U.S. Department of Homeland Security

Freedom of Information Act Branch
601 South 12th Street, TSA-20
Arlington, VA 20598-6020

Transportation Security Administration

3600.1
FOIA Case Number: TSA12-0730

October 18, 2013

Ms. Catherine Crump
American Civil Liberties Union
125 Broad Street
New York, NY 10004

Dear Ms. Crump:

On July 30, 2012, you submitted a Freedom of Information Act (FOIA), 5 U.S.C. § 552, request to the Transportation Security Administration (TSA) for documents pertaining to TSA's "use and/or funding of automatic license plate readers ('ALPRs')". On September 19, 2012, TSA informed you that a reasonable search of records was conducted and no responsive records were located. You then filed an administrative appeal challenging the adequacy of the search conducted by TSA on November 17, 2012. On January 8, 2013, you were advised that a second search for records was conducted and TSA located records responsive to your request and remanded them to the FOIA Branch for processing. You were further advised that once the processing was completed the FOIA Branch would respond directly to you using FOIA case number TSA12-0730.

A report consisting of 179 has been reviewed and 170 pages are being released in their entirety, with portions of the remaining nine pages withheld pursuant to Exemption (b)(6), which allows for the withholding of all identifying information that applies to a particular individual when the disclosure of such information "would constitute a clearly unwarranted invasion of personal privacy." This requires the balancing of the public's right to disclosure against the individual's right to privacy. After performing this analysis, it was determined that the privacy interest in the identities of the individuals in the records you have requested outweigh any minimal public interest in disclosure of the information.

Fees

The fees incurred to process your request do not exceed the minimum threshold necessary for charge and, therefore, there are no fees associated with processing this request.

Administrative Appeal

In the event that you wish to appeal this determination, an administrative appeal may be made in writing to Kimberly Walton, Assistant Administrator, Office of Civil Rights & Liberties,

Ombudsman and Traveler Engagement (CRL/OTE), Transportation Security Administration, 601 South 12th Street, East Building, E7-121S, Arlington, VA 20598-6033. Your appeal must be submitted within 60 days from the date of this determination. It should contain your FOIA request number and state, to the extent possible, the reasons why you believe the initial determination should be reversed. In addition, the envelope in which the appeal is mailed in should be prominently marked "FOIA Appeal." Please note that the Assistant Administrator's determination of the appeal will be administratively final. If you have any questions pertaining to your request, please feel free to contact the FOIA Branch at 1-866-364-2872 or locally at 571-227-2300.

Sincerely,

Teresa J. Rivera

for Yvonne L. Coates
Branch Manager

Enclosure

Transportation Security Administration

Automatic License Plate Recognition Study and Analysis

Comprehensive Report - All Vendors

This document was completed in support of the
Transportation Security Administration
Highway & Motor Carrier Division and the Chief Technology Office

Competition Sensitive, Proprietary, and Commercial in Confidence
ALPR Technology Data compiled from:
Remington-Elsag Law Enforcement Systems, LLC, PIPS Technology
and Appian Technology, Inc. are included and should not be publicly released.

Prepared by: Northrop Grumman

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1.0 EXECUTIVE SUMMARY

During the 3-week time period from August 6 through August 23, 2007, the Northrop Grumman Transportation Security Solutions (TSS) Surface Team supported the Highway and Motor Carrier (HMC) Division and the Chief Technology Office (CTO) of the Transportation Security Administration (TSA) in conducting Automatic License Plate Recognition (ALPR) technology demonstrations in the vicinity of the Washington Dulles International Airport (IAD).

The purpose of the demonstrations was to independently collect vendor-generated and supplied data for analysis and comparison to evaluate how the different ALPR equipment performed under similar conditions. Another purpose was to gather firsthand information to assess how the technology could be utilized independently, or integrated with other products or information, to:

- Enhance the outer layer of security for airports or other surface transportation scenarios.
- Add defense in depth to current security measures.
- Enhance the ability of preventing terrorist attacks by improving first response alert time.

The information gathered during the demonstrations, coupled with information gathered and analyzed in researching and evaluating ALPR technology, is presented in this comprehensive report. The report contains the integrated data covering all vendors participating in the August 2007 IAD ALPR technology. **This report provides an all encompassing overview of the ALPR demonstrations and has been prepared for internal TSA use ONLY.**

In order to minimize the possibility of inappropriately releasing proprietary, competition sensitive, or company confidential information three additional reports assessing the ALPR technology have been written:

> **Appian Technology, Inc. ALPR Demonstrations Report:** Addresses and contains an evaluation of their ALPR technology demonstrations data collected during the time period from August 20 through August 24, 2007. It also incorporates some additional data that was provided by Appian Technology, Inc. (herein referred to as Appian Technology) in preparation for, and subsequent to, their demonstrations. This report is prepared for TSA and Appian Technology and should not be released externally without the specific prior approval of Appian Technology.

Remington-Elsag Law Enforcement Systems, LLC ALPR Demonstrations Report: Addresses and contains an evaluation of their ALPR technology demonstrations data collected during the time period from August 6 through August 10, 2007. It also incorporates some additional data that was provided by Remington-Elsag Law Enforcement Systems, LLC (herein referred to as Remington-Elsag). This report is prepared for TSA and Remington-Elsag and should not be released externally without the specific prior approval of Remington-Elsag.

PIPS Technology ALPR Demonstrations Report: Addresses and contains an evaluation of their ALPR technology demonstrations data collected during the time period from August 13 through August 17, 2007. It also incorporates some additional data that was provided by PIPS Technology in preparation for, and subsequent to, their demonstrations. This report is prepared for TSA and PIPS Technology and should not be released externally without the specific prior approval of PIPS Technology.

Of the vendors participating in the August 2007 ALPR technology demonstrations, Appian Technology had the highest combined total percentage of correct license plate reads.

The following charts summarize the overall license plate read percentages for each of the participating vendors.

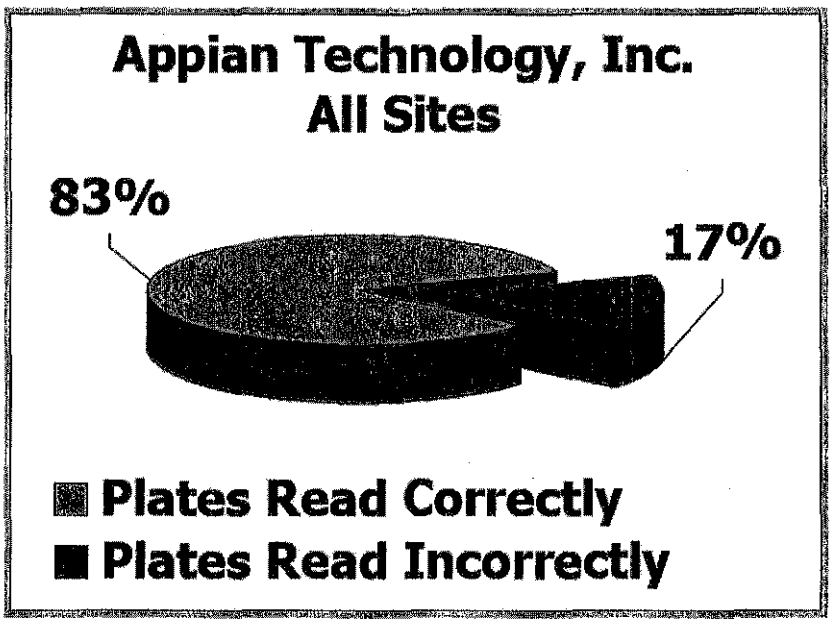


Chart 1: Appian Technology Inc Read Percentages

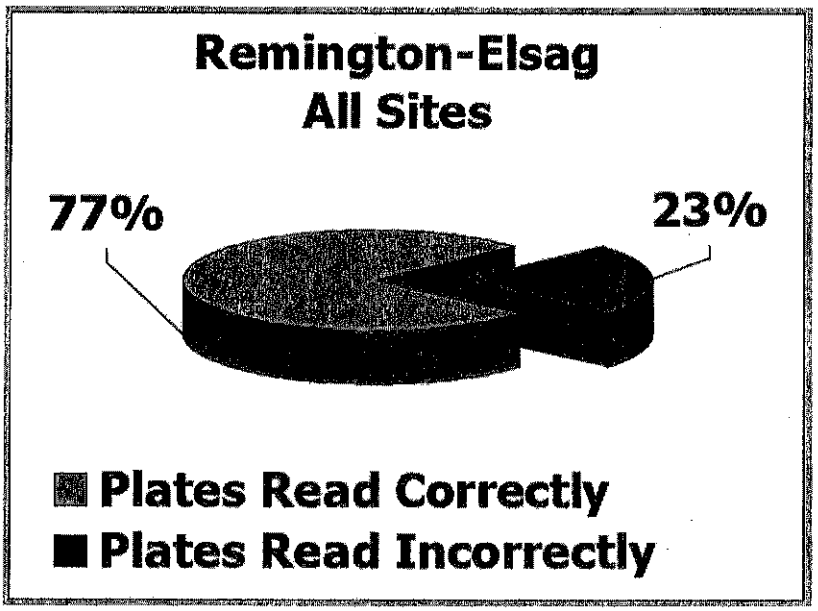


Chart 2: Remington-Elsag Read Percentages

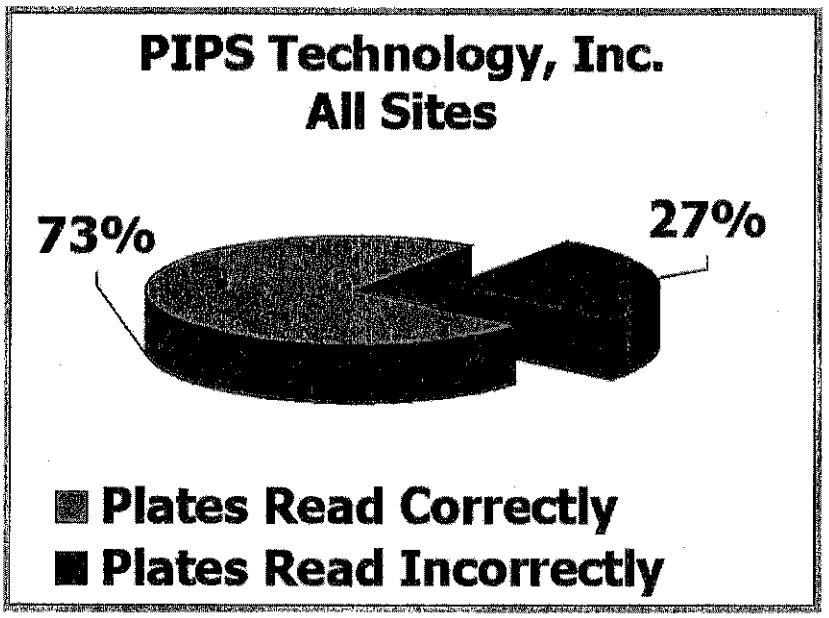


Chart 3: PIPS Technology Read Percentages

2.0 PROJECT BACKGROUND

The TSA, operating within the Department of Homeland Security (DHS), is charged with protecting the nation's transportation network. Within the TSA, Transportation Sector Network Management (TSNM) leads the eight divisions charged with planning and executing the overarching national effort to protect and secure our countries intermodal transportation systems.

Since the creation of TSA in 2001, there have been many programs and measures undertaken, across the various transportation modes, to provide for or improve the safety of the traveling public. This report provides a summary of a recent collaboration effort, primarily focused on improving surface transportation security, but with applicability and utility in a layered security strategy of enhancing security crossing modes of transportation. The ALPR demonstrations were completed in conjunction with, and with the support of, the TSA HMC Division and the CTO.

The project involved preliminary research and analysis on remote vehicle identification via document research, technical interchange meetings, demonstrations, and interviews; by meeting with subject matter experts from local and Virginia and Maryland state authorities; by attending demonstrations of the past and current technologies; and by observing demonstrations and field experiments of these technologies by the manufacturers.

Once initial analysis was performed, the TSA and Northrop Grumman team members discussed the findings. Northrop Grumman then began to survey the existing vendors whose systems are used to identify vehicles as they approach or pass surveillance points to determine system suitability and their willingness to participate in actual demonstrations and analysis. After selecting three vendors who performed demonstrations at IAD, Northrop Grumman created this operational study and analysis by evaluating the data gathered firsthand and additional data provided from the vendors.

3.0 DEMONSTRATIONS OVERVIEWS

Northrop Grumman worked with the TSA HMC staff to select a publicly accessible facility where product technology demonstrations could be performed and later evaluated. The TSA staff project liaison selected IAD located in Chantilly, Virginia. Realistic ALPR product demonstrations scenarios were created and deployment locations were evaluated to assess how Commercial Off-the-Shelf (COTS) ALPR technologies could be deployed at discrete locations to enhance the outer security along the Dulles Toll and Access Roads and on IAD grounds.

Although the license plate read results from each vendor are compared with the other participating vendors, these demonstrations were not intended to put the vendors into a competition. The demonstrations were conducted over a consecutive 3-week time period, rather than concurrently, to allow each vendor the opportunity to independently deploy their ALPR equipment in a live scenario. Each vendor was able to show the TSA, and the invited demonstrations observers representing other government and law enforcement agencies, the various types of ALPR equipment; highlight their different technologies; and explain firsthand the possible advantages of using ALPR as a layer of security.

Prior to the August 2007 demonstrations, the selected vendors worked with Northrop Grumman and the TSA staff liaison to ensure that the demonstrations equipment was properly installed and in position for the demonstrations. The vendors ensured that their screening equipment continued to work properly throughout the demonstrations that results of the screening were being documented completely.

3.1 Demonstrations Scenarios

In order to evaluate the different ALPR technologies, practical demonstrations scenarios were created and shared with each of the vendors in advance of their demonstrations dates. These common scenarios were executed by each of the vendors, during each week of the 3-week period, in an attempt to achieve a common baseline for consistent comparison of the results.

3.1.1 Blacklisted Plates

In order to evaluate the vendors' capability to quickly identify and respond to license plates of known interest, a collection of retired license plates from each of the United States (U.S.) was purchased. From that collection, 20 of the plates, referred to as the "Blacklist", were selected to be used for detection and operator alert evaluation during the IAD technology demonstrations. The blacklisted plate information was provided to the vendors in advance of the demonstrations period so that they could be added to their

alert databases. Of the 20 plates chosen to be used as blacklisted plates, 12 of the plates were purposely selected for the demonstrations period because prior research had revealed that the plate design, lettering, or background had presented challenges for ALPR camera image capture or system recognition/interpretation during past evaluations.

Table 1: Pre-supplied Blacklist Plates

Pre-Supplied - Blacklist Plates - Purchased Plate Information		
Plate	ST	Offense
7740FF	MI	Carjacking while Armed
DNW720	VT	Kidnapping
616638	DE	Scofflaw
496AN	WY	Aggrevated Assault
6A69357	MT	Attempted Robbery
18A4807	MT	Scofflaw
1LJ225	SD	Parole Violation
47C147	SD	Amber Alert
11M625 G	AL	Carjacking while Armed
159GOE	AR	Kidnapping
ANL5846	GA	Scofflaw
JVB975	HI	Aggrevated Assault
RBQ299	KS	Attempted Robbery
MKW207	MD	Scofflaw
219SYC	MO	Parole Violation
HIZ434	ND	Carjacking while Armed
DHR155	OH	Kidnapping
Z14CVP	TX	Scofflaw
DNW720	VT	Aggrevated Assault
727STS	WA	Attempted Robbery

Route Drivers - Blacklist - Car 1		Car 2	
Plate	ST	Plate	ST
6A69357	MT	30E6712	IN
47C147	SD	18A4807	MT
X87QGH	FL	DNW720	VT
64E146	NE	1LJ225	SD
7740FF	MI	616638	DE
83YT70	MA	496AN	WY

Supplied Day 1 - Blacklist Plates - Northrop Personnel Plate Information				
Plate	ST	Make	Model	Color
[redacted]	VA	Nissan	Pathfinder	BLK
	MD	Ford	Tarurs	GRN
	VA	Jeep	Commander	RED
	VA	Acura	3.2TLS	WHT
	VA	Ford	Explorer	RED
	MD	Nissan	Maxima	GRN
	VA	Subaru	Forester	BLK
	VA	Ford	Mustang	BLK
	MD	Honda	Accord	Plum
	MN	Honda	Civic	RED

3.1.2 Demonstrations Scenarios Routes Driven

Route drivers were each given six sets of licenses plates to use on their vehicle and a set of scenarios with three demonstrations routes mapped out.

Figure 1: Route Driver One, Blacklist Plates

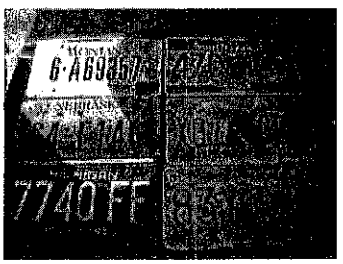


Figure 2: Route Driver Two, Blacklist Plates

Driven Route: The vehicle route starting point was the parking lot to the east of the intersection of Autopilot and Aviation Drives, shown as Point 1 in the Figure 3 below. The driver would affix the blacklisted plate to his/her vehicle and begin the route by pulling out of the parking area, turning right onto Aviation Drive, passing the fixed camera location, and continuing on to pass the mobile camera location. In the image, Point 1 is the Parking Area, Point 2 is the Fixed Equipment Area, Point 3 is the Mobile System Exit Traffic Site, and Point 4 is the Covert Equipment Site.

The driven route continued from Point 3, where the driver performed a U-turn on Rudder Road, and returned to the Dulles Access Road going toward the covert equipment at Point 2. Once they had passed under the bridge where the covert equipment was located, the driver would then continue on to Saarinen Circle, taking a right onto Copilot Way, and driving back to the initial starting area at Point 1. The driver would then change license plates and start the route over again.

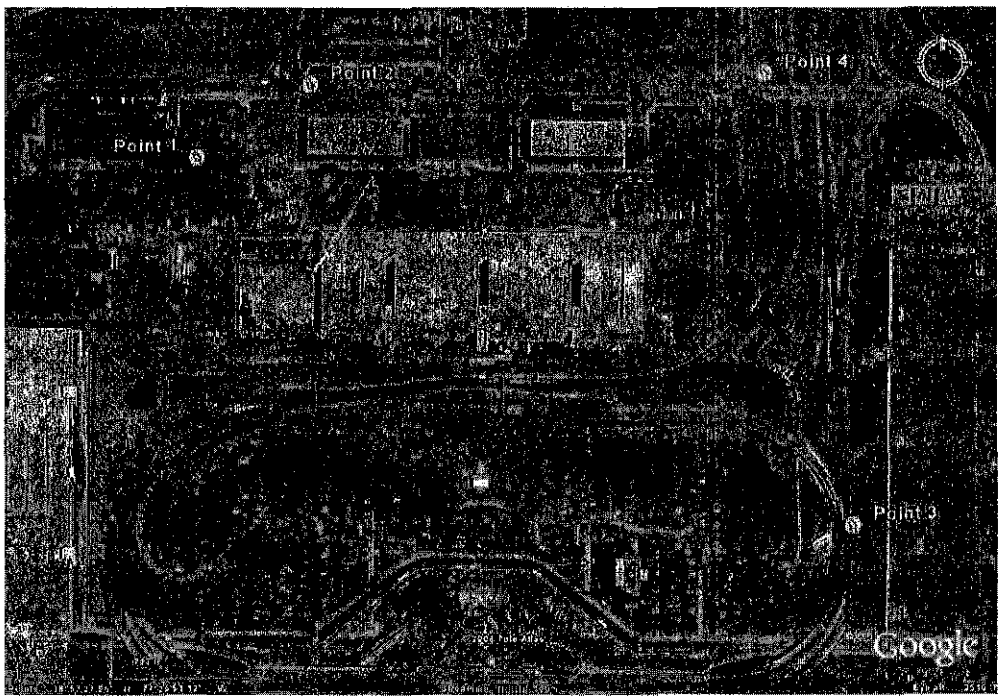


Figure 3: Demonstrations Route Map

3.2 Demonstrations Locations

Covert C amera E valuation Site: The location that was chosen to demonstrate the vendor's covert camera and the equipment's capability to monitor vehicle entrance traffic as it approached the airport was the east entrance of the Dulles Access Road, located at approximately Latitude 38:57:32:21 North and Longitude 77:26:43:56 West near the Aviation Drive Bridge.

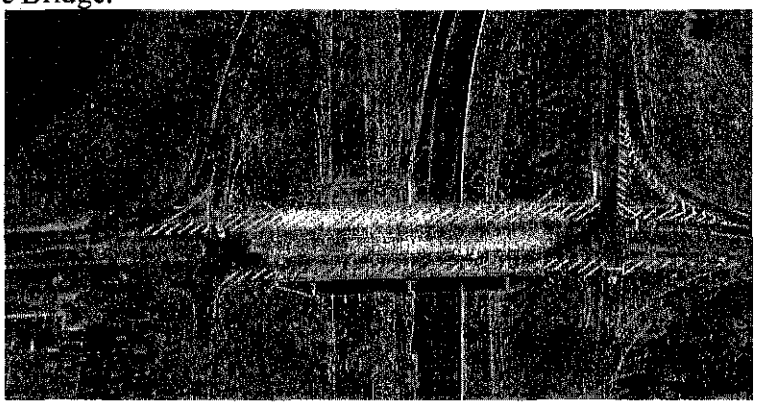


Figure 4: Covert Camera Evaluation Site

Fixed Camera Evaluation Site: The fixed cameras and equipment were installed on the traffic light at the corner of Autopilot Drive and Aviation Drive and monitored traffic as it traveled eastward along Autopilot Drive. This location was chosen due to fixed power availability and to monitor vehicles traveling towards the airport that may not have used the Dulless Access Road. The intersection of Autopilot Drive and Aviation Drive is located at approximately Latitude 38:57:29:53 and Longitude 77:26:59:52.

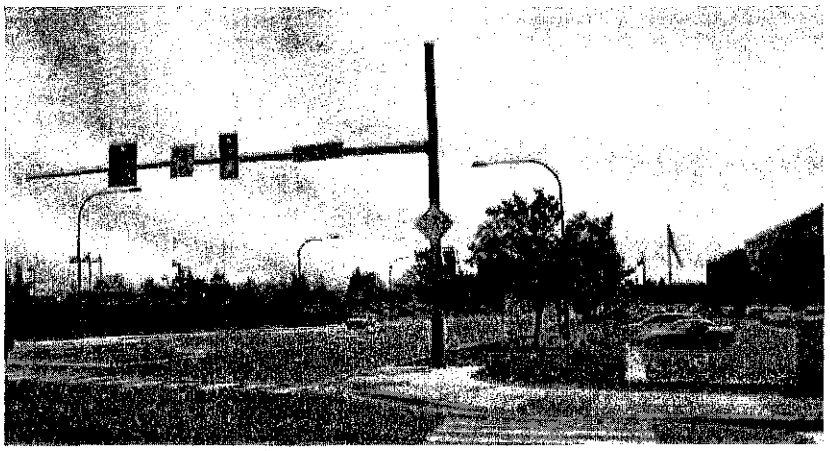


Figure 5: Fixed Camera Evaluation Site

Mobile C amera S ystem E xit T raffic Evaluation S ite: The exiting airport traffic equipment monitoring location site was set up closer to the airport to catch the traffic flow exiting the airport. The location as approximately Latitude 38:57:17:15 North and Longitude 77:26:38:53 West. This exit location was selected to demonstrate the ALPR roadside mobile abilities.

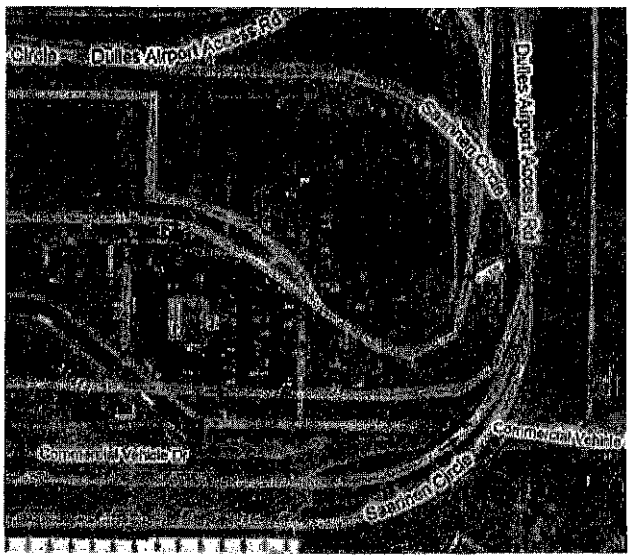


Figure 6: Mobile Camera System Exit Traffic Evaluation Site

Mobile Camera Evaluation at Airport Parking Sites: There were two parking areas chosen at IAD to demonstrate the Mobile ALPR equipment. The first area was the daily parking lot located at Autopilot Drive. The vendors drove through the parking garage in ALPR equipped vehicles, starting at the main level's entrance and moving up to the upper parking deck. The second area chosen for evaluation was the long-term parking lot where each vendor was asked to drive through the entire set of lots. This parking area has the capacity to hold up to 8,000 cars.

3.3 Demonstrations Site Limitations

Vehicle Speeds: Demonstrations were performed using drivers operating vehicles traveling the actual vehicle traffic patterns in the vicinity of IAD and were evaluated as they traveled with other vehicles governed by the posted speed limits. There was no attempt made to verify the maximum ALPR camera performance capabilities related to vehicle speeds claimed by each vendor as part of the demonstrations conducted.

Power Supply: The ALPR cameras and associated equipment used by the vendors for their demonstrations were installed for a 1-week period and then uninstalled. The proximity and availability of electrical power was a key factor in choosing the location for the fixed camera evaluations.

Camera Access: At the fixed camera evaluation site the cameras monitoring vehicle traffic were installed on the arm of the traffic light post, approximately 20 feet above ground level. Access to the cameras involved closing a lane of traffic and using a scissor lift to reach the camera. Each vendor had limited opportunity to reposition their cameras after initial installation.

Weather: The demonstrations took place over a 3-week period in August 2007, and each vendor dealt with weather-related issues. During Week 1, Remington-Elsag dealt with daytime temperatures in excess of 100 degrees; during Week 2, PIPS Technology dealt with excess of 90 degree temperatures and rain; and during Week 3, Appian Technology dealt with rain and some fog-like conditions.

Data Downloads: Vendors used Global System for Mobile communications (GSM)/General Packet Radio Services (GPRS) networks to download their data from the fixed camera site and were limited by the transfer speeds and issues associated with that technology.

3.4 Demonstrations Video Tapes

Video cameras, set up on tripods, were used to capture and monitor passing traffic at two of the ALPR locations. Those locations were the traffic light where the fixed cameras where located and the bridge where the covert cameras were located. The videos were created in order to monitor the evaluations and for post evaluation analysis and comparison of total cars passing the evaluation sites during the periods that the ALPR cameras were in operation.

4.0 VENDOR EQUIPMENT OVERVIEW

Different weather-related and ambient environmental conditions, such as snow or rain, high sunlight, low light and the nighttime darkness, can affect an ALPR camera's operational capability and performance. To combat these conditions, ALPR vendors use different types and combinations of cameras, such as monochrome, color, and video, with infrared (IR) illumination as the light source.

ALPR camera IR illuminators work within undetectable margins for human eye and are often used where a traditional light or camera flash might disturb the vision of the drivers or alert the drivers to the cameras presence. When coupled with a monochrome or color camera the IR illuminates the plate's reflective surface causing the characters to stand out and allowing for an image to be read or captured.

The following table summarizes the ALPR cameras used by the vendors during the demonstrations:

Table 2: ALPR Cameras Used Summary

Vendor	Site	Camera	Integrated Illuminator	Monochrome	Color	Internal processor	Zoom Capability	Mobile Video	Stationary Video
Remington	**Mobile**	**MPH-900**	X	X		X			
Remington	**Mobile**	**MPH-V3**			X		X	X	
Remington	**Covert**	**XPH-8700**	X	X		X			
Remington	**Fixed**	**FPH-900**	X	X		X			
PIPS	**Mobile & Covert**	**P362**	X[1]	X[1]	X[1]				X[2]
PIPS	**Fixed**	**P372 Spike**	X[1]	X[1]	X[1]	X		X[3]	
Appian	**All**	**Cobra**	X[4]	X[4]	X[4]		X	X[5]	X[5]
Appian	**Mobile**	**Viper**			X		X	X	

[1] For the P362 and P372: Optional integrated color or monochrome
[2] For P362: Color overview camera can be from a separate video feed
[3] For P372: Real time jpeg hardware compression is available for video streaming over IP.
[4] For Cobra: May replace Cobra internal color camera with video
[5] For All Cobra: May connect to an existing system's video feed to the Cobra camera.

4.1.1 Equipment as Described by Appian Technology Inc.

The ALPR system used by Appian Technology during the demonstrations at IAD was comprised of the Cobra camera and the Talon Sentinel processor.

The Cobra Camera

The Cobra Automatic Number Plate Recognition (ANPR) camera, as described in documentation provided by Appian Technology, is an image capture system with a range of internal camera and IR illumination options. It was designed to read license plates at day or night and is suitable for mobile, fixed, and long range ALPR. The Cobra camera was used at all evaluation sites during the IAD demonstrations.

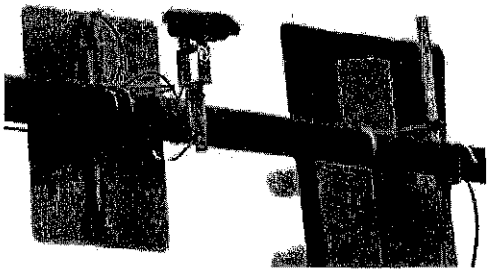


Figure 7: Appian Technology Cobra Cameras Fixed Evaluation Site

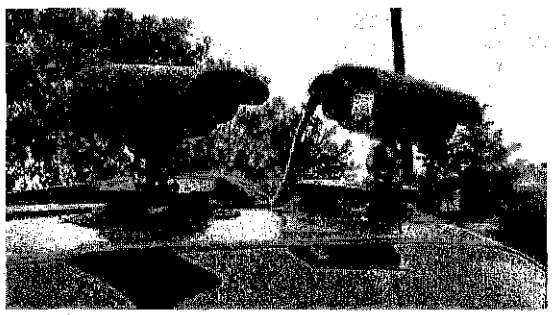


Figure 8: Appian Technology Portable System Mobile Evaluation Site

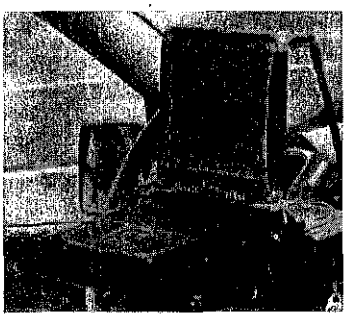


Figure 9: Appian Technology Portable Laptop System Mobile Evaluation Site

The Cobra camera is designed to read license plates and associated images and then transmit these results to Appian Technology's back-end database. The Cobra allows the user to select a variety of options including: IR illumination, dual cameras, and long range illumination options. All cameras have control settings that can be changed remotely in real time.

Key features of the Cobra include:

- High resolution optical zoom cameras
- Easily adjustable settings
- Range of up to 45 meters
- IR wavelength choices available
- Features to combat night time effect of bright headlights and improve accuracy of recognition

Technical specifications, provided by Appian Technology, describing the Cobra camera used during the demonstrations are provided below.

Table 3: Cobra Camera Technical Specifications

Technical specifications	
Monochrome Camera Module	**Communications:** Bi directional RS 232 communications with PC's. Allows settings to be downloaded to the camera, and uploaded to the computer. Camera settings can be stored off-site, and sent into the camera. This eases maintenance and allows a central database to store and retrieve camera settings.
Lens: 18X Zoom f=4.1 mm (wide) to 73.8 mm (tele), F1.4 to F3.0	
Signal System: EIA/CCIR	
Image Sensor: Exview HAD CCD	
Angle of View (H): 48 degree (wide end) to 2.7 degree (tele end)	
S/N Ratio: More than 50 dB	
Electronic Shutter: 1/50 to 1/10,000 Sec. 16 steps	**Cable:** RS232, power and video, all galvanically isolated
Gain: Auto / Manual (-3 to 28 dB, 2 dB steps)	**Connectors:** Metal shell connectors
Camera Operation	**Mounting Bracket:** Full 3 axis gimballed mount
Switch: Zoom tele, Zoom wide	**Heat shield:** Available as an option, use of the heat shield is recommended in environments where high heating through exposure to sunlight is encountered
Video Output: VBS: 1.0 Vp-p (Sync. negative) Y/C Output	
Color - PAL or NTSC	
Color Camera Module	**Operating Voltage:** 9 to 40 V DC
Lens: 18X optical zoom f=4.1 mm (wide) to 73.8 mm (tele), F1.4 to F3.0	12 to 24 V AC
Image Sensor: Exview HAD CCD	110 to 240 V AC
Angle of View (H): 48 degree (wide end) to 2.8 degree (tele end)	(Using external Power supply/interface unit)
	Power Consumption: 8 W typical

S/N Ratio: More than 50 dB **Electronic Shutter:** 1/50 to 1/10,000 Sec. 16 steps **Gain:** Auto / Manual (-3 to 28 dB, 2 dB steps) **Camera Operation** **Switch:** Zoom tele, Zoom wide **Video Output:** VBS: 1.0 Vp-p (Sync. negative) Y/C Output **IR Illuminator** 810nm, 870nm, 940nm - variable pulse **Options:** duration and illumination power **Integrated Light** Measures the daylight, and can alter the **Sensor:** camera's settings to optimize the video	**Dimensions:** Camera: H-90mm X W–80mm X D-185mm Camera with sun shield: H-115mm X W-90mm X D-20mm Bracket: H-80mm **Weight:** Camera: 1.7 KG Camera with sun shield: 1.8 KG Camera with Bracket: 1.8 KG **Environmental:** Sealing: IP 67 Temperature: Storage - 20° C to + 60° C Operational - 10° C to + 55° C Wind Loading (mounted on Cobra bracket) - 160 Kph / 45m/s

The Talon Sentinel Data Processor

The processor element of Appian Technology's system takes the license plate images from the camera and executes the plate recognition processes. The Talon ANPR software is used as a standard for the Cobra camera. Talon hardware can support any suitable IR camera or PAL/NTSC video cameras. The Talon Sentinel, a computer hardware platform with wireless communications, was used as the recognition software for the Cobra camera during the covert demonstrations at IAD in August 2007.

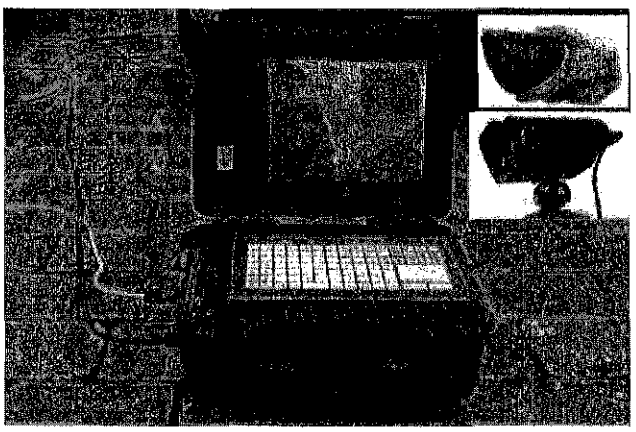


Figure 10: Appian Technology Talon Sentinel

The Talon Sentinel is a mini computer that includes a 20GB hard drive and a Windows operating system. The Talon Sentinel was originally designed for military image processing applications and to operate in any environmental conditions. Various types of hotlists can be used and Talon can be connected to remote hotlist databases. An extract of all vehicles of interest on the National Crime Information Center (NCIC) can be preformed and local hotlists can be created, edited, imported and managed remotely on the Talon Sentinel. The Talon Sentinel and camera to be directly connected to any Web-based service

Key features of the Talon Sentinel, provided by Appian Technology, include:

- Highly cost effective, rugged, and compact 'luggable' PC for field-based ANPR applications
- Fanless high reliability operation
- Casing offers total protection for internal PC
- Casing is NATO codified and tested to MIL C-4150J, IP-67 and ATA
- Thermally designed to operate when closed
- Two PCI card slots for supported frame grabbers
- DC powered for vehicle/battery-based applications
- Multiple battery packs enable sentinel platform to be left unattended for days at a time
- Hibernation during periods of inactivity, significantly reducing power consumption
- Optional integral high brightness display
- Optional integral membrane keyboard with mouse pad
- Highly compact and versatile

4.1.2 Equipment as Described by Remington-Elsag

The ALPR capabilities of Remington-Elsag used during these demonstrations consisted of three systems: the Mobile Plate Hunter (MPH)-900, the XPH-8700, and the FPH-900.

MPH-900 Camera

The MPH-900 camera, combined with command center software, is able to coordinate hundreds of fixed and mobile ALPR devices to capture license plates in real time. The MPH-900 was used and evaluated at the mobile site during the ALPR demonstrations at IAD in August 2007.

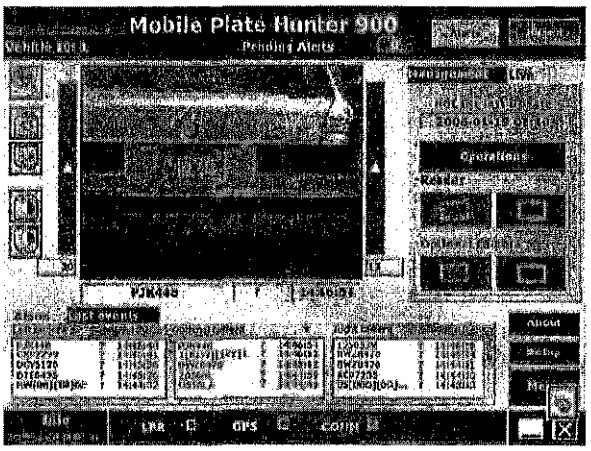


Figure 11: Remington-Elsag MPH-900 Command Center Software

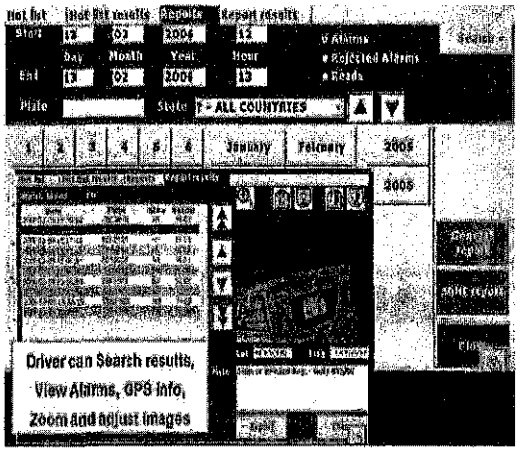


Figure 12: Remington-Elsag MPH-900 Command Center Software Reports

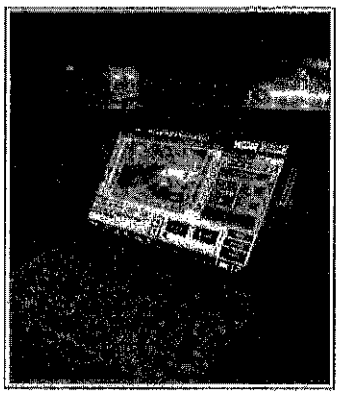


Figure 13: Remington-Elsag Laptop with MPH-900 Software

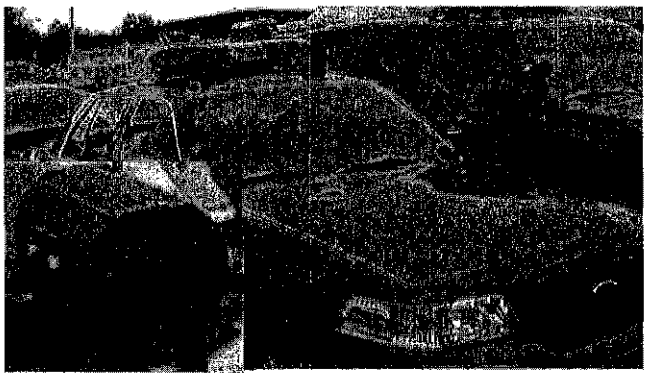


Figure 14: Remington-Elsag MPH-900 Camera

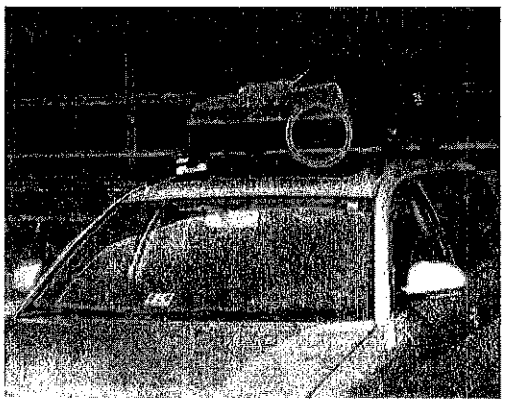


Figure 15: Remington-Elsag MPH-900 Covert Mounting

The MPH-900 camera can read cars traveling up to 140 mph in four lanes of traffic and can read at passing speeds of 75 mph.[1] The MPH-900 translates the read plate data into a digital image, checks an onboard hot list database, and returns an alarm back to the operator in milliseconds if there is a match. The alarm also lists what crime was committed. The MPH-900 also delivers date, time, and GPS locations, pinpointing the most recent sightings of a suspect vehicle.

According to Remington-Elsag, the MPH-900 provides the following benefits:

Real-Time Intervention:

- Watch list filtering
- Probable cause generation for unbiased, targeted search
- Auto theft recovery
- Plate manipulation
- Rental contract violations

Intelligence Gathering:

- Link analysis
- Recurring traffic pattern analysis
- Suspect surveillance
- "Late Hit" analysis

[1] According to Remington-Elsag Proprietary Information booklet. These numbers were not tested as part of the August 2007 demonstration.

Other benefits:

- Built-in capability to communicate with a police operations center for alarm notification and database updates
- Ability to receive and transmit wireless updates
- Processor unit is the size of a small box for easy storage in the trunk of a vehicle
- Low power consumption: unit requires less than 60W of 12V DC to function

The MPH-900 instantly alarms on a blacklisted plate and will display on either a laptop computer or a mobile data terminal (MDT). An alarm consists of an audible sound and visual alert display on the computer screen. Alarms can be configured in a variety of ways by the computer operator, such as different sounds for different levels of threat. Alarms can be broadcast to an operations center or a support vehicle. The system has the ability to store a hot list of license plates with up to four million lines of data. The system works day or night in all weather conditions.

MPH-V3 Camera

Another enhancement to the MPH-900 is the MPH-V3. The MPH-V3 was used during the IAD demonstrations at the mobile site. It was mounted inside of the car and the MPH-900 was mounted on the roof. The MPH-V3 is a dashboard mounted portable unit that allows video and zoom up to a mile away. The MPH-V3 should work in any daylight condition and is only compatible with the MPH-900.

According to Remington-Elsag, the MPH-V3 allows the user to:

- Scan plates directly in front of LPR vehicle
- Scan plates from a 22x zoom distance
- Link to a recording device for Digital Video Recorder (DVR)
- Conduct surveillance from nearly a mile

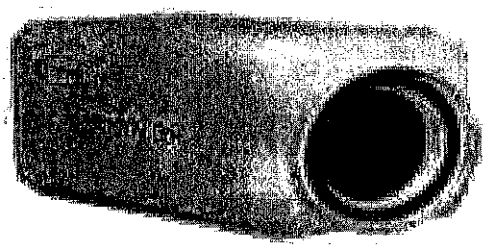


Figure 16: Remington-Elsag, MPH-V3 Camera

XPH-8700 Camera

The second type of system used by Remington-Elsag during the ALPR demonstrations was the XPH-8700 at the covert site. The XPH-8700 was developed as a solution for covert fixed ALPR. It is a portable, all-in-one camera that integrates all the components required to enable ALPR from fixed installations. All necessary parts are together inside a case that looks similar to a standard video-surveillance outdoor camera. Components inside the case include the sensor, an independent IR light system, processing unit, and an independent power source inside a construction barrel.

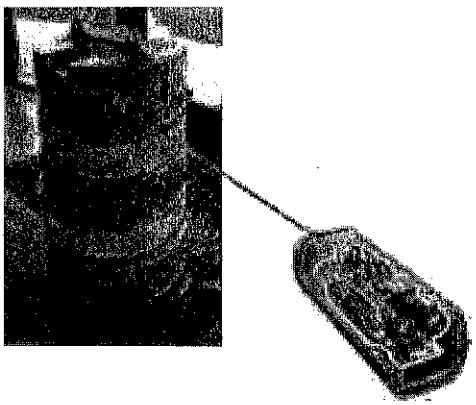


Figure 17: Remington-Elsag, XPH-8700 Covert Unit

The XPH-8700 provides the same real-time intervention and intelligence gathering benefits as the MPH-900. The XPH-8700 can coordinate with the MPH-900. XPH-8700 alarms can be broadcast to an operations center, laptop, or Personal Digital Assistant (PDA). The system operates on a rechargeable independent power source and works day or night at highway speeds.

FPH-900 Camera

The third system used by Remington-Elsag during the ALPR demonstrations was the FPH-900 at the fixed site. The FPH-900 offers a solution for fixed location ALPR. The FPH-900 contains all of the essential components of the XPH-8700 that are detailed in the first paragraph of the XPH-8700 section. The same benefits apply to the FPH-900 as the previous two systems.

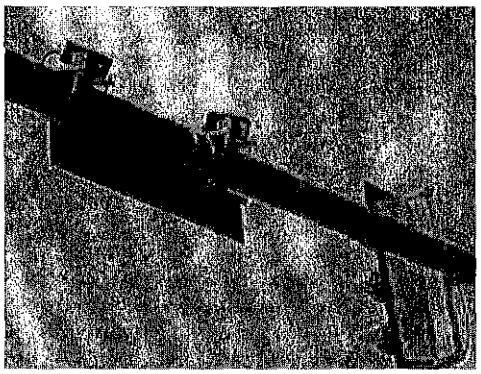


Figure 18: Remington-Elsag FPH-900

Similar to the MPH-900, the FPH-900 instantly alarms on a blacklisted plate and will display on either a laptop computer or a MDT. Alarms are audible and visual and can be broadcast to an operations center or a support vehicle. The system can contain a hot list with up to four million lines of data. The system works day or night in all weather conditions. The FPH-900 is the best solution for gate and high speed applications.

