METRO TRANSIT PARK-AND-RIDE

Security Project

System Evaluation

July 2000

MINNESOTA DEPARTMENT OF TRANSPORTATION

METRO TRANSIT PARK-AND-RIDE SECURITY PROJECT

SYSTEM EVALUATION

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ACKNOWLEDGEMENTS

The project team is grateful for the hard work and cooperation of the following public and private partners in the design, deployment and operation of the Metro Transit Park-and-Ride Security System:

- General Security Services Corporation (GSSC)
- Maplewood Police Department
- Metro Transit Police

EXECUTIVE SUMMARY

In 1998, a Metro Transit Department Task Force was formed to study security issues at park-and-ride lots and bus stops. The Task Force consisted of representatives from the Transportation and Security Departments of the Metropolitan Council, law enforcement officials from Minnetonka and Maplewood, and representatives from Mn/DOT's TMC and Pre-Design Department. The primary goal of this Task Force was to recommend sites for researching security implementations for transit park-and-ride lots, and to make recommendations on project design issues. This research effort was approved and supported by Mn/DOT and the Alternative Transportation Innovations Committee of the Metropolitan Council.

A research/operational test project was undertaken to evaluate the usefulness of an audio/visual security system at the Metro Transit Park-and-Ride located at County Road C and TH 61. This park-and-ride security project involved the design, implementation and evaluation of motion-actuated video surveillance, innovative two-way communication equipment (code blue kiosk) and contracted security monitoring of the Metro Transit Park-and-Ride lot.

Metro Transit's goal was to implement an affordable security system that would allow for a limited amount of monitoring through the use of technologically advanced equipment in a system that could be easily replicated throughout the transit system. Another goal of this project was to determine which technologies could potentially reduce the number of crimes and improve passenger safety. Finally, Metro Transit desired to improve the

security in an innovative, cost-effective manner. It should be noted that the overall goal of deploying security systems at park-and-ride lots is to encourage ridership on existing bus routes through better park-and-ride and bus stop security.

The Metro Transit Park-and-Ride security system, which consisted of a surveillance system and a code blue kiosk system, was designed and implemented primarily to meet customers' personal safety and property needs.

Secondarily, the security system was designed and implemented to satisfy Metro Transit's need for a tool to assist law enforcement officials in apprehending perpetrators, as well as simple and cost-effective technologies for addressing customer needs.

The technologies deployed as part of this project included a code blue kiosk; fixed closed circuit television (CCTV) cameras; a pan, tilt, zoom (PTZ) camera; loop detectors; and video recording devices. General Security Services Corporation (GSSC) was the security system provider for this project. GSSC and Metro Transit were project partners.

GSSC received video from the PTZ camera, and fixed CCTV cameras monitored these cameras and was responsible for notifying local law enforcement officials of a crime in progress. GSSC also provided a manual method of videotaping the crime.

The park-and-ride lot has two entrances that were equipped with loop detectors. When a vehicle entered the park-and-ride lot, the camera panned to the appropriate lot entrance and an alarm sounded at GSSC's monitoring center. Then, GSSC security personnel

were to use the video cameras to identify the vehicle, record the associated license plate and note any security issues related to the entering vehicle. In addition, the PTZ surveillance video was routed to the Metro Transit police operations center via an ISDN connection for park-and-ride usage and capacity monitoring. Additionally, this ISDN connection was used for 24 hour video recording of the lot, which could have been used to assist in the apprehension of perpetrators in the event of criminal activity taking place at the park-and-ride lot.

A code blue kiosk was installed at the outbound bus stop (on Maplewood Drive) so it would be visible to passengers waiting for their bus. However, the code blue kiosk was not visible to the express bus passengers that were waiting for their bus on Highway 61. The alarm from the code blue kiosk was routed to GSSC's control center 24 hours per day, seven days per week. The code blue kiosk was equipped with two-way voice capability to provide voice communications loud enough to be audible by a person standing next to the code blue unit.

As a result of testing, it was determined that the code blue kiosk, loop detectors, fixed CCTV cameras and video recording devices were the most affordable, reliable and effective security devices. Additionally, even though a public address system was not deployed, it was determined that this type of technology would be an excellent crime and theft deterrent. Through public surveys of park-and-ride users, Metro Transit determined that the code blue kiosk and CCTV cameras were the most recognized and important security devices to users for improving personal and property safety because these technologies help to protect their vehicles while parked in the lot. Due to unforeseen

circumstances, the code blue kiosk was not directly tested during the course of this project. However, with proper cooperation between the security provider and the local Police Department a code blue kiosk has an excellent potential of improving the security at park and ride lots throughout the transit system. The following list contains important lessons learned from the Metro Transit Park-and-Ride research/operational test project:

- Park-and-ride users stated that security, convenience, enough parking and well-lit lots are the most important features they look for when choosing a park-and-ride lot to use.
- Through this project, dial-out CCTV systems have been shown to have too much transmission delay to be effective for security purposes. Additionally, dial-out CCTV systems that are equipped with joystick functionality encounter a long delay between the time a command is sent to the camera and when the camera responds. These delays render these CCTV systems of limited utility when used for security purposes of limited utility.
- Vehicle-activated surveillance systems are most effective in express lots that do not have regular activity during non-peak hours.
- The number of CCTVs required to obtain full surveillance of a parking lot will vary with the configuration of the lot. Increasing the height of the camera may or may not be effective, depending on the resolution and image quality that is obtainable over the communications medium being used.
- The use of fixed cameras at key locations allows security personnel to view those locations much more quickly.

- It should be noted that, with the strategic placement of fixed CCTVs and integration of the Transit Department's operations center, an indirect benefit of improving transit operations can be derived through surveillance of park-and-ride and bus stop usage and capacity.

1. INTRODUCTION

In 1998, a Metro Transit Department Task Force was formed to study security issues at park-and-ride lots and bus stops. The Task Force consisted of representatives from the Transportation and Security Departments of the Metropolitan Council, law enforcement officials from Minnetonka and Maplewood, and representatives from TMC and Mn/DOT's Pre-Design Department. The primary goal of this Task Force was to recommend sites for researching security implementations for transit park-and-ride lots, and to make recommendations on project design issues. This research effort was approved and supported by Minnesota Guidestar.

The Alternative Transportation Innovations Committee (ATIC) of Minnesota Guidestar has been soliciting ideas for innovative and research-oriented projects to be funded by their Quickstart Grant. The ATIC choose the Metro Transit Park-and-Ride security project as one of the projects to receive a portion of this grant.

Security Control Systems, Inc. was the original security system partner in this project. SCS's contract was terminated because of inactivity on the project. General Security Services Corporation (GSSC) was subsequently selected to provide the security system for this project. GSSC, Mn/DOT and Metro Transit were project partners. GSSC provided for and installed all of the equipment, Metro Transit provided site preparation and all in-ground work along with project management, and Mn/DOT provided project management and evaluation. GSSC owned all of the security equipment during the study. The Mn/DOT/GSSC contract provided the option for Metro Transit to purchase the system from GSSC if desired, otherwise, GSSC would remove the equipment from the site and retain ownership.

1.1 Project Description

The purpose of this operational test was to evaluate the usefulness of an audio/visual security system at the Metro Transit Park-and-Ride lot location (County Road C and TH 61). The Metro Transit Park-and-Ride lot was chosen because the lot was under construction when the project began, allowing for easier installation of the security system and associated conduit. This site also was experiencing an increasing number of thefts, property damage and other incidents.

