

# CRIME IN RAPID TRANSIT SYSTEMS: AN ANALYSIS AND A RECOMMENDED SECURITY AND SURVEILLANCE SYSTEM

Robert Shellow, James P. Romualdi, and Eugene W. Bartel,  
Carnegie-Mellon University

This study is directed toward identifying the influence that crime has on transit ridership and toward developing measures for increasing patron and system security on a major transit network. Because of the preponderance of crime and harassment on rapid transit as opposed to surface transit, recommendations are directed toward test demonstrations on the rapid transit segment of the system. All suggested improvements are based on systematic analyses of transit crime patterns, ridership trends, a survey of public perception of transit crime, present security measures, and general operating procedures. Profiles of transit crime are derived from an 18-month series of crime data collected on the system. A crime-ridership index is employed to measure risk to patrons on various parts of the transit system. Present inadequacies in surveillance and response capability of police are described. The question of increasing manned patrols as opposed to substituting electronic or mechanical systems is examined from the viewpoint of assuring patrons of rapid protective response should an emergency arise. A publicly activated closed-circuit television system is offered as one means of addressing the security needs on high-risk portions of the rapid transit network.

•TRANSIT OPERATORS throughout the nation have long recognized the potentially injurious effect that crime has on public confidence in mass transit systems. The presumption is that withdrawal of confidence is accompanied by a withdrawal in patronage as well. With the prospect of rapidly expanding existing systems and the construction of new ones, this issue is increasingly important. This is particularly true for rail rapid transit serving suburban metropolitan areas where the justification of the system will depend, to a large extent, on its ability to draw commuters away from private automobiles. It is the image of these systems that will determine, to a great extent, the outcome of the quest for new riders. Though residents of the inner city are captive to public transit and few possess the means to avoid its use, it is suggested that the appearance of crime may well be at the basis of declining use. Furthermore, there is a growing possibility that potential suburban riders will be disproportionately discouraged from public transit by their anxiety about crime.

Because of their relative collective inexperience with crime, potential suburban riders are more likely to be alarmed by the presence of crime on public transit even if it occurs far from the neighborhoods or routes they frequent. The transit security problem clearly illustrates the interdependence between the lives of city and suburban dwellers. Not only must the burden of crime be lifted from inner-city residents as a matter of public service, but such action is mandatory if suburban patrons are to feel sufficiently secure on public transit to make its use a regular part of their daily lives.

An overall approach to the question of crime on transit systems has three general components:

1. The establishment of the nature and extent of crime on the system and its relation to overall urban crime statistics (as it exists if the transit system is presently operating or as it might be expected for a proposed system),

2. The public's perception of security and the extent to which it will affect riderships (this is in addition to the inherent responsibility of the operating agency to protect the riding public), and

3. The deployment of effective means not only to reduce crime but also to increase the public perception of security and to do both in a cost-effective manner.

In spite of the seriousness of the problem, a surprisingly small amount of work has been reported in this area. A recent study concerned with the renovation of a particular underground rapid transit station indicates the importance of the issue of security (1). A survey of potential and existing users of the single rapid transit station analyzed clearly pinpointed security as the most preferred kind of improvement. But, in general, studies to establish the effect of key variables in the choice of transit mode invariably ignore security, despite its apparent importance for non-work-related trips. For example, one of the most comprehensive attitudinal surveys attempting to quantify and rank transit system attributes does not explicitly deal with security (2).

In recognition of the need to pursue studies in this area, the Transportation Research Institute at Carnegie-Mellon University began a team effort to structure the transit crime problem and define criteria against which proposed security or surveillance measures could be tested (3, 4). Subsequently, the Transportation Research Institute and the Urban Systems Institute of Carnegie-Mellon University undertook to collect, analyze, and interpret data pertaining to crime, public attitudes, and system operation for a large urban rapid transit system. The study, supported by the Urban Mass Transportation Administration, also designed a pilot security and surveillance system that was responsive to the actual and perceived security problem.

This paper presents the principal findings and recommendations of the study in the belief that the crime characteristics and recommended security system are indicative of characteristics and solutions that are appropriate to other existing or proposed systems. However, specific data and even reference to the city in question are omitted for two reasons: First, there is a natural sensitivity on the part of any urban area to overly publicized data on crime or detailed analyses of the effectiveness of various components of its security system, and second, there is no evidence that the details of crime and its distribution are representative of anything but the city in question. Thus, it is only the general characteristics and conclusions that might have application to other areas.

