STATUS REPORT ON OPERATIONS OF CCTV SYSTEM USING LEASED FIBER OPTIC CABLES (FEBRUARY 1995–AUGUST 1995)

PB99-155400

by

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Research Report 2923-2
Research Study Number 7-2923
Research Study Title: Development, Implementation, and Evaluation of a Closed Circuit Television System for Houston Freeways and Arterial Streets Utilizing Leased Fiber Optic Cables

Sponsored by the
Texas Department of Transportation

December 1995

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

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NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

Technical Report Documentation Page

1. Report No. TX-99/2923-2	2. PB99-155400	3. Recipient's Catalog No.
4. Title and Subtitle STATUS REPORT ON OPERATIONS OF CCTV SYSTEM USING LEASED FIBER OPTIC CABLES (FEBRUARY 1995–AUGUST 1995)		5. Report Date December 1995 6. Performing Organization Code
7. Author(s) Gene P. Ritch		8. Performing Organization Report No. Report 2923-2
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135		10. Work Unit No. (TRAIS) 11. Contract or Grant No. Study No. 7-2923
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Transfer Office P. O. Box 5080 Austin, Texas 78763-5080		13. Type of Report and Period Covered Research: February 1995-August 1995 14. Sponsoring Agency Code

15. Supplementary Notes

Research performed in cooperation with the Texas Department of Transportation.
Research Study Title: Development, Implementation, and Evaluation of a Closed Circuit Television System for Houston Freeways and Arterial Streets Utilizing Leased Fiber Optic Cables

16. Abstract

This report analyzes a seven month operations and maintenance log that covers ten CCTV cameras in a leased contract with a Public Utility Company that furnished and installed all equipment, including the fiber optic cable, and maintains all equipment. A nontechnical evaluation of the video quality is offered. A special events condition was covered where future involvement will be forthcoming. Because of increased SC&C, monitoring staff awareness is investigated.

17. Key Words Maintenance Log, Video Operations, Fiber Optic Communications, Network Operation	18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif.(of this report) Unclassified	20. Security Classif.(of this page) Unclassified	21. No. of Pages 56	22. Price

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

IMPLEMENTATION STATEMENT

This report presents the analysis of the maintenance records over the first seven (7) months of a leased fiber optic network operation. Similar projects applicability includes: 1) the lessee and the lessor must collectively produce the maintenance log; 2) the maintenance provider must complete the documentation on any repair item(s); 3) the maintenance provider shall document repaired items; 4) the maintenance provider documents conclusions; and 5) the maintenance provider shall document non-malfunctioned equipment or procedures. TTI recommends revisions in the maintenance records.

The low level television camera utilized in the leased equipment performs much better than current project cameras.

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ACKNOWLEDGMENT

Appreciation is given to the Interim Traffic Management Center (ITMC) staff under Carlton Allen's direction for keeping the information logged as to the operation and maintenance activities of the Astrodome monitoring. TxDOT's Houston District and the Federal Highway Work Administration is commended for providing the funding resources through State and Federal Congestion Mitigation and Air Quality (CMAQ) Improvement and Priority Corridor Programs.

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SUMMARY

A public utility company that operates a fiber optic cable plant in Houston provided, under a leased contract, ten (10) closed circuit television (CCTV) video cameras around the Astrodome. The fiber optic cable company purchased, installed, and provided maintenance for all the equipment in the CCTV monitoring (cameras, housings, video fiber optic transceivers, fibers, video switcher, video recorder, and monitors). The analysis of the maintenance record for the first four months indicates the following summarized information: 1) recorded information changed as time passed; 2) the maintenance provider seldom documented the problem or solution; and 3) without the maintenance repair comments, it is difficult to draw conclusions as to the effectiveness of maintenance, whether the problem(s) are being solved or if any maintenance is being conducted. The good news is that five of 10 cameras were never reported as to having a maintenance call. As a general rule, the equipment is stable and performs to the specifications. The camera used in the project has low light level capabilities which surprised TxDOT since current SC&C camera projects do not have such sensitive components.

Very limited monitoring of the Astrodome cameras occurred during the 1995 Houston Livestock Show and Rodeo over the 17-day period. An example where the visual information from the CCTV changed the Metropolitan Transit Authority (METRO) bus route during the nighttime return trips of passengers to park and ride lots confirms the utility of the monitoring process.

Also investigated was the possible affect the continuous video monitoring on the principle freeways around the Astrodome complex had on the ITMC staff and the possible increase in the ITMC discovering traffic incidents at a greater frequency than found on "other" freeways. The Motorist Assistance Program (MAP) operation has a database that contains information on freeway incidents. The ITMC staff routinely discovered about 11 percent of all MAP incidents throughout all freeways in the last six months. For a four-month period just in the Astrodome project vicinity, the ITMC staff discovered seven percent of the incidents.

INTRODUCTION

Eight programs entitled Surface Transportation are under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. Within the various subprograms of Surface Transportation is the Congestion Mitigation and Air Quality Improvement (CMAQ) subprogram. CMAQ directs funds towards transportation projects in Clean Air Act Amendments (CAAA) non-attainment areas for ozone and carbon monoxide (1).

Houston meets the attainment requirements for all criteria air pollutants specified in the CAAA except for ozone. The Houston-Galveston severe ozone non-attainment area includes eight (8) counties. The CAAA requires a 15 percent reduction in volatile organic compound (VOC) emissions, adjusted for growth between 1990 and 1996, and full compliance with the ozone standard by 2007 (2).

Research, another of the eight programs of ISTEA, has a subprogram entitled the Intelligent Vehicle-Highway Systems (IVHS). IVHS provides for a Priority Corridors Program. The Priority Corridors Program provides funding for operational tests of new and emerging technologies under "real world" conditions. The funding package, secured between the CMAQ and Priority Corridors Programs, provided a five-year lease period for CCTV cameras and fiber optic communications.

The cameras used around the Astrodome Complex provide a means to support visual monitoring of the traffic conditions in real time. In normal everyday operations, the system can provide the ability to view traffic incidents and assist the ITMC operators and MAP officers in completing the roadside assistance stops. This process enables the ITMC operator to view the incident and quickly formulate decisions as to how to prioritize the MAP officer's response(s).

