POLICE

FORT PIERCE

MEMORANDUM

To: Robert J. Bradshaw, City Manager

From: R. Sean Baldwin, Chief of Police

Date: July 9, 2014

Re: Commission Conference Agenda - Shotspotter

As requested, the police department has surveyed some other jurisdictions using Shotspotter to determine their experience with this technology. I have enclosed a memorandum from Lieutenant Robert Ridle, which summarizes feedback received from Palm Beach County, FL; Riviera Beach, FL; Wilmington, NC; and Rocky Mount, NC. All agencies are reporting very positive results.

In addition to this survey, I have also enclosed a few additional references. The first is the *Shotspotter Gunshot Location System Efficacy Study* conducted by CGS Analysis. This study is endorsed by the National Organization of Black Law Enforcement Executives (NOBLE). As a result of the study, NOBLE came to the conclusion that Shotspotter is an "effective tool for combatting gun violence and its downstream effects on the community." NOBLE concluded that with Shotspotter:

> *…officers go home safe; illegal gun use is reduced; a greater number of criminals are apprehended; and a strong message of "zero tolerance for gunfire" is sent to the community at large –* ***ultimately building a better relationship between first responders and the community they serve****.*

I have also included a copy of *Gunshot Sensor Technology: Can you hear me now?* that was written by faculty at Radford University. This article ultimately concludes that this technology "is an innovative and reliable way to report gunfire to law enforcement."

Finally, I have enclosed a copy of our latest proposal from Shotspotter for reference.

I will be available to the City Commission at their conference meeting on July 14, 2014, to answer any additional questions on this subject.

POLICE

FORT PIERCE

MEMORANDUM

To: Frank Amandro, Deputy Chief

From: Robert Ridle, Lieutenant

Date: 7.8.2014

Re: ShotSpotter References

Per your request, I attempted to contact the six references provided by Phil Dailly, customer service representative for ShotSpotter. I was able to speak with four of the references after leaving voicemail and sending email to each contact. Two of the references are from Florida and shorter term users (1-2 years). The other two are from North Carolina and longer term users (2-3 years). None of the people I spoke with had any studies or statistics readily available.

Lt. Ed Luty, Palm Beach County Sheriff's Office – Lt. Luty stated his department uses the system in the Belle Glade area and they "love it". It has been in use for approximately one year and has greatly enhanced their response time to shooting related incidents. Lt. Luty said that they have made numerous arrests because of alerts from ShotSpotter including one arrest where a juvenile male was shooting a gun on a high school campus before fleeing. He added that PBSO had just decided to continue with the system for another year. He said it was important before committing to the system to be certain there are places to install the sensors as FP&L initially did not want the sensors on their poles in Belle Glade.

Assistant Chief Michael Madden, Riviera Beach Police Department – "The system notifies us of gunshots that would otherwise not be reported. ShotSpotter puts us on the scene faster which creates a situation where witnesses are still there and physical evidence can be more easily located. It also rules out misinformation provided by suspects who may try to misdirect the police. Our officers have come to depend on ShotSpotter to provide accurate locations of reported gunfire. They trust the system and it allows them to respond with a higher level of situational awareness."

Captain Jim Varrone, Wilmington Police Department (NC) - Wilmington Police have been using ShotSpotter for 2.5 years and recently doubled their coverage to six square miles. Their budget for the system is around $200,000 per year, of which their local Housing Authority contributes $80,000. The bulk of Wilmington's aggravated assaults and shooting related calls are from Housing Authority properties. According to Varrone, since ShotSpotter has been in place the number of calls for service related to gun shots has decreased. He also said that the system has helped to clear homicides as it enables officers to get to scenes quicker, thereby locating evidence, witnesses, and potential suspects before scenes become contaminated and people leave the area. He said that the system is so effective that their officers have had to

change the way they respond to ShotSpotter alerts as the officers can potentially arrive on the scene of an active shooting situation.

Sergeant Ryan Hepler, Rocky Mount Police Department (NC) – Rocky Mount Police have been using the system for over three years. Sergeant Hepler said the system is a great tool that not only helps their officers respond to shooting incidents quicker, but is also a great investigative tool after the fact. He said his department had made several Federal cases using ShotSpotter and it had aided in getting a conviction in a homicide trial. He said ShotSpotter was a great company to work with. He said one consideration for any department would be man-power and having adequate personnel to respond to the alerts. Sgt. Hepler, like Capt. Varrone, said that officers would need training on how to respond to ShotSpotter alerts as the likely hood of them arriving on the scene of an active shooting event or as shooters are leaving the area are increased versus traditional 911 dispatched calls.

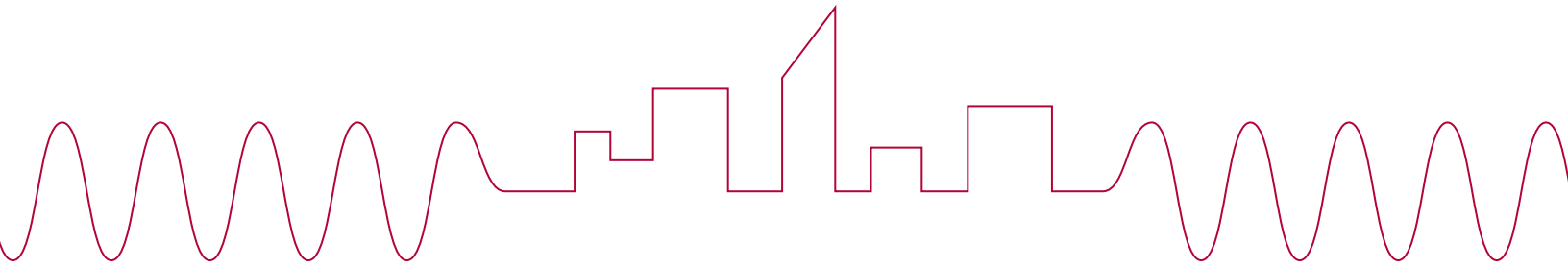
CSG Analysis

ShotSpotter

Gunshot Location System®

Efficacy Study

Conducted by CSG Analysis
Authors: Nick Selby, David Henderson
and Tara Tayyabkhan



Endorsed by the National Organization of
Black Law Enforcement Executives

Foreword

National Organization of Black Law Enforcement Executives

The National Organization of Black Law Enforcement Executives (NOBLE) was established as a highly competent public service organization at the forefront of providing solutions to law enforcement issues and concerns, and to the ever-changing needs of our communities. Our commitment is to ensure the advancement of quality law enforcement practices and professionals with true equality and opportunity. Consistent with that vision, part of our mission is to support efforts to share knowledge and information among our colleagues, and to enable fair and superior law enforcement capabilities and practices throughout the world.

One significant way we seek to enable action in the cities and communities we serve is to function as a learning and knowledge clearinghouse. In this important role, NOBLE seeks to leverage the collective knowledge of our members and the many professionals in the criminal justice community.

NOBLE is pleased to endorse the ShotSpotter Gunshot Location System® (GLS) Efficacy Study. We believe the study, conducted by CSG Analysis, is a notable research report. It finds, among other things, that the ShotSpotter Gunshot Location System improves the effectiveness of first responders and their investigative process, and ultimately helps improve law enforcement agencies' ability to engage with their communities and to protect those they serve.

NOBLE's hope is that this research and these findings will help educate and inspire new ideas and ways of successfully taking the actionable data this system provides to build on intelligent policing and law enforcement programs and practices throughout the United States and the world.

Law enforcement agencies and professionals are continually challenged to do more with fewer resources, and they must consistently evaluate how they operate and achieve their mission. The most adept agencies leverage smart police technology as a driver of community and predictive-policing strategies. It is NOBLE's aim to promote this approach as an avenue for agencies to better position themselves for long-term success and positive impact in their communities.

As evident in this report, agencies nationwide have found the ShotSpotter Gunshot Location System to be an effective tool for combating gun violence and its downstream effects on the community. The system has also changed the way that agencies respond, investigate, and ultimately and most importantly, reduce and prevent gunfire.

When law enforcement agencies can better assess and respond to gunfire incidents, better outcomes are possible: officers go home safe; illegal gun use is reduced; a greater number of criminals are apprehended; and a strong message of "zero tolerance for gunfire" is sent to the community at large—ultimately building a better relationship between first responders and the communities they serve.

It is a critical goal of NOBLE to make available solutions to the ever-changing challenges which confront law enforcement agencies and communities. As a result of this research, NOBLE recognizes the clear benefit that agencies can realize from the ShotSpotter Gunshot Location System, including its integration with next generation technologies and law enforcement standards. NOBLE endorses the concept that the ShotSpotter GLS is an essential part of technology for law enforcement and intelligence-led policing initiatives.

About CSG Analysis

As a police officer-owned and operated company providing research and analysis on law enforcement technology and intelligence capabilities and methods, CSG Analysis (CSGA) is uniquely qualified to conduct this research. Since 2009, its principals have provided consulting services to law enforcement agencies and officers on local, county and federal levels. Principals are currently sworn police officers and investigators (full-time and part-time), who are trained in homicide and gunshot investigations and criminal and internal affairs investigations. Prior to founding CSGA, its principals have produced more than 500 industry analysis and user deployment reports for a range of customers in the private sector (F100 firms, large investment banks, and very large online and brick-and-mortar retailers). Prior to and since the founding of CSGA, its principals have advised government organizations including US federal agencies and intelligence organizations, security research organizations and the European Union. CSG Analysis also provides consulting to large private enterprises on threat intelligence and analysis, and network security, and to vendors of products serving these public and private markets. CSG Analysis is behind the successful law enforcement intelligence and technology website, Police-Led Intelligence.[1]

Since 2004, CSGA principal **Nick Selby** has been one of the most published and quoted thought leaders and analysts in the commercial information security and data protection industry. A recently sworn police officer in the Dallas-Fort Worth area, Selby has written more than 500 research reports for commercial customers in the information security, investment banking and manufacturing sectors. From 2005 to 2009, as Vice President for Research Operations and Research Director, Enterprise Security for industry analyst firm The 451 Group, Selby led a team of more than 35 professional research analysts who provided in-depth and objective research reports to more than 800 clients, which included more than 80 investment banks, and several government entities and agencies. Selby is the author of widely quoted research on the Enterprise Security Information Management, criminal malware, anti-fraud and Data Loss Prevention industries. Since 2008, Selby has been researching the law enforcement technology and intelligence markets. A faculty member at The Institute for Applied Network Security, Selby has been a regular speaker at conferences including the International Association of Crime Analysts (IACA); Social Media and Internet in Law Enforcement (SMILE); the RSA Security Conference; BSides Security; Information Security Europe; SANS; and America's Growth Capital Conferences. He is the co-founder, with David Henderson, of the website Police-Led Intelligence (http://policeledintelligence.com).

CSGA principal **David Henderson** is a 13-year veteran police sergeant and investigator who currently serves on a federal law enforcement task force in the Dallas-Fort Worth area. He is a patrol sergeant, who, as a detective, has led numerous homicide and shooting investigations as well as internal affairs and other investigations. He currently conducts information technology-based investigations. A TCLEOSE police instructor and experienced warrants officer, Henderson has contributed to the writing of successful grants, and has a tested understanding of agency procurement procedures (including sole-source items). Henderson is intimately familiar with the budgetary process and the politics and culture of policing. He is the co-founder, with Nick Selby, of Police-Led Intelligence (http://policeledintelligence.com).

Tara Tayyabkhan M.A. is CSGA's statistician and data collection advisor. Ms. Tayyabkhan completed her Master's degree in Psychology at the University of New Hampshire with a specialization in research methods and biopsychology. She has served as assistant professor at the University of Pennsylvania and the University of New Hampshire. Her work has been published in the journal *Pharmacology Biochemistry and Behavior*, and she has presented at many conferences, including the annual conventions of the American Psychological Association, the Society for Neuroscience, and at Harvard's Research Group on Brain and Behavior symposium.

CSGA-ShotSpotter Efficacy Study Project Credits
Project Manager: Scott Spitzer
Report Design and Infographics: David Wenk

1. Executive Summary

This report, based on structured interviews with police agencies around the United States, details how the ShotSpotter Gunshot Location System® (GLS) improves productivity, response time and effectiveness by providing more information and intelligence to law enforcement and public safety professionals responding to incidents. This in turn improves officer safety and officer and investigative efficiency.

The ShotSpotter GLS detects gunshots through acoustic sensors. Using a patented method of computer analysis,[2] it provides police and public safety agency users with information and intelligence on gunfire incidents, including shot location and incident mapping, number of shots detected, and audio playback.

This report was commissioned by ShotSpotter and is endorsed by the National Organization of Black Law Enforcement Executives (NOBLE).[3] Its findings are independent. Its purpose is to examine the effectiveness of the ShotSpotter GLS at locating and reporting gunshots, informing more efficient investigations, increasing arrests, simplifying the jobs and increasing the safety of police officers and communities. It specifically compares the ShotSpotter GLS to 9-1-1[4] in terms of the reporting of gunshots, and examines how having data produced by ShotSpotter GLS has affected the work and procedures of patrol and detectives who respond to and investigate gunshot crimes.

The study's authors from the police officer-owned independent commercial research firm CSG Analysis, met with five respondent groups—command staff, analysts, detectives, patrol officers and dispatchers—from seven police agencies throughout the United States. These agencies were selected by ShotSpotter for characteristics including the length of deployment (all have had ShotSpotter for more than a year), and the fact that before installation, each agency indicated it had a substantial criminal gunfire problem.

The participating agencies were Brockton, Mass.; East Palo Alto, Calif.; Nassau County, N.Y.; Richmond, Calif.; Riviera Beach, Fla.; Rochester, N.Y.; and Saginaw, Mich. The study's authors conducted all of the interviews in person at each of these agencies. No agency received compensation or consideration for its participation. All interview transcripts, surveys and raw data on which the report's conclusions are based are available for inspection to confirm the authors' findings.

The ShotSpotter GLS significantly enhances patrol officers' ability to locate the scene of a shooting over 9-1-1 alone, and provides officers more situational awareness when responding to gunshot calls. This information and enhanced awareness has saved lives and led to arrests. Since many gunshots are not reported to 9-1-1, but almost all within a ShotSpotter-covered area are detected by the ShotSpotter. The system allows cities to better understand the true level of gunfire in their communities and deploy resources more effectively.

ShotSpotter's accuracy in pinpointing the precise location(s) from which shots were fired was critical not only to solving gun crimes, but even in one case, in determining which agency should investigate the incident.

Command staff at all seven agencies noted significant community and public relations benefits and value from ShotSpotter, leading to compelling improvements in community policing, increased community

responsiveness to gunfire, and a decreased sense of disenfranchisement among community stakeholders. In short, ShotSpotter deployments increase positive community engagement with law enforcement.

False positives, a ShotSpotter activation which is ultimately determined to have been caused by something other than a gunshot, are the single most common complaint of ShotSpotter users, and they pose an operational problem. This report examines the cause and level of false positives and makes specific recommendations to reduce them. False negatives, an absence of a ShotSpotter activation when a gunshot is known to have occurred, are very rare and not considered an operational issue by respondents.

Finally, this report considers ways in which agencies may get better value from their ShotSpotter deployment by introducing new workflow management and best practices. Implementing these would result in more strategic use of ShotSpotter to inform Intelligence-Led Policing, Neighborhood and Community Policing, and other important policing, law enforcement and crime reduction initiatives.

