lines would result in significant service degredation due to increased vehicle dwell. And, because few multi-trip tickets in the U.S. are discounted, passenger attraction to the convenience of the multi-trip ticket is frequently offset by the effort required to purchase the ticket. The measure of convenience afforded by the present multi-trip ticket may become quite marginal, for example, in some zoned systems which also require a cash supplement in addition to the multi-trip ticket.

The European approach to multi-trip ticketing, on the other hand, is quite different. Because European self-service systems provide special devices called validators or cancellers which the passenger uses directly to "validate" individual trips with the multi-trip ticket, the multi-trip ticket does not represent an additional driver burden or contribute to increased dwell time. In fact, the opposite is most often true; increased usage of multi-trip tickets contributes to increased service productivity because the substitution of the validator for driver "validation" removes the requirement for front-door-only boarding. In high capacity situations, the use of multiple validators divides the boarding queue and may significantly reduce dwell time.

In self-service systems, therefore, the multi-trip ticket has considerably more appeal both to the transit operator and the transit consumer than its U.S. counterpart. For the operator, multi-trip ticketing streamlines rather than complicates fare collection. And because of tangible benefits such as decreased dwell time and decreased driver involvment, the operator is more inclined to offer a discount to encourage its use. For his or her part, the passenger in the self-service system gains not only the convenience of not having to pay cash for each trip and the financial benefit of the discount but also is rewarded by being allowed quick and easy access to the vehicle.

2.1 Types of Multi-Trip Tickets

Almost all European self-service multi-trip tickets fall into one of five categories:

1. The "Cut-and-Stamp" ticket as used in Geneva, Switzerland (cf. Volume II, p.76) is designed to permit the passenger to insert the ticket into the validator in the same manner for each trip. In addition to stamping the appropriate validation information onto the ticket, the validator cuts a portion of the ticket so that on subsequent insertions the information will automatically be printed on an unused portion of the ticket.

2. The "Orient-and-Stamp" ticket as used in The Hague, Netherlands (cf. Volume II, p.91) must be oriented by the passenger prior to insertion into the validator so that the validation information is printed on an unused portion of the ticket.

3. The "Fold-and-Stamp" ticket as used in Munich, West Germany (cf. Volume II, p.126) permits the passenger to insert the ticket in same orientation each time. However, because the validator merely stamps the ticket, the passenger must fold the ticket so that the information will be printed onto the proper location. In zonal systems where each segment of the ticket corresponds to a trip segment rather than a full trip, the passenger must not only ensure that the ticket is folded so that printing will occur on an unused segment but that it will appear on the proper segment i.e., the validation sequence is crucial to proper validation.

4. The "Tear-and-Stamp" ticket as used in Cologne, West Germany (cf. Volume II, p.31) is the European equivalent of the U.S. tear-off multi-trip ticket. In practice, most passengers do not physically tear apart the ticket but fold the ticket so that an unused portion is validated for each trip. This ticket differs from the "Fold-and-Stamp" style of ticket in that sequence is not important; the tickets are separable and may be distributed in booklet form or as loose tickets. Trips which require the use of more than one ticket segment require that each ticket be validated separately.

5. "Stack-and-Punch" tickets as used on the bus system in Paris, France (cf. Volume II, p.147) are essentially similar in nature to the "Tear-and-Stamp" tickets in that they are individual tickets. The primary difference is in their validation. When the ticket is inserted into the validator, the validator will simultaneously stamp and punch the ticket; this cutting of the ticket is designed so that trips requiring more than one ticket can be validated with a single insertion. The relationship of the punched holes ties the group of tickets together in a way that is unique for each validation.

As indicated, each type of ticket requires a different degree and type of passenger involvement. The "Cut-and-Stamp" version is the most straightforward and convenient for the passenger in most instances. It is also the most readily adaptable to the use of special validators designed to accept and validate only legitimate tickets (cf. Volume III, p.21). However, as evidenced by the number of properties which do not use such a ticket but prefer one of the other ticket types, the "Cut-and-Stamp" ticket is not necessarily the ultimate or best ticket for all self-service applications. One of the other forms of multi-trip ticketing might be approprate to a specific application depending on:

a. the number of passenger classifications,

b. the complexity of the fare structure to be accommodated,

c. the types of trips made by the typical user, and

d. the manner in which self-service is introduced to the system.

2.2 Limitations of European Experience

The manner in which self-service is introduced to the transit system can have a significant bearing on the type of multi-trip ticket that will be adopted. In fact, for many European operations, it has been the overriding factor determining the evolution of the system to its present form.

Copenhagen and Cologne provide examples of the two extremes in this respect. Copenhagen recently made a system-wide shift from a token-based self-service system to a ticket-based system. Because its bus system did not have validators of any type, it had considerable flexibility in choosing the type of validator it would use. Copenhagen chose the "Cut-and-Stamp" form of ticket partly because of the convenience it offered its passengers and partly because it desired the ticket recognition features available with such a validation.

Cologne's self-service system, on the other hand, evolved in a more piece meal fashion. Cologne began its self-service by modifying the device used by the conductor into a validator for use by passengers on lines from which conductors had been removed. Thus, Cologne's self-service gradually expanded with passengers using the same tickets on both the self-service and the conductor-serviced portions of the network.

The unique aspect of Cologne's validators compared to most is that instead of printing validation information across the face of the ticket (i.e., perpendicular to the direction of ticket insertion), Cologne's validators print horizontally to the direction of ticket insertion. Such horizontal imprinting allows Cologne to use narrow throat validators and small tickets without squeezing the data into a small area on the ticket. As long as most trips could be completed using one ticket--as was the case when transit operations were wholly within Cologne--the system presented few problems.

However, transit regionalization over the past few years has greatly expanded the transit network with the Cologne system being but one of five transit operators in the 597 route-kilometer system that also includes Bonn, West Germany. Because of the direction of the printing during validation, Cologne is prevented from adopting the "Fold-and-Stamp" approach to multi-zone trips--which incidentally Bonn does use. The result is that passengers making trips of more than two zones must validate more than one ticket for each trip. Although infrefrequent, a passenger might have to insert his ticket as many as five times to complete a ten-zone trip; between each insertion, the passenger must refold (or tear apart) the ticket so that an unused (new) ticket is inserted each time.