## DESCRIPTION OF DATA-GATHERING PROCESS

The city in question operates a rapid transit system with some portions elevated, others at grade, and a few miles in tunnels. A surface bus system is also operated. Protection is provided by the regular city police force and a special transit unit (transit police). In addition to detailing all transit operations regarding station and route ridership figures and trends for different times of the day, week, month, and season, 18 months of verified police crime reports were analyzed.

Public attitudes toward the transit system were also surveyed, particularly with regard to perception of the level of crime occurring on the transit system and the general security of the facilities. Some 45 potential questions were asked in a telephone interview of 1,556 persons.

## STUDY FINDINGS

### Ridership

The ridership trends for the system studied are rather typical of major urban areas. Ridership on the total transit system dropped 22 percent from 1962 to 1972, while per capita automobile registration increased over 20 percent in the same decade. Ridership originating on the bus system fell four times as far as that originating on rapid transit.

Gradually during the decade riders shifted their use from evening peak and off-peak hours to the 9:00 a.m. and 3:00 p.m. period (Fig. 1). Most of the reduction occurred in the 3:00 p.m. to midnight interval. It is not coincidental that this later afternoon,

evening, and nighttime decline in use is correlated with both the incidence of serious crime and the public's perception of unsafe periods.

### Crime on the System

During the 18-month study period, analyses of verified police reports clearly portray that (a) most crimes occur on the rapid transit system and (b) robbery is the crime of greatest frequency. About 75 percent of all crime occurred on rapid transit lines, mostly on elevated station platforms. Three out of four crimes were robberies, occurring at times when there is a drop in use and when patrons tend to be isolated or share the facilities with few other people. Thus, over two-thirds of the robberies occurred between 6:00 p.m. and midnight. Assault and battery, on the other hand, was more likely to occur when the system is congested. Almost half were found in the 4:00 to 10:00 p.m. period, with a peak during the 5:00 to 6:00 p.m. rush hour when the jostling of passengers entering or leaving trains is common. The hourly pattern for robberies continued into the weekend evenings of Friday and Saturday, although there is something of a shift in the robbery peak to the after-midnight hours (Figs. 2 and 3).

Simply reporting the volume of crime occurring on rapid transit or bus, in different months, days, or hours, could be somewhat misleading because of the variation in ridership during these periods. However, by dividing the reported incidents during a particular period by the ridership during the same period, a crime-ridership index was obtained that is a more accurate measure of the risk exposure. Thus, as shown in Figure 4, the risk index for rapid transit is compared to that for bus over the days of the week. The weekend increase in risk is readily apparent. Overall, risk on rapid transit was markedly higher than on the bus system. Figure 5 shows the indexes by hour of the day and underscores the high risk associated with the late evening and early morning off-peak hours.

Perhaps the most instructive of all findings relates to the geographic distribution of crime on the system throughout the city. A mapping of stations with high crime-ridership indexes closely overlapped areas of high unemployment as well as police districts experiencing high crime rates. In looking at the residences of apprehended offenders in relation to the site of their crime, it became clear that criminal predators tended to work in territory that was familiar to them and were not likely to use public transit as a means for extending their territory beyond their own neighborhood or as a means of escape.

Over 75 percent of all crimes on the rapid transit system were committed on station premises, and over two-thirds occurred on platforms. Less than 33 percent of all robberies occurred on trains, whereas a slightly greater proportion of batteries and almost half of all crimes against persons were committed on rapid transit vehicles.

### The Public's View of the System

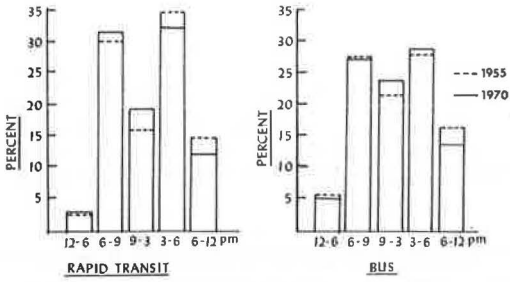
Because a major objective of the study was an assessment of the public's attitude toward transit service, and especially transit crime, an attempt was made to determine the extent to which an individual's perception of the incidence of transit crime was realistic and how this perception affected ridership behavior. Accordingly, the public attitude survey served to determine habits of use, perception of service, assessment of crime, and preferred security measures.

Of those responding, 95 percent had used rapid transit at one time or another, 75 percent within the last year.