4.1.3 Equipment as Described by PIPS Technology

CAMERA TYPES

P362 Camera

The P362 is the compact ALPR image capture system from PIPS Technology. The P362 is equipped with patented filter and flash techniques to read images clearly even in bright light, such as that from the sun or other cars. Although it was primarily designed for mobile or portable applications, the small size of the P362 makes it suitable for many other applications such as parking, law enforcement, and access control. During the ALPR demonstrations at IAD in August 2007, the P362 was used on a car as a mobile application with the processor in the trunk of the car, similar to the picture below:

Figure 19: PIPS P362 Camera roof mount

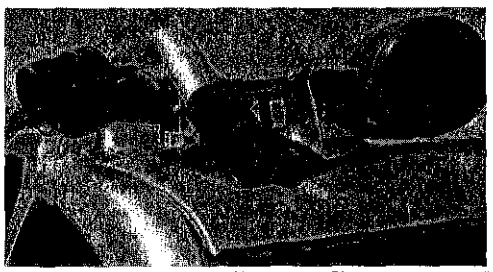


Figure 20: PIPS P362 Dual Cameras roof-corner mount

Figure 21: PIPS P362 Camera optional portable window mount

PIPS describes the camera unit as a monochrome charge coupled device (CCD) camera with a high IR sensitivity, surrounded by an illuminator consisting of a ring of eye-safe, IR light-emitting diodes (LEDs). The metal housing is waterproof and the unit has no moving parts. The P362 boasts the capability of easy mobile or fixed system

configuration and installation. As an option, the P362 can be supplied with an integrated overview camera (color or monochrome). This means that an ALPR system using the P362 camera will, under suitable lighting, always provide two images, a color and a monochrome.

For mobile surveillance, the P362 camera is connected to the mobile computer, which runs the Police ANPR Graphic Interface System (PAGIS) software. The P362 scans the license plates of passing vehicles. The numbers are then sent through PAGIS where a real-time comparison is made of license plate reads to the database and alerts are given when a match is made. During the ALPR mobile demonstrations, certain license plates were manually entered into the PAGIS, all of which should have registered as a match.

P372 'Spike' Camera

The P372 'Spike' is an integrated ALPR camera, illuminator, and processor that are supposed to save on system cost, complexity, and implementation. The P372 was designed for mobile and fixed applications. During the ALPR demonstrations at IAD in August 2007, Spike was used at the fixed and covert sites.

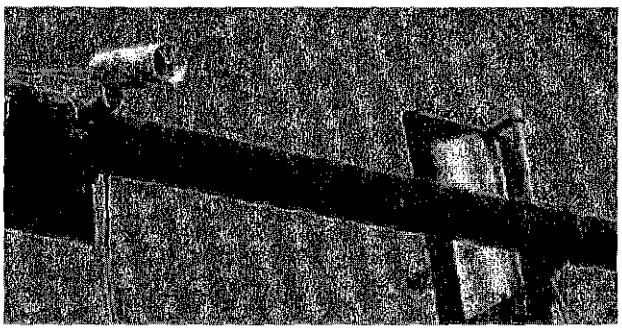


Figure 22: PIPS P372 mounted onsite traffic light

Figure 23: PIPS P372 camera and sun shield

As with the P362, the P372 Spike has a monochrome CCD camera with a built in IR LED. The main difference with Spike is the integrated processor, which incorporates PIPS Technology's Autoplate ALPR engine. The engine can operate internally from the video image or by an external sensor.

Spike will output the following ALPR data:

- Time, date, and location
- License plate patch image or full IR image
- Overview image (if camera fitted)
- Read confidence

PIPS states that Spike can be integrated into a variety of systems via Transmission Control Protocol/Internet Protocol (TCP/IP) Ethernet with socket and FTP protocols, a relay output (for example, to control a barrier), RS232, as well as true IP connectivity over GPRS/GSM. An optional wireless LAN connection provides the capability to save on installation and cabling costs. Set-up and monitoring of the camera is accomplished through a web browser interface from a PC or a Personal Digital Assistant (PDA). A USB port allows stored data to be removed from the camera.

5.0 POST DEMONSTRATIONS DATA ANALYSIS

5.1 Video Tape Vehicle Count

For **Appian Technology,** the total amount of video recorded for the traffic light and covert sites was 529 minutes of video tape (9 hours) and number of vehicles counted from the tapes was 3,487.

For **Remington-Elsag**, the total amount of video recorded for the traffic light and covert sites was 954 minutes (16 hours) and the number of vehicles counted from the tapes was 5,805.

For **PIPS Technology,** the total amount of video recorded for the traffic light and covert sites was 742 minutes (12 hours) and the number of vehicles counted from the tapes was 5,345.

Table 4: Post Demonstrations Video Tape Analysis.

Site	Tape Length (min)	Tape Length (hr)	Car Count from Video
Appian Technology, Inc.			
Fixed	267	6	1385
Covert	262	4	2102
Total	529	10	3487

Site	Tape Length (min)	Tape Length (hr)	Car Count from Video
Remington-Elsag			
Fixed	633	11	3144
Covert	321	5	2661
Total	954	16	5805

Site	Tape Length (min)	Tape Length (hr)	Car Count from Video
PIPS Technology			
Fixed	370	6	1775
Covert	372	6	3570
Total	742	12	5345

5.2 Post Demonstrations Image Data Analysis

Following the August 2007 demonstrations period, Northrop Grumman performed an extensive and manpower intensive review of the capture license plate image data that was recorded by each of the vendors during their demonstrations periods. Team members visually compared each of the software-generated license plate read interpretations to the images of the actual license plates and manually recorded what the system read. The following sections summarize the results for each of the vendors.

5.2.1 Post Demonstrations Image Data Analysis for Appian Technology, Inc.

Appian Technology submitted their results in Microsoft (MS) Excel and HTML format.

Table 5: Appian Technology Data Sample

Plate as Read	Date	Camera ID	Plate Image (Bigfish Website)	Plate Image (Local File)
JYC8879	2007-08-20 13:00:09	8	http://209.155.65.	c:\images\0\0\0
JYC8879	2007-08-20 13:00:09	3	http://209.155.65.9	c:\images\0\0\0
KGJ8384	2007-08-20 13:00:11	6	http://209.155.65.9	c:\images\0\0\0
KCJ8384	2007-08-20 13:00:11	7	http://209.155.65.9	c:\images\0\0\0
UHV99U	2007-08-20 13:00:45	6	http://209.155.65.9	c:\images\0\0\0

Appian Technology's camera images were both captured and stored at a high resolution, producing a sharp image. For each vehicle plate read, Appian Technology provided one or two images. When there are two images, Appian Technology's system combines them together and saves them as one single image. This method saves database space, while maintaining a higher resolution. Examples of these images, which were decreased in size to fit this document, are shown on the next page. The images shown were taken, using the Cobra camera, at various locations.

Figure 24: Appian Technology Image at Mobile Equipment Site

Figure 25: Appian Technology Image at Covert Camera Site

Figure 26: Appian Technology Image at Fixed Camera Site

Figure 27: Appian Technology Fixed Camera Night Image

Figure 28: Appian Technology Fixed Camera Day Image

Figure 29: Appian Technology Covert Camera Night Image

5.2.2 Post Demonstrations Image Data Analysis for Remington-Elsag

Remington-Elsag submitted their results in MS Excel and HTML formats with all linked images provided on dual layer discs.

Table 6: Remington-Elsag Data Sample

Data Backup - 8/13/2007 7:06:09 PM **Mobile Test 8-7 1-4pm**				
Date	Gate/Mobile Unit	Plate (State)	Image	Color Image
08/07/2007 - 3:59:59 PM	Mobile System	60R193(?)	Image	Image
08/07/2007 - 3:59:50 PM	Mobile System	KBJ7888(?)	Image	Image
08/07/2007 - 3:59:45 PM	Mobile System	14735UW(?)	Image	Image
08/07/2007 - 3:59:44 PM	Mobile System	P4118(?)	Image	Image

Remington-Elsag's cameras can capture multiple images and stores them at a high resolution which produces a sharp image. During the mobile demonstrations, each license plate read had two images, one color and one black and white. The images shown on the next page are taken from Remington-Elsag's database of license plate captures.

Figure 30 : Remington-Elsag MPH-900 and MPH-V3 Image at Mobile Equipment Site

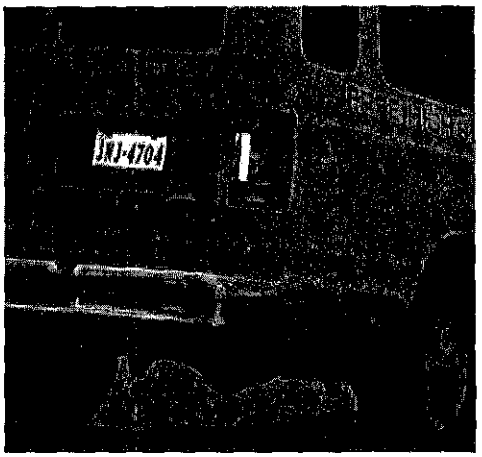


Figure 31: Remington-Elsag XPH-8700 Image at Covert Camera Site

Figure 32: Remington-Elsag FPH-900 Image at Fixed Camera Site of a Michigan Plate

5.2.3 Post Demonstrations Image Data Analysis for PIPS Technology, Inc.

PIPS Technology provided their demonstrations results in a different format than the other vendors. They allowed access to their data stored offsite via the Internet by loading two laptops provided to PIPS Technology with the proprietary PIPS back-end software. A dongle, a piece of hardware that must be attached to the computer to make the secured software run, was also provided and had to be connected to the laptop in order to gain access to the data. The dongle is a security device that prevents the unauthorized copying of protected software, but it also made the post demonstrations analysis of the PIPS Technology image data more challenging.

After several attempts to retrieve the demonstrations data stored at PIPS Technology the Northrop Grumman analysts identified three issues. The first issue was that not all the expected data was present or retrievable. When exporting data from the back-end database only 10,000 lines of text data would export. The second issue the analysts faced was the challenge of having to use the back-end software for image and text interpretation. The process of verifying the data was extremely slow and data manipulation or enhancement for image interpretation was difficult. The third issue was that copying, saving, and storing the images individually off of the back-end software via the Internet for archival or external analysis was not feasible. The images were binary and saved in such a way that the back-end software and associated dongle was required to view them. The PIPS Technology representatives were asked to provide their full demonstrations image and read data as well as a method that would allow the images and text to be stored and manipulated outside of their proprietary software. PIPS Technology was not able to re-supply the full data set, but they did provide an executable script that was installed and run on the laptops and that pulled the available data from their back-end database into a MS Excel spreadsheet and stored copies of the images to a local directory.

Table 7: PIPS Technology Data Sample

DATE & TIME	Site	Plate As Read	IR Image	Color Overview
8/13/2007 11:43	fast lane	KGU9486	Patch	Overview
8/13/2007 11:43	fast lane	AB123	Patch	Overview
8/13/2007 11:43	fast lane	ZF7120	Patch	Overview

PIPS Technology images were captured at a high resolution and were viewable in near real time during the demonstrations but are stored at a lower resolution in their back-end database. The reason for the lower resolution is to decrease the size of each image in order to save space in the database and also to allow the ability to store more images if necessary. The images shown on the next page are some examples of license plates captured by PIPS Technology.

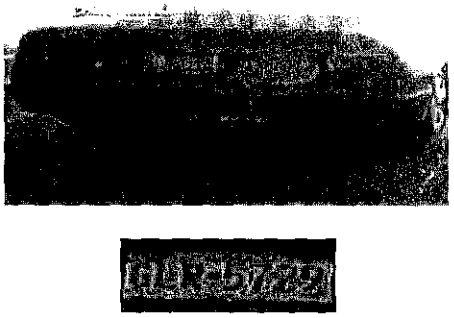


Figure 33: PIPS Technology P362 Image at Mobile Equipment Site

Figure 34: PIPS Technology P372 Image at Fixed Camera Site

Figure 35: PIPS Technology P372 Image at Covert Camera Site

One consequence that resulted from lowering the image resolutions for database storage is that some of the image captures were not readable during post demonstrations data analysis, even after enlargement and attempted enhancement. Below are what these image captures looked like to the human eye. They are shown in actual size and clarity, as provided by PIPS Technology, before any changes.

Figure 36: Sample Images (Actual Size and Clarity before Enhancement)

6.0 VENDOR RESULTS OVERVIEW

This section summarizes all the ALPR vendor demonstrations and discusses the results from the analyzed data that was collected at IAD during the August 2007 demonstrations period. Each vendor demonstrated their ALPR technology in three stationary camera equipment locations for traffic surveillance, and in two mobile camera equipment locations – vehicle parking lot sites in the vicinity of the airport.

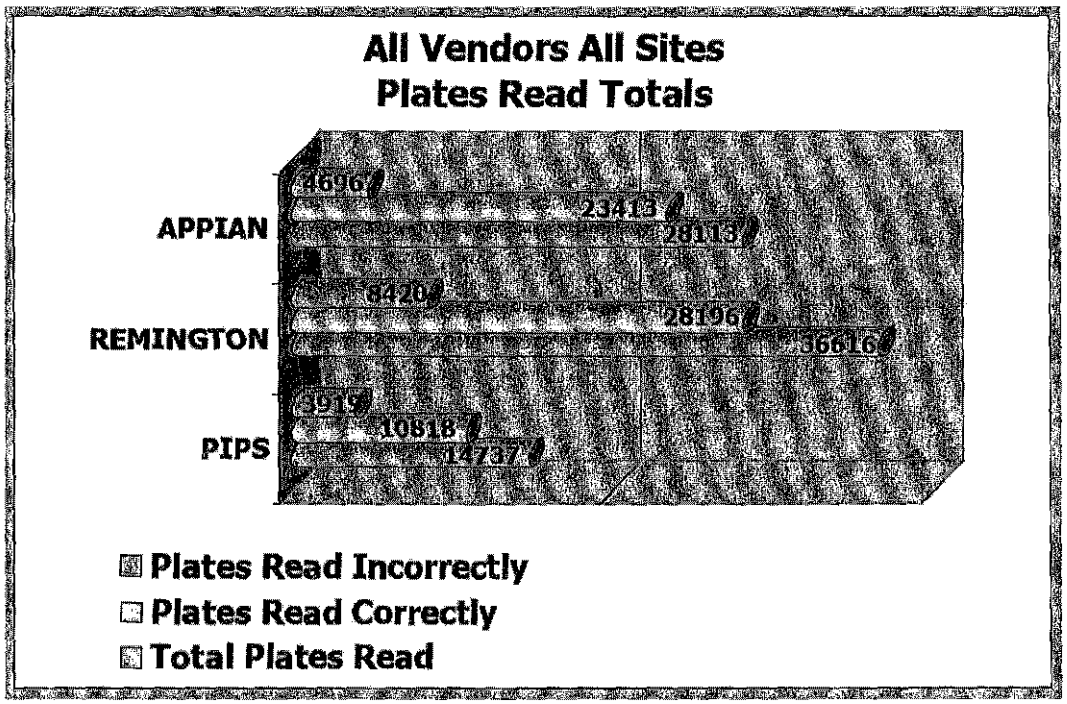


Chart 4: Combined Results for all 5 Evaluated Sites

6.1 Fixed Camera Site Evaluation Results

The purpose of this part of the demonstration was to show how placing fixed cameras at strategic intersections around the airport could benefit security in times of high alert. The first stationary camera equipment location was set up at a traffic light pole located on the corner of Aviation Drive and Autopilot Drive (see section 3.1 of this report for site description). During their demonstrations dates, each vendor mounted two of their cameras on the arm of the traffic pole. These cameras read the rear plates of vehicles passing under the traffic light. This was the only camera location that had an external power source available to operate the vendors' cameras and associated equipment.

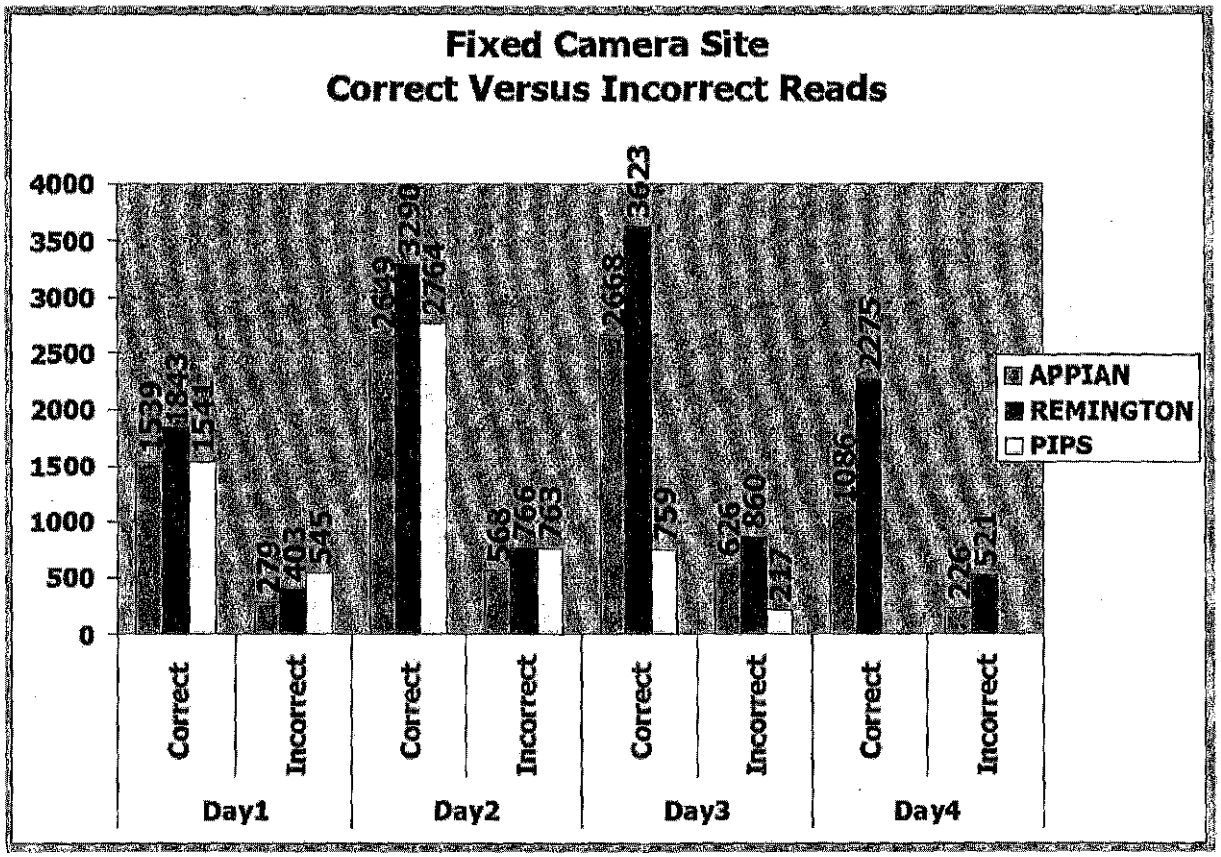


Chart 5: Fixed Camera Site Reads[2]

[2]PIPS lost Day 1 data due to database crashes and Day 4 data for reasons unknown. Appian uninstalled equipment early on Day 4 in order to meet OCONUS travel arrangements.

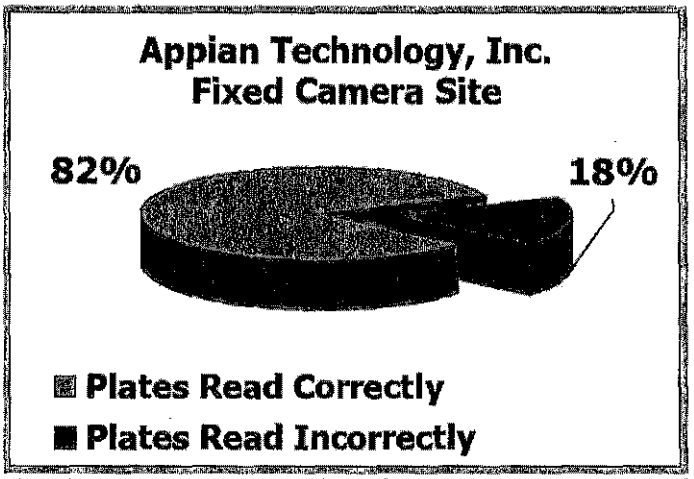


Chart 6: Appian Technology Fixed Camera Site Read Percentages

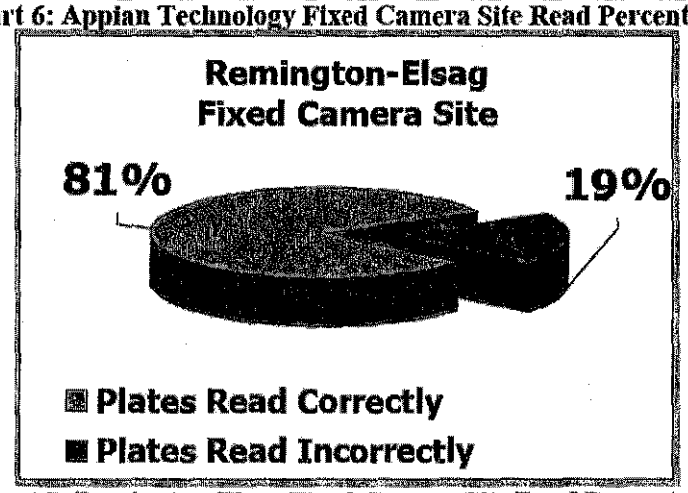


Chart 7: Remington-Elsag Fixed Camera Site Read Percentages

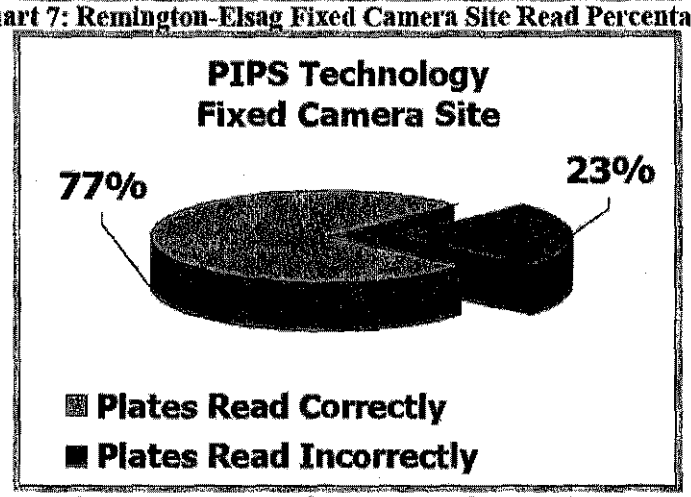


Chart 8: PIPS Technology Fixed Camera Site Read Percentages

6.2 Covert Camera Site Evaluation Results

The purpose of this demonstration was to show how portable equipment with self-contained power could be deployed. The second stationary camera equipment location was set up near the Dulles Airport Access Road entrance, under the Aviation Drive Bridge (see section 3.1 of this report for site description). The vendor supplied covert camera equipment to be positioned in that location for pre-determined amounts of time. The covert equipment used was portable ALPR equipment and was set up to monitor incoming Dulles Access Road traffic as it passed by the location going toward the airport.

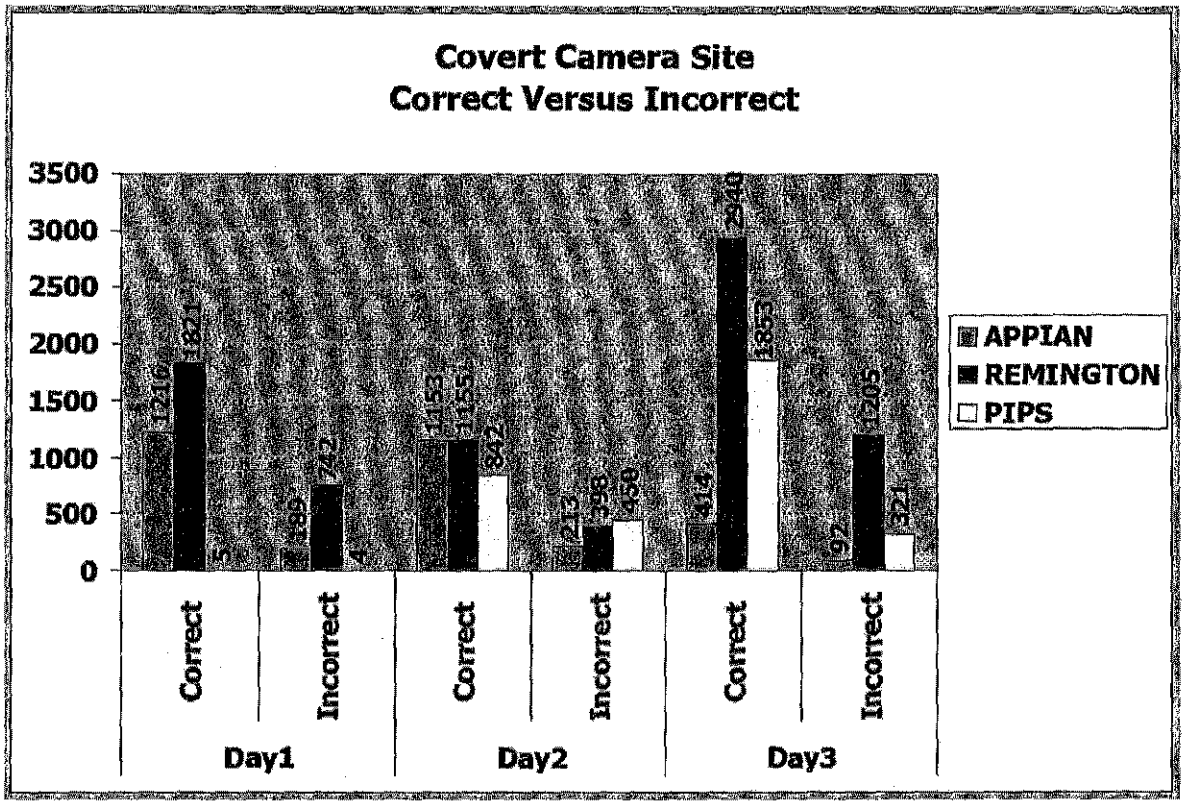


Chart 9: Covert Camera Site Reads[3]

[3]Covert data demonstrations were held for 3 days only. PIPS lost Day 1 data due to a database crash. Because of the covert camera was on the side of the road and close to heavy traffic, Appian gave visitor demonstrations of their covert system at a safer location.

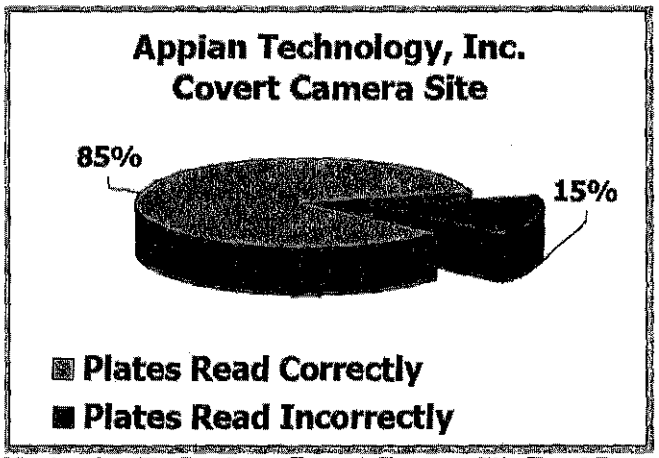


Chart 10: Appian Technology Covert Camera Site Read Percentages

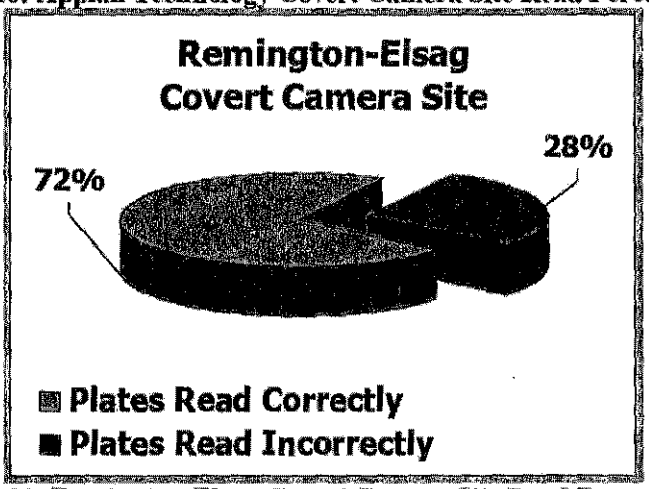


Chart 11: Remington-Elsag Covert Camera Site Read Percentages

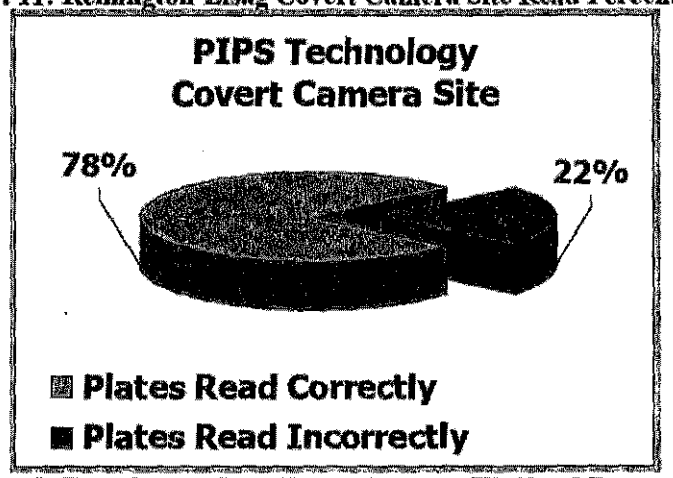


Chart 12: PIPS Technology Covert Camera Site Read Percentages

6.3 Mobile Camera System Exit Traffic Site Results

The purpose of this part of the demonstrations was to show how mobile equipment could be used and deployed by airport security to assist in monitoring traffic. The third stationary demonstrations scenario was set up on the side of the Dulles Access Road monitoring the exit traffic vehicles as they left the airport complex from Saarinen Circle (see Section 3.1 of this report for site description). The vendors' vehicle, pre-equipped with ALPR cameras, monitored the exit traffic for predetermined amounts of time each day.

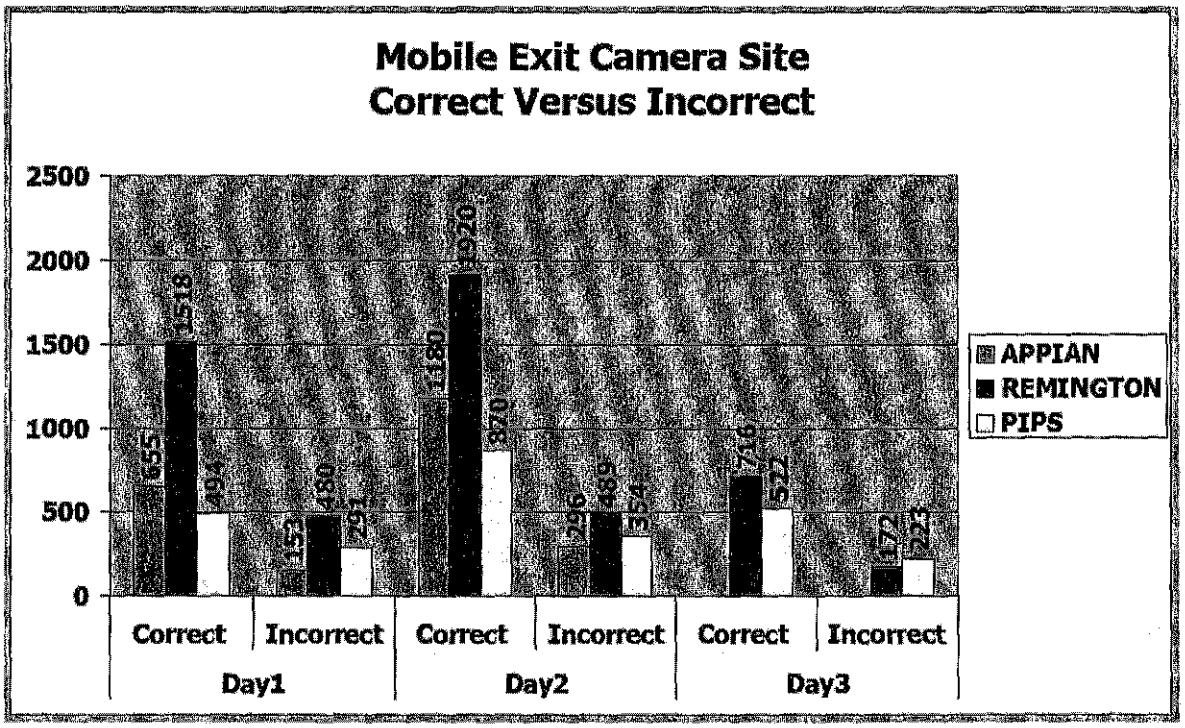


Chart 13: Mobile Exit Camera Site Reads[4]

[4] Mobile Exit demonstrations were held for 3 days only. Day 3 was during morning hours only. Appian gave site visitors demonstrations of mobile equipment on Day 3 – no data.

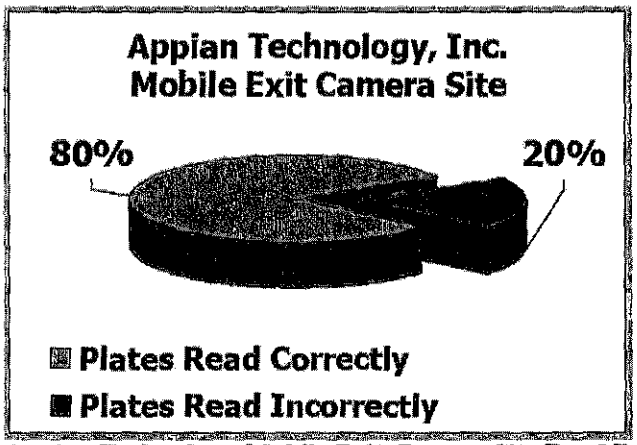


Chart 14: Appian Technology Mobile Exit Camera Site Read Percentages

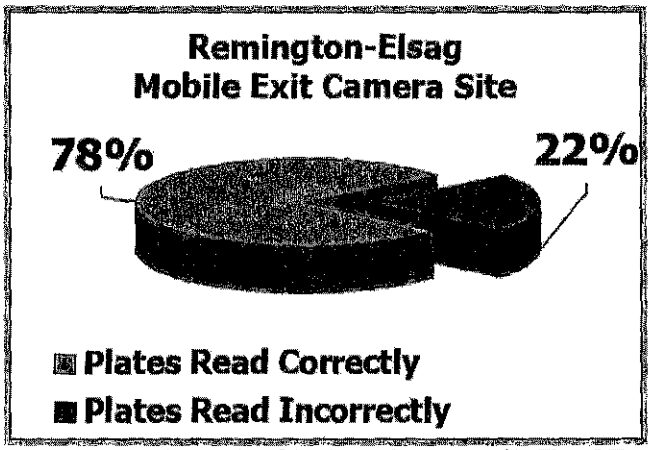


Chart 15: Remington-Elsag Mobile Exit Camera Site Read Percentages

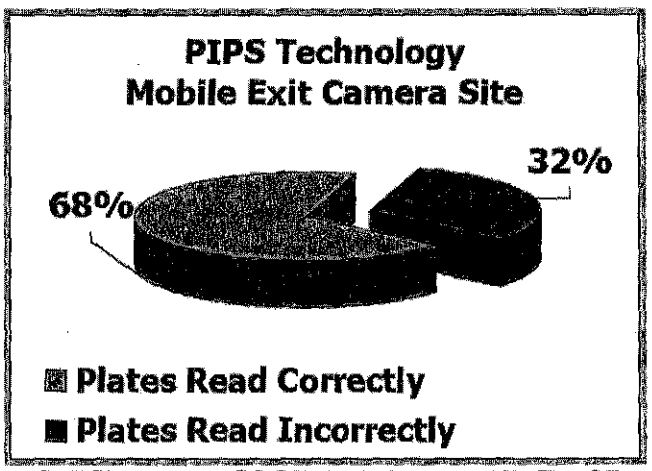


Chart 16: PIPS Technology Mobile Exit Camera Site Read Percentages

6.4 Mobile Equipment Evaluation at Parking Areas Results

These demonstrations were conducted to show how using the mobile equipment to scan parking areas could provide help with identifying suspect vehicles. The fourth and fifth sites consisted of two parking areas where demonstrations would be held. The first was a daily parking garage and the second was the long-term parking area (see Section 3.1 of this report for site descriptions). The vendor's pre-equipped ALPR vehicle was driven by the vendor, with two Northrop Grumman staff members in the vehicle, through one of the daily parking garages and through the entire long-term parking area. These demonstrations were also performed to provide IAD personnel information on how newer ALPR equipment could be used to improve their currently installed parking lot monitoring systems.

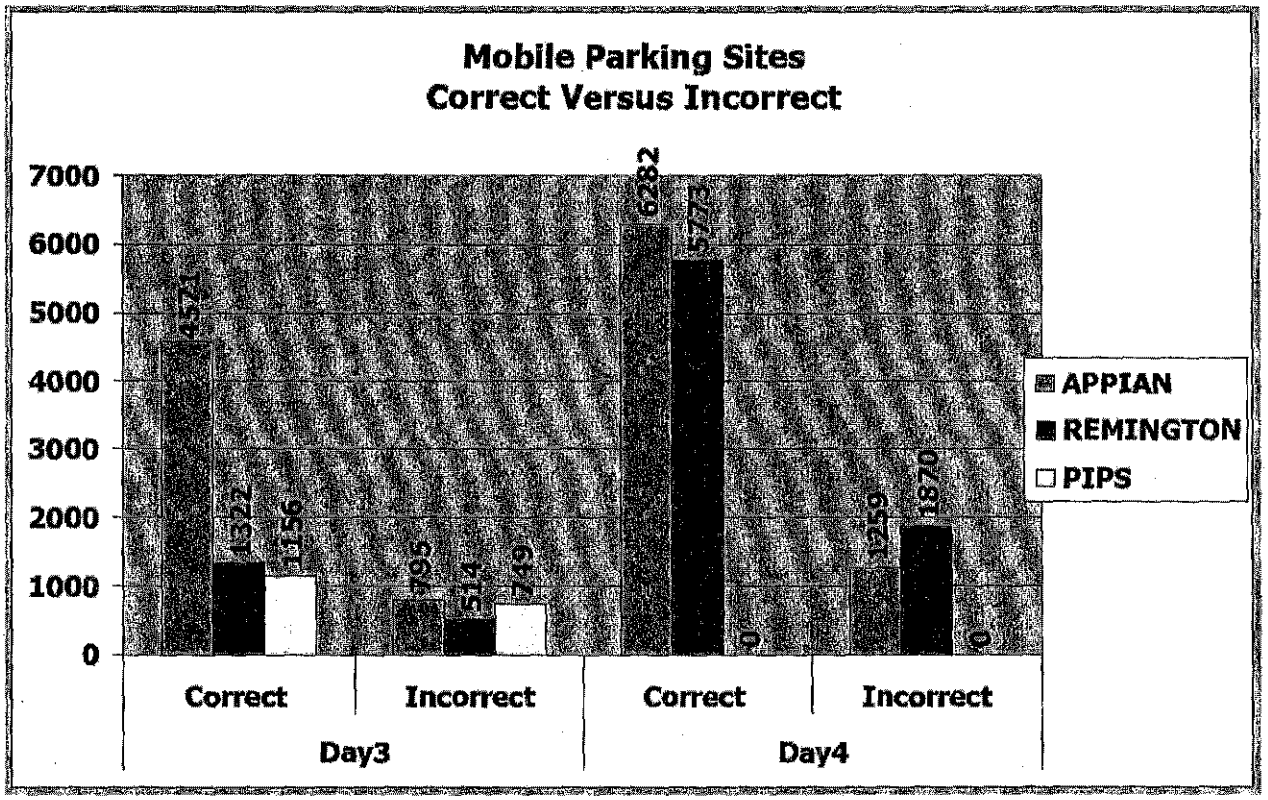
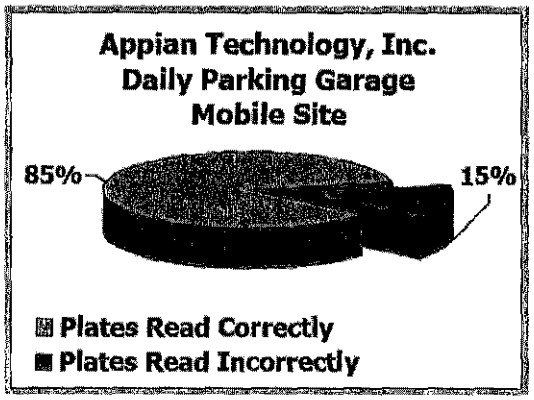


Chart 17: Mobile Parking Locations Reads[5]

[5] Mobile parking demonstrations were held in two locations, the daily parking garage and the long-term parking area. Remington and PIPS performed reads for three levels of the parking garage and Appian performed reads of all levels. For long-term parking all vendors scanned all the sections of long-term parking. PIPS lost all of their long-term parking data. Reason unknown.



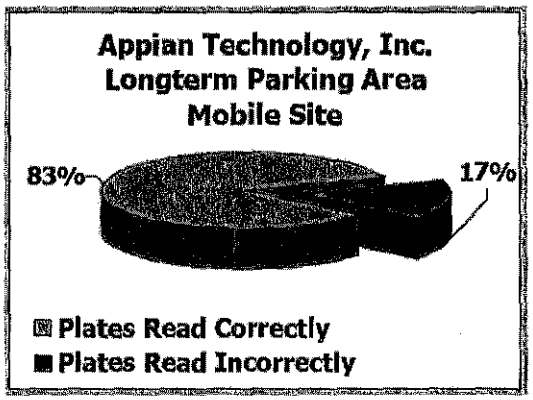
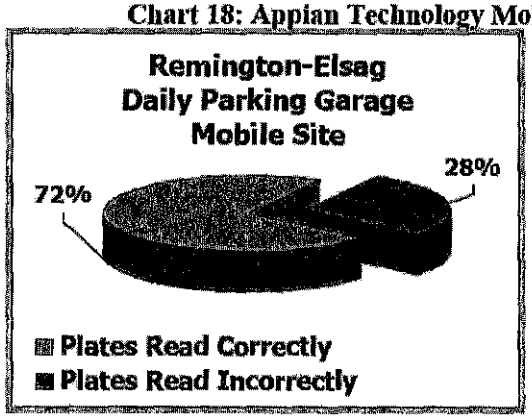


Chart 18: Appian Technology Mobile Parking Sites Read Percentages



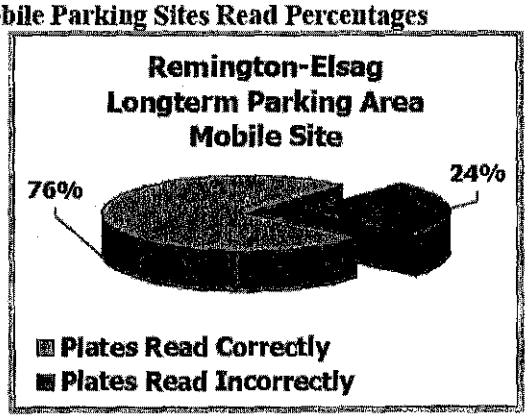
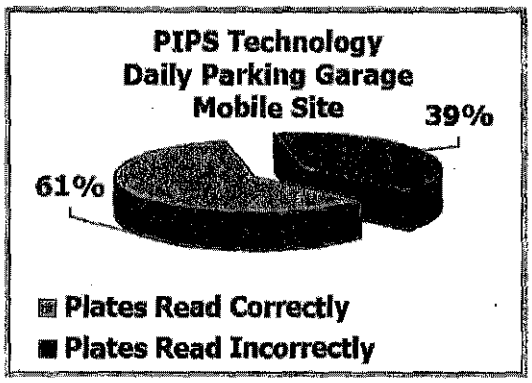


Chart 19: Remington-Elsag Mobile Parking Sites, Read Percentages



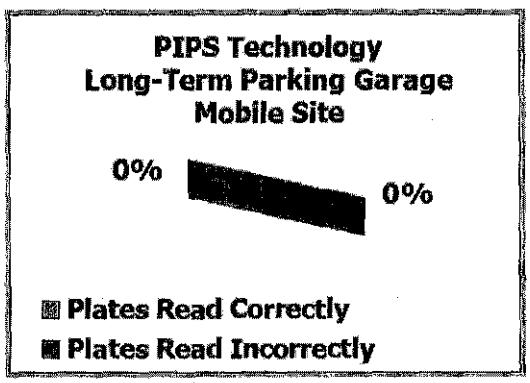


Chart 20: PIPS Technology Mobile Parking Site Read Percentages.[6]

[6] Chart 20 contains information representing missing data; PIPS Technology long-term Parking lists 0 percent as the results. While onsite, Northrop Grumman staff monitoring the demonstration witnessed 6931 plates that should have been read; However, within the results there were only 992 lines of text and the associated images were missing.

7.0 VENDOR RESULT BREAKDOWNS

7.1 Breakdown of All Sites Incorrect Reads

The following tables provide a summary of the number and types of errors that were noted in the post demonstration analysis of the collected data. In some cases multiple errors reading the plate images were observed on an individual license plate. Errors in plate interpretation were recorded individually; however, regardless of the total number of errors found on a plate, it was counted as single incorrect image read.