On the surface, the two examples appear to provide an important lesson from the European experience with self-service. Copenhagen began its ticket-based form of self-service essentially from scratch and went with a system-wide implementation; it appears as a result to have a very convenient self-service system. Cologne, on the other hand, adopted self-service on a line-by-line basis; its present form of self-service appears to be cumbersome and inconvenient. The tendency, therefore, may be to conclude that the system-wide implementation may be the best and possibly the only way to implement a self-service system. The examples might also seem to indicate the merits of a "Cut-and-Stamp" style of ticket as opposed to other forms of tickets.

Such "lessons" from the European experience must be drawn with extreme caution, however, and must consider all the relevant factors which contributed to a particular system configuration. Cologne's "mistake" is not particularly the result of pursuing a phased implementation but rather of relying on a method of validator imprinting which was not readily adaptable to extensive transit regionalization. Had Cologne, for example, adopted the "perpendicular" approach to information printing, a "Fold-and-Stamp" style of ticket might have evolved to accommodate the zonal structure of today's system. The examples provide little insight into the merits of the Copenhagen approach versus such an alternative.

What the European experience does show, however, is that any new self-service system must consider fully not only the near-term operation of self-service but also its potential and flexibility relative to system changes and expansion. Because of the unique manner in which many self-service systems have developed in Europe, a number of their "lessons" are not directly applicable to the current U.S. effort. One cannot simply point to the apparent success of specific European configurations and conclude that it deserves to be modeled without considering the possible concessions which have been made during its development and whether or not such are also acceptable in the intended application. The following sections discuss some of these trade-offs which have guided European developments and which must be considered in new applications.

2.3 Scope of the Initial Implementation

A system-wide implementation of self-service provides the property the flexibility to choose the type of ticket and the method of validation it deems most appropriate for its present and future use. The price for having such flexibility is the need for extensive capital outlays at the very beginning and the preparation for an "overnight" system-wide shift to self-service. A system-wide conversion to self-service does not, however, dictate a particular ticket type. In a system-wide implementation, ticket choice is a matter of other considerations: fare flexibility, fare policy with respect to zonal charges, etc.

In a phased implementation, ticket type may be a major consideration. To the greatest extent possible, the self-service portion of the transit network must blend in and work with the remainder of the transit operation. This means that passengers originating on the self-service system should be able to transfer to the conventional system without additional fares, that passengers originating in conventional network should be permitted to transfer to the self-service system; and that both systems can be used freely for individual but independent trips.

In all three areas, the cash paying passenger can be handled without difficulty. The receipt in the self-service system can serve as the transfer for connecting with the conventional system and the transfer issued in the conventional system provides a proof-of-payment for the self-service system. Connections from the self-service network to the conventional system can also be readily accommodated using any one of the five multi-trip ticket types common to self-service provided the transit property does not require transfers to be surrendered to the driver. Several of the multi-trip ticket types, however, present some problems in completing trips originating on the conventional service or in their use for mixed types (Table 1).

Short of providing the driver with a special device to validate the multi-trip ticket, none of the combined multi-trip tickets (i.e., tickets which are not separable into individual tickets) can be readily used for these latter, problem types of trips. The driver cannot simply punch the ticket since this opens the possibility of the passenger using the ticket continuously for fare rides on the self-service system--by claiming it had just been validated by a driver. Consequently, in a mixed system a separable ticket is advantageous because it can be used on both parts of the system.

TABLE 1 - TICKET RESTRICTIONS POSED BY TYPE OF IMPLEMENTATION

Type of Ticket	System-Wide Implementation	Phased Implementation		
		Compatibility of Traditional Ticket with Conventional Fare Collection	Changes required to Interface with Conventional Fare Collection	Other Factors
Cut-and-Stamp	No Restriction	Poor Ticket would have to be validated manually in conventional network	Major During period of mixed operations, tickets would have to be sold loose or in booklet form	Guillotining of ticket during validation would facilitate visual inspection for farebox collection
Orient-and-Stamp	No Restriction	Ticket type essentially impractical for use in a phased implementation. The modifications required to accommodate its use in a mixed system would completely alter the character of the ticket into one of the other four types.		
Fold-and-Stamp	No Restriction	Poor Ticket would have to be validated manually in conventional network	Minor Ticket perforated to permit separation for use in conventional system	With multi-zone usage, passenger might attempt to use unstamped but used portions in the conventional system
Tear-and Stamp	No Restriction	Good Ticket separable for use as payment in conventional network	Minor Tickets would have to be collected by hand on conventional system to prevent re-use of validated tickets	Driver would collect and hold valuable tickets--requires methods to prevent re-sale by drivers
Punch-and Stamp	No Restriction	Very Good Ticket alteration permits visual inspection when deposited into farebox	None Tickets usable in mixed operations	Validation technique justified only for zonal applications.

This is not to say that the "Tear-and-Stamp" form of ticket is the only ticket that can be used but it is the most practical for phased implementations. Sold loose or in booklet or strip form, this type of ticket can be used in both parts of the system; it provides a surrenderable ticket for use in the conventional system. To prevent passengers from depositing previously validated tickets into the farebox for trips on the conventional system, it is advisable that drivers collect the tickets from the passengers instead. And because drivers would be collecting valuable, unused tickets, the booklet or strip form of ticket is probably advisable to provide at least some measure of preventing used tickets from re-entering the network as new tickets. If tickets are to be deposited by the passenger into the farebox, it is desirable for the validators to physically alter the ticket either by punching or cutting the ticket so that the driver can readily verify that an unused ticket has been deposited.

2.4 Fare Structure Considerations

Certain ticket types (and validation methods) are more appropriate to certain types of fare structures than others. The "Punch-and-Stamp" form of validation, for example, as currently used by some European systems is specifically designed to support a self-service system of relatively few zones. Its use in a flat fare system would be unjustified because the punch feature, which "ties" several tickets together in one validation, is unnecessary in a flat fare arrangement--unless, of course, a future change to a zonal system is made. Although the previous section notes that this form of ticket validation might facilitate the farebox collection of tickets in non-self-service portions of a transit system, its adoption in its traditional form would have to be justified on the basis of a possible transition to a zoned system. In a strict flat fare system, another form of physical alteration to permit visual inspection of the ticket would be preferred to avoid the complexity inherent in the random punch.