This research project was undertaken to determine viable security options that could be deployed to alleviate the users' safety concerns about using the facility. Additionally, the system was designed to provide law enforcement officials with usable tools to assist in the apprehension of the perpetrators.

This park-and-ride security project involved the design, implementation and evaluation of vehicle actuated video surveillance, innovative two-way communications equipment (code blue kiosk) and contracted security monitoring of the Metro Transit Park-and-Ride lot. The following evaluation report documents the benefits and lessons learned from the technology implemented as part of this project.

1.2 Goals and Objectives

One of the goals of this project was to determine which technologies have the potential to reduce the number of crimes and improve passenger safety. Secondly, Metro Transit desired to improve the security in an innovative, cost-effective manner. Essentially, Metro Transit's goal was to implement an affordable security system that would allow for a limited amount of monitoring through the use of technologically advanced equipment in a system that could be easily replicated throughout the transit system. It should be noted that the overall goal of deploying security systems at park-and-ride lots is to encourage ridership on existing routes through better park-and-ride and bus stop security.

The three main objectives of this research project include:

- Issuing a public survey at the Metro Transit Park-and-Ride lot to solicit opinions relative to ridership use, lot features, lot security and desired park-and-ride enhancements.
- Ensuring that the security system technologies deployed were geared toward meeting the customer's needs.
- Resolving the technological "bugs" in deploying an effective, inexpensive system that can be replicated in other park-and-ride lots statewide.

1.3 Needs Addressed

This system was designed and implemented primarily to meet customers' personal safety and property safety needs.

The customer needs were determined through documentation of complaints received about break-ins and other crimes that had occurred at various park-and-ride lots.

Secondarily, the system was designed and implemented to satisfy the following Metro Transit need for a tool to assisting law enforcement officials in apprehending perpetrators, as well as simple and cost-effective technologies for addressing the customers' needs.

Metro Transit has several options that can be employed to meet the security needs of park-and-ride lots like their Maplewood lot. These methods range from the most expensive option of hiring an armed security guard to occupy the lot on a full-time basis to the lowest-cost option of an unmonitored, stand-alone video surveillance system. For this project, a sophisticated camera and vehicle detection system was used in an effort to reduce the costs of monitoring the lot. The security needs of the lot were addressed by transmitting a video feed to the security provider when activity in the lot was detected. In addition, the video feed was transmitted to the Metro Transit Police Department, where output from the cameras was continually recorded and used as a potential case-solving tool in the event of criminal activity.

1.4 Desired Benefits

The overall benefit of deploying this security system was to ensure a safe and comfortable experience for transit users. This can be achieved if several other individual benefits are achieved. For example, a desired benefit of the system implementation was to reduce the potential for damage to a passenger's personal property at the park-and-ride lot. In addition, travelers will benefit from the prevention of damage to passenger amenities, such as bus shelters, route information signs and pay telephones.

1.5 Technologies Implemented

The project team determined what technologies would best meet the customer's needs through internal brainstorming sessions and through talking to transit providers in other cities. For example, transit providers in Houston, Texas are very active in deploying and researching security systems at their park-and ride lots. As a result, the following technologies were selected and deployed as part of this project:

- A Closed Circuit Television Camera (CCTV) with pan, tilt, zoom capabilities
- Fixed cameras
- A code blue kiosk

2. SECURITY SYSTEM PROVIDER

General Security Services Corporation (GSSC) was the security system provider for this project. GSSC provided the cameras, communications equipment and code blue equipment and retained ownership of the equipment during the study. Once the system was proven effective, GSSC's and Mn/DOT's contract stated that Metro Transit would purchase the system from GSSC if desired. Ultimately, GSSC did remove the equipment.

Metro Transit and Mn/DOT partnered with GSSC under the following conditions:

Mn/DOT paid GSSC to furnish and install all of the equipment at the park-and-ride site. Metro Transit installed the power and communications cabling at the park-and-ride during construction of a parking lot expansion. During the testing period, all of the equipment was owned by GSSC. The equipment remained the property of GSSC until the testing was complete. At that time, if the equipment worked properly and Metro Transit was satisfied, Metro Transit had the option to purchase the equipment from GSSC.

Initially, GSSC was to monitor the lot each time a car entered the parking facility between the hours of 8:30 a.m. and 3:30 p.m. GSSC also controlled the code blue kiosk during business hours. During these hours, the actuated surveillance system sounded an alarm at GSSCs control center when a vehicle entered the lot, and the PTZ camera moved to a predetermined location to view the entering vehicle. This type of actuated monitoring system provides the most benefit at an express lot because activity during non-express hours (mid-day and evening) is minimal. Therefore, it is likely that a vehicle entering the lot during non-express hours is entering for a

non-transit purpose. During this projects' test phase, the operational hours of the Metro Transit Park-and-Ride lot were expanded because the designated use of the lot changed from an express only lot to a combination express lot and a regular route lot. Because of this change, buses were leaving from the lot once per hour, versus only at the peak periods. Therefore, the lot was being accessed throughout the day several times per hour, which caused GSSC to receive an average of ten false alarm calls per hour. Consequently, GSSC altered their monitoring by performing a remote guard tour (via the CCTV cameras) of the lot once per hour between the hours 9:00 a.m. and 3:00 p.m. Additionally, GSSC monitored the code blue kiosk and randomly monitored the lot using the CCTV system 24 hours per day, seven days per week.

3. PUBLIC SURVEYS

Metro Transit, in an effort to gather the opinions of park-and-ride lot users, asked GSSC's marketing department to design a survey form to be distributed to the park-and-ride users. Mn/DOT's OATS office and Metro Transit reviewed the form and made revisions. George Serumgard of Metro Transit administered the survey on site by handing clipboards and pencils to transit users entering the park-and-ride lot, and collecting them while the participants waited for their bus. Response rate to the survey was very high.

Mr. Serumgard summarized the results and performed the statistical analysis on the responses. GSSC analyzed these survey results in preparation for this report.

3.1 Description

The survey was dispensed on May 5, 1999 on-site at the park-and-ride lot from 6:45 a.m. to 7:38 a.m. The surveys were administered to passengers as they entered the park-and-ride lot and were collected at the bus stop. Many passengers refused the survey due to inclement weather and the inconvenience of filling it out.

The park-and-ride lot has a total of 220 parking spaces, of which 190 were occupied that day. Over twenty percent (39) of the total passengers entering the lot that morning, responded to the survey. Of the 39 surveys filled out, 6, or 15.3%, were incomplete. It should be noted that

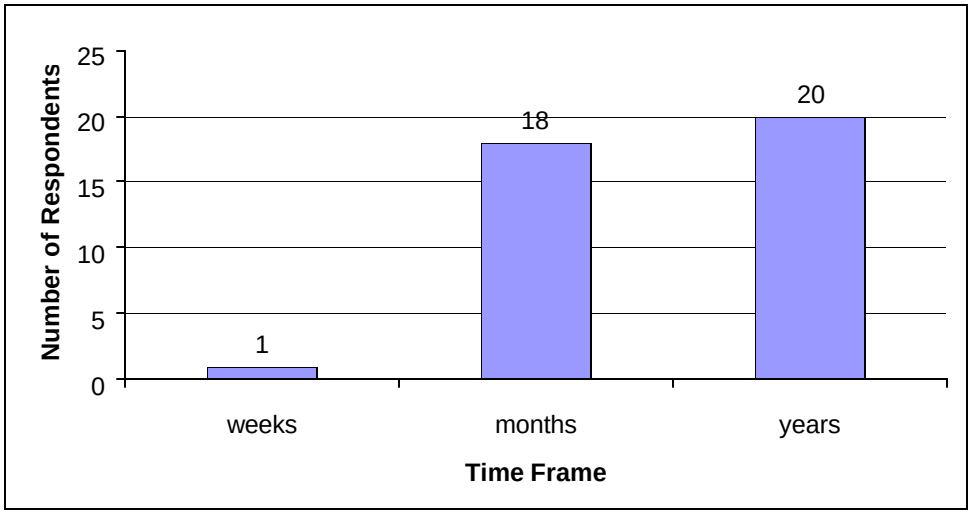
results from the incomplete surveys were used in the survey compilation totals. The survey questions and the results of the survey are shown in the following pages.