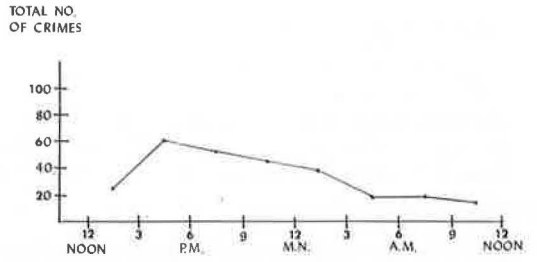
The survey indicated a pervasive lack of public confidence in transit security. Furthermore, this perception of insecurity has significantly affected ridership. About one-fifth of those who do not use transit and 16 percent of rapid-transit-only riders cited the lack of security from harassment and crime while riding or waiting for the bus as reasons for not using the bus system. But when it came to rapid transit, itself, 25 percent of those who do not use it and 30 percent of bus-only riders cited lack of security for not riding trains.

Both bus and train users agreed that the entire transit system was especially unsafe at night. Nine out of ten would not use either system after 9:00 p.m.; almost none would

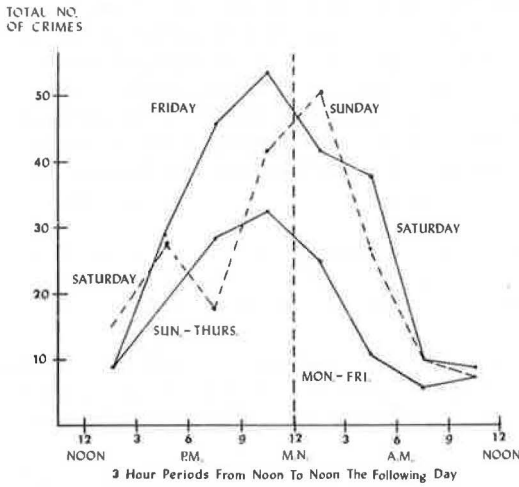
**Figure 1. Rapid transit and bus ridership distribution (by time interval) for 1955 and 1970.**



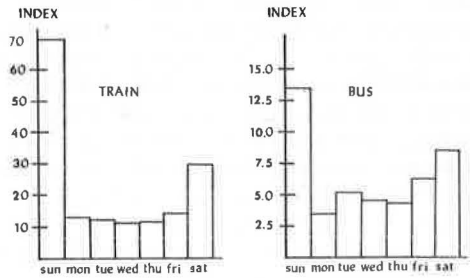
**Figure 2. Assault and battery reports (by time period).**



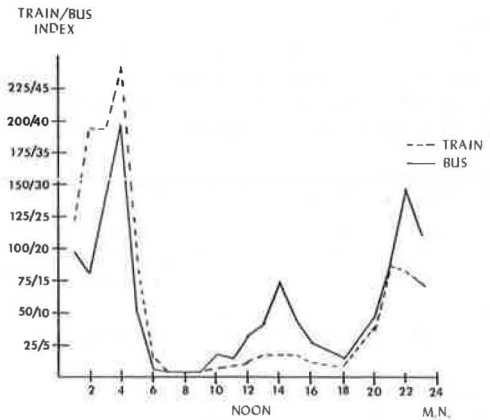
**Figure 3. Robbery reports (by time period).**



**Figure 4. Rapid transit and bus crime-ridership indexes (by day of the week).**



**Figure 5. Rapid transit and bus crime-ridership indexes (by hour of the day).**



after midnight. Lack of security was cited by 84 percent of the bus users and 89 percent of the rapid transit users as a reason for not riding after 9:00 p.m.

When asked to rate various features of the transit system, over half of the train riders rated safety from harassment and crime while riding or waiting for trains as fair to very poor.

A sizable percentage of the riders in one survey (8 percent) had been victims of crime. Within the victim group, about half experienced theft, a fourth robbery, and another fourth assault and battery.

To determine under what conditions perceived insecurity was highest, riders were asked to rank nine conditions associated with using transit facilities. Out of nine possible locations, the stairs, rampways, and tunnels of the train system were ranked least secure, followed closely by station platforms and trains in motion. Riders felt most secure while riding the bus, while going from their home to the bus or rapid transit stop, and while waiting at the bus stop (in decreasing order).

Subsequently, respondents were asked to rank which security measures in their estimation would give them the greatest reassurance. Most felt that the best promise of improvement in security lay in the deployment of more police (including K-9 patrols) to the station platforms and on trains or in the knowledge that quick assistance could be obtained in any emergency.

### Calculating Risks on the System

But is public transit truly a "crime-ridden" environment? There is no simple or direct way by which risk of victimization on a transit system can be calculated.