A comparison of all five ticket types with respect to fare structure is presented in Table 2. The table indicates the type of fare structure in which each ticket type is most appropriate i.e., whether a particular ticket type is characteristically a flat-fare ticket or a zonal-fare ticket. This comparison indicates several different ticket types have their best application in a particular fare structure category.

TABLE 2 - USE OF MULTI-TRIP TICKETS IN FLAT-FARE AND ZONAL SYSTEM

<table>
<tr><th>Type of Ticket</th><th>Flat Fare</th><th>Few Zones</th><th>Multiple Zones</th><th>Accommodation Of Different Trip Types</th></tr>
<tr><td>Cut-and-Stamp</td><td><u>Best</u>

Single validation per trip--same passenger activity each trip</td><td rowspan="2"><u>Good</u>

Several options available for use:

a. One validation per zone--with zone-imprinting validator

b. One validation per trip--with zone-imprinting validator, tickets specify number of zones from origin allowed

c. Without zone-imprinting validator--tickets specify actual zones where valid</td><td rowspan="2"><u>Conditional</u>

Incremental zone charge impractical since multiple validations required. Tickets must specify number of zones for which ticket is valid--requires grouping of fare prices to reduce number of different tickets.</td><td rowspan="2"><u>Fair</u>

Each ticket specifies the maximum number of zones of travel per validation--shorter trips possible but at same cost as longer trip. Different tickets required for different types of trips.</td></tr>
<tr><td>Orient-and-Stamp</td><td><u>Best</u>

Single validation per trip but convenience favors cut-and stamp</td></tr>
<tr><td>Fold-and-Stamp</td><td><u>Conditional</u>

Convenience favors other ticket type unless shift to multiple zones in future</td><td><u>Good</u>

Passenger charged according to use--readily expandable to accommodate additional zones</td><td><u>Best</u>

Trip of any number of zones possible with single validation with trip cost proportional to number of zones</td><td><u>Very Good</u>

Ticket designed to accommodate numerous trip types</td></tr>
</table>

TABLE 2- USE OF MULTI-TRIP TICKETS IN FLAT-FARE AND ZONAL SYSTEMS (Continued)

Type of Ticket	Flat Fare	Few Zones	Multiple Zones	Accommodation Of Different Trip Types
Tear-and-Stamp	Best One validation per trip--permits common tickets in mixed systems	Marginal Best accomplished through using different ticket types to avoid multiple validation	Poor Excessive number of validations required for multiple trips	Fair Accommodates different trip types--but usage tends to be cumbersome
Punch-and-Stamp	Conditional May be practical for farebox insertion in phased implementation	Best Validation technique specifically for zonal usage of individual tickets	Poor Probably impractical for use with a large number of zones	Good Passenger inserts number of tickets equal to number of zones

The comparison among the different ticket types in any particular category is more difficult since it is dependent on a number of other factors. In a flat fare application, for example, the decision between the separable types of tickets and the other types of tickets may depend on the scope of the initial implementation i.e., whether a system-wide or a phased introduction is planned. As indicated in Section 2.3, one of the separable forms of tickets may be more appropriate to a partial deployment.

In a system-wide application in a flat fare network, the choice is between the "Cut-and-Stamp" and the "Orient-and-Stamp" tickets. From the standpoint of passenger convenience and understanding, the "Cut-and-Stamp" style is obviously preferable--providing somewhat increased maintenance requirements are accepted (see Section 2.6). The "Cut-and-Stamp" version might also be favored from the standpoint of the control of fare evasion since it provides less opportunities for its misuse; although such appears legitimate, no documentation of this is readily available.

For zonal applications, a major consideration is the ability of the ticket to serve a variety of trip types. The Munich "Fold-and-Stamp" style of ticket, for example, is frequently characterized as being cumbersome, hard to understand, difficult to use, etc. because it requires the passenger to be well versed in its usage. However, the ticket is by far the most versatile with respect to accommodating different trip types. A passenger may readily use the same ticket both for trips involving a few zones and a large number of zones simply by choosing the number of zones which must be validated. Thus commuters may use the same ticket for both the trip to and from work (multiple zones) and for short midday trips (one or a few zones). Similarly, the occasional trip which involves a greater number of zones than normal can be taken with having to purchase a special ticket or pay a premium.

With other ticket types--for example, the "Cut-and-Stamp" ticket--special procedures must be established to permit such ticket flexibility. Even then, certain passengers will find it necessary to have more than one ticket to complete different types of trips.

Copenhagen procedures illustrate some of the ways of achieving greater flexibility with other tickets and some of the remaining problems. Basic fares in Copenhagen are handled using three different tickets (all of the "Cut-and-Stamp" format):

1. a nine-trip ticket valid for one to three zones of travel,

2. a ten-trip ticket valid for up to six zones,

3. a ten-trip ticket usable for travel over the entire system.

If a passenger having a three-zone ticket (Type 1) wishes to make a four-zone trip, he may at his option validate the three-one ticket twice to cover such a trip. By electing this option the passenger trip cost is approximately $0.88--still less expensive than a four-zone single-trip ticket ($1.20) but not as low as using the second type of ticket ($0.80). Similar opportunities are available for other trip combinations. Thus, a measure of ticket flexibility can be achieved with relatively minor inconveniences through careful pricing concessions. (Section 2.5 discusses the pricing aspects of multi-trip ticketing.)

The long-distance commuter, i.e., the typical holder of the third type of ticket, who wishes to make a shorter and less expensive trip has little recourse but to purchase a second ticket. Using the "long-distance" ticket would be extremely costly (approximately double the cost of a single-trip ticket).

2.5 Fare Pricing Considerations

As the Copenhagen example in the previous section has indicated, choosing between different types of tickets may depend on weighing of several factors including site demographics (types of trips expected) and fare pricing and policy considerations. Table 3 summarizes the bases for fare pricing inherent in each of the five ticket types and serves to indicate the nature of the fare policy commitment made when particular types of tickets are adopted.

In general, the "Fold-and-Stamp" and the separable forms of tickets are premised on zonal pricing. A fixed relationship exists between the price of the base fare and the zonal charges. As a consequence, zonal charges must be equal and changes to the fare level equally affect all trips.

The other forms of tickets are essentially "average-price" approaches to fares. Trips may be priced on the basis of trip type without specific reference to an incremental zone charge. Thus, fare pricing is highly flexible with unequal zone charges and a variety of discounts possible.