Table 8: All Vendors, Breakdown of Incorrect Reads

	APPIAN	REMINGTON	PIPS
Type	Counts		
Total Plates Read	28113	36616	14737
Correct Reads	23413	28196	10818
Incorrect Reads	4696	8420	3919
Total Mistakes (multi per plate)	6126	11846	5979
Added Digits	29	762	177
Dropped Digits	2016	6624	748
LPSymbol	334	18	210
Stacked Digits	430	30	255
Transposed Digits	3317	4412	4589

Table 9: Appian Technology, Inc. Plate Error Count

Appian	Added Digits	Dropped Digits	Read LPSymbol	Stacked Digits	Transposed Digits	Read Writing
Fixed Site						
8/20/2007	2	103	29	26	144	8
8/21/2007	9	201	51	58	292	31
8/22/2007	7	247	50	59	298	40
8/23/2007	4	92	17	32	110	12
Covert Site						
8/20/2007	0	79	4	10	113	0
8/21/2007	0	99	10	9	97	1
8/22/2007	0	38	2	2	58	3
Mobile Exit						
8/20/2007	0	50	4	14	100	0
8/21/2007	3	122	13	12	183	16
8/22/2007	n/a	n/a	n/a	n/a	n/a	n/a
Mobile Parking						
8/22/2007	1	337	61	68	480	0
8/23/2007	3	551	108	132	756	1

Table 10: Remington-Elsag Plate Error Count

Remington	Added Digits	Dropped Digits	Read LPSymbol	Stacked Digits	Transposed Digits	Read Writing
Fixed Site						
8/6/2007	25	250	3	3	185	15
8/7/2007	22	493	0	3	372	22
8/8/2007	28	524	3	4	447	25
8/9/2007	8	325	2	10	249	32
Covert Site						
8/6/2007	4	532	1	0	295	101
8/7/2007	3	278	1	0	216	25
8/8/2007	23	905	3	0	446	139
Mobile Exit						
8/6/2007	114	217	3	2	133	80
8/7/2007	107	188	0	5	152	86
8/8/2007	13	88	0	0	60	27
Mobile Parking						
8/9/2007	7	408	0	0	150	2
8/10/2007	384	1105	2	4	637	16

Table 11: PIPS Technology Plate Error Count

PIPS	Added Digits	Dropped Digits	Read LPSymbol	Stacked Digits	Transposed Digits	Read Writing
Fixed Site						
8/13/2007	48	123	33	24	394	14
8/14/2007	66	177	47	66	502	32
8/15/2007	15	27	19	41	147	5
8/16/2007	n/a	n/a	n/a	n/a	n/a	n/a
Covert Site						
8/13/2007	0	1	0	0	3	0
8/14/2007	7	129	14	14	386	0
8/15/2007	8	41	21	33	247	9
Mobile Exit						
8/13/2007	6	32	9	0	3	0
8/14/2007	6	45	14	14	386	0
8/15/2007	4	66	21	33	247	9
Mobile Parking						
8/15/2007	6	66	42	31	652	0
8/16/2007	lost data	lost data	lost data	lost data	lost data	lost data

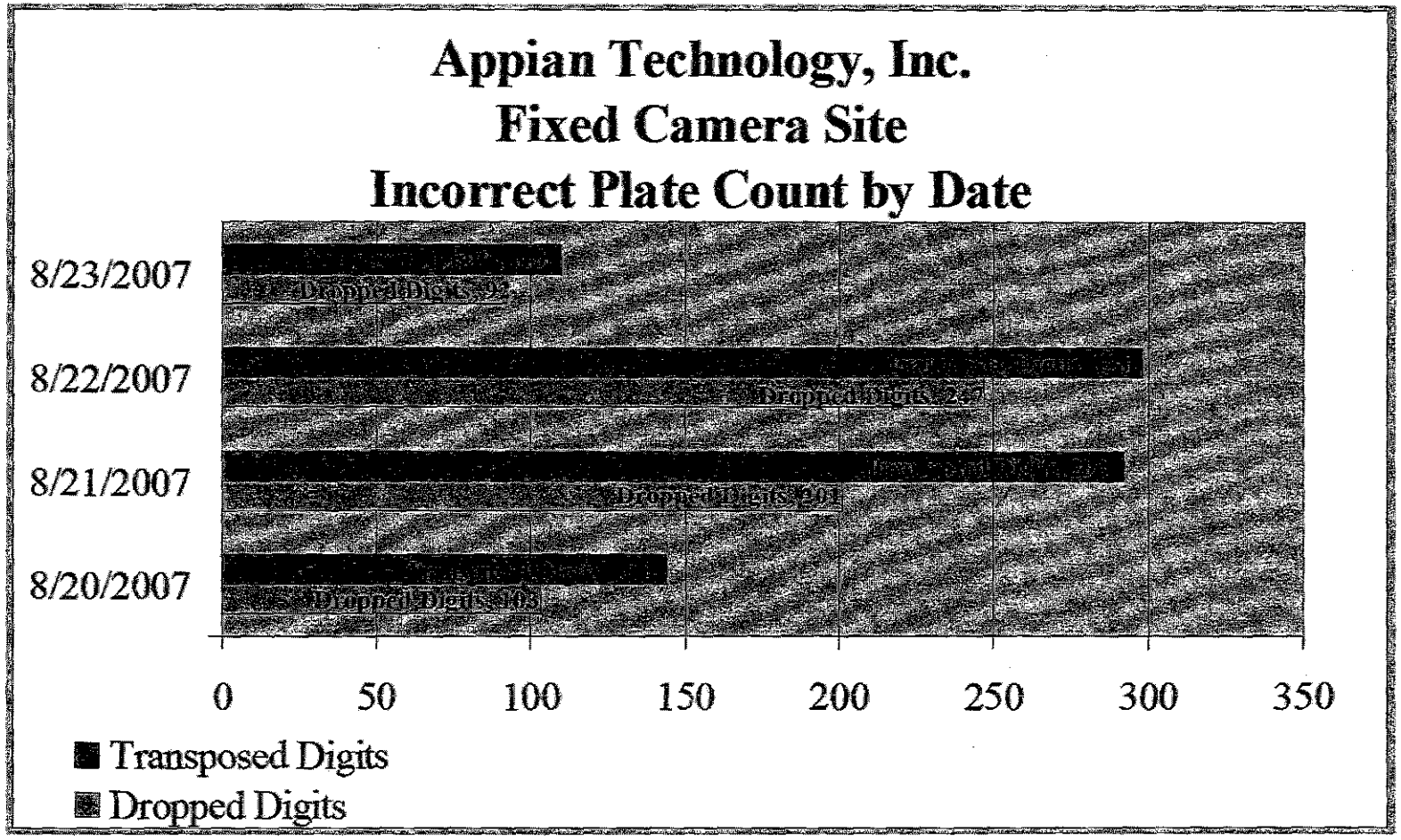


Chart 21: Appian Technology Fixed Camera Site Transposed and Dropped Digits by Date

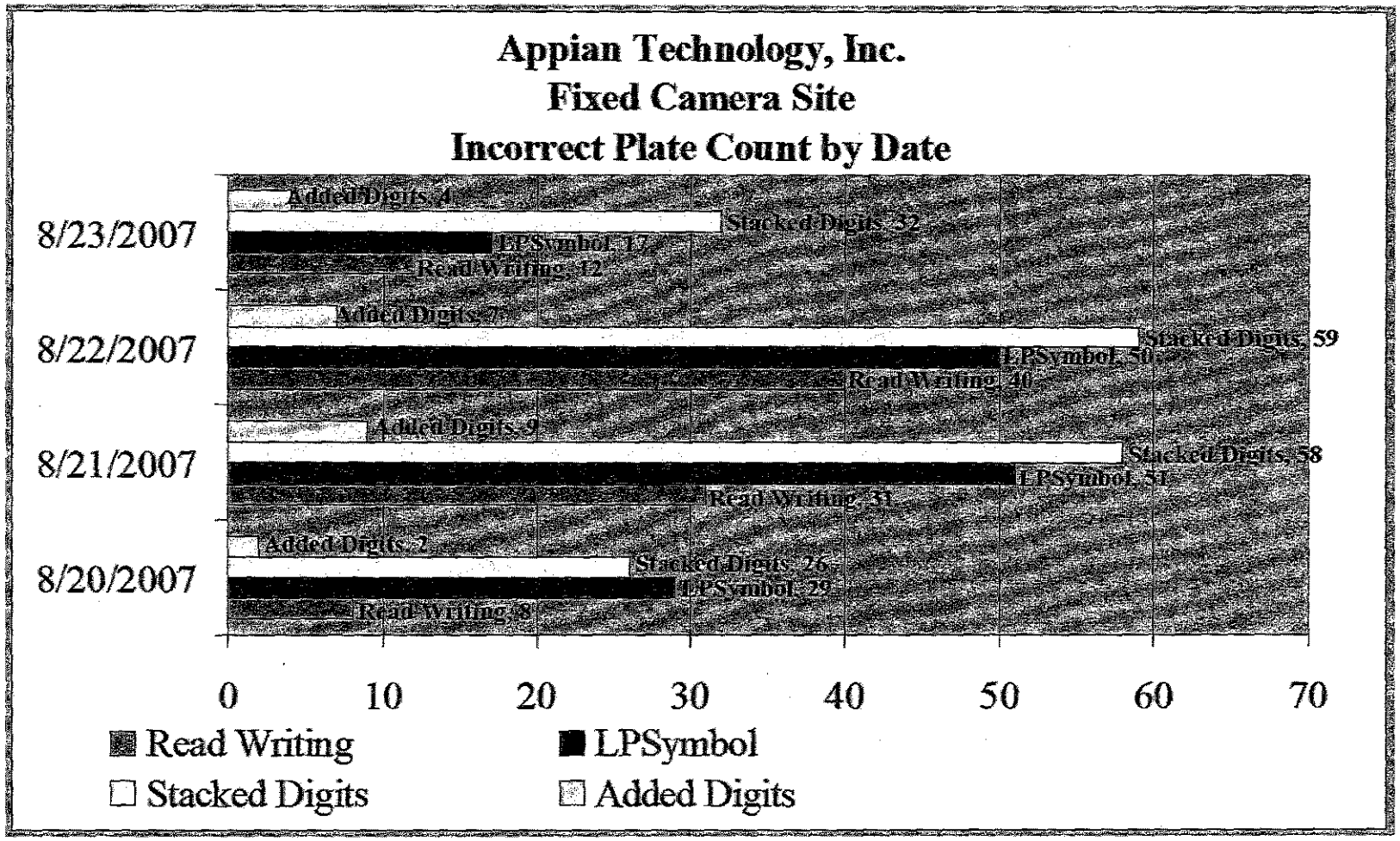


Chart 22: Appian Technology Fixed Camera Site Breakdown of Incorrect Readings by Date

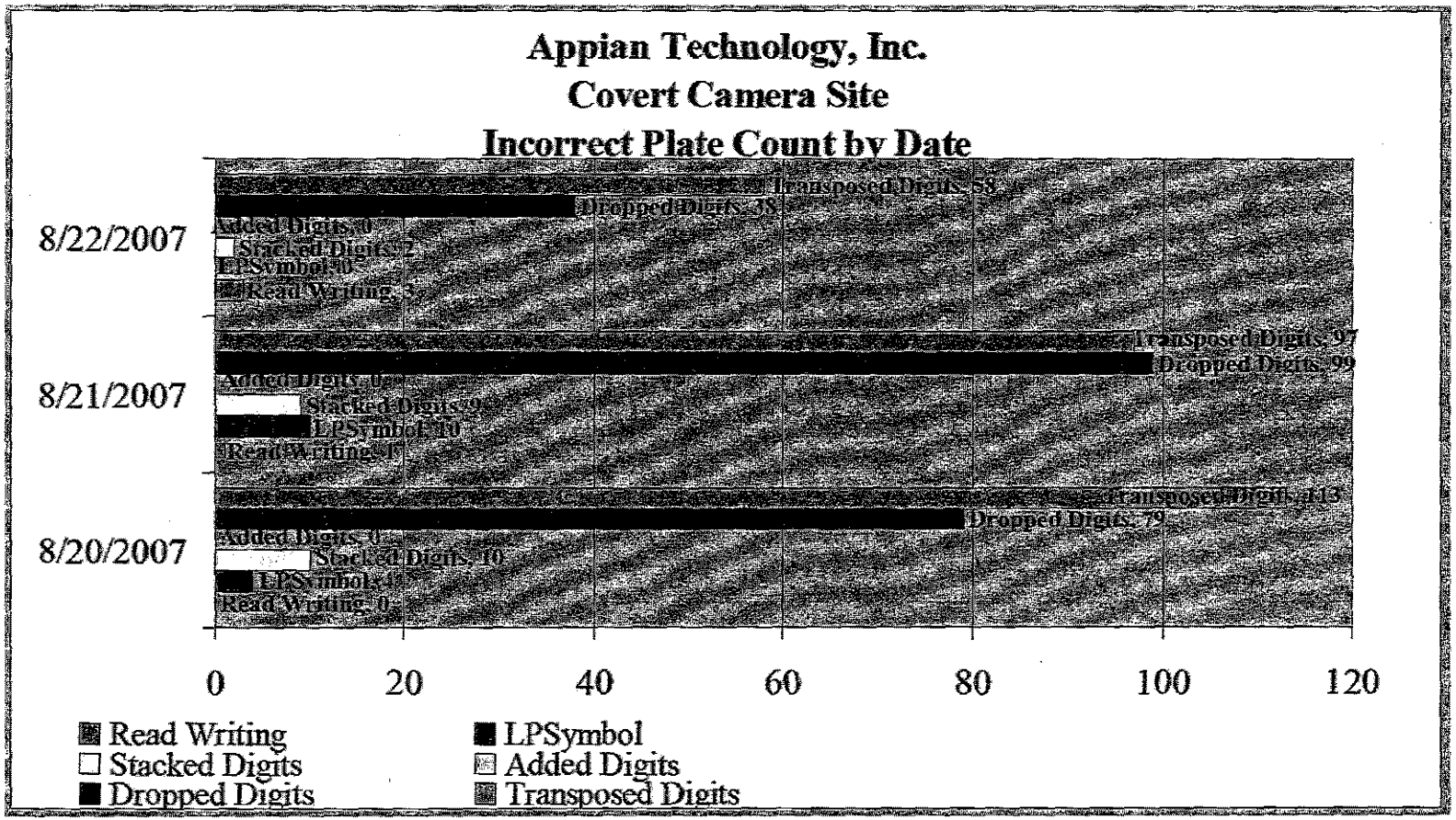


Chart 23: Appian Technology Covert Camera Site Breakdown of Incorrect Readings by Date[7]

[7] Covert data demonstrations were held for 3 days only. Because of the covert camera was on the side of the road and close to heavy traffic, Appian gave visitor demonstrations of their covert system at a safer location. For that reason, there were fewer data results for Day 3.

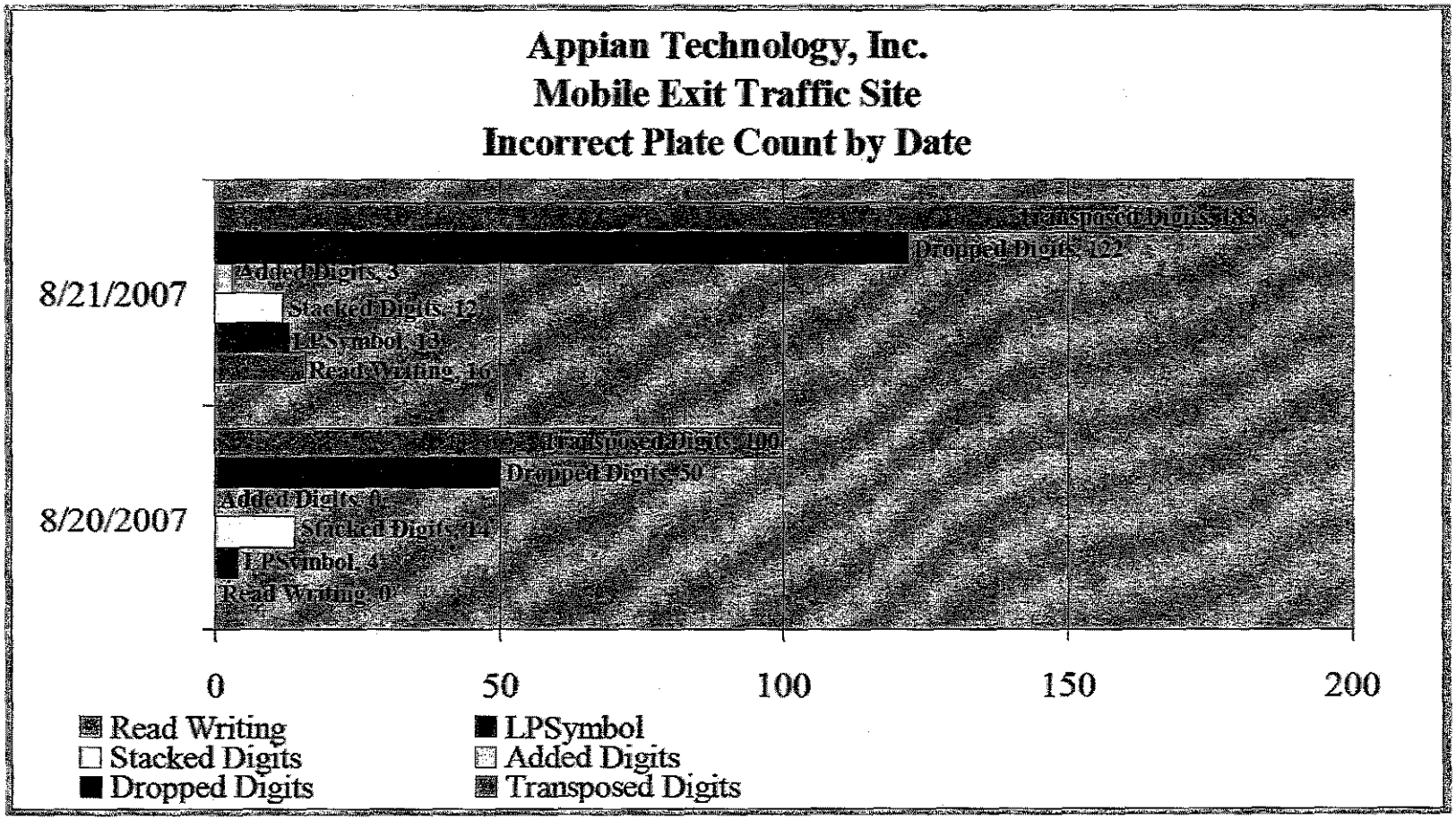


Chart 24: Appian Technology Mobile Exit Traffic Site Breakdown of Incorrect Readings by Date[8]

[8] Appian was missing data for 8/20/2007 and 8/21/2007 due to request from MWAA police to move vehicle.

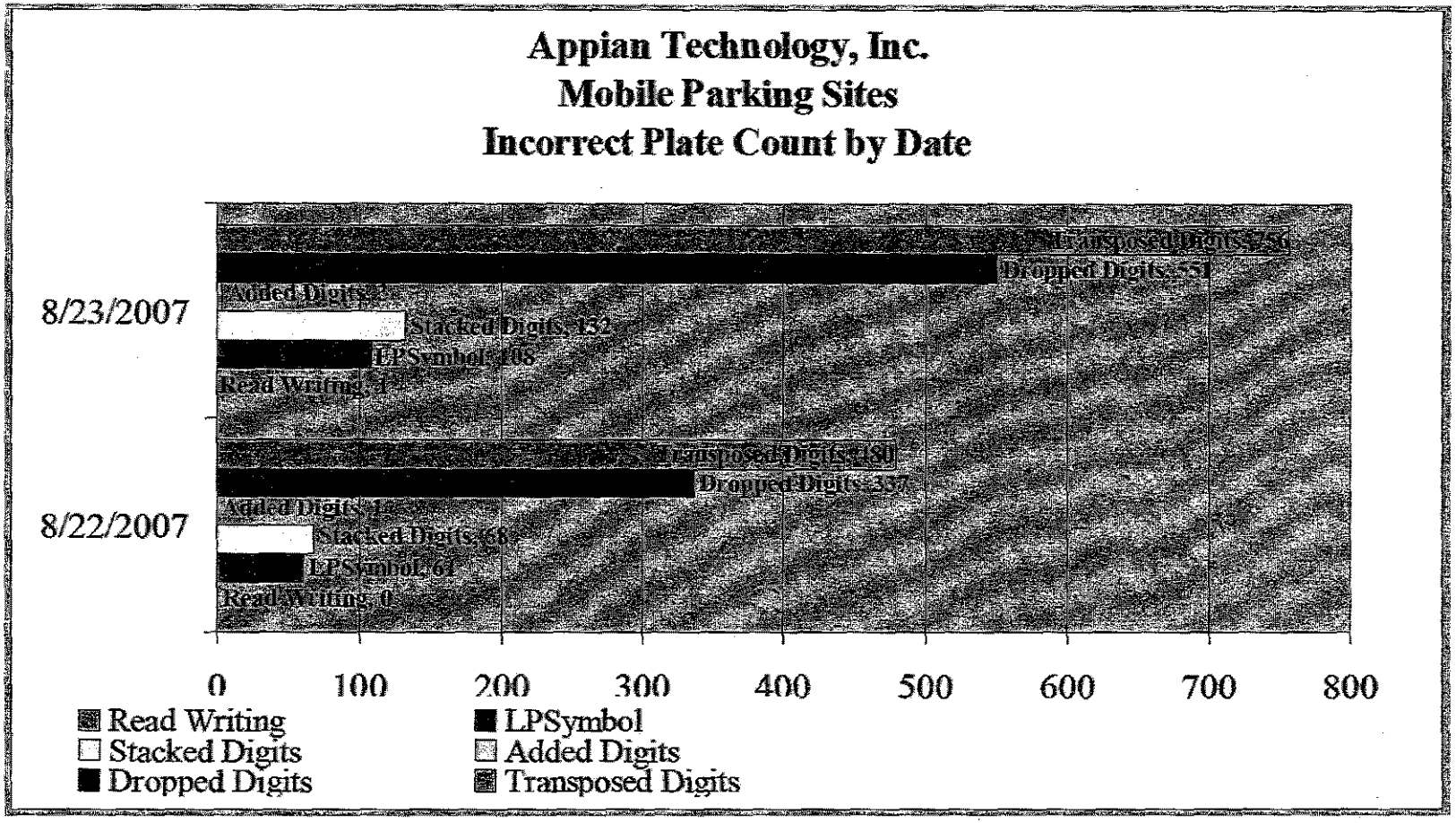


Chart 25: Appian Technology Mobile Parking Sites Breakdowns of Incorrect Readings by Date

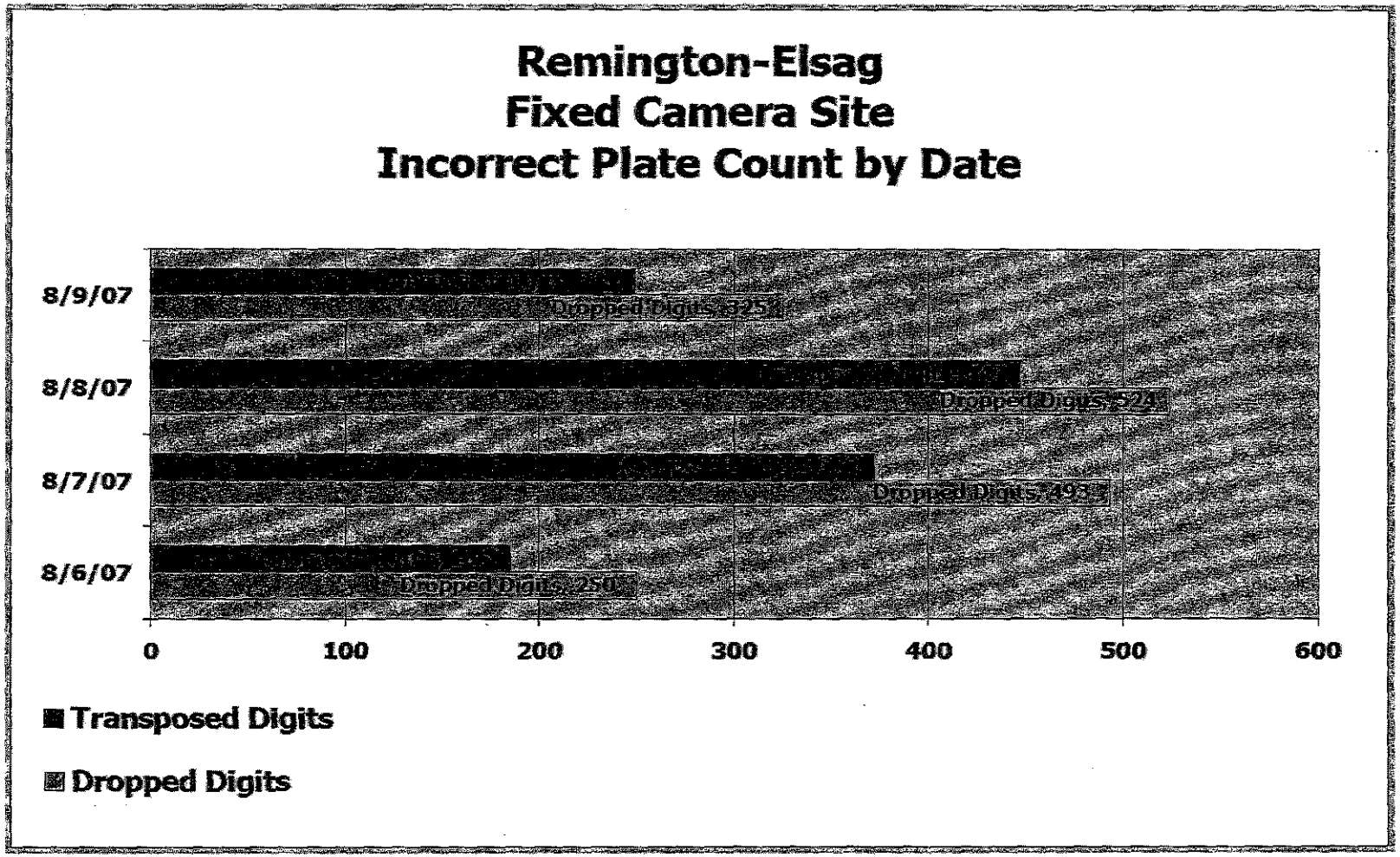


Chart 26: Remington-Elsag Traffic Light – Fixed Camera Site, Breakdown by date of highest amount of errors occurring in Transposed and Dropped Digits.

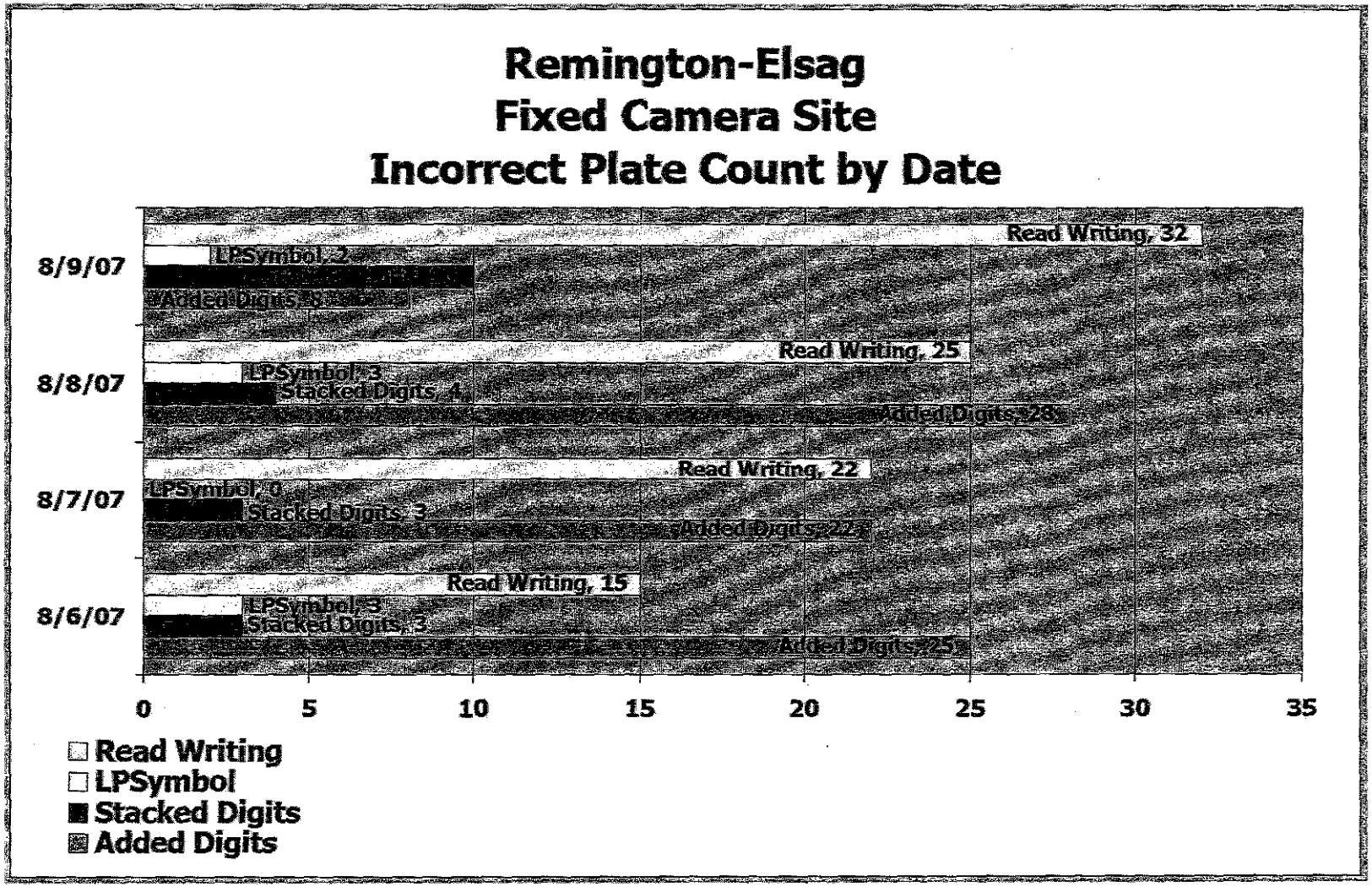


Chart 27: Remington-Elsag Fixed Camera Site, Breakdown of incorrect readings by date.

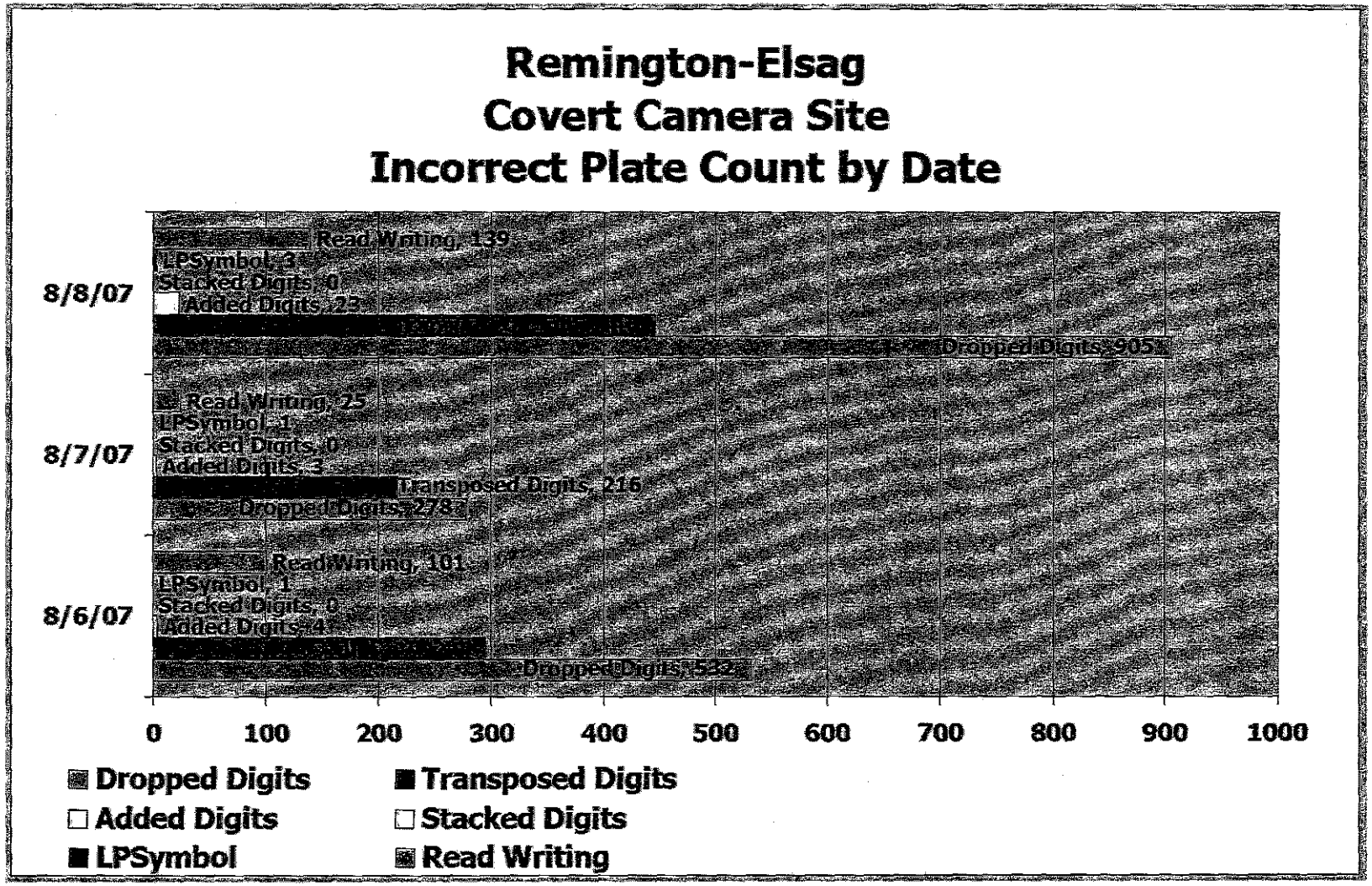


Chart 28: Remington-Elsag Bridge – Covert Camera Site, Breakdown of incorrect readings by date.

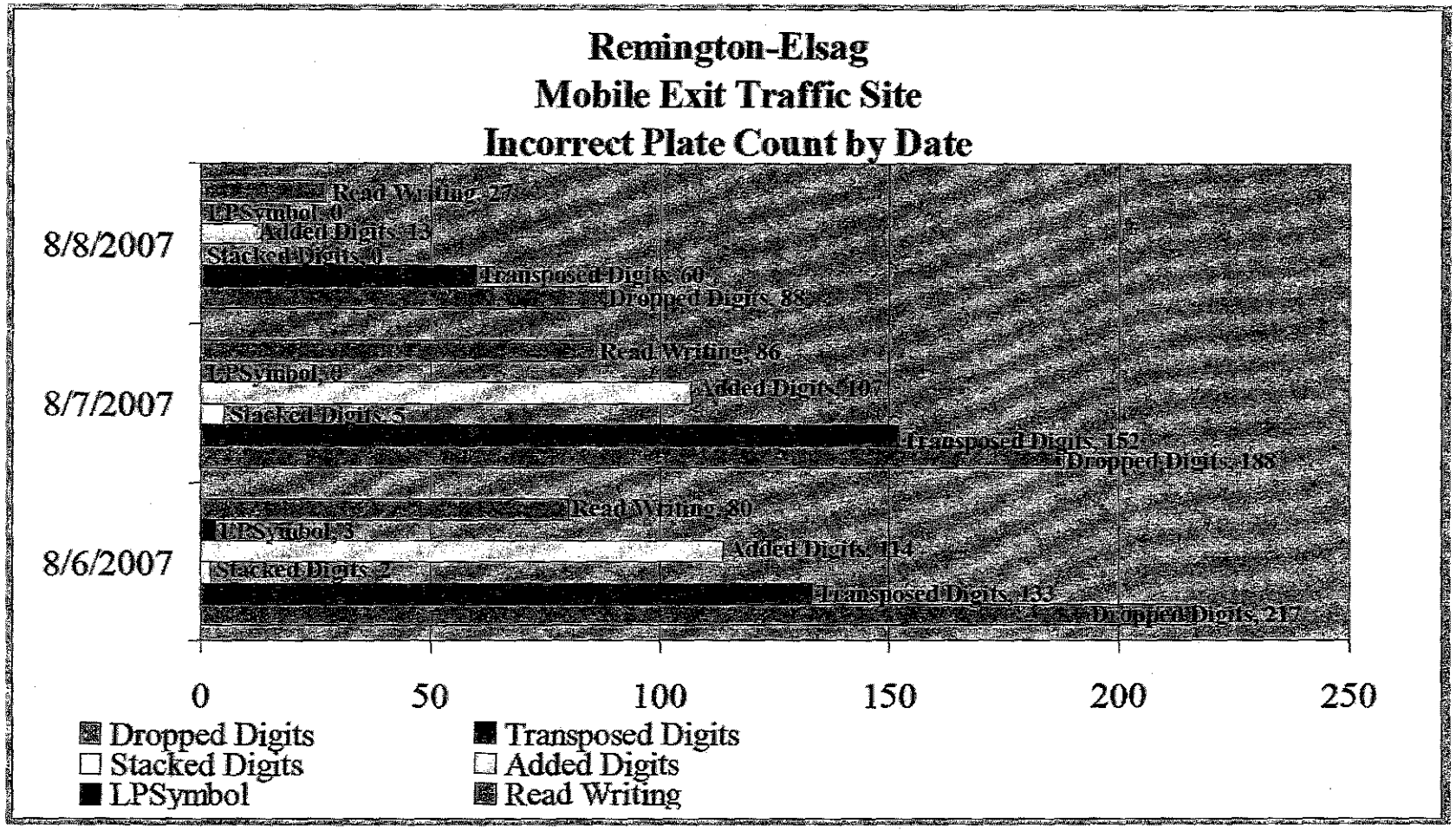


Chart 29: Remington-Elsag Mobile Exit Traffic Site, Breakdown of incorrect readings by date.

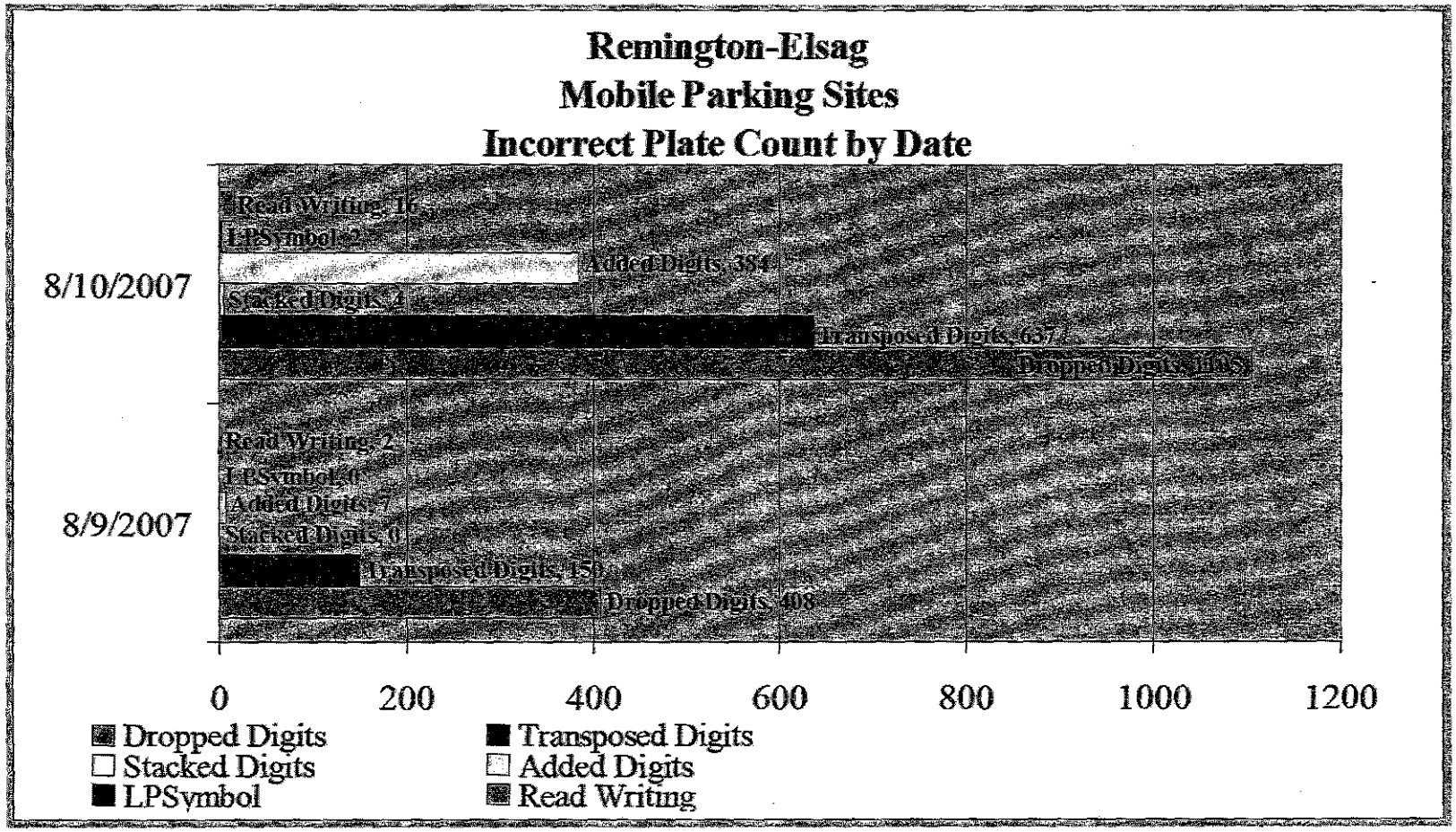


Chart 30: Remington-Elsag Mobile Parking Sites Breakdown of incorrect readings by date.

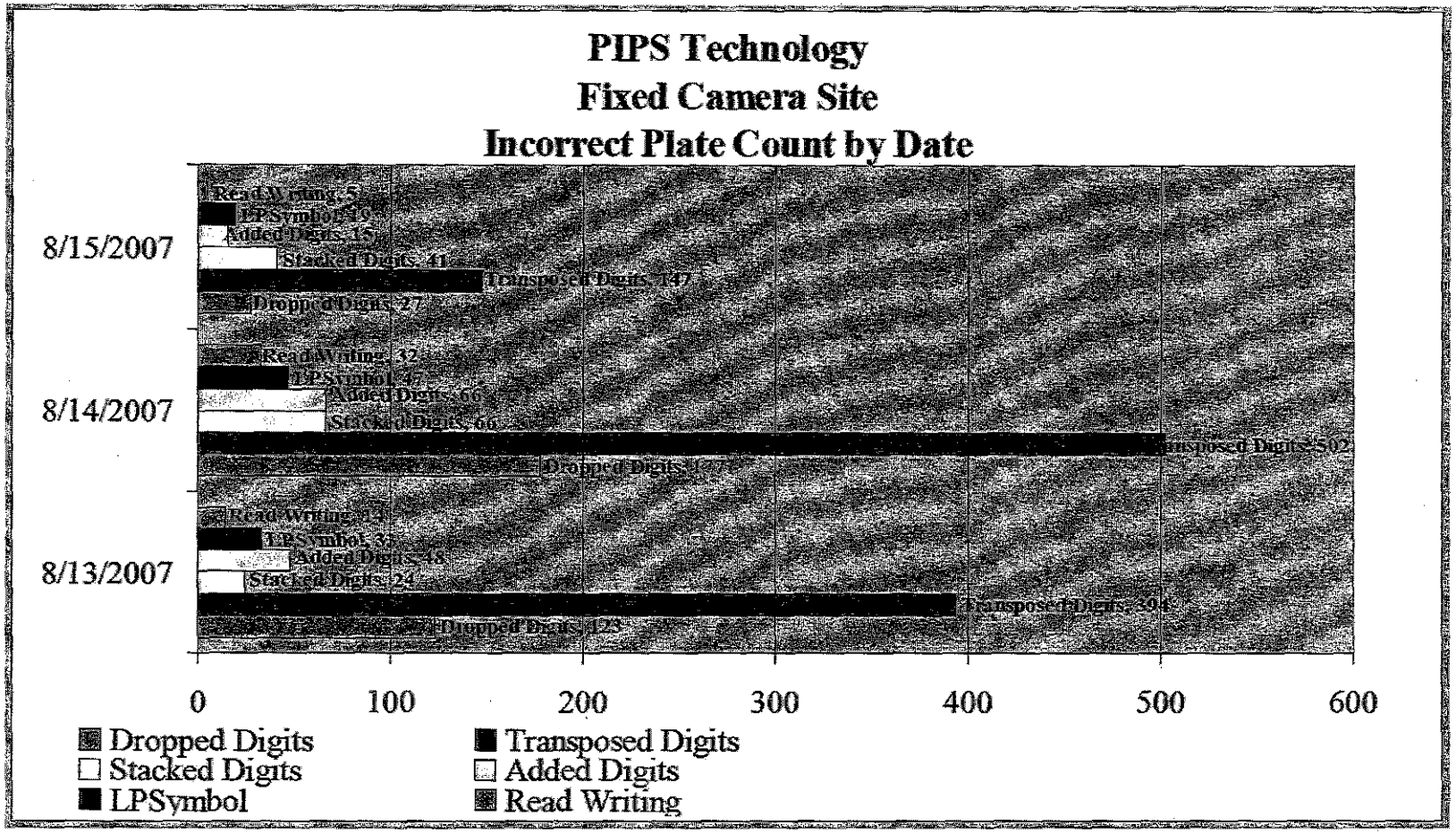


Chart 31: PIPS Technology Fixed Camera Site Transposed and Dropped Digits by Date [9]

[9] PIPS was missing data from Day 1, 8/13/2007.