3.2 Public Notification of the Security System

The existence of the security system at the park-and-ride lot was not advertised to the general public because the project participants wanted to test the impact of the technology on security, rather than the impact of advertising on security. In addition, there was a concern about over-stating the system's capabilities to the public if the system did not perform as expected. However, the CCTVs and code blue kiosk were directly noticeable by the public and indicated the existence of an on-site security system.

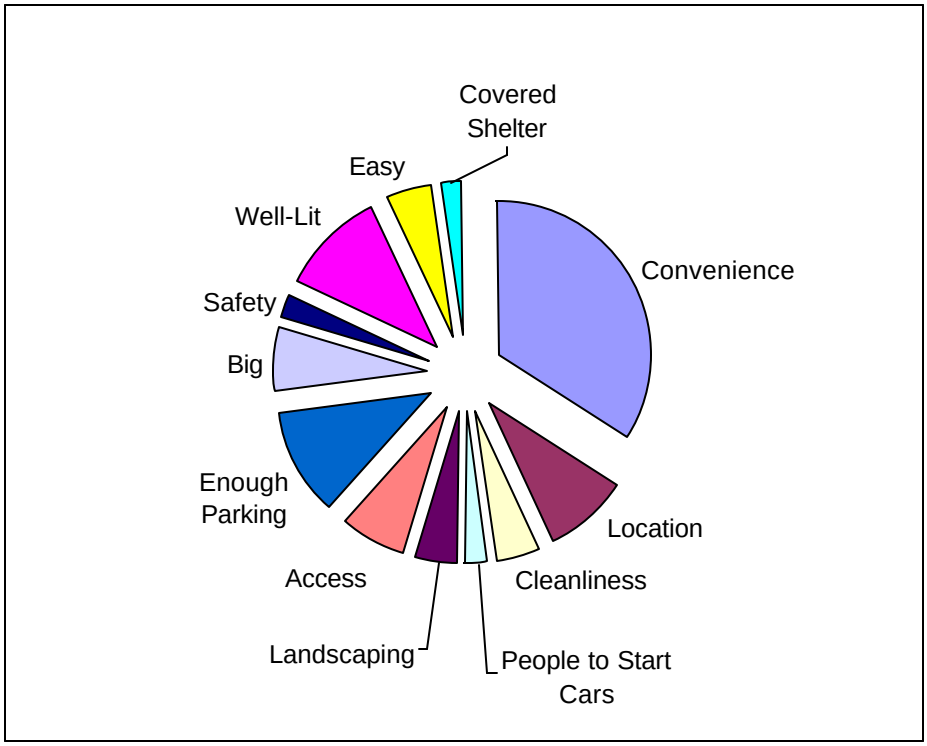
3.3 Results

Question 1 – How long have you used this park-and-ride lot?



Because most respondents have used the lot for several months or years, their statements can be qualified as valid regarding the use of the lot.

Question 2 – What features do you like in the park-and-ride lot?



Many respondents stated multiple features; however, the most predominant responses included convenience, enough parking and a well-lit lot.

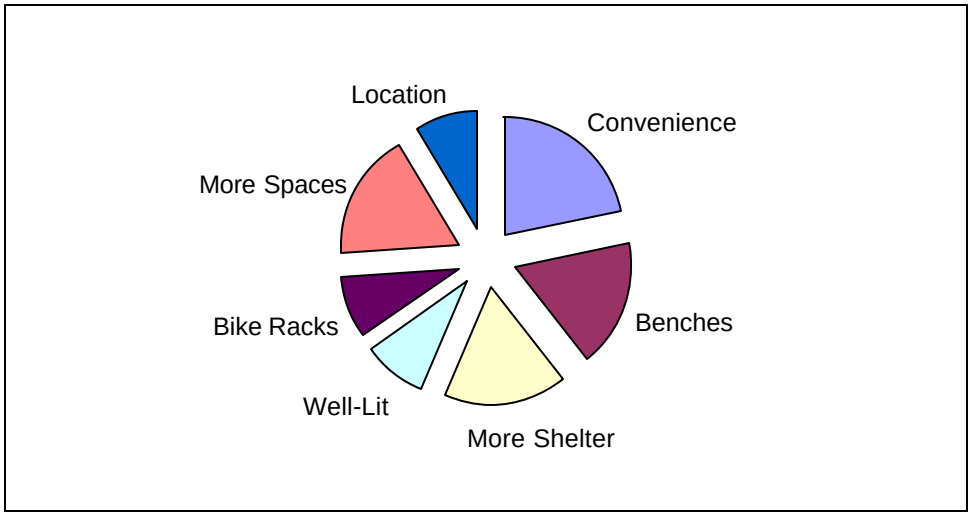
Question 3 – Are there additional features you would like in this lot?

Responses:

Yes – 8 responses

No – 24 responses

Question 3A – Define the features



Question 4 – Have you used other park-and-ride lots?

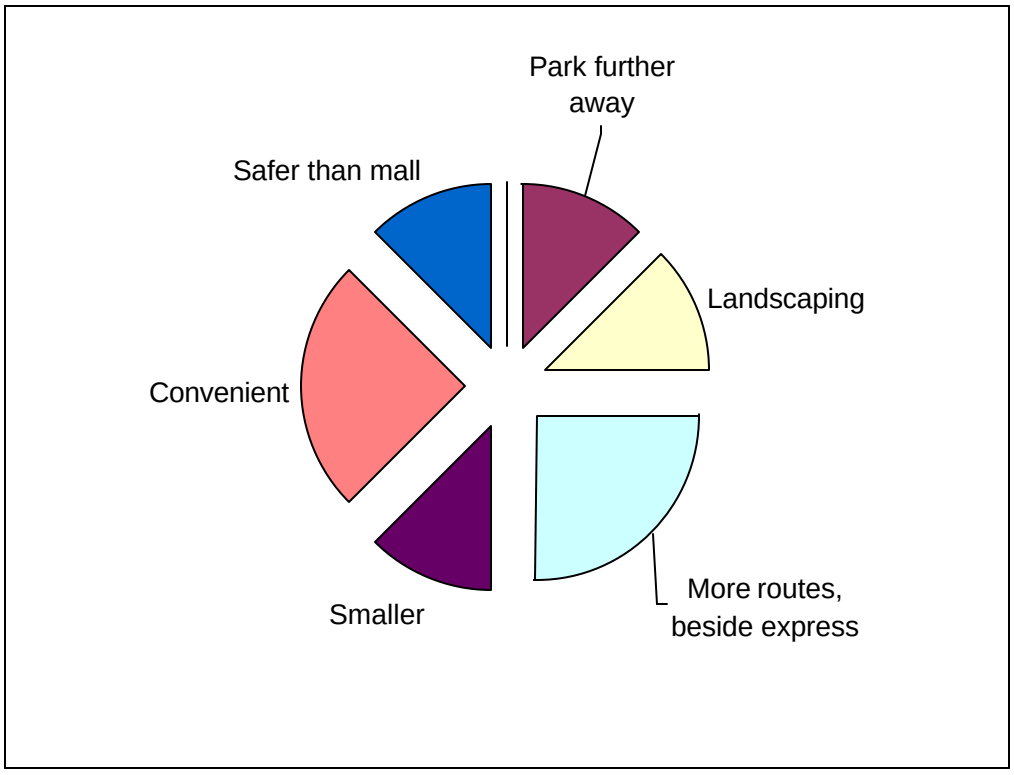
Responses:

Yes – 14 responses

No – 24 responses

The majority of respondents have no other lot for comparison, which may have skewed the survey results.

