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DRAFT Technical Report

for

SECURES Demonstration in San Bernardino County – Bloomington Area

2003-IJ-CX-K021

Revision - 0

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National Institute of Justice

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Executive Summary

In October 2003 Planning Systems Inc. (PSI) teamed with the Center for Society Law and Justice (CSLJ) and the Department of Justice / Office of Justice Programs entered into a cooperative agreement 2003-IJ-CX-K021 for the deployment, operation and analysis of an acoustic gunshot detection system in San Bernardino County California. The National Institute of Justice (NIJ) – Office of Science and Technology, oversaw the project. Chris Miles, Senior Program Manager, Sensors, Surveillance, and Biometrics provided oversight and direction on behalf of NIJ.

This report is presented in three basic sections. The first section provides an overview of the enhancements to the technical tools used in the deployment of the SECURES® system and to the SECURES® display software. The second section of this report is the overview of deployment and operational initiatives as reported by PSI personnel. The third section represents the findings by CSLJ as an independent third party assessor.

The use of technical tools in the form of acoustic and RF modeling can greatly enhance the deployment of SECURES® by reducing the normal amount of field manpower and time required in an empirical approach to sensor and receiver placement and installation. This enables police departments to deploy or even relocate a SECURES® system in minimum time with limited exposure within the area of deployment. Not only does this save time and costs in installation but it also has the ability to identify deficient areas in advance so that these can either be re-engineered to assure coverage by the system being deployed or can provide additional situational awareness to patrol officers.

Enhancements to the SECURES® display software provides dispatch personnel with better tools to more accurately define and convey the gunshot locations to patrol.

The deployment and operations of the SECURES® systems in was plagued by delays in securing a valid poly use agreement with the local providing utility, Southern California Edison (SCE). Much progress was made with the onset of the program in 2003 including software enhancements, system layout, training and even the initial installation of the receiver and base station assemblies. However, once the issues concerning the pole use agreement for the intended area was overcome in 2007 with separate pole use agreements with both SCE and AT&T (formerly PacBell) much of the enthusiasm developed earlier on with all parties concerned had dissipated. Nonetheless the system was deployed as intended.

The results gained from the assessment by CSLJ were disappointing. The area in which SECURES® was deployed netted few gunshot alerts. There were no corroborating reports from the SBCSD to support actual ground truth events. The span of time from initial time of planned deployment in 2003 to actual deployment in 2007 had not only diminished enthusiasm but also the resources available to support this effort locally.

1.1 Development And Use Of Acoustic And Radio Frequency Modeling For Best Practices Sensor Deployment

Note: The development of the models discribed in this section were funded under DOJ/NIJ cooperative agreement no. 2003-IJ-CX-K021 SECURES® Demonstration in San Bernardino County California and were utilized for the demonstrations in Newport News and Hampton Virgina.

In order to more efficiently and accurately deploy sensors in the complex urban environment, PSI developed an acoustic prediction model, dubbed the Acoustical Urban Evaluator, and adapted an industry standard Radio Frequency (RF) propagation model.

The Acoustical Urban Evaluator model allows for mutiple "what if" scenarios for sensor deployment based on available assets for the mounting of sensors such as utility poles or buildings. The model determines for a given sensor layout good and bad coverage areas. This identifies where additional engineering is required to enhance the bad coverage areas or, where corrective actions are cost prohibitive, provides the user valualbe situational information.

The RF Propagation model employed is a commercially available package from EDX Corporation. This model is employed by many DoD, federal and state agencies to assist in designing radio system deployments. The model is utilized to determine the suitability of sensor locations with respect to RF connectivity to the receiver station.

Use of these models greatly increases the speed at which the sensor grid is designed while maximizing both sensor acoustic and RF performance resulting in a "best practices" deployment.

Acoustical Urban Evaluator Model

This section briefly describes the model used by the Acoustical Urban Evaluator. The purpose of the model is to emulate the SECURES® gunshot detection and localization methodology within a given urban confine with a preliminary SECURES® sensor layout; predict locations that can or cannot provide the required detections for a localization; and identify these locations as good or bad areas for the acoustic gunshot detection and localization of the SECURES® sensor layout within the defined urban area.

The methodology of the SECURES® system requires that for a given position of a shooter or gunshot localization that a minimum number of sensors detect the acoustic event within a specified time frame in order to facilitate the respective localization.

The Acoustical Urban Evaluator Model considers the propagation of an acoustic gunshot signature at a specified Sound Pressure Level (SPL) from the shooter or gunshot location to all possible sensor locations. If enough propagations of the gunshot acoustic signature reach the minimum number of SECURES® sensors in valid form for detection within the specified timeframe a localization is declared and the respective gunshot location is considered good for the respective sensor layout. If not it is considered bad and denoted accordingly. This process is repeated for minimal distances between locations throughout the area of interest for deployment.

Defining the affects on acoustic propagation is a science unto itself. To provide a basic overview for understanding the issues involved, only a few of the primary effects will be presented for the reader. Thus a very fundamental model will be reviewed with the following approximations:

1. Linear acoustics.
2. Flat terrain.
3. Homogeneous atmosphere.
4. Infinite wedges (corners) and wide barriers.
5. Vegetation barriers not included.
6. Only the first diffraction around the closest obstacle is taken into account

If a direct line-of-sight path exists between a shooter position and a sensor, the acoustic gunshot signature is propagated simply from the shooter location to the sensor locations. This is the case of acoustic propagation above a half-plane (ground). The ground can be modeled as hard or soft (i.e. having a finite acoustic impedance). Since the horizontal distances traveled are relatively short, up to a few hundred meters, the atmospheric effects on sound propagation are neglected. Two ray paths are possible: the direct path and the reflected path (see
Figure .) The SPL at the sensor is therefore influenced by the range from the shooter to the sensor and the interference between the direct and reflected acoustic rays.

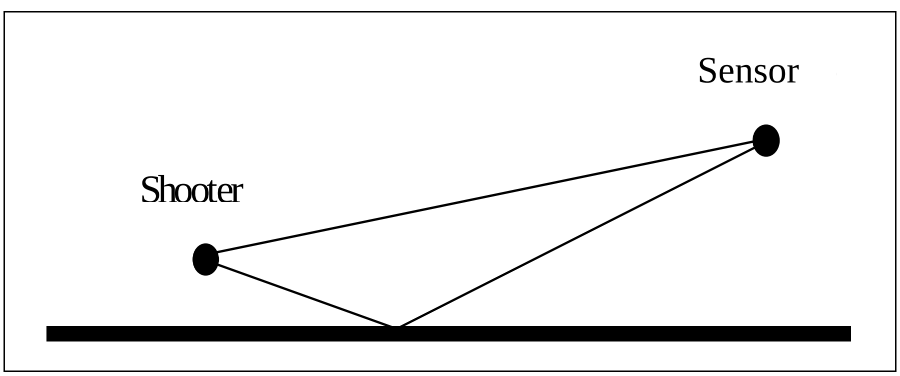

Figure 1. Acoustic Propagation above Ground: The Direct Path and the Ground Bounce

If the direct line-of-sight is obstructed by an obstacle, diffraction of sound around the obstacle has to be considered. Currently any type of building along the propagation path is considered a wide barrier, a 90-degree wedge or both (Figure 1 and Figure 2). The theory of diffraction developed by Pierce [3], [4] is applied to determine the acoustic field at the sensor.