Certain incidents where personal or vehicular damages or blockages to moving lane(s) of traffic occurs enables the ITMC staff to contact the local enforcement agency(ies) at the earliest possible moment. Special events, in this monitored area, increase traffic demands to the freeways, frontage roads, and city street systems. The traffic control systems along the frontage roads and city streets do not have automated interconnected coordination but rely on manual overrides by hired off-duty law enforcement personnel. Visual monitoring enables evaluation of this override traffic control scheme and can lead to increased traffic movement efficiencies into and out of the Astrodome complex. Increasing traffic management efficiencies assists in meeting the goals of both CMAQ and the Priority Corridors Programs.

OPERATIONS

The daily operations of the CCTV camera system requires minimum activities by the ITMC staff. Basically, the operator turns on the monitors and the camera positions remain unchanged unless a roadway disturbance warrants a change. Overlapping camera coverage is possible from camera to camera for units 1 through 8 as shown in Figure 1. Cameras 9 and 10, because of installation on Houston city street intersections, do not provide adequate overlapping coverage. Many hours may pass without camera movements. At the close of the operations center's day, the operator switches off power to each monitor. The power down extends the screen life and reduces the heat generated within the control room. Since the ITMC is temporarily housed in a commercial office building where usage is normally from 8:00 a.m. until 5:00 p.m. five days per week, cooling the ITMC area after hours is a problem. Therefore, controlling heat generation goes a long way towards cooling the premises. Whenever a video monitor exhibits a problem, the operator places a call to Phonoscope's main switchboard where up to three maintenance individuals may receive the call. If after hours, an answering service will record the problem.

MAINTENANCE LOG ANALYSIS

Phonoscope's contract required a notebook with a section denoting the maintenance log which includes the date, description of the problem, the call-in and response time of day along with the resolution for the servicing technician. This log is not a daily operations and maintenance log but the exceptions from normal use. As shown in Appendix A, the typical log entry depicts the date, which camera was affected, a few word/pneumonic description of the problem(s), the call-in time, a response time, a resolution of the problem, and if a technician responded. A transcribed copy (contained in the Appendix) presents the maintenance activities from February through August 1995. The actual maintenance log sheets are the results of everyday activities of the assigned ITMC staff which from time to time may have missing, questionable, unrecognizable, or completely unreadable responses. A sample log is shown in Appendix B. The following comments are conclusions drawn from studying the information included in the original documents:

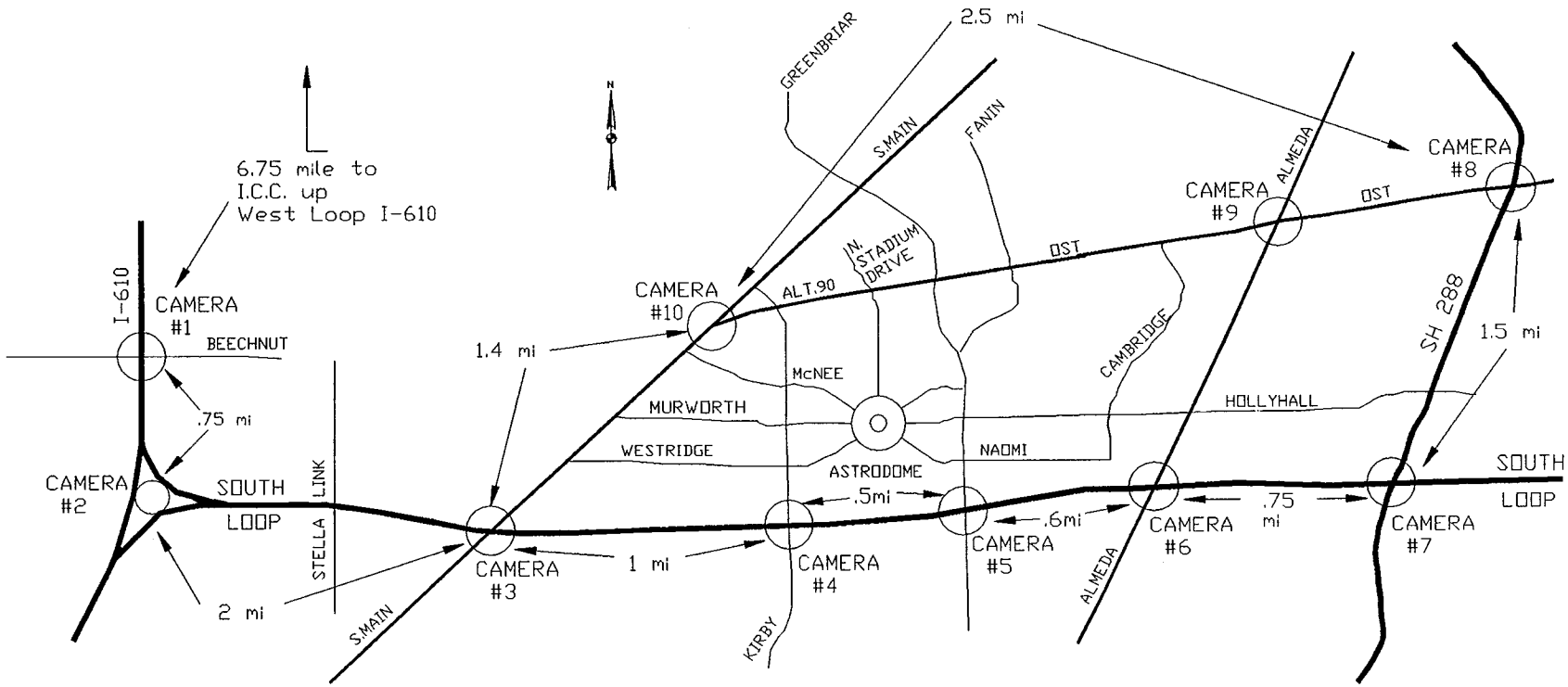


Figure 1. CCTV Camera Locations

- Over the course of the listings, information content changed. Also, confidence in the validity of the information is shown to continue to increase.
- For the first two or three months, the ITMC staff tried to keep the equipment up and running without notifying the maintenance personnel. This took the form of: 1) waiting for a period of time when the AC power from the power company at that site had a few minutes of outage; 2) turning the camera off for several minutes and then turning the camera back on; or 3) manipulating the camera controls functions.
- The information mandatory for accurate and meaningful analysis is missing. In the current log recordings, it is impossible to determine total downtime for any camera. The overall deficiencies found in the current maintenance log illustrate the necessity for a maintenance log revision.
- The current logged information shows the necessity for the maintenance personnel's input for solutions to problems. The logged information's utility should include the time units to conduct each phase of the problem/solution work tasks.
- As shown, Camera 9 has a history of continuing malfunctions or the same problem occurring over several days. Without the technician's input and the maintenance record being reorganized, it is difficult to know when one problem terminates and the initiation of a new problem begins.
- Without the technician's input, it is difficult to draw conclusions as to the state of operations for those malfunctioning cameras, communications, or ITMC equipment.