To compare crime risk on rapid transit with that associated with living in a neighborhood and using the city streets requires that street crime be expressed as an index of crimes per million entries onto the public streets. Inasmuch as this is not presently feasible, we chose to measure rapid transit crime in terms of incidence per 100,000 riders because city crime is expressed in rates per 100,000 community residents. Such rates can be grossly approximated for transit crime for each 100,000 occupants of the "rapid transit community." For our purposes, this community was considered to consist of those persons 16 years and older who used rapid transit daily. The fact that the rapid transit community is less stable than a city, that some people use rapid transit far more than others, and that we have no idea of the extent to which occasional users contributed to our victim lists only invites caution in the use of such comparative figures.

Robbery was used as the "bellwether" crime that it properly is. The non-transit robbery rate for police precincts analyzed is an average of 954 robberies per 100,000 residents for 1971. By using a series of calculations, it can be estimated that there are approximately 228,000 persons, 16 years and older, on the rapid transit system each weekday. If indeed this group is the rapid transit community, it probably accounts for the greater part of the system's 135,000,000 rapid transit rides annually. Based on robbery data for rapid transit victims 16 years and older, this population experiences a robbery victimization rate of 332 per 100,000 persons (about one-third of the rate for the rest of the city, although somewhat greater than the national average of 187 per 100,000 as computed by the Federal Bureau of Investigation).

These calculations, taken with the average crime-ridership index of seven occurrences of serious crime per every 1,000,000 entries onto the rapid transit system, should be far from cause for alarm. Even the risk factor of 91 per 1,000,000 for the most dangerous part of the network might be seen as favorable odds by most prudent patrons.

### Paradox of Reality Versus Perception

Why then is there the mounting concern over transit crime? Why does it persist as an issue? The most we can say is that, in this instance, appearances are more important than reality. With heightened national awareness of crime, particularly stranger-to-stranger crime, the public is likely to be highly sensitized to each oc-

currence even before it is reported. Anticipation itself quite likely adds to the impact of each publicized transit crime, especially if crime occurs in space where people may feel trapped.

This is the paradox that is so central to any consideration of mass transit security. It is not the reality of crime on the system that makes the difference, but how it is differentially perceived. Furthermore, the general public expresses considerable concern over crime on the system even though this concern appears to be out of reasonable proportion to the occurrence of criminal events. Indeed, as has been pointed out by Bard (5) in a study relating to sense of security in public housing projects: "A general sense of security in a community is not derivative of crime statistics alone. There is mounting evidence that citizens feel secure when there is the conviction that government is responsive to their needs."

### Summary of Findings

1. On the basis of a series of crime profiles, crime appeared to be disproportionately located along the rapid transit portion of the public transit system.

2. When expressed in terms of the crime-ridership index, the patterns of transit crime closely corresponded to high-crime and high-unemployment areas of the city.

3. Robbery on isolated, elevated platforms during off-hours at these high-risk locales outranked all other crimes at other times elsewhere throughout the system.

4. Police response capability was severely hampered by gaps in the communications-response network on which unit dispatch is based. Indeed, it was found that a major communication gap existed between the victim or witness of a crime and police headquarters.

5. A crime on public transit (especially on rapid transit) was perceived to be a serious problem by a significant number of survey respondents, despite the fact that the robbery victimization rate on transit properties was estimated at one-third of that for the rest of the city. This finding confirms the hypothesis that perceived security is at least as important as the reality of crime on public transit.

### A REFINED STATEMENT OF THE PROBLEM

Two central questions remain: How can the public's perception of security on transit systems be improved, and how can the actual number of crime incidents be reduced? If we literally accept the preference of survey respondents for security improvements, we would recommend a sizable increase in police-patrol at stations and on trains. But relying totally on the use of manpower for surveillance is of questionable cost-effectiveness in deterring crime. Few on-view crimes were reported by police during this study except for special decoy operations. Although police perform an extremely important role in the overall provision of protective services, it is our contention that, because few crimes develop within the police officer's sight, his role is mainly a response function rather than one of surveillance. This is not to say that patrols do not deter crime, but rather that good response capability is apparently more cost-effective than routine patrol and surveillance. The permanent positioning of patrolmen on a station platform appears to be an effective (although costly) method of deterring crime at the site; however, it is probably limited to that site alone. The long rampways, numerous stairways, and obstructed sight lines of many rapid transit stations seriously erode the ability of a small number of officers to provide effective surveillance. Furthermore, the effectiveness of allocating men to fixed posts for up to 8-hour tours is constrained by the effects of physiological fatigue and exposure to the elements during inclement weather.

Another look at what survey respondents think will increase their sense of security suggests that there is a central theme underlying their views: assurance that assistance can be rapidly obtained. Any public transit system that could convince patrons of this fact (with or without the continuous physical presence of police officers) is likely to meet this need.