Question 4B – If yes, how do those lots differ from this one?



Metro Transit's Park-and-Ride lot at the Maplewood Mall is the preferred alternative of those respondents who use other park-and-ride lots. As a result, the majority of the shown responses referred to the Maplewood Mall lot.

Question 5 – Is security at park-and-ride lots important to you?

Responses:

Yes – 31 responses

No – 1 response

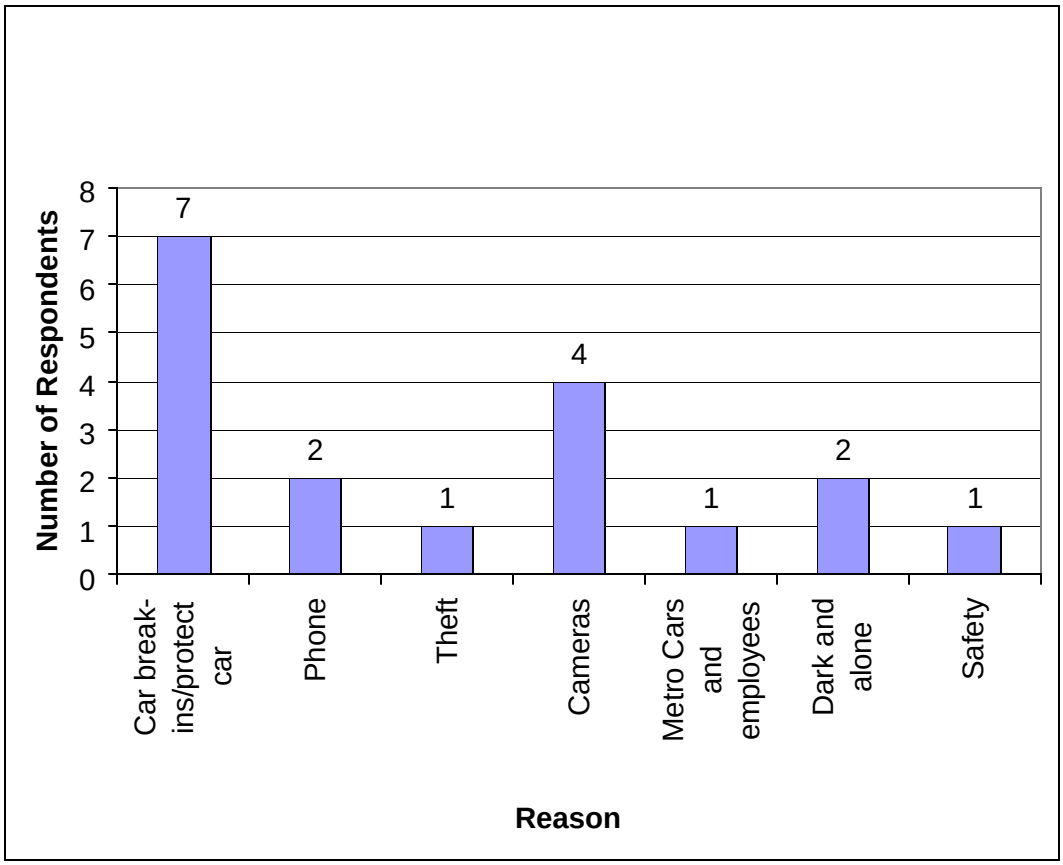
Question 6 – Did you know there is security at this location?

Responses:

Yes – 10 responses

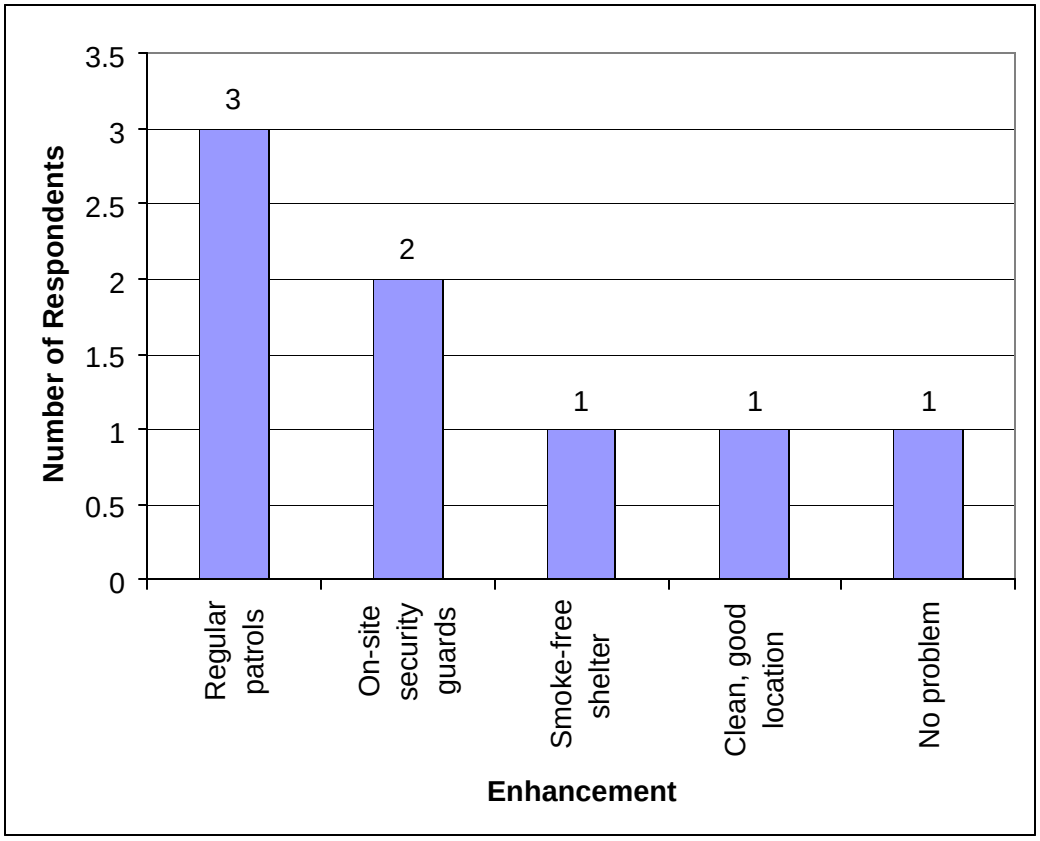
No – 26 responses

Question 7 – If so, what is the security and why is the security important to you?



The respondents noted that in-place security is most important for their safety at night, and to prevent theft of their vehicles or personal property.