The positive aspects of the maintenance logs are:

- Cameras 2, 3, 4, 7, and 8, were maintenance free for the review period. The log sheets indicate that these cameras were never singled out as having an individual problem(s) at any point from the camera to the monitor.
- The light gathering ability of the Sony cameras used in the Astrodome project were a surprise to the ITMC staff. The video images from the other SC&C

cameras did not have the equivalent light gathering capabilities in the nighttime conditions. The Sony cameras provided a superior nighttime video scene that has TxDOT revisiting the SC&C specifications to include the lower light level capabilities exhibited by the Sony cameras.

- The fiber cable plant network provided excellent operations. With the exception where the buried fiber cable was broken by a backhoe doing trenching work, the fiber cable network provided 100 percent up time. The only other logged problem was a fiber break inside the cabinet at the base of the camera pole. All video signals are "home runs" or the fiber is continuous from the camera site to the rack mounted fiber receivers at the ITMC. The successful up time of the fiber cable plant means that the maintenance supervisors are providing their field forces with up-to-date routing information and fiber assignments. The maintenance, construction, and installers perform their work tasks satisfactorily.

The negative aspects of the operation and maintenance over this review period are:

- Phonoscope management did not replace a departed Operation Manager. Thus, all direct contact with Phonoscope management stopped. The only communication that remained was through the maintenance personnel. Questions TxDOT had that required a response from Phonoscope management were never answered. Phonoscope has assigned a management interface point person that will hopefully reenergize the management level communication. Meaningful communications between TxDOT and Phonoscope will renew for TxDOT insight into the operation and management of a fiber optic cable plant.
- The pan stops for the camera positioning for three cameras were not optimally placed. This information surfaced after all installations were complete. To change the stop(s) requires camera housing removal. This removal requires a bucket truck. Phonoscope would reset the stops if TxDOT provided the bucket truck. To date the pan stops have not been changed.

- Figure 2 depicts the relative positioning of the video switcher and the location of the ITMC staff. To control a camera, the staff person must walk to the Astrodome video switcher, make the controlling options, and return to the monitoring area. To reduce overall effort requires a remote video control unit implementation. This unit can reside near the staff monitoring area and does not require the staff person to physically move in order to control the Astrodome camera(s).
- The sunshield on the camera housing required by the specifications does shield the sunlight as a general rule. The problem that is occurring is that blowing rain droplets collect on the outside of the camera housing faceplate bypassing the sunshield's influence. The visual effects do not completely render the camera scenes unusable, but it requires extra effort to collect visual information. This problem may have a solution. It may take a super slick faceplate coating or a larger, expansive sunshield to deflect the rain. The droplets forming during wet and windy conditions may be a recurring operational problem.

VIDEO QUALITY

The video quality statements are a personal evaluation of the video images compared between monitors and additional video monitor scenes from the other SC&C projects at the ITMC. The yearly camera and communications tests scheduled to occur in December 1995 may be delayed due to the relocation of the ITMC to its permanent location, known as the TranStar Center. Reporting of these tests will be forthcoming. The video quality statements follow:

- As a normal rule, the operator switches off the monitors around 10:00 p.m. each weekday and switched back on around 5:00 a.m. The monitors remain off for Saturday and Sunday. Two reasons for the on/off sequences: 1) the extension of the life of the CRT monitors; and 2) during non-business hours, air conditioning in this commercial building is non-existent which means heat generated via the video equipment cannot be eliminated.