TABLE 3 - FARE PRICING CONSIDERATIONS IN MULTI-TRIP TICKETING

Type of Ticket	Traditional Basis for Trip Pricing	Relationship of Zonal Charges to Base Fare	Adaptability to Trips of Varying Length	Fare Adjustment Flexibility	Ticket Diversification
Cut-and-Stamp Orient-and-Stamp	<u>Individual Trip</u> Each segment of ticket corresponds to one trip of a specified number of zones; multiple validations usually permitted to allow several passengers to travel on same ticket.	<u>Flexible</u> Ticket pricing completely open --permits declining incremental pricing and uneven zone charges	<u>Poor</u> Difficult to use a ticket for a trip exceeding the specified number of zones. Use for a lesser number of zones results in unequal zonal charges	<u>Good</u> Isolated fare changes possible to individual elements of the fare structure	<u>Wide</u> A larger variety of tickets must usually be offered--several for each passenger classification (for zone systems). Special-purpose tickets may proliferate
Fold-and-Stamp	<u>Individual Zone</u> Each ticket segment corresponds to one zone of travel	<u>Fixed</u> Based fare must be equal to or a multiple of the zone charge	<u>Good</u> Passenger charged exactly for the number of zones	<u>Fair</u> Requires that base fares and zonal charges be changed together to maintain the relationship required for ticket use.	<u>Narrow</u> Generally, few ticket types are offered. Different fares for different classes of passengers are usually offered through modifications of the use of the limited number of available tickets.
Tear-and-Stamp Punch-and-Stamp	<u>Multiple Zone</u> Each ticket (segment) usually corresponds to more than one zone to reduce the number of tickets required for longer trip types	<u>Fixed</u> Base fare equivalent to a multiple of the zone charge; trips requiring additional zones must also use multiple zone tickets	<u>Fair</u> Trips in which number of zones is divisible by the multiple used in the ticket are fairly charged; others overcharged. Varying trip lengths are nevertheless possible.		

Either ticket type requires certain concessions, however, to keep the number of tickets to a minimum. The differences can best be illustrated by considering the adaptation of a particular ticket type to a specific fare structure. Consider, for example, the application of a "Cut-and-Stamp" ticket versus a "Fold-and-Stamp" ticket in a basic four zone system, the structure of which is shown in Table 4. Assuming no fare adjustments, three different "Cut-and-Stamp" tickets are required to accommodate the special user classifications and three more to accommodate the base and zonal fares. The "Fold-and-Stamp" form of ticket cannot be used without some adjustment to the fares such as, for example, the reduction of the base fare to $0.50. If such an adjustment were made, the system might be supported using only three tickets; special student and downtowner tickets continue to be necessary but senior citizens could use the standard ticket but validate only one section. Future fare levels would be accommodated in the same way for both tickets.

More radical modifications to the fare structure may permit an even greater reduction in the number of tickets required. For example, a base ticket having a value of $0.25 per segment combined with a half-price ticket would result in the fare levels shown in Table 5. Similar concessions are possible with the "Cut-and-Stamp" ticket but are more limited.

For the four zone system illustrated, the convenience and flexibility of the trip-oriented type of ticket favors its adoption compared to the zonal type of ticket. However, as the number of zones increases, groupings of fare levels as in Copenhagen is necessary to avoid a proliferation of ticket categories. If special user classifications are also to be charged other than on a flat fare basis, ticket types will also increase.

2.6 Miscellaneous Factors

Table 6 summarizes some of the other considerations in choosing among different tickets. Some tickets more readily accomodate a greater number of trips than others. Some require a relatively high quality ticket stock either because they are used for a longer period of time or because it is necessary to ensure proper registration during validation. And some tickets may be prone to misuse by the purchasing passenger while others may be more susceptible to re-use by another passenger. All of these must be considered.

TABLE 4 - EXAMPLE FARE STRUCTURE

	PRESENT FARE LEVELS	FUTURE FARE LEVELS
Base Fare	$0.55	$0.65
Zone Surcharge	$0.25	$0.30
School Fare	$0.35	$0.40
Senior Citizen	$0.25	$0.30
Intra-Downtown (Zone 1)	$0.10	$0.10

TABLE 5 - EXAMPLE MODIFIED FARE STRUCTURE

	PRESENT FARE LEVELS	FUTURE FARE LEVELS
Base Fare	\$0.500	\$.0600
Zone Surcharge	\$0.250	\$0.300
School Fare	\$0.375[a]	\$0.375[a]
Senior Citizen	\$0.250[b]	\$0.250[c]
Intra-Downtown	\$0.125	\$0.125

KEY:

a: Three segments of half-price ticket

b: One segment of base fare ticket

c: Two segments of half-price ticket

TABLE 6 - OTHER MULTI-TRIP TICKET CONSIDERATIONS

Type of Ticket	Maximum Practical Trip Quantity	Quality of Ticket Stock and Effect on Method of Distribution	Potential For Misuse by Purchasing Passenger	Potential For Re-Use by Another Passenger	Periodic Maintenance Areass
Cut-and-Stamp	10-12 Segments	High Heavy stock usually favors pre-cut, pre-valued distribution	Low Decision to defraud primarily at time of purchase	Low Less than 10 percent of passengers could pass ticket to another passenger	Printing mechanism Cutting mechanism Chad removal
Orient-and-Stamp	4 Segments (8 trips possible but cumbersome)	Low Thinner stock which permits leporello storage and distribution	Low Similar to Cut-and Stamp	Moderate One trip in four made with exhausted ticket which could be passed to another passenger.	Printing mechanism
Fold-and-Stamp	10-12 Segments (Number of trips equal to or less than this)	Low Similar to Orient-and-Stamp	High Passenger presented with opportunity to defraud on each trip	Low Lower trip number per ticket off-set by ticket hold-over from unequal usage	Printing mechanism
Tear-and-Stamp	No Physical Limitation	Low Similar to Orient-and-Stamp	High Similar to Fold-and-Stamp	High Ticket readily usable by another passenger	Printing mechanism
Punch-and-Stamp	No Physical Limitation	Moderate Stock must ensure clean punching and ticket alignment	High Similar to Fold-and Stamp	High Ticket readily usable by another passenger	Printing mechanism Punching mechanism Chad removal Random-punch feature

Finally, hardware requirements are important since different ticket types impact quite differently on vending and validation. As Table 6 indicates, certain tickets present a greater maintenance effort but in general these are insufficient in themselves to warrant the acceptance or rejection of a particular style of ticket. (Reference Volume III for a discussion of the vending aspects of multi-trip tickets.)