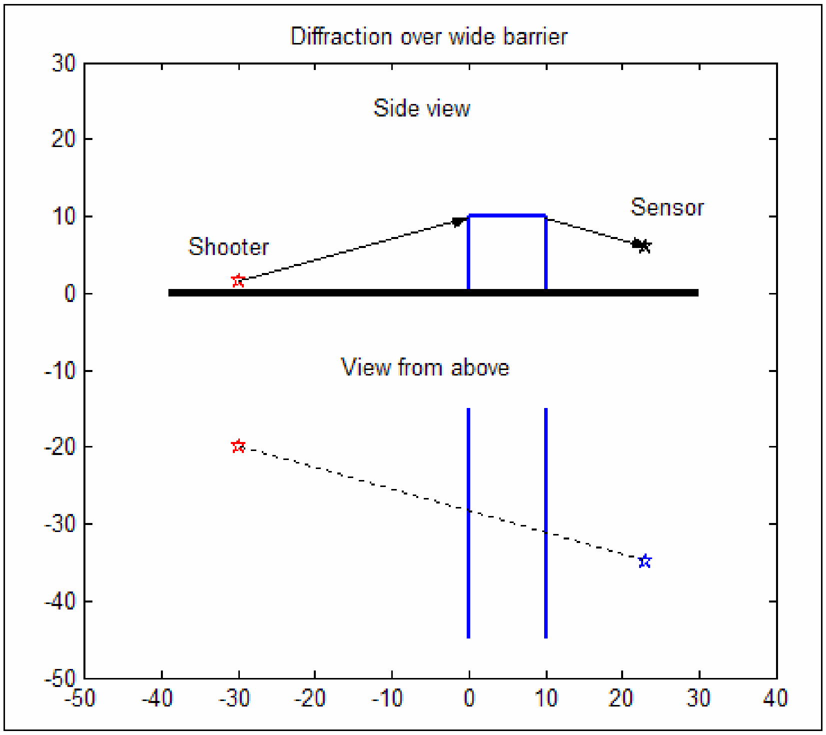

Figure 1. Diffraction Over Wide Barrier

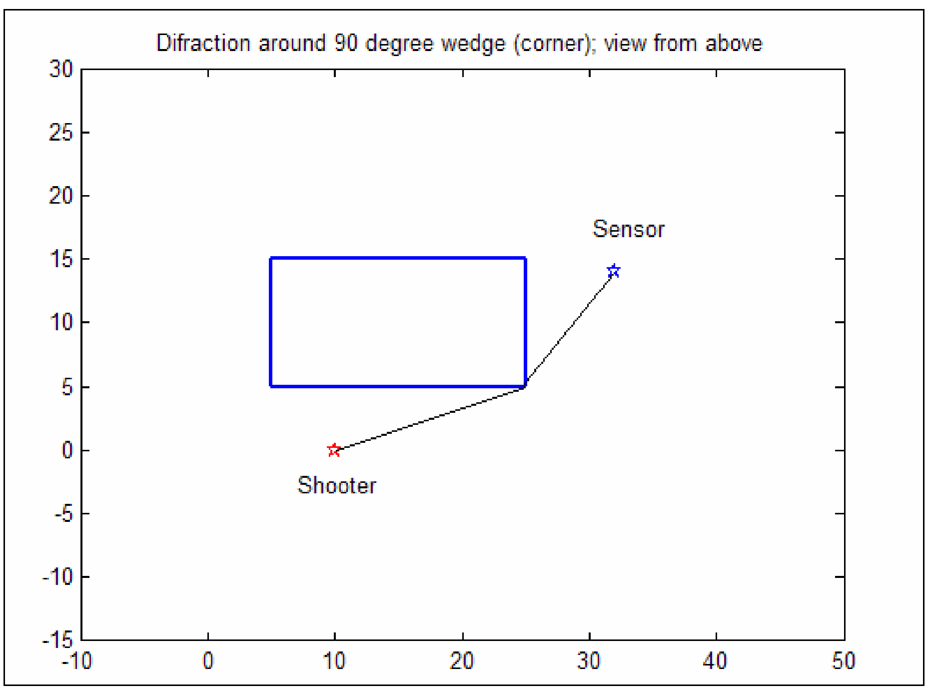

Figure 2. Diffraction Around a Corner

The urban environment is input to the program in the form of standard GIS shapefiles. At least 2 shapefiles are necessary: one containing the footprints of the buildings and one containing the positions of the pole units in the surveyed area. The buildings are all assumed to be parallelepipeds.

Figure 3 illustrates an area to be surveyed acoustically featuring buildings, sensors and street centerlines as loaded from shapefiles.

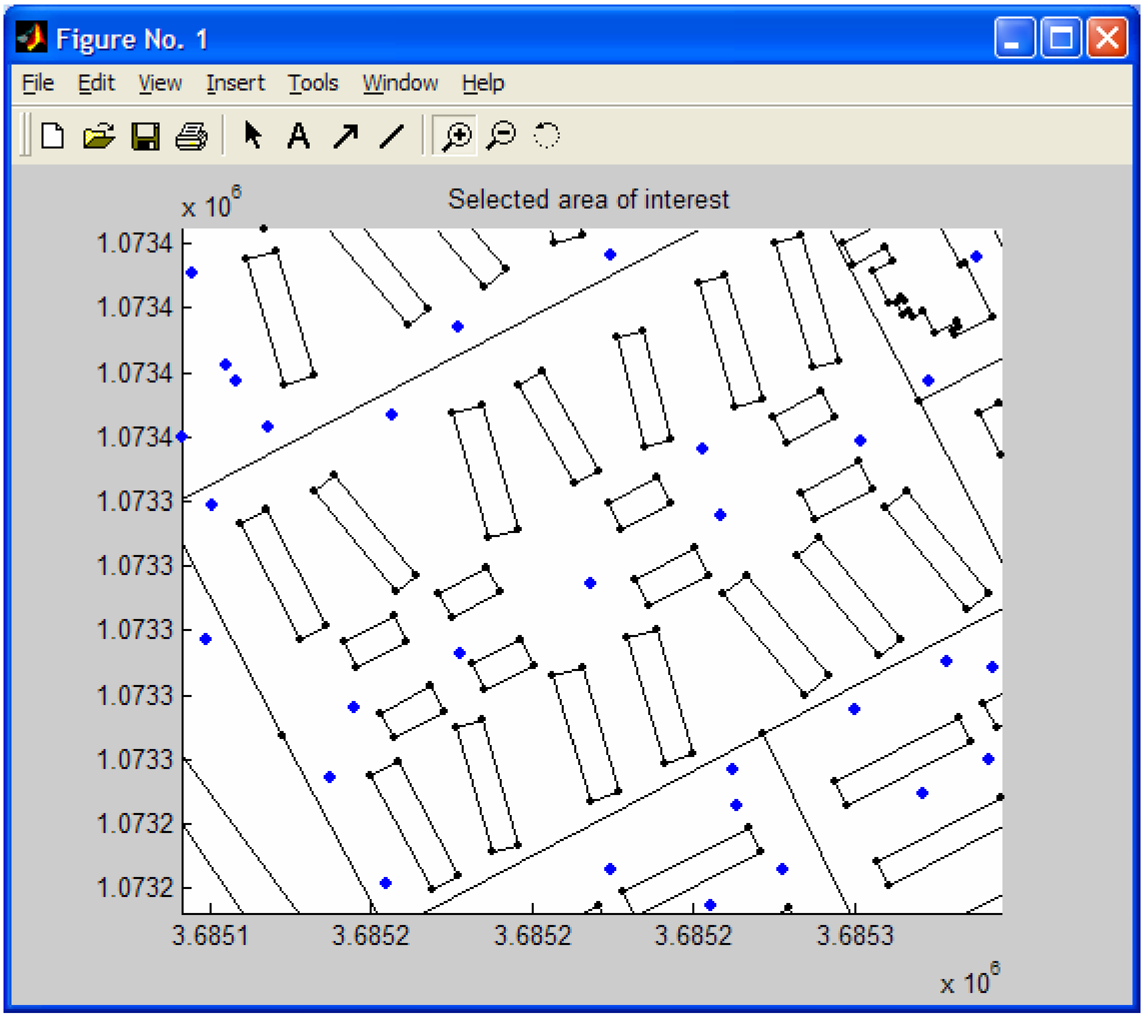

Figure 3. Example of an Urban Area to be Surveyed

Figure 4 illustrates the result of the survey: the green dots represent shooter positions that can be detected and localized; the red are the positions that could not be localized. Thus the output points to potential areas where optimal acoustic coverage is not achieved with the sensors selected in this scenario. The red dots signify positions not localized; green dots – positions that are localized.