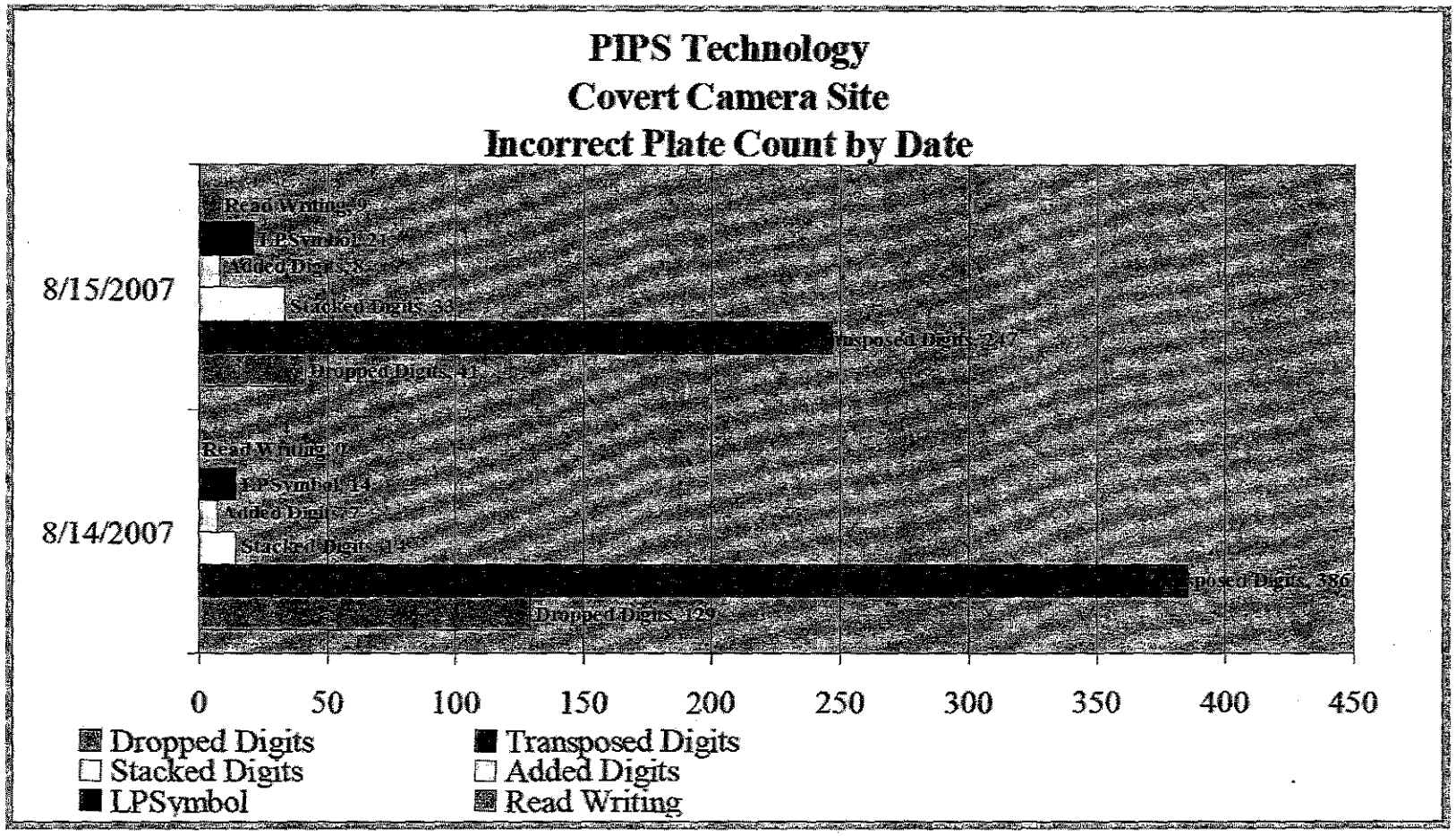


Chart 32: PIPS Technology Covert Camera Site Breakdown of Incorrect Readings by Date [10]

[10] PIPS was missing data for 8/13/2007 from the covert location due to a database crash.

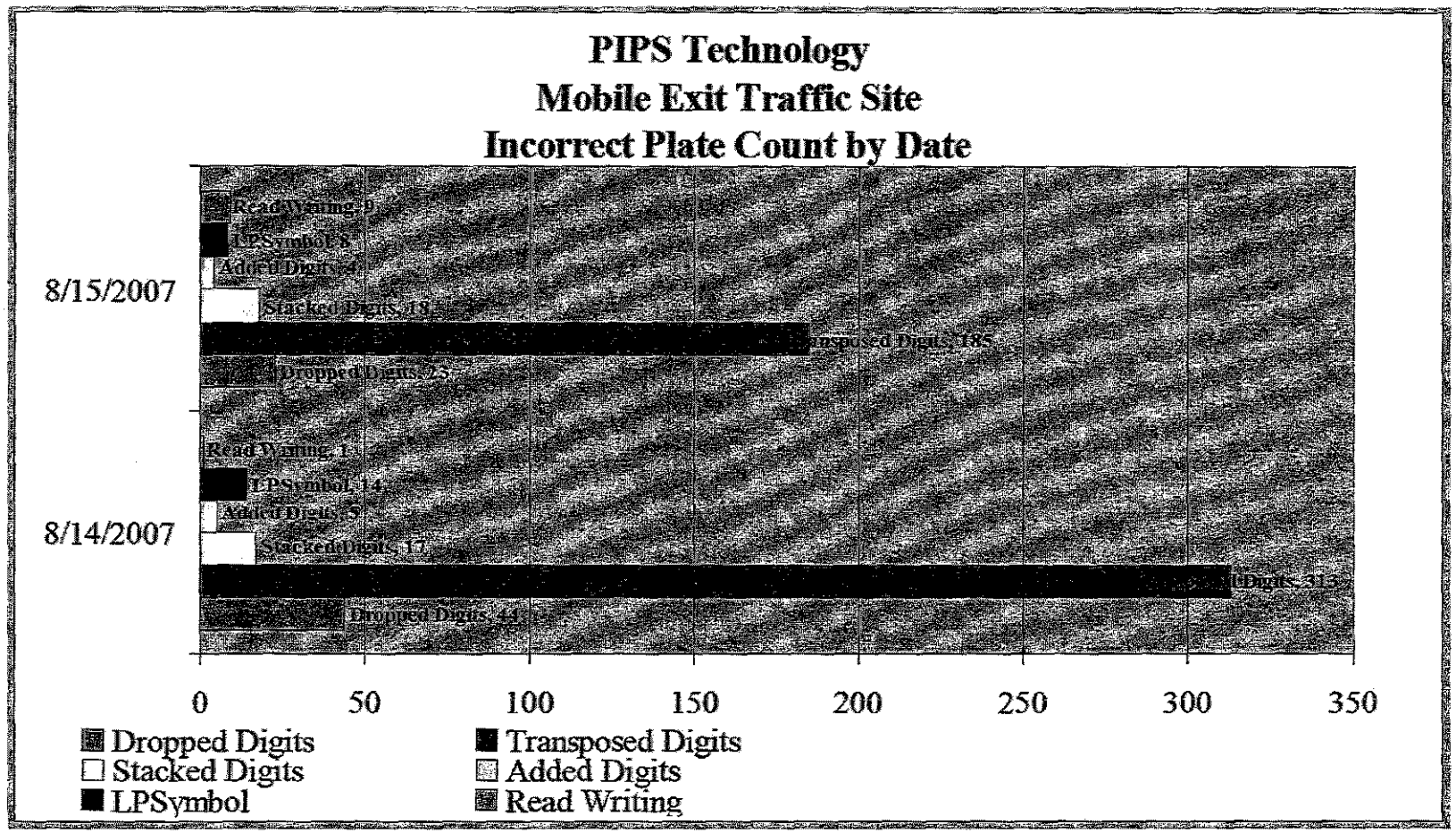


Chart 33: PIPS Technology Mobile Exit Traffic Site Incorrect Readings by Date [11]

[11] PIPS was missing data for 8/13/2007 and 8/15/2007 due to a request from MWAA police to move vehicle.

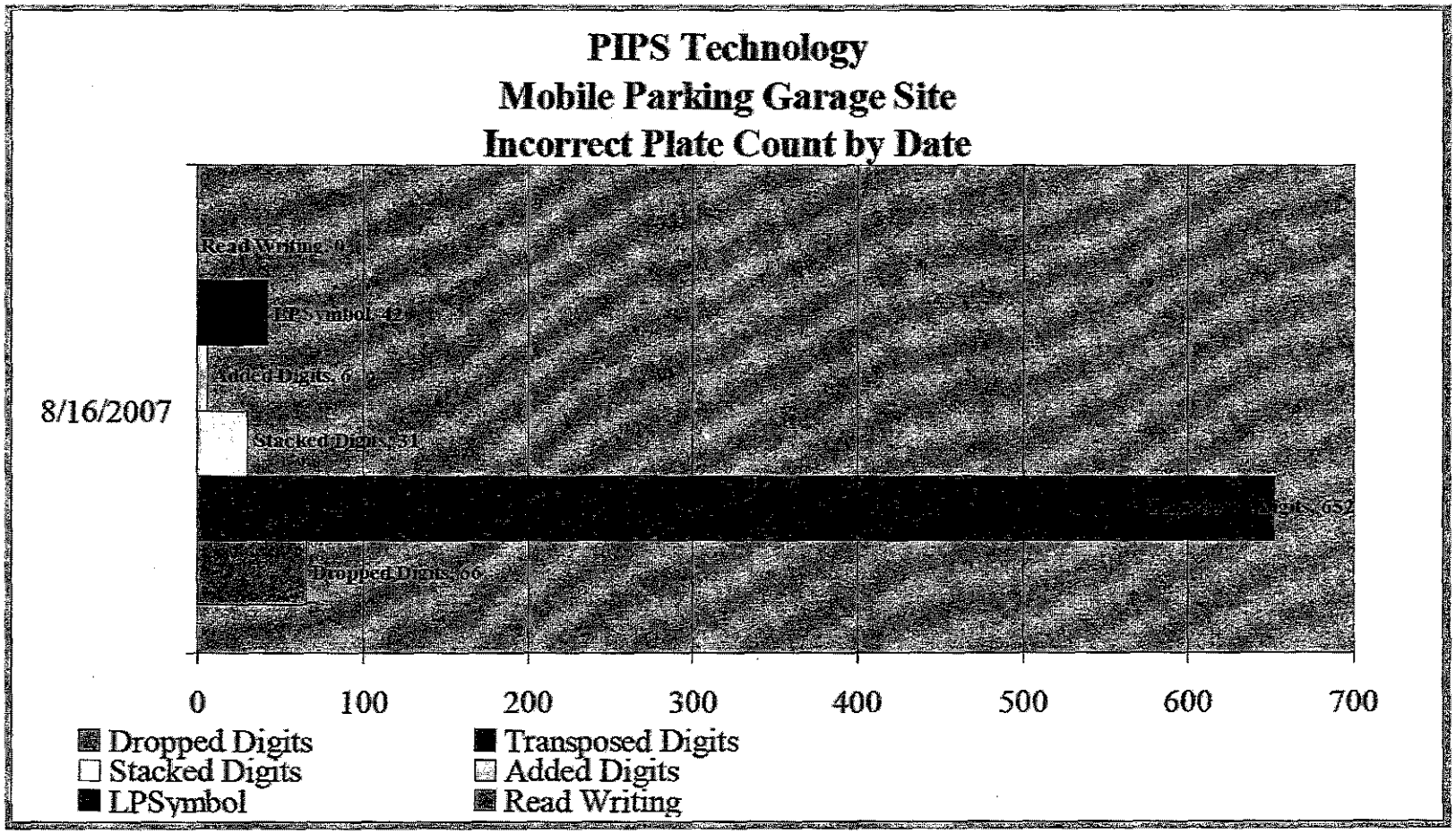


Chart 34: PIPS Technology Mobile Parking Site Incorrect Readings by Date[12]

[12] PIPS was missing data for long-term parking. Reasons unknown.

7.2 Incorrect Read Samples - Dropped Digits

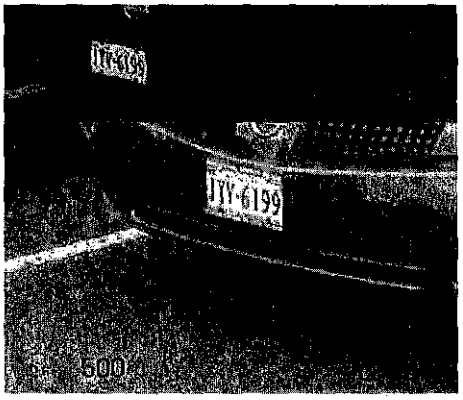
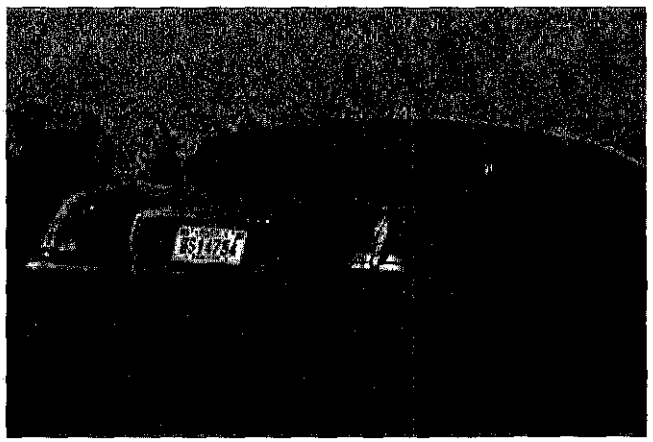
Example: **Appian** **As Read: JT6199** (dropped digit 'V', read 'Y' as 'T') **Actual Image: JYV6199** Date: 08/23/07 Time: 12:05:22 Camera: Mobile Parking Site	
Example: **Remington** **As Read: H54754** (Dropped digit '1') **Actual Image: H514754** Date: 08/7/07 Time: 9:28:42 AM Camera: Bridge – Covert Site	
Example: **PIPS** **As Read: JXP249** (Dropped digit '1') **Actual Image: JPX1429** Date: 08/14/07 Time: 10:26:22 AM Camera: Bridge – Covert Site	 

Figure 37: Incorrect Read Samples – Dropped Digits

7.3 Incorrect Read Samples - Transposed Digits

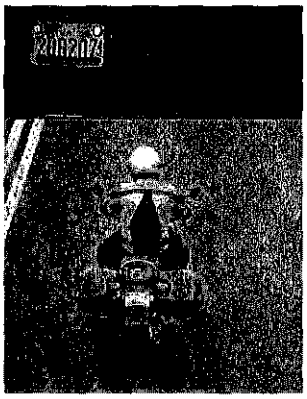
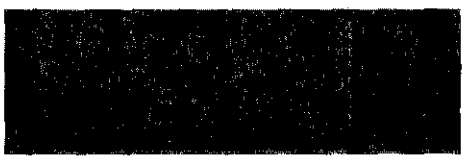
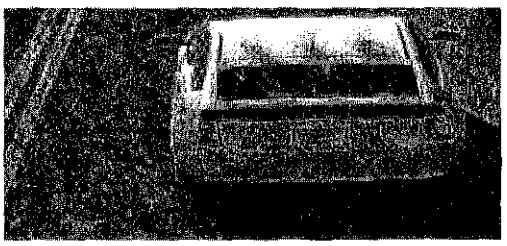
Example: **Appian** **As Read: 2BB207** (read '8' as a 'B') **Actual Image: 288207** Date: 08/21/07 Time: 16:21:22 Camera: Traffic Light – Fixed Camera	
Example: **Remington** **As Read: 375488** (read 'B' as '8') **Actual Image: 37548B** Date: 08/7/07 Time: 2:02:26 PM Camera: Mobile Exit Site	 
Example: **PIPS** **As Read: 3367CE** (read '3' as '2' and 'E' as 'F') **Actual Image: 2367CF** Date: 08/14/07 Time: 8:17:33 AM Camera: Traffic Light Site	 

Figure 38: Incorrect Read Samples – Transposed Digits

7.4 Incorrect Read Samples - Stacked Characters Read as Single Characters

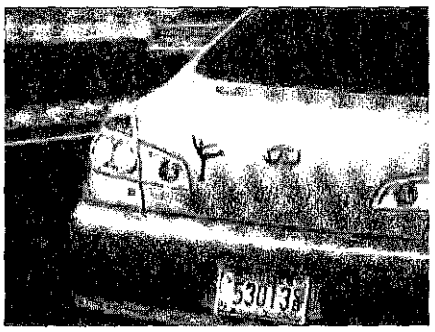
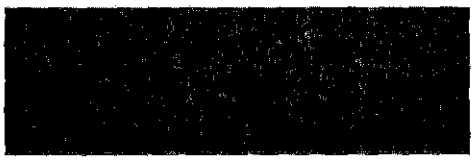
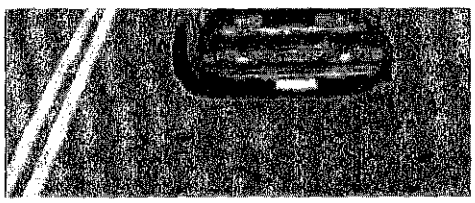
Example: **Appian** **Plate As Read: 770232** **(read StackedHD as '7')** **Actual Image:** **StackedHD 70232** Date: 08/23/07 Time: 12:57:10 PM Camera: Traffic Light	
Example: **Remington** **Plate As Read: 530131** **(StackedCB as '1')** **Actual Image: 53013** **StackedCB** Date: 8/7/07 Time: 3:14:34 PM Camera: Traffic Light	 
Example: **PIPS** **Plate As Read: 234303Y** **(read Icon as 23 and** **StackedFT as 'Y')** **Actual Image:** **Icon(Pentagon) 4303** **StackedFT** Date: 8/13/07 Time: 4:42:17 PM Camera: Traffic Light	 

Figure 39: Incorrect Read Samples – Stacked Digits

7.5 Incorrect Read Samples – License Plate Symbols (LPSymbols) Mistaken as Characters

Example: **Appian** **Plate As Read: T8BR3H** (read '&' as a '8') **Actual Image: T&BR3H** Date: 08/23/07 Time: 11:55:15 PM Camera: Mobile Parking	
Example: **Remington** **Plate As Read: PWX1092** (read image bird/tree as 'P') **Actual Image: WX1092** Date: 8/6/2007 Time: 7:20:07 PM Camera: Traffic Light – Fixed Site	
Example: **PIPS** **Plate As Read: 4140815** (read Disability icon as a '4' and 'I' as a '1') **Actual Image: Icon of wheelchair 140815** Date: 08/15/07 Time: 10:21:05 AM Camera: Mobile Exit Site	

Figure 40: Incorrect Read Samples – LPSymbols

7.6 Incorrect Read Samples - Added Characters

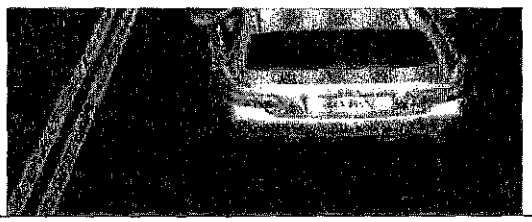
Example: **Appian** **Plate As Read: JAFENTW** (Added digit 'W') **Actual Image: JAFENT** Date: 08/20/07 Time: 3:52:13 PM Camera: Traffic Light	
Example: **Remington** **Plate As Read: 14KH176** (Added digit '1') **Actual Image: 4KH176** Date: 8/6/2007 Time: 5:59:13 PM Camera: Traffic Light – Fixed Site	
Example: **PIPS** **Plate As Read: 8KFJ286** (Added digit '8', dropped a '5') **Actual Image: KFJ2865** Date: 08/14/07 Time: 7:43:30 PM Camera: Traffic Light – Fixed Site	 

Figure 41: Incorrect Read Samples – Added Characters

7.7 Incorrect Read Charts - Dropped Digits

Table 12: All Vendors - Dropped Digits 0-9 & A-Z

Appian Technology, Inc. All Sites	
Dropped Digit	Count
0	33
1	595
2	45
3	34
4	77
5	72
6	43
7	49
8	37
9	34
A	47
B	6
C	7
D	28
E	17
F	10
G	10
H	209
I	82
J	113
K	60
L	61
M	53
N	36
O	2
P	21
Q	0
R	11
S	14
T	14
U	17
V	6
W	24
X	4
Y	52
Z	9
unk	88

Remington-Elsag All Sites	
Dropped Digit	Count
0	358
1	637
2	337
3	343
4	265
5	345
6	278
7	281
8	266
9	190
A	207
B	137
C	120
D	180
E	178
F	99
G	87
H	204
I	27
J	211
K	157
L	246
M	287
N	134
O	7
P	58
Q	6
R	98
S	103
T	67
U	84
V	74
W	118
X	74
Y	126
Z	140
unk	86

PIPS Technology All Sites	
Dropped Digit	Count
0	30
1	187
2	16
3	21
4	17
5	17
6	16
7	10
8	19
9	15
A	14
B	12
C	15
D	13
E	14
F	8
G	18
H	21
I	6
J	43
K	51
L	11
M	28
N	8
O	0
P	10
Q	1
R	3
S	12
T	9
U	5
V	6
W	20
X	11
Y	15
Z	11
unk	35

7.8 Incorrect Read Charts - Transposed Digits

Table 13: Appian Technology - Transposed Digits - Alpha Characters

Appian Technology, Inc.
All Sites
Transposed Digits – Alpha Characters

Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS
A/4	6	D/unk	1	H/R	2	K/W	2	Q/P	1	T/H	4	V/K	1
A/4	16	D/Y	3	H/W	12	R/X	1	P/M	1	T/I	72	W/1	2
E/6	2	E/0	1	M/N	87	L/J	5	P/R	3	T/J	4	W/M	4
A/7	2	E/5	1	J/3	2	L/2	1	P/U	1	T/K	1	W/N	5
A/8	1	E/7	1	T/A	2	L/7	1	Q/0	7	T/S	3	W/R	1
A/J	2	E/9	1	J/D	2	L/B	1	Q/3	1	T/N	3	W/V	1
A/M	2	E/B	1	T/E	1	L/C	1	Q/7	1	T/U	2	W/V	1
A/X	1	E/C	1	J/H	7	L/D	3	Q/8	1	T/V	2	X/K	1
B/0	3	E/F	8	T/J	7	L/E	5	Q/9	6	T/W	1	X/M	1
B/6	2	E/H	6	J/T	10	L/E	1	Q/A	2	T/Y	8	X/N	1
B/8	56	E/J	1	T/J	4	L/F	2	Q/B	1	U/1	2	X/V	1
B/9	2	E/K	2	J/6	1	L/I	1	Q/D	3	U/0	9	X/Z	1
B/E	4	E/L	1	J/V	1	L/J	3	Q/J	2	U/2	1	Y/7	1
B/F	7	E/M	1	M/X	2	L/K	1	Q/O	1	U/3	2	Y/9	1
B/G	1	E/P	1	L/V	23	L/M	3	Q/P	1	U/5	2	Y/R	1
B/H	121	E/S	1	H/D	1	L/N	1	Q/U	1	U/6	1	Y/T	1
B/J	1	E/U	1	H/U	1	L/P	1	Q/Z	2	U/7	1	Y/J	1
B/R	4	F/5	1	M/8	2	L/R	9	R/3	1	U/8	1	Y/V	38
B/S	2	F/C	2	T/M	5	L/unk	1	R/5	2	U/D	4	Y/X	4
B/V	1	F/G	9	M/1	16	M/4	1	R/6	1	U/E	1	Z/1	4
C/0	4	F/H	2	J/2	1	M/4	1	R/8	5	U/F	1	Z/2	69
C/5	1	F/I	1	T/3	8	M/6	1	R/B	3	U/G	1	Z/6	19
C/6	1	F/R	2	J/4	5	M/E	1	R/G	1	U/H	4	Z/6	2
C/F	7	F/V	1	H/A	1	M/H	1	R/E	1	U/I	1	Z/7	62
C/G	6	F/W	1	J/E	1	M/K	2	R/H	3	U/J	8	Z/M	1
C/K	1	F/Y	1	J/F	1	M/N	9	R/K	1	U/K	1		
C/L	3	G/0	1	J/R	1	M/V	1	R/P	1	U/L	2		
C/T	1	G/3	1	J/I	3	M/W	5	R/S	1	U/M	23		
C/Z	2	G/5	4	J/K	1	M/Y	1	S/5	42	U/Q	1		
D/0	16	G/6	84	J/L	1	N/M	16	S/8	1	U/R	1		
D/1	1	G/8	1	J/M	9	N/O	6	S/9	15	U/T	1		
D/3	1	G/B	1	J/O	1	N/P	1	S/Z	2	U/V	6		
D/B	5	G/S	1	J/W	1	O/1	2	T/4	1	V/4	1		
D/H	3	H/1	4	J/M	2	O/6	3	T/8	1	V/7	1		
D/K	1	H/5	1	K/1	1	O/8	2	T/A	1	V/9	2		
D/O	2	H/8	2	K/8	1	O/9	2	T/B	1	V/M	28		
D/R	2	H/9	1	K/I	1	O/C	2	T/C	1	V/N	3		
D/Q	1	H/C	3	K/J	1	O/D	5	T/D	1	V/W	46		
D/R	1	H/I	1	K/M	2	O/P	1	T/E	1	V/Y	10		
D/U	6	H/M	176	K/N	7	O/Q	13	T/F	1	V/Z	1		

Table 14: Remington-Elsag - Transposed Digits - Alpha Characters

Remington-Elsag All Sites Transposed Digits - Alpha Characters											
Incorrect / Correct Read	Count	Incorrect / Correct Read	Count	Incorrect / Correct Read	Count	Incorrect / Correct Read	Count	Incorrect / Correct Read	Count	Incorrect / Correct Read	Count
A/1	40	H/1	48	J/I	2	M/W	5	T/Y	4	X/T	1
A/4	13	H/11	2	J/L	2	N/H	1	U/0	1	X/Y	5
A/6	3	H/2	5	J/M	1	N/M	16	U/11	2	X/Z	1
A/8	1	H/3	7	J/N	3	O/0	93	U/3	1	Y/1	121
B/5	2	H/4	5	J/S	1	O/B	1	U/AA	1	Y/7	1
B/6	3	H/5	12	J/U	1	O/C	1	U/A	1	Y/A	1
B/8	141	H/6	1	J/V	2	O/D	122	U/C	1	Y/I	3
B/D	3	H/7	3	J/W	1	O/H	1	U/H	9	Y/K	1
B/E	13	H/8	11	K/0	2	O/N	1	U/J	3	Y/M	1
B/F	1	H/9	3	K/1	135	O/Q	22	U/L	19	Y/T	13
B/H	19	H/A	6	K/4	2	O/U	5	U/L1	1	Y/W	2
B/P	3	H/B	2	K/7	99	P/1	1	U/J	1	Y/X	1
C/U	2	H/I	1	K/A	7	P/2	1	V/1	28	Z/2	20
C/4	1	H/U	1	K/D	1	P/3	1	V/4	3	Z/7	23
C/G	1	H/W	1	K/H	7	P/F	23	V/7	4	Z/W	1
C/H	1	I/0	1	K/L	2	P/H	1	V/D	1		
C/I	1	I/1	242	K/M	10	P/N	1	V/L	1		
C/L	6	I/2	1	K/N	1	P/W	1	V/M	2		
D/0	62	I/3	1	K/V	1	Q/0	10	V/W	29		
D/5	2	I/D	4	K/W	1	Q/6	1	V/Y	7		
D/8	1	I/H	1	K/X	1	Q/9	1	W/8	1		
D/B	1	I/J	2	L/1	6	R/A	1	W/G	2		
D/O	13	I/L	2	L/B	1	R/F	1	W/H	6		
E/B	1	I/T	10	L/D	4	R/P	10	W/M	323		
E/F	2	I/U	1	L/E	1	S/1	1	W/N	2		
F/0	1	J/1	47	L/H	13	S/5	253	W/V	2		
F/1	1	J/3	2	L/I	2	S/6	1	X/1	171		
F/R	1	J/4	1	L/N	2	S/8	1	X/8	1		
F/T	1	J/5	1	L/U	1	T/1	91	X/11	1		
G/6	85	J/A	4	M/G	1	T/7	5	X/3	4		
G/8	1	J/D	3	M/H	30	T/D	1	X/A	2		
G/C	5	J/E	2	M/L	1	T/I	6	X/I	3		
G/E	1	J/H	1	M/O	1	T/L	1	X/K	1		

Table 15: PIPS Technology – Transposed Digits - Alpha Characters

PIPS Technology
All Sites
Transposed Digits - Alpha Characters

Incorrect / Correct	All Sites Count	Incorrect / Correct	All Sites Count	Incorrect / Correct	All Sites Count	Incorrect / Correct	All Sites Count	Incorrect / Correct	All Sites Count	Incorrect / Correct	All Sites Count	Incorrect / Correct	All Sites Count	Incorrect / Correct	All Sites Count
A/1	8	C/I	2	G/S	1	J/C	1	M/H	163	R/0	1	U/1	2	X/E	1
A/2	1	C/X	3	G/W	1	J/7	1	M/K	3	R/1	2	U/8	2	X/F	3
A/3	1	C/Z	1	H/I	1	J/9	1	M/L	1	R/5	1	U/D	8	X/H	1
A/4	35	D/0	19	H/8	1	J/0	2	M/N	23	R/6	1	U/H	15	X/I	3
A/6	10	D/5	1	H/B	1	J/B	1	M/0	1	R/7	2	U/J	1	X/K	16
A/8	7	D/6	1	H/R	1	J/C	1	M/X	3	R/8	5	U/L	1	X/M	3
A/9	1	D/E	13	H/D	2	J/D	4	M/W	14	R/A	1	U/M	10	X/S	1
A/B	2	D/K	1	H/M	14	J/F	1	M/K	1	R/B	9	U/O	3	X/Y	5
A/D	2	D/O	5	H/X	1	J/G	2	N/S	1	R/D	1	U/R	1	X/Z	17
A/F	2	D/Q	7	H/W	10	J/H	2	N/H	1	R/E	1	V/7	2	Y/3	2
A/H	7	D/R	3	I/0	1	J/I	10	N/J	1	R/F	4	V/B	1	Y/4	1
A/N	3	D/U	2	I/1	161	J/K	1	N/P	1	R/H	46	V/J	1	Y/5	1
A/K	36	D/V	1	I/2	2	J/M	2	N/M	19	R/K	16	V/M	1	Y/6	2
A/J	8	E/0	1	I/3	2	J/S	3	N/R	2	R/N	5	V/N	2	Y/7	8
A/L	1	E/6	1	I/4	2	J/T	8	N/W	8	R/P	1	V/W	5	Y/9	1
A/M	7	E/7	1	I/7	1	J/U	2	N/Y	1	R/Q	1	V/Y	5	Y/C	1
A/N	1	E/A	5	I/9	1	J/W	2	O/0	500	R/T	1	W/0	1	Y/F	4
A/R	2	E/F	11	I/A	3	J/Y	2	O/1	2	R/V	1	W/1	11	Y/I	49
A/U	1	E/J	2	I/C	1	J/Z	2	O/6	1	R/W	3	W/S	1	Y/K	8
A/X	4	E/K	230	I/D	2	K/0	1	O/8	3	S/3	1	W/6	2	Y/M	1
A/Y	2	E/P	1	I/E	1	K/2	1	O/D	12	S/5	94	W/7	1	Y/N	1
A/Z	1	E/T	1	I/G	1	K/6	1	O/F	2	S/6	1	W/9	2	Y/P	1
B/0	6	E/X	1	I/F	5	K/B	1	O/G	1	S/8	1	W/A	1	Y/T	11
B/8	75	E/Z	3	I/G	1	K/C	1	O/H	1	S/9	4	W/B	4	Y/V	28
B/9	2	F/0	1	I/H	3	K/E	4	O/J	1	S/G	1	W/D	1	Y/X	22
B/D	9	F/7	1	I/J	15	K/H	7	O/K	1	S/M	1	W/E	1	Y/Z	1
B/E	7	F/9	1	I/L	22	K/L	2	O/Q	22	T/1	20	W/H	40	Z/1	1
B/F	1	F/A	5	I/M	1	K/M	9	O/U	76	T/6	1	W/I	5	Z/2	66
B/H	138	F/K	1	I/O	1	K/N	1	P/1	3	T/7	10	W/J	2	Z/4	1
B/K	2	F/R	1	I/P	1	K/R	25	P/3	1	T/8	4	W/K	6	Z/6	2
B/M	2	F/U	3	I/S	1	K/S	1	P/Z	1	T/B	1	W/L	1	Z/7	24
B/N	6	F/Y	1	I/T	9	K/Z	2	P/6	2	T/F	6	W/M	74	Z/G	1
B/P	2	G/0	1	I/U	2	L/A	1	P/C	1	T/H	2	W/N	67	Z/L	1
B/R	3	G/4	2	I/W	2	L/C	1	P/E	15	T/I	7	W/R	2	Z/T	1
B/T	2	G/6	61	I/X	3	L/D	4	P/H	0	T/J	11	W/U	1		
B/U	2	G/8	6	I/Y	10	L/J	1	P/J	1	T/K	1	W/V	5		
B/W	5	G/B	1	I/Z	23	L/K	3	P/R	1	T/L	2	W/X	4		
B/Y	1	G/C	1	J/H	5	L/N	1	P/T	1	T/M	1	W/Y	1		
C/0	2	G/D	1	J/O	1	L/U	1	P/U	1	T/P	1	W/Z	1		
C/8	2	G/C	4	J/0	1	M/4	1	P/W	1	T/S	1	X/1	2		
C/D	1	G/E	1	J/1	26	M/6	1	P/X	1	T/V	25	X/6	1		
C/E	19	G/I	1	J/2	10	M/7	1	P/Y	3	T/X	4	X/7	4		
C/G	8	G/K	6	J/3	89	M/8	1	P/Z	1	T/Y	45	X/8	1		
C/K	3	G/N	1	J/4	10	M/A	2	Q/0	3	T/Z	3	X/B	2		
C/L	1	G/R	1	J/5	1	M/B	1	Q/D	1	U/0	11	X/D	2		

Table 16: Appian Technology - Transposed Digits - Numeric Characters

Appian Technology, Inc.
All Sites
Transposed Digits - Numeric Characters

Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS	Incorrect / Correct Read	ALL SITE TOTALS
0/I	4	1/W	2	5/N	2	8/E	3
0/Z	2	1/Z	2	5/S	138	9/0	6
0/3	6	1/Y	9	5/W	1	9/3	3
0/5	1	1/M	1	6/2	1	9/4	3
0/6	3	1/H	1	6/4	2	9/5	1
0/7	1	2/3	6	6/5	3	9/7	1
0/8	13	2/4	3	6/C	1	9/8	1
0/9	14	2/5	1	6/F	3	9/S	3
0/A	1	2/9	4	6/G	8		
0/B	5	2/9	6	6/P	1		
0/C	67	2/E	1	6/S	1		
0/D	124	2/H	1	7/0	3		
0/E	4	2/R	1	7/2	9		
0/G	1	2/Z	14	7/5	1		
0/H	2	3/4	11	7/6	1		
0/L	2	3/4	1	7/9	3		
0/O	23	3/5	3	7/B	1		
0/Q	23	3/6	3	7/E	1		
0/R	2	3/7	4	7/0	1		
0/U	9	3/B	1	7/2	50		
0/W	2	3/D	2	7/3	27		
1/0	1	3/O	5	7/3	2		
1/2	1	3/S	1	8/0	1		
1/3	2	3/Y	1	8/1	1		
1/4	3	3/Z	1	8/2	1		
1/6	1	4/2	1	8/3	9		
1/7	3	4/6	1	8/5	3		
1/A	4	4/8	1	8/6	14		
1/B	1	4/B	1	8/8	1		
1/D	6	4/A	3	8/&	6		
1/E	2	4/L	1	8/A	1		
1/H	11	4/M	2	8/B	353		
1/I	87	4/Y	1	8/BL	1		
1/M	10	5/0	1	8/F	2		
1/K	2	5/1	2	8/G	1		
1/L	13	5/3	2	8/H	55		
1/M	1	5/6	7	8/P	3		
1/P	2	5/8	1	8/Q	2		
1/R	16	5/9	2	8/S	4		
1/U	3	5/B	1	9/9	13		

Table 17: Remington-Elsag - Transposed Digits - Numeric Characters

Remington-Elsag All Sites Transposed Digits - Numeric Characters							
Incorrect / Correct Read	Count	Incorrect / Correct Read	Count	Incorrect / Correct Read	Count	Incorrect / Correct Read	Count
'0/1	2	'1/H	59	'4/5	1	'7/Z	2
'0/3	1	'1/I	468	'4/9	1	'8/0	6
'0/5	1	'1/J	19	'4/A	32	'8/1	2
'0/8	2	'1/K	3	'4/L	2	'8/3	1
'0/A	2	'1/L	21	'4/M	10	'8/6	6
'0/B	5	'1/M	6	'4/N	8	'8/9	2
'0/C	12	'1/N	2	'4/Z	1	'8/A	2
'0/D	223	'1/T	32	'5/9	1	'8/B	292
'0/G	1	'1/U	4	'5/S	19	'8/D	1
'0/H	1	'1/V	1	'6/0	1	'8/E	4
'0/Q	23	'1/W	2	'6/5	4	'8/H	141
'0/U	7	'1/X	4	'6/7	1	'8/P	1
'1/0	2	'1/Y	6	'6/8	1	'8/S	2
'1/2	2	'11H	4	'6/9	2	'8/Z	1
'1/3	6	'2/1	5	'6/A	1	'9/0	1
'1/4	5	'2/7	5	'6/E	2	'9/1	1
'1/5	2	'2/M	2	'6/G	27	'9/3	1
'1/6	1	'2/Z	60	'6/H	1	'9/4	1
'1/7	7	'3/0	1	'6/S	2	'9/5	1
'1/8	3	'3/J	8	'7/1	3	'9/8	2
'1/9	1	'3/K	1	'7/2	1	'9/J	1
'1/A	3	'3/V	1	'7/4	1	'9/N	1
'1/B	1	'3/Y	1	'7/7	1	'9/P	1
'1/D	10	'4/1	4	'7/8	1	'9/S	2
'1/E	1	'4/3	1	'7/T	2	'9/T	1

Table 18: PIPS Technology Transposed Digits - Numeric Characters

PIPS Technology
All Sites
Transposed Digits - Numeric Characters

Incorrect / Correct	Count	Incorrect / Correct	Count	Incorrect / Correct	Count	Incorrect / Correct	Count	Incorrect / Correct	Count	Incorrect / Correct	Count	Incorrect / Correct	Count
0/1	87	1/D	1	2/7	22	4/H	1	6/C	1	7/V	1	9/2	5
0/2	2	1/E	1	3/0	2	4/J	1	6/E	8	7/X	4	9/3	33
0/3	6	1/F	1	3/1	8	4/K	4	6/F	2	7/Y	8	9/4	15
0/4	7	1/H	1	3/2	64	4/L	26	6/G	43	7/Z	3	9/5	7
0/5	2	1/I	37	3/4	13	4/M	2	6/H	1	8/0	25	9/6	1
0/6	10	1/J	36	3/5	4	4/P	1	6/K	14	8/1	5	9/7	11
0/7	1	1/K	2	3/6	2	4/W	2	6/L	1	8/2	3	9/8	20
0/8	18	1/L	17	3/7	8	4/X	1	6/O	1	8/3	2	9/D	2
0/9	2	1/M	5	3/8	7	4/Z	2	6/R	1	8/4	6	9/G	1
0/A	1	1/N	1	3/9	8	5/1	2	6/S	1	8/5	1	9/P	12
0/C	15	1/R	1	3/A	1	5/3	2	6/U	1	8/6	5	9/S	1
0/D	31	1/T	7	3/D	1	5/6	3	6/W	1	8/9	9	9/T	1
0/K	1	1/U	1	3/H	1	5/7	1	6/X	2	8/B	59	9/V	8
0/Q	9	1/W	1	3/S	1	5/8	1	7/0	1	8/C	1	9/X	1
0/U	8	1/X	1	3/W	1	5/9	2	7/1	10	8/D	1	9/Y	1
0/V	1	1/Y	4	4/0	5	5/A	1	7/2	4	8/E	1		
0/W	2	1I/H	2	4/1	7	5/S	24	7/3	14	8/F	1		
1/0	14	1I/H	1	4/2	5	6/0	4	7/4	2	8/H	15		
1/2	3	1I/N	1	4/5	6	6/1	6	7/5	3	8/K	2		
1/3	6	1I/O	3	4/6	15	6/2	2	7/6	1	8/M	4		
1/4	19	1I/U	1	4/8	6	6/3	3	7/9	5	8/N	6		
1/5	6	2/0	1	4/9	2	6/4	38	7/D	1	8/P	1		
1/7	4	2/1	1	4/A	6	6/5	20	7/E	1	8/Q	1		
1/8	2	2/3	1	4/B	1	6/7	2	7/H	1	8/R	5		
1/9	5	2/7	33	4/D	1	6/8	30	7/I	2	8/V	1		
1/A	2	2/9	2	4/E	1	6/9	1	7/J	2	8/W	3		
1/B	2	2/P	1	4/I	1	6/A	9	7/L	1	9/0	11		
1/C	2	2/R	5	4/G	1	6/B	4	7/T	10	9/1	27		

7.9 Incorrect Read Charts - Stacked Digits

Table 19: Appian Technology - Stacked Characters Read as Single Digits

Appian Technology Stacked Digits All Sites											
Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count
/StackedBY	2	3/StackedPS	1	6/StackedTU	4	A/StackedTW	2	R/StackedTR	1
/StackedDD	1	3/StackedTU	4	6/StackedTV	1	B/StackedOH	1	R5/StackedDA	1
/StackedG61	1	3/StackedTV	2	7/StackedBY	5	C/StackedDK	1	SR/StackedCA	1
/StackedHA	1	4/StackedFT	1	7/StackedCA	1	C/StackedG42	1	T/StackedTA	3
/StackedHS	1	4/StackedMB	1	7/StackedHD	1	C/StackedHD	1	T/StackedTV	16
/StackedTV	1	4/StackedSG	1	7/StackedID	1	C/StackedPS	3	U/StackedG62	1
/StackedTW	1	4/StackedTW	2	7/StackedTA	2	C/StackedTU	4	U/StackedHS	5
0/StackedAL	17	5/StackedAN	1	76/StackedPS	2	D/StackedBY	1	U/StackedHU	2
0/StackedAN	14	5/StackedCA	39	8/StackedBY	8	F/StackedFT	1	U/StackedHV	3
0/StackedBY	1	5/StackedCB	21	8/StackedCA	1	G/StackedCB	2	U/StackedUD	1
0/StackedCB	9	5/StackedDHS	2	8/StackedCB	23	G/StackedFD	8	U/StackedUS	2
0/StackedDV	1	5/StackedDHS	2	8/StackedCC	1	G/StackedFH	2	U/StackedW9	1
0/StackedHD	2	5/StackedHA	9	8/StackedCR	1	G/StackedFT	3	U/StackedWD	2
1/StackedCA	8	5/StackedLC	1	8/StackedCT	1	H/StackedCA	2	V/StackedBY	3
1/StackedG11	1	5/StackedRA	2	8/StackedDV	1	H/StackedDK	1	V/StackedHV	1
1/StackedG61	2	5/StackedTP	1	8/StackedHD	2	HC/StackedPS	1	W/StackedHA	1
1/StackedHD	2	5/StackedTU	1	8/StackedJH	1	I/StackedG62	1	W/StackedHS	1
1/StackedTA	12	5/StackedTW	1	8/StackedTU	1	J/StackedG10	1	W/StackedWR	1
1/stackedTT	1	6/StackedCA	6	8/StackedTW	1	K/StackedTA	1	X/StackedCA	3
1/StackedTV	2	6/StackedCB	3	8/StackedUS	1	L/StackedAL	4	X/StackedDA	1
1/StackedTW	3	6/StackedDHS	1	9/StackedBY	2	L/StackedFB	1	X/StackedHA	3
2/StackedCA	8	6/StackedFT	1	9/StackedCB	1	M/StackedHP	1	X/StackedTA	22
2/StackedCC	1	6/StackedG61	1	9/StackedFT	1	P/StackedBY	6	Z/StackedFP	1
2/StackedPH	1	6/StackedHA	1	9/StackedTW	5	Q/StackedAN	9	Z/StackedTL	1
3/StackedCA	1	6/StackedHD	1	A/StackedAN	6	R/StackedCA	15	ZQ/StackedAN	1
3/StackedCB	2	6/StackedRAV	1	A/StackedTR	1	R/StackedDK	1		

Table 20: Remington-Elsag- Stacked Characters Read as Single Digits[13]

Remington-Elsag Stacked Digits All Sites	
Incorrect / Correct Stacked	Count
1/StackedAL	1
1/StackedBY	3
1/StackedCB	4
3/StackedHU	1
D/StackedHU	1
G/stackedFD	1
V/StackedHV	1
W/StackedBY	1
X/StackedTA	17

[13] Remington's system does not read stacked digits; the system ignores the stacked letters and reports the full sized letters only. However, the system alarms on partial plates.