2. Key Findings

- **ShotSpotter GLS' accuracy enables a faster response to gunfire.**
  The accuracy of ShotSpotter GLS in pinpointing the precise location(s) from which shots were fired was critical not only to solving gun crimes, but also in determining who was to investigate. ShotSpotter is considered by patrol officers and agencies to be equally or more valid, and more reliable, than 9-1-1 calls from eyewitnesses or others in indicating when and where gunshot crime has occurred. This speed to response has saved lives and led to more arrests. *Page 19*

- **Patrol officers trust ShotSpotter data over 9-1-1.**
  ShotSpotter GLS enhances patrol officers' ability to locate the scene of a shooting more quickly and precisely, and provides more situational awareness. This helps save lives and leads to arrests. Patrol officers respond with a more tactical overall response to ShotSpotter calls. Most important, patrol officers value and trust ShotSpotter information: they trust ShotSpotter data over 9-1-1 information alone in gunfire reports, to tell them exactly when, how many, and where gunshots were fired. *Page 20*

- **ShotSpotter GLS has changed the way detectives[5] approach homicide investigations.**
  ShotSpotter GLS influences the decisions detectives and investigators make about where and what to search for before arrival on-scene and while on-scene. It also informs the types of questions they will ask of witnesses and suspects. With ShotSpotter data, detectives arrive on-scene knowing empirically the number of shots fired, the time of the shots, and the location of the shots, so their initial questions can be corroborative and disqualifying in terms of witnesses and suspects. This differs from the pre-ShotSpotter paradigm, in which the initial questions were inquisitive and reconstructive. *Page 15*

- **False positives are an operational issue...**
  The false positive—a ShotSpotter GLS activation which is ultimately determined to have been caused by something other than a gunshot—is the single most common complaint of ShotSpotter users.
  False positives pose an operational problem. Those most affected by these operational issues are dispatchers, followed by patrol officers. Detectives and Commanders are typically not affected by false positives. Analysts are affected in that the data they work with is not representative of gunfire incidents without scrupulous cleaning through reclassification of activation data (gunshot alerts). *Page 28*

- **...but false positives are unrelated to efficacy.**
  The critical tactical reality is that patrol officers cannot investigate a report of any kind unless they know where it has occurred. While calls to 9-1-1 can either be confirmed as "true" or left unsolved and "undetermined," a false positive report from the ShotSpotter GLS is easily debunked because of the system's highly accurate geospatial capabilities. ShotSpotter's accuracy means that the human resource may always be effectively deployed to find out whether a gunshot or other sound has occurred. This is distinct from any discussion of whether ShotSpotter is able to programmatically distinguish the sound of a gunshot from the sound of, for example, a dumpster or of a truck backfiring. *Page 29*

2.1 Secondary Findings

- **ShotSpotter increases officer safety when responding to gunshot calls.**
  Patrol officers respond with a more tactical overall response to gunshot calls initiated by ShotSpotter GLS activations.[6] They universally say that ShotSpotter provides them more situational awareness to responding to gunshot calls than 9-1-1 alone,[7] and it "Always" or "Sometimes" affects the route patrol takes to respond to gunshot calls.[8] ShotSpotter GLS data "Often" affects the priority patrol officers assign to a call.[9]

- **ShotSpotter provides agencies with better crime data.**
  All agencies reported that ShotSpotter GLS allowed them to better measure the true level of gunfire in their jurisdictions. Since many gunshots are not reported to 9-1-1, ShotSpotter GLS allows cities to better understand the true level of gunfire in their communities. This effect is most beneficial in agencies with a concerted reclassification regime (see below).

- **False negative rates are very low and need not be inversely correlated to false positives.**
  False negatives, an absence of a ShotSpotter activation when a gunshot is known to have occurred, are very rare and not considered an operational issue by respondents. While minimizing false negatives often results in a corresponding increase in false positives in a given system, the design of the ShotSpotter system suggests that false positives may be reduced in ways that need not increase false negative rates: through technology improvements, better reclassification of activations by users, training, and experience with the system. It is also important to note that 9-1-1 calls cannot result in confirmed false positives, only in unexplained incidents. Another important note is that while false negatives are verifiable with both 9-1-1 and ShotSpotter, false positives are only verifiable with ShotSpotter. This is because ShotSpotter provides a highly accurate time and place of activations.

- **Failure to properly reclassify activations decreases customer value.**
  Most customers are not reclassifying activations after investigation by patrol. The cause of this failure lies in both ShotSpotter training, customer time, and resource constraints. The result is less reliable statistical data (which may be used by agencies to inform programs including community, neighborhood and intelligence-led policing) and hindered ability to leverage ShotSpotter as a strategic asset.

3. Methods

To assure objectivity, a methodological framework was created comprising strict adherence to the script and recording of all interviews. All raw data is open for peer review and available at http://www.shotspotter.com/resources/efficacystudy.

3.1 Respondents

Seven agencies were selected by ShotSpotter for the study. These agencies met the criteria that they had a deployed ShotSpotter installation for more than one year, and that the agency had seen notably high rates of illegal gunfire prior to the installation of ShotSpotter. Neither respondents nor respondent agencies were compensated for their participation. Respondents were not promised any consideration by ShotSpotter or CSGA for their participation, but were told that they could review the raw transcripts that pertained to their agency, and receive a copy of the final report. A copy of the email communication sent by ShotSpotter to each agency requesting their participation may be found online at http://www.shotspotter.com/resources/efficacystudy.

3.2 Respondent Groups

ShotSpotter activations (alerts) do not act in a vacuum; detection of a gunshot by the system initiates a cycle of procedures involving personnel at every stage. To evaluate ShotSpotter and its data as deployed in agencies and followed through its lifecycle, the study sought information from five groups.

1. Dispatchers, the first recipients of ShotSpotter activations, were queried about their procedures and policies pre and post ShotSpotter installation, and to determine what information provided by ShotSpotter was being passed to first responders to gunshot incidents.

2. Patrol officers were asked about the information they receive from dispatch, and the trust they place in ShotSpotter data versus that provided by 9-1-1 callers and other channels of reporting gunshots. Patrol officers were also asked how ShotSpotter affects their work, their safety and their tactics.

3. Detectives were asked about their homicide and shooting investigation methods pre- and post-ShotSpotter, their trust in the information provided to them by ShotSpotter, and whether ShotSpotter increases their investigative efficiency.

4. Analysts were asked whether they were using ShotSpotter data to support statistical analysis, crime mapping and predictive intelligence programs, as well as to support further strategic initiatives such as grant writing and resource redeployment.

5. Commanders were interviewed on ShotSpotter's overall effectiveness at reducing illegal gunfire and increasing officer safety.

3.3 Interview Locations

Agencies interviewed were Brockton, Mass., East Palo Alto, Calif., Nassau County, N.Y., Richmond, Calif., Riviera Beach, Fla., Rochester, N.Y., and Saginaw, Mich. Interviews were held in person at each of these agencies. All but two interviews—Brockton, Mass. and Riviera Beach, Fla.—were conducted by David Henderson and Nick Selby. Due to scheduling and travel concerns, all interviews in Riviera Beach, Fla. were conducted by David Henderson. All interviews in Brockton, Mass. were conducted by Nick Selby.

Prior to commencement of the study, an eighth agency was contacted, and early versions of the interview scripts were tested on respondents from the respondent groups represented in this study. No transcripts were made of the recordings of those interviews, nor are any of the responses from those interviews considered as part of the analysis for this study.

3.4 Survey Instrument

Each respondent group received a different set of questions. However, every interview began with the reading of a script introducing the rigor of the interview, informing the respondent that the interviewer works for CSG Analysis' parent company TRM Partners, not ShotSpotter, and disclosing clearly CSGA's financial remuneration by ShotSpotter to conduct the survey. For example, each interview script included the phrase "Once again, I do not work for ShotSpotter. The questions I am asking were developed by us and not ShotSpotter and the study is being independently conducted. ShotSpotter is paying TRM Partners for its work on this study, however it does not have control over our findings. Our findings are independent and based on your answers...." The actual interview scripts may be viewed at http://www.shotspotter.com/resources/efficacystudy.

3.5 Interview Schedule

A schedule was devised to alternate interviewers with respondent groups. Interviews began in East Palo Alto, Calif. on 18 February 2011, and continued with Richmond, Calif. (19 February); Saginaw, Mich. (22 February); Rochester, N.Y. (23 February); Nassau County, N.Y. (24 February); Riviera Beach, Fla. (2 March) and Brockton, Mass. (17 March).

3.6 Administering the Interviews

Interviews were conducted at police headquarters in each of the agencies, in facilities provided by the agency. Interviews were audio recorded using a Sony ICD-SX750 stereo digital recorder, and Apple iPhone 4 monophonic digital recorders (Voice Memo). Access to the raw, unedited recording of any interview is available until 15 April 2012 upon request.[10]

Interviewers were trained to deliver the script in a standard tone which strived to be scripted but neither monotone nor conversational. Interviewers were instructed to carefully rephrase questions which were not understood by respondents. Some pre-crafted, rephrased questions were provided. Prompts to be used to elicit more information were provided where appropriate.

Questions inquiring about stories of specific incidents that illustrate the worst and best qualities of ShotSpotter were pseudo-randomly sorted,[11] so that some respondents were asked to tell an anecdote first of the best, and then the worst, and some were asked the opposite order.

3.6.1 Exceptions

During the course of the project, several variations and exceptions occurred during the interview process. Minor deviations from the scripted survey instrument occurred on several occasions which CSGA considers to be well within the threshold of expected "conversational" deviations and which are themselves not significant with respect to the outcome.

On several occasions questions were asked out of order when pages of the survey instrument were read out of order. This occurred in East Palo Alto, Calif. (Dispatch); Saginaw, Mich.; and Brockton, Mass. (Command Staff); and some other interviews. In one interview, the subject (Dispatch) reconsidered an answer to a question as the interview concluded, and an off-script, recorded discussion took place to modify the previous answer stated. In each such instance, the error was detected and the questions were read, and are transcribed and marked as "Supplemental."

At East Palo Alto, Calif., the crime analyst employee most familiar with ShotSpotter was in the process of being hired by ShotSpotter Inc., and was interviewed by CSGA at the East Palo Alto Police Department Headquarters while in the employ of both the agency and ShotSpotter.

In Richmond, Calif., no analyst was available for interview, and the interview was conducted with a command staff (Lieutenant) who supervised but did not conduct intelligence or crime analysis.

In Saginaw, Mich., two patrol officers sat in on the patrol officer interviews, and jointly provided answers. In Rochester, N.Y., both interviewers attended all but the interview with the detective. In Nassau County, N.Y., Saginaw, Mich., Richmond, Calif., and East Palo Alto, Calif., (and, as stated, Rochester, N.Y.) both interviewers attended the interview with Command Staff. On several occasions, the interviews were interrupted by uninvolved third parties having brief communication with the interviewee (saying hello, asking for some unrelated information, etc). Several dispatch interviews were conducted in dispatch centers, which led to interruptions by actual calls for service or communication with officers in the field.

3.7 Transcription

Raw, unedited audio recordings were digitally transmitted to CA Transcription Service (CATS[12]), a specialist transcription service for academic researchers based in Plymouth, England. Orthographic transcriptions of these audio recordings were made and delivered as Microsoft Word documents. These documents served as the source data for all analyses. Copies of the source (raw, unedited) audio recordings and the unedited transcripts as provided by CATS are available at http://www.shotspotter.com/resources/efficacystudy.

3.8 Analysis

Analysis was performed by Nick Selby and Tara Tayyabkhan. Quantitative data as well as binary answers were extracted and analyzed. These data were used primarily to understand general trends across agencies. Qualitative data (responses) were aggregated per respondent group and per question, examined and categories of response coded. Responses on similar themes were collected and patterns identified using standard qualitative analysis methods. Representative quotations were chosen to illustrate verified patterns and trends.

4. Results

4.1 Command Staff

4.1.1 Key Findings

- Command staff bought ShotSpotter because of gunfire related crime in their jurisdictions.
- Gunfire crime has been reduced since installation, which commanders at least indirectly attribute to ShotSpotter. Other crime types have been reduced as well.
- Commanders like and trust ShotSpotter. They believe it is effective. Indirectly or directly, they say, ShotSpotter saves lives of citizens and officers.
- They place a high value on having ShotSpotter deployed at their agency, and would buy it again if they had to make the decision again.
- Further, commanders feel that the communities into which ShotSpotter has been deployed have generally positive feelings towards it, and have not raised civil liberty or surveillance concerns.
- Command staff view ShotSpotter's value primarily as tactical, though some agencies are leveraging ShotSpotter for strategic value and, notably, strategic community relations.

4.1.2 Analysis

Command staff state that ShotSpotter was purchased because of gunfire-related crime in their cities.[13] When asked to name the driving reasons for deciding to purchase ShotSpotter, commanders told us that gun violence was a major concern for a number of reasons. These included citizen casualties and fatalities, officer safety, and public relations. Some respondents pointed to the reputation of their city as being "violent" as a driving force behind the purchase.

In two cities,[14] commanders referred specifically to their city's reputation: "We've been rated the most violent city of over 40,000 in the nation," said one.[15] All commanders expressed strategic departmental imperative to reduce gunfire violence, and increase arrests for illegal gunfire.[16]

Agencies state that there was an initial increase in

> *"A key part of [Commissioner Larry Mulvey's] tenure here has been an integrated effort to reduce the incidence of gun-related violence."* – Nassau County, N.Y.[17]

reported gunfire incidents at deployment of ShotSpotter. Some agree that this increase was not indicative of an actual increase in gunfire incidents. It became clear to agencies that prior to installation of ShotSpotter unknown numbers of gunshots were not being reported by citizens using 9-1-1, which itself is an issue of the community's relations with and trust of police and the level of citizens' "comfort" with the sound of gunfire—that is, the level to which they are inured to it in a given area.

Initial spikes in gunfire reports also resulted from false positives that were not properly reclassified. They were incorrectly counted as gunshots rather than as possible gunshot calls for service. As we shall see, reclassification of ShotSpotter GLS activations by agencies is an important aspect of system maintenance. Our research found that reclassification levels, policies and procedures were lacking in almost all agencies we interviewed.

Regardless of the reasons for the initial spike, most of the agencies reported[18] that the level of gunfire incidents in their cities had decreased—sometimes significantly—since installation. The greatest variations were in Brockton, Mass., which reported that the incidents had remained about the same,[19] to Saginaw, Mich., which reported that gunfire incidents were "Down drastically…[P]robably in the area of forty percent [from 2008 to 2010]."[20] One commander said that the situation was too dynamic to answer the question.[21]

"[After the] initial deployment [gunfire incidents rose] markedly but that's an aspect of non-reporting by people in the community. They were numbed by the amount of gun violence they were hearing. [I] would say we're coming up on the two year mark [during which] our gunfire incidents have gone down now every month slowly and we're in better shape than we were." *– Richmond, Calif.*[22]

Command staff feel that ShotSpotter is at least partially responsible for this downward trend, however they note that non-gunfire-related crimes in their cities had gone down,[23] and this is not credited to ShotSpotter.[24]

Indirectly or directly, commanders say that ShotSpotter saves lives. We asked, "Do you believe ShotSpotter is responsible for saving lives in your community?"[25] and while the responses reflected hesitation to credit any single piece of equipment, technology, or tactics with saving lives, ShotSpotter was recognized as making a significant contribution to lives not being lost. Brockton, Mass. was the only agency stating it had insufficient data to answer, but all other agency commanders replied variants of "yes" or "indirectly, yes." From the crime analyst in Nassau County, N.Y., we heard about a specific example of officers responding to a ShotSpotter activation that preceded a 9-1-1 call and getting to the scene while the victim was still alive. Because the ShotSpotter activation came first, a life was saved by that activation that might have been lost had the officers not responded until the emergency call came into the 9-1-1 system.[26]

Commanders are "Confident" or "Very Confident" of the information ShotSpotter provides[27]; five of the seven agencies (71%) placed a "Very High" value on having ShotSpotter deployed in their city (one agency placed this value at "Somewhat High," while the other placed it at "High").[28]

While respondents tended towards stating that ShotSpotter did not prevent illegal gunfire incidents[29] (two said it was "Somewhat Effective" or "Effective" at preventing gunfire incidents, three said it was "Ineffective," and two did not answer), when asked to evaluate ShotSpotter generally,[30] commanders called ShotSpotter "Effective" or "Effective [within] limitations (East Palo Alto, Calif.)"[31] or "Effective in the scheme we use it in (Nassau County, N.Y.)"[32] for a range of reasons[33] including:

- Being at least partially responsible for a reduction in gun crime
- Producing real-time and strategic intelligence and crime trend data
- Increased investigative efficiencies and forensics benefits
- Superiority over 9-1-1 calls alone in terms of arriving on the correct scene faster
- Reporting of otherwise unreported incidents of gunfire
- Enhanced officers' situational awareness
- Community and public relations benefits

"It throws an incredible benefit to me as a police administrator to be able to walk into a community that in other places may be very hostile or mistrusting of the police. It builds a relationship between the law enforcement organization and the community. [In] our experience it does have significant forensic benefit. [In] my opinion, the benefit to the individual police officer's situational awareness is incalculable. – Nassau County, N.Y.[34]

Command staff view ShotSpotter's value primarily as tactical,[35] though some agencies are leveraging ShotSpotter for strategic value and, notably, strategic community relations. In Saginaw, Mich., Nassau County, N.Y., and Richmond, Calif., commanders spoke of ShotSpotter being leveraged by the Chief or Commissioner as a positive community impact, demonstrating the department's level of proactive commitment to the community. When taken as part of an overall campaign to inform communities that the police care about gun violence, commanders report excellent, positive results measured in community relations, more calls to 9-1-1, and more calls to tip lines. The publicity is also used by command staff as a deterrent, putting criminals on notice that the city is proactively listening.[36]

Interestingly, respondents did not report vandalism against the ShotSpotter sensors in the same manner that license plate reader and pole camera technologies have been attacked in the past.[37] Further, commanders feel that the communities into which ShotSpotter has been deployed have generally positive feelings towards it,[38] and have not raised civil liberty, or surveillance concerns.[39] This comment, from Richmond, Calif., was typical: "I think that, overall, the good citizen that's aware of ShotSpotter is happy about it...[W]e have citizens in neighborhoods that don't have gunfire issues that want ShotSpotter, because their belief is it'll make their neighborhood even more safe."[40]

Agency command staff place a high value on having ShotSpotter deployed at their agency, and would buy it again[41] if they had to make the decision again.[42]

4.2 Detectives/Investigators

4.2.1 Key Findings

- ShotSpotter has changed the way detectives approach homicide investigations by influencing their decisions about where and what to search for before arrival on-scene, while on-scene, and when forming questions they will ask of witnesses and suspects.