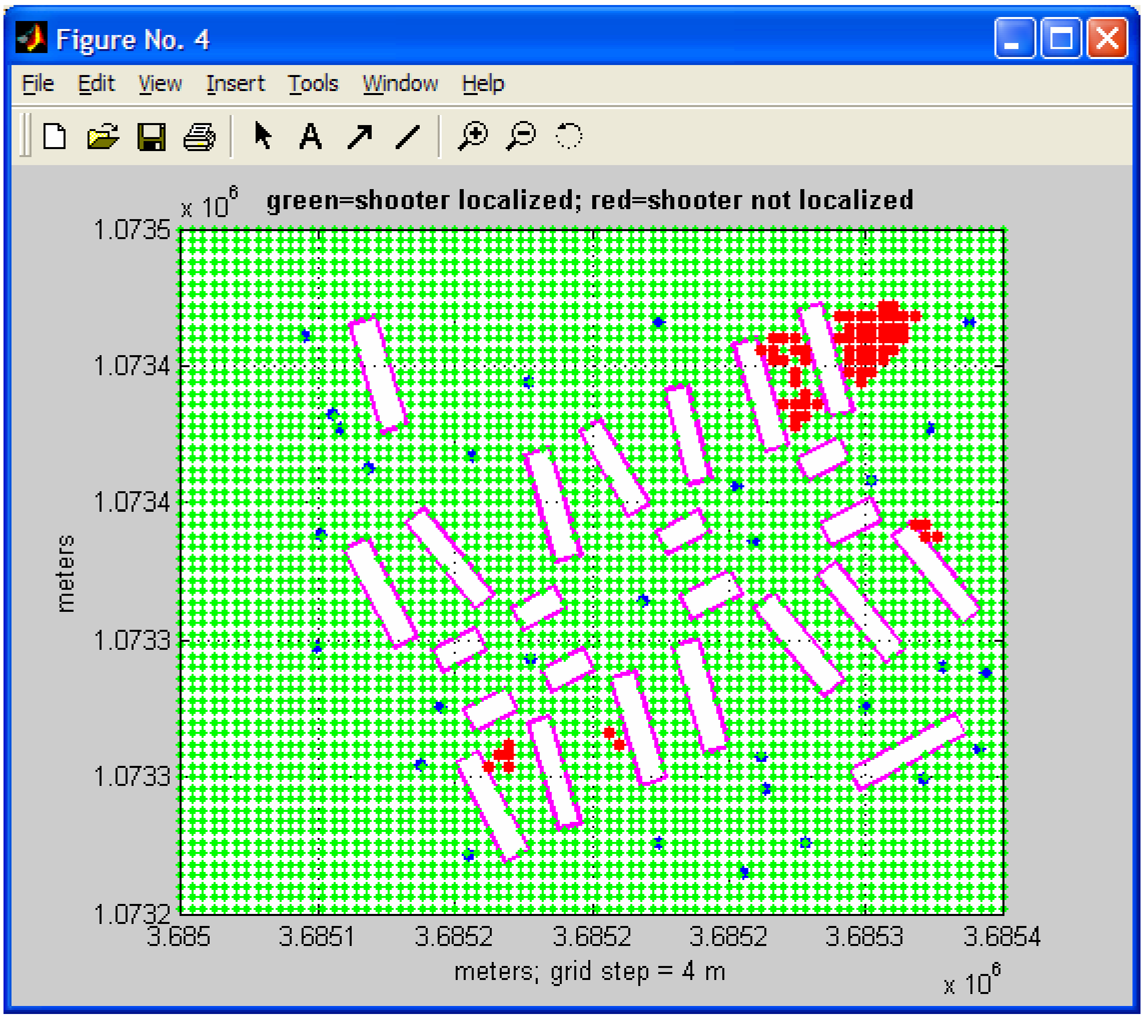

Figure 4. Acoustic Model Output Demonstrating Gaps in Coverage

Radio Propagation Model

This section describes the models used by the EDX Signal software package in the prediction of SECURES® radio performance. EDX Signal software is a collection of modeling and design tools for wireless communications systems. EDX Signal can predict service areas and path performance using advanced propagation models that account for terrain and can model the behavior of radio signals around building in urban settings.

Model Components

Terrain Data

Terrain features have a dominant effect on long distance radio signal propagation. Terrain elevation data is a good way to identify high points that may potentially be good receiver sites.

Building Data

Buildings can represent significant obstructions to the RF signal path. A building polygon database describes the exact footprints of individual buildings with their associated heights. It may also include rooftop detail such as air conditioning structures and elevator shafts.

Propagation Model

The transmission of electromagnetic waves from one point to another is a complex physical phenomenon, especially when the environment is complicated with features such as mountains, buildings, and/or foliage, in addition to changing atmospheric conditions, rain and other variable elements. Depending on transmission frequency, location and so forth, all of these things can potentially affect the strength of the signal at some point away from the transmitter. Because it is a complex phenomenon, it is not possible to predict the signal strength or transmission path loss exactly. As a result, over the years many models have been developed to estimate as accurately as possible the signal loss over the transmission path and its variations.

Many different propagation models are available with EDX Signal software. EDX technical support recommended either TIREM-EDX or Anderson 2D v1.00 for the SECURES® application. TIREM stands for Terrain Integrated Rough Earth Model, one of several propagation models in a propagation package developed by the National Telecommunications and Information Administration (NTIA) in conjunction with various branches of the US Department of Defense. This model is one the more complex currently used. The Anderson 2D model is a basic physical model that uses traditional ray techniques to calculate path loss. Like most models, for a given transmitter-receiver pair, it first determines if the path is line-of-sight or non-line-of-sight. Based on this determination, one of two calculation branches is used.

RF Analysis

Maps developed using signal level information from one or more transmitters can be used to help design RF systems and predict performance in terms of real service objectives. These studies are called "area studies" because the calculations are done for a grid of points covering an area. The area studies are calculated using a radial line method. The study sector for a given transmitter is defined as basically a circular arc that extends from the start azimuth clockwise around to the stop azimuth. The size of the arc is determined by these azimuths and by the study radius. The resolution of the coverage across this arc depends on the azimuth spacing or increment, and the point spacing along the study radials. A propagation study is performed at each point on each radial to determine the field strength at that point. This information is then interpolated to establish field strength or other signal level information at the actual grid points. As you move further out from the transmitter, the accuracy of the results decreases. The radial lines become farther apart and the points used to calculate the value at each grid point become further away from the desired location so there is an associated loss of accuracy. For the SECURES® RF survey, these area studies are used to provide a quick overview of a potential deployment area and highlight problem areas. In order to achieve more accurate results, it is necessary to perform a link study at each potential transmitter location. Link studies are designed to communicate information between two distinct points rather than from one point to a broad area of use.

Three different types of calculations were of primary interest for the SECURES® RF analysis and will be described in greater detail:

- Power Level Area Study
- Strongest or Most Likely Server Study
- Link Study

For the area studies, it was necessary to place a transmitter at the potential SECURES® receiver location and examine the received signal characteristics at each transmitter location. Since each RF path is bi-directional, the results should be identical if the receiver and transmitter locations are swapped.

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Power Level Area Study

EDX signal evaluates the received signal power level using the following equation:

$$P = ERP_d + G_r + 4.30 - [32.45 + 20\log_{10}f + 20\log_{10}\underline{d} + XPL] + 30.0 \text{ DBmW}$$

Where P is the signal power at the terminals of the receive antenna in decibels relative to 1 mW, ERP_d is the transmitted ERP in dBW relative to a dipole antenna, G_r is the gain of the receive antenna (dBd), f is the frequency in MHz, d is the distance to the receive location in kilometers, and XPL is the excess path loss due to terrain, buildings, and attenuations values derived from propagation curves such as those published by the FCC or ITU=R. An example of a power level area study plot is shown in Figure 5. This plot provides a quick estimate of the expected power level at the receiver for any potential pole location.