Table 21: PIPS Technology - Stacked Characters Read as Single Digits[14]

PIPS Technology Stacked Digits All Sites									
Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count	Incorrect / Correct Stacked	Count
_/StackedDC	1	6S/StackedOH	1	G/stacked(ID)	1	MV/StackedHV	1	W/StackedG11	1
/StackedFT	3	6W/StackedHU	1	G/StackedCB	4	O/StackedHU	1	W/StackedHP	2
/StackedTA	1	8/StackedAN	1	G/StackedID	1	OF/StackedGF	1	WA/StackedHA	1
/StackedTV	1	8/StackedHD	1	GI/StackedG10	1	OV/StackedBY	1	WD/StackedW3	1
0/StackedDV	1	9/StackedAT	2	GS/StackedCA	1	PD/StackedFD	4	WJ/StackedN3	1
0/StackedHV	1	9/StackedBY	6	H/StackedDHS	2	PF/StackedFT	1	WV/StackedBY	1
1/StackedG42	1	9/StackedDI	1	HG/StackedHS	1	R/Stacked911	1	X/StackedCA	1
1/StackedTA	1	9/StackedG11	1	I/Stacked(LRH)	1	R/StackedPD	1	X/StackedHA	3
19/StackedGF	1	9/StackedTR	1	I/StackedCA	2	S/StackedCA	4	X/StackedTA	10
2/StackedAL	9	A/StackedAN	15	I/StackedTA	5	S/StackedCA	12	X/StackedTR	3
2/StackedCA	3	A/StackedCA	3	J/StackedCT	1	S/StackedCB	1	X/StackedTW	1
2/StackedCB	1	A/StackedTA	1	J/StackedHU	5	S/StackedCB	1	Y/StackedBY	1
2/StackedSL	1	A2/StackedAL	1	J/StackedSG	1	S/StackedFD	2	Y/StackedFT	1
25/StackedTW	1	AW/StackedHS	1	J/StackedTA	1	T/StackedTT	2	Y/StackedHS	1
3/StackedTR	1	B/StackedID	1	J/StackedTU	2	T5/StackedED	1	Y/StackedHV	2
3/StackedTV	2	B/StackedPD	1	J/StackedTW	2	T8/StackedTS	1	Z5/StackedPS	1
4/StackedAL	1	B1/Stacked911	1	J4/StackedTU	1	T9/StackedTR	1	ZU/StackedTU	1
5/StackedAN	1	B6/StackedNB	1	JD/StackedID	1	TC/StackedTT	1		
5/StackedBY	2	BT/StackedBY	24	JI/StackedUF	1	TM/StackedTH	2		
5/StackedCA	6	BW/Stacked911	1	JR/StackedTW	1	TM/StackedTW	1		
5/StackedFD	1	C/StackedHS	1	JV/StackedTF	1	TW/StackedTU	1		
6/StackedCB	9	E/StackedFD	2	K/StackedFD	2	U/StackedDHS	1		
6/stackedCR	2	E/StackedFOP	2	K/StackedTA	1	U/StackedHU	3		
6/StackedED	1	E/StackedID	2	M3/StackedHU	1	UA6/StackedDHS	1		
6/StackedFD	1	F/StackedFT	3	MA/StackedHA	1	V/StackedBY	1		
6/StackedID	1	FA/StackedTA	1	MJ/StackedHU	1	V/StackedNP	1		
6/StackedTT	1	FI/StackedG43	1	MS/StackedHS	1	W/StackedG11	1		

[14] The PIPS system read 131 license plates with stacked digits correctly.

7.10 Incorrect Read Charts – LPSymbols Mistaken as Characters

Table 22: Appian Technology- LPSymbols Incorrectly Read as Characters

Appian Technology LPSymbols All Sites		Appian Technology LPSymbols All Sites		Appian Technology LPSymbols All Sites		Appian Technology LPSymbols All Sites		Appian Technology LPSymbols All Sites	
Incorrect Read / Correct Icon	Count	Incorrect Read / Correct Icon	Count	Incorrect Read / Correct Icon	Count	Incorrect Read / Correct Icon	Count	Incorrect Read / Correct Icon	Count
0/Icon(badge)	1	4/icon(airplane)	1	8/Icon(disability)	3	G/Icon(plane)	1	T/Icon(=)	1
0/Icon(disability)	1	4/Icon(bird)	1	8/icon(firefighter)	4	G/Icon(unk)	3	T/Icon(BrzStr)	1
0/Icon(firefighter)	1	4/Icon(disability)	2	8/Icon(pentagon)	4	H/Icon(pentagon)	1	T/Icon(disability)	1
0/Icon(frog)	1	4/Icon(plane)	4	8/Icon(unk)	3	I/Icon(lighthouse)	1	T/Icon(heart)	1
0/Icon(GWface)	1	4/Icon(unk)	1	9/icon(disability)	1	J/Icon(pentagon)	1	T/Icon(maryland)	1
0/Icon(maine)	1	5/Icon(cat)	2	9/Icon(firefighter)	1	J/Icon(university)	1	T/Icon(pentagon)	4
0/Icon(pet)	1	5/Icon(disability)	4	9/Icon(lighthouse)	1	J/Icon(unk)	1	T/icon(star)	1
0/Icon(shield)	1	5/Icon(firefighter)	1	9/Icon(pentagon)	16	JU/Icon(pentagon)	1	T/Icon(unk)	1
0/Icon(turtle)	1	5/Icon(pet)	3	9/Icon(unk)	1	K/Icon(lighthouse)	1	U/Diplomat	1
0/Icon(unk)	5	5/Icon(plane)	2	A/Icon(lighthouse)	5	K/Icon(plane)	3	U/Icon(pentagon)	4
08/Icon(clover)	1	5/Icon(wildlife)	1	B/Icon(&)	1	L/Icon(bird)	3	U/Icon(pet)	2
1/DirtMark	1	6/DirtMark	1	B/Icon(pentagon)	1	L/Icon(maryland)	1	U/Icon(unk)	1
1/Icon(disability)	4	6/Icon(&)	2	C/Icon(disability)	2	L/Icon(university)	1	UU/Icon(pentagon)	1
1/Icon(lighthouse)	10	6/Icon(airplane)	1	C/Icon(firefit)	1	L/Icon(unk)	2	V/Icon(lighthouse)	2
1/Icon(mason)	1	6/Icon(disability)	34	C/Icon(pentagon)	2	L8/Icon(unk)	1	V/Icon(plane)	1
1/Icon(pentagon)	3	6/Icon(firefighter)	1	C/Icon(unk)	1	N/Icon(unk)	2	V/Icon(university)	1
1/Icon(pet)	3	6/Icon(pentagon)	5	CE/Icon(airpatrol)	1	O/Icon(unk)	1	V/Icon(unk)	1
1/Icon(ribbon)	1	6/icon(plane)	53	D/Icon(pet)	1	P/Icon(badge)	1	V/Icon(Vtech)	1
2/Icon(bird)	1	6/Icon(unk)	2	D/Icon(unk)	2	P/Icon(ball)	1	W/Icon(cowboy)	1
2/Icon(lighthouse)	1	7/Icon(bird)	1	E/Icon(disability)	1	P/Icon(pentagon)	3	X/Icon(lighthouse)	1
2/Icon(pentagon)	1	7/Icon(cat)	2	E/Icon(pentagon)	2	P/Icon(pet)	2	Y/Icon(unk)	1
2/Icon(pet)	1	7/Icon(flag)	1	E/Icon(pet)	1	P9/Icon(duck)	3	Z/Icon(bird)	1
2/Icon(ribbon)	1	7/icon(lighthouse)	4	F/Icon(bird)	3	Q/Icon(maine)	1		
26/Icon(pentagon)	1	7/Icon(orange)	1	F/Icon(helmet)	1	R/Icon(fish)	1		
3/DirtMark	1	7/Icon(pentagon)	2	F/Icon(snake)	1	S/Icon(disability)	2		
3/Icon(firefighter)	3	7/Icon(Uni)	1	G/Icon(face)	1	S/Icon(greyhound)	1		
3/Icon(pentagon)	2	7/Icon(unk)	1	G/Icon(maryland)	1	S/Icon(medal)	1		
3/Icon(pet)	7	8/Icon(&)	8	G/Icon(pet)	1	SQ/Icon(clover)	1		

Table 23: Remington-Elsag - LPSymbols Incorrectly Read as Characters

Remington-Elsag LPSymbols All Sites	
Incorrect Read/ Correct Icon	Count
1/Icon(bowlpin)	1
1/Icon(disability)	2
1/Icon(lighthouse)	1
1/Icon(logo)	1
7/Icon(-)	1
7/Icon(orange)	1
8/Icon(=)	1
8/Icon(-)	2
F/Icon(crane)	1
F/Icon(=)	1
P/Icon(bird)	1
P/Icon(flower)	4
W/Icon(=)	1

Table 24: PIPS Technology - LPSymbols Incorrectly Read as Characters

PIPS Technology LPSymbols All Sites	
Incorrect Read / Correct Icon	Count
1/Icon(Butterfly)	3
1/Icon(Lighthouse)	9
1/Icon(Pets)	1
1/Icon(UPSsymbol)	1
2/Icon(Eagle)	1
2/Icon(Pentagon)	4
2/Icon(Plane)	1
23/Icon(Pentagon)	10
25/Icon(Pentagon)	1
2D/Icon(RUsticker)	1
2I/Icon(Pentagon)	1
3/Icon(Eagle)	1
3/Icon(Horse)	3
3/Icon(Medal)	1
3/Icon(Pentagon)	2
3/Icon(pets)	1
4/Icon(Butterfly)	2
4/Icon(circle)	1
4/Icon(Disability)	7
4/Icon(Eagle)	2
44/Icon(Cowboy)	1
46/Icon(Cowboy)	2
48/Icon(UPSsymbol)	1
4A/Icon(ResqSquad)	2
5/Icon(Disability)	1
6/Icon(Ball)	1
6/Icon(Butterfly)	1
6/Icon(Disability)	10

PIPS Technology LPSymbols All Sites	
Incorrect Read / Correct Icon	Count
6/Icon(Plane)	9
63/Icon(Pentagon)	1
7/Icon(Eagle)	1
7/Icon(Lighthouse)	1
7/Icon(Piper)	2
8/Icon(&)	2
8/Icon(UofM)	1
9/Icon(circle)	2
9/Icon(Eagle)	7
9/Icon(Pentagon)	1
9/Icon(unk)	1
96/Icon(Cowboy)	1
A/Icon(&)	1
A/Icon(circle)	2
A/Icon(Disability)	29
A/Icon(Eagle)	1
A/Icon(Lighthouse)	5
A/Icon(Pets)	3
A/Icon(turtle)	1
A/Icon(VAunk)	2
AJ/Icon(Pentagon)	1
AO/Icon(Cowboy)	1
B/Icon(&)	2
B/Icon(Eagle)	1
C/Icon(Lighthouse)	1
C/Icon(Pentagon)	1
C/Icon(Plane)	2
CA/Icon(Lighthouse)	1

PIPS Technology LPSymbols All Sites	
Incorrect Read / Correct Icon	Count
D/Icon(FireDept)	1
D/Icon(Medal)	1
E/Icon(Piper)	1
F/Icon(bird)	1
G/Icon(&)	1
G/Icon(Pentagon)	2
G/Icon(Plane)	1
IU/Icon(RU)	1
J/Icon(Horse)	1
J/Icon(Line)	1
J/Icon(Pentagon)	1
J/Icon(Piper)	1
J/Icon(Ship)	4
J4/Icon(sticker)	1
L/Icon(Fish)	1
O/Icon(FireDept)	1
P/Icon(Lighthouse)	2
S/Icon(Disability)	1
S/Icon(FireDept)	1
S/Icon(panther)	1
S/Icon(Plane)	1
T/Icon(Eagle)	1
V/Icon(line)	1
X/Icon(circle)	1
X/Icon(Fish)	1
X/Icon(Horse)	1
X/Icon(Pentagon)	1
X/Icon(Piper)	2

PIPS Technology LPSymbols All Sites	
Incorrect Read / Correct Icon	Count
Y/Icon(eagle)	1
Z/Icon(bird)	1
Z/Icon(Disability)	4
Z/Icon(flag)	1
Z/Icon(Horse)	2
Z/Icon(Piper)	9
Z/Icon(ship)	2
ZJ/Icon(Pentagon)	1

7.11 Incorrect Read Charts - Added Digits

Table 25: All Vendors, Added Digits to License Plate Read

Appian Technology Added Digits All Sites	
Added Digits	Count
Added-0	1
Added-1	1
Added-2	2
Added-3	1
Added-4	1
Added-6	1
Added-8	1
Added-A	1
Added-F	5
Added-K	1
Added-L	7
Added-N	1
Added-P	2
Added-Q	2
Added-R	1
Added-T	1
Added-U	1
Added-W	1

Remington-Elsag Added Digits All Sites	
Added Digits	Count
Added-0	8
Added-1	632
Added-2	2
Added-3	1
Added-4	7
Added-5	2
Added-6	2
Added-7	8
Added-8	5
Added-9	1
Added-A	10
Added-C	1
Added-F	4
Added-H	4
Added-I	1
Added-J	9
Added-K	2
Added-L	12
Added-M	2
Added-P	4
Added-T	2
Added-U	6
Added-V	11
Added-W	5
Added-Y	4

PIPS Technology Added Digits All Sites	
Added Digits	Count
Added-0	2
Added-1	39
Added-2	4
Added-3	6
Added-4	5
Added-6	7
Added-7	3
Added-8	3
Added-9	2
Added-A	3
Added-C	2
Added-D	1
Added-E	2
Added-F	2
Added-G	1
Added-I	35
Added-J	12
Added-K	2
Added-L	3
Added-M	1
Added-P	2
Added-R	8
Added-S	1
Added-T	1
Added-U	2
Added-W	15
Added-Z	4
Added-Y	3
Added-Z	6

7.12 Reported Alarms - Blacklisted Plates

A selected set of blacklisted plates was chosen to be used for the demonstrations. In addition, the legal license plates belonging to the Northrop Grumman team members participating in the demonstrations was recorded. The list of these plates was given to each vendor on the first day of their demonstrations and was used to assess the vendors' camera performance at the stationary camera locations. A random selection of plate numbers taken from parked vehicles was recorded, provided to the vendors, and used during mobile camera demonstrations in the parking areas. The tables below, compiled from vendor data, list the plates, the number of times they were read, and the number of alarms recorded. The plates listing zero in both the "Times Read" and "Number of Alarms" columns represent instances where a demonstrations observer manually noted and recorded a plate that should have been captured but the system did not read or alarm.

Table 26: Reported Alarms – Blacklisted Plates

APPIAN					
Blacklist Plate	Times Read	Number of Alarms	Blacklist Plate	Times Read	Number of Alarms
BGN8168	1	1	KGG4640	2	2
CH5085	1	1	KGH6352	2	2
EHL8393	2	2	KJT3853	1	1
EPV694	4	4	101869H	3	3
GOBOYGO	1	1	101869H	3	3
HARNESS	1	1	18A4807	11	5
JML2283	2	2	30E6712	14	3
JUN7445	2	2	6A69357	12	0
JXL3281	2	2	7740FF	0	0
JYV414	1	1	83YT70	0	0
KDW858	2	2	DNW720	0	0
NSB423	2	2	HAR13Y	10	7
RTY659	2	2	HIZ434	0	0
SETON7	2	0	[redacted]	3	2
ABASUSA	3	3	[redacted]	9	8
C74006	2	2	[redacted]	7	7
GAMEDAD	2	2	[redacted]	13	13
JGS7895	1	1	MKW207	0	0
JWK6418	3	3	RBQ299	0	0
JYV5078	2	2	X87QGH	9	7
KCP120	6	2	[redacted]6	3	3
KFS3594	3	2	Z14CVP	0	0
KGF2741	3	2			

Remington					
Blacklist Plate	Times Read	Number of Alarms	Blacklist Plate	Times Read	Number of Alarms
80485	4	4	KEZ6636	2	2
405FFZ	2	2	WESCOTS	4	4
496FKD	2	1	YFN6048	2	2
6L07513	2	1	YTD8956	2	2
CK5124	2	2	YZE4293	2	2
O19DEC	1	1	18A4807	1	1
PCH593	1	0	30E6712	9	0
UFRPH	2	2	496AN	0	0
7270	3	3	4CRK92	1	0
1JETLAG	1	0	6A69357	8	2
22764	1	0	7740FF	11	10
42008L	4	2	DSV2822	1	1
5SPRTS	2	2	HAR13Y	15	8
6B4857	2	1	[redacted]	9	7
BS0456	1	1	JVB975	8	8
HNG653	1	1	[redacted]	14	13
HPZ249	2	1	[redacted]	9	9
JKT4517	2	2	[redacted]6	11	9
JUB4060	3	3	X87QGH	6	0
JXV9173	1	1	[redacted]	8	8
JZM3190	3	2	[redacted]	8	8
KAY2783	3	2			

PIPS					
Blacklist Plate	Times Read	Number of Alarms	Blacklist Plate	Times Read	Number of Alarms
4149BD	1	1	18A4807	6	6
419BJK	2	2	1LJ225	0	0
43778L	2	2	30E6712	6	0
606MNG	1	1	3RUH106	0	0
880SXB	1	1	40209	1	1
978BDA	1	1	47C147	0	0
A139834	1	1	496AN	6	0
AJJ1076	1	1	616638	0	0
AKN8TV	1	0	6535922	1	0
'CMNURDS	3	0	6A69357	6	6
CU9356	1	1	7740FF	1	0
EYE1739	2	2	G6217754	0	0
'FAITHE	3	0	[redacted]	7	5
JER3940	2	2	HBB1455	0	0
KGX8049	1	0	[redacted]	12	3
MRROBUS	1	0	JFK2498	0	0
SCOMFRT	1	1	K6X8049	0	0
VANDAS	1	0	[redacted]	11	10
W75VFY	1	1	KCE4295	1	0
WPN8137	1	1	[redacted]	5	4
[redacted]	1	1	KXX30Z	1	0
YCF6646	1	1	X87QGH	6	0

8.0 PERFORMANCE IMPROVEMENTS

In new installations, all errors would be monitored by the vendor for excessive mistakes and adjustments made to the system to improve upon the system's capabilities. The results of the camera and software performance would be modified and refined to target improvements and corrections for commonly recurring mistakes and adjustments would be made to the system.

The vendors who performed demonstrations at IAD indicated that they would normally target their software interpretation algorithms to the location of the camera installations and would refine the algorithms to maximize the correct interpretations of the most expected state vehicle plates. The August 2007 demonstrations included blacklist plates from a broad cross section of the U.S. so it was not necessarily prudent to adjust algorithms to focus on Washington D.C. metro area plates which were most prevalent in the vicinity of the IAD demonstrations area.

8.1 Performance Improvement Example: Appian Technology

An example of commonly recurring image misinterpretation taken from **Appian Technology's** data would be the Maryland seven character license plates. In some of these plates, where the license plate contained the character 'M', the system read the 'M' character as an 'H'. In post demonstrations analysis of Appian Technology's data, there were approximately 176 occurrences of the 'M' being read as 'H'. To correct the transposing of digits, or mismatching of alphanumeric characters like this example would require adjustments to the systems interpretation algorithms.

Appian: Covert Camera Site
As Read 827H114 – Actual: 827M114
Date: 08/21/07 **Time:** 2:52:41 PM

Figure 42: Appian Technology Plate Read

8.2 Performance Improvement Example: Remington-Elsag

An example of how updates to a commonly recurring image misinterpretation could improve performance results was taken from **Remington-Elsag's** data. In post demonstrations analysis of Remington-Elsag's data, there were approximately 317 occurrences of the transpositions of the characters 'W' and 'M' where the letter 'M' was identified by the system as a 'W'. To correct the transposing of digits, or mismatching of alphanumeric characters like this example, would require adjustments to the systems algorithms.

Remington-Elsag: Covert Camera Site
As Read WVZ627– Actual: MVZ627
Date: 08/06/07 **Time:** 3:14:25 PM

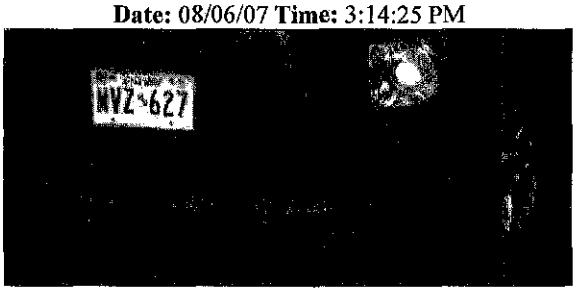


Figure 43: Remington-Elsag Plate Read

8.3 Performance Improvement Example: PIPS Technology

An example of how updates to a commonly recurring image misinterpretation could improve performance results was taken from PIPS Technology's data. In post demonstrations analysis of PIPS Technology's data, there were approximately 230 occurrences of the transpositions of the characters 'E' and 'K' where the letter 'K' was identified by the system as an 'E'. To correct the transposing of digits, or mismatching of alphanumeric characters like this example, would require adjustments to the systems algorithms.

PIPS: Fixed Camera Site
As Read ZZE3985 – Actual: ZZK3985
Date: 08/13/07 **Time:** 4:35:34 PM

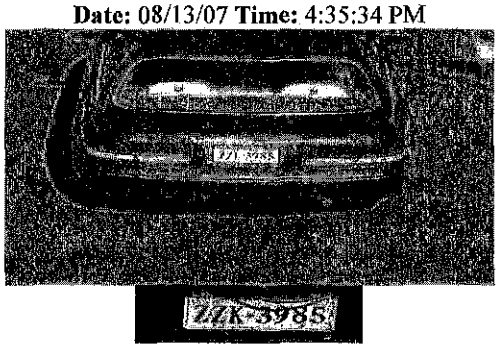


Figure 44: PIPS Technology Plate Read

9.0 APPLYING THE PARETO PRINCIPLE

The Pareto principle, also known as the 80-20 rule, states that for many events, such as those described above, 80 percent of the effects come from 20 percent of the causes. The demonstrations data was analyzed to the number of errors occurring on each license plate and the type of each error. It was than sorted by the number of occurrences and the top 20 percent of those errors were selected as the number of errors for possible fixes.

9.1 Applying the Pareto Principle to Appian Technology Data

The data indicated 53.01 percent of errors came from transposed digits and 46.99 percent of errors came from dropped digits (Table 27). If the vendor were to perform fixes and updates to the top 20 percent of the dropped and transposed errors (Table 28), the read rate could improve as much as 80 percent putting it to an approximate read rate of 97 percent accuracy (Chart 35).

Table 27: Appian Technology Percentage of Error Types

Error Type	Detail	Count	Percent of Error Type	Cumulative
Dropped	1	594	46.99%	46.99%
Transposed	8/B	353	27.93%	27.93%
Transposed	O/0	317	25.08%	53.01%

Table 28: Appian Technology Original Reads and Estimated Reads After Fixes

Original Reads			
Plates Read Correctly	Plates Read Incorrectly	Total # of Mistakes (multiple per plate)	Average Mistakes Per Plate
23413	4696	6127	1.3
After Fixes			
Plates Read Correctly	Plates Read Incorrectly	Total # of Mistakes (multiple per plate)	Average Mistakes Per Plate
28315	942	1225	1.3

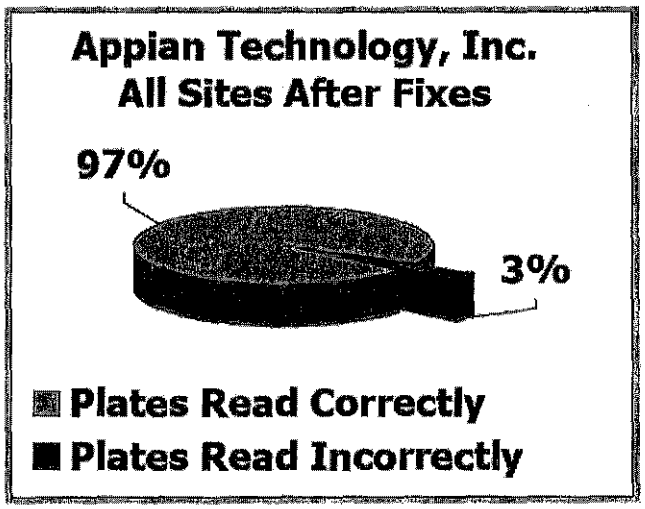


Chart 35: Appian Technology Possible Read Percentages after Fixes (Pareto 80-20)

9.2 Applying the Pareto Principle to Remington-Elsag Data:

The data indicated 54.92 percent of errors came from dropped digits; 25.90 percent of errors came from added digits; and 19.18 percent of errors came from transposed digits. (Table 29) If the vendor were to perform fixes and updates to the top 20 percent of the dropped, added and transposed errors (Table 30), the read rate could improve as much as 80 percent putting it to an approximate read rate of 96 percent accuracy (Chart 36).

Table 29: Remington Sum of All Counts and Percentages of Error Types

Error Type	Detail	Count	Percent of Error Type	Cumulative
Transposed	'1/I	468	3.95%	14.71%
Dropped	1	639	5.39%	5.39%
Dropped	0	357	3.01%	17.72%
Dropped	5	345	2.91%	20.63%
ADDS	Added-1	635	5.36%	10.75%

Table 30: Remington Original Reads and Estimated Reads After Fixes

Original Reads			
Plates Read Correctly	Plates Read Incorrectly	Total # of Mistakes (multiple per plate)	Average Mistakes Per Plate
28196	8420	11846	1.4
After Fixes			
Plates Read Correctly	Plates Read Incorrectly	Total # of Mistakes (multiple per plate)	Average Mistakes Per Plate
37673	1692	2369	1.4

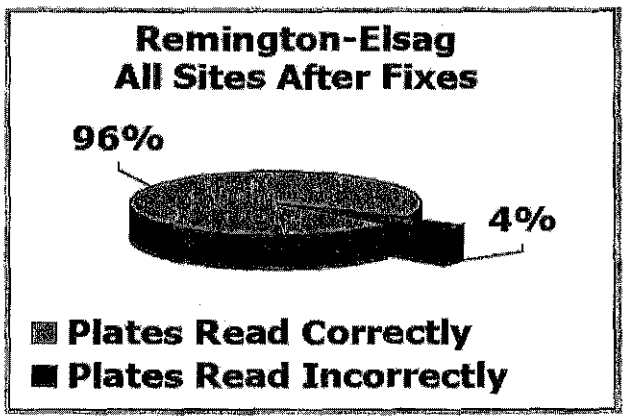


Chart 36: Remington-Elsag, Possible Read Percentages after Fixes (Pareto 80-20)

9.3 Applying the Pareto Principle to PIPS Technology Data:

The data indicated 84.93 percent of errors came from transposed digits and 15.07 percent of errors came from dropped digits (Table 31). If the vendor was to perform fixes to the top 20 percent of the dropped and transposed errors (Table 32), the read rate could improve as much as 80 percent putting it to an approximate read rate of 95 percent accuracy (Chart 37).

Table 31: PIPS Sum of All Counts and Percentage Error Types

Error Type	Detail	Count	Percent of Error Type	Cumulative
Transposed	'O/0	500	40.29%	40.29%
Transposed	E/K	230	18.53%	58.82%
Transposed	'M/H	163	13.13%	71.96%
Transposed	'I/1	161	12.97%	84.93%
Dropped	1	187	15.07%	15.07%

Table 32: PIPS Original Reads and Estimated Reads After Fixes

Original Reads			
Plates Read Correctly	Plates Read Incorrectly	Total # of Mistakes (multiple per plate)	Average Mistakes Per Plate
10818	3919	5979	1.5
After Fixes			
Plates Read Correctly	Plates Read Incorrectly	Total # of Mistakes (multiple per plate)	Average Mistakes Per Plate
15601	797	1196	1.5

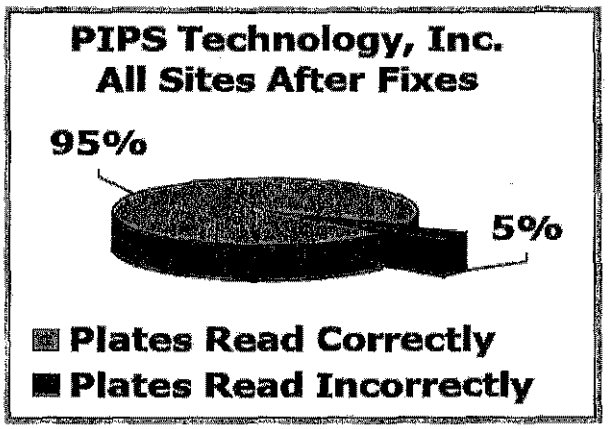


Chart 37: PIPS Technology, Possible Read Percentages after Fixes (Pareto 80-20)

10.0 VENDOR EQUIPMENT IMAGES

10.1 Appian Technology, Inc. Images

Figure 45: Appian Technology Cobra Camera

(Openings from left to right ANPR Monochrome module, Color module, IR illuminator)

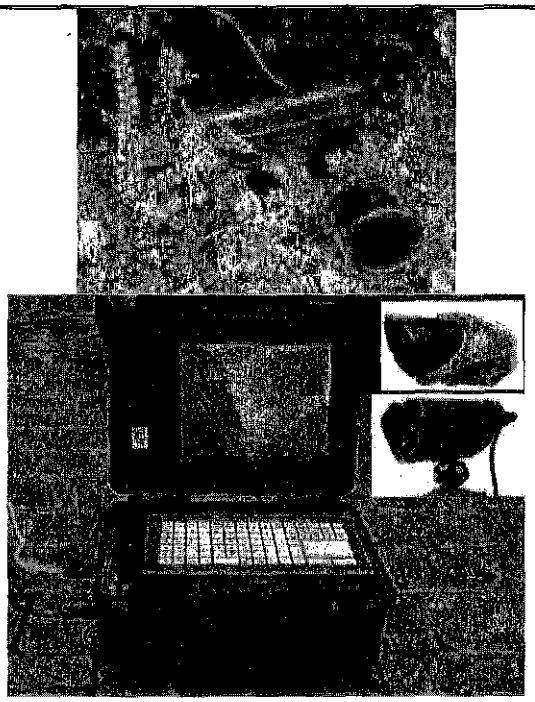


Figure 46: Appian Technology Talon Covert System

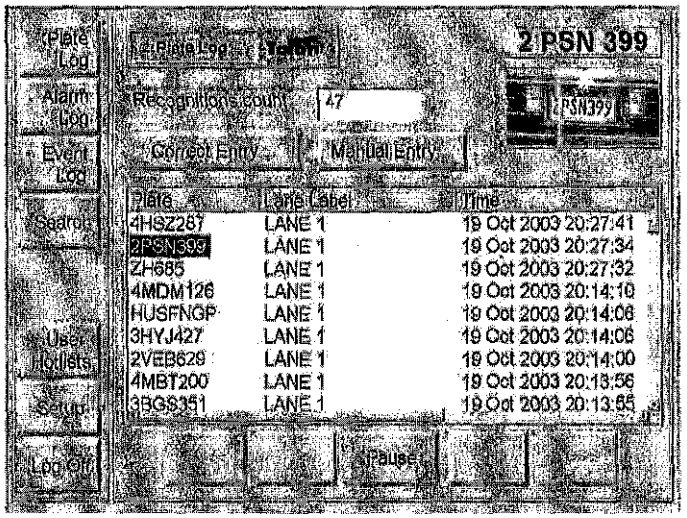


Figure 47: Appian Technology Talon GUI

Figure 48: Appian Technology Portable System

Figure 49: Appian Technology Portable System (close-up)

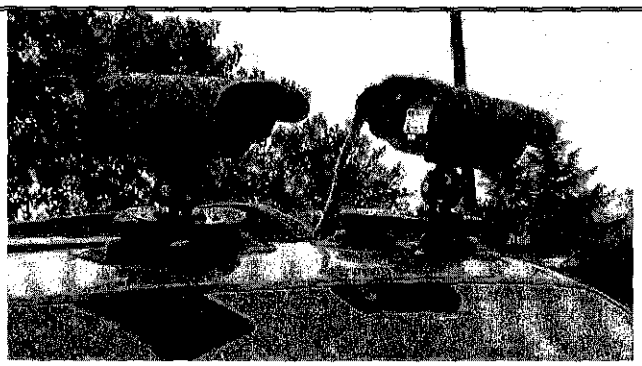


Figure 50: Appian Technology Portable Camera System – Suction Cup Version

Figure 51: Appian Technology Cobra Cameras

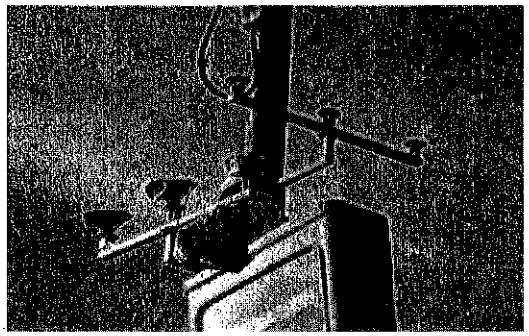


Figure 52: Appian Technology Cobra Display Mounted in UK

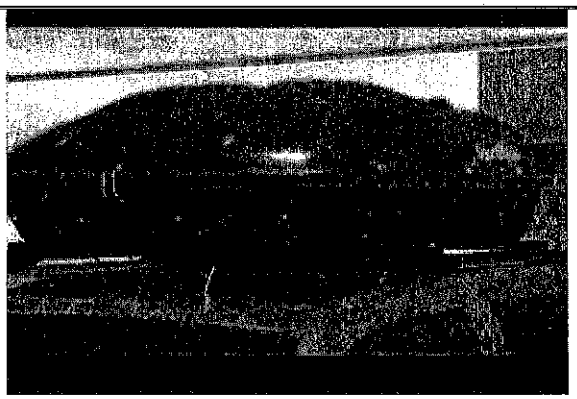


Figure 53: Appian Technology Covert Vehicle Sport Rack

10.2 Remington-Elsag Images

In the first image, Camera 1 reads both parked vehicles and cars that are passed on the left, Camera 2 reads up to two lanes of oncoming or parked vehicles on the right, and Camera 3 is an optional camera that can be rotated in all directions to supplement left and right cameras (MPH-V3 camera 22x zoom distance).

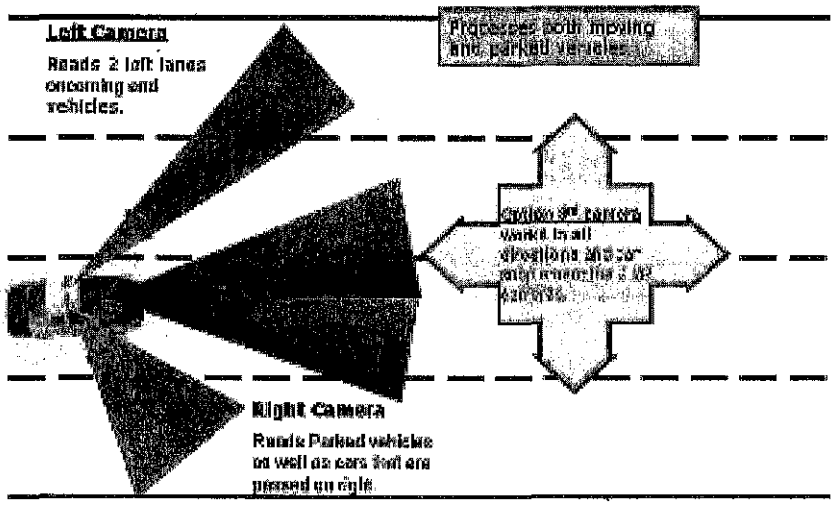


Figure 54: Remington-Elsag: Camera Setup Overview

Figure 55: Remington-Elsag Custom Installation FPH-900 Unit

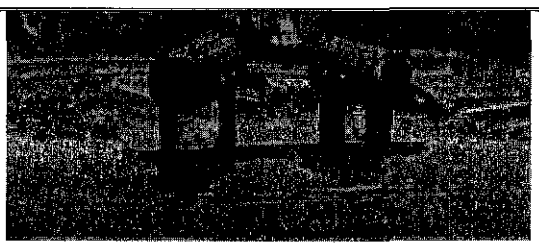


Figure 56: Remington-Elsag MPH-900 Unit

Figure 57: Remington-Elsag MPH-900 Covert Mobile ALPR System

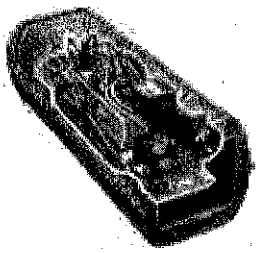


Figure 58: Remington-Elsag FPH-900

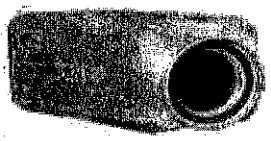


Figure 59: Remington-Elsag MPH-V3 Unit

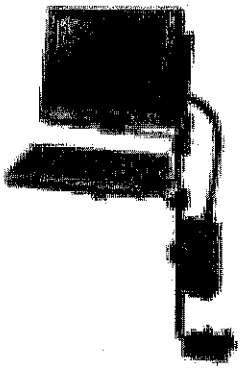


Figure 60: Remington-Elsag MDT/PC Touch Screen In-Vehicle System

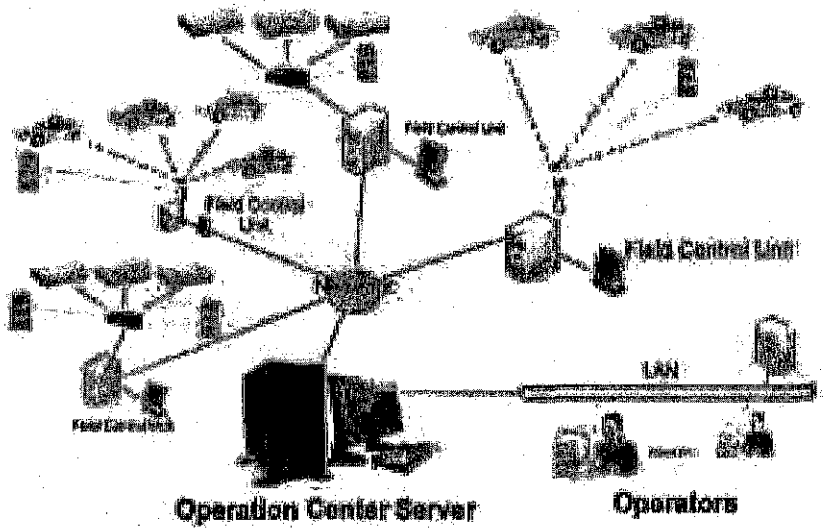


Figure 61: Remington-Elsag ALPR Operations Center Network Example

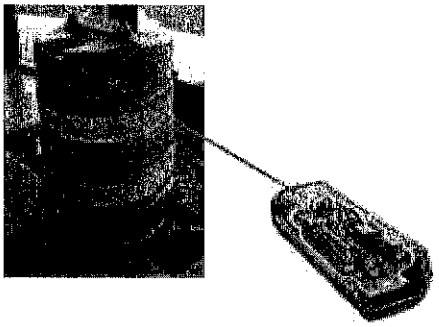
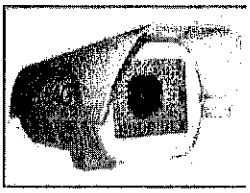


Figure 62: Remington-Elsag The XPH-8700 Covert Fixed ALPR System



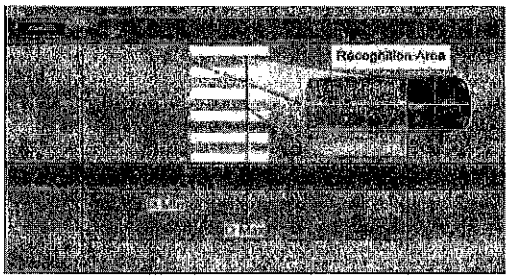


Figure 63: Remington-Elsag AutoDetector Fixed Gate Unit

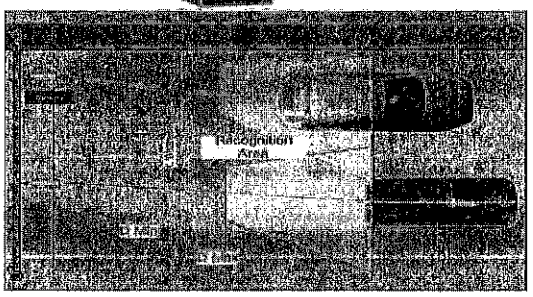


Figure 64: Remington-Elsag AD-HR IP Smart Sensor

10.3 PIPS Technology Images

In the first image, Camera 1 reads both parked vehicles and cars that are passed on the left within a distance of 20-30 feet, Camera 2 reads oncoming traffic and parked cars on the right within a distance of 15-18 feet, and Camera 3, either mounted on the roof or window of the car, reads side view only within a distance of 9 feet.

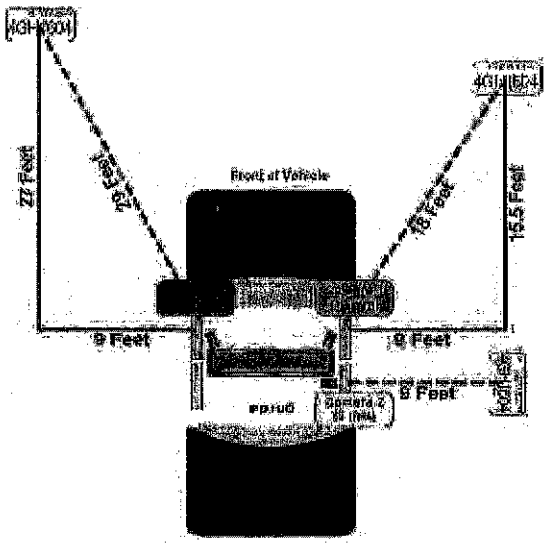


Figure 65: PIPS Technology Overview camera Mounts

Figure 66: P1 PIPS Technology P362, Portable Window Mount

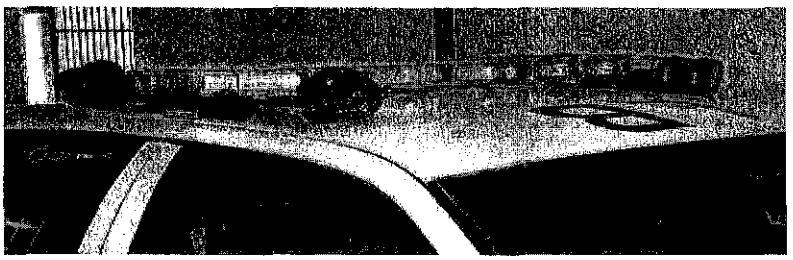


Figure 67: PIPS Technology Three Cameras Light Rack

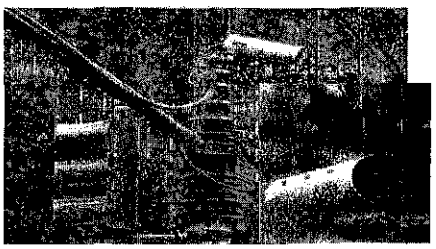


Figure 68: PIPS Technology Portable P372

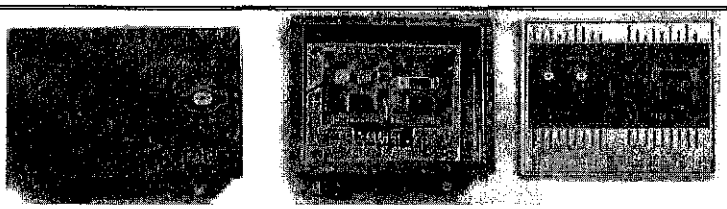


Figure 69: PIPS Technology Spike + Interface Box

Figure 70: PIPS Technology P362 Covert Unit

11.0 VENDOR RESULTS SUMMARY AND TECHNOLOGY HIGHLIGHTS

11.1 Demonstrations Camera Reference Summary

The table below provides a summary of the camera equipment used by each of the participating vendors during the demonstrations.

Table 33: Camera Equipment Summary

Weather conditions such as rain, high sunlight, low light, the dark can affect an ALPR camera's capability. To combat these conditions, ALPR vendors use a combination of cameras, monochrome and color, with IR.									
Vendor	Site	Camera	IR Illuminator	Monochrome	Color	Internal processor	Zoom Capability	Mobile Video	Stationary Video
Appian	All	Cobra	X	X	X[1]		X	*[5]	*[5]
Appian	Mobile	Viper			X		X	X	
Remington	Mobile	MPH-900	X	X		X			
Remington	Mobile	MPH-V3			X		X	X	
Remington	Covert	XPH-8700	X	X		X			
Remington	Fixed	FPH-900	X	X		X			
PIPS	Mobile & Covert	P362	X	X	X				*[2]
PIPS	Fixed	P372 Spike	X	X	X	X		*[3]	

[1] For the P362 and P372: Optional integrated color or monochrome.
[2] For P362: Color overview camera can be from a separate video feed.
[3] For P372: Real time jpeg hardware compression is available for video streaming over IP.
[4] For Cobra: May replace Cobra internal color camera with video.
[5] For All Cobra: May connect to an existing system's video feed to the Cobra camera.

11.2 Stoplight Performance Chart

The full performance chart, as it is shown below contains proprietary and competition sensitive data and should NOT be distributed.

Table 34: Stoplight Performance

Stoplight Performance Chart					
Rating Codes: GREEN Good; YELLOW Fair; RED Poor		Remington Elsag	PIPS	Appian	Remarks / Explanation
1.	**IR Capability**	Green	Green	Green	IR illuminators provide scene illumination so an additional light source is not needed. The IR illuminator works at an undetectable range for human eyes so there is no disturbance for drivers. When coupled with a monochrome or color camera the IR light bounces off the license plate, illuminating the plate's reflective surface and causing the characters to stand out, allowing for an image to be taken.  (Images are examples that were not captured from demonstration.)
2.	**Monochrome Camera**	Green	Green	Green	Monochrome provides black and white images.  (Image not captured from demonstration.)

Stoplight Performance Chart					
Rating Codes: GREEN Good; YELLOW Fair; RED Poor		Remington Elsag	PIPS	Appian	Remarks/Explanation
3.	**Color Camera**	Green	Green	Green	Color cameras are used in addition to IR & monochrome, allowing for color overview to be added to the images, giving more detail.  (Image not captured from demonstration.)
4.	**Zoom Capability**	Green	Red	Green	Zoom capability refers to the ability to modify the distance an image of a vehicle plate can be captured. **Remington**: Mobile camera only, has up to 22x zoom capability, operator can modify camera settings. **PIPS**: Cameras do not have zoom capability. Maximum distance the camera can capture an image is 50 feet. **Appian**: All cameras (mobile, fixed and covert) have 18x zoom capability.
5.	**Pulse Technology**	N/A	Green	Green	Pulse technology is technology in which the IR is pulsed or flashes at a specified rate. Limitations are that the pulse grows weaker as it travels farther from its source. Pulse technology is not used by all vendors. **Remington:** Used image capture rather than pulse technology. **PIPS:** Pulse is 60 times per second; maximum distance the camera can capture an image is 50 feet. **Appian**: Cameras use both pulse technology and zoom.
6.	**Mobile Video Capability**	Green	Red	Green	**Remington:** The Mobile MPH-V3 can be linked to a recording device for DVR. **PIPS:** Does not offer mobile video at this time. **Appian**: Internal Stinger camera processor can handle up to four video inputs.
7.	**Stationary Video Input/Output**	Yellow	Green	Green	**Remington:** Fixed camera does not have video input or output capability at this time. **PIPS:** The P372-Stinger will allow for video streaming over IP. Overview camera can be separated video feed or the built-in multiplexer can send two signals on a singer output. **Appian**: All Cobra cameras can handle up to four video inputs and can superimpose ALPR on existing Closed-Circuit Television (CCTV) infrastructure.