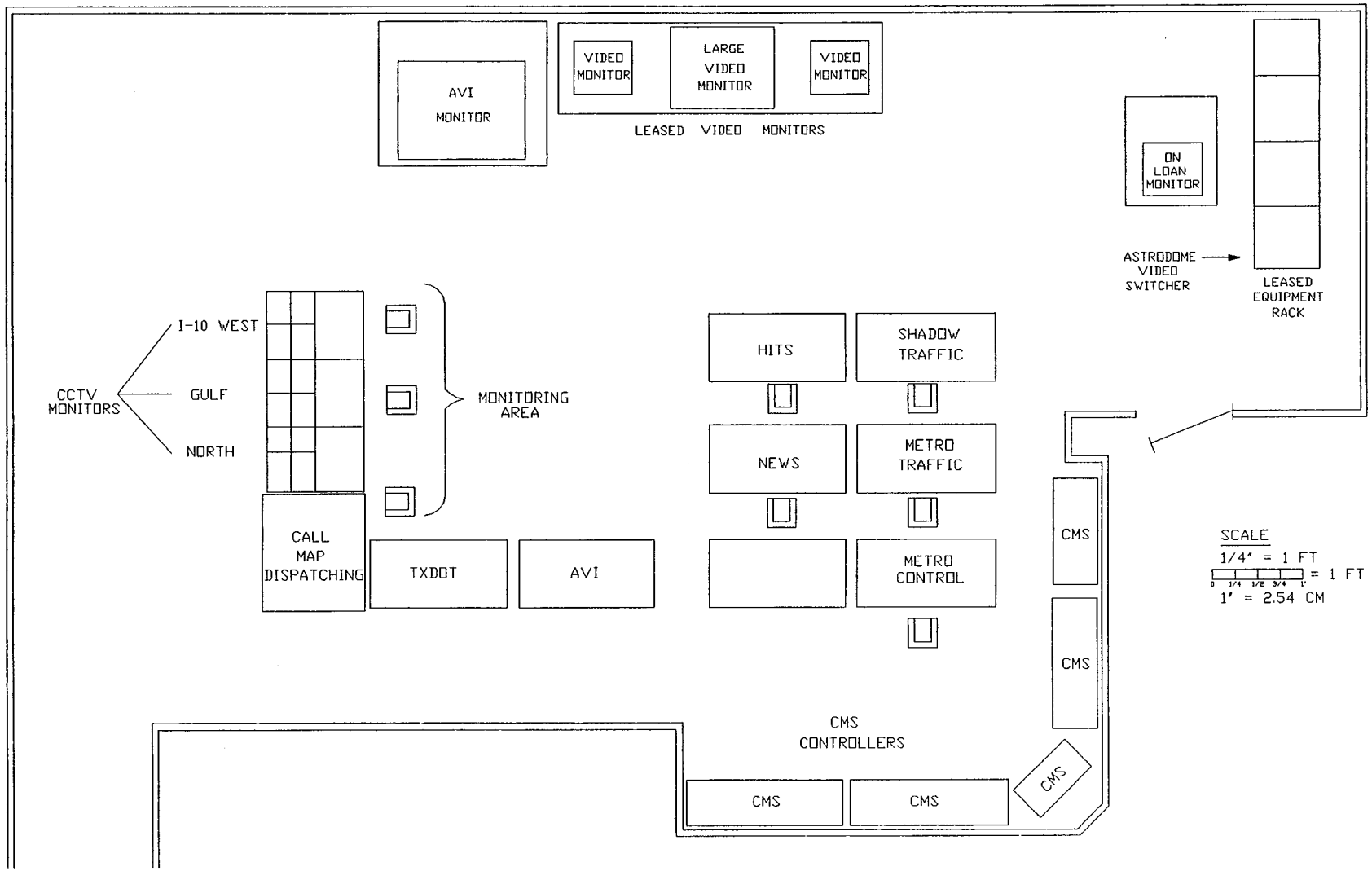


Figure 2. Leased Equipment Positioning in ITMC

- The large screen TV CRT has few cases where screen burning is occurring. The start of burned in shadows on the faceplate of several monitor's CRT is occurring. The "burned in" effect results from the same video scene being displayed for hours. The burned effect is irreversible.
- The cameras are a CCD design and may remain operational indefinitely without component damage.
- The video image quality is constant from day to day and monitor to monitor. There are very few cases where line jitter, "snowing" effects, or reduced resolution are noticed. The initial installation of the alphanumeric character generation electronics produced vertical "jitter." The manufacturer upgraded the components. Upon reinstallation, the alphanumeric equipment produces faultless operation.
- The communication system (video transceivers and the fiber) must be functioning properly as the video information remains of constant high quality. December test plans require additional operation status information.

As a general rule, the video information presents constant, smooth images.

MONITORING EXAMPLE
1995 HOUSTON LIVESTOCK SHOW AND RODEO (HLSR)

The 1995 HLSR performances, held in the Astrodome complex, began on February 17, 1995 and continued until Sunday, March 5, 1995. On weekdays, only one performance was held at 7:00 p.m., while on Saturdays, two performances were held at 11:00 a.m. and at 7:00 p.m. and on Sundays, only one performance at 7:00 p.m., for a total of 20 rodeo performances over 17 days. The general attendance was over 1,810,000, up 12 percent from the previous year. Approximately 25 percent of the attendance traveled by METRO bus fleet from one of five park and ride facilities. The regular ITMC staff monitored the weekday daytime traffic in and around the Astrodome. The ITMC staff did not monitor weekend traffic. With TxDOT authorization, the author monitored traffic conditions weekdays after 10:00 p.m. and weekend days up to two hours after the rodeo performance termination. This time period provided traffic conditions information to the traffic operation personnel, METRO bus operation, and the rodeo bus loading operation at the Astrodome. Several vehicle accidents occurred during the 17-day period of rodeo operation. Rapid Houston Police Department (HPD) contact may have provided quicker response times to the accident scenes.

The first accident occurred at the Fannin exit eastbound on I-610 South Loop approximately one hour before the start of the rodeo performance. This exit serves 50 percent of the traffic destined for the eastside of the Astrodome parking. HPD provided immediate response. The actual wreck area did not totally block the exit ramp roadway. A dangerous situation existed when the high speed traffic coexisted with stopped traffic in the adjacent lane(s). All buses were already using an alternate exit, thus, no direct changes to the bus routes needed to be made, yet could have been. The accident area cleared before secondary accidents occurred.

The second accident occurred on a Saturday night at OST and South Main at 10:00 p.m. The rodeo performance normally ended at 10:30 p.m. This intersection serves traffic from the Astrodome parking on the north and west sides. HPD did not service the accident as quickly as before but did clear the scene as quickly as possible. The exiting traffic

experienced significant delays. Bus operations used the east side of the Astrodome complex and experienced no effects. If traffic enforcement personnel working intersections on South Main had communications to the ITMC, assistance could have been given denoting delays due to the traffic accident and improper timing patterns along South Main.

The third major accident happened on eastbound I-610 just before the SH 288 interchange at 11:15 p.m. on the last Sunday night of the rodeo. The multi-vehicle accident directly affected the inside two lanes of a six-lane section. HPD reacted quickly to this accident scene, but traffic queue rapidly affected all six lanes. Two METRO bus routes used this freeway section. One METRO route changed to an alternate route as a direct result of the location of the accident. The real time traffic conditions based on the camera scenes enabled the location of the accident, severity based on vehicle numbers, and positions and availability of an alternate route status to be instantly evaluated. Furthermore, radio voice equipment at the ITMC and METRO's bus fleet management centers provided communication capabilities. Each bus driver could communicate to the Astrodome bus fleet manager when leaving the parking lot after loading. Approximately 10 percent to 15 percent of the remaining bus ridership benefitted from the route change of the one bus route.

While the above three accidents had only small effects on the overall traffic conditions during peak loading and unloading of the Astrodome parking facility, the control of traffic signals in and around the Astrodome provides major traffic condition changes. The CCTV information provides real time feedback as to the success of signalization changes. All traffic entering or exiting the Astrodome parking facilities go through one or more traffic signals. Any improvements by saving delay at these traffic signals will lead to significant cost savings as well as reducing air pollutants.

Several meetings were held with rodeo officials prior to the 1995 rodeo concerning the potential uses of the ITMC information. Due to the short lead time between the Astrodome project equipment acceptance and rodeo start, officials decided that organized monitoring by committee and information use within the rodeo organization were underutilized. Meetings held after the 1995 rodeo discussed the potential usages and need for adequate advanced plans.