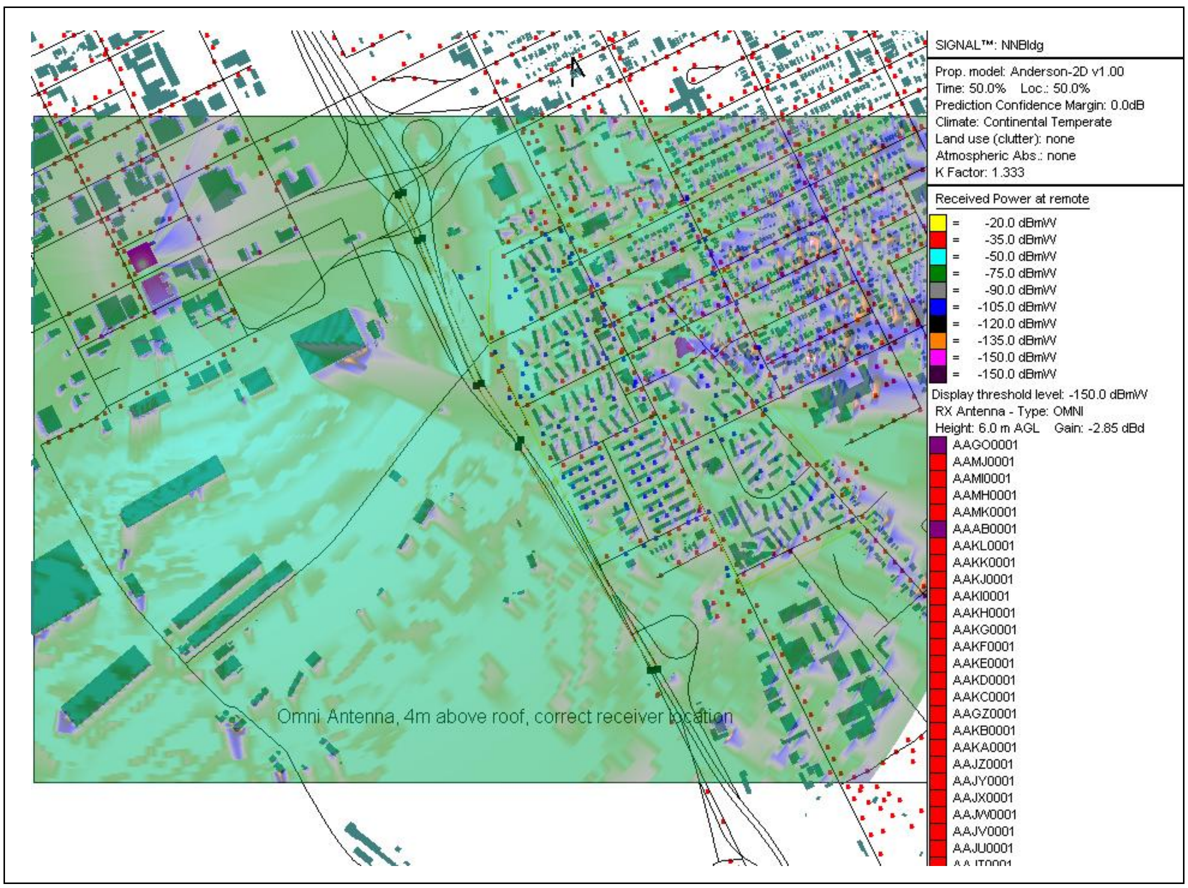

Figure 5. Sample Power Level Area Study Plot

Strongest or Most Likely Server

The strongest server map display shows the identity of the transmitter supplying the strongest received signal at each grid location. The program automatically assigns colors to transmitters in the study and then color fills the map according to these color-assignments and the ID for the transmitter. An example of a strongest server area study plot is shown in Figure 6. Since only one transmitter was present for the SECURES® configuration, the strongest server map will quickly show what pole locations exceed the threshold.

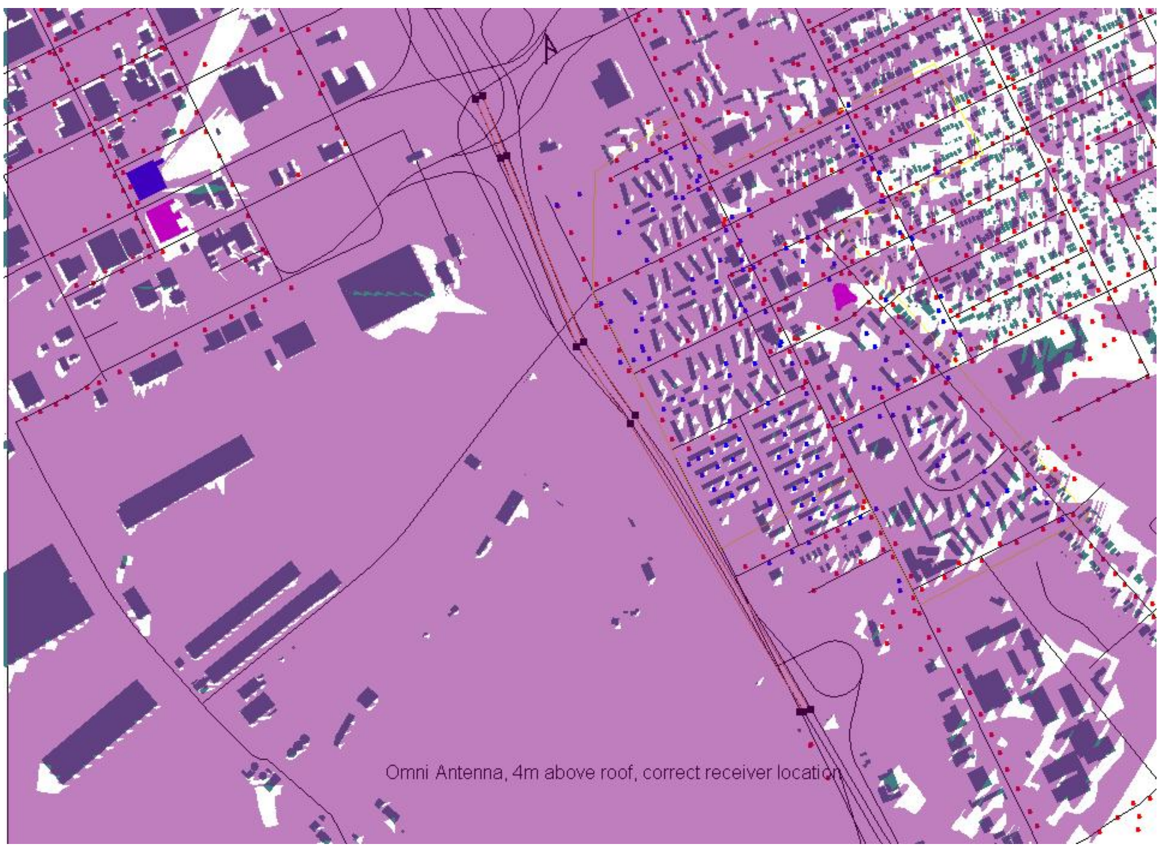

Figure 6. Power Level Area Study Plot

Link Study

Link systems are designed to communicate information between two distinct points. EDX signal can display a profile of the signal link traveling over terrain between these points (Tx and Rx). Building a reliable communications system requires the ability to predict how each system component will perform in the presence of many types of natural and man-made features which can potentially obstruct the link. An example of a link study plot is shown if Figure 7.

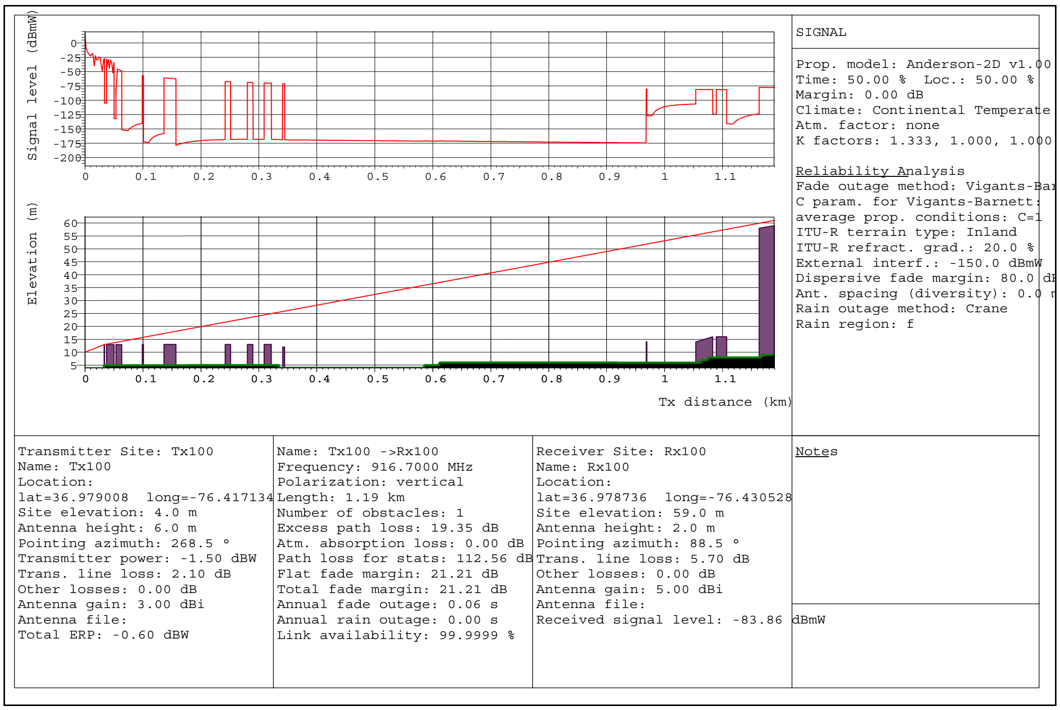

Figure 7. Link Study

1.2 Advancements to SECURES® Display Software

Note: The advancements to the SECURES® display software in this section were funded under DOJ/NIJ cooperative agreement no. 2003-IJ-CX-K021 SECURES® Demonstration in San Bernardino County California and were utilized for the demonstrations in Newport News and Hampton Virgina.