Stoplight Performance Chart					
Rating Codes: GREEN Good; YELLOW Fair; RED Poor		Remington Lisag	PIPS	Appian	Remarks / Explanation
8.	**Image Resolution**	Green	Red	Green	**Remington:** Remington's monochrome image captures, after processing, were overall of the highest resolution, easily viewed and could be blown up to larger views without distortion. However, their color images were often grainy and blurred. **PIPS:** PIPS image captures, after processing, were the most difficult to read. Color images were often blurred or unreadable while many of the monochrome images were no longer high resolution and required the use of photo software to enhance the image. **Appian:** Appian's monochrome image captures, after processing, were high resolution, easily viewed without requiring being blown up in size to view. However, their color camera often had grainy images.
9.	**Max Viewing Range, Fixed/Stationary Cameras**	Yellow	Yellow	Green	**Remington:** 49 feet **PIPS:** 50 feet **Appian:** 114.83 feet
10.	**Max Viewing Range, Mobile Camera**	Green	Yellow	Green	Video is operator controlled. **Remington:** MPH-V3 - 5280 feet **PIPS:** 50 feet- streaming video over IP **Appian:** All demonstrated cameras 114.83 feet
11.	**Store Additional Images**	Yellow	Green	Yellow	Operator may enter additional images and data to the existing records. **Remington:** Yes, may add images or notes. **PIPS:** Yes, may add images and notes. (Green because of ability to cross reference additional data entered.) **Appian:** Yes, may add images and notes.
12.	**LPR Processor inside camera**	Green	Green	Green	The internal processor stores images and data to be downloaded by the operator at a anytime. **Remington:** XPH-8700 cameras **PIPS:** P372 cameras **Appian:** Internal processor not demonstrated. The Stinger camera, with an internal processor, was displayed but was not to be officially introduced to the market until later in 2007.
13.	**LPR Processor separate from camera**	Green	Green	Green	External processor stores images and data which may be accessed by the operator at anytime. **Remington:** MPH-900 camera **PIPS:** P362 camera **Appian:** Cobra camera

Stoplight Performance Chart *					
Rating Codes: GREEN Good; YELLOW Fair; RED Poor		Remington Elsag	PIPS	Appian	Remarks / Explanation
14.	**Laptop External Capture Cards**	Yellow	Yellow	Green	Capture cards are used when video is being sent to the processor. If using a laptop to capture the data, the average laptop comes with one external capture card slot and one internal video capture card. **Remington:** Does not work with Video other than their MPH-V3 mobile camera. **PIPS:** Requires one external capture card per camera with a max of two cameras per laptop. **Appian:** Requires one external capture card for up to four cameras.
15.	**Sleep Mode or ability to preset auto on / off**	Yellow	Green	Green	All vendor systems allow the operator the ability to set a power save mode. There are two modes: Sleep or the ability to turn on/off at a specified time and hibernate, where the system saves power after a certain amount of inactivity. **Remington:** The system can be preset to hibernate. **PIPS:** The system can be preset to sleep or to hibernate. **Appian:** The system can be preset to sleep or to hibernate.
16.	**External Triggering system response**	Green	Green	Green	All the vendors have the capability to use external triggers. External triggers can be used by the operator to capture images at specific events or set up to wake the system from sleep/hibernation. **Remington:** Yes, requires external trigger to wake from hibernate. **PIPS:** Yes, requires external trigger to wake from hibernate. **Appian:** Yes, requires external trigger to wake from hibernate.
17.	**Internal Triggering system response**	Red	Green	Green	The ability to preset the system to wake at a specified time after 'sleep'. **Remington:** No. System requires external trigger to wake. **PIPS:** Yes. Sleep mode uses motional sensor which wakes the system when movement enters the camera's field of view. **Appian:** Sleep mode can have preset time that wakes the system.
18.	**Covert Systems Equipment Storage**	Green	Yellow	Green	**Remington:** XPH-8700 camera is located inside of a construction barrel. A camera includes processor and illuminator. **PIPS:** P362 camera was set inside a fake vehicle light bar. The processor was inside vehicle. **Appian:** Cobra camera with the keyboard, monitor, processor and power located inside of a pelican-case.

Stoplight Performance Chart					
Rating Codes: Good / Fair / Poor		Remington Eisag	PIPS	Appian	Remarks / Explanations
19.	**Covert System Power Supply**	Green	Green	Green	All vendor covert systems can be supplied power by power sources such as local power supply, battery, generator etc. **Remington:** Used a standard 12 VDC battery within the covert barrel. **PIPS:** Used vehicle as power source. **Appian:** Used generator as power source.
20.	**Vehicle System Power Supply**	Green	Green	Green	**Remington:** Plugs into the vehicle's power supply and an additional 12 VDC power supply is provided to power down the unit when the vehicle is turned off. **PIPS:** Plugs into the vehicle's power supply. **Appian:** Plugs into the vehicle's power supply
21.	**Front End Software and Back-end Database Requirements**	Green	Yellow	Green	Each vendor supplies front-end software that has specific licensing requirements. Contact vendors for specifications. Each vendor can use basic SQL database for their back-end. One vendor requires upgrades. **Remington:** Licensing requirements for front end software; requires basic SQL back-end – no licensing required for back-end. **PIPS:** Licensing requirements for front end software and software enhancement required depending on number of clients; May use basic SQL back-end up to 100,000 packets of data storage than must upgrade to full SQL version. – licensing required for full SQL version. **Appian:** Licensing requirements for front end software; requires basic SQL back-end– no licensing required for back-end.
22.	**Capability to Store and Retrieve Data**	Green	Green	Green	**Remington:** Yes **PIPS:** Yes **Appian:** Yes
23.	**Data Mining**	Green	Yellow	Green	**Remington:** Amount of storage available depends on the size of the client's database. **PIPS:** Basic software to 100,000 packets (a typical packet contains perhaps 1,000 to 1,500 bytes of data), beyond 100,000 packets requires an upgrade to the back-end software. Amount of storage also depends on size of client's database. **Appian:** Amount of storage available depends on the size of the client's database.
24.	**Training**	Green	Green	Green	**Remington:** Offers training for equipment usage, front end and back-end software. **PIPS:** Offers training for equipment usage, front end and back-end software. **Appian:** Offers training for equipment usage, front end and back-end software.

Stoplight Performance Chart					
Rating Codes: GREEN Good; YELLOW Fair; RED Poor		Remington Elsag	PIPS	Appian	Remarks / Explanation
25.	**Mobile & Stationary Equipment Portability**	Green	Green	Green	All vendors have mobile and stationary equipment that is portable. If a vehicle breaks down or if a specific type of vehicle is needed, than portable mobile units allow for equipment to be moved from vehicle to vehicle as needed. **Remington:** Magnetic strip mount for roof mount cameras. **PIPS:** Magnetic Strip mount for roof mount cameras. **Appian:** Magnetic strip or suction cup for roof mount cameras.
26.	**Customized Network**	Green	Green	Green	**Remington:** Builds its own network, example shown in 'Images' section. **PIPS:** Partners with Motorola for networks or distributors of equipment supply. **Appian:** Builds its own network.
27.	**Fixed Camera Multi-lane coverage**	Green	Green	Green	For fixed or stationary cameras the use of one camera per lane is recommended. The cameras positioned to allow for a slight overlap between lanes or onto the shoulder of the road. **Remington:** Yes, recommends one camera per lane. **PIPS:** Yes, recommends one camera per lane. **Appian:** Yes, recommends one camera per lane.
28.	**Multiple Mobile Cameras**	Green	Yellow	Green	**Remington:** Yes: up to four cameras, including video/zoom camera. **PIPS:** Yes: up to three cameras, video is by streaming data over IP. **Appian:** Yes: up to four cameras including video/zoom camera.
29.	**Reading U.S. Demonstrations Plate Variations**	Green	Yellow	Yellow	Vendors were asked to show their system's alarm capabilities. Blacklists were set up using a random sampling of 12 plates taken from U.S. states; using plates of Northrop Grumman employee vehicles onsite; and using random plates pulled from parking areas. (See Blacklist Section for plate specifics.) **Remington:** Of 176 blacklisted plate reads, the system alarmed on 130. **PIPS:** Of 100 blacklisted plate reads, the system alarmed on 55. **Appian:** Of 149 blacklisted plate reads, the system alarmed on 105.
30.	**Multiple Alarms Handled**	Green	Green	Green	**Remington:** Multiple alarms are stacked in order received. **PIPS:** Multiple alarms are stacked in order received window bar can be color coordinated. **Appian:** Latest alarm takes priority.
31.	**Alert Capability**	Green	Green	Green	All systems offer audible and visual alert and allow the customer the option of setting personal .wav files for alerts. **Remington:** Yes **PIPS:** Yes **Appian:** Yes

Stoplight Performance Chart					
	Rating Codes GREEN: Good YELLOW: Fair RED: Poor	Remington eTrsag	PIPS	Appian	Remarks / Explanation
32.	**Severe Weather**	Yellow	Green	Green	**Remington:** Yes, demonstrations held in August. Virginia temp of 109 degrees with extremely high humidity. Camera located inside polymer barrel was stationed in full sun and began to have problems. Once system moved to shaded area, system worked with minimal data lost. **PIPS:** Yes **Appian:** Yes
33.	**Ability to Interact Watch lists**	Green	Green	Green	All Vendors have the ability to work with government watch lists. **Remington:** Yes **PIPS:** Yes **Appian:** Yes
34.	**Global Positioning System (GPS)**	Green	Green	Green	All vendors have the ability to trace coordinates of vehicle location by recorded alarms. **Remington:** Yes **PIPS:** Yes **Appian:** Yes
35.	**Ability to Read Stacked Digits**	Red	Green	Yellow	Many states include stacked digits as a part of their license plates. See section "Incorrect Reads – Stacked Characters Read as Single Characters." **Remington:** No. System ignores stack and alarms on partial plate number. **PIPS:** Yes. System reads some stacked numbers, does not alarm if partial plate is read. **Appian:** Yes. System reads some stacked numbers, does not alarm if partial plate is read.

11.3 Vendor Equipment Technology Highlights

The full chart, as it is shown below, should NOT be distributed to the vendors.

Table 35: Vendor Equipment Technology Highlights

Vendor Equipment Technology Highlights The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
ALPR Technology	**PROPRIETARY:** ❖ IR illumination, monochrome and color cameras with one mobile video camera , MPH-V3, that has zoom capabilities. Equipment captures license and image of vehicle. ❖ The only ALPR that can read all U.S. state license plates ❖ Two way voice recognition and response, allowing vehicle operator to keep hands on the wheel. ❖ Can read any photo reflective alphanumeric image, including the Federal Motor Carrier Safety Administration's (FMCSA) U.S. Department of Transportation (USDOT) numbers. (Used in the commercial Trucking Industry.) ❖ Offers a "Covert" XPH-8700 camera for fixed locations. Portable, all in one 'intelligent' camera that integrates all the components required to enable coordinated license plate recognition from fixed installations. Includes camera, sensors, self contained, independent IR light system,	**PROPRIETARY:** ❖ IR illumination, monochrome and color cameras. P372 Spike camera has the capability to stream video over IP. ❖ Dual Lens Camera – Color overview and IR lenses within each camera. Capture images of the vehicle and plate. ❖ Platefinder –continually searches the camera's field-of-view for the presence of a license plate. ❖ Triple Flash Technology – patented technology varies the flash, shutter and gain settings of the camera to capture multiple plate images. ❖ Offers covert model 372 camera fixed camera that contains camera, illuminator and processor in the one unit. (Camera still requires back-end software and database.) (6-8 inches long, same circumference as normal cameras.) ❖ Note: If car does not have plate, camera has capability to capture an image (.jpg / .bmp). Claims that it is the only system that can take picture using color side of camera and store it. ❖ Processor can be in notebook/laptop; in	**PROPRIETARY:** ❖ IR illumination, monochrome and color cameras. All cameras have zoom capability and one mobile video camera, Viper, with zoom capability. ❖ Dual Lens Camera with zoom capabilities. The Cobra camera cases have three openings in the front of the case, allowing three main formats: ❖ Cobra Dual – ANPR monochrome zoom camera, Color zoom camera and single illuminator. ❖ From left to right in picture below:- ANPR Monochrome module, color module, IR illuminator. ❖ Cobra Single – ANPR monochrome zoom camera and single illuminator ❖ Cobra Long Range – ANPR monochrome zoom camera and two illuminators. ❖ Cobra system can be supplied with a range of different internal camera and IR illumination options. ❖ Principal feature is the use of a high resolution optical zoom camera. ❖ Uses IR wavelengths to overcome

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	processing unit and independent power source. (Components are integrated inside an IP65 case resembling a standard video-surveillance outdoor camera.) ❖ An integrated MDT/PC in-vehicle system with touch screen is available. (Unique PC-in-Screen design, allows touch screen minimizing keyboard use, components tilts out of the way. Typically, no existing components need to be removed or relocated. Non-glare coated.) ❖ Portable systems are easily moved from vehicle to vehicle. ❖ Alarm can broadcast to operations center or to support vehicle. ❖ MPH-V3 is a digital video camera that assists the mobile mounted cameras by scanning the area directly in front of ALPR vehicle and overlapping into the areas scanned by the other cameras; It can scan plates from 22x zoom distance; can be linked to a recording device or DVR; and can conduct surveillance from nearly a mile away. ❖ MPH-V3 can be linked to a recording device for DVR. ❖ LPR car activity can be broadcast to up to 2 additional support vehicles. Allowing the MPH-900 equipped car to transmit the sound and image of the ALPR screen directory to the support	the 372 camera; or in the super-ex system illuminator. ❖ Can load pictures of people associated with plates or load and track using driver license numbers (option available but it is not currently used). ❖ Note: Claims that it is the only system that can search for partial 'string' plates. i.e. if plate was A_C-13_4 the system could pull correct plate 'ABC-1324'. ❖ Partnering with Motorola for network support. ❖ Patented: Claims to be the only company using a pulsed IR Illumination. Pulses at 60 times a second, these cameras have their own brain/firmware. Because of pulse technology, the camera has no moving parts. (i.e. lens zoom) Camera has to work so fast that technologically impossible to zoom in and out. ❖ Outdoor use: Rugged alloy housing, metal sun hood, sealed end caps (totally sealed enclosure). All cameras casing are nitrogen purged and waterproof to IP67 standard. ❖ Portable Systems are easily moved from vehicle to vehicle. ❖ P372 cameras will accommodate (additional cost) a trigger. Because cars without license plate will not trigger line of sight, the camera's trigger will cause an image of the car to be taken (claims to be the only system that can store these images).	possible issues with plate differing characters and contrasts. ❖ 18x zoom functionality allows optimized field of view (114.83 feet max). ❖ Long range dual illuminator has a range of up to approximately 147 feet (subject to wavelength). ❖ Uses improved processing gain and narrow band IR filtering to provide accuracy in conditions with high sunlight or bright headlights. ❖ All Cobra cameras maintain IP67 standard. ❖ Also used pulse IR illumination. IR Illuminator variable pulse 810nm, 870nm and 940nm. **Talon Sentinel System:** ❖ Dual IR and overview ANPR camera. ❖ Although system uses pulse technology, it can also zoom. ❖ Encased in an ultra high impact copolymer designed to operate in extreme environments. ❖ Platform can be deployed and set up in minutes, using a built in monitor and GUI. ❖ Case design uses neoprene O-rings and ABS latches, enabling the system to be buried in the ground for extended periods of times. ❖ Casing offers total protection for internal PC – airtight, watertight, dustproof, chemical resistant and

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	vehicles, minimizing reaction time. **MPH-900 – Mobile** • Watch list filtering • Probable cause generation for unbiased, targeted search • Auto theft recovery • Plate manipulation • Rental contract violations • Link analysis • Recurring traffic pattern analysis • Suspect surveillance • "Late hit" analysis • Coordination with Mobile Plate Hunters	❖ Question was asked – 'can images of driver be stored?' – Response was that they are the only system that has the ability to load .jpg and .bmp images of people and allow those images to be associated with the specific license plate. (Amber Alert could include photo of felon and of child with plate information.) System can be set to bypass the operator and only inform a specified terminal. The hit and notification is sent directly to the previously specified person and the normal operator does not see the hit occur. **Standard Unit** P362 – IR illumination with monochrome camera and optional color overview. **Optional Unit** –P372 – IR illumination with color overview or monochrome camera. Internal (video) triggering of read. Triple Flash patent – (Eye safety: Class 1M) ❖ IR with the ability to read from combination of color and IR cameras (effective up to 50 feet).	corrosion proof. ❖ Casing is North Atlantic Treaty Organization (NATO) codified and tested to Military (MIL) standard C-4150, IP-67 and ATA (Air Transportation Association). **Stinger Camera – Introduced to Market 2007** ❖ Camera case has cameras, illuminator and processor all fully integrated in a single sealed unit. ❖ Users can select a range of camera and IR illumination options, including dual cameras and long range illumination options. ❖ All camera settings can be controlled and adjusted remotely in real time. ❖ Offers choice of processor and Windows OS; additional electronic sensors, devices and applications can be integrated. These include, but are not limited to Dedicated Short Range Communications (DSRC)/Radio Frequency Identification (RFID), speed and red light detection devices - all connected to and controlled by Stinger. ❖ The processor is capable of handling up to four separate video inputs. ❖ A telemetry interface can be provided as an option to control a pan and tilt head for both ANPR cameras. This allows users to reconfigure cameras for different traffic conditions.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
			Viper Video ❖ Miniature color camera designed to be mounted in front of a vehicle's rearview mirror.
Zoom Capability	**YES:** **PROPRIETARY** Mobile MPH-V3 has the ability to scan plates from 22x zoom distance; link to a recording device for DVR; conducting surveillance from up to a mile away. Max Viewing range 5280 feet. The camera can be mounted on a moveable surface that rotates side to side. (Currently used for Mobile systems only.)	**NO:** **PROPRIETARY** Patented ability – The only company using Pulsed IR Illumination at 60 times a second. There cameras have their own brain/firmware. Pulse every 1/60th of a second. Speed of pulse disallows ability to zoom in and out therefore no moving parts in camera. Pulse grows weaker as it travels which limits distance to 50 feet. The camera can be mounted on a moveable object. (i.e. tripod) and slowly turned side to side.	**YES:** **PROPRIETARY** The ability to scan plates from 18x zoom distance. 18x zoom capability allows optimized field of view. Distance zoom limited to 114.83 feet max
Video input / output	MPH-V3 is a mobile digital video camera that assists the mounted IR cameras. It can be linked to a recording device or DVR.	The overview camera can provide video feed such as streaming video over IP, or the built-in multiplexer can send two signals on a single output. Video requirements: Two cameras can be run off a notebook or laptop but it requires one 'capture card' slot per camera. Panasonic CF29 offers a two card slot notebook and Motorola M1900 can come equipped with one internal capture card and one external card slot.	Viper has three different methods of control available to the operator. Standard RS232 command control protocol, through the software GUI interface available via a MDT touch screen or using a four button keypad mounted on the dash board of the vehicle. These buttons operate the zoom in/out function, one touch auto focus and a default setting activation. Internal Stinger camera processor can handle up to four video inputs. ALPR system can be superimposed on the existing CCTV infrastructure. Max Viewing range 114.83 feet. Video requirements:

Vendor Equipment Technology Highlights The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
			Four cameras can be run off a notebook or laptop one 'capture card' can handle up to four cameras.
Stores Additional images / information	Allows the operator to manually store additional captured images and notes associated with captured data. Ability to take snap shots and store the images.	Allows the operator to manually store additional captured images and notes associated with captured data. (Stores or captures multiple types of .jpg or .bmp images, such as onsite pictures, can be added to system records and pulled up if plate is read.) Ability to take snap shots and store the images	Allows the operator to manually store additional captured images and notes associated with captured data. Ability to take snap shots and store the images.
International Protection Standards	IP Rating 65-66	IP Rating 66-67	All cameras IP Rating 67 ❖ Casing is NATO codified and tested to MIL standard C-4150, IP-67 and ATA.
Nitrogen Purged Camera Casings	**No**	Uses as an additional precaution to keep the internal workings safe from the elements.	**No**
Software COTS	**SUPPLIED** Software is supplied and requires SQL back-end. Licenses are charged by the IP address. (i.e. a vehicle mobile system – one charge or each fixed camera.) Database does not require licensing.	**SUPPLIED:** Software is supplied and requires SQL back-end. Currently requires 1 license. One license will support up to 12 dispatch clients (upgrades available.)	**SUPPLIED:** Software is supplied and requires SQL back-end. There is a standard fee for the Back Office software and then a fee per ALPR system that is connected to the Back Office.
Sleep Mode or ability to preset auto on/off Internal/Exter -nal Triggers	Sleep mode can be set by user so that system will hibernate. Requires an external trigger to 'wake' the system. System can be set up to capture image when triggered.	During sleep mode, the camera searches for license plate within field of view. If plate appears, camera 'wakes up'. System can also be preset to hibernate then capture images when an external trigger occurs.	Offers both external and internal trigger System can be set by user to power on / off at specified times. System can be preset to hibernate then capture images when an external trigger occurs.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
Covert System Equipment / Storage / Power Supply	XPH-8700 camera is located inside of a construction barrel (IP65). A camera includes processor and illuminator. Power supply can be by local source, vehicle, battery or generator.	Covert set within fake light display. (Vehicle light bar) or tripod. Non-vehicle equipment would require camouflage. Power supply currently by local source, vehicle, battery, or generator.	Keyboard, monitor, processor and power supply can be located inside of a Pelican-case. Camera is separate, attached to the case by cabling. (Copolymer case IP67 and NATO tested MIL C-4150). Power supply can be by local source, vehicle, battery or generator. System can use 12v with 35 amp hour capability. If requested, Appian Technology supplies Marine batteries.
Covert Surveillance	**YES:** **PROPRIETARY:** Offers LPT-900 Covert Mobile. Offers FPH-900 custom. Offers the XPH-8700 (fixed and portable) cameras. ❖ Includes camera, sensors, self contained, independent IR light system, ALPR processing unit and independent power source. (Components are integrated inside an IP65 case resembling a standard video-surveillance outdoor camera.) ❖ System operates either on available power supply or on an independent rechargeable power supply. (All data can be downloaded via a wireless network to the back-end database. It is possible to have a database on site and consolidate the data with the master each day.)	**YES:** **PROPRIETARY:** ❖ Offers model 372 fixed cameras (fixed locations only). ❖ Cameras contain illuminator and ALPR processor in one unit also includes termination box (6-8 inches long, same circumference as normal cameras). ❖ System operates either on available power supply or on an independent rechargeable power supply (Marine batteries). ❖ System can operate on power save mode with external trigger wake up. (All data can be downloaded via a wireless network to the back-end database.)	**YES:** Talon Sentinel System: ❖ Dual IR and overview ANPR camera. ❖ Encased in an ultra high impact copolymer designed to operate in extreme environments. ❖ Platform can be deployed and set up in minutes, using a built in monitor and GUI. ❖ Case design uses neoprene O-rings and ABS latches, enabling the system to be buried in the ground for extended periods of times. ❖ Casing offers total protection for internal PC – airtight, watertight, dustproof, chemical resistant and corrosion proof. ❖ Casing is NATO codified and tested to MIL standard C-4150, IP-67 and ATA (Air Transportation Association). ❖ Automatic in picture video trigger.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
			Does not require external trigger.
Vehicle System Power Supply	Plugs into the vehicles power supply and adds a 12 VDC power supply to 'gracefully' power down the unit when the vehicle is turned off.	Plugs into the vehicles power supply.	Plugs into the vehicles power supply.
Administrative Training	**YES:** Four levels of administration available, from read-only inquiry user to full administrator rights.	**YES:** Mobile Application (PAGIS) and the System Administration for the BOSS have training classes given (1 ½ days).	**YES:** Offers training courses for both users and administrators. Also offers 'train the trainer' classes.
Data Mining	**YES:** There are purge parameters built into the application that allow non-alarm plate reads and alarms to be independently scheduled for purge. Backup, restore and list management as well as insert and remove functions are all supported through the interface with the right permissions. There are four levels of administration available, from read-only inquiry user to full administrator rights. For customers expecting to retain more then 3 million plate records in the live database, Remington-Elsag recommends full SQL Server be used and that the database environment be designed and supported according to the customer's own classification and procedures (that is, you determine how mission critical the data is to your environment.)	**YES:** Requires back-end software ran on an SQL machine. Max amount of data that can be stored with the standard setup in the Microsoft SQL server Desktop Engine (MSDE) is 100,000 data packets. If large amounts of data are to be stored, than an upgraded version of the PIPS software will be required (cost increase). Once software is upgraded, limited only by size of customer storage. Once the software is updated, the storage amount is limited only by the size of the customer's database.	**YES:** Requires back-end software ran on an SQL machine. PRO: Once the software is updated, the storage amount is limited only by the size of the customer's database. ❖ The storage amount is limited only by the size of the customer's database.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	❖ The system default is to save plates for a specified amount of time, keep only those plates flagged and discard the rest. ❖ The system default can be modified to keep all data. ❖ Limited only by size of customer storage database. (i.e. If the customer is expecting to retain more then 3 million plate records in the live database than Remington-Elsag recommends full SQL Server be used and that the database environment be designed and supported according to the customer's own classification and procedures.		
Data Purging	Has parameters that can be independently scheduled for non-alarm and alarm plate reads that will purge old data. Has the ability to differentiate between hit and non-hit data, allowing user to maintain hits while purging non-hits.	Has the ability to purge data older than a certain period, but does not differentiate non-hit from hit data.	Purging data parameters can be preset by user
Queries & Data Returned	❖ What information is provided in response to a search? Date, time, plate, GPS lat/long, image file name, image and state if the installation is configured to classify state. ❖ Has the ability to track all movements of one plate? o A search for hits related to a single plate can be executed and exported into MapPoint or other mapping software	❖ What information is provided in response to a search? License Plate Patch: IR Image of the License Plate; License Plate Read; GPS Coordinates; Color Overview Image; Date and Time Stamp. ❖ Has the ability to track all movements of one plate? o Previous hits are flagged in MapPoint using fixed camera GPS coordinates.	❖ What information is provided in response to a search? Date, time, plate, GPS lat/long, image file name, image and State if the installation is configured to classify state. ❖ Has the ability to track all movements of one plate? A search for hits related to a single plate can be executed and exported into MapPoint or other mapping software allowing track definition.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	allowing track definition. ❖ Does the system have the ability to cross reference (i.e. license plate to driver's license, social sec number etc.)? o Customers can load information on a note related to the alarm and notify the user of information like make, model and color or wanted person's name. o Customers can build lists of vehicles associated with suspended drivers but usually build lists using suspended vehicles. ❖ Are there any limitations to the amount of data a customer can store? o No. The limitation is on your infrastructure not in the software. With enough disk space and processing power your database of choice is the limiting factor.	❖ Does the system have the ability to cross reference (i.e. license plate to driver's license, social sec number etc.)? o If driver data is associated with the plate in the system. ❖ Are there any limitations to the amount of data a customer can store? o If storing over 100,000 data packets than an upgraded version of the software and licensing will be required as well as full version of SQL.	❖ Does the system have the ability to cross reference (i.e. license plate to driver's license, social sec number etc.)? Customers can load information on a note related to the alarm and notify the user of information like make, model and color or wanted person's name. Customers can build lists of vehicles associated with suspended drivers or vehicles ❖ Are there any limitations to the amount of data a customer can store? ❖ No. The limitation is on your infrastructure not in the software.
Database	The system is typically installed with Microsoft Desktop Engine (MSDE) or SQL Server. (The simplest version of the Microsoft database can be used and requires no additional licensing, maintenance or administration.)	With basic version of the back-end office software, the customer may use basic SQL version. If using the enhanced version of back-end software, than full version of SQL is needed. (additional licensing would be needed for both)	MSDE or SQL Server.

Vendor Equipment Technology Highlights The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
System Patches to Algorithms	Uses an internal algorithm. System is programmed to automatically run algorithms if plate digits are ambiguous. Remington supplies patches to fix issues.	Fuzzy logic is available. Customer can administer temporarily fixes to force the system to read an ambiguous digit. PIPS Technology will patch the software to fix.	System offers the user the ability to set multi-level internal reads to provide multiple reads of problem digits but would impact the operational performance increasing negative alarms. Appian Technology supplies a software patch to fix
Hardware Requirements - Supplied by Vendor	**PROPRIETARY:** Camera, cabling, mounts, portable processor, software supplied. Offers a MDT sold separately. **OPTIONS:** ❖ Offers a touch screen system (available thru Remington-Elsag at additional cost). ❖ Offers a two way voice recognition system (Created by and available thru Remington-Elsag). ❖ Touch Screen minimizes the need for keyboard use. ❖ Voice recognition allows vehicle operator's attention to remain on the road (can integrate into an existing MDT).	**PROPRIETARY:** Camera, cabling, processor and software supplied. Offers MDTs at a separate cost. **OPTIONS:** ❖ Offers touch screen system (available thru PIPS Technology at additional cost). ❖ Touch screen minimizes the need for keyboard use.	Camera, cabling, mounts, portable processor, software supplied. Offers MDT standard with non-covert systems. Talon 'pelican-case' cover system includes built in monitor, GUI and 2 PCI slots for frame grabbers. **OPTIONS:** ❖ Integral high brightness 15" TFT display. ❖ Integral sealed membrane keyboard and mouse pad. ❖ Touch screen minimizes the need for keyboard use. ❖ Touch Screen for non-covert systems are standard with system (covert - optional).
Hardware Requirements - Supplied by Customer	Laptops not supplied. For an additional cost, the company offers an in-vehicle MDT/PC touch screen system as an option. Database equipment: Typically a MSDE or SQL Server.	Laptop/notebook & back-end database are not supplied. For an additional cost, the company offers an in-vehicle MDT system. (Representative recommended that laptops or similar equipment be bought from outside the company in order to save the customer additional cost.)	Laptops and back-end database not supplied. NOTE: Covert 'pelican case' includes processor, screen, keyboard etc as part of the case.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
Compatible With Current Cameras & Systems	**YES:** Vendor would need to review current systems, but it is possible to run their technology on some currently used systems.	**NO:** Claims that compatible only with PIPS Technology cameras and equipment. NOTE: Evidence has been shown by other sources that the cameras will work with other vendor's equipment.	**YES:** ALPR can be superimposed with current CCTV systems. Has also shown ability for its system to work with other cameras, including PIPS.
Stationary & Portable Unit Availability	Portable, Temporary and Permanent Yes: Vehicle cameras may be mounted using a magnetic strip, allowing the customer to move the equipment from one vehicle to another.	Portable, Temporary and Permanent Yes: Vehicle cameras may be mounted using a magnetic strip, allowing the customer to move the equipment from one vehicle to another.	Portable, Temporary and Permanent Yes: Vehicle cameras may be mounted using a magnetic strip, allowing the customer to move the equipment from one vehicle to another.
Network	**YES:** Builds its own network or integrates with current setup.	**YES:** Partners with Motorola for distributors of equipment supply.	**YES:** Builds its own network or integrates with current setup.
Stationary (fixed) / permanent Locations Multi-lane coverage	**YES:** Typical traffic lane is 11 feet wide. Each camera has the ability to read two lanes however, suggests using one camera per lane.	**YES:** APLR P372 Cameras Typical traffic lane is 11 feet wide. Horizontal view on one camera is 5 feet. For double lanes, where more than one lane is passing through a single gate, two cameras are recommended, giving a 'cross over' radius with a minimum of 8 feet horizontal view. **NOTE:** Typical traffic lane is 11 feet wide – horizontal view on one camera is 5 feet, view	**YES:** Typical traffic lane is 11 feet wide. Each camera has the ability to read two lanes however, suggests using one camera per lane.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
		for 2 would have crossover range giving minimum of 8 feet.	
MOBILE Multi-lane coverage	**YES:** **Up to four Lanes** **PROPRIETARY:** Can read up to four lanes at one time with three cameras. Each camera has the ability to read two lanes however, suggests using one camera per lane. ❖ Recommends 1 camera per lane, four camera limit in a vehicle (one can cover two lanes)	**YES:** **Up to 3 Lanes** Vehicle has three cameras that can be mounted on a permanent bar. Or two camera's on bar and one camera mounted on the window frame. ❖ Recommends one camera per lane, Maximum of three cameras.	**YES:** **Up to 4 Lanes** **PROPRIETARY:** Can read up to four lanes at one time. Each camera has the ability to read two lanes however, suggests using one camera per lane. ❖ Recommends one camera per lane, four camera limit in a vehicle (one can cover two lanes)
Mobile to Mobile (moving vehicle with camera clearly reading oncoming traffic.)	**YES:** Permanent roof mount: 140 MPH closing speeds and 75+ MPH passing speeds. (day or night any weather) ❖ Magnetic strips are secure for closing speeds and allow camera to be moved from vehicle to vehicle easily.	**YES:** Permanent roof mount: 130 MPH closing speeds. ❖ Magnetic Strip and Window Mount cameras make the cameras easy to move from vehicle to vehicle.	**YES:** Permanent roof mount: 130 MPH closing speeds. Magnetic strips are secure for closing speeds and allow camera to be moved from vehicle to vehicle easily. Suction cup mounts are recommended for low speed areas such as parking garages.
MOBILE Camera Locations	❖ **Camera 1** reads both parked vehicles and cars that are passed on the left. ❖ **Camera 2** reads up to two lanes of oncoming or parked vehicles on the right. ❖ **Camera 3** Optional camera that can be rotated in all directions to supplement left and right cameras. (MPH-V3 camera 22x zoom distance).	❖ **Camera 1** reads both parked vehicles and cars that are passed on the left, distance of 20-30 feet. ❖ **Camera 2** reads oncoming traffic and parked cars on the left, distance of 15-18 ❖ **Camera 3** Mounted on the window of the car or mounted via a special curved light bar mount; reads side view only; distance of 9 feet.	❖ **Camera 1** reads both parked vehicles and cars that are passed on the left, distance of 20-30 feet. ❖ **Camera 2** reads oncoming traffic and parked cars on the left, distance of 15-18 ❖ **Camera 3** Optional Camera that can be rotated in all directions to supplement left and right cameras (Viper video

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	❖ **Camera 4** Optional camera that can be mounted in the back window to read behind the vehicle; catching plates as they pass. Can be linked to a recording device or DVR to conduct surveillance up to a mile away.	Distance can be varied for type of area (one way street, parking lots etc).	camera).
Reading U.S. Plate Variations or Vehicles without plates	Reads all U.S. and UK plates, parts of Mexico and Canada. Does not have an automatic method to capture vehicles without plates.	Difficulty with 'red on white' or 'green on white' such as Massachusetts. Flat Plates: Has difficulty with flat plates. Can load algorithms based on area where equipment will be used to read those flat plates. Has an **optional** trigger that will cause the system to capture and store an image if the vehicle does not have a plate.	Reads most U.S. and all UK, including flat plates. May require a developer to modify the programming depending on any changes made to the U.S. plates. Types must be rectangular, square, normal polarity (dark on light) and inverse to be read. Does not have an automatic method to capture vehicles without plates.
ALPR Read Capabilities – DOT Numbers	**YES:** Any photo reflective alphanumeric image (will read taxi phone numbers etc.). Demonstrations results did show DOT as being read.	**NO:** OCR-based technology that scans license plates only and some boat plates. Has difficulty with flat plates and plates such as Massachusetts (red on white or green on white).	**YES:** Initially vendor thought the system reading DOT numbers was not desired and had been trying to stop it from doing so. Any photo reflective alphanumeric image (will read taxi phone numbers, etc.). Demonstrations results did show DOT as being read.
Multiple Hits Handled	**Fixed Systems:** The alarms will queue up; claims tested this successfully with thousands of queued alarms. **Portable Systems:** Alarms queue up as well, but after a configurable period (default 3 minutes) the	**Fixed Systems:** When you get a hit, the screen stays up until acknowledged. If it is not acknowledged and another hit occurs, the hits are 'stacked' in order of hit time. System does not differentiate or prioritize by type of hit. **Portable Systems:**	**Portable and Fixed Systems:** The alarms will queue up; latest takes precedence over previous alarms. User can preset so alarms will stack in queue or come to front of queue depending on type of alarm.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	alarm is still permanently recorded but the system returns to the normal display mode. ❖ The system uses voice notification saying: "Stolen Vehicle", "Stolen License Plate", "Wanted or Missing Person", "Suspended or Revoked Registration", and "Scofflaw or other violation". ❖ The text messages are specific to the vehicle and can include make, model, color, registered owner name, or customer-specified data. ❖ For portable units, if another hit occurs while the user is dealing with current alarm, the system will not interrupt them. The system will queue the second alarm until the user has completed working on the first. o If another hit occurs and the unit is not currently in use, the alarm will sound and all hits will be displayed in the order received. o Alarms are set to expire, once an alarm expires, display will return to normal mode. ❖ For fixed units, lists all the alarms on the interface and each can be opened with a single click. The interface is web-based; windows are opened in new browser windows. The alarm bells are color coded by type (gate, car, un-cancelled). The text of the alarm is not displayed until the user	Alarms queue up and opened screens remain up until acknowledged. ❖ BOSS System Administration may assign a point value to each type of hit severity of the crime. ❖ Admin can assign a specific color border for each assigned value – color coordinating windows based on crime severity. ❖ If multiple hits occur, the new hit's windows stack behind the first hit. ❖ The operator is notified that there is another hit by alarm and if previously assigned by admin, colors at the top of the windows can be used as reference to severity. ❖ Claims system will stack additional hits up to 999 pop-up windows. Stacks in order received, will not automatically prioritize.	

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	clicks on the new alarm icon. The user can click on each new alarm and open all windows in a "stacked" or tiered window display. o Alarms will not expire without user acknowledgement. ❖ Claims system will queue "thousands" of hits. Stacks in order received; will not automatically prioritize.		
Audible Alerts	**YES:** ❖ Offers ability to vary alerts so that each alarm represents a single set (i.e. stolen, traffic violations, amber alert etc). ❖ Voice recognition can be set to say 'stolen', 'amber alert', etc. ❖ When you get a hit, the fixed system screen stays up until acknowledged. o Mobile system can be set to time out. ❖ Will stack additional hits without interrupting user's work.	**YES:** ❖ When you get a hit, the screen stays up until acknowledged. ❖ Will stack additional hits up to 999 screens. ❖ Stacks in order received; will not prioritize (although it does audible and visual notices). ❖ Administrator can pre-set database to also display color-bar along top of window. Each color is associated with a certain type of hit/crime.	**YES:** ❖ Offers ability to vary alerts so that each alarm represents a single set (i.e. stolen, traffic violations, amber alert etc). ❖ When you get a hit, the fixed system screen stays up until acknowledged. o Mobile system can be set to time out. ❖ Default is for new hits to come to the 'top' – may interrupt user's current work. However, the system can be programmed not to do so.
Severe Weather	**YES:** Works day or night in all weather conditions. ❖ High resolution cameras are **IP66 standard** for weather, water jets, moisture and dust. ❖ General use cameras are **IP65 standard** for particles and dust. Note: Demonstrations held in August,	**YES:** Works day or night in all weather conditions ❖ Fixed systems offer rugged alloy housing, metal sun hood, sealed end caps (totally sealed enclosure). All camera's casings are nitrogen purged and waterproof to **IP67 standard**. ❖ Representative noted that heavy rain on **mobile** cameras 'rarely' affected resolution.	**YES:** Works day or night in all weather conditions ❖ All Stinger & Cobra cameras maintain IP67 standards. ❖ Covert pelican case design uses neoprene O-rings and ABS latches, enabling the system to be buried in the ground for extended periods of times. This case offers total protection for the internal PC – airtight, watertight,

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	Reston, Virginia temp was 109 degrees with extremely high humidity. Camera located inside polymer barrel in direct sunlight. Began to have problems - once system moved to shaded area, system worked. Minimal data lost.	❖ Representative noted that heavy rain on **fixed** cameras may blur the images	dustproof, chemical resistant and corrosion proof. ❖ Case is also NATO codified and tested to MIL STAN C-4150, IP-67 and ATA (Air Transportation Association) ❖ Automatic in picture video trigger. Does not require external trigger.
Ability to Interact with Watch Lists	**YES:** Can interact with any watch list as long as permissions are given.	**YES:** Can interact with any watch list as long as permissions are given.	**YES:** Can interact with any watch list as long as permissions are given.
Search Data	**YES:**	**YES:**	**YES:**
Vehicle Outer Mounting Options	**Mounting Options:** ❖ Roof Mounts: Magnetic Strips Permanently attached to roof or light bar. Mounted inside objects such as Light display or sports/luggage rack. ❖ Bumper Mounts: Can be mounted to truck bumpers in front of the grill.	**Mounting Options:** ❖ Roof Mounts: Permanently attached - PIPS casing has a required bracket. PIPS will customize the mount bar so that it attaches to current light bar. Magnetic Strip Mount, includes a wire tether for safety. ❖ If it is a 2-Camera Portable System, a laptop computer can be utilized with portable mounts. ❖ If it is a 3 or 4 – Camera System, it must be "hardwired" in the vehicle, an independent ALPR Processor must be supplied (SupeRex) and a Touch Screen Monitor with Mounting Console must be supplied.	**Mounting Options:** Roof Mounts: Magnetic Strips Permanently attached to roof or light bar. Mounted inside objects such as Light display or sports/luggage rack. Bumper Mounts: Can be mounted to truck bumpers in front of the grill.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
Global Positioning System (GPS)	**YES:** ❖ GPS location is pinpointed on a map, showing most recent sightings of a suspect vehicle. ❖ User may pull previous sighting from the database and display on a map.	**YES:** ❖ GPS location is pinpointed on a map, showing most recent sightings of a suspect vehicle. ❖ User may pull previous sighting from the database and display on a map.	**YES:** ❖ GPS location is pinpointed on a map, showing most recent sightings of a suspect vehicle. ❖ User may pull previous sighting from the database and display on a map.
SUPPORT	**YES:** A contact number is given to customer where they may reach Technical Support 24X7. Maintenance is free for the first year and 5 percent (5 percent ongoing support – 10 percent non ongoing support) of system cost thereafter. Support includes software upgrades.	**YES:** A contact number is given to the customer where they may reach Technical Support All PIPS Technology supplied hardware and software is covered by a one-year warranty. At the expiration of the first year, PIPS Technology recommends that the Customer extend their maintenance agreement. Broken parts are replaced or repaired in the Knoxville Office. (PIPS Technology advises for multiple systems, it is advisable to keep one or two units in inventory for mission critical applications.) Problematic license plates that require OCR	**YES:** A contact number is given to customer where they may reach Technical Support 24X7.

Vendor Equipment Technology Highlights *The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
		Updates and all software upgrades or "patches" are at no cost to the customer so long as the customer is under a Maintenance Agreement.	
Limits to Number of States	System can be programmed to read all states or to read only those that customer needs. Multi State Contract available to any National Association of State Procurement Officials (NASPO) state.	OCR "Engine" – Unlike some players in the ALPR community, PIPS does not use generic OCR engine for all states and regions. PIPS Technology uses a customized OCR engine specific to the state or region of interest. The engine reads the captured IR plate image and converts it to a data file. System can is programmed to read a certain number of surrounding states.	System can be programmed to read all states or to read only those that customer needs.
Weight in Motion monitoring	Products can be used with weight-in-motion and radiological monitoring applications.	PIPS Technology products have been used for weight-in-motion and radiological monitoring applications.	Products can be used with weight-in-motion and radiological monitoring applications.
Target Who Receives Data	Offers a covert option – either for plates or for tracking employee IDs. System can be set to bypass the operator. Flagged target is sent directly to a previously specified person. Current operator would not see flag occur.	Offers a covert option – either for plates or for tracking employee IDs. System can be set to bypass the operator. Flagged target is sent directly to a previously specified person. Current operator would not see flag occur.	Offers a covert option – either for plates or for tracking employee IDs. System can be set to bypass the operator. Flagged target is sent directly to a previously specified person. Current operator would not see flag occur.
Driver Interaction "Hands Free" Capabilities: **TOUCH SCREEN**	**YES:** Offers an "MDT/PC" - a touch screen in-vehicle system (sold separately). ❖ Unique PC-in-Screen design allows simple installation. ❖ No remote wiring or remote system unit. ❖ Touch screen minimizes searching for keyboard and keys. ❖ Non-glare coating and touch screen improve visibility for user. Self-	**YES:** Offers an "MDT" touch screen system. No additional information made available about the system.	**YES:** Offers an "MDT" touch screen system. For the Talon case, the touch screen is a part of the system.