## A REVIEW OF POSSIBLE REMEDIES

Various electronic devices appear to have attributes that could provide the needed assurance. However, most currently available security devices are the type designed for areas or facilities closed to the general public. As a result, these devices provide no assistance in distinguishing between the criminal and the law-abiding citizen in a 24-hour facility such as a transit system. In the following sections, some potential transit security devices are described briefly along with their shortcomings. A total system is then proposed that minimizes these shortcomings and provides direct response to the crime patterns and perceived security needs revealed by this study.

### Simple Alarms

The simple alarm devices available are quite limited in their scope and only serve to draw local attention and increase the awareness of onlookers in the surrounding area.

Alarms may be effective in satisfying the public concern for personal security; however, they have definite drawbacks that restrict their potential usefulness in a public area. Prominent among these are the following:

1. Witnesses may refrain from using the alarm for fear of drawing the offender's attention to themselves, and they may not wish to become obviously involved;
2. The loud noise produced by the alarm may cause the offender to become agitated and harm the victim more seriously than he originally intended;
3. The exact location of the alarm is not always easily discernible, particularly when there are similar alarms in the surrounding areas;
4. The inability to distinguish between valid and false alarms could possibly overtax the response capability of the police; and
5. Because the witness or victim cannot relay information, details regarding the occurrence are not available to the police until they arrive at the scene.

Although the use of emergency telephones in public areas can reliably reduce the time lag between the crime occurrence and police notification, the system also has drawbacks: (a) the need to know and dial the police number, (b) the need to verbally identify the location, and (c) the improper use of the phones by the public for private calls or false reports. Some of these problems may be overcome by using a system in which the caller need not dial nor identify his location. In one, the caller lifts the receiver, which activates an alarm at the security console. The caller's phone is self-locating. Although it helps to reduce apprehension about security by providing a system the public can activate, this more complex system still has limitations:

1. The false-alarm problem is prevalent. In one university employing this approach, 70 percent of all alarm calls proved to be false.
2. Details regarding an occurrence or ongoing events are not necessarily available to the police, who must, therefore, approach the location without knowing the nature of the situation.
3. The telephone receiver must be replaced to stop the alarm. Even in known false-alarm cases, an officer must be sent to the location to replace the receiver. The receivers can also become a target for vandalism.
4. Witnesses may feel that the actions necessary to use the telephone would be such as to attract the offender's attention and thereby involve themselves more than they are willing to be involved. For this reason, they may not use the telephone.

### Continuous Closed-Circuit Television Monitoring

Continuous, closed-circuit television (CCTV) surveillance of the transit stations could provide authorities with visual information regarding all events taking place within the area covered by the cameras. TV coverage could greatly reduce false alarms by permitting only monitor operators to make alarm judgments and could provide police with reliable information about the situation they will be entering. Automatic video taping also can provide details about the incident, offender, and victim that could aid in the arrest. In the public's opinion, continuous TV coverage may be viewed

as a welcome increase in security or as creating an unappealing "Big Brother" climate. Public reaction is uncertain but probably is dependent on the usefulness of the TV component in producing a prompt police response. Continuous TV monitoring, however, has the following limitations:

1. Persons viewing continuous monitors are subject to fatigue and therefore may not be alert enough to detect a crime in progress;
2. Considerable manpower is necessary to provide surveillance of all stations continuously and completely;
3. The citizen does not actively participate in his own protection and cannot easily communicate the specifics of his problem to the monitor operator; and
4. Observers may be unable to gain a detailed and accurate description of events and offenders from a momentary TV picture.

#### Assessment of Alerting Devices

In reviewing the various electronic and mechanical devices that could conceivably provide assurances of security in rapid transit, we made the following assessment: Alarm systems are plagued by false alarms and lack of information from the incident scene; phone systems are also subject to false alarms and vandalism, with only verbal information available from the scene; and standard CCTV systems are hampered by the monitor operator's viewing fatigue, and they do not provide verbal communications with the viewed area. Although they could possibly have a favorable effect on the public's perception of security, none of the available electronic countermeasures can effectively meet all the problems encountered in a publicly accessible area. What is needed is a system that will

1. Permit a witness or victim to notify the police quickly, efficiently, and, in some cases, inconspicuously, thereby increasing the public's perception of security as well as actual security;
2. Provide the police with a reliable description of the offense, the offender, and the existing situation before the police arrive on the scene;
3. Reduce the number of false alarms and amount of vandalism so that police can devote more time to legitimate calls; and
4. Minimize increments in manpower costs necessary to effectively accomplish these objectives.