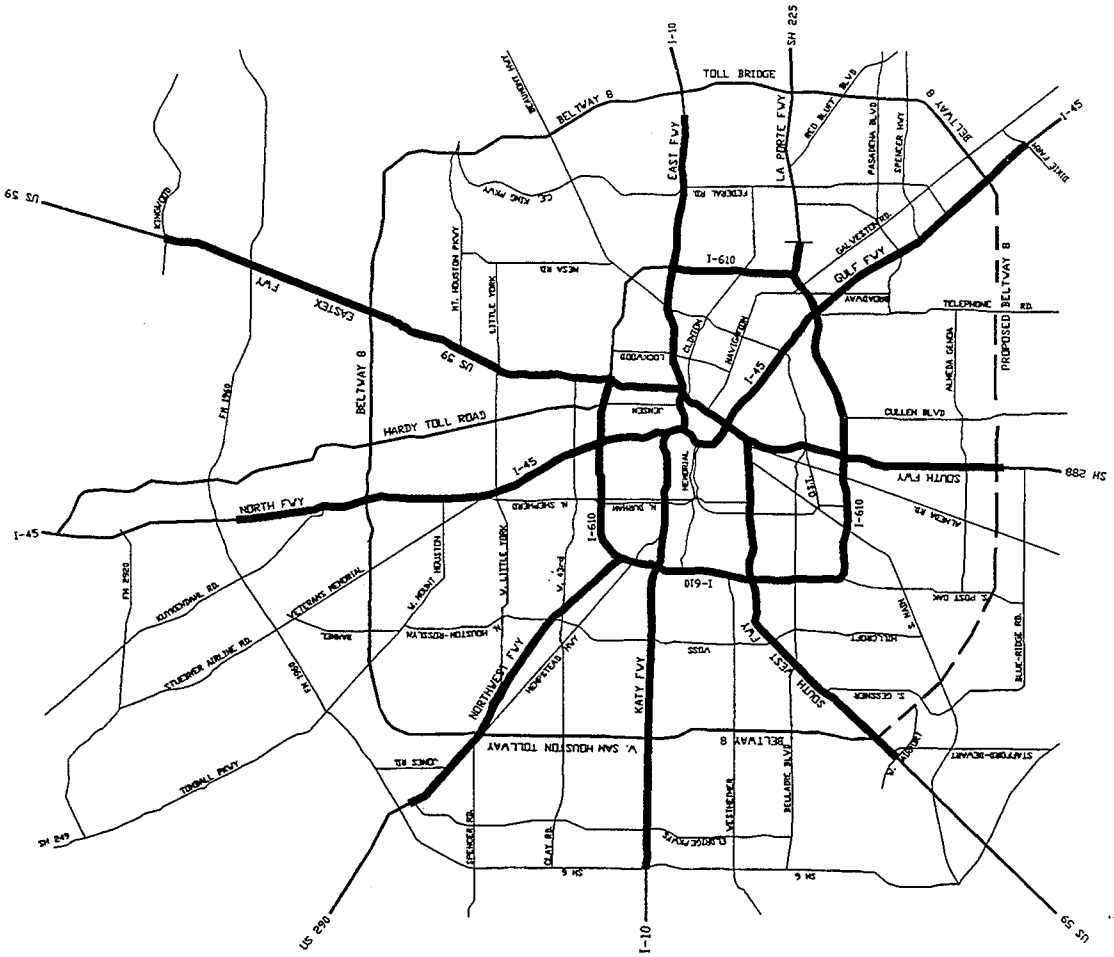
Even the issues of how to import a video signal from the ITMC to the Astrodome complex are being investigated along with how to utilize the AVI information that is available either over telephone line dialup, fiber optic communications, radio frequency equipment, etc. Meetings will continue to be held with the interested parties to more fully utilize the uses of video monitoring around the Astrodome complex.

EFFECTS ON CALL MAP STATISTICS

The Houston Motorists Assistance Program (MAP) started in 1989 through a public/private partnership to aid stranded motorists along the major freeways within an approximate 24 kilometer (15 mile) radius of the Central Business District and along the I-610 Loop Freeway. The Metropolitan Transit Authority of Harris County (METRO), the Texas Department of Transportation (TxDOT), the Harris County Sheriff's Department (HCSD), the Houston Automobile Dealers Association (HADA), and Houston Cellular Telephone Company provide funding for the MAP program. MAP currently patrols 241 kilometers (150 miles) of freeway with nine mini-vans continuously between the hours of 6:00 a.m. and 10:00 p.m. on non-holiday weekdays (Figure 3). Each vehicle comes equipped with hand tools, gasoline, water, jumper cables, etc., as needed to assist motorists. The push-bumper equipped vehicles can also move vehicles stranded in the travel lanes to the emergency shoulder. A cellular telephone is available to motorists; motorists may use this telephone to call for additional assistance and/or to inform others of their delay. TxDOT staff in the ITMC dispatches the vans driven by HCSD deputies.

Through funding provided by TxDOT, the Texas Transportation Institute (TTI) maintains a database documenting program operation. This includes the information as recorded by the deputies in the field using the MAP Incident Log (Figure 4). Using this information, TTI prepares quarterly operational summaries and statistical analyses as needed to evaluate operations.

With the increased video surveillance via the Astrodome project cameras, would the awareness of the ITMC staff to detect incidents increase? Access of the MAP database answers the question. A database query for MAP coverage of the Astrodome area was conducted for the months of January 1995 through April 1995. These months coincide with the Astrodome project's CCTV operations. The usage rates are shown in Appendix B and summarized in Tables 1 and 2. The overall average incident discoveries by the ITMC as shown in Table 1 is about 11 percent. In Table 2, the average incident detected by the ITMC



* Patrol limits based upon patrol routes provided by TxDOT

Figure 3. Limits of Houston Motorists Assistance Program Patrol Area

MAP INCIDENT LOG FOR _____ FREEWAY PATROL Rev 01/94

DEPUTY NAME: _____ RADIO NO.: _____

DAY/DATE: _____ SHIFT: ☐ AM ☐ PM INCIDENT NO.: _____

FREEWAY/DIRECTION: _____ # LANES: _____ LOCATION: _____

LOCATION: ☐ LEFT SHOULDER ☐ MAIN LANE(S) BLOCKED 1 2 3 4 5 6 ☐ RIGHT SHOULDER

MANNER DETECTED: ☐ MOVING PATROL ☐ ICC ☐ OTHER _____

TIME OF INCIDENT OCCURRENCE — DRIVER ESTIMATE: _____

TIME INCIDENT DETECTED OR MAP NOTIFIED: _____

TIME MAP ARRIVED ON SCENE: _____ TIME FRWY BLOCKAGE CLEARED: _____

TIME DISABLED VEHICLE LEFT SCENE: _____ TIME MAP CLEARED: _____

TYPE OF INCIDENT:
(mark only one)