Vendor Equipment Technology Highlights The following chart contains information provided by the vendors. Not all of these claims were verified as part of the ALPR demonstrations.			
	Remington-Elsag	**PIPS Technology**	**Appian Technology**
	contained PC-in-Screen design keeps equipment in center area. ❖ Components tilt out of the way further minimizing installation and improving space efficiency in the vehicle. Typically, no existing components (radios, etc) need to be removed or relocated.		
Driver Interaction "Hands Free" capabilities: **VOICE RECOGNITION**	**YES:** Two way voice recognition and response. Sold separately, the system installs easily on an existing MDT or a handheld device (sold separately). The officer stays focused on the road and the suspect vehicle. The System has a Wide range of phonetic alphabets supported allowing the officer to use the most comfortable set (Adam, Boy, Charles,… Alpha, Bravo, Charlie,…). The system tracks all activity to allow integrated reporting with the MPH-900 and augments the MPH-900 by allowing the officer to quickly check plates outside of the camera's view.	**NO:**	**NO:**

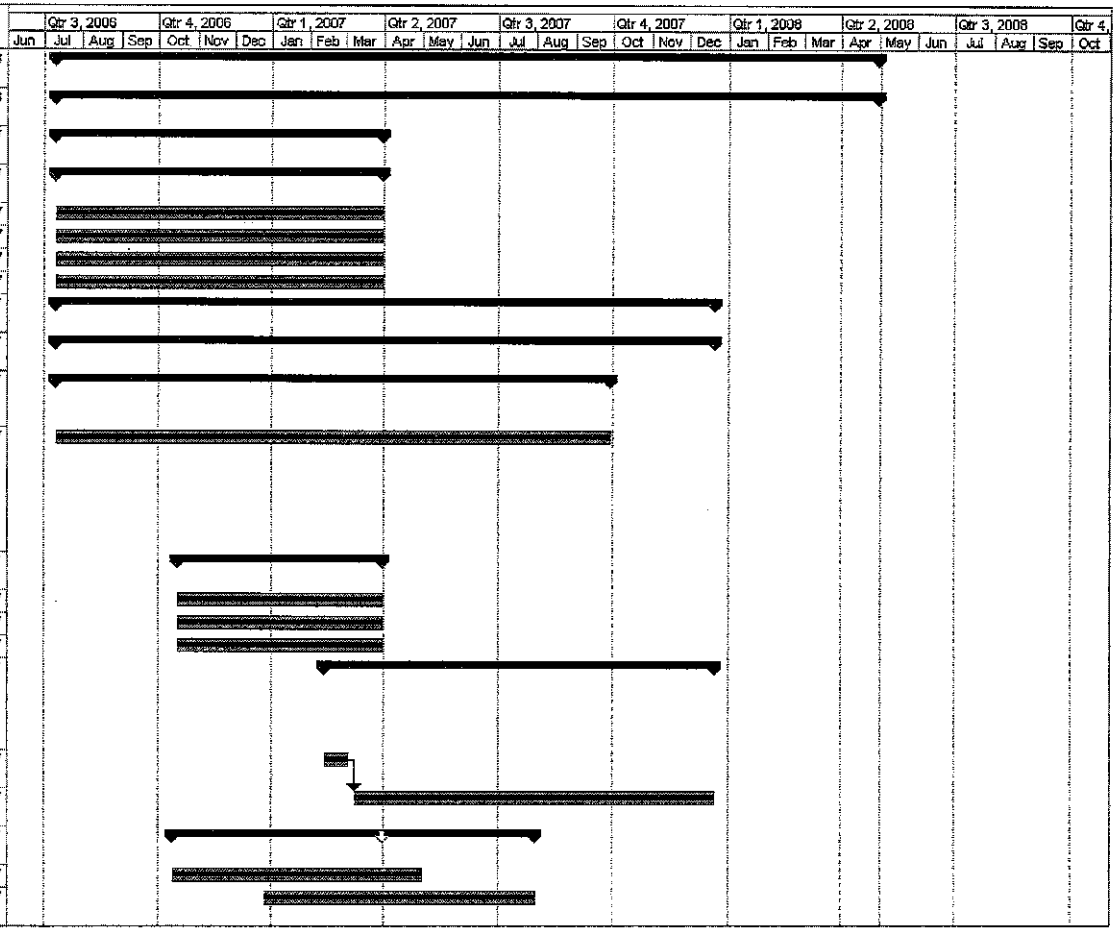
12.0 CONTACT INFORMATION

Table 36: Contact Information

Northrop Grumman Contact Information
(b) (6) Project Manager Command and Control (C2) Systems Division 2340 Dulles Corner Blvd Mailstop: UVA389/3S02 Herndon, VA 20171 (b) (6)
(b) (6) Team Lead C2 Systems Division 2340 Dulles Corner Blvd Mailstop: UVA389/3S02 Herndon, VA 20171 (b) (6)
Vendor Contact Information
(b) (6) Director of Engineering **Remington-Elsag Law Enforcement Systems** PO Box 788 Pleasant Garden, NC 27313 Main Office: 336-379-7135 www.elsagnorthamerica.com
(b) (6) General Manager - USA **Appian Technology Inc** 13850 Ballantyne Corporate Place Charlotte, NC 28277 Main Office 704-887-5245 www.appian-tech.com
(b) (6) Southeast Regional Sales Manager **PIPS Technology** 804 Innovation Drive Knoxville, TN 37932 Main Office: 865-392-5540 www.pipstechnology.com

13.0 PROJECT SCHEDULE

ID	Task Name	Start	Finish
1	**06CITY56-Truck & Vehicle Identification Pilot & Operations**	**Mon 7/10/06**	**Tue 4/29/08**
2	**Develop a PowerPoint presentation explaining the goals and objectives of this**	**Mon 7/10/06**	**Tue 4/29/08**
3	**Identify Available COTS Identification Systems**	**Mon 7/10/06**	**Fri 3/30/07**
4	**Identify applicable technologies for Vehicle Identification**	**Mon 7/10/06**	**Fri 3/30/07**
5	RFID	Mon 7/10/06	Fri 3/30/07
6	License Plate Reader	Mon 7/10/06	Fri 3/30/07
7	Vehicle Matching	Mon 7/10/06	Fri 3/30/07
8	Others	Mon 7/10/06	Fri 3/30/07
9	**Identify Vendors for Details on Available COTS**	**Mon 7/10/06**	**Thu 12/20/07**
10	**Identify Manufactures for relevant security technologies.**	**Mon 7/10/06**	**Thu 12/20/07**
11	**Collect strength and weaknesses information via vendor demo and research.**	**Mon 7/10/06**	**Fri 9/28/07**
12	Collect available research data. (Cost, installation, maintenance, operational, lifespan, portability, power requirement, calibration, communication, data collection/database, and upgrades capability)	Mon 7/10/06	Fri 9/28/07
13	**Attend relevant/available product demonstration(s).**	**Mon 10/16/06**	**Fri 3/30/07**
14	At Product manufacturing Site	Mon 10/16/06	Fri 3/30/07
15	At Vehicle manufacturing Site	Mon 10/16/06	Fri 3/30/07
16	At symposium/Shows	Mon 10/16/06	Fri 3/30/07
17	**Generate and maintain a comparison matrix Draft Report for the identified vendor systems/capabilities and weaknesses**	**Mon 2/12/07**	**Thu 12/20/07**
18	Deliver a Copy of Draft Report to TSA for Review/Comments.	Mon 2/12/07	Fri 3/2/07
19	Generate Final Report (including TSA Comments)	Thu 3/8/07	Thu 12/20/07
20	**Plan a Demo for TSA selected Vehicle Identification product**	**Thu 10/12/06**	**Mon 7/30/07**
21	Select a demo site with Airport Access	Thu 10/12/06	Mon 4/30/07
22	Coordination with local police, law enforcement and Transportation office(s)	Tue 12/26/06	Mon 7/30/07



ID	Task Name	Start	Finish
20	**Plan a Demo for TSA selected Vehicle Identification product**	**Thu 10/12/06**	**Mon 7/30/07**
21	Select a demo site with Airport Access	Thu 10/12/06	Mon 4/30/07
22	Coordination with local police, law enforcement and Transportation office(s)	Tue 12/26/06	Mon 7/30/07
23	**Demonstration Required Equipment**	**Wed 12/20/06**	**Tue 7/10/07**
24	Initial Demonstration Review	Tue 2/20/07	Mon 7/9/07
25	Identify demo parts and personnel support on loan from vendors.	Wed 12/20/06	Mon 4/9/07
26	Identify demonstration sites at selected ai	Thu 2/1/07	Thu 6/21/07
27	Request needed Demo Equipment from Selected manufacturer(s)	Mon 3/12/07	Fri 6/29/07
28	Request TSA Authorization to purchase or rent required equipment/training.	Wed 3/28/07	Wed 7/4/07
29	Final Demonstration Review	Tue 5/1/07	Tue 7/10/07
30	**Plan Vehicle Identification Demonstration**	**Mon 7/23/07**	**Fri 8/24/07**
31	Final Demonstration Review	Mon 7/23/07	Wed 8/1/07
32	Remington-Elsag Demonstration	Sun 8/5/07	Fri 8/10/07
33	PPS Technology Inc.	Mon 8/13/07	Fri 8/17/07
34	Appian Technolgy PLC	Mon 8/20/07	Fri 8/24/07
35	**Generate reports based on Demonstration Execution.**	**Sun 9/30/07**	**Tue 4/29/08**
36	Collect all the data from event.	Sun 9/30/07	Tue 10/30/07
37	Generate a Draft Report	Wed 10/31/07	Thu 11/8/07
38	Present Draft Report to TSA for comments	Thu 11/15/07	Tue 11/20/07
39	Generate a Final Report to include TSA comments	Fri 11/30/07	Mon 12/10/07
40	Deliver Final Report to TSA	Thu 12/20/07	Tue 4/29/08

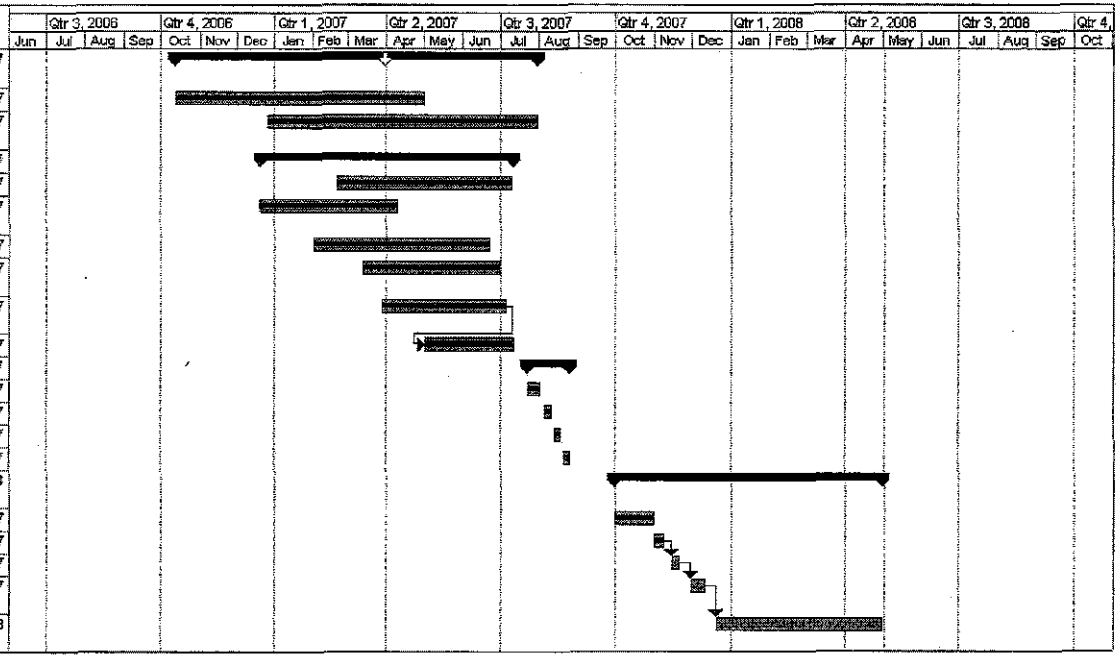


Figure 71: Project Schedule

14.0 BACKGROUND RESEARCH

14.1 License Plate Formats:

In the U.S., license plates are issued by an agency of the state and the formats of issued plates vary from state to state making it difficult for a system to be put into place that can read all license plates. The following is just a sample of the differences between states:

- Georgia:
  - Passenger plates - I, O, Q, U, and V are not used.
- Idaho:
  - County allocation system. Counties were coded by first letter and then numerically, so that the first county alphabetically to start with 'B' is given code '1B', the second is '2B', etc.
- Maryland:
  - Does not use I, O, Q, nor U on any plate, *other than organizational, vanity, and amateur radio.*
- Mississippi:
  - County allocation system. Regular passenger plates are embossed, but rental car series and special issues are flat. Mississippi does not use the alpha character 'O' or the numerical combination '666' on plates.
- New York:
  - Empire State High Plates - Letters I, O, and Q are not used in any position.
- North Carolina:
  - On specialty plates the numeral '0' & letter 'O' are interchangeable. *The special characters (*&^# percent@$!?) may be used* in your plate text.
- North Dakota:
  - Passenger plates use 'I' and 'O' in the *middle position only*, but an exception was made for the GKI, GLI, GMI and GNI series.
- Ohio:
  - A zero (Ø) must always be led or followed by another number 1-9.
- Virginia:
  - Does not use I, O, or Q on *standard* passenger plates.
- Florida :
  - Wheelchair icon: The license plate might read 46798 with a wheelchair icon following. *The wheelchair icon actually stands for "WT". The tag would be run as 46798WT.*

Unfortunately, there is no quick fix for setting a national format standard. One frequent suggestion is that states refrain from allowing the use of vanity plates and instead use a system like the county allocation systems where the characters are based on state, county, and vehicle type. However, by charging fees for vanity plates, states are able to make more revenue.

14.2 State Names:

The major objective of any ALPR system is to interpret license plate alphanumeric characters. Some states are looking for applications that read the jurisdiction which issued the plate. This task is a difficult one because not all states have the full state name on the plate; some used specialized or cursive fonts and the location of the state name on the plates varies. When the state name is present, it is usually either too small to be captured by the system's color camera or it is coated, as the background of most plates are, with reflective paint so IR cameras do not pick it up.

Some applications suggest, when entering blacklisted plates, the state information be associated with the data so if there is a hit the system pops up the associated state and the officer can check the information against the current hit.

14.3 Multiple Jurisdictions:

Sharing data is often listed as an issue. State Police, County Police, and City Police forces would be able to benefit if they would be willing to share their data with other police agencies.

Federal, State, and local regulations require that agreements between agencies within their respective jurisdictions receive advanced approval from their governing hierarchy. This precludes informal information sharing agreements between those agencies. Add to this, the fact that many requirements vary from agency to agency according to the statutes by which they were governed and you begin to see the difficulty of sharing data from city to city, city to county, etc.

"Florida's . . . home to about 400 law enforcement agencies, including city, county, and university police departments, sheriffs, and district attorneys. All of them have their own budgets, computer-aided dispatch systems, and record management systems. The problem was that none of them were connected. The Florida Department of Law Enforcement (FDLE) established eight metadata planners, one for each of the state's seven regions plus one for the Department of Corrections. Then the FDLE decided to use the National Information Exchange Model, an interagency framework for sharing information using Extensible Markup Language, an open standard that allows exchange of information regardless of computer systems or platforms.[GCN Article]"

15.0 APPENDICES

Appendix A - Acronyms

ALPR	Automatic License Plate Recognition
ANPR	Automatic Number Plate Recognition
ATA	Air Transportation Association
BOSS	Back Office System Server
CCD	Charge Coupled Device
CCTV	Closed-Circuit Television
COTS	Commercial Off The Shelf
CTO	Chief Technology Office
DHS	Department of Homeland Security
DOT	Department of Transportation
DSRC	Dedicated Short Range Communications
DVR	Digital Video Recorder
FDLE	Florida Department of Law Enforcement
FMCSA	Federal Motor Carrier Safety Administration
FTP	File Transfer Protocol
GPS	Global Positioning System
GPRS	General Packet Radio Services
GSM	Global System for Mobile communications
GUI	Graphical User Interface
HMC	Highway Motor Carrier
IAD	Washington Dulles International Airport (Airport CodeO
IP	International (Ingress) Protection
IR	Infrared
LAN	Local Area Network
LED	Light-Emitting Diode
LPR	License Plate Recognition
LPSymbols	License Plate Symbols
MDT	Mobile Data Terminal
MIL	Military Standard
MPH	Miles Per Hour
MPH	Mobile Plate Hunter
MSDE	Microsoft Desktop Engine
MWAA	Metropolitan Washington Airports Authority
NATO	North Atlantic Treaty Organization
NCIC	National Crime Information Center
NTSC	National Television Systems Committee

OCONUS	Outside Contiguous U.S.
OCONUS	Outside Continental U.S.
OCR	Optical Character Recognition
PAGIS	Police ALPR Graphical Interface System
PDA	Personal Digital Assistant
RFID	Radio Frequency Identification
SOP	Standard Operating Procedure
TCP/IP	Transmission Control Protocol/Internet Protocol
TSA	Transportation Security Administration
TSNM	Transportation Sector Network Mangement
TSS	Transportation Security Solutions
UK	United Kingdom
U.S.	United States
USB	Universal Serial Bus

Appendix B - Definitions of Terms

Algorithm:

In mathematics, computing, linguistics, and related disciplines, an **algorithm** is a procedure (a finite set of well-defined instructions) for accomplishing some task which, given an initial state, will terminate in a defined end-state. The computational complexity and efficient implementation of the algorithm are important in computing, and this depends on suitable data structures.

There are six primary algorithms that the software requires for identifying a license plate:

Plate localization – responsible for finding and isolating the plate on the picture
Plate orientation and sizing – compensates for the skew of the plate and adjusts the dimensions to the required size.
Normalization – adjusts the brightness and contrast of the image.
Character segmentation – finds the individual characters on the plates.
Optical Character Recognition (OCR) - translates images of text into machine – editable text or pictures of characters into a standard encoding scheme representing them.
Syntactical/Geometrical analysis – check characters and positions against country specific rules.

Capture Card:

The capture cards have the ability to capture multiple camera video source inputs, whether raw video or multiplexed. One card can handle up to eight inputs and multiplex will give you 16 inputs. It converts the video signal from the camera into a digital signal used by the operating system in conjunction with the applications.

Some ALPR systems require an external capture card be used for their cameras in addition to the internal video caption card. (Return to stoplight chart)

Character Cells:

Every letter or number occupies a single *cell*. A cell nominally is 3 inches (7.6 cm) high; this measurement can vary slightly depending on the cell's vertical placement. Unusual "truncated" character cells are only 2 inches (5.1 cm) in height. Each cell's width and syntax (whether restricted to a letter or a number) act to determine the maximum number of cells which -- on North American plates -- is 8½.

Blank spaces, short hyphens, periods and bullets are narrower than most characters and occupy a *half-cell*. *Half-height* characters (in the vertical) can be stacked so two are accommodated within a single cell. On occasion, three may be stacked vertically as done by the State of Maryland, or embossed diagonally on some U.S. Federal Government-issued plates. Even four diagonal characters are found on some State of Nevada dealer plates.

Data Packet:

In information technology, a **packet** is a formatted block of information carried by a computer network. A packet consists of three elements: the first element is a *header*, which marks the beginning of the packet; the second element is the payload, which contains the information to be carried in the packet; the third element is a *trailer*, which marks the end of the packet.

Excluded Characters:

Absent from the set of standard letters and numbers (A through Z; zero through nine). On State of Wyoming plates, for example, the letters "I", "O" and "Q" are not used when all other characters are numbers. The number "1" may not be substituted for the letter "I" nor the number "0" for the letter "O". A four-character plate cannot contain more than two letters "W" nor two letters "M".

License Plate Fabrication:

Embossing — The most commonly encountered means of plate manufacturing; a metal blank is placed face-down on an anvil and the character die is struck into it. The letters and numbers appear in relief on the front of the plate.

Incusing — Also called "debossing" is similar to embossing except the plate is face-up on the anvil. Viewed from the front, the characters seem to be pressed inward. Plates from Vermont are incused.

Single-Step Technique — Used by Alaska, Arkansas, Colorado, Delaware, the District of Columbia, Georgia, Indiana, Iowa, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, New York, Ohio, Oregon, South Dakota, Tennessee, Texas, Washington, Wyoming, the U.S. Federal Government and the Department of State), the plate is not hammered at all. A graphic lamination process applies the materials so foreground characters remain flush with the background. Other locales are considering a transition to this newer methodology.

Flat — Delaware, Indiana, Iowa, Montana, Nebraska, South Dakota, Tennessee, Wyoming, and the District of Columbia, have digitally produced flat license plates. Many U.S. states now use a color thermal transfer production process that produces a flat license plate for only short-run plates such as personalized license plates and special interest plates.

Infrared (IR):

IR lies between the visible and microwave portions of the electromagnetic spectrum. IR is the part of the invisible spectrum that is contiguous to the red end of the visible spectrum and that comprises electromagnetic radiation of wavelengths from 800 nm to 1 mm. IR light has a range of wavelengths, just like visible light has wavelengths that range from red light to violet. "Near IR" light is closest in wavelength to visible light and "far IR" is closer to the microwave region of the electromagnetic spectrum.

Characteristics: IR radiation has a longer wavelength (lower frequency) and lower energy than light from the visual spectrum. The spectral range from 700 to 1350 nanometers can be photographed but conventional cameras are limited to the range of approximately 700 to 925 nanometers. IR beyond the 1350 nanometer range can be imaged but only with special non-photographic equipment.

International Protection (IP) Ratings:

The IP Rating system provides a means of classifying the degrees of protection from solid objects and liquids afforded by electrical equipment and enclosures. Specifications for Degrees of Protection of Enclosures of Switchgear and Control Gear for voltages up to and including 1000 VAC and 1200 VDC, BS 5420:1977; and IEC 144:1963. (Also referred to as the Ingress Protection Rating.)

IP65:

An IP test standard. TheIP65 standard ensures that there will be no particles or dust intrusion to the units.

IP66:

An IP test standard. The IP66 standard ensures that there will be no particles or dust intrusion to the units and they are protected against strong jets of water – limited ingress permitted (e.g. for use on ship decks).

IP67:

An IP test standard. The IP66 standard ensures that there will be no particles or dust intrusion to the units and they are waterproof if submerged in water up to 1 meter.

Optical Character Recognition (OCR)

A type of computer software designed to translate images of handwritten or typewritten text (usually captured by a scanner) into machine-editable text, or to translate pictures of characters into a standard encoding scheme representing them (e.g. ASCII or Unicode).

Safety Class 1M:

Class 1M laser products have a wavelength range of 302.5 to 10^6 nm. Like Class 1 laser products, Class 1M products are safe to eyes and skin under normal conditions, including when users view the laser beam directly. However, users should not incorporate optics that could concentrate the output into the eyes (e.g., a telescope with a 1M laser emitting a well-collimated beam).

Scofflaw List:

A list of drivers who violate the law or fail to answer court summons. Typically a vehicle's license plate number will be placed on the "scofflaw" list when the owner of the vehicle has a ticket that has remained unpaid for a certain number of days. It will remain on the scofflaw list until the amount owed has been paid in full.

Syntax:

Any consistent ordering of characters, defined by systematic placement of letters and/or numbers; Horizontal character spacing also is a component of syntax. When fewer than the maximum number of characters appears on the plate, justification (whether flush left, flush right, centered or full) is another attribute that can designate a particular issuing authority. With a "custom-ordered" or "personalized" plate (sometimes termed a "vanity" or "prestige" plate), syntactic rules and regulations generally do not apply. Though, in a majority of such cases, the plate's character allowance (number of cells) is unchanged.

Special Characters:

*Special character*s form a superset of the typical ones. They may be true letters (Ñ), numerals (Ø), symbols (&) or icons (like the "keystone" found on State of Pennsylvania plates).

Appendix C - Report Requests and Demonstration Site Visitors

The following is a list of contacts who TSA and Northrop Grumman agreed to give a copy of either the comprehensive or one of the three split reports to in order to use the IAD sites and the ALPR equipment and a list of contacts who requested a copy of the full report.

Report Requests

Full Report
Scott T. Johnson
Deputy Federal Security Director
Transportation Security Administration (TSA)
Washington Dulles International Airport (IAD)
(b) (6)
Alan Paterno
Deputy Assistant Federal Security Director – Compliance
Transportation Security Administration (TSA)
Washington Dulles International Airport (IAD)
(b) (6)
(b) (6)
Airport Security Coordinator
Washington Dulles International Airport
Washington D.C. 20041-0045
(b) (6)
(b) (6)
General Manager, District of Columbia Parking Associates
Washington Dulles International Airport
44910 Saarienen Circle
Dulles, VA 20166
(b) (6)

Requested Full Report
(b) (6)
Project Manager
Office of Law Enforcement Technology
Technology
2001 Main Street
Suite 500
Wheeling, West Virginia
(b) (6)
(b) (6)
Office of National Drug Control Policy
(b) (6)
Jim Taylor
Branch Chief
Threats, Vulnerabilities & Consequences
TSNM Pipeline Security
U.S. Department of Homeland Security
Washington, D.C.
(b) (6)

Split Report - Vendor Specific
Remington-Elsag Law Enforcement Systems
(b) (6) President
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Demonstration Site Visitors

Name	Company	Position
(b) (6)	Office of Law Enforcement Technology Commercialization	Project Manager
	Office of National Drug Control Policy	Senior Law Enforcement Advisor
	Office of National Drug Control Policy	Program Analyst
	Office of National Drug Control Policy	ONDCP Contractor Support
	SPAWAR	Program Manager
	DHS (Contractor)	DHS Contractor
	Office of National Drug Control Policy	Policy Analyst
Jim Taylor	DHS - TSNM Pipeline Security	Branch Chief
(b) (6)	Signet Technologies	VP Sales and Marketing
	Signet Technologies	
	B&W Automation	Partner
	Sensor Concepts & Applications, Inc.	Senior Systems Engineer
	Sensor Concepts & Applications, Inc.	
	Sensor Concepts & Applications, Inc.	
	British Embassy	UKTI
	British Embassy	UKTI
	IBM	Associate Partner IBM Public Sector
	IBM	Associate Partner IBM Public Sector
	IBM	
	Signal Innovations Group, Inc	VP, Business Development
	Signal Innovations Group, Inc	Director of Engineering
	Integrian	VP Sales and Marketing
	G2Tactics	Program Manager

Appendix D - International Protection (IP) Standards

International Protection – First Number: Protection Against Solid Objects

The International Protection Rating system, also called the "Ingress Protection (IP) Standards" provides a means of classifying the degrees of protection from solid objects and liquids afforded by electrical equipment and enclosures. Specifications for Degrees of Protection of Enclosures of Switchgear and Control Gear for voltages up to and including 1000 VAC and 1200 VDC, BS 5420:1977; and IEC 144:1963. (Also referred to as the Ingress Protection Rating)

The IP number is composed of two numbers, the first referring to the protection against solid objects and the second against liquids. As displayed in the charts below, the higher the number, the better the protection.

First number - Protection against solid objects / human contact

* Describes the devices ability to guard and restrict human or tool contact with the hazardous portion of the device.
** It also indicates the protective characteristics of the device with respect to entry of undesired solid objects.

First Digit	Digit Protective Degree for persons*	Test Parameter or Provisions	Protective Degree for equipment**	Test Parameter or Provisions
0	Not Provided	Not Available	Not Provided	Not Available
1	Protection from causal contact. Back of the hand	Access of objects 50mm or greater	Protected from entry of a foreign object >= 50mm	A 50mm diameter ball could not penetrate the device
2	Protection from insertion of a Finger	Adequate Space is ensured between the tip of the finger joint (defined as 12mm diameter and 80mm length) and the hazardous point of the connection	Protected from entry of 12.5mm or greater diameter object	A 12.5mm diameter ball could not penetrate device
3	Protection from entry of Tools and similar objects	Tools 2.5mm diameter or greater can not penetrate	Protected from foreign objects 2.5mm or greater entering the connection	A 2.5mm diameter ball could not penetrate the device
4	Protection from wire and similarly sized objects	Wires 1.0mm diameter or greater cannot penetrate the connection	Protected from foreign objects 1.0mm or greater entering the connection	A 1.05mm diameter ball could not penetrate the device
5	Protection from wire and similarly sized objects	Wires 1.0mm diameter or greater cannot penetrate the connection	Dust Resistance	Inhibits the entry of most dust particles in to the device, but is not completely dust tight
6	Protection from wire and similarly sized objects	Wires 1.0mm diameter or greater cannot penetrate the connection	Dust Proof	No dust entry into the device

International Protection – Second Number: Protection Against Liquids

Second number - Protection against liquids

* Describes the ability of the device to prevent undesired water entry. Essentially, it is to indicate the level of water resistance and/or waterproofing of the device.

Second Digit	Protection of Equipment	Test Parameter or Provisions (test samples are all configured in a normal manner)
0	Not Provided	Not Provided Not Available
1	No harmful influence to the device from water dropping vertically	Apply dripping water from a height of 200mm for 10 minutes at a volume of 1ml per minute on the sample
2	No harmful influence to the device from water dropping vertically; when device is tilted to 15 degrees from its vertical axis	Apply dripping water from a height of 200mm at 3ml per minute for a total of 10 minutes. Shift the sample so the device's front, back, left and right side, oriented 15 degrees to the vertical axis are each sprayed for 2.5 minutes.
3	No harmful influence to the device from rainfall when the device is tilted 60 degrees from its vertical axis	Spray simulated rainfall for at least 5 minutes from a height of between 300 to 500mm above the sample. Shift the sample so the spray is directed to all sides of the sample when the sample is tilted 60 degrees from its vertical axis. * Water volume: 10 (+/-0.5) liters per minute. Spray * Spray Pressure: 50-100kPa * Duration: 1 minute/ each square meter of the apparatus's surface
4	No harmful influence to the device by having water splashed from any angle	Spray simulated rainfall for a total of at least 5 minutes from a height of at least 300-500mm above the sample. Shift the spray angle to all angles up to 180 degrees from the sample's vertical axis * Water volume: 10 (+/-0.5) liters per minute. * Spray Pressure: 50-100kPa * Duration: 1 minute/ each square meter of the apparatus's surface
5	No harmful influence to the device from a direct stream of water jetted from any angle	Apply a water jet stream for a total of at least 3 minutes using a designated nozzle with an opening of 6.3mm from all directions. * Distance between nozzle and sample: 2.5 to 3 meters * Jet stream volume: 12 liters +/-0.5 percent per minute * Jet stream size: maintain a nominal 40mm O.D. thickness at 2.5 meters from the nozzle tip. * Duration: 1 minute per each square meter of the sample device's surface
6	No water penetration into the device when subjected to a powerful direct stream of water jetted from any angle	Apply water jet stream for at least 3 minutes, using a designated nozzle with an opening of 6.3mm from all directions. * Distance between nozzle and sample: 2.5 to 3 meters * Jet stream volume: 100 liters +/-0.5 percent per minute * Jet stream size: maintain a nominal 120mm O.D. thickness at 2.5 meters from the nozzle tip. * Duration: 1 minute per each square meter of the sample device's surface
7	No water penetration into the device when immersed under the following conditions	Submerge the sample for 30 minutes at a depth of 1 meter from the water's surface.
8	The device is able to withstand continuous use while submerged at a designated external pressure	Per agreement between Manufacture & Customer

Appendix E - Appian Technology Inc Proposed Solution for Washington Dulles International Airport

Each vendor was asked to provide a proposal of how they would improve security around IAD. The proposals are attached "as is" and were not edited in any way other than format. *These ALPR Proposals reflect the opinions of the proposal's authors and do not necessarily represent the position or opinions of this document's authors or corporation.*

Appian Technology Inc

www.appian-tech.com

Automatic License Plate Recognition Systems

Solution Proposal

For

Washington Dulles International Airport

Contents

1. Introduction

Applan Technology very much welcomes the opportunity to submit a proposal on how an Automatic License Plate Recognition system could be deployed at Washington Dulles International airport to aid multiple law enforcement agencies, government agencies and commercial operations at the airport.

Applan Technology has been providing ALPR (Talon/Spectrum) systems to customers since 1993. Systems deployed are in use by a number of Police Departments in the United States, Police Forces in the United Kingdom, Police Forces around the world and other Government Agencies.

The Applan Technology product range has a number of unique features that are typically not offered by other ALPR suppliers:-

- Cobra Dual camera – a camera module containing both a colour and mono camera modules, both with individual and independent zoom capability.
- Talon ALPR Engine – Neural Network ALPR algorithm with the ability to run multiple neural networks to be able to correctly identify license plates from multiple States simultaneously. Able to identify license plates using both colour and infra red video signals.
- SPECTRUM ALPR Policing Application – Intelligence lead policing application which includes Global Positioning System co-ordinates in conjunction with running license plates against multiple independent databases.
- STINGER Intelligent ALPR Camera – The only standalone, independent ALPR camera with on board ALPR recognition with both a colour and mono camera modules, both with individual and independent zoom capability.

Applan are currently engaged in the provision of ALPR to a number of international police forces and government agencies. Applan is the only ALPR supplier to all 43 police forces in England and Wales through the Spectrum project.

The high accuracy of the Talon ALPR system makes Applan a first choice for those customers who require a high performance ALPR capability on multi-carriageway roads, whether in transportable, mobile or fixed site installations. Talon is also the chosen system in ten UK port installations, major airports, the Docklands, motorways, CCTV systems, in various police mobile and transportable configurations and in the city of London's Ring of Steel.

The Ring-of-Steel is independently tested on a regular basis and must maintain performance levels in excess of 95%.

Applan Technology has been operating in the US for the last four years and established Applan Technology Incorporated, office in Charlotte, North Carolina since September 2006.

To date Applan Technology has in excess of one hundred and fifty systems in operation across the US.

The Mayor of New York City visits London's 'Ring of Steel' ANPR System

10 December 2007

The Mayor was visiting City of London Police to find out about the Square Mile's anti-terrorism measures.

Mr Bloomberg was shown the City's Talon Automatic Number Plate Recognition system (ANPR) supplied by Appian Technology PLC. Cameras 'read' vehicle number plates as they enter the zone and check them against police databases, notably the Police National Computer (PNC). A match can be identified and the City Police Control Room alerted within f our seconds. Depending on what the vehicle occupants are wanted for, resources are deployed appropriately to intercept or monitor it.

Although the ANPR system was initially installed as part of the Force's anti- terrorist policing, it also helps with wider policing activities and to inhibit crime in general. In its first three years of operation, it scanned 75 million vehicles as they passed through the Entry Points.

The Mayor of New York is one of many international visitors to be shown how ANPR benefits the City. In recent months, visitors to Wood Street have included Australian, German, Malaysian, Moldovan and Singaporean nationals.

2. Software

Talon – ALPR recognition Engine

Applan Technology is the leading manufacturer and supplier of high performance, high accuracy Automatic License Plate Recognition (ALPR) systems. Applan's A LPR products are based on a proprietary neural network recognition engine called Talon. Neural network t echnology is superior to any template based Optical Character Recognition (OCR) A LPR system, offering significantly higher performance and accuracy, typically better than 97%.

Talon is a software based processor designed to be installed on to modern compu ' ters running the Windows operating system.

Talon ALPR can be supplied with a diverse range of additional Talon application software, providing a complete 'end to end' ALPR solution.

Talon is the result of the most extensive development program undertaken by any A LPR company. Development was started by Raael Electronics in 1998 with an initial $20 million investment; the system has been continually refined and improved to maintain its leading market edge and superiority.

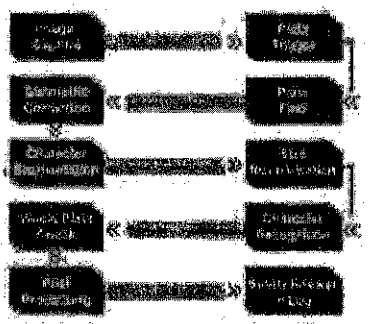
Talon Features

- Unique Neural Network Processing
- Automatic "In Picture" Trigger - no need for an external trigger
- Automatic geometric correction for skew, tilt and rotation
- Automatic plate character segmentation and size normalization
- High accuracy - typical performance in excess of 97%
- High speed vehicle plate recognition - in excess of 195 kph
- 24 hour/365 day 'all weather' capability
- Manual and synthetic training
- International number plate reading capability
- Automatic positive database matching and system alarms
- Operates on any industry standard PC platform
- Vehicle and Number Plate Image Output and Archiving

The Talon ALPR Recognition Process

First of all Talon finds the presence of a vehicle registration plate. Talon has a sophisticated 'plate finding' algorithm, this algorithm very accurately detects the presence of license plate in the camera's field of view. When a license plate is detected, a trigger is activated which initiates a suite of software recognition algorithms. These algorithms identify the position of the plate in the image, extract the plate image, apply geometric distortion compensation if necessary and segment the plate into individual characters.

Each character is then fed into a software neural network. This network uses a unique mathematical perceptron model, unlike multi layer perceptron models (MLP) the Applan model cannot suffer from 'over learning' and a reduction in accuracy. The network produces an estimate for every character input resulting in a string of characters, which is its best estimate for the number plate. For each passing vehicle multiple recognition results are obtained and our advanced post processor will analyse and produce the best result.



These features contribute to the extraordinary accuracy of the Talon system.

Our Talon ALPR products are available for a number of ALPR applications:

- Fixed Site System -town and city center, border control and access control systems
- Mobile In-car Systems - commonly used by Police forces and security forces worldwide.
- Portable System -
- Laptop System - up to 2 lanes per PC.

Talon Software Applications

Talon ALPR can be supplied with a range of application software modules:

- Policing, Surveillance, Counter-Terrorism
- Imaging
- CCTV Integration
- Access Control
- Car Park Management
- Traffic Management
- Enforcement, Tolling, Congestion Charging
- Bespoke

Talon for Policing, Surveillance and Counter-terrorism

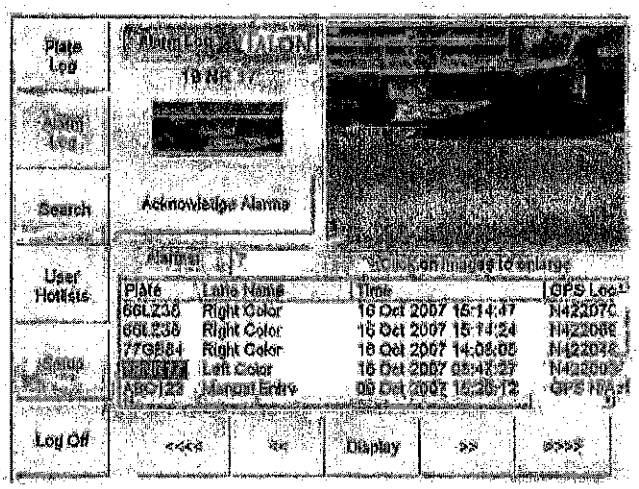
'ALPR enables us to turn the tables on the criminals. Instead of the criminals creating fear, I want to make them fearful of using the roads. And if they do venture out, I want them to know that ALPR increases significantly the chances that they will identified, stopped and arrested...'[1]

— Hazel Blears, Minister of State for Crime reduction, Policing and Community Safety

Talon Spectrum application: sophisticated, user friendly software, for fixed, mobile and transportable ALPR applications

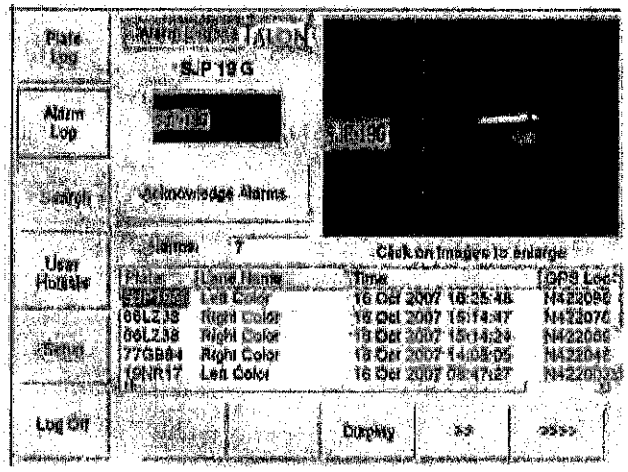
Spectrum is the Talon application software for Policing and Surveillance applications, allowing local and national databases to be interrogated based on the plate read for detection and identification of stolen and wanted vehicles.

When an entry is stored to the database, an image of the plate from the recognition camera is stored with the recognition. The system can be configured to show an additional larger image to enable the operator to verify the colour and vehicle type.



The SPECTRUM application enables the user to conduct search (partial or full plate data) of both license plates captured during the present shift plus data captured for the proceeding seven days.

The response to any match against any database can be configured to enable either the user in the vehicle to receive a visual and audible alarm or a remote user to be informed via an email or text message.



The SPECTRUM system provides a high profile of the available functionality:-

- Plate Read
  - Text string result of the license plate
  - Text interpolation of license plate
- Images
  - Plate Patch – Image of license plate
  - Overview Image – contextual overview image
- Data
  - Date and Time
  - Confidence Level
  - GPS Information
  - Camera/Lane Identity
- Search capability
  - Search alarm log – All matches against alarm databases
  - Search plate log – List of all license plates recorded by the system
  - Partial search
  - Specific characters search
- Hot Lists
  - Import of databases
  - Management of database hot lists
  - Profiles for databases
- System Administration
  - User profiles
  - Talon Engine Access
  - Data import/export
  - System administration tools

Hot Lists

A number of different types of hot list can be used, namely:

- NCIC Extract - an extract of all vehicles of interest from the Police National Computer.
- Local Hot lists - Hot lists of up to 50,000 entries can be created, edited and imported.
- Bulk-loaded Hot lists - large Hot lists of more than 50,000 entries can be imported.

Talon can also be connected to a remote hot list database (e.g. NCIC) and perform live checks for each plate against the remote database. This connection can use an arbitrary barer, e.g. a GSM/GPRS/WIFI modem.

If a GSM/GPRS modem is fitted, the system can send SMS pager messages for each hot list hit. The GSM modem can also be used to provide over-the-air updates to the hot list databases.

Big-Fish is a powerful central server application software module that is designed to manage and control multiple ALPR assets, ALPR vehicle fleets, multiple fixed ALPR camera systems, handheld ALPR devices and portable ALPR devices.

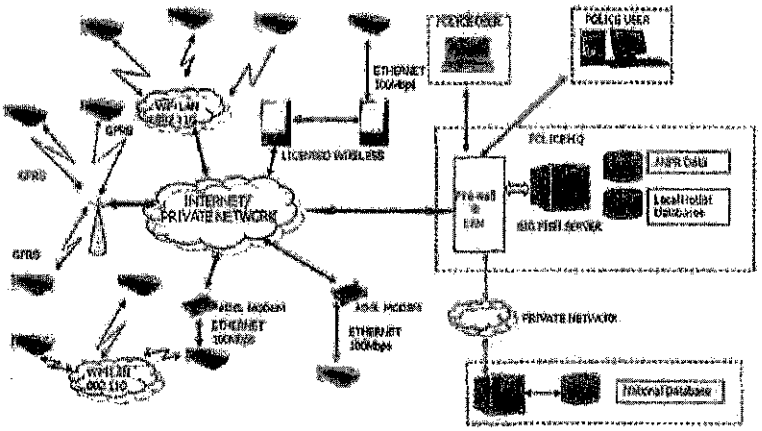
- **Automatically retrieves and collects** ALPR data from multiple assets simultaneously. Big-fish can collect in excess of 500,000 plate reads with additional overview images per day. Big-Fish allows the user to react to live ALPR alerts the instant they occur. Receive information from hundreds of ALPR clients in real-time.

- **Stores ANPR related data** - The "reads" that are stored contain full infrared plate patch and overview images. The Big fish database capacity is 4Terabytes this equates to decades of vehicle of data. Automatically updates with new hotlist data etc.

- **Search and Manage ANPR data.** Alerts can be received anywhere on the network and they can be received by an unlimited numbers of users in the control room Big-Fish includes unique technology that delivers live information, as it happens, direct to the user. From a standard web browser, as well as view incoming feeds from any connected camera.

- **Full secure user management** Uses standard network architecture Provides a web based user interface (standard web browser) Provides 128bit SSL encryption, user authentication and full auditing Can display live read and alert data to hundreds of browser terminals, The facility is extremely simple for the user to operate but can provide valuable management and intelligence information. This information can be accessed from CCTV and Police Control rooms simultaneously.

- **Interfaces with external databases** provide a live link to the Police National Computer. Other databases that can be incorporated typically include: DVLA Database a list of all vehicles of interest from the DVLA computer. Local Hot lists Hot lists of up to 50,000 entries can be created, edited and imported. Bulk loaded Hot lists large Hot lists of more than 50,000 entries can be imported. Fully NAAS compliant (when live PNC option included)


POLICE USER
POLICE USER
ETHERNET
100Mbps
GPRS
GPRS
GPRS
INTERNET/
PRIVATE NETWORK
LICENSED WIRELESS
POLICE HQ
Firewall
&
VPN
ANPR CAMS
Local Hotlist
Database
GIS MAP SERVER
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ETHERNET
100Mbps
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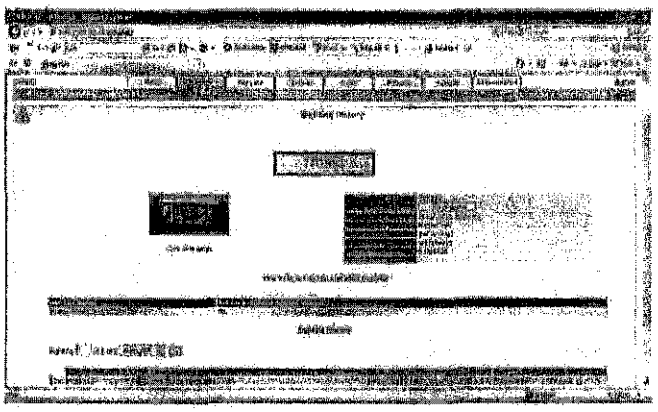
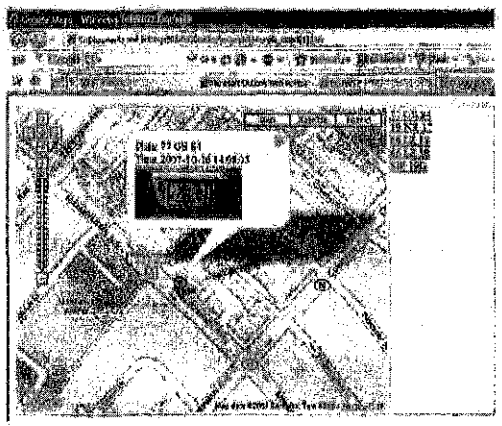
100Mbps
National Database





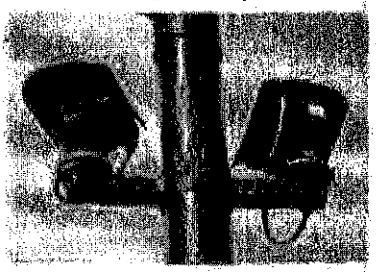
3. Cameras

Appian Technology has a full range of specifically designed cam eras for ALPR application. The cameras are based on expertise gained from deploying ALPR systems with high demanding performance specifications in various high security locations around the world.

The Appian Technology ALPR system also has the capability to work with other cameras resulting in the system being camera agnostic.