Question 8 – What further security enhancements would you like to see implemented?



The most important security enhancements that respondents would like implemented are regular patrols of the lot and on-site security guards.

Question 9 – Are you willing to share your experience in this lot with us?

Responses:

Yes – 17 responses

No – 9 responses

Most of the people who took time to complete the survey were willing to further discuss their experiences and thoughts regarding the park-and-ride lot. This high participation rate usually indicates an extreme negative, or an extreme positive, satisfaction level.

Question 10 – Do you have any other comments you would like to make that may help our future plans?

Responses:

One respondent thanked Metro Transit employees for replacing a lost card within two days and was pleased.

4. INCIDENT RESULTS

During the operational test phase of the project, one car break-in occurred, but due to an improperly functioning PTZ camera, no video was available of the crime.

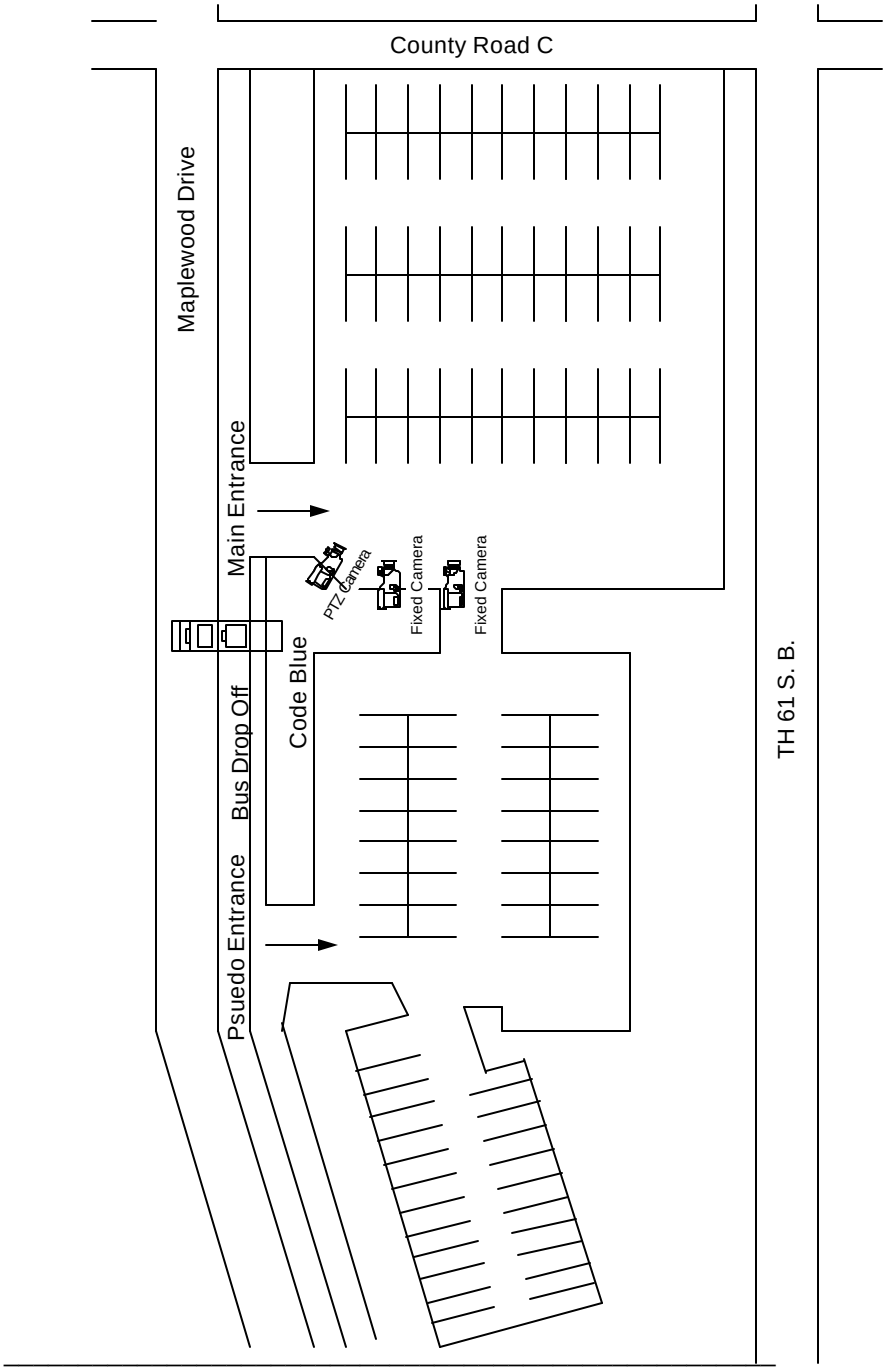
No substantial decrease in the number of incidents was shown as a result of installing this system. It should be noted that this type of system would be more worthwhile installed on a lot that experiences a significantly higher crime rate. Additionally, there is not sufficient data available to conclude that police response times to crimes in progress were reduced as a result of this project.

5. Equipment
5.1 System Description

5.1.1 Site Diagram

The Metro Transit Park-and-Ride lot is located in the southwest corner of the TH 61 and County Road C intersection (see Figure 1).

Figure 1 – Metro Transit Park-and-Ride Site Diagram



5.1.2 Site Photos

The following photos were taken of the park-and-ride lot on March 20, 2000:

Photo 1 – View of the Main Entrance

Photo 2 – Video Cameras

Photo 3 – Code Blue Kiosk

Photo 1 – View of the Main Entrance

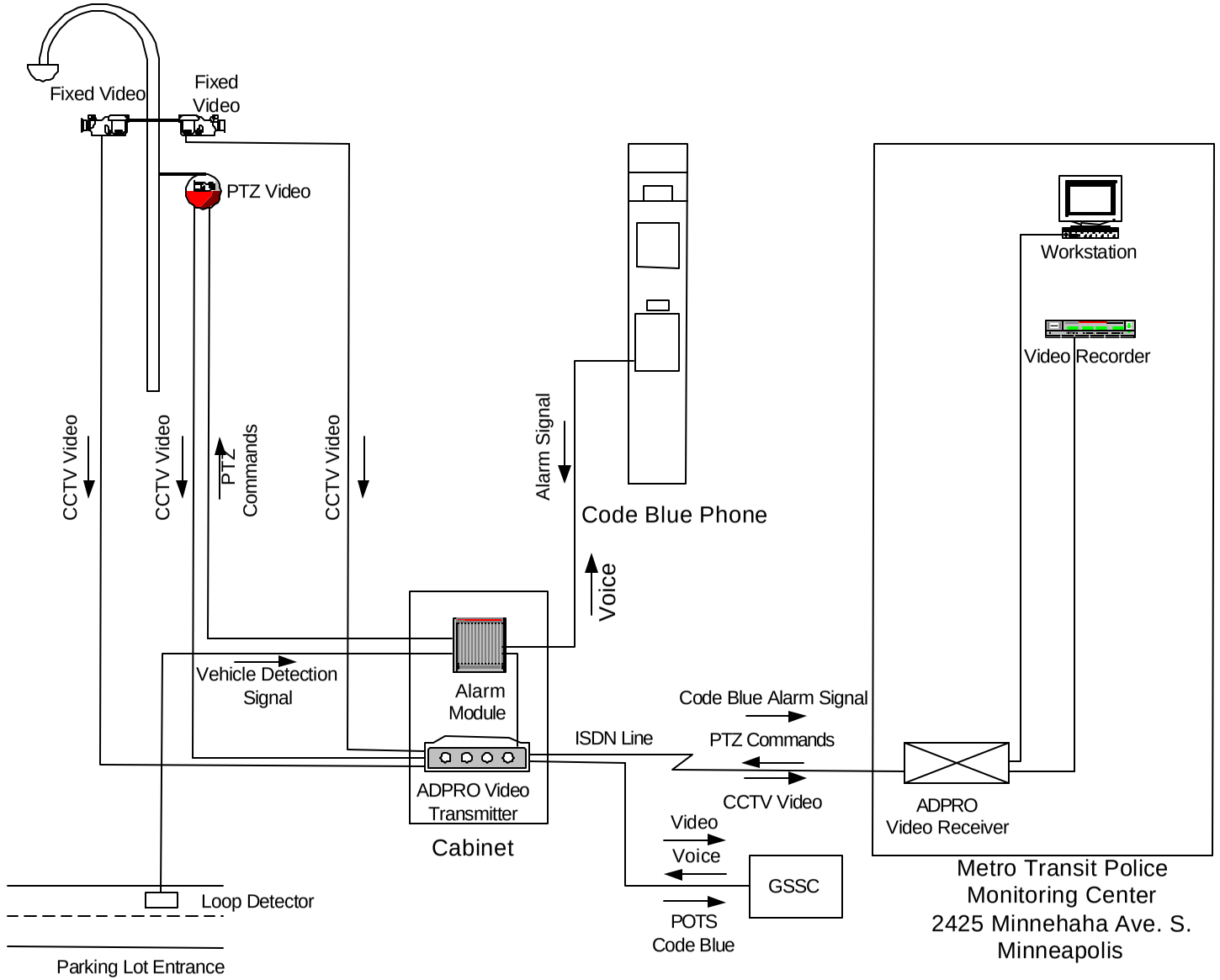
Photo 2 – Video Cameras

Photo 3 – Code Blue Kiosk

5.1.3 System Diagram

The surveillance video was transmitted to the Metro Transit Police Monitoring Center at 2425 Minnehaha Avenue South in Minneapolis, through ISDN lines. In addition to the video transmissions, code blue communications were transmitted to the GSSC security operations center via a separate Plain Old Telephone System (POTS) line. Please see the following diagram (Figure 2) for a detailed system schematic.

Figure 2 – System Diagram



5.1.4 Components

GSSC furnished and installed all of the necessary equipment to achieve the goals and objectives of the park-and-ride security research project. The following is a list of equipment that was initially installed at the park-and-ride site:

Table 1 – Metro Transit Park-and-Ride CCTV Equipment

Amount	Model	Designation
1	KTA12DW3MEP	Kalatel outdoor domed housing with heater/blower and presets
1	WVCP645	Panasonic low light level color camera
1	C70501	Cosmicar 5.8-58mm A/I lens with presets
1	KTA02-12W	Kalatel wall mount
1	KTA07-12	Kalatel pole mount adapter
1	KTA04-12	Kalatel power supply
1	KTD460P	Kalatel preset alarm module
1	KTD300	Kalatel programming keypad
1	KTSDA	Kalatel distribution amplifier
1	TLC2100SHD	GYYR recorder
1	220323	ADPRO video transmitter
1	CB1	Code Blue System

An ADPRO video transmitter was installed in a Mn/DOT signal cabinet located on the park-and-ride lot for this project. Note: the EEPROM contained in the ADPRO transmitter used in this project can be upgraded as compression ratios and transmission speeds improve. It is possible to perform this upgrade in the field and with no additional reprogramming of the system.

It was determined, after initial system testing, that one PTZ camera was not providing sufficient surveillance coverage. Therefore, Metro Transit police provided two fixed cameras and GSSC provided the housings and mounts (see Table 2). GSSC installed this additional equipment.

Table 2 - Additional CCTV Equipment

Amount	Model	Designation
2	14BHI-24	EMI Environmental Housing
2	CCHM8	EMI Mount
1	PS2440S-8	Power Supply

The following equipment was installed at the Metro Transit Police Department and at the park-and-ride lot to allow Metro Transit police to record the video transmissions:

Table 3 - Metro Transit Police Department Equipment

Amount	Model	Designation
1	220323	ADPRO transmitter
1	220317	ADPRO receiver
2	300291	ISDN Modem

Note: The equipment listed above is equipment used at the park-and-ride and should only be considered as spec equipment. Other equipment manufacturers make equipment of equal quality.

5.1.5 System Operation

The contracted monitoring service (GSSC) was to notify local law enforcement officials of a crime in progress and provide a manual method of videotaping the crime. In addition, the surveillance video was routed to the Metro Transit operations center for 24-hour monitoring and video-recording. The intention of the 24 hour video recording of the lot was to assist in the apprehension of perpetrators in the event of criminal activity taking place at the park-and-ride lot. Finally, another possible use for the monitoring would be to direct buses that were behind schedule past park-and-ride lots that did not have any waiting passengers, allowing those buses to get back on schedule and consequently provide better service for transit users.

GSSC received video from the PTZ camera and fixed CCTV cameras. The park-and-ride lot has two entrances that were equipped with loop detectors. When a vehicle entered the park-and-ride lot, the camera panned to the appropriate lot entrance and an alarm sounded. Then, GSSC security personnel used the video cameras to identify the vehicle, record the associated license plate and note any security issues related to the entering vehicle. In addition, GSSC had the ability to manually record the video images they received from the PTZ camera. Metro Transit received video from the PTZ camera only via an ISDN connection. GSSC maintained control of the PTZ camera, but Metro Transit had the capability to manually record the video images.

The PTZ camera had three predetermined locations (automatic presets) to which the camera would automatically move if a vehicle were detected entering the lot. The automatic presets were defined for the south drive entrance, the north drive entrance and the code blue kiosk. In addition, automatic presets were programmed for six other locations in the park-and-ride lot. The PTZ camera terminal in the GSSC control center was equipped with a joystick so security

personnel could manually follow a person's movements in the park-and-ride lot. It should be noted that an existing pay phone was relocated from the boarding platform to the drop-off area to discourage non-transit users from entering the lot and triggering the PTZ camera alarm.

A code blue kiosk was installed between the main entrance and the bus shelter so it would be visible to passengers waiting for their departing bus. However, the code blue kiosk was not visible to the express bus passengers that were waiting for their bus on Highway 61. The alarm from the code blue kiosk was routed to GSSC's control center 24 hours per day, seven days per week. The code blue kiosk was equipped with two-way voice capability to provide voice communications loud enough to be audible by a person standing next to the code blue unit. The original system design included a speaker system, which would have allowed security personnel to notify perpetrators they were being watched and to assist patrons wanting assistance. However, this system was not installed because of the expense of installing the necessary conduit at the park-and-ride lot. It should be noted that if the necessary conduit were in place, a speaker system would be relatively inexpensive and would be a worthwhile security enhancement.

The only involvement the Maplewood Police had in this security project was to respond to incidents after business hours.

As part of system enhancements proposed midway through the test, the south entrance was to be blocked off. This component was not installed due to the delay (inconvenience) to motorists entering the lot. An additional system enhancement involved adding two fixed CCTV's at the lot. It was determined, after initial system testing, that one PTZ camera was not providing

sufficient surveillance coverage. Therefore, Metro Transit provided two fixed cameras and GSSC provided the housings and mounts. GSSC installed this additional equipment.