Although available electronic systems do not meet these needs individually, a combination of them holds considerable promise, providing "off-the-shelf" components are employed.

#### PROPOSAL FOR AN INTEGRATED TELEVIEW ALERT SYSTEM

The combination of the alarm, telephone, and CCTV system into a publicly activated operating unit has, to our knowledge, not been attempted before. Such a coordinated system, which we term the teleview alert (TVA) system, would provide the public with an emergency phone and alarm system for quick and efficient communication with the authorities in the event of trouble. Television coverage would provide the police with a method for determining the legitimacy of the alarm and, by video taping, with a reference for describing the events and the offender. By linking the alarm system with the television so that the appropriate television cameras and recorders come on automatically only when an alarm is activated, the fatigue problems and manpower requirements associated with other systems of full-time surveillance are eliminated.

The proposed TVA system holds promise in that it reduces false alarms, provides critical surveillance information, and allows the public to quickly notify the authorities of the problem. The TVA system combines the communication capability of an emergency phone and alarm system with the surveillance coverage of a CCTV system.

The crime profiles emerging from this study indicate that the typical victim is usually isolated and waiting on a station platform, most often between 7:00 p.m. and 2:00 a.m. The offender, after committing the crime, typically leaves the system as



quickly as possible by the nearest exit. Apprehension rates are highest (about 65 percent overall) if the police can respond to the offense scene in less than 5 minutes. Principal security coverage should be enforced during the period from 7:00 p.m. to 2:00 a.m.

### Components of the TVA System

**Movable Gates or Barriers**—Movable barriers would be used during periods of low ridership to restrict the publicly accessible platform area to that space necessary for a reduced train length. These gates, as shown in Figure 6, should be attractive, transparent, and effective as deterrents to prevent passengers from penetrating the unused portions of the platform.

The restricted platform [90 to 115 ft (27 to 35 m) long] can be effectively covered by only four television cameras, instead of several times the number required to survey the total platform [500 to 600 ft (152 to 183 m) long]. Robbery with assault often occurs under conditions of low passenger density, which is typical of many long platforms at night. The limited platform area would force the waiting passengers to gather in a small area, simultaneously making them potential witnesses and reducing the area to be patrolled by police.

**Emergency Phones**—Installation of an emergency phone system (Fig. 7) would provide the public with a direct voice link with the authorities and eliminate a major communication gap that presently exists in transit systems. The phones would enhance the public's perception of security measures and reassure patrons that they can contact the authorities whenever they need assistance. Two phone units are located on a typical island platform, one near the stair or exit ramp, and one about two-thirds of the distance to the remote barrier. (A split platform should have four phones.) These phones are essential to the primary operations of the TVA system. Well-marked boxes will contain a standard receiver handset with an armored cable and a pushbutton activator. The caller must lift the receiver, then momentarily depress the pushbutton activator. This will initiate the call and trigger the TVA system. The central monitor observer can reset the phone even if the receiver has been left dangling by a vandal or an excited victim. In fact, he can reset the system to be otherwise operational, even if the receiver has been torn off by a criminal. The user will not be required to dial or state his location; the system will be self-locating.

**Closed-Circuit Television Cameras**—CCTV cameras would provide the base for effective operation of the system. They would give the authorities essential visual verification of any alarm condition so that false alarms could be screened out and the appropriate response initiated.

Four cameras at the platform level will, in the case of an island, provide overlapping coverage of the open section. Where there are side platforms, overlapping is accomplished by two cameras per platform. An additional camera will be located at the turnstile and will be used to discern actions occurring on the platform whenever the system is activated. A trained monitor observer will, based on actions observed, make a decision regarding the response of the police or other emergency service or identify a false alarm.

All the cameras should be pointed away from the platform exit, which is located at one end of the platform portion under surveillance. All cameras would provide a uniform direction reference, offering a face-on picture of an offender leaving the area. The additional camera in the turnstile area would be used to provide a more detailed facial picture of any offender as he exits, and would also cover the agent's booth, turnstiles, and change and token vending machines.

All five camera signals should be transmitted to the monitor location at one time. This enables the monitor observer to make a decision based on a complete station picture and not on a single area, which may or may not contain the crime scene. The five TV pictures will provide the observer with coverage of station areas where, according to crime statistics, about 80 to 85 percent of all recorded station crimes occur.

**TVA Bars**—The televue alert bars (Fig. 8) will be the primary public activators, in addition to the emergency telephones, for the TVA system. They should be freely

Figure 6. Artist's concept of transparent platform barrier in (a) non-deployed and (b) deployed position.