3. SINGLE-TRIP TICKETING IN SELF-SERVICE

The cash-paying passenger--either one that rides infrequently or occasionally or one that simply chooses not to participate in one of the multi-ride forms of payment--is repeatedly cited as a source of problems in self-service systems:

a. Litter created by discarded single-trip tickets is a significant problem for both the transit system and the community served by it.

b. Fare evasion is encouraged because alighting passengers can readily pass on still valid tickets to boarding passengers.

c. Passenger service times are greater for cash-paying passengers and therefore contribute greatly to service delays.

d. Cash-paying passengers require significant driver involvement in the fare collection activity and increase the driver work load.

The problems are common to most self-service systems but the attitudes of the properties towards them and the approaches taken to their solution are quite different. While there is no question that single-trip ticketing must be made available, there is some debate over how convenient it should be for the passenger. Many European properties appear to encourage the multi-ride forms of fare payment not only by providing significant financial benefits to the passenger through the discounts offered for such tickets and passes but also by maintaining the large gap in their convenience.

In all but a few European systems, discounting is the primary "solution" to single-trip ticketing. Through such incentives, most European systems have reduced single-trip sales to a small percentage of total trips; in The Hague, for example, single-trip tickets account for approximately seven percent of total trips.

A second favored strategy of European systems is to provide alternate means of distributing single-trip tickets, i.e., other than through the driver; Munich and Geneva rely heavily on the use of vending machines and most of Milan's passengers receive single-trip tickets from newstands and other outlets. As a result of these two strategies, a very small percentage of trips in typical self-service systems are made using tickets purchased from the driver or from a station agent.

Because of this low percentage of driver sales, most European systems continue a manual form of driver ticket sales in which drivers simply exchange pre-valued tickets for monies received. Those that do provide drivers with devices to issue tickets appear to do so primarily for revenue accounting and ticket security rather than soley for the purpose of easing the driver workload.

3.1 Single-Trip Ticket Vending

As noted, many European properties provide machine-vending of single-trip tickets. In most applications, this alternate means of distribution reduces driver ticket sales and permits unrestricted boarding by all passengers; it usually offers little protection from the possible exchange of tickets between passengers--except in the fully automated systems common in Switzerland.

The Swiss systems generally make the purchase of a single-trip ticket as convenient as that of a multi-trip ticket. Sold through wayside vending machines, the Swiss approach to single-trip ticketing removes the vehicle driver completely from fare collection functions. And because validators are also deployed only at wayside, the opportunity for the exchanging of tickets between passengers is greatly reduced. In other systems, i.e., systems with on-board validators, the passenger may gamble that an alighting passenger will pass on a valid ticket; the passenger holds a multi-trip ticket in reserve to use if a "free" ticket is not received. However, in the Swiss system, if such a gamble is lost, the passenger must return to the machine to purchase a ticket.

The Swiss systems also typically dispense a pre-validated single-trip ticket, i.e., a ticket which is validated when issued as opposed to one validated at time of use. Systems such as that in Geneva which provide machines at nearly every stop can readily justify the simultaneous issue and validation approach to single-trip vending. Other properties, which do not provide such extensive coverage, appear to be divided on the issue of whether or not single-trip tickets should be vended with validation data.

Table 7 summarizes some of the advantages frequently cited for the separation of ticket validation from the activity of purchasing a ticket. In general, the selling of tickets is preferable to the paying for trips. However, the relative passenger convenience provided by the two approaches is frequently debated. On the one hand, such separation is

TABLE 7 - SINGLE-TRIP TICKET DISTRIBUTION THROUGH PASSENGER-OPERATED MACHINES

	Factor	Validated At Time Of Issue	Validated At Time Of Use
	Fare Structure Flexibility	Good Flat-fare, time-based, zone-based and location-based tickets can all be sold	Better Somewhat difficult to accommodate location-based sales but method will support line-based and direction-based tickets more readily
	Passenger Convenience	Debatable Passenger involved in one action per trip compared to separate purchase and validation	Debatable Passenger may purchase in advance of trip--whenever convenient; however, passenger may equate purchase with validation
Off-Board	Machine Requirements	Good Machines most practical in high-volume locations--however, usage restricted to that specific location	Better May be able to reduce number of machines; may also lessen change-making requirements
	Passenger Flow	Good Passengers served quickly but many may wait until vehicle in sight to maximize time of validity	Better Passengers may purchase tickets when arriving at the stop with no "ticking away" of time while waiting
	Storage of Ticket Stock	Better Ticket has no value until issued by the machine	Good To avoid storing valuable stock, the machine may not assign value until time of issue
On-Board	Validation at time of issue requires vending machines that provide both time and zone information--and therefore additional capital cost and possibly reliability problems. However, some of the advantages cited for "time-of-use" validation for off-board use are not present in on-board uses. The decision, therefore, depends more on these cost/reliability issues. In any event, to avoid passenger confusion all on-board single-trip ticketing should be similar, i.e. on-board machine vending should model the on-board ticketing done by the driver.		

undesirable because it requires the passenger to take two separate actions to complete a trip; some argue that not only is this inconvenient and time-consuming but may also complicate fare enforcement since some passengers will mistakenly equate ticket purchase with trip payment. Others contend that these minor disadvantages are more than outweighed by the ability to by a ticket at any time--whenever the correct change is available for example.

Hardware considerations are not an important factor in choosing between the two approaches. The simultaneous issue-and-validate requires additional features such as a clock; however, the capital cost and maintenance ramifications of these features are not significant. It should also be noted that the separation of the two functions does not necessarily lead to problems of ticket value; special operations may be performed by the vending machine to give the ticket value without tying it to a trip. Options range from printing the ticket on blank stock to relatively minor alterations to pre-printed stock without which the ticket is considered valueless. Munich machines, for example, emboss each ticket at the time of issue to denote value; an inspector can "feel" for fraudulent or stolen stock (cf. Volume III, p.8).