Upon demonstrating the prior SECURES® display software to the Hampton Police Department, Newport News Police Department, and San Bernardino County dispatchers, coupled with feedback provided from previous users, it was determined that improvements to the SECURES® display software would be required. The previous display software ran on a stand alone PC and had a basic tool set. A representation of this display is shown in Figure 8 below. The deployment of sensors in two areas and the segmentation of dispatcher workload across different geographicic areas of the city necessitated changes to the system software. The dispatchers, accustomed to third generation Computer Aided Dispatch (CAD) software sytems also requested a more rich set of features.

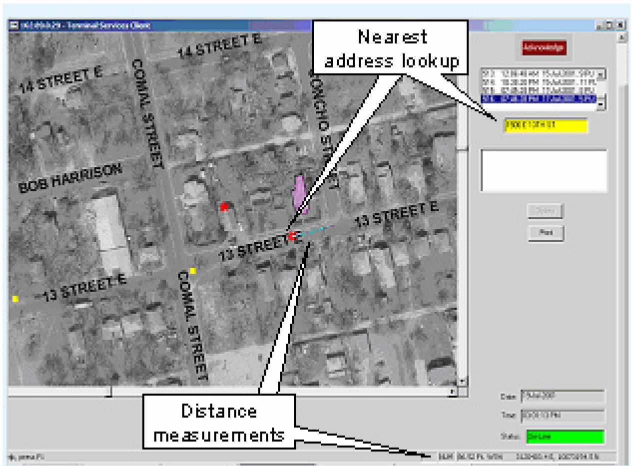

Figure 8 Previous SECURES® Display

The SECURES® Display Software displays each new gunfire incident occuring in the area where SECURES® sensors are installed. The software is intutive and easy to learn. Software documentation, online help, and training are provided to the user by CSLJ. The SECURES® Display Software may reside anywhere on the network connected with the SECURES® Base Station server. The SECURES® Base Station Software collects sensor activations and calculates localization of incidents. Typically the application runs on a dispatcher's Computer Aided Dispatch workstation but may reside on standalone or wireless mobile computer running MS Windows 95, Win2K NT or XP.

San Bernardino County Sheriff Department, Newport News Police Department, and Hampton Police Department elected to run the display application on each CAD workstation in their 911 Communication centers. This helps achieve rapid response to SECURES® activations, enhances situational awarness for everyone in the center and promotes more continuous flow of information during the calltaker to dispatcher handoff during the incident management process. The enhancements to the SECURES® Display Software are detailed in the next section.

Display Enhancement Features

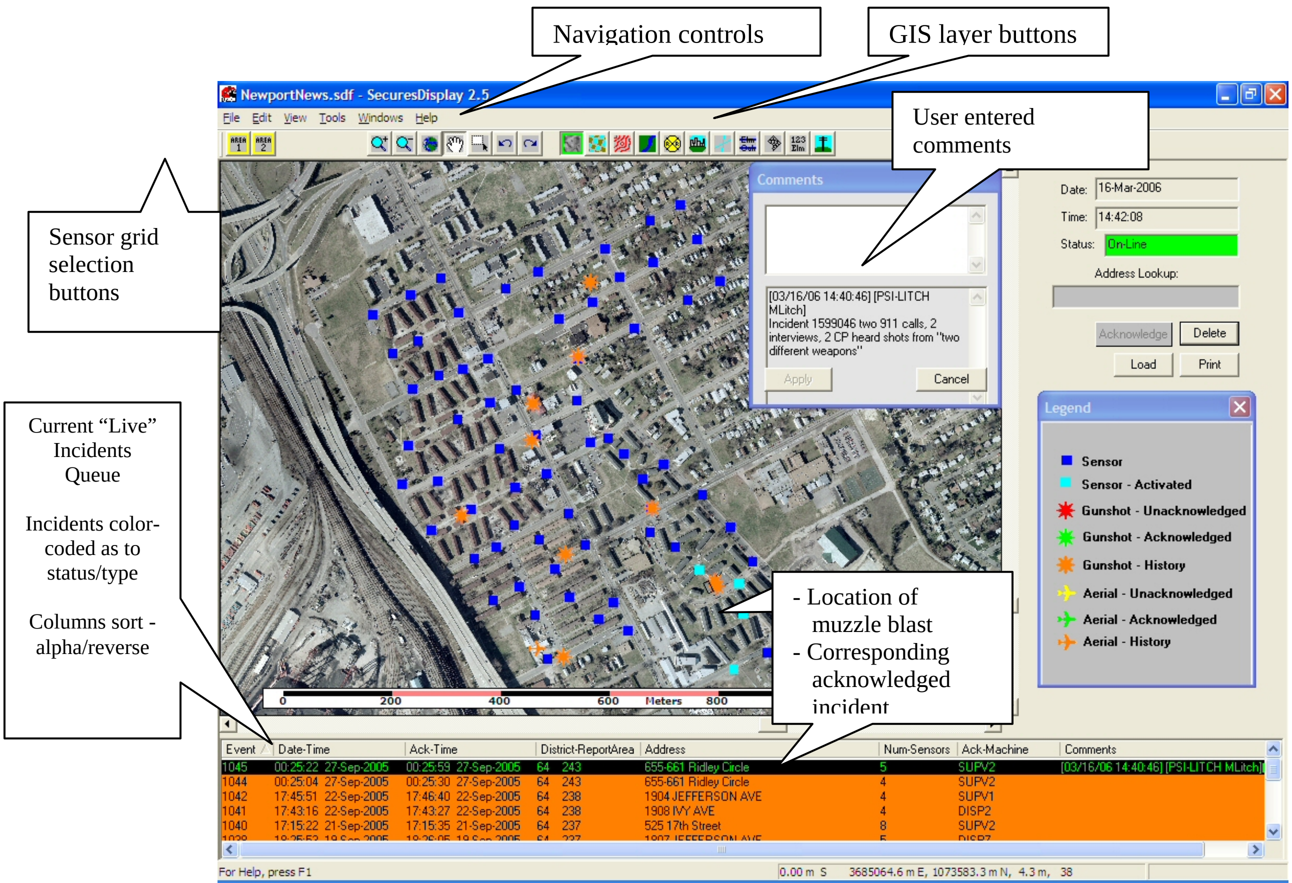

Figure 10 SECURES® Display

- High resolution color aerial ortho-photography base map
- Simple to use GIS Layer overlays - any useful planometric layer as defined by the client

- Intuitive navigation:
  - Area wide view button
  - Zoom In & Out buttons
  - Zoom selection rectangle
  - Drag panning
  - Undo & Redo buttons

- Multi-sensor grid support
- Multi workstation support:
  - o Acknowledgements are time stamped and identified by workstation
  - o Acknowledgements are distributed to all workstations
  - o Areas of responsibility feature – segmentation of workload by multiple users

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- User may choose to make different sensor grids Active, Passive or Disabled
- Easy to understand visual cue as to monitoring status of sensor grid area
- One button navigation between different sensor grid areas

- On application startup, any unacknowledged incidents are reloaded
- Improved data presentation:
  - Event number
  - Date / Time of incident
  - Ack / Time
  - District
  - Address – automatically resolved on new incident arrival, can be UTM, MGRS etc.
  - Number of Sensors activate
  - Ack / By
  - Ad hoc address lookup, user may choose to change incident address or not.
  - May sort by any column
  - Multi select acknowledge and delete

- Improved incident management:
  - User acknowledges incident either singly or multi-selects
  - User may choose to let incidents accumulate or delete from queue
  - Incidents may be recalled by Historical Incident Lookup feature
- Historical incident lookup:
  - Search by:
    - Event time & date
    - Ack time & date
    - Event number
  - Filters:
    - Time range
    - Location (sensor grid)
    - Ground based events
    - Aerial based events

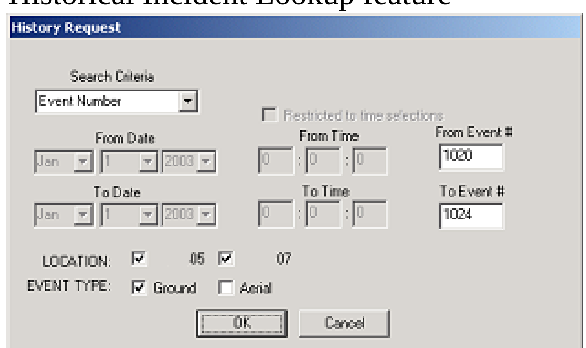

Figure 11 Historical incident lookup

- Measurement tool to allow user to measure distance and bearing from map objects to muzzle blast location
- Location sensitive mouse cursor – displays UTM coordinates
- Legend of icons and incident status. Audible new incident alert configurable by system administrator. Selectable military or standard time formats.
- One button incident printing
- Incident Comments may now be entered by the user about individual incidents. User comments are date/time stamped and once entered cannot be edited or deleted.
- XML interface with open application programming interface to facilitate development of interfaces to external customer systems such as Computer Aided Dispatch systems, Mobile Computer Terminals, web servers and coupled surveillance cameras.