- Detectives say ShotSpotter data allows them to investigate more efficiently. By this they do not necessarily mean that ShotSpotter saves them time, but that the questions they ask of witnesses and suspects are corroborative and disqualifying as opposed to inquisitive and reconstructive.

- Detectives trust the time and location information ShotSpotter provides[43] and use it to aid investigations.

- They rate their overall confidence in ShotSpotter data as "High" or "Very High."

- Detectives responsible for locating forensic gunshot evidence consider information provided by ShotSpotter before they begin their search.

4.2.2 Analysis

ShotSpotter has changed the way detectives[44] approach homicide investigations by influencing the decisions they make about where and what to search for before arrival on-scene and on-scene, and when forming questions they will ask of witnesses and suspects.[45]

Detectives say ShotSpotter data allows them to investigate more efficiently.[46] This does not necessarily mean that ShotSpotter saves them time.[47] Rather, respondents report ShotSpotter data provides detectives with a more effective questioning paradigm.

Since the deployment of ShotSpotter, detectives tell us that they consider information provided by ShotSpotter on the number of shots[48] and the geographical area to inform the limits of their evidentiary search, and also in forming the questions they will ask of witnesses or suspects. Some detectives have never received information on moving shots (for example, indicating drive-by shooting). All had received, and used, information regarding geolocation and number of shots, in their consideration of search and investigation.

With ShotSpotter data, detectives know empirically the number of shots, the time of the shots and the location of the shots, so their initial questions can be corroborative and disqualifying in terms of witnesses and suspects.[49] This may differ from the pre-ShotSpotter paradigm, in which we are told the initial questions were inquisitive and reconstructive.[50]

This is a fundamental improvement in investigative efficiency due solely to the availability of ShotSpotter GLS data.

For example, without ShotSpotter data, detectives must often first establish how many shots were fired. Since witness accounts vary, finding more than one witness who can corroborate the number of shots fired, the location of the shots and the time of the shots is challenging, as is determining which witnesses are accurate and truthful, and a range of other conditions from lying, confused, merely inaccurate, etc.

Once the witness accounts are gathered and correlated, the detectives must then corroborate these accounts with physical evidence before any reasonable level of certainty can be established as to the facts of the event. Only then can they make determinations about which witnesses, based on their statements, can be believed and counted upon later to assist in the investigation or testify.

With ShotSpotter data, detectives can arrive at the scene knowing specifically how many shots were fired, from where, and at what precise time. If the detective knows that four shots were fired, (s)he won't waste time with a witness who claims to have heard nine; similarly, if (s)he knows one shot was fired and a suspect claims to have fired at someone who shot first, the detective can discredit this story.

Based on respondents' answers, we surmise that when detectives state that ShotSpotter data makes them more efficient, they refer not necessarily to a product of time savings, but rather to the quality of their investigations.

Detectives are split on whether it saves them time on investigations "Always" or "Sometimes." Detectives asked whether ShotSpotter allowed them to investigate more efficiently answered "Yes" at four of the seven agencies (57%), and "Sometimes" at two agencies (28%). One agency did not respond to this question.

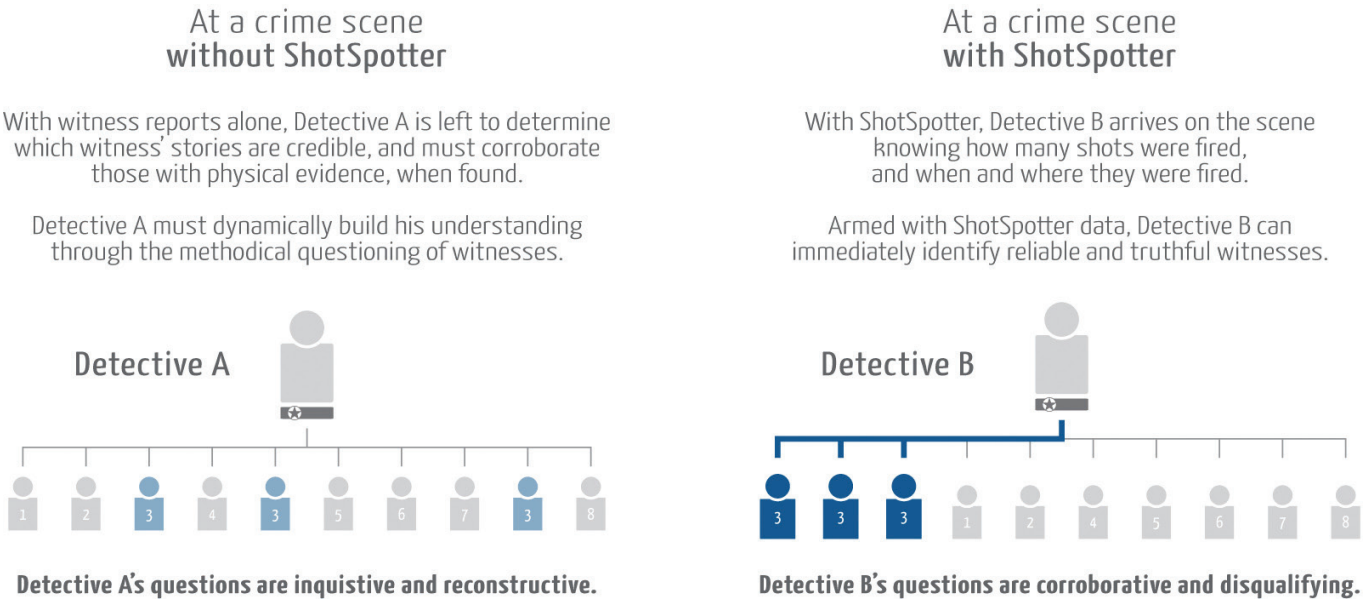


Figure 1. ShotSpotter's effect on investigative procedures.

Those who answered "Sometimes" said that, for example, ShotSpotter took some of the guesswork out of investigations, but it is important to note that no detective would commit to any concrete time savings afforded by ShotSpotter.[51]

Respondents did allude to efficiencies other than within the questioning paradigm, for example in locating forensics (a reference to the geospatial accuracy which was a common refrain among detectives when referring to locating, for example, forensics[52]) and especially in learning of incidents in which no 9-1-1 calls had been received.[53]

No detective respondent was able to definitively state how much time ShotSpotter saved him when asked,[54] except for comments such as "Minimal."[55] That is not to say, however, that ShotSpotter does not save time on certain investigations, but merely that it may not be the primary indicator of "efficiency" in this context. Some detectives relayed stories of ShotSpotter informing investigators of the location of a shot far from where a body was discovered, for example when the pinpoint location of a shot in a large (six or seven block) area would have otherwise been difficult.

"It might have taken us two, three hours to get to that point where, just going back and looking just because ShotSpotter said an address, we went to that address and fortunately it drew a witness out that probably would have eventually come across but it would have been a lot sooner [with ShotSpotter]."[56]

Another detective relayed a story of a time when the geographical accuracy was wrong, but the time stamp of the incident proved important to an investigation; the detectives had received an activation[57] that was not accurate, but had a witness who provided an important statement about the gunshot and placed it as occurring within a seven minute window.

> *"[Based] off of the ShotSpotter when we went back and reviewed it, we heard one shot and then we determined that the crime happened there, and then as far as our investigation we corroborated with certain phone calls that were made to hit at that particular time so we [were] able to get the exact times. It was very important…to our investigation."*[58]

Before ShotSpotter was deployed, detectives who searched for evidence (and in at least one agency, evidence technicians who search for evidence on behalf of detectives) did so based on unknown variables, including number of shots and geographical area of the crime scene. Respondents describe setting perimeters loosely ("If you think you need to go one street north, go two streets north"[59]) based on low trust of witness statements.[60] If ShotSpotter data is available, some detectives will use it to pinpoint the area and then broaden from the epicenter of the shot location outward.[61]

Detectives trust the location information it provides[62] and use it to aid investigations; four of the seven detective respondents said that they have "High" confidence in the data that ShotSpotter provides them; two rated their confidence level as "Very High"; and one expressed "Somewhat High" confidence.[63]

ShotSpotter has also been used to discredit at least one alibi, such as one in which a gunman shot in self-defense after shots were fired at him. This is a use of ShotSpotter data that we expect to see more of: the use

of activation records and recordings to disprove claims of acting in self-defense. The case in Saginaw, Mich. involved the shooting death of an elderly woman who was apparently not the target but the victim of a single gunshot. In this case ShotSpotter assisted detectives in finding the specific location from where the gunshot emanated, some 800 feet from where the victim was found. The ShotSpotter location data led to a canvas that resulted in a suspect being named by a resident.

When detectives confronted the suspect, he claimed that he was shooting in self-defense and that another man had shot at the suspect first. Examination of ShotSpotter data showed only one activation, debunking his alibi.[64]

"Oh, it's just a winning system. You can't go wrong with being able to locate the victim within inches, and then being there on-scene that quickly, and as people are moving around you're able to capture all of your witnesses, you'd be able to capture people in the area, and you're able to get that story from the beginning. It's just it's like being put at a crime scene literally as the crime is being committed."[65]

4.3 Patrol Officers

4.3.1 Key Findings

- According to patrol officers, ShotSpotter's accuracy—of both geographic location of an incident and of the number of shots fired—is its best attribute. ShotSpotter allows officers to locate the scene of a shooting more quickly and more precisely.

- The accuracy of ShotSpotter GLS in pinpointing the precise location(s) from which shots were fired was critical not only to solving gun crimes, but even to determining who was to investigate.

- Patrol can better qualify calls and make better tactical decisions with ShotSpotter over 9-1-1 alone.

- Patrol officers respond with a more tactical overall response to gunshot calls initiated by ShotSpotter GLS activations. ShotSpotter provides more situational awareness when responding to gunshot calls than 9-1-1 alone, to the extent that it sometimes affects the route patrol officers take to respond to gunshot calls.

- Patrol officers value ShotSpotter information; despite false positives (ShotSpotter activations for sounds other than gunshots) patrol officers trust ShotSpotter over 9-1-1 alone in gunfire reports.

4.3.2 Analysis

ShotSpotter's accuracy, of both geographic location of an incident and of shots, is its best attribute[66] according to patrol officers. The fact that ShotSpotter GLS data allows officers to respond to a specific location, knowing the specific time that a gunshot happened, means that patrol officers feel they have increased situational awareness, especially when compared to 9-1-1.[67] "You know instead of just a general direction within multiple blocks, you can narrow it down to a certain block so it would increase officer safety as better knowing where the shots are coming from."[68]

Other patrol officers also point out the fact that ShotSpotter will provide accurate, verifiable information even in cases when there is no 9-1-1 call, allowing them to "Pinpoint one house and park down the street and approach in a safer and more tactical manner."[69]

Speed of the call, too, is important to responding patrol officers, who feel that even an additional 30 seconds on a gunshot call over 9-1-1 would be of a tactical advantage—let alone the fact that they are given data on single or multiple gunshots and satellite mapping of the area of the gunshot call.[70] The faster officers arrive, the safer they feel, and the more options they have to arrest, investigate, and potentially save lives of victims.

When asked to describe the way ShotSpotter changes how they respond to a call, all seven Patrol group respondents framed their answer in either direct or indirect comparison with gunshot incidents reported by eyewitnesses (which are the source of all 9-1-1 calls). In Riviera Beach, Fla., ShotSpotter is a crucial

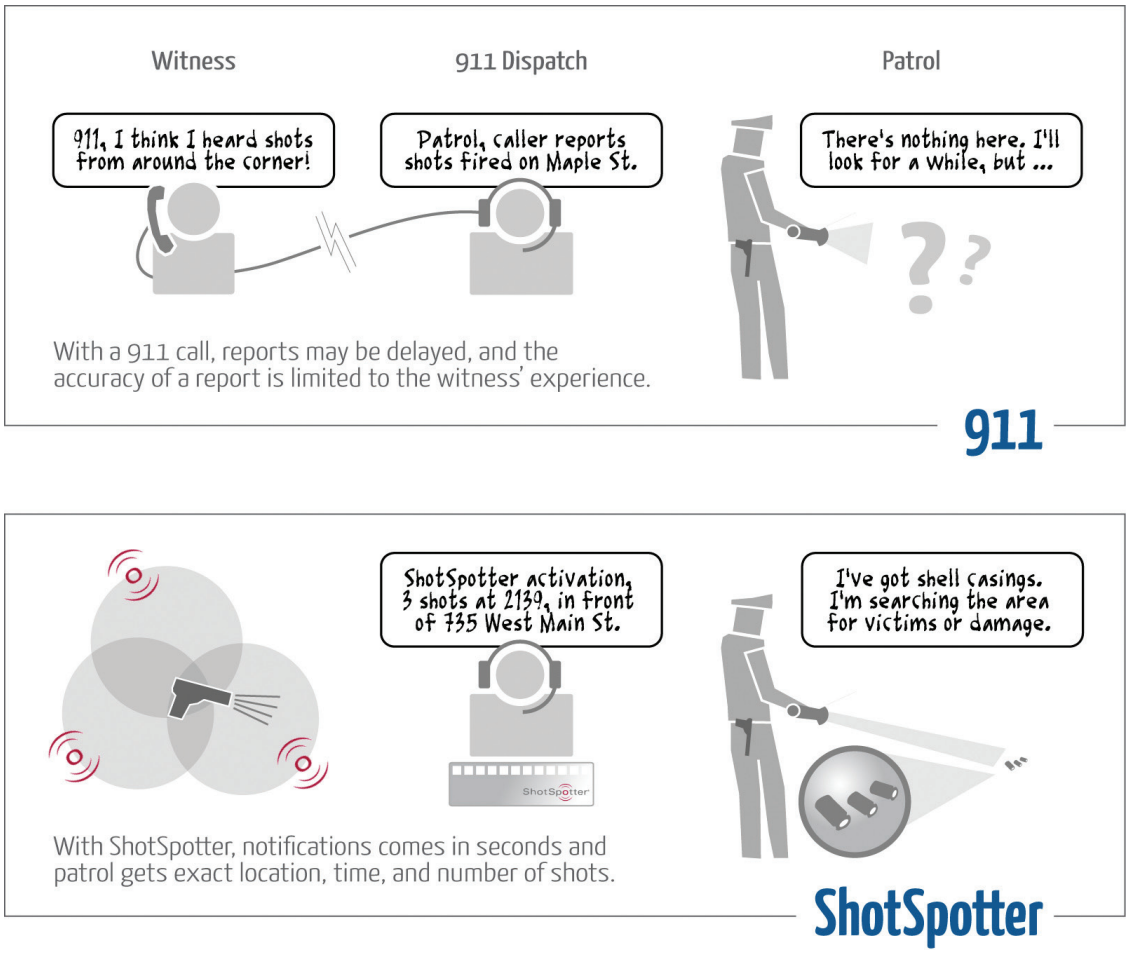


Figure 2. 9-1-1 vs. ShotSpotter on Patrol

information source, providing information about gunshots that would otherwise go unreported: "I don't even know how many we weren't getting because people usually don't call [9-1-1] in this city."[71]

Officers in Saginaw, Mich. and Nassau County, N.Y. corroborate that people often do not report gunshot incidents,[72] while in East Palo Alto, Calif., more gunshots appear to be being reported by residents via 9-1-1 than previously.[73]

Residents of Richmond, Calif. may be calling 9-1-1,[74] but the information from those calls is not considered reliable, while ShotSpotter is,[75] which was also reported by other agencies.[76] It is of note that the Richmond, Calif. patrol officer cites false positives as a central complaint with witness-reported (9-1-1) gunshot calls, and sees ShotSpotter as an improvement over this.