3.2 Driver Ticket Sales

Reducing driver activity in the collection, monitoring, and enforcement of fares is one of the major benefits of self-service. Through discounts and alternate means of distribution, many European systems have reduced the volume of on-board ticket sales by the driver to a small percentage of the total trips; Swiss systems have, as a matter of policy, completely eliminated driver ticketing.

The models presented by European systems for the implementation of self-service in the U.S., however, tend to diverge significantly from accepted U.S. practices, particularly with respect to driver responsibility for revenue security and accountability. Throughout Europe, fare revenues continue to be "driver-associated" as opposed to the "vehicle-association" common in the U.S. Secure storage, i.e., fareboxes, is uncommon; all fares are received by the driver.

This difference in revenue focus partly explains the current methods of driver ticket sales in Europe, including some of the practices regarding the validation of tickets sold by drivers:

a. Because drivers continue to collect and safeguard fares, having them handle and distribute quantities of tickets with pre-assigned values is not the issue it would be in the U.S. Consequently, many European systems are supported by manual driver ticket sales, i.e., the driver exchanges tickets with pre-assigned value for the equivalent cash received from the passenger. Drivers are subject to on-the-spot accounting for the total amount--much the same way U.S. properties ensured drivers could account for change in the past.

b. Concern more for driver security than revenue security and accountability has led a number of European properties to use special ticket issuing machines. These machines "create" rather than dispense tickets and thus remove the theft/robbery potentential posed by the possession of pre-assigned value tickets. Because drivers receive the revenue from the sale of tickets, most machine deployments are also "driver associated", i.e., machines are assigned to drivers rather than vehicles. On-the-spot accountability is the same as the manual system.

c. Driver-centered ticket sales also produce driver-related breakdown of ticket sales and trip numbers but are not a convenient source of trip data by line, vehicle, etc. Other factors have largely dominated the decision by some properties to separate the sales and validation operations in driver ticketing as well as in the vending. But the separation provides some additional statistical information.

Obviously, driver ticket sales in the U.S. cannot model many of the European practices. A return to driver responsibility for cash is untenable. Similarly, driver responsibility for quantities of tickets having pre-assigned value would not be feasible in most instances. Driver ticketing in the U.S. transit environment would have to conform to the vehicleoriented practices followed by the vast majority of U.S. systems.

3.2.1 European Driver Ticketing

European systems, although not representing wholly transferable models for U.S. applications, provide numerous examples of alternative approaches to such ticketing--approaches which typify the use of currently available hardware. As noted previously, manual procedures are still common practice. However, a number of European properties use some type of ticket issuing machine to assist driver ticketing functions.

Table 8 compares different machine functions relative to their use to support self-service operations. The machines themselves may range from simple mechanical devices for dispensing pre-printed tickets to electronic machines which "create" a ticket together with time, date, zone, and price information from blank stock. All provide for ticket counting so that revenue accountability is maintained.

The simplest approach, i.e., the use of an elementary device to dispense pre-printed tickets, provides some convenience to the driver compared to issuing tickets manually. But, because the machine performs no other function than ticket dispensing, the ticket is not a receipt and must still be validated. The marginal driver convenience is, therefore, offset by passenger inconvenience. In addition, the machine introduces valuable stock which must be safeguarded--more so than present transfers because ticket stock is neither date nor route specific. Consequently, this approach to driver ticketing offers little benefit to U.S. operations; European operations derive more from its use because revenue accountability is provided.

The feature which transforms a valueless ticket stock into a valuable document should be considered essential for U.S. application. At least some modification to the ticket stock should take place at the time the ticket is issued to reduce ticket theft. Whether this modification is minor, e.g., imprinting a transit logo onto partially pre-printed stock, or major, e.g., completely printing a ticket from blank stock, depends largely on cost considerations.

Whether or not one or more of the other information elements should also be added is a more difficult decision. Each "buys" a certain advantage; implies varying degrees of equipment complexity; and involves different driver and passenger activities. By providing none of the extra elements, the most elementary equipment is possible; but, tickets must be validated by the passenger. And, unless separate machines are used for different fare categories, the driver must continue to monitor

TABLE 8 - DRIVER TICKETING MACHINE FEATURES

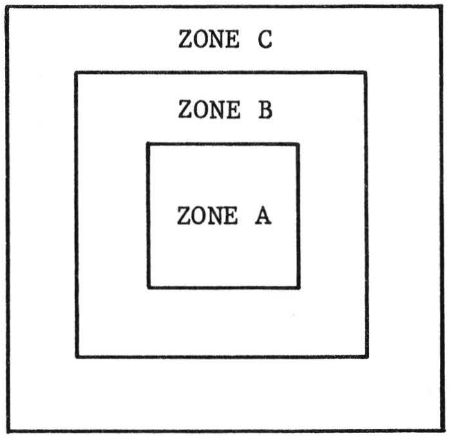
Data Element	Machine Capability	
	None	Produces unvalidated ticket which the passenger most validate before ticket is acceptable as proof-of-payment.
Time/Date	Manually Set	Two options: frequent resetting of time, e.g. 15 minute intervals to correspond to time of issue or infrequent setting of time, e.g. each run or route segment to correspond to expiration time. Frequent sets involve significant driver involvement. Concessions to permit infrequent sets are desirable.
	Automatic	Clock-based machines are more expensive--and generally do not fully remove the driver. Date must be set and time monitored. Mismatch of information with validator a potential problem.
	None	Sufficient for flat fare systems. Limits conversion to zonal system unless some other indicator available to provide this information.
Zone	Driver-Input	Not required in flat-fare systems but considered necessary in zonal systems if validated ticket to be provided. Driver is responsible for changing whenever zone boundary crossed.
	None	Requires the driver to monitor fares to ensure passengers are eligible for different ticket values. No enforcement possible once receipt obtained from driver.
Price	Driver-Input	Driver has to verify that the amount deposited corresponds to value of the ticket issued and must select appropriate price (usually a choice of push buttons) but does not strictly monitor eligibility of individual passengers for particular ticket value.

the payment of the correct fare by different user groups. Once past the driver no verification of correct payment is possible since all passengers receive the same "receipt" regardless of the amount paid.