- ☐ ABANDONED VEHICLE (ABVEH)
- ☐ ACCIDENT (pick one)
  - ☐ MAJOR FREEWAY BLOCKAGE (AMA)
  - ☐ MINIMAL FREEWAY BLOCKAGE (AMI)
  - ☐ NO FREEWAY BLOCKAGE (ANB)
- ☐ DEBRIS ON ROAD (DR)
- ☐ FIRE (FI)
- ☐ FLAT TIRE (F)
- ☐ MECHANICAL (M)
- ☐ STALLED VEHICLE (S)
- ☐ OTHER (O) _____

TYPE OF ASSISTANCE PROVIDED:
(mark as many as needed)

- ☐ ACCIDENT ASSISTANCE (AA)
- ☐ DEBRIS REMOVAL (DE)
- ☐ DIRECTIONS/INFO (DIR)
- ☐ EXTINGUISH FIRE (E)
- ☐ FIRST AID (FA)
- ☐ FLAT TIRE (FL)
- ☐ FUEL (FU)
- ☐ JUMP START (J)
- ☐ MINOR ENGINE REPAIR (MER)
- ☐ MOTORIST USE PHONE (MUP)
- ☐ PUSH VEHICLE (P)
- ☐ TRAFFIC CONTROL (TC)
- ☐ TRANSPORT MOTORIST (TM)
- ☐ USE OF TOOLS (UOT)
- ☐ WATER (WA)
- ☐ WRECKER CALLED (W)
- ☐ OTHER (O) _____

VEHICLE INFORMATION: YEAR _____ LICENSE PLATE _____ COLOR _____
MAKE _____ MODEL _____

DRIVER INFORMATION: ☐ MALE ☐ FEMALE ☐ NO DRIVER

NUMBER OF OCCUPANTS: ☐ DRIVER ONLY ☐ 2 ☐ 3 ☐ 4+

PHONE LOG:

NUMBER CALLED	≈ AIR TIME	NUMBER CALLED	≈ AIR TIME

CITIZEN'S NAME (print) _____ CITIZEN'S SIGNATURE _____

COMMENTS: _____

Figure 4. MAP INCIDENT LOG

staff just in the Astrodome camera coverage is about 7 percent. The comparison indicates that the ITMC staff is performing worse in the Astrodome area than the overall averages. Some of the problems may exist due to the reporting by the officer on the MAP project. The awareness of the ITMC staff with enhanced documentation will be more closely monitored in future reports.

Table 1. All Houston Freeway Incidents Serviced by MAP

Reported By	Nov 94		Dec 94		Jan 95		Feb 95		Mar 95		Apr 95		Average	
ITMC	200	10%	201	9%	226	11%	215	11%	266	11%	226	11%	222	11%
Moving Patrol	1713	85%	1697	83%	1796	86%	1706	86%	2044	85%	1772	85%	1788	85%
Not Specified	90	5%	127	8%	78	3%	53	3%	105	4%	88	4%	90	4%
Total	2003	100%	2025	100%	2100	100%	1974	100%	2415	100%	2086	100%	2100	100%

Table 2. MAP Service Data Just in CCTV Areas

Reported By	Jan 95		Feb 95		Mar 95		Apr 95		Average	
ITMC	4	4%	7	7%	8	8%	7	8%	6.50	7%
Moving Patrol	82	92%	84	88%	89	89%	79	89%	83.50	90%
Not Specified	3	4%	4	5%	3	3%	3	3%	3.25	3%
Total	89	100%	95	100%	100	100%	89	100%	93.25	100%

RECOMMENDATIONS

The very first recommendation is that TxDOT and Phonoscope meet, agree, and produce a revised maintenance recording document, which will bring the TxDOT problem definition and Phonoscope maintenance personnel into solving the problem(s) and documenting the information. Without the completed maintenance record, information useful to TxDOT is less than 50 percent. TxDOT requires accurate maintenance information transferrable to the fiber optic cable plant designs being installed for TxDOT in the SC&C projects throughout the city freeways.

The second most important recommended issue is to thoroughly investigate the operations of the low light gathering capabilities of the television camera being leased on the project. This camera reflects the more recent implementation of solid-state cameras whose costs are very close to the television camera costs currently being bid and installed on the SC&C projects. This camera provides a definite advantage in enabling nighttime vision for the ITMC monitoring.

Other recommendations taken from the first analysis of the first months of operations are: 1) ITMC staff become more aware of the continuous video coverage offered by the Astrodome complex cameras, which is unlike the other video monitoring equipment which provides only a few camera views per freeway; 2) a more active role by TxDOT in informing and meeting with the Astrodome complex agencies so that active use of the AVI may be possible, and work towards understanding the usefulness of the capabilities of the Astrodome monitoring; and 3) use the foundation of knowledge gained to date concerning the operations of leased services from a public utility company and develop alternative monitoring scenarios utilizing the normal expansion of these service providers.

REFERENCES

1. U.S. Department of Transportation Booklet: FHWA-PL-92-008.

APPENDIX A.

TRANSCRIBED MAINTENANCE LOG

MAINTENANCE LOG February 1995					
		Time			
Date	Description	Call-In	Response	Resolution	Technician
02/16	#9 OST and Almeda — Picture on and off a couple of times	8:14 noticed		Corrected itself.	
02/17	#9 OST and Almeda — No picture/blue screen	3:45	7:10	Back on.	
02/20	#9 OST and Almeda — No picture/blue screen	6:05 off	6:10 on	Back on.	
02/20	#1 Beechnut and 610 — No picture/blue screen	12:20 off	12:28 on	Back on.	
02/20	#1 Beechnut and 610 — No picture/blue screen	13:09 off	13:15 on	Back on.	
02/20	#1 Beechnut and 610 — No picture/blue screen			Back on; checked with Ritch; didn't call in 15:40.	
02/20	#9 OST and Almeda — No picture/blue screen	19:30 off	19:38	Back on.	
02/20	#1 Beechnut and 610 — No picture/blue screen	20:22 off		Called Phonoscope number twice; woman refused to take call.	
02/21	#9 Dark Picture — Turned off/on; came back on	7:35 off	7:37 on		
02/21	#1 Picture out	11:00	11:45	Replace video.	JBQ
02/27	All monitors were blue screen; no control 3:45 am. Camera #9 auto scanned for 2 minutes at 7:32.	7:32			

MAINTENANCE LOG March 1995					
Date	Description	Time		Resolution	Technician
		Call-In	Response		
03/08	#9 not working	15.55 off	17:05	Bad connection at plug.	JBQ

MAINTENANCE LOG April 1995					
		Time			
Date	Description	Call-In	Response	Resolution	Technician
04/05	#9 Dark Picture — Turned off and on; came back on	7:30 off	7:39 on		
04/05	#9 Dark Picture	7:43			
04/13	#9 Camera not working	8:10			
04/21	#9 Camera not working				
04/27	#9 Camera blue screen	6:45 off	6:55 on	Back on — blue screens.	