The geospatial accuracy of ShotSpotter provides patrol officers with information about the actual location of a shooter, as distinct from the location where witnesses experience the gunshot. In East Palo Alto, Calif., the

respondent reported an incident in which the victim was in a different location than the shooter, something that was understood through ShotSpotter information.[77]

In a different portion of the interview, the patrol officer from Richmond, Calif. described an incident in which pedestrians fired shots into a bus that was moving across jurisdictional lines. The accuracy of ShotSpotter in pinpointing the precise location(s) from which the shots were fired was critical not only to solving the crime, but even to determining who was to investigate.[78] As it turned out, a witness claimed the shooting had occurred in their jurisdiction, while ShotSpotter said it had occurred in another jurisdiction. Patrol walked to where ShotSpotter indicated the shooting had occurred and found shell casings.

ShotSpotter can improve outcomes by helping patrol officers get to the scene faster, which makes them more likely to encounter the perpetrator, according to the respondent from Brockton, Mass.[79] A nearly identical answer is given by the patrol officer from the Nassau County N.Y. Police Department, who put it this way: "You feel pretty damn sure you're going on a gunfire…a gun call. And you know you're going there and you're going there much faster than you would've in the past. And you've got to be concerned that you're going [to] either come into contact with that person or you're going or passing that person as you are coming into the scene."[80]

The above responses represent five of the seven respondents' answers to the specific question about how ShotSpotter changes their response to a call. Rochester, N.Y. and Saginaw, Mich. patrol officers also discuss the advantages ShotSpotter provides; they see it as mainly corroborative. In Rochester, N.Y., ShotSpotter activations are described as one of the factors that plays into how to respond to a call.[81] In Saginaw, Mich., the ShotSpotter activation may be part of a more complex calculation: "If we receive multiple calls from any residents in addition to a ShotSpotter activation it can…dictate a change in response there."[82]

Patrol officers respond with a more tactical overall response to ShotSpotter calls[83] (in response to the question, 'Do ShotSpotter calls result in a more tactical overall response,' five of seven (71%) say "Yes," one (14%) says "No," and one said "Somewhat," conditioning his response on ShotSpotter plus additional information including corroborating 9-1-1 calls).

Patrol officers universally say that ShotSpotter provides them more situational awareness to responding to gunshot calls.[84] It "Always" or "Sometimes" affects the route patrol takes to respond to gunshot calls,[85] and it often affects the priority patrol officers assign to a call.[86]

Officers make arrests due to ShotSpotter information.[87] Most important, patrol officers value and trust ShotSpotter information over 9-1-1 in gunfire reports despite false positives (ShotSpotter activations for sounds other than gunshots).

4.4 Dispatch

4.4.1 Key Findings

- Dispatchers believe that nearly 70% of ShotSpotter activations are triggered by gunshots.
- Dispatchers always receive and pass on to patrol the time, number and location of shots as provided by ShotSpotter. This is much more information than can possibly be given by 9-1-1.
- Dispatchers have high confidence that when the ShotSpotter graphical waveform display shows the appropriate "signature" waveform, an actual gunshot—and not a false positive—has occurred.
- Dispatchers have the greatest exposure to, and the most operational challenges with, false positives.
- Neither analysis of activations as they occur, nor reclassification after patrol investigation is being completed to an optimal level. Activation analysis procedures and policies on reclassification are vague and not well followed.
- A failure to adhere to best practices and consistent procedures means customers do not get all the strategic value possible from ShotSpotter.

4.4.2 Analysis

Dispatchers are most affected by false positives. When the ShotSpotter monitoring screen displays an activation bearing the signature gunshot graphical acoustic signature,[88] they believe that[89] 67% of alerts on average are caused by actual gunfire.[90] Specific estimates from dispatchers as to what percentage of ShotSpotter activations constituted real gunshots and not false positives included 75% (Saginaw, Mich.[91]); 50% (Rochester, N.Y.[92]); 70% (Riviera Beach, Fla.[93]); 97% (Richmond, Calif.[94]); 50% (Nassau County, N.Y.[95]); 60% (Brockton, Mass.[96]). An outlier reported five percent; see endnote[97] for why his comments have not been included in our calculation of the average.

Dispatchers reported a range of events which would trigger false positive activations. The most commonly reported sources of false positive activations are, in no particular order: dumpsters, trucks, motorcycles, helicopters, fireworks, construction, vehicles traveling over expansion plates on bridges or into potholes, trash pickup, church bells, and other loud, concussive sounds common to urban life. Dispatch respondents report that false positives are more likely to occur during daytime shifts when more of these noises are likely to occur.[98]

Six of seven dispatchers also reported that when the graphical waveform display showed what we have come to call the "classic ShotSpotter gunshot waveform" which is described by respondents and people at the company with whom we spoke as a waveform resembling "a sideways Christmas tree" that they had high confidence that the activation was caused by a gunshot and not something else.[99]

Because of the prevalence in pre-study interviews[100] of dispatcher complaints of false positives, we sought information from dispatchers on their real-time analysis of ShotSpotter activations based on the graphical waveform displayed by the GLS and the audio playback of gunshots from various sensors. Dispatchers reported that the audio of candidate gunshots was nearly always available for their review[101] and that agency policy dictates that dispatchers view and listen to candidate gunshots on activation.

While respondents said in many cases that there was a policy or procedure to analyze activations and determine whether they thought it was a gunshot or some other sound,[102] we found that, other than "just listening to it," we did not find among the respondents a cogent procedure to better differentiate between actual gunshots and other sounds.[103] We do not suggest that this is an insufficient procedure given a dispatcher trained to discern a recording of an actual gunshot. However, prior to ShotSpotter being installed, few dispatchers had experience or training in discerning recorded gunshots; none had experience with audio waveform analysis, and three of the seven dispatchers had never heard a live gunshot. Four had, though on the shooting range, where presumably they wore hearing protection which muffles the sound of the gunshot.

Dispatchers say that they rely on a range of methods which indicate either a lack of guidance or training—training which dispatchers themselves say they have not received.

For example, in Saginaw, Mich., dispatch reported that "We're not the experts, but if it does…sound like a gunshot we still advise police…."[104] While in Rochester, N.Y., the dispatcher believed that larger caliber weapons and rapidity were key to detecting real gunshots from fireworks, which he believed were the most common false positive source.[105] Riviera Beach, Fla. and Brockton Mass. staff dispatch with police officers, who base their determinations both on the sound[106] and the distance from the sensor as reported by ShotSpotter.[107] At Nassau County, N.Y., the dispatcher says she listens repeatedly to make certain when she is unsure.[108]

Others depend on the classic ShotSpotter gunshot waveform[109] or a combination of looking and listening.[110]

Dispatchers report that false positive activations are more likely during day shifts,[111] saying that more of the types of noises which seem to trigger false positives occur then.

Dispatchers say that, despite their annoyance at false positives, they always monitor ShotSpotter activations, and they nearly always report key ShotSpotter information—the location address, the number of shots and the time of the shots—to patrol.[112]

A false negative (when a gunshot is known to have occurred and the ShotSpotter system does not detect it) is a far more serious issue than a false positive. Five agencies—Rochester, N.Y., East Palo Alto, Calif., Riviera Beach, Fla., Brockton, Mass., and Richmond, Calif.—reported false negatives had occurred.[113] However, each said that these occurrences were very rare,[114] and in Nassau County, N.Y., on follow-up it was revealed that the "false negative" was actually a shot from inside a building.[115] One dispatcher indicated false negatives were a problem, however we discount this for reasons stated at endnote."[116]

4.5 Analysts

4.5.1 Key Findings

- Analysis departments show the widest degree of variation, and analyst sophistication varies so widely that it is impossible to generalize based on the responses that we received.

- Based on reports from other respondent groups and analyst responses, analysts are not receiving reliable and correctly reclassified ShotSpotter data. This hinders strategic and even tactical analysis of the ShotSpotter activation data.

- The agencies best at analysis and workflow are ensuring that ShotSpotter activation data is reclassified, then aggregating and correlating it with other crime data—for example crime mapping, gang intelligence, parolee and probationer, open source intelligence—to form a rich and predictive intelligence view of an area.

- Lessons of use from the better analysis shops should be disseminated among the ShotSpotter user community so that more agencies may understand the strategic potential of the data ShotSpotter produces.

4.5.2 Analysis

Analysis departments show the widest degree of variation, and analyst sophistication varies so widely that it is impossible to generalize based on the responses that we received. Therefore, we have elected to show how a "best case" scenario can look, with inputs from Nassau County, N.Y. Police Department; and the Rochester, N.Y. Police Department.

Perhaps the most important consideration in terms of successful analytics is the human factor, and human involvement, with the ultimate success of a strategic use of ShotSpotter. An analyst in Rochester, N.Y. referred to looking through ShotSpotter data and finding a recent event which had activated ShotSpotter, but which was merely acknowledged by the dispatcher. No dispatch to patrol had been made, nor had any reclassification of the alert.[117]

The decision not to dispatch the call to patrol may have been, according to the analyst, acceptable in the context of a maturing program, in which dispatchers are trained to acknowledge but not dispatch calls when it is clear that it is an "algorithm error."[118] But the failure to reclassify has a snowball effect. Not only do the analysts not have accurate gunshot activation data for even basic statistical analysis purposes, but any algorithmic improvements made by ShotSpotter to the GLS are halted when sounds which are clearly helicopters to a human listener, are allowed to be misclassified by the system: "It speaks to the human factor challenges of having ShotSpotter work effectively as part of an operational strategy."[119]

During our field interviews, we had hoped to learn that analyst departments were leveraging the ShotSpotter data to support intelligence operations at the department consistent with crime analysis, intelligence analysis,

or national policing programs such as community policing and intelligence-led policing. However, we found that for many reasons observed, due to a lack of standard ShotSpotter data workflow or activation data lifecycle management primarily associated with lack of consistent and comprehensive reclassification or cleaning, analysts cannot access the data necessary to support the use of ShotSpotter to inform these programs. Several respondents[120] agreed that this model represents an effective workflow:

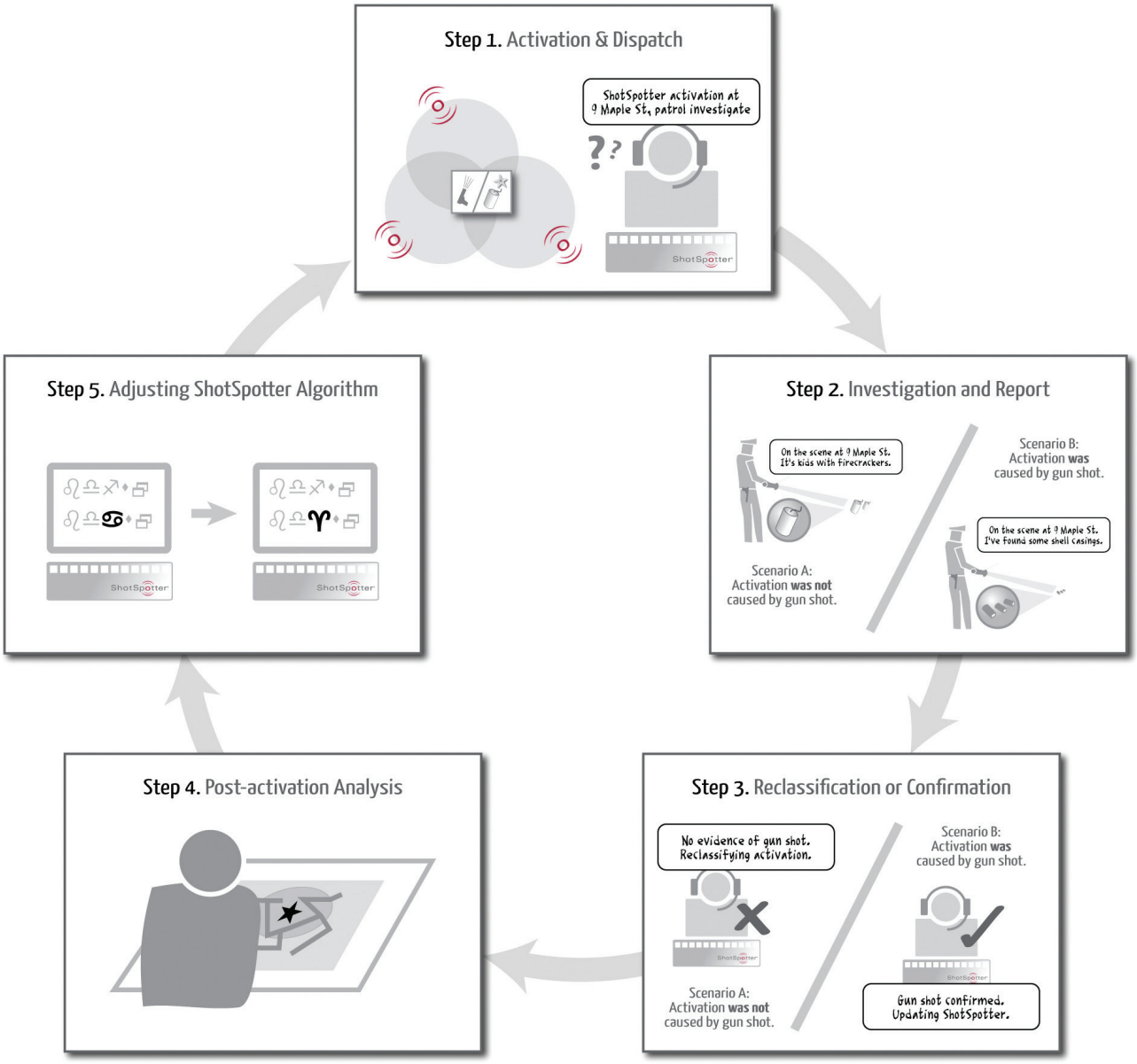


Figure 3. Sample ShotSpotter GLS Activation Lifecycle

Without accurate reclassification of activation data, based on empirical data provided by established patrol investigative techniques, neither effective analysis nor retraining of the ShotSpotter algorithm or personnel is possible. This relegates ShotSpotter data to merely tactical usage and aggravates the operational issues of false positives experienced by dispatchers. Ironically, the work of reclassification by dispatchers would likely ameliorate future false positives as it would identify problem areas which may be addressed by ShotSpotter technicians.

As a basic example, simple quantitative expression of ShotSpotter data such as that in Figure 4 is not possible unless the data are properly reclassified:

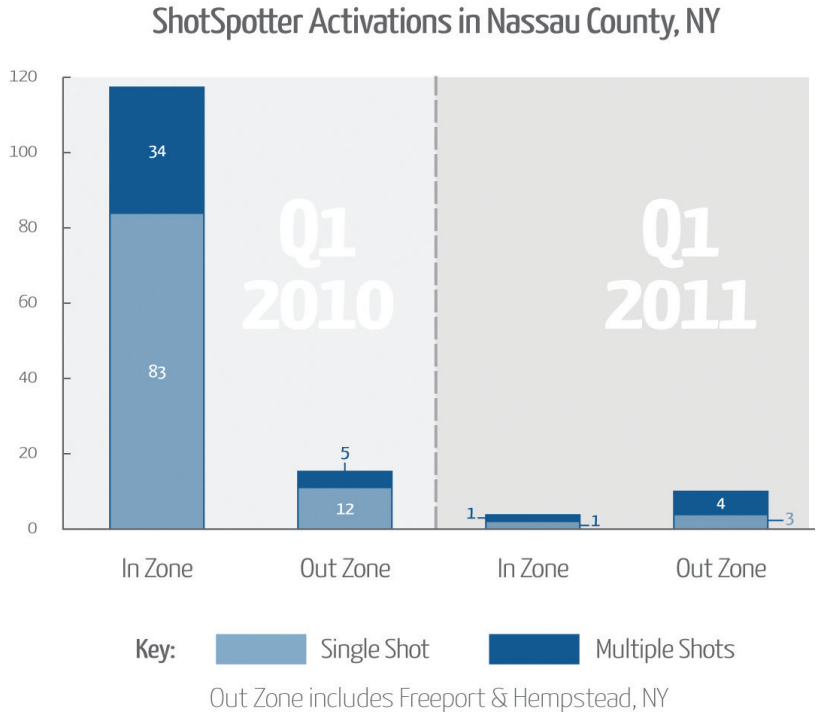


Figure 4.
Source: Nassau County Police Department, Asset Forfeiture and Intelligence Unit

In this chart, the analyst shows that "In Zone," meaning within the area of the ShotSpotter coverage, the number of single gunshots fell from 83 in the first quarter of 2010 to one in the first quarter of 2011; multiple gunshots fell from 34 to zero in the same period. This fundamental articulation—it is not analysis—is literally impossible without accurate reclassification of ShotSpotter activations. Nassau County, N.Y. is certain that the 83 ShotSpotter activations which occurred in the first quarter of 2010 were gunshots, not anything else.