Time/date additions are necessary to change ticketing from a simple distribution (selling) of tickets to the issuing of receipts. Without time/date information, passengers must validate tickets after purchase. Assuming that combined purchase and validation is desirable in on-board ticketing, machines with time/date capabilities are necessary. Various types of machines are available to supply the information automatically--using an internal clock. Or time/date may be treated as a manual input supplied by the driver for example at the beginning of each run. If the latter, more manual approach is adopted, time/date information should correspond to the end of ticket validity--similar to conventional transfer practice--rather than denote purchase time.

Many self-service systems do not use ticket price to establish the limits of trip authorization but rather another indicator such as the number of zones of travel for which the ticket is valid. This substitution facilitates fare changes because equipment does not have to be modified to denote new ticket values. It also eases ticket inspection since the inspector can readily compare ticket validity against the circumstances of its present usage. Given a ticket is valid for a specified number of zones, usage can be judged only if the zone in which the trip originated is also known. Consequently, zonal indicators corresponding to the zone of origin are necessary in zonal systems. The indicators must be provided both in the validator subsystem and in the driver ticketing subsystem--unless passengers are required to validate tickets after they are purchased from the driver. Zone of origin can be eliminated in only the simplest of zonal systems by tying tickets to specific zones in the case of multi-trip tickets or by selling tickets which correspond to destination zones in the case of single-trip tickets (see Figure 1). Such an arrangement is somewhat cumbersome but may be appropriate in certain situations--such as to offer special discount zones in an ostensibly flat fare system or where driver participation in the setting of zones cannot be secured.

Adding price (or some other indicator tied to the price of the ticket) permits a somewhat lesser driver involvement in the actual monitoring of the payment of appropriate fare amounts by different classes of passengers. The driver continues to verify that amounts correspond to the type of ticket issued but not that these amounts are legitimate for the particular user. Enforcement of proper fare payment by user class is left to the separate inspection process.



Validators provide time/date information only

Driver issuing machines provide a single indicator (plus time and date)

Multi-Trip Tickets

Tickets identify specific zones in which the ticket is valid when time/date stamped. Requires six different tickets corresponding to travel combinations: Zone A, Zone B, Zone C, Zones A&B, Zones B&C. and the Entire Service Area.

Single-Trip Tickets

Driver sells one of three types of tickets depending on the amount of money received. The single code (corresponding to destination zone) substitutes for the double code of both origin and eligibility.

FIGURE 1. ADAPTATION OF ZONAL STRUCTURE TO NON-ZONAL EQUIPMENT

Price encoding represents a relatively minor increase in machinecost and adds a driver function--selecting the ticket category relative to the fare paid. The disadvantages may be justified by the removal of the driver from the verification of the eligibility of different passengers for different fares. Ticket distribution by fare price also offers more detailed data on the types of tickets sold--data which is often not available except through special surveys or counting operations. Labor factors ultimately determine the practicality of including the pricing feature in driver issuing machines applied to flat fare systems. In zonal networks, price or an indicator of price is necessary to permit inspection of proper fare payment.

3.2.2 Limitations and Future Alternatives

Devices capable of supplying any or all of the information previously discussed are currently used in many European systems and are available from a number of suppliers--with some restrictions. In general, most of the available equipment are separate items, independent of other self-service hardware. Presently, there are no production models of driver-operated ticketing equipment which fully operate in conjunction with other self-service hardware and share similar data elements. Time, date, and/or zonal information must be supplied independently even though this data may exist simultaneously within the validator subsystem on the vehicle.

To date, on-board vending machines and on-board validators are the only two subsystems which have been integrated to the point of sharing data. Zonal inputs to both are made through a common driver console. Data links between driver issuing equipment, validator subsystems, and fareboxes have received little attention. Nevertheless, some efforts have been made to reduce the level of driver activity required in self-service operations. Some British systems, for example, permit the driver to "dump" the farebox display remotely--through the same console used to set zone and price information for ticket printing. At least one European property has automatic zone setting; zonal information is provided by wayside transmitters to automatically set validator information as the vehicle passes the zone "marker". and, innovations such as the eventual use of external "markers" to trigger announcements of zone changes automatically are being considered. However, such innovations--including changes which would tie various self-service subsystems together and which might be desirable in U.S. operations--are likely several years away.

With recent product developments, particularly with the advent of microprocessor-based validators, data has become much more centralized than in the past. Previous generations of validators operated rather independently, with each containing their own clock for example; newer generations of validators are controlled through a master driver console. Based on these developments, it is likely that any new generation of driver ticket issuing equipment would make full use of the data already available through the master console; it would not likely take the form of a ticket issuing device which provided the control function for the validators. From the supplier viewpoint, a ticket issuer under control of a master console would permit greater product flexibility and require less development effort. Such would also be advantageous to the transit property since it would facilitate incremental system expansion, beginning with either ticketing or validating devices and later expanding to include the other.

Alternative driver ticketing options must also consider the role of the farebox which is a common U.S. characteristic but uncommon in Europe. Present self-service hardware may provide some elementary tie such as the control of ticket issue and the transfer of cash to the vault through a single action. But other links such as central ticket and revenue accountability, i.e., counting of ticket value issued and cash received in one subsystem, are not presently available. The ultimate system for a U.S. application might be to use the farebox to control and provide the input for the printing of ticket price thus removing the driver from the comparison of cash received to the value of the ticket issued. In essence, the farebox would become the basis for on-board ticket vending in the U.S.

Future innovation might ultimately lead to the driver-less version of self-service shown in Figure 2. In this configuration, the driver would be completely removed from the self-service system--except for the monitoring and reporting of malfunctions. Such a futuristic concept is just that--a possible future development. It would not be advisable for U.S. applications to force this or other major development efforts beyond the state-of-the-art because of the potential problems and costs involved. Still, properties can attempt to anticipate future requirements and procure equipment which has the capability for expansion and modification. Just as the flat-fare property should consider the probability of adopting a zonal fare structure and procure on the basis of that possibility, the property must consider the desirability of integrated subsystems and procure on the basis of the adaptability of the equipment to such an eventuality.