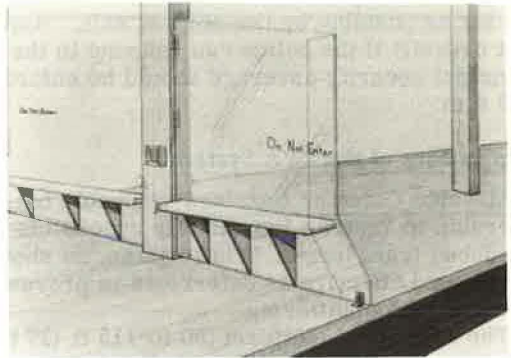
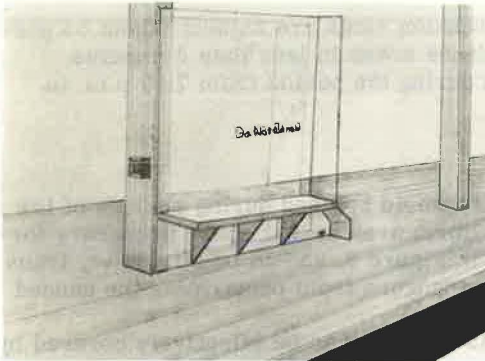


Figure 7. Artist's concept of emergency telephone, internal view.

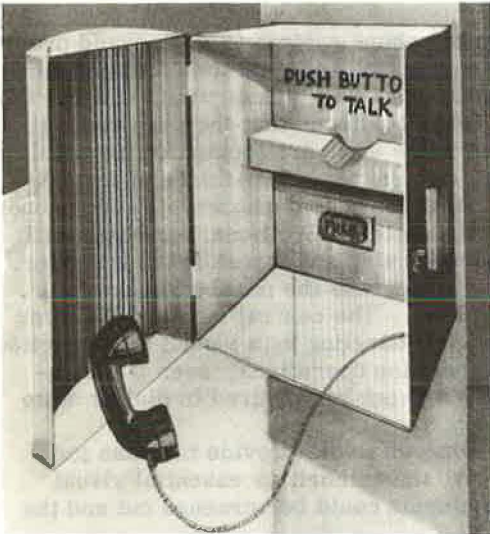


Figure 8. Artist's concept of TVA bar with activation indicator lamp.

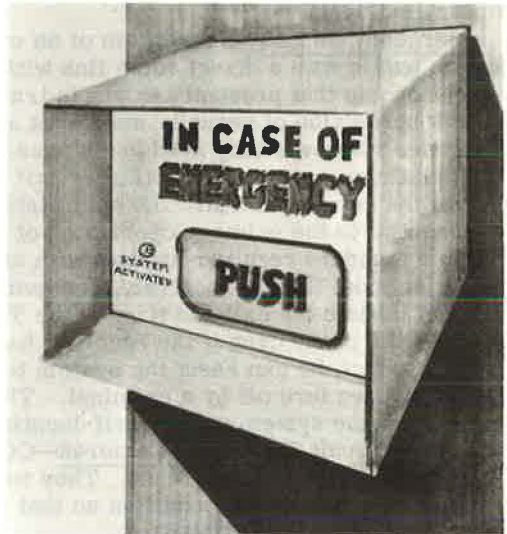
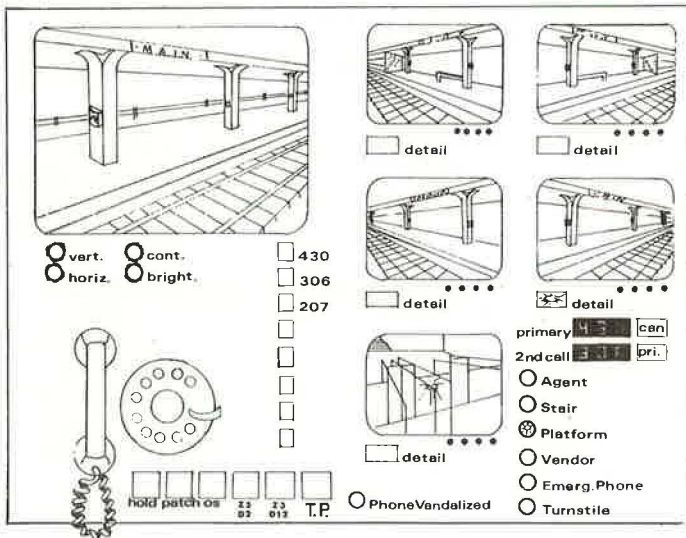


Figure 9. Artist's concept of TVA central monitor main display model.



accessible to the patrons, preferably placed every 20 to 30 ft (6 to 9 m) on the open section of the platform area, some in the stairwells or ramps, and at least one within the turnstile area. All bars, except those in the stairway and ramps, would be within range of the television cameras. These activating devices should require a deliberate action on the part of the user. To avoid alarming an offender, an inconspicuous action such as pushing a lever is preferable. A small signal light on the unit would indicate to the user that contact had been made. Once the bar is depressed or a phone removed from its hook, the unit would become permanently activated until remotely reset by the central monitor operator. A station agent's foot switch would also serve as a TVA bar.