5.2 CCTV

Maplewood Drive is the TH 61 frontage road abutting the entrance to the park-and-ride lot. When a vehicle entered the lot, the camera panned to a predetermined location (i.e., the lot entrances area). The CCTV system installed for this test was a dial-out system, meaning that when a vehicle activated the camera by driving over the loop detector, the camera panned to a predetermined location while dialing the monitoring station. Because of the delay associated with dialing, the vehicle had already left the camera's field of view by the time the video signal was actually received at the control center. An additional problem occurred when people test-driving cars from the automobile dealerships across TH 61 used the lot to turn around or change drivers. This caused many false alarms. These false alarms were irritating to the operators and clouded their perception of the system's usefulness.

The Kalatel pan/tilt system worked well, except when the ambient temperature fell below-20 degrees Fahrenheit with a 20-mph wind. Under these conditions, the pan/tilt did not operate very well; its grease solidified due to the inability of the heaters to compensate for the cold. However, these extreme conditions only occurred on two or three days during the testing period.

The PTZ camera terminal in the GSSC control center was equipped with a joystick to allow security personnel to manually follow a person's movements in the park-and-ride lot. A problem with this feature was a long delay between the time a command was sent to the camera and when the camera responded. Then, another delay occurred when the video was transmitted back to the control center. As a result, the combined delay was too long, rendering this feature of limited utility.

Another challenge with using the CCTVs was associated with the configuration of the lot. The rows in which cars parked were configured in several directions, so the PTZ and fixed cameras were unable to view activity down the rows of parked vehicles. To solve this problem, the cameras could have been installed higher and/or more cameras could have been installed for complete coverage. However, increasing the height of the camera would only have had a minimal effect on solving this problem because the resolution quality of the video was so poor that it was difficult to identify a person in the lot. The interface between the ADPRO transmitter and the ISDN system was believed to limit the resolution and quality of the video images. The CCTV system was configured in such a way that only the non-static portion of the video image was refreshed. This feature allowed for improved resolution and frame rate. GSSC had the ability to alter the frame rate, which would alter the resolution. However, because the video was being sent over a POTS line, the frame rate, resolution and the camera reaction time to commands were limited. As a result, the usefulness of the CCTV system was significantly decreased.

It should be noted that, even though the video monitoring was not successful in this test project, such a system has great potential to be a worthwhile form of security if the following issues are appropriately addressed:

- Better image quality and resolution (i.e., better communications line)
- Better PTZ control (i.e., better communications line)
- Deploying a sufficient number of cameras to provide surveillance of the entire parking lot
- Using fixed cameras to view key locations, allowing operators to view that location much more quickly

5.3 Code Blue Kiosk

The code blue kiosk was never used by park-and-ride lot users for an emergency during the testing period. This has both positive and negative implications. First, at other code blue installations, many calls received from the code blue are false alarms, and on the positive side, it implies the location was correctly chosen because the phone was not misused. Also, perhaps the presence of the code blue device prevented crimes. On the other hand, non-use could imply the park-and-ride users were either not conscious of the safety devices available and/or they did not appreciate their value.

The close proximity of KSTP AM radio tower caused two problems with the code blue kiosk. First, the radio transmissions from the tower caused static on the phone line. Second, the code

blue metal structure acted as an antenna. The phone received radio transmissions, which prevented the phone from automatically hanging up or shutting off. When this occurred, GSSC had to remotely hang up the phone from the control center. As a result, the code blue kiosk did not work properly for the duration of the test.

5.4 Loop Detectors

Metro Transit installed loop detectors at both park-and-ride lot entrances when the lot was recently expanded. There were no problems with these loops throughout the duration of the testing.

5.5 ISDN

The reason an ISDN line was used for this project was because it allowed for higher bandwith video transmissions than POTS lines. The Metro Transit Police Control Center was networked with the CCTV system via an ISDN line providing a 128K transmission rate. However, new compression algorithms have recently been implemented on POTS lines that have allowed for improved video transmissions on that medium. Therefore, the incremental amount of bandwidth gained by ISDN does not justify the additional cost of ISDN over POTS.

One of the biggest problems encountered was the delay caused by installation of the ISDN line. The line was installed to the Metro Transit Police Department relatively quickly, but installation was delayed at the park-and-ride for four months. Once the ISDN line was installed, US West spent two months de-bugging the system. First, they were unable to properly connect both portions of the ISDN line to the Metro Transit control center, which effectively cut their available video transmission rate in half. As a result, the video resolution and frame rate at Metro Transit's control center was limited for the duration of the project. Second, a relay went down in the system, causing the signal to drop out on a daily basis.

From this experience the project team learned that when ordering multiple ISDN lines, it is necessary to stipulate that each of the lines (channels) is dependent on the other lines. Otherwise, a charge will be incurred for a line that could not be used if one segment of the system is not operational as soon as the other segments are.

It should be noted that the use of DSL connection should be investigated for future projects of this type. DSL connections are less expensive than ISDN and have the potential to provide faster, more reliable video transmissions.

5.6 Modem

The primary maintenance problem that occurred during the testing period was the loss of the control signal from the modem. When this occurred, a GSSC technician was required to travel to

the park-and-ride lot to reinitialize the modem. From the signal loss to reinitialization, GSSC could receive video images but could not control the PTZ function. Because of this, GSSC replaced the modem and was required to reprogram it so it would automatically re-dial GSSC's control center in an effort to reinitialize.

GSSC does not have an accurate record of the number of service trips they made to the park-and-ride lot to reinitialize the modem after a loss of signal occurred. However, an estimated number of trips to the site is six. The total cost for servicing the security system was $106 per trip, for an estimated total of $636.

5.7 Transmitter

The ADPRO transmitter was installed in a Mn/DOT signal cabinet and worked very well throughout the test. There was a fan inside the cabinet, which provided air circulation. Even though there was no heater in the cabinet, the transmitter functioned properly through the winter.

6. SYSTEM COSTS

6.1 Equipment and Installation

The following costs for the equipment and installation were incurred by GSSC as part of this research project.

Table 4 – Metro Transit Park-and-Ride CCTV Equipment

Amount	Model	Designation	Cost
1	KTA12DW3MEP	Kalatel outdoor domed housing with heater/blower and presets	$1,514
1	WVCP645	Panasonic low-light level color camera	$1,040
1	C70501	Cosmicar 5.8-58mm A/I lens with presets	$982
1	KTA02-12W	Kalatel wall mount	$76
1	KTA07-12	Kalatel pole mount adapter	$42
1	KTA04-12	Kalatel power supply	$122
1	KTD460P	Kalatel preset alarm module	$237
1	KTD300	Kalatel programming keypad	$474
1	KTSDA	Kalatel distribution amplifier	$142
1	TLC2100SHD	GYYR recorder	$1,979
1	220323	ADPRO video transmitter	$3,525
1	CB1	Code Blue System	$3,881
		Total	**$14,014**

It was determined, after the initial system testing, that one PTZ camera did not provide sufficient surveillance coverage. Therefore, Metro Transit police provided two extra cameras and GSSC provided the housings and mounts (see Table 5). GSSC installed this additional equipment.

Table 5 – Additional CCTV Equipment

Amount	Model	Designation	Cost
2	14BHI-24	EMI Environmental Housing	$344
2	CCHM8	EMI Mount	$72
1	PS2440S-8	Power Supply	$128
		Total	**$544**

The total cost for the CCTV equipment was $14,588. The total installation cost for the above equipment was $3,968. Therefore, the total equipment and installation cost was $18,526.