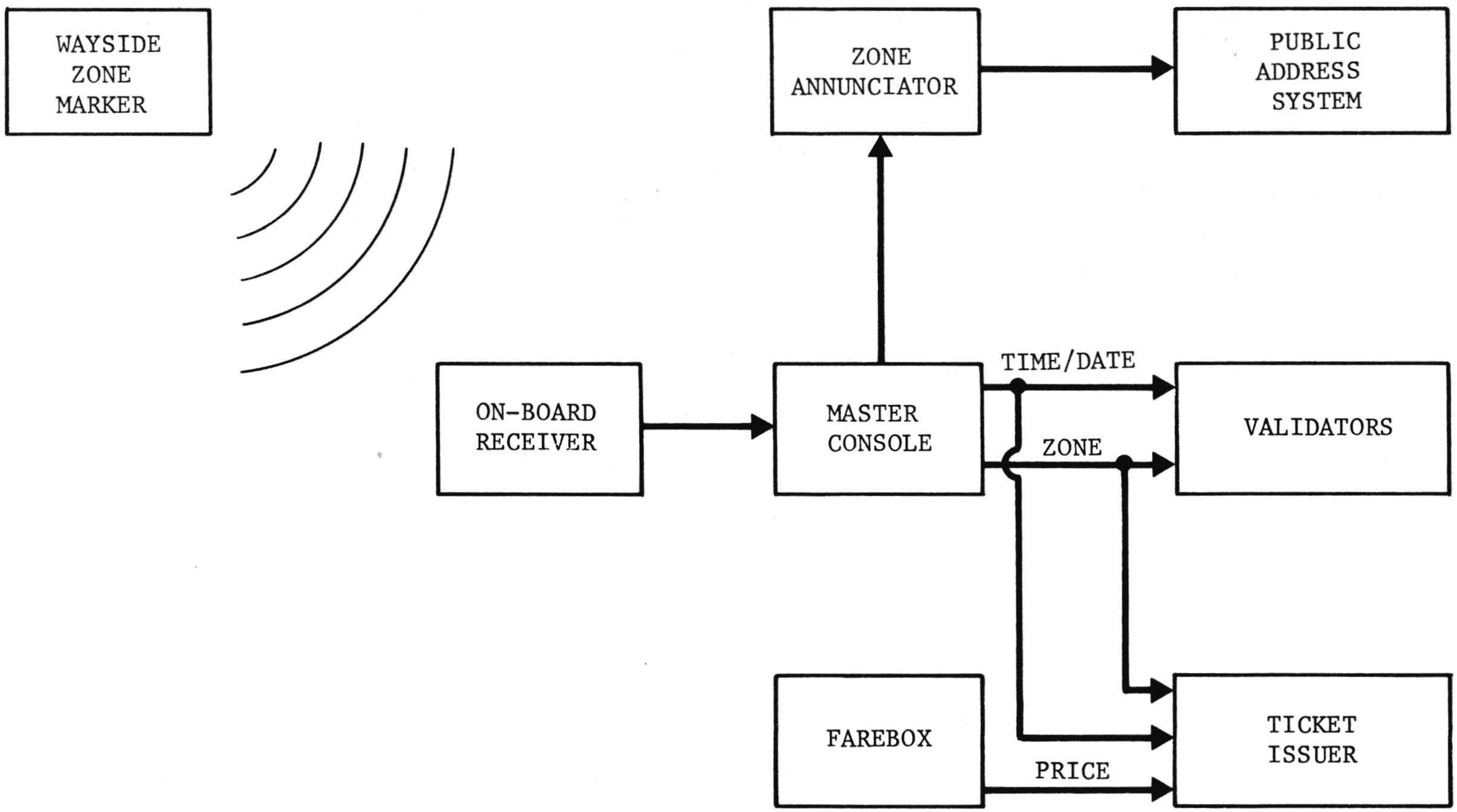


FIGURE 2. SELF-SERVICE WITH MINIMAL DRIVER INVOLVEMENT

4. CONCLUSIONS AND RECOMMENDATIONS

The previous discussion has attempted to highlight the relative advantages and disadvantages of various approaches to ticketing in self-service systems without specifically identifying best or preferred approaches. Obviously, the ultimate choice of the particular approach will depend on many site specific considerations including not only cost and convenience factors but also factors relating to labor conditions and fare policies. Certain conclusions, however, can be drawn with respect to particular applications. They are:

1. For system-wide implementations in a flat fare network, the "Cut-and-Stamp" approach to multi-trip ticketing is the most desirable.

2. For phased implementations in a flat fare network, a booklet approach to multi-trip ticketing is preferable and physical alteration of the ticket during validation is highly desirable.

3. Wayside ticket vending should incorporate features which assign ticket value at the time of issue; storing valuable ticket stock should be avoided whenever possible.

4. Wayside single-trip tickets should be dispensed without validation.

5. Drivers should not simply sell tickets but should provide passengers with receipts, i.e., validated tickets.

The type of driver-operated equipment used to accomplish this last item cannot be specified. However, several factors dictate an uncomplicated, simplified approach:

a. the availability of suitable equipment and the funds available for such equipment,

b. driver workloads resulting from the use of such equipment,

c. the future trend of single-trip ticketing and the extent to which efforts are made to reduce the volume of such ticketing, and

d. the prospect of future developments which might be more appropriate to U.S. farebox practices.

Self-service in the U.S. is, after all, an untried concept and, as such, a major redevelopment effort to improve the state-of-the-art without first testing the concept would be undesirable, particularly with respect to the objective of the demonstration program being supported by UMTA. Also, the procurement of the more sophisticated driver issuing devices is considered undesirable during the initial stages of self-service. Rather concerted efforts to reduce single-trip ticketing on-board and to simplify the fare levels of single-trip tickets should be considered. Simple concessions such as expanding the validity period of the receipt may permit the use of more elementary devices; it might even permit the retention of the present manual transfer system--one time/date input per run--and therefore obviate the need for a clock-based ticket issuing device. Similar concessions are also possible in zonal systems, e.g., tying price to zone to allow foregoing the zonal option in ticketing machines.

This is not to say that driver ticketing should forever continue on a manual basis or continue to be supported by present hardware. However, a greater U.S. market expectation is needed to encourage the development of products more appropriate to U.S. practices. Given the success of self-service in the U.S., UMTA support of a development, test, and evaluation effort could take several forms:

a. a "modified" validator compatible with the existing validator subsystem but issue single-trip tickets,

b. a "modified" registering farebox which would issue receipts, or

c. an on-board ticket vending machine to replace the farebox.

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☆ U. S. GOVERNMENT PRINTING OFFICE : 1980 311-586/196