2 Deployment and Operation of SECURES®

2.1 Introduction to SECURES®

SECURES® is the civilian version of a family of acoustic gunshot detection and localization systems being developed by PSI. The technology is based on military weapons fire localization systems originally funded by Defense Advanced Research Projects Agency (DARPA) and currently owned by PSI. Military versions of the system include man portable sniper and mobile artillery detection and localization.

The system consists of a grid of acoustic sensors mounted to utility poles or buildings in the area plagued by gunfire, a radio receiver housed in a building within a mile of the sensor grid and a display terminal located at the police communications center. The sensors are completely self-contained; battery operated; and need no external connections. The sensors detect the explosive muzzle blast of a gunshot, while rejecting background noise and transmit a message to the receiver. A data communications link from the receiver to the police communications center carries the detection message. See Figure 12: System Overview.

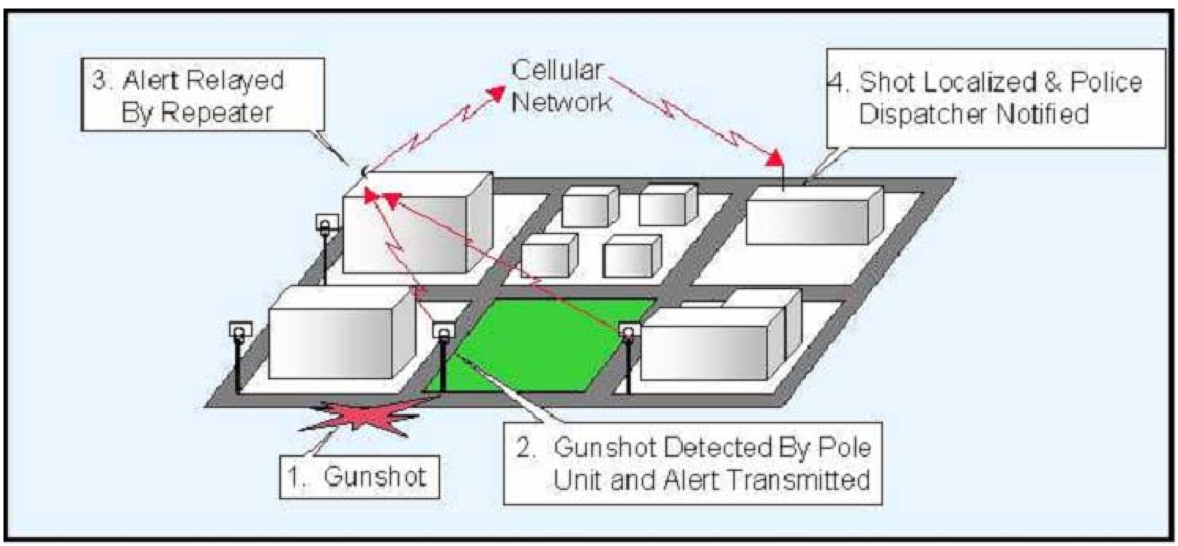

Figure 12: System Overview

Within seconds of a shot being fired, police dispatchers view the precise location on a computer display in the 911 communications center. The location and time of the gunshot is displayed on an aerial photograph of the instrumented urban area. The street network, building “footprints” as well as the closest address to the gunshot are visible on the display. A gunshot detection system has several benefits such as:

- Precise position and time of outdoor gunfire localized and recorded
- Rapid response to gunfire independent of 911 calls reporting gunfire
- Corroborates 911 calls for reports of gunfire
- More accurate incidence and location of outdoor gunshots will be known
- Assist in locating physical evidence, provides corroborating evidence
- Enhanced officer safety
- Integrated with police Standard Operating Procedures (SOPs)
- Direction of vehicle travel of drive by shootings can be determined
- Easy interface to CAD, CCTV, Mobile Computer systems

2.2 SECURES Deployment in San Bernardino County California – Bloomington Area

2.2.1 Technical Support to Deploy SECURES®

PSI coordinated with SBCSD Planning Division to incorporate the SECURES® technology into the SBCSD 911 Communications Center. Crime analysis techniques were utilized to identify two deployment areas with a high incidence of gunfire. The candidate area identified by SBCSD command and patrol personnel as the most effective area to deploy the system was in the Bloomington area

Acoustic modeling and radio frequency propagation models were used to select sensor locations and a receiver station site. Consideration was given to the area's terrain, structure heights and utility poles, which would provide the most suitable placement of sensors for ideal coverage. The structures within the site boundaries are typically one and two story buildings of both multi and single-family dwellings. The area is largely residential with light commercial and community structures (churches, schools, etc.) within the boundaries. The County's own Geographical Information System data was integrated into the SECURES® Display application

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2.2.2 Pole Use Agreement for Sensor Mounting

By far the most time consuming step in implementation was to obtain a Pole Use Agreement. Negotiations directly between Southern California Edison (SCE) and PSI proved difficult and lengthy beginning in 2003. This effort was further hampered by a continual change in points of contacts with SCE. Eventually negotiations netted an agreement in 2006 but only for the use of 30 poles. The balance of the requested poles had already been leased to PacBell and thus PSI was compelled to enter into negotiation with them commencing in 2006. PacBell became AT&T and a pole use agreement for an additional 50 pole locations was finally granted in early 2007.

Figure 9: Typical Sensor Installation

2.2.3 Sensor Installation

Once the Pole Use Agreements had been consummated, the installation of the SECURES sensors within planned area was scheduled. All sensors were installed over a three-day period. A live fire test was conducted to confirm system functionality. Figure 10 depicts the sensor grid covering two areas in the Bloomington area. Sensors were mounted exclusively to utility poles.

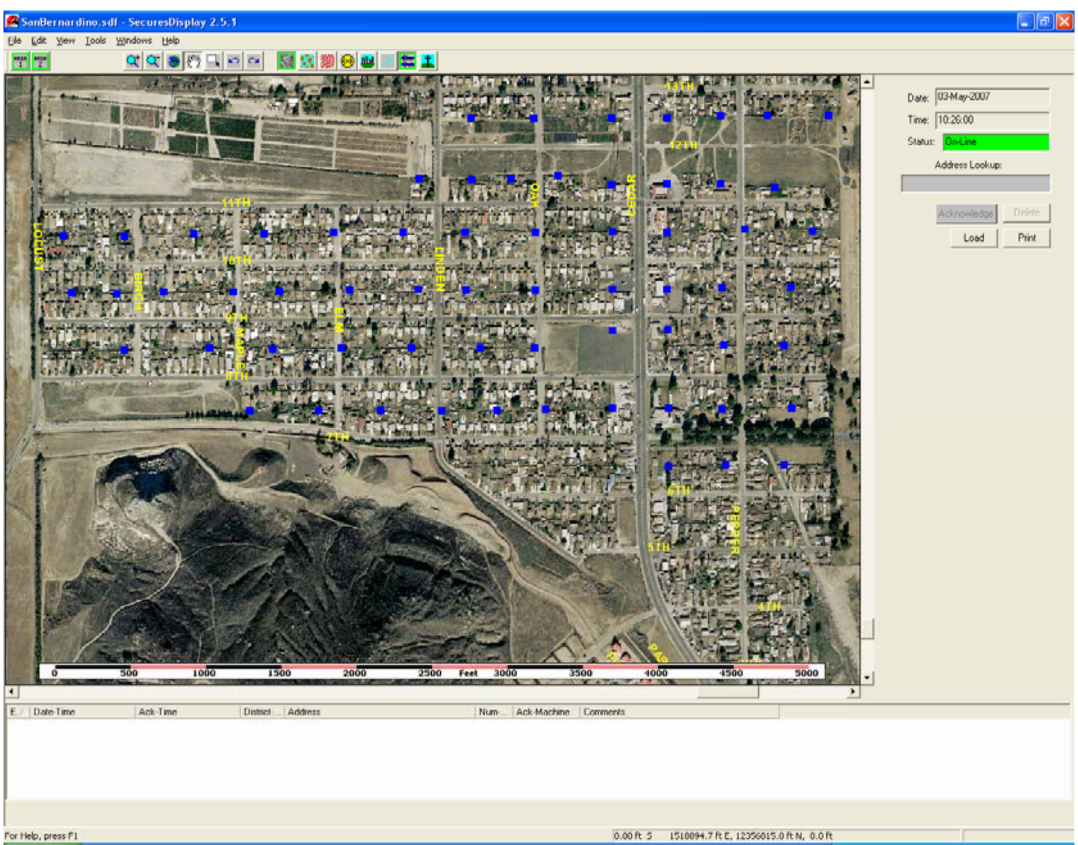

Figure 10: Sensor lay-down in Bloomington area

2.2.4 Receiver Station

The SECURES® Receiver Station was originally installed in 2005 within a maintenance platform above the gymnasium of the Bloomington High School. This location was slightly problematic relative to the size of the receiver station assembly. Access for an item of this size was only available from the roof. A crane was employed for its installation. Once the sensors were installed in 2007, the condition of the receiver station was assessed and required the update and replacement of several main components.