Further, depictions of changes in level of ShotSpotter activations without such cleaning will use data riddled with false positives, leading to precise sounding statements based on (at best) imprecise data and potentially faulty conclusions.

Because so few agencies can demonstrate that they engage in this regular, systemic, and predictable reclassification, we believe that ShotSpotter must better educate its customers as to the critical importance of reclassification, and provide training and re-currency training for all users.

At the Nassau County, N.Y. Police Department (NCPD), all reclassification of ShotSpotter activations are conducted by detectives in the intelligence bureau[121]; all ShotSpotter activations are reviewed by detectives in the intelligence bureau.[122] The Intel bureau reviews all reports generated by the department, including officer "aideds" (reports by officers coming to the aid of an injured person). "[The Intelligence Unit reads] any report that comes into the police department's possession or [which is] created by a police officer."[123]

The NCPD performs daily, weekly, monthly, quarterly, and annual crime statistical reporting, trend analysis, Uniform Crime Report (UCR) preparation, COMPSTAT (called NassSTAT locally); it also creates strategic crime analysis reports, intelligence analysis and intelligence reports, and crime mapping.[124] The unit overlays the ShotSpotter confirmed shot map with gang member residencies, sex offenders, probationers and parolees, party houses, and drug houses.[125]

The NCPD as a whole uses ShotSpotter as a source of data to support not just its tactical response to gunshots, but is used by command staff for strategic imperatives including personnel and resource decisions[126] and to support applications for grants to purchase equipment other than ShotSpotter, for example, license plate readers and cameras:

> *"We've used ShotSpotter to show one our activity of shots being fired in the zone. We then take that activity and the ShotSpotter [activity] to apply for technology such as cameras license plate readers and we're in the process now of interacting the three together."*[127]

It seems that the key to this strategic use of data by NCPD relies wholly on the use of reliably cleaned ShotSpotter data. NCPD reported among the lowest rates of false positive and false negative complaints by Dispatch and Patrol of any of the agencies interviewed. We speculate that this is because of the strictly followed agency-wide procedures and written policies governing the use of ShotSpotter at each stage of an activation's lifecycle.[128]

4.6 Trans-Respondent Group Findings

Two high level issues emerged during the research of this study that transcend any single respondent group and affect each of them. These issues are false positives—a ShotSpotter activation which is ultimately determined to have been caused by something other than a gunshot—and the comparison of ShotSpotter to 9-1-1 alone.

There are aspects of these two issues which are related, however it is important to note a critical distinction between 9-1-1 and ShotSpotter:

ShotSpotter is a reporting channel in which there may be activations which report:

- Actual gunshots
- False positives
- False negatives (no activation when a gunshot is known to have occurred)

9-1-1 is a reporting channel which can have reports of:

- Actual gunshots
- False negatives

By definition, 9-1-1 cannot have "false positives"—the system is too imprecise and there are too many unknowns—but rather a relatively high degree of "unexplained incidents" in which officers are summoned to a call at an imprecise set of coordinates as reported by a caller and fail to find evidence.

4.6.1 False Positives

The false positive, a ShotSpotter activation which is ultimately determined to have been caused by something other than a gunshot,[129] is the single most common complaint of ShotSpotter users. False positives pose an operational problem for users. Those most affected by these operational issues are dispatchers, followed by patrol officers. Detectives are typically not affected by false positives. Analysts are affected in that the data they work with is not representative of gunfire incidents without scrupulous cleaning through reclassification of activation data. Command staff did not feel that ShotSpotter placed undue burden upon non-financial resources.[130]

While false positives are a problem that must be addressed (and we see in the data some likely avenues of remediation[131]), it is important to note that these operational issues do not diminish and indeed are orthogonal to the general efficacy of the ShotSpotter product.

We began investigating this when most patrol officer respondents, and even some dispatchers, made the counterintuitive statement that false positives do not affect their confidence in the accuracy of the data they receive from ShotSpotter.[132]

In the case of ShotSpotter, accuracy—a quality that each respondent across all categories allowed was a clear product characteristic, and which patrol officers referred to as the product's best attribute[133]—refers to the ability of ShotSpotter to accurately determine a specific temporal and geospatial, or geographical, location of an event.

To understand the seeming contradiction, we analyzed the inputs and responses from the different channels of 9-1-1 and ShotSpotter, and our hypothesis follows.

Simply put, "what happened" is separate from "where and when it happened." Cops will tell you that they would rather handle a call of "something is happening at 521 North Adams Street" than one of "a homicide is in progress somewhere in the city." ShotSpotter is accurate about the "where" which means that incidents can be rapidly investigated.

Any comparison of ShotSpotter to other reporting channels, like 9-1-1, which do not give a reliable and accurate statement of at least "where," will favor ShotSpotter because "what" can be investigated when the "where" is known, while the reverse is not true.

More specifically: geospatial accuracy means that the human resource may always be effectively deployed to find out whether a gunshot or other sound has occurred. This subject is clearly distinct from and more important than any discussion of whether ShotSpotter is able to programmatically distinguish the sound of a gunshot from the sound of, say, a dumpster or truck backfiring.

The critical tactical reality is that patrol officers cannot investigate a sound of any kind unless they know where it has occurred. Conceptually, this means that a false positive report from ShotSpotter is easily debunked because of its highly accurate geospatial capabilities.

Conversely, on a 9-1-1 call in which the caller heard a gunshot, and when patrol officers respond and do not immediately find an injured person or other evidence of a shooting, it is highly difficult if not impossible to determine whether a gunshot has occurred, because no location information is available other than that of the caller, and the caller's perceived direction of sound at an approximate time as estimated and reported.

4.6.2 ShotSpotter versus 9-1-1

As we have seen, patrol officers trust ShotSpotter over 9-1-1 as a single source reporting tool. Patrol officers believe that ShotSpotter activations arrive faster, and provide crucial time-of-incident, specific location and number of shots information not given by 9-1-1.[134] They trust ShotSpotter over 9-1-1 to activate more often when gunshots are fired because of repeated gunshot incidents in which no 9-1-1 call was made."[135] However, some agencies report that, since gunshot incidents have been on the decline and the community has seen more proactive response since ShotSpotter deployment, more gunshots appear to be reported by residents via 9-1-1 than previously.[136]

When witnesses call 9-1-1,[137] the information from those calls is not considered reliable, while ShotSpotter is.[138] The geospatial accuracy of ShotSpotter provides Patrol officers with information about the actual location

of a shooter, as distinct from the location where witnesses experience the gunshot. This is a crucial distinction, and has led, as described in the patrol section, to settlement of discussions over which agency has jurisdiction on a particular incident.[139]

ShotSpotter can improve outcomes by helping Patrol officers get to the scene faster than 9-1-1 alone,[140] increasing the likelihood of an arrest and, as we have seen, decreasing the time to get gunshot victims to life saving medical treatment. In the case of a shot police officer or citizen, seconds count, and ShotSpotter is seen by first responders as effective in providing fast and highly accurate alerts of gunfire much faster and more accurate than 9-1-1.

When combined with 9-1-1, ShotSpotter offers patrol and detectives a powerful tool that helps them to quickly communicate with witnesses and potential suspects. Taken together, the two systems form a corroborative network of information which can be used by patrol to investigate incidents in progress: ShotSpotter gets them to the correct location while 9-1-1 provides a number to call to ask additional questions about the incident that the witness may be able to answer.[141] This corroborative is seen in priority given by patrol officers to calls coming from multiple channels as well.[142]

Command staff in Richmond, Calif. say that patrol officers also look to ShotSpotter to confirm 9-1-1 calls in a similarly corroborative fashion:

> *"They're so embraced with this technology, if we get a standard 9-1-1 call of shots fired at the corner of Walk and Don't Walk, the radio puts it out that way. The immediate question is, "Did you get a ShotSpotter hit?" Because they know that's going to put them at the right place. I think officers feel it makes them safer, because they know they're going to the correct location."* [143]

5. Suggested Further Study

5.1 Activation Lifecycle

More in-depth analysis of the lifecycle of ShotSpotter activations in the context of departments such as Nassau County, N.Y. is required in order to identify the factors that can increase the integration of ShotSpotter into strategic crime reduction programs, policies and practices.

5.2 Dispatcher Training

The variation among dispatchers seems to point to training issues (ab-initio or re-currency) that should be easily addressed. Dispatchers seemed unclear on the total amount of ShotSpotter training they had received. However, five dispatchers said specifically that they had received an hour or less on waveform recognition and audio gunshot recognition training.[144] All mentioned that the training heavily focused on waveform recognition and the system's distinction between fireworks and gunshots,[145] and some limitations on the system such as the inability to detect gunshots from within buildings.[146]

Dispatcher complaints and attitude towards false positives are an operational concern: we suspect dispatcher hostility towards the technology may lead to less attention being paid to initial monitoring of activations (including waveform and audio review), and in agencies where dispatch is charged with reclassification, poor acknowledgement of alerts without dispatch or even reclassification. An examination of this scenario was not in the scope of this paper and may require additional study.

5.3 9-1-1 versus ShotSpotter: False Negatives

Few agencies have reliable data of ShotSpotter activations that have been verified as gunshots correlated with events in which no 9-1-1 call was received. However, this is an interesting topic and may be valuable to agencies seeking to increase their community policing and neighborhood policing efforts to better engage with citizens and encourage participation and cooperation. It would also be useful to have hard data on the percentage of known gunshots (through confirmed ShotSpotter activations) which are not typically reported to 9-1-1 for statistical analysis.

5.4 Policy and Lifecycle Best Practices

The study results suggest that agencies would benefit from assistance from ShotSpotter based on its experience with agencies throughout the world in developing more effective policies. Best practices regarding activation response, dispatch and reclassification, analysis and activities on the part of agencies will lead to the most effective ShotSpotter system implementation. Additionally, ShotSpotter sharing information with customers on how to use ShotSpotter in strategic analysis, and in support of other initiatives such as grant writing, hotspot identification, and other intelligence-led policing activities, is suggested.

6. Endnotes

1 http://policeledintelligence.com

2 US Patent #7,474,589 B, issued 6 Jan 2009

3 National Organization of Black Law Enforcement Executives, http://noblenational.org

4 9-1-1, the universal U.S. emergency number for all telephone services, source: http://www.fcc.gov/pshs/services/911-services/Welcome.html

5 CSGA views the titles "Detective" and "Investigator" as descriptive of the same role: those who investigate gunshot crimes or homicide

6 "Does a ShotSpotter alert to a gunshot call result in a tactical response from you overall?" n=7

7 "Does ShotSpotter help increase your situational awareness while dealing with a "shots fired" call?" n=7

8 "Does information gathered by ShotSpotter affect the route that you travel when responding to a gunfire call?" n=7

9 "Does a ShotSpotter alert affect the priority which you assign to a gunfire call?" n=7

10 Requests may be made at http://policeledintelligence.com/contact. Please allow one business-day for a reply. Replies will contain a hyperlink pointing to the recording requested on a public-facing Internet server.

11 Interviewers were instructed within the script to "flip" the question order per respondent.

12 http://bit.ly/hiklEN

13 What were the driving reasons for deciding to purchase ShotSpotter? N=7

14 See, eg, Saginaw, Mich., Command, lines 4-8 and Rochester, N.Y., Command, lines 5-6

15 Saginaw, Mich., Command, lines 4-8

16 See, e.g., Riviera Beach, Fla., Command, line 5, and Nassau County, N.Y., Command, lines 7-9

17 Nassau County, N.Y., Command, lines 7-9

18 "Have gunshot incidents in your city gone up or down since deployment of ShotSpotter?" N=7

19 Brockton, Mass., Command, line 42

20 Saginaw, Mich., Command, lines 128-133

21 Nassau County, N.Y., Command, lines 87-88

22 Richmond, Calif., Command, lines 390-400

23 "Have other non-gun related crimes gone up or down since ShotSpotter deployment?" N=6

24 See for example, Saginaw, Mich., Command, lines 142-144, and Nassau County, N.Y., Command, line 91

25 "Do you believe ShotSpotter is responsible for saving lives in your community?" n=7

26 See Nassau County, N.Y., Analysts, lines 179-184; "The police officer responded before the 9-1-1 calls got out. One individual was already deceased. The second individual was wounded and due to that quick response it possibly saved his life from bleeding out in the street." Also see Saginaw, Mich., Command, lines 130-133: "[W]e've had... probably in the area of a 40% reduction in the two years that we've been using ShotSpotter. Our homicides have been cut in half...I'm assuming ShotSpotter is at least responsible for a portion of that. I couldn't tell you exactly how much."

27 "How confident are you in the information ShotSpotter provides?" Six-point Likert-scale, n=7

28 "What value do you place on having ShotSpotter deployed in your city? Six-point Likert-scale from "very low" to "very high." n=7

29 How effective is ShotSpotter at preventing illegal gunfire incidents in your city? Six-point Likert-scale from "very ineffective" to "very effective." n=7

30 "Is ShotSpotter effective?" n=7

31 East Palo Alto, Calif., Command, lines 157-158

32 Nassau County, N.Y., Command, line 229

33 For example, see Saginaw, Mich., Command, lines 130-133; Nassau County, N.Y., Command, lines 231-239; Brockton, Mass., Command, lines 148-150; Riviera Beach, Fla., Command, lines 167-178; Rochester, N.Y., Command, lines 216-242

34 Nassau County, N.Y., Command, lines 231-239

35 Do you see the value of ShotSpotter at your agency being primarily tactical or primarily strategic? N=7

36 See, for example, Nassau County, N.Y., Command, lines 21-24; Richmond, Calif., Command, lines 140-143; and Saginaw, Mich., Command, lines 20-22

37 See, for example, Richmond, Calif., Command, 535-537, "[E]vidence that ShotSpotter is not viewed as a threat...even by the crooks is that no one has taken any counter-measures to destroy or damage the equipment."

38 Do citizens in your city say it makes them feel safer? N=7; In your opinion how do your citizens feel about ShotSpotter do they have a good or bad perception of it? N=7; Any Big Brother or similar civil liberties concerns? N=7

39 See responses including, "I would say the general law abiding citizen probably has [a] positive [perception of ShotSpotter] (East Palo Alto, Calif., Command, lines 63-64)"; "I think there are excellent perceptions in the area where ShotSpotter is deployed...which actually flood over into areas where it's not deployed. People have very good feelings about it. I've actually run across [no civil liberties concerns]. Ten years ago I would tell you that this may have been problematic. Today, people are clamoring for an expansion or enhancement (Nassau County, N.Y., Command, lines 94-102)."

40 Richmond, Calif., Command, lines 512-516

41 If you had the decision to make over would you decide the same way? N=7

42 Saginaw, Mich., Command, line 171; Rochester, N.Y., Command, line 83; Riviera Beach, Fla., Command, line 63; Richmond, Calif., Command, line 567; Nassau County, N.Y., Command, line 108; Brockton, Mass., Command, line 57; East Palo Alto, Calif., Command, line 74

43 "What's your confidence level in ShotSpotter information on a scale from very high to very low?" n=7

44 CSGA views these titles as descriptive of the same role: those who investigate gunshot crimes or homicide. The only difference is a regional one, that detectives are referred to as investigators in some regions.

45 Agencies differ in the manner in which detectives are notified, and the time at which they arrive on the scene. Saginaw, Mich., Rochester, N.Y., Riviera Beach, Fla., Richmond, Calif., Nassau County, N.Y., and Brockton, Mass., detectives arrive as the scene is being processed and/or the scene is held for their arrival, while East Palo Alto, Calif., detectives sometimes arrive after the scene is cleared. Some agencies (Richmond, Calif., and Rochester, N.Y.) rely heavily on evidence technicians to locate and collect evidence. We have taken these factors into account in our analysis but note that we have not interviewed these evidence technicians to determine whether they receive and/or use ShotSpotter data.

46 "Does ShotSpotter allow you to investigate more efficiently?" n=6. Four replied, "Yes." Two others specified that it did, "on some occasions, I think so (Saginaw, Mich., Detectives, line 212)" or, "In some situations, yes." (Richmond, Calif., Detectives, line 213).

47 "Does ShotSpotter save you time on investigations?" n=6

48 Detectives were asked if they consider the geographical data, number of shots, time of shots and information on whether the shots were moving (as in a drive-by shooting) from ShotSpotter before arriving on the scene, and on the scene before conducting a search or questioning witnesses and suspects: "Do you consider the following information from ShotSpotter and make that consideration part of your search strategy: Geodata? Number of shots? Time of shots? Time between shots? Moving shots?" n=7

49 For example, "Absolutely, because you may be asking 'how much shots did you hear' when you already have that answer. Where were you in po...you know, the vicinity when you heard the shots. And again, because the sensors depending on their location may actually closer than a witness (Nassau County, N.Y., Detectives, lines 187-192)," and, "If ShotSpotter said seven shots and the witness said seven shots obviously, y'know, we know that there are counts consistent with the information we have (Saginaw, Mich., Detectives lines 172-176)."