MAINTENANCE LOG May 1995					
		Time			
Date	Description	Call-In	Response	Resolution	Technician
05/04	#9 camera blue screen	6:45 off	6:50 on		
05/04	#9 camera off and on still off @				
05/24	All monitors except large screen are out: @ 8:15 pm monitors 1, 2, 3, 4, and 10 working (with no control on #10 only) @ 8:00 pm monitor 7 @ 8:40 pm monitors 5 and 9 @ 8:50 pm monitor 8 @ 8:57 pm monitor 6; "Matt" phoned ICC and said that #6 would be fixed tomorrow				 TR TR TR TR TR
05/25	All monitors back on	11:55			
05/25	#10 no controls; #6 out	12:00		Called Phonoscope and left pager message.	

MAINTENANCE LOG June 1995					
		Time			
Date	Description	Call-In	Response	Resolution	Technician
06/01	#9 Blue screen off @ 18.57/on 19:00	did not call	did not call	Hit side of 19" cabinet housing receiver equipment.	
06/01	#9 Blue screen off 19:54/on 19:55			Hit side of 19" cabinet.	
06/12	#5 Blue screen — no picture of 5:50	6:58	called	Will have technician call; power was out.	JC
06/13	#5 Still out off 5:30	8:21	9:30	Will make sure they (TxDOT) know about it.	David
06/13	#5 Call Ray Smith — Let him know about AC power failure (TxDOT Maintenance)	9:34		TxDOT will get on it — will be Wednesday (14th) before fixed.	
06/14	#5 Still out	5:30	9:18	Power switch turned off.	Called in by Ray Smith

MAINTENANCE LOG July 1995					
		Time			
Date	Description	Call-In	Response	Resolution	Technician
07/05	#9 Blue screen off 20:05		20:06 on	Hit left side of cabinet.	
07/06	#10 Blue screen of 18:42		18:43 on	Hit left side of cabinet.	
07/10	#9 Keeps going on and off	17:00	17:12	Turned off.	
07/11	#9 On and off	18:55	19:25	Talked to David (Phonoscope).	
07/12	#9 Off 18:30	19:14		Talked to David; has turned it over to Jim (Phonoscope); Jim will call Carlton on 13th.	
07/13	#9 On at 6:00				
07/13	#9 Black screen — no picture (they, Phonoscope, will have a technician call back)	6:44		Talked to Patricia (answering service); talked to Pam-Calvin at 6:55.	
	#9 On at 7:11				
07/13	#9 Blue screen	11:35		Talked with George at Phonoscope.	
07/13	#9 Blue screen	13:38	Still off 19:00	Phonoscope called again.	
07/13	#9 Came back on 20:00				
07/14	#9 Black screen at 9:58	9:59		Talked to George, who said "talk to Rob at 10:56." Rob advised that parts were ordered for the cabinet.	
07/14	#9 Black Screen at 12:10	12:10		Talked to Calvin.	
07/14	#9 Blue Screen at 19:00	19:11		Talked to David and advised him.	
07/17	#9 Blue Screen at 18:38	18:40		Talked to David and advised him.	

MAINTENANCE LOG July 1995 (continued)					
		Time			
Date	Description	Call-In	Response	Resolution	Technician
07/18	#9 Blue screen off 14:12	14:14		Part is ordered. Just turn off/on per Jim Cox (Phonoscope).	
07/18	#9 14:57 per Carlton. Turned off/on; came back on				
07/19	#9 Black screen at 7:08	7:12		Talked with Cindy. Will have a technician call back. Talked to Calvin. He could not advise when #9 would be fixed.	
07/20	#9 Came on at 10:20				
07/24	#5 Blue screen	11:58		Power line cut.	Richard Darb
07/25	#5 Still out	6:00			
07/25	#9 Black screen at 18:50	18:51		Talked to Tom. Called; no answer. Talked to Jim Cox; he cut the power to #5.	Tom
07/25	#9 Came back on at 20:13				
07/26	#5 Blue screen				
07/26	#5 Back on 7:58				
07/27	#9 Black screen at 19:12	19:12		No answer.	
07/28	#9 Blue screen	9:15		Bypass titler card.	George

MAINTENANCE LOG August 1995					
		Time			
Date	Description	Call-In	Response	Resolution	Technician
08/22	#10 Camera will not move, pan, tilt, zoom — not operational. There is a picture. Notified David Pickartz (Phonoscope).	11:50	1:30	Replace transceiver card.	Jim Cox
08/24	#8 Blue screen. No picture. Turned off and on. No response.	8:37	9:55	Called/advised David. Power out.	David
08/31	#6 Blue screen. No picture.	11:20	11:27	Craig (dispatcher) called back @ 11:27.	
08/31	#6 Back on. City working on electricity. NOTE: Week of August 28, 1995. Phonoscope rented a bucket truck visited each camera site cleaned lens, greased housing, and conducted other maintenance. This function scheduled by Phonoscope; only notified TxDOT one week before.		11:50	Jim called.	

APPENDIX B.

ORIGINAL MAINTENANCE RECORD SAMPLE

MAINTENANCE LOG

IH–610 South Loop Freeway & Arterial Streets Serving the Astrodome Area

Date	Description of Problem	Time: Call–In	Time: Reponse	Resolution	Technician
7-13-95	#9 monitor (Black screen) (No picture)	6:41		Talked to Patricia (Answer ser) Pam	Calvin
——	They will have a tech call back		#9 ON @ 7:11		6:55
7-13-95	#9 monitor Blue screen	11:35		Talked with George At Phonoscope	
7-13-95	#9 Monitor Blue screen	13:38	still off 1400	Phonoscope called again	
7-13-95	#9 " 20:00 Came Back on				
⊛ 7-14-95	#9 " 9:58 Black Screen	9:59		Talked to George ON @ 10:56	Rob
7-14	#9 " 12:10 Black screen	12:10		Talked to Calvin	
7-14	#9 . Blue Screen 19:00	19:11		Talked to David and advised him	
7-17	#9 Blue Screen 18:38	18:40		Talked to David @ 18:42 and advised him	
7-18	#9 Blue Screen 14:12	14:14		Part is ordered just Turn off + on Per Jim Cox	
7-18	#9 14:57 Turned off + ON per Carlton Came Back on				
7-19-95	#9 7:08 Monitor Black screen	7:12 Am	Talked with Cindy she will have a tech call back		
——	talked to Calvin / could not advise when the #9 would be fixed				
7-20-95	#9 monitor ON @ 10:20 Am				
7-24-95	#5 monitor Blue Screen	11:58	Power line cut ON @ 8:50 am 7-26-95		Richard Darb
7-25-95	# 5 still out	6:00			
7-25-95	#9 Black Screen @ 18:50	18:51	[illegible]	Talked to Tom	Tom.
7-25-95	#9 Came Back on @ 20:13			Call, No Answer	

⊛ Rob advised that parts were ordered for the cabinet. 7-14-95 11:00 Am

Phonoscope Monthly Log Review _____
Technician

APPENDIX C.