Figure 15: Roof Access for Receiver

Figure 16: Receiver Station

The receiver antenna was mounted in a non-penetrating manner on the roof of the high school.

Figure 18: Non-Penetrating Base

Figure 17: Receiver Antenna

2.2.5 Training

Figure 19: CSLJ providing SECURES training

Training was developed and provided by UNO/CSLJ. As a component of the training, PSI developed and provided a gunshot simulation program that simulates three gunshot incidents. Materials and field guides were also prepared. A critical component of the training was to standardize search procedures to allow CSLJ to determine the source of the acoustic event. The value of all information in the San Bernardino County Assessment was dependent upon the effort SBCSD deputies expended in determining the source of each acoustic event through finding shell casings, fireworks residue, witness interviews etc. Inasmuch as there was a considerable time lapse from the original training based on anticipated system deployment and the actual system deployment, training was repeated upon system deployment in 2007 prior to Go-Live.

3.0 CSLJ Assessment

March 25, 2008

To: George Orrison:

Planning Systems, Inc

Reston VA

From: Dr. Peter Scharf

Research Professor

Texas State University

Re: Qualitative assessment of San Bernardino SECURES® San Bernardino County Sheriff's Department Bloomington Area Field Implementation Experiment Based upon information available to this reviewer

I. Abstract:

This is a report based upon limited data regarding the installation of the SECURES® gunshot technology in the Bloomington area of San Bernardino County. In considering this assessment it is important to note:

1. CSLJ had no role in the implementation of the field deployment from June-September 2007;
2. Data was collected as agreed on a one day site visit to SBCSD in February, 2008
3. The information available to this assessor was by the standard of materials available for SECURES assessments in Austin, Hampton and Newport News, incomplete; and

4. The assessment was undertaken several months following completion of the implementation.

This report represents a qualitative assessment of efforts to install a gunshot detection system in San Bernardino, California, from June-September 2007 by Planning Systems, Inc. This choice was in effect forced upon the assessor when faced with an absence of standardized data on which to draw inferences with greater certainty of truth. Data provided to the assessor suggests that the project was only actively managed in June and July. This project appears to have been successful in many of its processes; (especially training) however the actual implementation appears to have not achieved its major objectives. Even this conclusion is uncertain given the absence of data related to core elements of the program including:

- Police response data
- Categorization of shooting events triggered by SECURES®
- Data related to any "live fire" test
- Investigations of shots fired
- PSI source data
- Etc.

In assessing data made available to this assessor it appears that there were a great many "unfounded" activations in response to SECURES® alerts. The cost of the high number of false positives represented a significant problem for both Newport News and Hampton Police Departments and apparently especially so (according to the Fontana Police Commander) in San Bernardino. In San Bernardino of 52 recorded incidents (from June 2007-September, 2007 almost all were categorized as unfounded. Explanations for this pattern was interpreted by the Commander of the unit as due to the distances involved in responding to incidents in the Bloomington area and to officers(deputies) lack of confidence in the technology. He suggested that the project might have been more successful in an urbanized area, for example, the City of San Bernardino. Other explanations for the high rate of unfounded calls may be found in long dispatch runs, lack of confidence by officers in the system and cursory "searches" by officers. Perhaps greater qualification was needed for the site. The experiment was delayed due to pole use agreements, fiscal constraints limiting involvement by the vendor and support too by SBCSD. In this case given more positive results in East Orange and Hampton the disappointing results might have been an implementation failure rather than judged as a technology limitation. The results of the effort were disappointing.

The Implementation of SECURES® in the San Bernardino Bloomington Area:

SECURES® is an acoustic gun shot detection system that seeks to identify source points of gunshots in neighborhoods in which it is implemented. Having been deployed in Dallas and Austin, Texas and in Hampton and Newport News, Virginia as well as East Orange, New Jersey, the technology was by agreement and funded through a legislative earmark, deployed in a relatively "high" activity area in San Bernardino, referred to as the "Bloomington area." The technology which SECURES(R) is an acoustic Gunshot Detection System (GDS) that has been believed by the vendor to significantly deter violent crime and reduce calls for service It is advertised to allow police to respond quickly to gunshot incidents and make apprehensions helping to better protect communities. From the time of a gunshot incident to the localized display on a GIS map, the claimed (by PSI) elapsed time is only 3-5 seconds. Localization is claimed to be accomplished usually within ten feet and correlated with the closest street address provided by the GIS database. Specifically, the technology is expected to:

- Provides audio and visual alerts within seconds after the shot is fired

- Automatically zooms to and displays a gunshot's location on an aerial photograph
- Displays the gunshot's date, time and geographical coordinates
- Displays the location of the pole units that detected the shot
- Automatically identifies the address nearest to the gunshot
- Displays a cumulative history of gunshot events

Main operating features of the technology as described in the San Bernardino Training Manual provided by PSI included the following:

- Provides audio and visual alerts within seconds after the shot is fired
- Automatically zooms to and displays a gunshot's location on an
- aerial photograph
- Displays the gunshot's date, time and geographical coordinates
- Displays the location of the pole units that detected the shot
- Automatically identifies the address nearest to the gunshot
- Displays a cumulative history of gunshot events

With its mixed demography, defined boundaries, the Bloomington Area appeared suited to a field assessment of the technology.

San Bernardino County Sheriff's Department is the primary law enforcement agency for the county of San Bernardino. San Bernardino County is geographically the largest in the nation, encompassing 20,186 square miles. San Bernardino County Sheriff Gary S. Penrod is an elected official. Sheriff Penrod ran unopposed in 2006 and was elected to his fourth, four-year term as Sheriff. Sheriff Penrod oversees a staff of 3,400 and an annual budget of $361 million. There are 24 incorporated cities within San Bernardino County. Fourteen of those contracts with the San Bernardino County Sheriff's Department for law enforcement services.

The Bloomington area reports low to moderate income and a greater than 50% Hispanic population with higher than expected for Fontana calls for service by SBCSD, arrests and reported crimes. The incidents which the technology targeted were perceived as both a drag upon operations and an important policing problem as indicated below:

DATE	ENTERED	DISPATCHED	EN ROUTE	ONSCENE	CLOSED	LOCATION	INITIAL CALL	CLOSED AS	DISPO
1/7/04	17:09:36	17:10:43	17:10:52	17:18:02	17:34:53	BANANA AV /JURUPA AV	SHOTSF	SHOTS FIRED	UTL