50 For example, "If I'm talking about witnesses what am I going to...ask them again their observation. What were they doing particularly there. How long they've been there. Are they related to anybody at the scene. Are they injured. And we'll go from that (Nassau County, N.Y., Detectives, lines 118-122)."

51 See, for example, Richmond, Calif., Detectives, lines 209-215, and Saginaw, Mich., Detectives, lines 209-215

52 See, for example, Brockton, Mass., Detectives line 258; East Palo Alto, Calif., Detectives lines 312-323;

53 Nassau County, N.Y., Detectives, lines 269-291

54 "On average, how much time do you think ShotSpotter saves you in a given investigation?" n=7

55 e.g., Brockton, Mass.: "It's a minimal time" (Line 248); "It could probably save us less than an hour on incidents where maybe an eyewitness account isn't available... (Saginaw, Mich., Detectives, lines 221-223)" etc.

56 Saginaw, Mich., Detective, lines 273-282

57 It is unclear from this interview (East Palo Alto, Calif., Detective Kevin Ferreira, lines 246-268) whether the shots occurred inside the ShotSpotter coverage area.

58 East Palo Alto, Calif., Detective Kevin Ferreira, lines 246-268

59 Brockton, Mass., Detectives, lines 117-118

60 Brockton, Mass., Detectives, lines 64-82

61 See, for example, Saginaw, Mich., Detectives, lines 144-153

62 "What's your confidence level in ShotSpotter information on a scale from very high to very low?" n=7

63 Detectives: Saginaw, Mich., lines 225-231; Brockton, Mass., lines 266-269; Nassau County, N.Y., lines 305-309; Richmond, Calif., lines 221-229; Riviera Beach, Fla., 236-329; Rochester, N.Y. lines 199-201; East Palo Alto, Calif., lines 380-384

64 Chief Cliff, Saginaw, Mich., lines 84-97

65 Riviera Beach, Fla., Detectives, lines 388-397

66 "What's the best attribute of ShotSpotter?" n=7

67 See, e.g., Saginaw, Mich., Patrol, lines 486-503, and Rochester, N.Y., Patrol, lines 410-417

68 Saginaw, Mich., Patrol, lines 486-503

69 Riviera Beach, Fla., Patrol, lines 344-348; and Richmond, Calif., Patrol, lines 300-302

70 Nassau County, N.Y., Patrol, lines 468-477

71 Riviera Beach, Fla., Patrol, lines 123-125

72 "I would say that the question has to do with the neighborhood, too. You know, if you get down to the worst part of the neighborhood, they're used to gunfire—so no one's calling (Saginaw, Mich., Patrol, lines 264-266)." "You would be surprised how many times that people don't call up for gunfire (Nassau County, N.Y. Patrol, lines 234-236)."

73 "In the past we used to didn't get that many calls, but now, if you get a shooting, we're gonna get two or three calls (East Palo Alto, Calif., Patrol, lines 278-281)."

74 "Usually citizens will usually call on multiple gunfire. If it's a one shot it's probably a fifty-fifty, you know, between a ShotSpotter and a citizen calling in (Richmond, Calif., Patrol, lines 161-164)."

75 "Before, we'd get a shots fired call from a citizen [and] it may or may not be the case. The citizen may think [there's] a backfire, or it could be a backfire or fireworks or whatever. Now we have a system in place that verifies gunfire (Richmond, Calif., Patrol, lines 102-105)."

76 "Yes, I put more belief in [ShotSpotter] than I do the general public calling in (Brockton, Mass., Patrol Interview, lines 140-141)."

77 "We had one time when they pinpointed right to the front yard, and it even gave us an address [for this camera from then]. When we got there, people were shot in one area, they were looking, [and] they say 'ShotSpotter picked up [shots] over in this area' and we looked inside there, [and] we found the casings in his area. So definitely they were shooting down the street at the person. So even though the person was shot say down the street ShotSpotter told us exactly where they were shooting from (East Palo Alto, Calif., Patrol, lines 168-177)."

78 "Last week there was a shooting, a bus pulled up to a bus stop and there was some guys standing outside; they knocked on the window and fired three two or three rounds into this bus. Nobody on the bus got hit, but somebody got nicked with some flying glass. Well, we got the call that the bus had stopped at a certain location. We get there, they give us a ShotSpotter alert at a location that's about two blocks in a different jurisdiction outside of the coverage area. So when the officer get there he talks to the bus driver who said that the incident occurred at a different location other than what the ShotSpotter gave. So the particular incident where the ShotSpotter claimed it occurred was in the County's Sheriff's department jurisdiction, and the and the location where the bus driver said it occurred would be in our jurisdiction. So we had the Sheriff's department out looking at our area for casings and there wasn't any there. So I went to the location of the ShotSpotter activation and right where it said it occurred were the casings (Richmond, Calif., Patrol, lines 307-324)."

79 "One is the accuracy—you know you're actually going to where you believe the gunshots are coming from instead of a third party calling in and saying they heard gunshots from a particular area. You know where that area is. [Two] is the speed of it which increases the likelihood that we're actually going to come across, hopefully, the perpetrator himself (Brockton, Mass., Patrol, lines 105-113)."

80 Nassau County, N.Y., Patrol, lines 122-136

81 "If you have a citizen that's calling in shots fired, or if you have a call after that that says, you know, report that somebody shot, it just lends more credibility to the call and all the factors together kind of play in together (Rochester, N.Y., Patrol, lines 97-99)."

82 "If we receive, like I said before, if we receive multiple calls from any residents in addition to a ShotSpotter activation, it can dictate, or if it's traveling in a certain direction, dictate a change in response there (Saginaw, Mich., Patrol, lines 174-178)."

83 "Does a ShotSpotter alert to a gunshot call result in a tactical response from you overall?" n=7

84 "Does ShotSpotter help increase your situational awareness while dealing with a "shots fired" call?" n=7

85 "Does information gathered by ShotSpotter affect the route that you travel when responding to a gunfire call?" n=7

86 "Does a ShotSpotter alert affect the priority which you assign to a gunfire call?" n=7

87 "Have you ever been able to effect an arrest due to the use of ShotSpotter?" n=7

88 The "classic gunshot waveform" the dispatchers say, resembles a sideways "Christmas tree" and is a distinctive graphical representation.

89 "When you see the classic gunshot waveform, how confident are you that the system has detected actual gunfire and not something else that might trigger a ShotSpotter activation?" n=7

90 "And in your estimation what percentage of activations are really gunshots and not one of those other things?" n=7

91 Saginaw, Mich., Dispatch lines 293-294

92 Rochester, N.Y., Dispatch, line 290

93 Riviera Beach, Fla., Dispatch, lines 327-328

94 Richmond, Calif., Dispatch, lines 324-328

95 Nassau County, N.Y., Dispatch, line 375, amended from an earlier statement in the interview that it was 80% (at line 258)

96 Brockton, Mass., Dispatch, line 268

97 The outlier in this case was the dispatcher in East Palo Alto, Calif., where the respondent reported (East Palo Alto, Calif., Dispatch, lines 258-265) a 95% false positive rate–that is, only five percent of ShotSpotter GLS activations are actually gunshots. We have no analysis of the reason for this divergent opinion. We do note that when this same dispatcher, East Palo Alto, Calif., was asked the previous question about his confidence when he sees the "classic gunshot waveform," he responded, "I'm only confident if I hear it." [Ibid., line 255]. In response to a different question "When you listen to the audio, what are your criteria for determining whether something is not a gunshot?" [lines 197-198] he responds, "I do look at the waveform," [Line 199] however it is unclear whether these responses when taken in their totality indicate this dispatcher is following the procedures to properly use the system upon initial activation. We have discounted the estimate from this dispatcher for these reasons. We note that, if we were to have included his estimate, this would reduce the perceived true gunshot reporting rate to 58%.

98 This table is based on a series of questions asked of each respondent dispatcher. The questions and the responses which have been tabulated here may be found in the following documents: East Palo Alto, Calif., [Lines 306-341]; Saginaw, Mich., [lines 341-401]; Nassau County, N.Y., [lines 299-346]; Riviera Beach, Fla., [lines 386-477]; Rochester, N.Y., [lines 329-386]; Richmond, Calif., [lines 377-440]; Brockton, Mass., [lines 300-345].

99 See, Saginaw, Mich., Dispatch, lines 286-290; Rochester, N.Y., Dispatch, lines 274-286; Riviera Beach, Fla., Dispatch, lines 300-324; Richmond, Calif., Dispatch, lines 318-321; Nassau County, N.Y., Dispatch, lines 249-253; and Brockton, Mass., Dispatch, lines 261-265

100 See Section 3.4

101 For example, Richmond, Calif., Dispatch Lines 271-272; East Palo Alto, Calif., Dispatch, lines 182-183; Nassau County, N.Y., Dispatch, line 197; Rochester, N.Y., Dispatch, lines 197-197; Brockton, Mass., Dispatch, line 212; Riviera Beach, Fla., Dispatch, line 257, Saginaw, Mich., Dispatch lines 235-239

102 "Let's look a little closer at those activations resulting from something other than a gunshot. When you detect one is there a procedure to reclassify that activation in the system?" n=7

103 "When you listen to the audio what are your criteria for determining whether something is not a gunshot?" n=7

104 Saginaw, Mich., Dispatch, lines 249-256

105 Rochester, N.Y., Dispatch, lines 206-213

106 Brockton, Mass., Dispatch, lines 226-229

107 Riviera Beach, Fla., Dispatch, lines 266-273

108 Nassau County, N.Y., Dispatch, lines 211-216

109 Richmond, Calif., Dispatch, lines 282-294

110 East Palo Alto, Calif., Dispatch, lines 199-203

111 "Does [the ratio between false positives and actual gunshots] change between any given shift? N=7

112 This is a series of questions to each dispatcher, starting, e.g., at line 114 in Brockton Dispatchers and continuing to line 198. A complete compilation of the questions to and responses from each Dispatcher in this series is available at http://www.shotspotter.com/resources/efficacystudy. In the table on that page, the column D indicates that the dispatcher receives the information from ShotSpotter Always, Sometimes or Never, and the column P indicates that the Dispatchers passes this information on to patrol Always, Sometimes or Never.

113 Ibid.

114 See, for example, East Palo Alto, Calif., Dispatch, line 341, and Richmond, Calif., Dispatch, lines 433-439

115 Nassau County, N.Y., Dispatch, lines 343-346

116 Brockton, Mass., Dispatch, lines 365-369; respondent first called these "false positives" but on confirmation referred to them as "false negatives." "The false positives. I wish they would pick up. That's my one grief. Sometimes even in the sensor area they don't pick up a gunshot when its there." This is inconsistent with other reports from that agency, and separately, the dispatcher appeared confused by the question, so we have discounted it in our analysis.

117 Rochester, N.Y., Analysts, lines 311-330

118 Ibid.

119 Ibid.

120 Richmond, Calif., Analysts, lines 143-149; Nassau County, N.Y., Analysts, lines 87-90; Riviera Beach, Fla., Analysts, lines 96-98; East Palo Alto, Calif., Analysts, lines 86-90

121 Nassau County, N.Y., Analysts, lines 87-88

122 Ibid., line 2

123 Ibid., lines 5-7

124 Ibid., lines 12-38

125 Ibid., lines 46-74

126 Nassau County, N.Y., Command, lines 137-138

127 Nassau County, N.Y., Analyst, lines 134-138

128 Nassau County, N.Y., Command, lines 130-133

129 The most commonly reported sources of false positive activations are, in no particular order: dumpsters, trucks, motorcycles, helicopters, fireworks, construction, traffic hitting expansion plates on bridges or potholes, trash pickup, church bells, and other loud, concussive sounds common to urban life. Dispatch respondents report that false positives are more likely to occur during daytime shifts, when more of these noises are likely to occur.

130 When asked whether ShotSpotter was a burden to resources other than financial, commanders replied "No" in Saginaw, Mich., Command, line 78; Rochester, N.Y., Command, line 43; Richmond, Calif., Command, line 275; Riviera Beach, Fla., Command, line 25; Nassau County, N.Y., Command, line 76; East Palo Alto, Calif., Command, line 35; and "Yes" in Brockton, Mass., Command, line 26.

131 ShotSpotter technology and recognition-engine improvements, and more effective, re-currency user training leading to better, more thorough and accurate reclassification of activations can reduce the overall number of false positives

generated programmatically. These steps also will render the historical data stored by ShotSpotter of activations more suitable for analysis and use to improve the ShotSpotter recognition technology. This suggests a best practices recommendation of a "ShotSpotter Activation Lifecycle Management" framework.

132 See "Patrol responses to questions on accuracy and false positives" at http://www.shotspotter.com/resources/efficacystudy

133 "What's the best attribute of ShotSpotter?" n=7

134 Nassau County, N.Y., Patrol, lines 468-477

135 Riviera Beach, Fla., Patrol, lines 123-125

136 "In the past we used to didn't get that many calls, but now, if you get a shooting, we're gonna get two or three calls. (East Palo Alto, Calif., Patrol, lines 278-281)."

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143 Richmond, Calif., Command, lines 177-183

144 Saginaw, Mich., Dispatch, lines 97-98; Rochester, N.Y., Dispatch, "Minimal" (line 63) and "The training should have been more in-depth" (line 52); Richmond, Calif., Dispatch "30 minutes on each" (lines 79-80); Nassau County, N.Y., Dispatch "I would say a good 20 minutes or half hour. He kept saying did we want to go over more until we were comfortable with it." (lines 51-53); East Palo Alto, Calif., Dispatch "Thirty or 40 minutes" (line 54-56)

145 See, eg, Richmond, Calif., Dispatch, lines 82-88

146 Ibid.

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By Ms. Fernicia Patrick
and Dr. Tod W. Burke

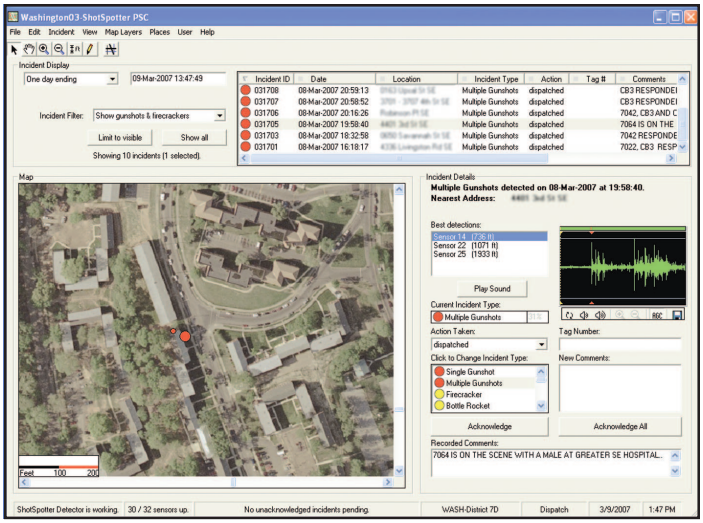
What are the advantages and limitations of this emerging technology?

Gun use is a frequent component of the violence which plagues many neighborhoods in the United States; in 2005, 71% of homicides were committed using a gun. To the dismay of law enforcement officers, residents do not always report the sound of gunshots and those who do report them may not be able to accurately discern where the shots came from. As a result, law enforcement officers' response to gunshots is often not as efficient as it could be. The length of time it takes for a citizen to report gunshots, and for officers to respond, provides offenders with the opportunity to flee and delays medical treatment for gunshot victims.

An Unfortunate Example

In October 2006, 35-year-old landscaper Jose Villatoro was cutting grass outside of a southeast DC apartment complex when he was fatally shot. Neighbors admitted to hearing shots, but did not call 911 because gunshots are so frequent in the area that the noise has become familiar and unremarkable. No police officers were in the immediate area at the time of the crime, but, due to gunshot location technology, they were able to quickly determine the location of the gunshots and make it to the scene within minutes. Although officers were not able to save Villatoro, they were able to arrest the suspect who only had time to flee a few blocks from the scene of the shooting.

The above incident is an example in which this technology has been effective. However, along with the development of gunshot location technology have come concerns about its implementation and its effectiveness as a means of apprehending suspects and preventing crime. The purpose of this article is to examine this technology as it relates to law enforcement and crime prevention.