The Cobra System

The Cobra system can be supplied with a range of different internal camera and IR illumination options offering unmatched flexibility - suitable for any A LPR application including mobile, fixed site and long range ALPR.



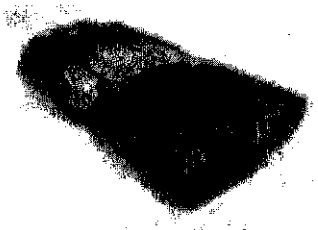
A principal feature is the use of high resolution optical zoom cameras - both for ALPR and high definition o verview/contextual imaging. Zoom functionality means the Cobra system can be rapidly optimised to suit differing plate and environmental conditions at ALPR capture points. The Cobra can be easily moved from one location to another and the settings simply a djusted - avoiding the need for time consuming, risky and costly re-lensing.

Zoom functionality enables the cameras field of view to be optimised to local plate sizes. Additionally, both IR pulse duration and illumination power can be adjusted by the user . In its long range dual illuminator configuration the camera has a range of up to 45 metres (subject to wavelength).

Obtaining high confidence recognition results in bright sunlight, when plate characters are partly shaded is a significant challenge. At n ight time the effect of bright headlights needs to be suppressed to improve the accuracy of recognition. The Cobra has a number of features designed to combat these problems, including improved processing gain and narrow band IR filtering.

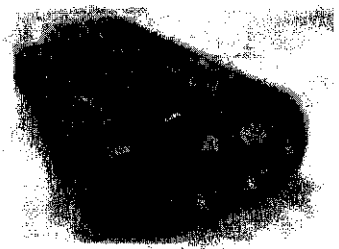
The Stinger System

The **Stinger** Intelligent Automatic License Plate Recognition Camera has cameras, illuminator and processor all fully integrated in a single sealed unit offering ease and simplicity of installation. The Stinger is designed to process and recognise licence plates and associated imagery and then transmits results using its integral communication interfaces. Communication options include GSM/GPRS or 3G and 802.11g WLAN and 100Mbps Ethernet.



The Stinger camera components are based on Appian's high performance Cobra Camera. Users can select a range of camera and IR illumination options offering unmatched flexibility, including dual cameras and long range illumination options. A principal feature of Stinger is the use of high resolution optical zoom cameras - both for ALPR and high definition overview/contextual imaging. Zoom functionality means the Stinger system can be rapidly optimised to suit differing plate and environmental conditions at ALPR capture points. All camera settings can be controlled and adjusted remotely in real time.

The processor element takes imagery from the camera and runs the plate recognition processes. Neural network Talon ALPR software is used as standard, Stinger can support additional recognition engines. The processor is a powerful mini-computer specifically developed for military image processing applications.



Featuring a 20GB hard drive and a Windows OS local hotlists can be securely stored and managed. This feature allows the Stinger to be directly connected to any web based services such as Back Office systems. The choice of processor and Windows OS offers great flexibility: additional electronic sensors, devices and applications can be readily integrated. These include (but are not limited to DSRC/RFID), speed and red light detection devices - all connected to and controlled by Stinger. The robust processor is designed to operate in harsh environmental conditions including extreme temperature fluctuations. The processor is capable of handling up

to 4 separate video inputs, each Stinger has the capability to connect and process imagery from a 'slave' Cobra dual ALPR camera.

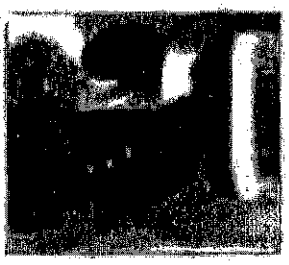
A telemetry interface can be provided as an option to control a pan and t lt head for both the Stinger and slave Cobra ALPR camera. This allows users to reconfigure cameras for different traffic conditions.

A Stinger ALPR system requires minimal installation and its discreet appearance has little impact on the environment, making it an ideal stand alone ALPR surveillance system.

The Stinger units could be deployed as a temporary "Ring of Steel" to support operational focus on a particular area. The units could then either remain in the same location or easily re -located and re-used at other locations.

The Viper System

The **Viper** is a miniature colour camera designed to be mounted in the front windscreen of mobile surveillance and ANPR vehicles. The camera is attached to the vehicle via a low profile stainless steel bracket; the camera casing is manufactured from T06601 aerospace grade aluminium. Results in an extremely lightweight camera ideally suited for mobile surveillance and ALPR operations. The Viper's small size has resulted in a camera that does not obstruct any part of the driver's vision. It is designed to sit directly in front of the rear -view mirror. Due to this unobtrusive design, Viper is the ideal choice for an in car/on board surveillance and A LPR camera.



The zoom feature means the Viper's field of view can be rapidly optimised to suit diff erent ALPR capture requirements. The high resolution CCD allows a much 'sharper' picture to be processed.

4. Plate Recognition Units (PRU)

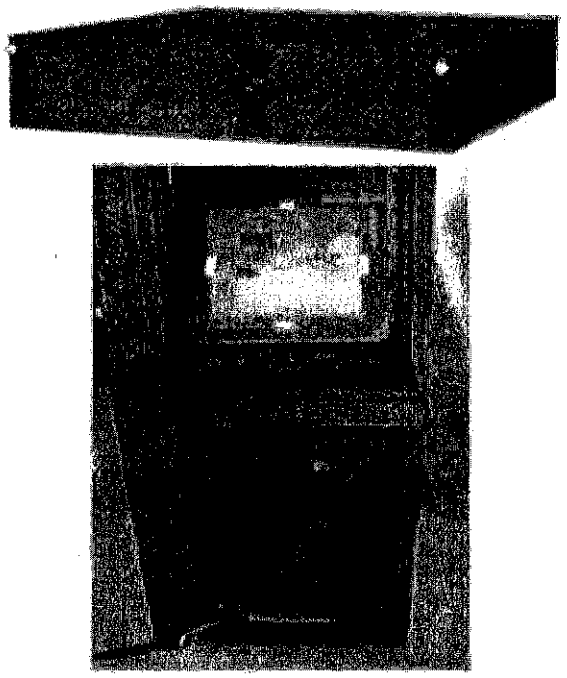
The Talon system operates on any platform that is running either Windows 2000 Professional, Windows XP professional and Windows Vista.

Therefore our clients can procure their own computers utilising any purchase power they have with any PC supplier.
The following Opus PC can be used for both mobile applications and/or fixed site locations with cabinet space available.

ITX Mobile-PC with vibration mounting kit:	357mm x 232.5mm x 99mm 14.28" x 9.3" x 3.96"
Weight:	2.1 - 3 Kg, 4.5 - 6.6 lbs *(depends on included components)*

The Sabre Unit

The Sabre Unit is a powerful and reliable industrial computer specifically designed and configured for ALPR image processing. Featuring a powerful Pentium processor, each Sabre unit is capable of processing 4 lanes of high speed, high density traffic with complimenting overview images.
Designed to be installed in the 'indoor environment', for example into a CCTV control rooms and surveillance offices, the Sabre is a powerful PRU. For mission critical systems the Sabre has a redundant PSU available as an option.
For large city centre and national ALPR systems multiple Sabre units are rack mounted. Each individual Sabre unit can then be controlled with a KVM switch.
Talon SP ALPR software and frame grabbers are installed on to each Sabre unit. Each sabre is powered by standard mains electricity and additional UPS systems can be supplied on request.



Design	19" Rack Mounted 2U	
Dimensions	Width	482mm
	Height	88mm
	Depth	450mm
Backplane	BP-2	4 X PCI & 1 X ISA (full length)

The Talon Sentinel

The Talon Sentinel Portable ALPR System offers the user the freedom and flexibility to move the Talon ALPR system from one location to another, from vehicle to vehicle or to and from fixed sites such as buildings offices and control rooms. In remote rural areas, where mains power may not be available the Sentinel can be run from a convenient battery pack.

The Sentinel is a rugged PC with full wireless GSM/GPRS/ communications, connected to two 'dual' infrared and overview Automatic License Plate Recognition (ALPR) cameras, capable of processing two lanes of high speed, high density traffic with overview imagery. The Sentinel unit has all camera power supplies and interfaces integrated into the unit, thus minimizing external cabling.

Encased in an ultra high impact resistant case, the platform is extremely strong and durable designed to withstand and operate in extreme environmental conditions. Neoprene O-rings and ABS latches seal perfectly, enabling the system to be ground buried for extended periods of time. The Sentinel system can set to hibernate during periods of inactivity significantly reducing power consumption. Using an inbuilt trigger interface, passing vehicles will 'wake' the Sentinel from hibernation when used in conjunction with a third party trigger system. The Sentinel will then recognise and record the number plates.

By using the wireless LAN card or the GSM/GPRS modem, multiple sentinel units can also be networked together to form an instant "ring of steel" incident reaction capability.

The Sentinel platform is designed to run Talon SP ALPR software and additional Talon software such the Spectrum and Sentry app

The mShark Handheld System

The mShark Handheld ALPR System offers the user freedom and flexibility to carry the ALPR system around on their person with virtually no effort at all. Using current technology, with a proven track record, this has been integrated into a mobile phone to provide the flexibility of mobile communications as well as an ALPR system in one hand-held device.

With mShark, the ANPR functionality is immediately available with no "warm up" time. This in turn allows quicker processing of any data captured on the handset against the onboard database and also external databases. The database can presently hold in excess of 10 million number plates "on board" the mobile phone or PDA. The system will immediately alert the operator if a match is found. There is also an option to manually input registration details and search them against the database.

Photographic evidence and images of number plates can also be stored by mShark. This data can then be to and from the system via the handsets Bluetooth capabilities.

The mShark is at present the World's smallest Automatic License Plate Recognition (ALPR) system. The ALPR system is available at the touch of a button wherever you are.

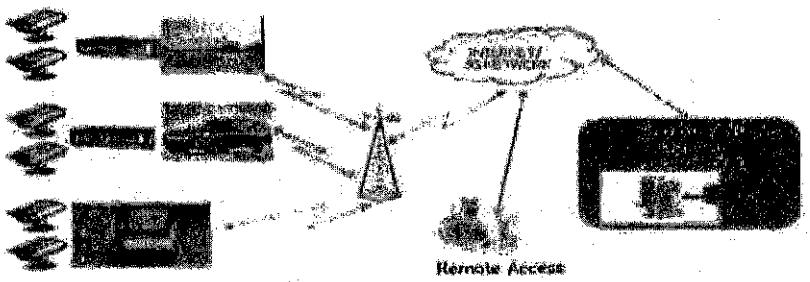
5. Washington Dulles Solution

For the demonstration at Washington Dulles airport Applan Technology deployed: -

- Fixed Site
  - OPUS ALPR unit plus Talon Software and 2 x Cobra Dual camera
- Transportable System
  - Talon Sentinel ALPR unit plus Talon Software and 2 x Cobra Dual camera
- Mobile System
  - OPUS ALPR unit plus Talon Software and 2 x Cobra Dual camera

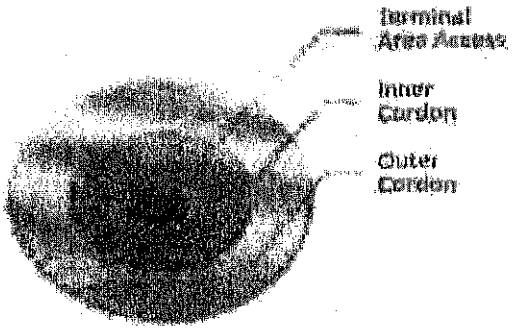
All units streamed data and images to a Big Fish server which was located in Applan Technologies office in Charlotte, NC.

Washington Dulles Configuration



Applan Technology that the ALPR system would be one of the strategies used to protect a potential terrorist target. The balance consists of enabling enough surveillance and control without impeding on the normal operation of the site and the commercial utilization of the site.

Applan would propose a multi layered ALPR system designed to be able to capture ALPR data and allow enough time for verification and reaction. This is typically addressed by implementing a number of cordon areas. The diagram below: -



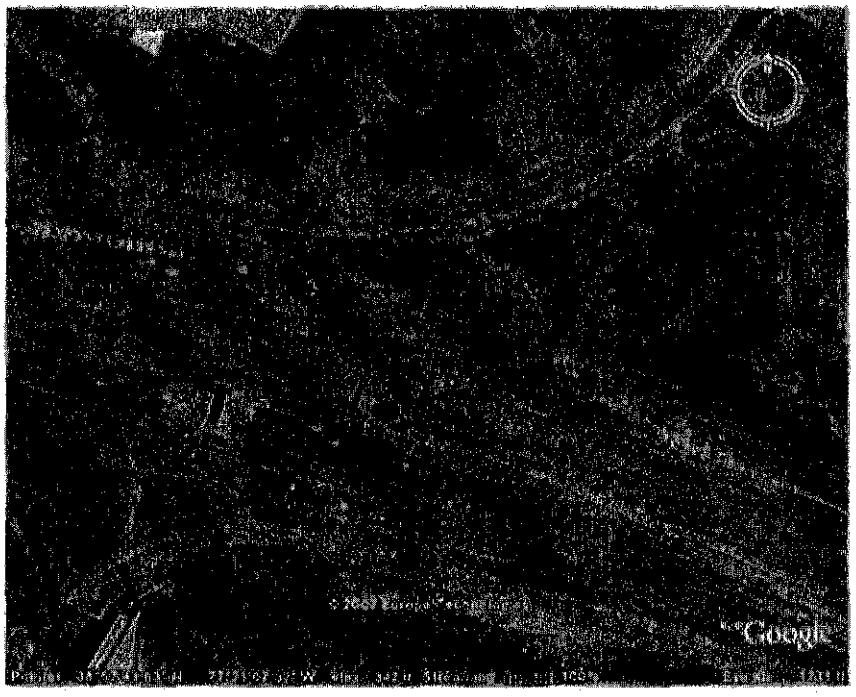
Outer Cordon

- The outer cordon would consist of ALPR systems being deployed on the Dulles Greenway – I267

The recommendation would be to deploy Stingers plus Cobras at strategic points for monitoring traffic that is potentially on route to Washington Dulles airport.

Deploying the Stinger would reduce the amount of civil engineering work and infrastructure work that is usually associated with fixed site ALPR systems on high speed roads. In addition the fact that a Cobra camera can be slaved from a Stinger means that there is additional cost savings. The only two things that need to be provided are power and communications.

On both the West bound and East bound roads there are suitable gantry systems that could be used for the mounting of Stingers/Cobras.

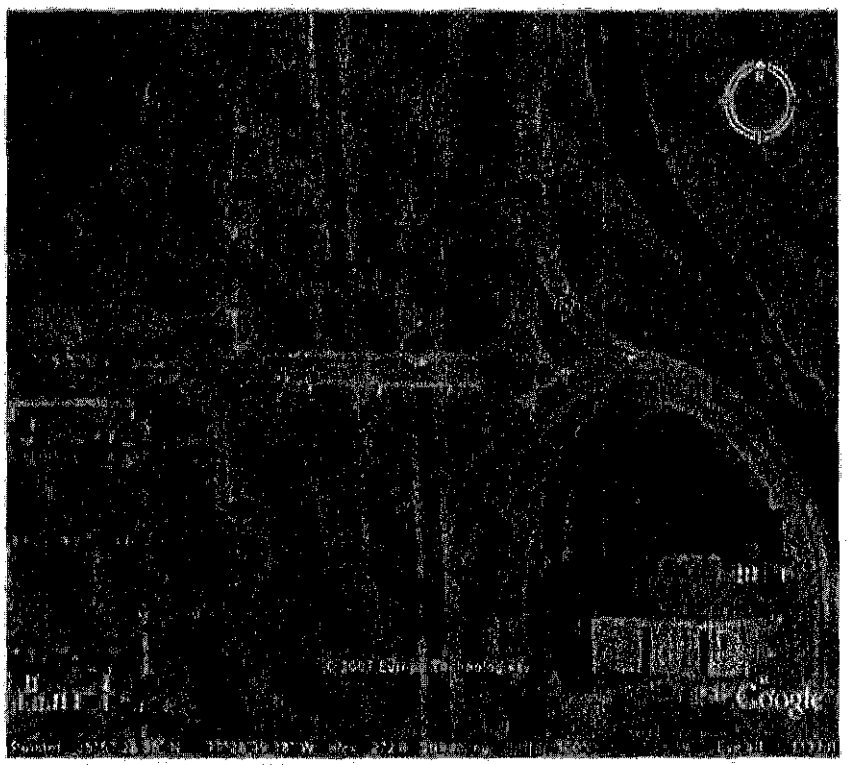


The planning indication would be:-

- East Bound
  - 3 x Stinger plus 3 x Cobra
- West Bound
  - 3 x Stinger plus 3 x Cobra

Inner Cordon

- The inner cordon would consist of multiple ALPR points covering both entry and exit points into the inner part of the airport road structure.

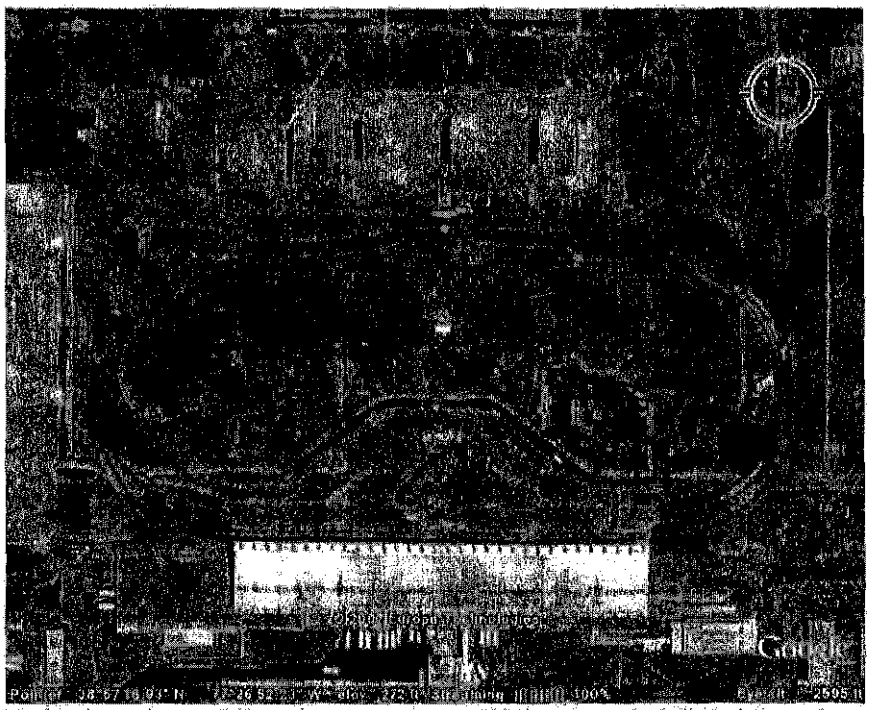


The planning indication would be:-

- 8 x Stinger plus 8 x Cobra

Terminal Area Access

- The terminal area wouldconsist of multiple ALPR points this could possibly be achieved by integrating into the existing CCTV system and utilising existing cameras. In addition it may be necessary to implement ALPR cameras at strategic points.



Appian Technology observed that there are existing ALPR cameras installed at the entrance and exit lanes to the car park located in the terminal area. It may be possible to utilize these cameras as additional resources to the ALPR system.

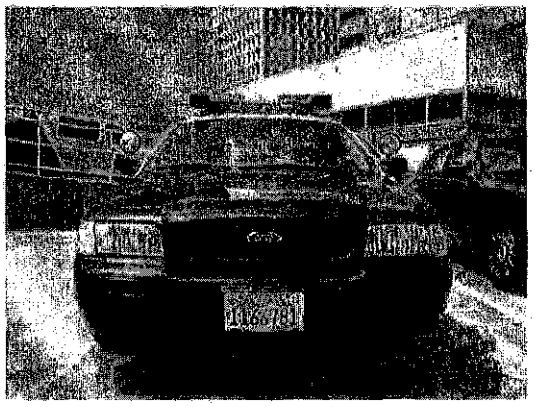
Other Points for Consideration

- Long Stay Car Parks

Appian Technology would suggest that it would be very advantageous to implement ALPR systems covering the entry and exit lanes at each of the long term car parks associated with Washington Dulles airport.

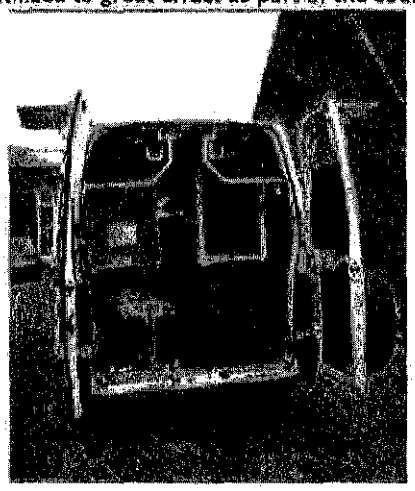
- Mobile

Appian Technology would suggest that it would be very advantageous to implement ALPR systems on multiple Law Enforcement vehicles that are util lzed around the Washington Dulles airport. These systems can be used for scanning car parks, flexible mobile check points.



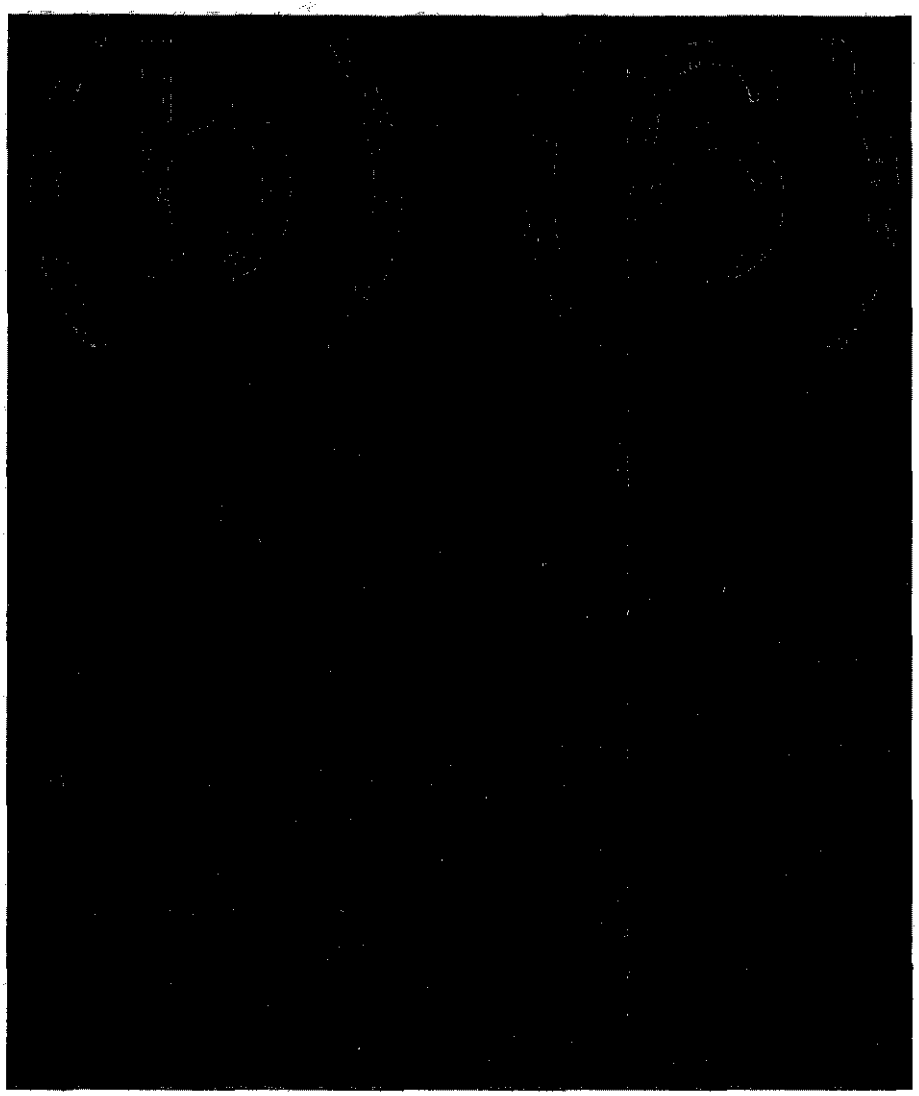
- Van Based

Appian Technology would suggest that it would be very advantageous to implement ALPR systems on a quantity of vans fit ted out as mobile/command ALPR vans. These systems have been utilized to great effect as part of the counter terrorist strategy for the United Kingdom.

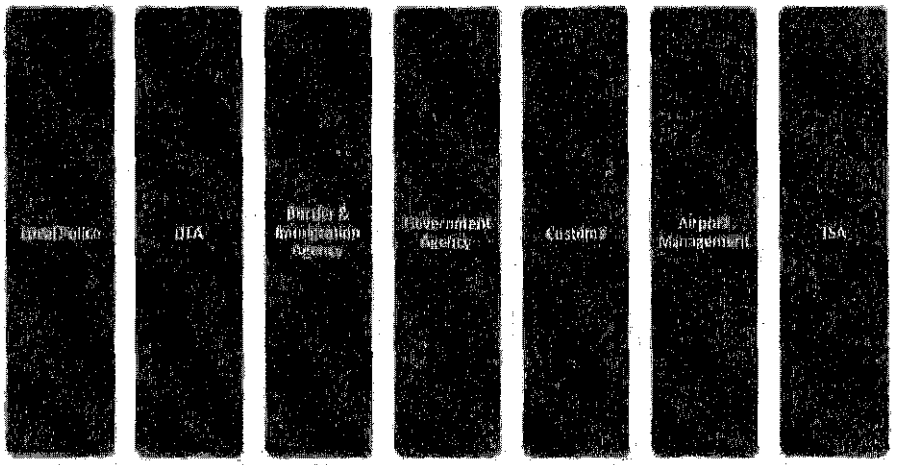


- Consultancy

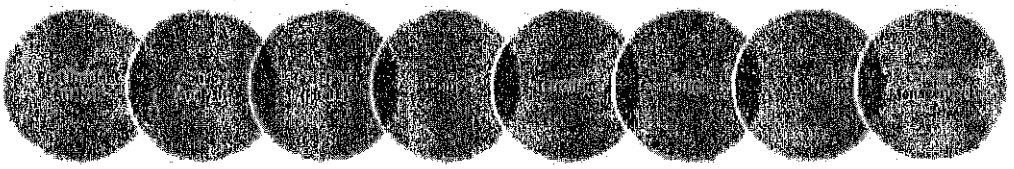
Applan Technology would be happy to work with TSA/Northrop Grumman project team on implementing such ALPR projects across TSA sites. In addition Applan would suggest utilising the skill and knowledge of consultants who have been involved on similar projects both in the UK and around the world. The background of the type of person is shown below [redacted].



Appian Technology has deployed a number of ALPR systems which provides data in different formats and presentation of data depending on the needs of the end user. This approach is under pinned by the diagram below demonstrating that data can be provided to multiple agencies from the same data capturing ALPR system.

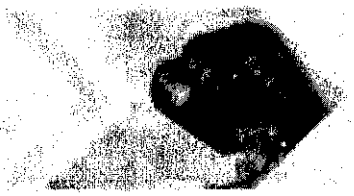


This enables the ALPR system to meet different functional requirements for different agencies from utilization of the same ALPR resource. An example of the different functionality is shown in the diagram below.



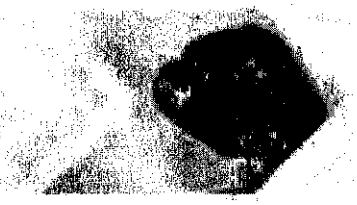
This results in one single reduced cost being shared across multiple departments and the ALPR system providing value to multiple entities.

6. Equipment Specifications



Cobra Image Capture System Configurations:

Single Configuration: Single illuminator – Single monochrome ALPR camera
Dual Configuration: Single illuminator – Single monochrome ALPR camera – Single color camera for overview imaging
Long Range Configuration: Two illuminators – Single monochrome ALPR camera
Camera specifications: Monochrome Camera Module
Lens: 18X Zoom f=4.1 mm (wide) to 73.8 mm (tele), F1.4 to F3.0
Signal System: EIA/CCIR
Image Sensor: Exview HAD CCD
Angle of View (H): 48 degree (wide end) to 2.7 degree (tele end)
S/N Ratio: More than 50 dB
Electronic Shutter: 1/50 to 1/10,000 Sec. 16 steps
Gain: Auto / Manual (-3 to 28 dB, 2 dB steps)
Camera Operation
Switch: Zoom tele, Zoom wide
Video Output: VBS: 1.0 Vp-p (Sync. Negative) Y/C Output Colour – PAL or NTSC Colour Camera Module
Lens: 18X optical zoom f=4.1 mm (wide) to 73.8 mm (tele), F1.4 to F3.0
Image Sensor: Exview HAD CCD
Angle of View (H): 48 degree (wide end) to 2.8 degree (tele end)
S/N Ratio: More than 50 dB
Electronic Shutter: 1/50 to 1/10,000 Sec. 16 steps
Gain: Auto / Manual (-3 to 28 dB, 2 dB steps)
Camera Operation
Switch: Zoom tele, Zoom wide
Video Output: VBS: 1.0 Vp-p (Sync. Negative) Y/C Output
IR Illuminator 810nm, 870nm, 940nm – Variable pulse
Options: duration and illumination power
Integrated Light Sensor: Measures the daylight, and can alter the camera's settings to optimise the video
Communications: Bi directional RS232 communications with PC's. Allows settings to be downloaded to the camera, and uploaded to the computer. Camera settings can be stored off-site, and sent into the camera. This eases maintenance and allows a central database to store and retrieve camera settings.
Cable: RS232, power and video, all galvanically isolated
Connectors: Metal shell connectors



Mounting Bracket: Full 3 axis gimballed mount
Heat shield: Available as an option, use of the heat shield is recommended in environments where high heating through exposure to sunlight is encountered
Operating Voltage: 9 to 40 V DC, 12 to 24 V AC, 110 to 240 V AC (Using external Power supply/interface unit)
Power Consumption: 8 W typical
Dimensions: Camera: H-90mm X W-80mm X D-185mm
Camera with sun shield: H-115mm X W-90mm X D-20mm
Bracket: H-80mm
Weight: Camera: 1.7 KG
Camera with sun shield: 1.8 KG
Camera with Bracket: 1.8 KG
Environmental: Sealing: IP 67
Temperatures:
Storage – 20° C to + 60° C
Operational – 10° C to + 55° C
Wind Loading (mounted on Cobra bracket) – 160 Kph / 45m/s
Accreditations and Approvals: CE, A & S (Vid G 5), FCA- E Mark, FCC

Stinger

Processor: 1.4 Ghz Intel Pentium M Processor
512 MB (Option of 1GB)
20GB Disk
Windows XPe - Embedded
4 x Independent Colour Streams - 75 Ohm I/P
GSM/GPRS
GPS (USB External Option)
802.11g
4 x USB 2.0
2 x RS232 full Modem
2 x RS232 simple
Analogue VGA O/P
802.3 100Mb/s
5v conditioned DC power output
Environmental Temperature Range -20°C to +50°C
Camera Configurations: Single and dual configurations
Camera Options: Monochrome - CCIR or EIA, Colour - PAL or NTSC
Illumination Options: 810nm, 870 nm, 950nm Integrated Light Sensor
Can be used to measure the daylight and alter the camera's settings to optimise the video.
Operating Voltage: 12 - 24V DC power input
110 to 240 VAC (Using external Power supply/interface unit)
Power Consumption: 40 W
Dimensions: Camera: H 91.07mm X W 180.17mm X D 364 mm
Camera with Bracket: H 176.88mm X W 180.17mm X D 364mm
Weight: Stinger; 4kg
Stinger with sun shield & Bracket: 4.2kg
Environmental: Sealing: IP 67
Temperature: Storage -20°C to + 60°C
Operational -20°C to + 50°C
Wind Loading (mounted on Stinger mounting bracket): 160 Kph (45m/s)
Accreditations & Approvals: CE, FCC
External Connections: • USB X 2, Ethernet, Power in
• Slave Camera
• GSM/GPRS Antenna
• WIFI Antenna
• USB for external GPS Engineering (KVM)

Viper

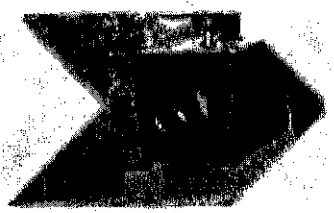


Image Sensor: 1/4 Type EX-view HAD CCD
Picture Elements: FCB-IX11A: Approx. 380K Pixels (768(H) x 494 (V))
FCB-IX11AP: Approx. 440K Pixels (752(H) x 582 (V))
Horizontal Resolution: NTSC: 470 TV lines (WIDE end)
PAL: 460 TV lines (WIDE end)
Lens: 10 x Zoom
F= 4.2mm (WIDE) to 42 mm
(TELE), F1.8 to F2.9
Zoom movement speed
Optical WIDE/Optical TELE 1.8 s
Optical WIDE/Digital TELE 3.5 s
Digital WIDE/Digital TELE 1.7 s
Digital Zoom: 4 x (40 x with optical zoom)
Angle of view (H): 46 degree (WIDE end) to 4.6 degree (TELE end)
Min. working distance: 10 mm (WIDE end), 1000 mm (TELE end)
Sync System: Internal
Min. Illumination: 1.5 lux (F1.8, 1/60s (NTSC) or 1/50s (PAL))
0.10 lux (F1.8, 1/4s (NTSC) or 1/3s (PAL))
Recommended Illumination: 100 to 100,000 lux
S/N ratio: 50 dB or more
Back light compensation: ON/OFF
Electronic Shutter Speed: 1/1 to 1/10,000 s (22 steps)
White balance: AUTO, ATW, Indoor, Outdoor, One Push WB, Manual WB
Gain: Auto/Manual (-3 to 28 dB, 2dB steps)
Aperture control: 16 steps
Focus: Auto (H,L), One-Push AF, Manual, Infinity Interval AF, Zoom Trigger AF
Preset: 8 positions
Serial Interface: VISCA protocol (TTL/RS-232C signal level)
9.6Kbps, 19.2Kbps, 38.4Kbps
Stop bit, 1/2 bit (switchable)
Video Output: VBS: 1.0 Vp-p (sync negative), V/C Output
Storage Temperature/Humidity: -20° to 60°C (-4° to 140°F)/20 to 95%
Operating temperature/humidity: 0° to 50°C (32° to 122°F)/20 to 80%
Power requirements/Power consumption: 9 to 12 V DC/1.6 W (2.0 W with active motors)
Weight: 95g (3 oz.)
Dimensions: 39.3 X 44.0 X 65.0 (1 9/16 x 1 13/16 x 2 5/8 in.) (w/h/d)

7. Current Installations

Applan Technology has in excess of two hundred systems deployed across the United States of America, fixed site and mobile systems.

In addition Applan has systems deployed in Canada and Mexico.

Applan equipment is at the heart of the majority of counter terrorism sites within the UK, including the "Ring of Steel" around the City of London.

In the A LPR market we have an extensive range of systems installed, these range from policing (including intelligence surveillance), traffic management, access control to enforcement.

Applan have installed A LPR systems in police sites throughout the UK. We have syste ms in the following locations (unnamed due to security classification):

- ALL 43 Polices in England & Wales
- Airports
- Ports
- Motorways
- Metropolitan Highways
- Inner City "Ring-of-Steel"
- Tunnels
- Covert Roadside Installations
- Secure Hospitals
- On Board Ferry Installations

Our Commercial Customer portfolio is extensive and includes many large organisations within the UK:

- Boots HQ, Nottingham – access control
- BAA, Glasgow and Edinburgh Airports
- Canterbury City Council
- Transport for London – traffic monitoring
- Bluewater Retail Park, Kent – site monitoring
- Tamar Bridge, Plymouth – traffic flow control
- Vodafone – Access Monitoring
- Newcastle City Council – Access control
- BMB HQ - Access control
- Northern Rock HQ, Newcastle
- NCP, Birmingham Airport
- John Lewis, Touchwood
- Astra Zeneca, Macclesfield
- BP, Sunbury and Milton Keynes
- Johnson Controls, Wilton

Applan Technology has worked with third party companies for integration of access control, road tolling enforcement and hazard detection systems.

8. Points of Contact

Technical:-

[redacted] – Vice President Technology (USA)
Email [redacted]
Cell
Office

Sales and Commercial:-

[redacted] – General Manager (USA)
Email [redacted]
Cell
Office
Fax

Please contact [redacted] or me if you would like any clarification or answering of any additional questions.

Yours sincerely

[redacted]
General Manager (USA)
www.epplan-tech.com

Appendix F - Remington-Elsag Proposed Solution for Washington Dulles International Airport

Each vendor was asked to provide an analysis of how they would use their technology to improve security around the Washington Dulles Airport. The proposals are attached "as is" and were not edited in any way other than format to fit into this report. *These ALPR Proposals reflect the opinions of the proposal's authors and do not necessarily represent the position or opinions of this document's authors or corporation.*

REMINGTON ELSAG LAW ENFORCEMENT SYSTEMS, LLC

April 15, 2008
RE: Dulles Airport LPR Security Ring

I have provided two different proposals that will cover all traffic inbound to the Dulles airport. This is meant to be a budgetary proposal and does not include any network equipment, cabling or network installation. This proposal assumes that the Elsag North America Operation Center software can be downloaded onto an existing site server. The server and associated hardware can be included in the estimate if required.

The first proposal sets the LPR perimeter relatively close to the airport. As it turns out, the closer to the airport we set the perimeter, the more equipment it takes to cover, and therefore the LPR equipment becomes a little more costly. The good news is that closer you are to the airport, the more likely it is there will be existing network infrastructure. If network infrastructure isn't available, it can be less costly to set up in closer proximity.

The first proposal puts LPR equipment at the following locations:

- Two cameras under the overpass of Aviation Drive covering the 2 inbound lanes of Rte 267. These two cameras can be controlled by one Field Control Unit.
- One pole mounted camera to cover ramp traffic off Aviation inbound onto Rte. 267. This camera will require a Field Control Unit.
- Two cameras pole mounted on Autopilot Drive covering inbound traffic (southbound). These two cameras will be controlled by one Field Control Unit. These cameras should be located between Aviation and Rudder.
- It is recommended that the airport be outfitted with one Mobile LPR unit for use with a car for vehicle of interest interdiction. This unit can be either permanently mounted or transportable to be moved form vehicle to vehicle. This vehicle will be able to upload and down load data to a centralized server/database wirelessly.
- This proposal includes six Operation Center Licenses allowing all fixed and bile LPR units/cameras to access the central database.

Remington-Elsag Proposal - Page 1 of 6

The second proposal puts LPR equipment at the following locations:

The second proposal sets the perimeter farther out, and takes less LPR equipment to cover the various possible inbound routes to the Dulles airport. While it takes less equipment to set the perimeter, the cost of setting up a network infrastructure is probably greater.

The second proposal fields LPR equipment as follows:

- Two cameras under the overpass of Rudder Rd. covering the two inbound lanes of Rte 267.
- One camera under the overpass of Rudder Rd. covering the inbound ramp off Rte. 267 onto Rudder Rd. All three cameras at the Rudder Rd. overpass will be able to share a single Field Control Unit.
- One camera pole mounted to cover inbound traffic on Autopilot Drive north of Rudder Road. This camera will require a Field Control Unit.
- It is recommended that the airport be outfitted with one Mobile LPR unit for use with a car for vehicle of interest interdiction. This unit can be either permanently mounted or transportable to be moved form vehicle to vehicle. This vehicle will be able to upload and down load data to a centralized server/database wirelessly.
- This proposal includes six Operation Center Licenses allowing all fixed and bile LPR units/cameras to access the central database.

Please see the attached price quotations for both Proposal #1 and Proposal #2. Let me know if you have any questions about this proposal, or if you need it changed in some way.

Thank you for the opportunity to quote this business,

(b) (6)
Director of Engineering
Elsag North America
(b) (6)

REMINGTON ELSAG LAW ENFORCEMENT SYSTEMS, LLC

Dulles Proposal 1

870 Remington Drive P.O. Box 1046
Madison NC 27025
Duns # 196140821 Fed Tax ID# 800119568
Phone: 1-866-9MPH900 (967-4900)
Fax: 336-379-7164

4/16/2008
** QUOTATION **
Quotation valid until: June 15, 2008
Prepared by: B.Howe
Projected Arrival Date: TBD
Terms: 2% 15 Days - 1% 30 Days

NASPO Multi-State Contract #PC62119 Award #19745
Hazardous Incident Response Equipment Group #38232

Model	Description	Cost	Units	Amount
MPH-900	MPH900 Mobile License Plate Reader – Includes Processor, 1 enclosure with 2 cameras and 2 Infrared Illuminators 2 image and character recognition processors and related software RELES MPH900 1 Complete 2 camera unit PERMANENTLY MOUNTED ON A VEHICLE.	**$21,525**	**1**	**$21,525.00**
FPH-900	Fixed Gate LPR Smart Camera and mounting hardware.	**$13,350**	**5**	**$66,750.00**
Wifi Upfit	Wifi Card installed after final assembly of system	**$575**	**1**	**$575.00**
FCU-900	Field Control Unit-Pole Mountable-includes ruggedized PC (1.6ghz/512mbram), 24vdc power supply(up to 8 cameras), surge suppression, environmental controls.	**$6,110**	**3**	**$18,330.00**
MPH-900INSTALL	Charge per vehicle for standard MPH-900 installation.	**$900**	**1**	**$900.00**
ENG SUP	Day rate for Remington-ELSAG engineering staff either on site or in the development lab.	**$1,250**	**5**	**$6,250.00**

MPH-900 UL	Field Wireless Synchronization Point includes base station and IP integration to assigned MPH-900 and FPH-900 units.	**$3,500**	**1**	**$3,500.00**
MPH-900 OPC	Operations Center License designed to coordinate multiple fixed and mobile units across.	**$975**	**6**	**$5,850.00**
ANNUAL SERVICE CONTRACT	5% of cost of Hardware, Software and Installation, includes all manufacturer defects and software updates.	**5%**		**See Below**
Phone Support	24 Hour Telephone Support by qualified MPH-900 technicians			**FREE**
ON-SITE TRAINING	Included in the purchase of both transportable and permanent MPH-900 installations available in group and individual sessions.			**FREE**
TRAINING CENTER MEMBERSHIP	Unlimited access to Remington ELSAG training classes held either in the field or at Company Facilities.			**FREE**
			TOTAL	**$123,680.00**

Service Plan for goods and services provided by the above quote

Year I	Free		
Year II	$5,162	Hardware and Software	Due: 4/1/07
Year III	$5,162	Hardware and Software	Due: 4/1/08
Year IV	$5,162	Hardware and Software	Due: 4/1/09
Beyond	$3,097	Software Only	Due: 4/1/10

Service Plan Includes: Software Updates Annual Training/Service Parts & Labor	Approval Signature:
Cash Discount Value if paid in 15days	$2,064.90
Cash Discount Value if paid in 30 days	$1,032.45

REMINGTON ELSAG LAW ENFORCEMENT SYSTEMS, LLC

Dulles Proposal 2

870 Remington Drive P.O. Box 1046
Madison NC 27025
Duns # 196140821 Fed Tax ID# 800119568
Phone: 1-866-9MPH900 (967-4900)
Fax: 336-379-7164

4/16/2008
** QUOTATION **
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Projected Arrival Date: TBD
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Hazardous Incident Response Equipment Group #38232

Model #	Description	Cost	Units	Amount
MPH-900	MPH900 Mobile License Plate Reader – Includes Processor, 1 enclosure with 2 cameras and 2 Infrared Illuminators 2 image and character recognition processors and related software RELES MPH900 1 Complete 2 camera unit PERMANENTLY MOUNTED ON A VEHICLE.	$21,525	1	$21,525.00
FPH-900	Fixed Gate LPR Smart Camera and mounting hardware.	$13,350	4	$53,400.00
Wifi Upfit	Wifi Card installed after final assembly of system	$575	1	$575.00
FCU-900	Field Control Unit-Pole Mountable includes ruggedized PC (1.6ghz/512mbram), 24vdc power supply(up to 8 cameras), surge suppression, environmental controls.	$6,110	2	$12,220.00
MPH-900INSTALL	Charge per vehicle for standard MPH-900 installation.	$900	1	$900.00
ENG SUP	Day rate for Remington-ELSAG engineering staff either on site or in the development lab.	$1,250	4	$5,000.00

MPH-900 UL	Field Wireless Synchronization Point includes base station and IP integration to assigned MPH-900 and FPH-900 units.	$3,500	1	$3,500.00
MPH-900 OPC	Operations Center License designed to coordinate multiple fixed and mobile units across.	$975	5	$4,875.00
ANNUAL SERVICE CONTRACT	5% of cost of Hardware, Software and Installation, includes all manufacturer defects and software updates.	5%		**See Below**
Phone Support	24 Hour Telephone Support by qualified MPH-900 technicians			**FREE**
ON-SITE TRAINING	Included in the purchase of both transportable and permanent MPH-900 installations available in group and individual sessions.			**FREE**
TRAINING CENTER MEMBERSHIP	Unlimited access to Remington ELSAG training classes held either in the field or at Company Facilities.			**FREE**
			TOTAL	[redacted]

Service Plan for goods and services provided by the above quote

Year I	Free		
Year II	$5,100	Hardware and Software	Due: 4/1/07
Year III	$5,100	Hardware and Software	Due: 4/1/08
Year IV	$5,100	Hardware and Software	Due: 4/1/09
Beyond	$3,060	Software Only	Due: 4/1/10

Service Plan Includes:
Software Updates
Annual Training/Service
Parts & Labor

Approval
Signature: _____

Cash Discount Value if paid in 15days $2,039.90

Cash Discount Value if paid in 30 days $1,019.95

Appendix G - PIPS Technology Proposed Solution for Washington Dulles International Airport

Each vendor was asked to provide an analysis of how they would use their technology to improve security around IAD. The proposals are attached "as is" and were not edited in any way other than format to fit into this report. *These ALPR Proposals reflect the opinions of the proposal's authors and do not necessarily represent the position or opinions of this document's authors or corporation.*

PIPS Technology chose not to submit a proposed solution for this document.