Table 6 – Miscellaneous Equipment and Installation Costs

Item	Cost
Installing the electrical service, equipment cabinet foundation, pushing conduit under sidewalk and driveway, wiring in the two loop detectors and concrete base for the code blue kiosk[1]	$5,399

1 – The labor and material required to bring power from the existing panel to the new equipment cabinet was $2,100. This amount was reimbursed to GSSC by Metro Transit. The remaining $3,299 went against GSSC's $10,000 contract.

The following equipment was installed at the Metro Transit Police Department and at the park-and-ride lot to allow the Metro Transit police to record the video transmissions. Note that this equipment was purchased, and is owned, by the Metro Transit Police Department.

Table 7 – Metro Transit Police Department Equipment

Amount	Model	Designation	Cost
1	220323	ADPRO transmitter	$3,525
1	220317	ADPRO receiver	$3,586
2	300291	ISDN Modem	$445

The total cost for the Metro Transit equipment was $7,556.

Note that the equipment listed above is used at the park-and-ride and should only be considered as spec equipment. There are other equipment manufacturers who make equipment of equal quality.

6.2 Operational Costs

GSSC monitored the code blue system from September 1, 1998 to December 31, 1999.

Initially, GSSC was contracted to monitor the park-and-ride lot each time a vehicle entered the lot between the hours of 8:30 a.m. to 3:30 p.m. As the midday routes were added to the lot's operations, GSSC altered their monitoring operations to include a guard tour of the lot once per hour between 8:30 a.m. and 3:30 p.m. The following monitoring fees are based on one guard tour per hour:

Table 8 - GSSC Monitoring Fees

Item	Cost
9/1/98 to 12/31/99 monthly monitoring $85 per month for 16 months	$1,360
9/1/98 to 12/31/99 hourly guard tours, Monday through Friday[2]	$6,000
9/1/98 to 12/31/99 24 hour code blue Monitoring	$400

2 – This cost is based on 150 hours per month at $2.50 per tour.

The total monitoring cost was $7,760.

7. EXPECTED FUTURE LOCATIONS

Another test site chosen for park-and-ride security monitoring is at Metro Transit's 65th and Brooklyn Boulevard Park-and-Ride lot. Security issues at this site are extensive, as several vehicles have been stolen in the past. This site will not employ video transmission from a PTZ or fixed camera; rather, video will be recorded on-site. In addition, sensors may be installed at the entrances in the roadway.

One advantage of choosing this site, with regard to system installation, is that the lot is relatively new. Additionally, the lot is in close proximity to Mn/DOT's fiber optic network, which could provide the high-bandwidth communications required to transmit video to the monitoring location if this feature is implemented.

The project participants discussed installing gate arms at this lot to restrict access at the secondary entrance. However, one of the goals of this security project is to install a system that does not change the way the lot operates. Because of this, no gate arms will be installed at the entrances because Metro Transit does not wish to inconvenience transit users. Also, the gate arms would negatively impact normal bus movement in and out of the lot.

8. LESSONS LEARNED

Upon completion of the Metro Transit Park-and-Ride security project, the following lessons were extracted:

- When designing and estimating the cost of installing a security system at a park-and-ride lot, it is important to note the location and/or availability of electrical service throughout the lot. Many lots will require trenching for the installation of additional electrical service, which can be costly.
- If the necessary conduit and electrical service is available, a speaker system that can be operated remotely is a worthwhile security enhancement at park-and-ride lots.
- Park and Ride users stated that security, convenience, enough parking and well-lit lots are the most important features they look for when choosing a park-and-ride lot.
- Gate arms are an effective tool for restricting access to park-and-ride lots. However, the geometry of each lot plays an important role in determining the overall effectiveness of the gate arms.
- Through this project, dial-out CCTV systems have been shown to have too much transmission delay to be effective for security purposes. Additionally, low bandwidth communication CCTV systems that are equipped with joystick functionality encounter a long delay between the time a command is sent to the camera and when the camera responds. These delays render these CCTV systems of limited utility when used for security purposes.

- Vehicle-activated surveillance systems are most effective in express lots that do not have regular activity during non-peak hours.
- The number of CCTVs required to obtain full surveillance of a parking lot will vary with the configuration of the lot. Increasing the height of the camera may or may not be effective, depending on the resolution and image quality that is obtainable over the communications medium being used.
- The use of fixed cameras at key locations allows the security personnel to view those locations much more quickly.
- ISDN lines allow for better video transmissions; however, new compression ratios on POTS lines have allowed for improved and less expensive video communications.
- When ordering multiple ISDN lines, it is necessary to stipulate that each of the lines (channels) is dependent on the other lines. Otherwise, a charge will be incurred for a line that could not be used if one segment of the system is not operational as soon as the other segments.
- It should be noted that the use of DSL connections should be investigated for future projects of this type. DSL connections are less expensive than ISDN connections and have the potential to provide faster, more reliable video transmissions.
- Choosing park and ride lots that are in close proximity to high bandwidth communications infrastructure (i.e., fiber optic networks, etc.) and/or lots that have an existing network of conduit is advantageous to security system communications installations.

- When deploying security systems in park-and-ride lots with multiple entrances, it will be necessary to either provide surveillance of all the secondary entrances, or to restrict access to those entrances during non-peak times (express lots only).
- Another possible use for park-and-ride surveillance systems is to direct buses that are behind schedule past park-and-ride lots that do not have any waiting passengers. This allows those buses to get back on schedule and provide better service for transit users.

9. CONCLUSION

Metro Transit's goal was to implement an affordable security system that allowed for a limited amount of security related monitoring. In order to achieve this goal, Metro Transit and GSSC designed and implemented various technologies to determine which had the potential to reduce the number of criminal incidents in the lot, improve passenger safety and improve the security of the lot. In order to accomplish this, three primary objectives and one indirect objective of the project were defined and met.

First, Metro Transit desired to determine which technologies and procedures are viable, inexpensive security options for park-and-rides and bus stops statewide. The technologies deployed include a code blue kiosk, fixed CCTV cameras, a PTZ camera, loop detectors and video recording devices. As a result of testing, it was determined that the code blue kiosk, loops, fixed CCTV cameras and video recording devices were affordable, reliable and effective security devices. Additionally, even though a public address system was not deployed, it was determined that this type of technology would be an excellent crime and theft deterrent.

The second project objective states that the technologies employed as part of a security system should be those technologies that are geared toward meeting the customers' needs. Through public surveys of park-and-ride users, Metro Transit determined that the code blue kiosk and CCTV cameras were the most recognized and important security devices to users. The most important reason that transit users listed these technologies is because they were perceived to prevent automobile break-ins and protect their vehicles while parked in the lot. It should be

noted that all of the technologies listed above were intended meet these customers' wants and needs.

Through the deployment of this security system, Metro Transit desired to improve police response time to crimes in progress through the use of contract monitoring and a phone link (code blue kiosk). Due to unforeseen circumstances, this was not directly tested during the course of this project. However, with proper cooperation between the security provider and the local police department, this objective has an excellent potential of being met with the implementation of this type of security system.

The final, an indirect objective of the project was to improve transit operations by allowing Metro Transit operations to monitor park-and-ride and bus stop usage and capacity. With the strategic placement of fixed CCTVs and integration of the transit department's operations center, this indirect benefit can be effectively derived from the type of security system described above.