1/10/04	19:38:46	19:39:13	19:39:13	19:48:28	19:56:30	LIVE OAK AV /RANDALL AV	MANGUN	SHOTS FIRED	UTL
1/28/04	20:22:32	20:22:32	20:22:32	20:33:26	20:57:31	18533 9TH ST	SHOTSH	SHOTS FIRED	NAT
2/13/04	21:44:19	21:45:00	21:49:50	21:53:24	22:05:20	14275 ARROW RT #12	SHOTSF	SHOTS FIRED	UNF
3/29/04	03:41:36	03:42:30	03:42:30	03:44:15	03:57:51	18893 13TH ST	SHOTSF	SHOTS FIRED	UNF
4/10/04	00:17:57	00:19:24	00:19:37	00:21:55	00:39:04	8388 BEECH AV	SHOTSF	SHOTS FIRED	NAT
4/10/04	15:51:17	15:51:54	15:51:59	15:58:05	16:27:02	14719 HAWTHORNE AV	SHOTSF	SHOTS FIRED	NAT
5/8/04	21:11:24	22:25:54	22:26:41	23:00:24	23:57:42	4850 S LYTLE CREEK RD	415P	SHOTS FIRED	NAT
5/15/04	01:42:24	01:42:48	01:43:10	01:43:31	02:07:21	9837 WILLIAMS AV	SHOTSF	SHOTS FIRED	SER
7/7/04	23:32:20	23:33:13	23:33:22	23:33:22	23:43:07	BANANA AV /IVY AV	SHOTSF	SHOTS FIRED	GOA
7/25/04	23:11:13	23:11:36	23:12:58	23:17:47	23:19:37	LOCUST AV /TAYLOR AV	SHOTSF	SHOTS FIRED	UTL
7/31/04	00:41:44	00:42:46	00:42:46	00:44:53	01:32:59	DRACENA CT /HAWTHORNE AV	SHOTSF	SHOTS FIRED	NAT
9/3/04	03:01:04	03:01:31	03:01:31	03:02:11	03:10:59	CEDAR AV /SAN BERNARDINO AV	SHOTSF	SHOTS FIRED	UTL
9/27/04	20:26:09	20:26:16	20:26:16	20:26:57	21:02:26	MAGNOLIA ST /VALLEY BL	SHOTSF	SHOTS FIRED	ARR

The San Bernardino County Sheriff's Office appeared interested in using the technology to address gunshot activity in this area. With the SECURES® system in place, it was expected that SBCSD police dispatchers would receive alerts of a gun shot and will dispatch police officers to those places where gun shots have been identified. The SECURES® gun shot detection system was expected to be a useful tool for SBCSD law enforcement deputies in reliably identifying the exact location of gunshots fired. SECURES® was also hoped by SBCSD executives to achieve, according to material presented by its developer the following services for both law enforcement agency personnel and the citizens of the Bloomington community[1], for example:

1) Creation of a rapid alert for SBCSD dispatchers regarding possible "shots fired" incidents;
2) Provide precise "shots fired" locations in the Bloomington community for response and field investigation efforts;
3) Offering SBCSD deputies using the technology precise definition of incidents of gun shots in crime hot spots among cities who deploy the SECURES® technology;
4) Facilitating a means to assure Bloomington citizens that "shots fired" incidents are promptly addressed; and
5) Development of a problem-solving tool for SBCSD deputies to use in analyzing "shots fired" incidents along with other data available to the agency.

The goal of NIJ research technology is to assure that policy makers have the best information regarding the deployment of these might consider are how experiments such as the assessment of SECURES® are significant in creating a research environment to facilitate clinical assessment of

[1] PSI SPIE,

emerging technologies. It is also important to recognize that it is important to address the "gap" between technology "potential and what might accomplish in the field in terms of cases cleared or crime reduction Further the assumption of the technology, that rapid police response to an acoustic "problem event" may not be shared by all within a particular department such as the San Bernardino County Sheriffs' Office.

The implementation of the technology was delayed to a number of factors including the failure to reach a pole use agreement with pole owners, transition in SBCSD leadership and at PSI. Some areas of involvement went extremely well as for example training delivered in 2004, 2005 and 2007 as suggested by reactions to training and a SECURES® patrol guide defining responses by Deputies to SECURES® activations In training received by SBCSD deputies duties defined in terms of response included:

Officer Response Requirements

1. A SECURES® alert will be dispatched as a Priority One call.
2. When possible, a SECURES® alert will generate a two-unit response.
3. Dispatch will immediately notify the patrol watch commander of a SECURES® alert.
4. Deputies will investigate all SECURES® alerts and gather evidence aimed at the identification of the following:
    a. Suspects/victims
    b. Involved vehicles
    c. Potential witnesses
    d. Property damage
    e. Location and verification of event
5. Dispatch will coordinate the incident with responding deputies.

Further, Deputies were urged to prepare an appropriate report based on the investigation.

Including the following information:

a. Observations

b. Interviews

c. Evidence recovered

d. Was the information provided by SECURES® accurate and helpful?

e. Result of the investigation

Live fire testing in May 2007 suggested strong results indicating the technical function of the system prior to the implementation.

Major milestones in terms of the SBCSD intervention included:

November 2003

- Dialog initiated between PSI, Congressional Staff and SBCSD
- Initial Staff Orientation

March 2004

- Second training
- Dispatch Orientation and “ride-alongs”

April, 2005

- Meetings with PUC
- Staff meetings

November 2006

- PUA request to SCE for 80 sensors returned with approval for 30 poles.

- Balance of requested poles already 'rented' to PacBel (AT&T)

December 2006

- Michael Litch SECURES® Project Manager leaves PSI
- Mr. George Orrison replaces Mr. Litch as PSI SECURES® project manager

January 2007

- SBC Project Management transferred to George Orrison
- Contact established with AT&T for PUA negotiation for 50 poles
- No-cost extension and reduced demonstration period (6-months) requested from NIJ

February 2007

- Requests to NIJ approved
- Deployment for SBC put into motion

March 2007

- Field assessment of receiver and base stations previously deployed conducted
- AT&T requirements for individual pole permits requiring engineered load analysis received and implemented

April 2007

- Requirements submitted to AT&T and PUA executed
- Base station replaced and receiver station components updated April 9th
- Sensors (78/80) installed April 10th - 12th

May 2007

- Refresher training provided to San Bernardino County Sheriff's Department by Mr. George Bradley - May 8th
- Display applications installed at SBC 911 Dispatch May 8th
- Live fire test for system calibration conducted May 9th
- SBCSD formally goes live May 28th

II. Assessment findings:

The data available for this assessment and did not lend themselves to quantitative statistical interpretation. The incidents (SECURES®) presented to me in the following format including incident#, priority, Unit and “To” and” From” location. Additional requests for information were not productive.

The problem presented to the assessor included the following limits:

1. No SECURES® call outcomes were presented or possibly collected;
2. Investigations conducted during experiment did not establish “*ground truth*” as was established in Newport News, Austin and Hampton;
3. Qualitative data from the San Bernardino implementation was unavailable to this assessor;
4. No systematic “beat’ response information was made available despite assessor requests;
5. No patrol categorization of events was attempted as in Newport News and Hampton;
6. CAD operators did not record “comments” to SECURES® activations; and
7. No control area data was collected.

Interviews conducted with SBCSD commanders suggested tremendous frustration with the implementation:

- Captain A suggested that "all calls were unfounded and that it took too long to set system up and also we didn't have enough units to respond to respond to area if shots were fired to get suspects..if there was ever a *righteous* call."
- Lieutenant B added that "no one was arrested, no weapons were seized. The system needs to be deployed in a city-for example city of San Bernardino."
- Patrol Deputy C noted" that the system missed an officer involved shooting and after that the guys lost confidence."
- Patrol Deputy D added that "the 4th of July was a fiasco and that about ended it."
- Patrol Deputy E thought that" the Department didn't really push-we had too much to do so it went *poof*."
- Patrol Deputy F "thought that field investigations to "source (of activation) was unrealistic given work-load demands.

III. Conclusions and Recommendations:

The most cautious conclusions that might be drawn from the experiment include the following conclusions:

1. The project was delayed by several years due to "*pole use*" issues, changes in PSI field management and possibly changes and loss of enthusiasm within SBCSD;
2. The project training was executed effectively but due to delays repeated three times;
3. The data available to the assessor does not exclude the possibility that there were no" true positive" activations, i.e. "a SECURES® activation triggered by a gun shot;

4. Of the 50 events recorded by SBCSD, most appear to be false positive events, but this is uncertain given lack of field investigation, cursory investigations and low priority of the project by field supervisors;
5. The perceptions by SBCSD officers independent of rank were neutral (try it somewhere else) to negative;
6. Project "disappointment" may be more of an implementation failure with multiple causes than reflect on value of the technology; and
7. Match of technology with dispersed housing and low density may have been problematic.

Recommendations suggested to NIJ to improve management of this type of project include:

1. NIJ might consider developing an implementation template to guide agencies in deploying new technologies;
2. NIJ might consider a site experiment seminar for agencies implementing new technologies;
3. Conducting enhanced *due diligence* on earmark funding to assure a reasonable match with requirements and needs of agencies targeted for funding;
4. Require an updated needs study when long periods of time precede implementation;
5. Analyze NIJ *Science and Technology* projects(*after action* study) where technology fails to be adopted to understand sources of this type of project outcome;
6. Develop requirements for agency "*buy in*" as a condition of funding; and
7. Define for agencies minimum data collection requirements.