MAP SERVICE FOR ASTRODOME PROJECT USING DATA WITHOUT ABANDONED VEHICLES INCLUDED

January 1995 (without AV)

Time

	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	Total per hour
610 W/Beechnut	1	0	1	4	2	1	1	0	1	0	2	0	0	0	0	0	0	13
610 W/Braeswood	0	0	1	1	3	0	0	0	1	1	0	1	0	1	0	0	0	9
610 S/I 610	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3
610 S/S Post Oak	2	0	2	1	2	0	0	0	2	1	2	0	1	3	2	0	0	18
610 S/Stella Link	0	0	1	1	2	0	2	0	0	0	2	0	1	0	0	0	0	9
610 S/S Main	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
610 S/Buffalo Speedway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
610 S/Kirby	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	3
610 S/Fannin	1	0	0	0	1	0	0	0	0	0	2	1	0	0	0	1	0	6
610 S/Almeda	0	0	1	0	3	0	0	0	0	0	5	0	1	0	1	0	0	11
SH 288/Holcombe	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2
SH 288/OST	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2
SH 288/Yellowstone	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
SH 288/Holly Hall	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
SH 288/I 610	0	2	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	7
SH 288/Holmes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total per cross street	4	4	7	8	15	3	3	0	4	3	15	4	5	5	7	1	0	88

Manner	Number	Percentage
moving patrol	82	93%
ICC	4	5%
other	2	2%
blank	1	1%
total	88	

February 1995 (without AV)

Time

	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	Total per hour
610 W/Beechnut	0	1	2	2	0	0	2	0	0	1	2	0	2	0	1	0	0	13
610 W/Braeswood	0	0	0	0	1	0	0	0	0	0	0	8	3	1	0	0	0	13
													0					
610 S/I 610	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
610 S/S Post Oak	0	0	0	1	0	0	1	0	1	3	0	1	1	0	1	0	0	9
610 S/Stella Link	0	2	3	2	1	0	1	0	1	1	1	0	1	0	1	0	0	14
610 S/S Main	0	0	2	0	0	0	0	1	0	1	0	0	0	0	0	2	0	6
610 S/Buffalo Speedway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
610 S/Kirby	0	0	0	0	0	0	0	0	0	2	2	0	6	1	2	0	0	13
610 S/Fannin	0	1	0	1	0	0	0	0	0	0	1	4	1	0	1	0	0	9
610 S/Almeda	0	0	1	0	0	0	0	0	0	0	0	5	2	0	0	0	0	8
SH 288/Holcombe	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	3
SH 288/OST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SH 288/Yellowstone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SH 288/Holly Hall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SH 288/I 610	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	3
SH 288/Holmes	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	3
total per cross street	0	4	9	6	2	0	5	1	2	8	9	20	19	2	6	2	0	95

Manner	Number	Percentage
moving patrol	84	88%
ICC	7	7%
other	2	2%
blank	2	2%
total	95	

March 1995 (without AV)

Time

	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	Total per hour
610 W/Beechnut	1	2	0	3	4	1	1	0	0	0	0	3	2	0	1	0	0	18
610 W/Braeswood	0	0	3	2	1	0	0	0	0	2	1	1	0	0	0	0	0	10
610 S/I 610	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
610 S/S Post Oak	0	0	0	1	1	0	1	0	0	3	1	2	6	0	2	1	0	18
610 S/Stella Link	0	1	0	1	0	1	1	0	1	0	0	2	0	1	2	0	0	10
610 S/S Main	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
610 S/Buffalo Speedway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
610 S/Kirby	0	1	1	0	2	0	0	0	0	1	2	1	7	0	0	0	0	15
610 S/Fannin	0	0	0	2	0	2	0	0	4	0	1	0	1	0	0	0	0	10
610 S/Almeda	0	0	0	1	0	0	0	0	0	2	1	0	2	0	0	0	0	6
SH 288/Holcombe	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
SH 288/OST	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SH 288/Yellowstone	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
SH 288/Holly Hall	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	0	4
SH 288/I 610	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	4
SH 288/Holmes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
total per cross street	1	5	4	12	10	5	3	0	5	8	7	12	23	1	5	1	0	100

Manner	Number	Percentage
moving patrol	89	89%
ICC	8	8%
other	3	3%
blank	2	2%
total	100	

April 1995 (without AV)

Time

	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	Total per hour
610 W/Beechnut	0	0	0	4	4	0	0	0	0	0	1	1	1	0	0	0	0	11
610 W/Braeswood	0	1	1	0	2	0	0	0	0	0	0	1	2	0	0	0	0	7
610 S/I 610	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2
610 S/S Post Oak	0	0	0	0	3	1	3	0	0	4	1	1	2	0	1	0	0	16
610 S/Stella Link	0	0	0	0	1	0	0	0	1	4	1	4	0	0	1	0	0	12
610 S/S Main	0	0	0	0	0	0	1	0	0	0	2	2	0	0	0	0	0	5
610 S/Buffalo Speedway	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	3
610 S/Kirby	0	1	3	0	0	0	1	0	0	1	2	1	2	1	0	0	0	12
610 S/Fannin	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	0	0	4
610 S/Almeda	0	0	0	1	2	0	1	0	0	0	0	2	2	0	0	0	0	8
SH 288/Holcombe	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
SH 288/OST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SH 288/Yellowstone	0	0	0	0	1	0	0	0	0	0	0	0	5	0	0	0	0	6
SH 288/Holly Hall	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
SH 288/I 610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SH 288/Holmes	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
total per cross street	0	2	5	5	14	1	6	0	1	10	11	13	17	1	3	0	0	89

Manner	Number	Percentage
moving patrol	79	92%
ICC	7	8%
other	0	0%
blank	3	3%
total	86	