A dedicated screen shot from the dispatch display of the ShotSpotter® system in Washington, DC, showing an incident location and the comments which were entered into the system

A highway drive-by shooting is picked up and displayed. This evidence can be used for investigation and can also be presented in court.

Advantages and limitations will be examined and recommendations will be provided in an effort to assist law enforcement agencies which may be considering the use of gunshot location technology.

History and Background of Gunshot Sensors

Gunshot locators are devices which detect and locate gunfire within seconds. Frequently, when gunshot sensors are used, law enforcement is notified prior to a citizen's call for service. These devices are small enough to be hidden on rooftops or utility poles, out of the public's sight, but are advanced enough to detect gunfire up to two miles away. Once a shot is fired, the sensor picks up the sound, uses acoustic technology to locate the origin of the shots, and sends the location and time of the gunfire through a telephone line to a central computer which notifies law enforcement. The central computer also retains a plot of gunfire locations within the area for future reference. Some gunshot sensor systems are equipped with surveillance cameras which can identify the shooter and alert the police command center or a mobile police unit.

The technology for these locators originated in 1993 from acoustic technology used to locate earthquakes – the arrival of energy to a particular location is used to determine the source of the energy. The effectiveness of the technology in the identification and reduction of random gunfire was first tested in 1996 in Redwood, CA. Since then, it has been adopted by law enforcement agencies across the United States. The military has also utilized gunshot sensors similar to the above acoustic locators to rapidly detect enemy gunfire. These locators provide military personnel with a clear advantage by allowing them to return gunfire to the precise location from which it came.

These systems are designed to detect gunfire over wide areas within cities, neighborhoods and along highways. For instance, in 2004, this technology aided in the apprehension of the Ohio highway sniper.

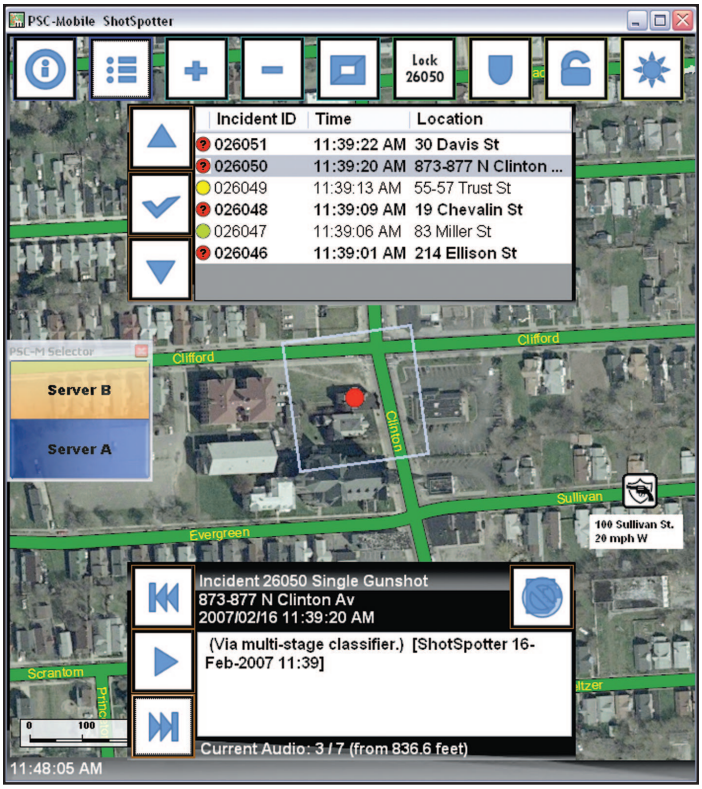
The aim of gunshot location systems is to identify a higher number of gunshots within an area and to decrease the response time of law enforcement officers. For instance, in South Carolina, just three minutes after shots were fired, police arrested two men accused of a vehicle break-in and recovered the weapon involved in the shooting. By not relying solely on citizen reports, law enforcement may gain a more reliable source of information regarding the location of gunfire.

Advantages and Limitations

Gunshot location technology locates gunfire faster and with more accuracy than humans. Providing the precise location and time of gunfire increases officer safety; aids in locating forensic evidence at the scene (i.e., shell casings and other physical evidence); provides key information to rapidly respond to potential Homeland Security crises; and allows law enforcement officers and medical emergency personnel to provide immediate aid to victims. For example, in November 2004, a man was shot in the neck and back; emergency dispatch was never contacted. The gunshot locator system alerted the police who then contacted paramedics who were able to save the man's life.

Gunshot locator systems have aided law enforcement in the recovery of illegal weapons which reduces the number of guns on the streets and increases the safety of citizens and officers. For instance, in Gary, IN, police confiscated 45 illegal weapons in one evening attributing much of their weapon recovery success to the gunshot locator system.

Gunshot locators have also been successful in increasing the amount of gunfire reported to law enforcement. Using this technology, Glendale, AZ, police detected 80 percent more incidents of gunfire than previously reported. The Los Angeles County Sheriff's Department discovered that only 11 percent of gunfire within the square mile covered by the gunshot location sensors was being reported by citizens. Additionally, this technology allows law enforcement to generate a map of the location of gunfire within the community and may assist in crime analysis efforts. This may help officers determine which areas would benefit from an increased police presence and gun violence reduction programming.



A screen shot of the software running in mobile data computers which enables officers to have instant gunshot locations right in their vehicle while on patrol

Although gunshot locator systems have the potential to make law enforcement's response to gun violence quicker and more reliable, this technology is relatively new in law enforcement. As such, there are several unresolved concerns. First, while gunshot locators have been associated with a 31 percent decrease in violent crime rates in Rochester, NY, valid empirical data is lacking and the technology's impact on arrest rates is debatable. Once these systems are used more routinely, it is likely that statistically reliable and valid data will be acquired.

Second, it is unclear whether gunshot sensors produce a deterrent effect. Although this technology has been credited for reducing gunfire between 60 to 80 percent (in Glendale, AZ; Los Angeles, CA; and Redwood, CA), it cannot be determined with any degree of certainty if the decrease was attributed to gunshot locators, police presence in the immediate area, citizen reporting or deterrence. However, those systems which include surveillance claim a deterrent effect. For instance, Chicago, IL, attributes much of its decrease in murder to video surveillance. Perhaps incorporating gunshot location technology in tandem with surveillance cameras would enhance deterrence.

Third, there may also be concern that noises similar to gunshots, such as backfires, will be misinterpreted by the sensors. However, new technology is able to discern such noises from actual gunshots.

Finally, the cost of these systems may be the determining factor when deciding whether or not to utilize the technology. It is estimated that gunshot locator systems would cost "approximately $150,000 for the first square mile and an additional $100,000 to $120,000 for each additional square mile of coverage" (systems which add this technology to existing surveillance cameras are estimated between $4,000 and $10,000 per square mile). With this in mind, it could cost millions to cover an entire city. While there are advantages to having an entire city covered by this technology, with limited funding and budget constraints, opponents would argue that funds could be better utilized in the hiring and training of law enforcement officers. In Chicago, however, criminals pay to monitor themselves, as money forfeited by offenders is used to pay for such locator systems. Additionally, crime analysis and/or problem oriented policing may serve as a cost-effective measure allowing officers to target problem areas.

Recommendations and Conclusion

Gunfire is not uncommon in many U.S. cities. Gunshot locators may aid in rapid response time to a shooting incident, particularly within areas which have a high frequency of gunfire. It is recommended that law enforcement agencies conduct extensive research to determine which areas, if any, are most frequently plagued with gunfire. Agencies should then ascertain whether the implementation of a gunshot sensor system is warranted. If the gunshot sensors are utilized and a reduction in gunfire is noted, law enforcement agencies should determine if displacement or diffusion has occurred. Additionally, agencies using gunshot sensors should partner with researchers/scholars to study the effectiveness of the technology. While the initial cost of these systems may appear high, this technology has the potential to have great impact on gunfire detection, suspect apprehension, officer and citizen safety, detection of forensic evidence, Homeland Security, recovery of illegal handguns and response time for emergency medical personnel. Gunshot sensory technology is an innovative and reliable way to report gunfire to law enforcement officers. While some concerns remain, gunshot reporting systems deserve serious consideration.

About the Authors: Ms. Fernicia Patrick is a graduate student at Radford University in Radford, VA. She can be reached at flpatrick@radford.edu.

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May 28, 2014

Chief Sean Baldwin
Fort Pierce Police Department
920 S US Highway 1
Fort Pierce, FL 34954

RE: Proposal ID# FTPIERCEFLB05282014

Dear Chief Baldwin,

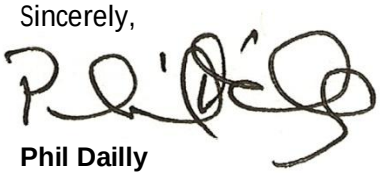
Thank you for the opportunity to provide you with this budgetary price proposal for the ShotSpotter Flex℠ Gunfire Alert and Analysis Service. Enclosed is our standard pricing, scope of work and terms.

SST customers boast ShotSpotter® capabilities as an effective force multiplier enabling them to efficiently use their resources to achieve reductions of gunfire and violent crime using our recommended best practices addressing tactics, techniques, and procedures in combination with our technology. Our goal is to provide you with tools to achieve this in the shortest amount of time.

SST is more than just a vendor of Gunshot Location Services. Our business approach is to be an agency partner. Working closely with many public safety and security agencies since 1995, we know firsthand what technology and complementary tactics, techniques, and procedures achieve results. Our experience and the courtroom-proven successes using ShotSpotter® data as evidence eclipse all other methods. SST delivers an encompassing solution to reducing gunfire and related violent crime and will be a critical data resource for your operations.

We stand ready to cooperatively work with you and the mission you serve.

Sincerely,



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Budgetary Price Proposal for a Subscription-Based ShotSpotter Flex℠ Gunfire Alert and Analysis Service

Proposal ID: FTPIERCEFLB05282014
Prepared on May 28, 2014
for: Fort Pierce Police Department

Submitted by:

Phil Dailly – Director, Southeast Region

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Introduction

SST is the industry leader in the development and delivery of innovative, interoperable inter networked wide area acoustic surveillance systems for gunfire detection, explosive events detection, enhanced critical infrastructure and key resource security, and counter sniper uses. With its mission of reducing illegal gunfire and related violent crime, and improving physical security solutions, SST services deliver situational intelligence that heightens the safety of first responders, public safety and military, and creates significant improvement in incident management, investigations and forensic analysis. SST's services are focused on improving public and community safety by ultimately helping reduce and prevent violent gun crime and improving intelligence led policing and community policing initiatives.

SST has established a proven track record of providing quality service to customers, worldwide, and is profitable and has solid financial backing.

Subscription-Based Gunfire Alert & Analysis Service

ShotSpotter Flex℠ is delivered in a subscription-based service model, making it more affordable and more easily deployed, and without the heavy up-front costs and IT resources and expenses of a traditional model of buying hardware and software licenses. For an annual subscription fee, agencies can now take advantage of crime-reducing features including: real-time location of gunfire, audio clips, reduced time-to-dispatch, and integration with video surveillance systems, among others. ShotSpotter Flex℠ also introduces Qualified Reviewed Alerts, a service that provides instant review and assessment of gunshot incidents by trained SST gunshot review experts. After SST review, valuable actionable incident data is passed to 9-1-1 dispatchers and Public Safety Answering Points (PSAPs) enabling faster and more accurate incident preparation and response.

ShotSpotter Flex's unique wide-area acoustic surveillance based system provides an effective and affordable method to detect, locate, respond to, and reduce gunfire throughout entire neighborhoods and communities. ShotSpotter Flex℠ is a solution that closely aligns with the challenges faced by public safety agencies and serves as a true and proven technology enabled force multiplier.

- A single affordable annual subscription fee aligns with the economic realities of agencies, communities, and available funding sources
- No cost to acquire, install, operate, and maintain … SST does it all
- Qualified Reviewed Alerts that pinpoint incidents allow personnel in 9-1-1 dispatch centers and PSAPs to make immediate and accurate dispatch and force response decisions
- Qualified Reviewed Alerts also provide otherwise unavailable situational intelligence that allows first responders to more safely approach and resolve active shootings

- Affordable coverage of larger areas enables agencies to address and reduce crime on a broader scale to permanently lower overall gunfire, homicides, and related violent crime throughout an entire community
- Scalable and extensible coverage areas
- Alerts to mobile consoles enable rapid responses while also increasing the overall efficiency of 9-1-1 operations
- Aggregated gunfire incident information is available for CompStat and forensic review
- Open interface to video surveillance and other complementary security systems
- Customer Experience Program promoting "best practices" and comprehensive training developed from ShotSpotter's large and diverse user community
- ShotSpotter is a *designated* and *certified* technology in accord with the Support Anti-terrorism by Fostering Effective Technologies Act of 2002 (the "SAFETY" Act)

SST Reviewer Alert Service

When ShotSpotter Flex detects gunfire, detailed incident data is rapidly within seconds sent to the SST Operations Center, our secure data processing and alert qualification facility. Immediately, a SST gunfire and acoustic expert analyzes the data, qualifies the incident and sends a validated alert to the dispatch center or other Public Safety Answer Points (PSAP) and even directly to mobile and field personnel. Qualified Alerts include critical situational awareness such as number of shots fired, shooter position, speed and direction of travel (of a moving shooter) and the exact time of gunfire.

The highly trained and specialized team of gunfire detection experts at the SST Operations Center has analyzed thousands of gunfire events captured by SST solutions. Their dedicated 24x7x365 expertise provides an instant assessment of all potential incidents, freeing up time that dispatchers and officers would otherwise spend analyzing alerts and giving agencies the level of data qualification they need to have complete confidence when dispatching based on alerts from ShotSpotter Flex. Drawing on their experience, SST experts are often able to add important situational intelligence to alerts, such as the possibility of multiple shooters and other critical data that can help personnel respond more safely and successfully.

Scope of Services

The purpose of this proposal is to provide pricing and corresponding terms and conditions for the procurement of the ShotSpotter Flex℠ subscription service offering including:

- Qualified reviewed alerts for gunfire
- Incident types (e.g., fireworks) that do not explicitly generate alerts will be logged and retained in the system's database, and as such will be available for reporting, analysis, and mining. In addition, the basic reports provided with the system will summarize gunfire and fireworks activity, even if (as an example) receipt of fireworks is disabled.
- Coverage area; footprint determined by customer requirement
- Sensor type(s) determined by SST or certified installer.
- SST hosted, secured, monitored and maintained infrastructure (server farm, storage, sensor networks)
- Allocation of Alert Consoles among different roles (call-taker, dispatcher, or mobile) is configurable at the discretion of the customer.
- Accessible and searchable alert history for two (2) years (additional years for a fee)
- One (1) Program Development and Subscription Orientation session
- Training Program that consists of: best practices, recommended TTPs, end-user documentation, administrator training and online end-user training
- High-level summary report and basic incident reports
- Reasonable support with Detailed Forensic Reports
- Standard customer support

Where possible, the system's acoustic sensors will be mounted on rooftops away from traffic. Where approved buildings are not available, or not an option, lamp poles or other suitable mounting locations will be considered provided they meet SST standards. All sites require 24hour by 365 day 100 to 240VAC, 50/60Hz power sources. Non-standard equipment required for system installation may require an additional fee and if so will be quoted accordingly. Should mounting locations be unavailable or should there be no sensor communications available at a site, SST will work with the customer to adjust the coverage area accordingly.

SST will be responsible for following all local, state and federal regulations, codes, rules and laws as it relates to the installation of the ShotSpotter Flex™ service.