**Monitoring Equipment**—At the central monitor's console six monitor screens are provided: five 9-in. (23-cm) screens and a large 17-in. (43-cm) high-resolution screen (Fig. 9). The five smaller screens simultaneously display all views of any one station, which are always in the same relationship to one another. Four monitors cover the platform, the fifth covers the exit turnstile, and the sixth provides a detailed view of whichever scene the observer chooses. The observer may call up views of any station as part of routine surveillance, but a station in alert would assume priority, and views of that station would be presented automatically, overriding his manual selection.

Five stop-action video tape recorders with time and date generators automatically record the five camera views at the alert scene. They also may be manually activated in a routine surveillance procedure. Capability is provided to transmit any one of the five signals back to the station agent's console for use in identifying offenders. This information would be available for later prosecution.

The central monitor observer has extensive telephone communication capability, which connects him with police dispatchers, traffic supervisors, station agents, and victims or witnesses on the platform.

Indicator lights advise the operator of which station is on alert and locate the alert within the station (platform, stair, agent, vending machine, turnstile, or emergency telephone). The monitor observer is also advised if an alarm at a second station has been activated, although the likelihood of this occurring is remote. The original alert station controls the monitor console until the monitor observer either cancels its alarm (resets the emergency sensors) or moves it to a secondary (hold) position, at which time the waiting station is automatically presented to the monitoring console.

**Public-Address Systems**—Public-address systems have already demonstrated their utility in notifying waiting patrons of scheduling problems. Such systems may also function as security devices when they are used in conjunction with TV coverage. Persons viewing the TV monitors could use the public-address system to talk with and reassure passengers in the waiting areas. Verbal warnings directed at vandals or pranksters might deter them from perpetrating their acts.

## CONCLUSIONS

The thrust of this study was the analysis and evaluation of existing and perceived crime on the rapid transit system of a major metropolitan area. Although not intended to represent transit systems in all cities, the findings suggest conclusions that are sufficiently basic to transit development programs everywhere and that should be given serious consideration in the improvement of existing systems or in the design of new ones. Of particular importance is the observation that, although the crime index on rapid transit systems may well be less than that on city streets (at least in the city studied), the public's impression of crime on the system is what is important and may well underlie a reluctance to use the system, particularly during off-peak hours.

We feel it is a paradox that, with so much attention given to riders' preference for transit-service characteristics and with much concern over those attributes of service that contribute to modal split, very little attention has been given to real and perceived security. Yet, on the basis of these study findings, security looms as a major deterrent to choice riders in off-peak hours.

The TVA system described in this paper is based on the most accurate data we have on transit crime and public attitudes toward it. Most of the criteria for an effective link between the public and security forces are met in such a way as to heighten the

public's perception of security. The total cost for such a security system appears relatively small when it is compared to the construction and operating expenses of a rapid transit system. This cost compares favorably to the heavy costs incurred when manned patrol is relied on exclusively.

#### REFERENCES

1. Broad and Columbia Subway Development Study: Final Report. Broad and Columbia Subway Study Group. Prepared for U.S. Department of Transportation, Assistant Secretary for Environment and Urban Systems, Aug. 1971.
2. Nash, A. N., and Hille, S. S. Public Attitudes Toward Transport Modes: A Summary of Two Pilot Studies. Highway Research Record 233, 1968, pp. 33-46.
3. Williams, E. M., et al. Control of Mass Transit Vandalism and Other Crime. Prepared for Fifth International Conference on Urban Transportation, Pittsburgh, Sept. 8-10, 1971
4. Williams, E. M., and Shellow, R. A Systematic Approach to Mass Transit Security. Presented at University Research and Training Program, Urban Mass Transportation Administration, U.S. Department of Transportation, Washington, D.C., June 1-2, 1972.
5. Bard, M. The Unique Potentials of the Police in Interpersonal Conflict Management. International Journal of Group Tensions (in press).