The following table lists the combined responsibilities of SST and its customer with respect to the acquisition, installation, training, and ongoing use of a ShotSpotter Flex℠ service:

DELIVERABLES, ROLES, & RESPONSIBILITIES	SST	Customer
Execute contract	✓	✓
Program Development and subscription orientation	✓	assure stakeholder participation
Conduct Site Survey for Acoustic and sensor communications feasibility for each sensor location proposed emplacement. Site surveys will follow contract execution; the site survey will determine the ultimate coverage area footprint and area exclusions. Actual coverage areas may vary from cursory and pre-sales discussions due to challenges that include: physical obstructions, radio or cellular reliability, availability and permissions at suitable mounting location.	✓	
Provisioning of hosted services and corresponding access for admin, Alerts, additional and optional role-based support packages (if applicable)	✓	
Provide secure storage of customer data (minimum of 2 years online, 5 years offline)	✓	
Monitoring of systems for customer support and “hands off” software upgrades	✓	
Run the SST System Profiler (a web-based analyzer) to verify system configuration and network access required for each computer (PC or MDC) which will access the ShotSpotter Flex service.		✓
Provision network access required to meet SST minimum specifications and requirements (ref “Host and Services Required to Use ShotSpotter Flex Clients” SST FED-72-01) for all computers (PC and MDC) which will access the ShotSpotter Flex Service.		✓
Install Alert Consoles on allocated workstations	✓	IT assistance PC or MDC
Configure data communications between the Alert Console workstation(s) and the hosted server.	✓	IT assistance PC or MDC
Provide GIS Data: Parcels, Addresses, Beat Boundaries and clearly identify the coverage area(s) and reporting areas		✓
Install necessary SST assets (ie, sensors) and, as appropriate, provision telecommunications lines and/or RF data radios including antenna systems with adherence to local electrical, and other relevant codes	✓	

DELIVERABLES, ROLES, & RESPONSIBILITIES	SST	Customer
Provision data communications to mobile computers to support Alert Consoles in patrol cars, command vans, etc.		✓
Integrate with complementary systems (e.g., video surveillance, CAD, Common Operating Picture)	Optional API, support only	✓
System calibration, and operational validation	✓	
End-user training (including admin training)	✓	assure stakeholder participation
Ongoing Reviewed Alerts and customer support	✓	

Coverage Area(s)

Systems are deployed to provide a blanket of coverage for one or more specified areas. Each area is bounded by a specific *coverage area perimeter.* The area(s) to be covered are shown in the aerial map image below, with each *coverage area perimeter* denoted by a boundary line.

The areas outlined in the images are rough estimates of the requested coverage area(s) and are not exact as they cannot be verified with actual acoustic propagation information to determine the precise size(s) of each area (e.g., in square miles or square kilometers). This verification can only be accomplished during the installation process, therefore the shapes may vary. Additionally if there is a discrepancy between the identified area(s) as defined by the square mileage listed in the caption and the area(s) outlined in any aerial image, the size listed in the caption text shall take precedence and be considered the true size and therefore what SST shall maximally deploy.

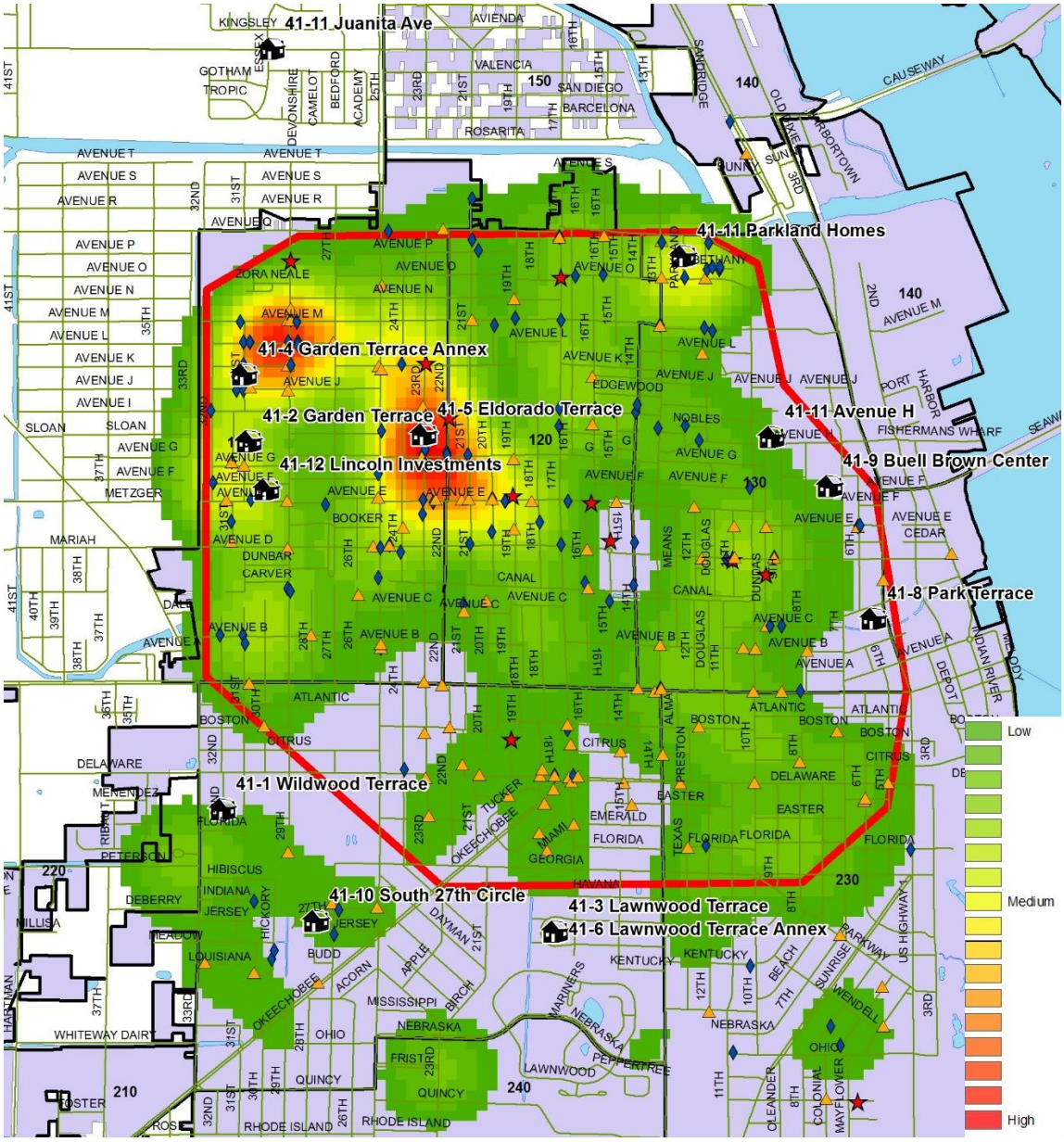

Figure 1: Proposed Coverage Area for ShotSpotter Flex

3.0 Square Miles (red outline)

Heat map represents Shots Fired calls from January 1, 2010 through February 25, 2012

Violent crimes include:

- ★ HOMICIDE
- ♦ AGG ASSAULT
- ▲ ROBBERY

The coverage area proposed would cover approximately 14.5% of the City's jurisdiction. This area represents 60% of the shots fired reported City-wide and 74% of the City's violent crimes.

Pricing, Terms, Conditions

The pricing provided is budgetary only and may be subject to change. Upon request, a formal binding quote will be submitted. A site survey may be required and performed to arrive at a final and binding price quote. The pricing provided remains valid for ninety (90) days from the date prepared (listed on the cover page). The price as listed herein does not include any state or local sales taxes. Customer is responsible for notifying SST if the price needs to be adjusted for sales taxes.

Price Schedule:

NON-RECURRING CHARGES:	
Service initiation and startup fee	$ 10,000 per Square Mile
Training – Strategic Program and Tactical Use	$ 10,000 per Account/Site
Heavy-duty wind-resistant sensor mounts	$ 10,000 per Square Mile
RECURRING CHARGES:	
Annual Subscription Fee (area ≥ 3.0 square miles)	$ 45,000 per Square Mile
DISCOUNTS:	
Prepaid 3-year Subscription for area ≥ 3.0 square miles (3 years paid in full, up front)	Waive Startup Fee
OPTIONAL NON-RECURRING CHARGES:	
Video Surveillance and/or PSIM Interface (does NOT include 3rd party middleware)	$ 19,000 per Account/Site

Budgetary Price Quotation:

Year 1 Non-Recurring Charges:

Service initiation and startup fee for 3.0 square miles (@$10,000/sq mi)	$ 30,000
Training – Strategic Program and Tactical Use (one-time charge)	$ 10,000
Heavy-duty wind-resistant sensor mounts (one-time charge @$10,000/sq mi)	$ 30,000
TOTAL NON-RECURRING CHARGES	$ 70,000

Year 1 Subscription Fee:

3.0 square mile coverage area (@$ 45,000/square mile)	$ 135,000
TOTAL YEAR 1 SUBSCRIPTION FEE	$ 135,000

Year 1 Total Fees:

Non-Recurring Charges	$ 70,000
1-year subscription for 3.0 square mile coverage area	$ 135,000
GRAND TOTAL YEAR 1	$ 205,000

Year 2 Total Fees (Optional Renewal):

Recurring 1-year subscription for 3.0 square mile coverage area	$ 135,000
GRAND TOTAL YEAR 2	$ 135,000

Year 3 Total Fees (Optional Renewal):

Recurring 1-year subscription for 3.0 square mile coverage area	$ 135,000
GRAND TOTAL YEAR 3	$ 135,000

Payment Terms

Payment for the service initiation and startup, all subscription fees, and any and all optional service fees shall be as follows:

- 50% of the Year 1 Total Fees due upon execution of agreement
- 50% of the Year 1 Total Fees due upon ShotSpotter Flex "live" status
- 100% of the Year 2 Total Fees due within one year after Flex "live" status
- 100% of the Year 3 Total Fees due within two years after Flex "live" status

Accompanying Exhibit

An exhibit specifying the item listed below is incorporated herein by reference and constitutes an integral part of this proposal. Unless specifically so-stated above, should there be any question of precedence between the exhibit and this proposal, then the exhibit, a single consolidated document shall be superior to the proposal itself. Items addressed within the consolidated document are:

- SST Flex℠ Service Agreement

SST, Inc. (also "ShotSpotter," "we," "us," or "our") and the end-user customer (also "Customer," "you" or "your") agree to the following Services and License Agreement and General Terms and Conditions (hereinafter, "Agreement").

The following Agreement is an essential part of the "Purchase Documents" (which term shall include this Agreement and all executed proposals and purchase orders, together with all attachments and appendices) under which you purchase ShotSpotter Gunshot Location services identified in the Purchase Documents and described herein ("Service"). Your access, or use of any part of the Service (and/or signature on the purchase order and/or agreement) shall constitute your representation that you have read all the terms and conditions of this Agreement, and your acceptance of them as an integral part of the Agreement and your purchase or order of the Service. If you do not agree to be bound by these terms and conditions, do not access or use any part of the Service.

1. SERVICES. In consideration of the parties' mutual undertakings set forth in the Purchase Documents and in this Agreement, you and we agree as follows:

For purposes of this Agreement, the Service shall consist of (i) providing access by the Customer to Reviewed Alerts delivered via a password-protected internet portal ("Alert Console") and user interface supplied by SST (together the Alert Console and interface shall be called the "Software") (ii) providing access to historical Reviewed Alerts and incident information via the Software; and (iii) other services as specified in the Purchase Documents.

Reviewed Alerts consist of data for gunfire incidents, detected by the ShotSpotter Gunshot Location System and reviewed by a SST incident reviewer employee (see Exhibit A).

SST will install or convert the ShotSpotter Gunshot Location System in the coverage area specified in the Purchase Document. SST will host the Service and may update the functionality and Software of the Service from time to time in its sole discretion and in accordance with this Agreement.

Except in the circumstances where a system has been previously purchased and is being converted, SST shall retain ownership of, and all rights to, all components of the ShotSpotter Gunshot Location System, including hardware components, Software and firmware. Under this Agreement the Customer is only licensing rights to access the incident information detected by the ShotSpotter Gunshot Location System.

2. LICENSE. The following sets forth the terms and conditions of your non-exclusive, non-transferable and terminable license to use the Service and Data (as those terms are defined herein).

This License creates important legal rights and obligations, so please read it carefully before using the Service. This License constitutes an offer by us to you. By manifesting electronically your assent to these terms, using the service, or by issuing a purchase order or signing a purchase agreement, you agree to be bound by the terms and conditions of this license. If you do not agree to be bound by the terms of this License, do not issue or execute a Purchase Document, or use the Service.

A. RIGHTS IN DATA. All Data created, generated, modified, compiled, stored, kept or displayed by SST through the Subscription Service in the course of providing the Subscription Service and related Services to Customer, remains the sole and exclusive property of SST . Subject to subparagraph (ii) below, SST expressly reserves the rights to copy, publish, display, adapt, modify, translate, perform publicly, make works derived from, transfer, sell, offer for sale, and to use any and all Data for any purpose. Notwithstanding the foregoing sentence and although SST owns the Data with respect to the Subscription Service, SST will provide reasonable notice if any Data to be released is specific forensic or law enforcement sensitive incident information – For discussion that may pertain to any active investigation or prosecution. At no time, either in a non-exclusive or exclusive data ownership, does SST release, sell, license, or otherwise distribute the gunfire alert Data to the press or media without the prior express consent, which shall not be unreasonably withheld.

If the customer purchases the exclusivity option, then SST will not distribute to any third party any Data related to or generated by ShotSpotter Gunshot Location System in Customer's coverage area, unless in response to a valid order or subpoena issued by a court or other governmental body, or as otherwise required by law.

SST expressly reserves the rights to copy, publish, display, adapt, modify, translate, perform publicly, make works derived from, transfer, sell, offer for sale, and to use any and all Data (including, without limitation, Reviewed Alerts) for any purpose, and to authorize, license, and sublicense others to do any or all of the same.

B. RESTRICTIONS. The Software and Data are our proprietary products, may incorporate components supplied to us under license by third-party suppliers, and may be protected by United States patent, trade secret, copyright law and international treaty provisions. All such rights in and to Software and Data and any part thereof are the property of us or our suppliers. By virtue of this License, you acquire only the right to use the Software and Data in accordance with this Agreement, but otherwise acquire no license, title or ownership rights, express or implied, in or to the Software or Data, or any right to use or practice any of our patents, copyrights, trademarks, or trade secrets, all of which rights are reserved expressly by us or our suppliers. You may not make any copies of the written materials or documentation that accompanied any component of the Software, or use them, or any other information concerning the Service that we have designated as confidential, for any purpose other than bona fide use of the Service or Software for the specific purposes contemplated herein, nor allow anyone else to do so. You shall not, without our express written consent, which

may be withheld or conditioned in our sole discretion: (i) modify, adapt, alter, translate, copy, perform or display (publicly or otherwise) or create compilations, derivative, new or other works based, in whole or in part, on the Software or Data, or on the Service; (ii) merge, combine, integrate or bundle the Software or the Data, in whole or in part, with other software, hardware, data, devices, systems, technologies, products, services, functions or capabilities; (iii) transfer, distribute, make available the Service, Data, or Software to any person other than the specific end-user customer identified to SST in the Purchase Documents, sell, resell, sublicense, lease, rent, or loan the Service, Data, or Software, in whole or in part, or (iv) provide use or permit operation of any of the Service, Software or Data by any person other than the original end- user customer designated in the Purchase Documents, nor in or through any application service provider, service bureau, rental or time-sharing arrangement; (v) disassemble, decompile, or otherwise reverse engineer or attempt to reconstruct, derive, or discover, any source code, underlying ideas, algorithms, formulae, routines, file formats, data structures, programming, routines, interoperability interfaces, drawings, or plans from the Data or Software, or any data or information created, compiled, displayed, or accessible through the System, in whole or in part; or (vi) remove, modify or obscure any identification or proprietary or restrictive rights markings or notices from the Data, Software or any component thereof.

SST and its licensors retain all ownership of all intellectual property rights in and to all Data, Software, all computer programs, related documentation, technology, knowhow and methods and processes embodied in or made available to you in connection with the Service, including, without limitation, all patent rights, copyrights, trade secret rights, trademarks and service marks. All rights not expressly granted to you herein are reserved by SST. You shall take all reasonable measures to protect SST's intellectual property rights in the Service and Software, including providing assistance and measures as are reasonably requested by SST from time to time.

You are hereby placed on notice that alteration or removal of copyright management information (including, without limitation, licensor's name and other identifying information, name of the Service, the terms and conditions of this License, and identifying numbers or symbols) embodied in or associated with the Service is prohibited, because such conduct may cause others to infringe our rights in and to the system, Service and/or Software. You may also not obscure or remove any confidentiality, patent, trademark or copyright notices on any component of the Service, or any documentation.

C. TERMINATION. You agree that your right to use the Service, Software and Data will terminate automatically if you violate any of the terms of this License, or fail to timely pay any sums you owe to us or resellers or integrators of our Service, or fail to renew the Service upon expiration of the Service term. In the event of termination, your access to the Data and Software will be terminated, and SST will cease delivering Reviewed Alerts, and disable your access to the Data. Customer agrees that SST shall not be liable to Customer nor to any third party for any suspension of the Service resulting from Customer's nonpayment of fees as described in this section.

D. MODIFICATION TO OR DISCONTINUATION OF THE SERVICE. SST reserves the right at any time and from time to time to modify, temporarily or permanently, the Service (or any part thereof). In the event that SST modifies the Service in a manner which removes or disables a feature or functionality on which Customer materially relies, SST, at Customer's request, shall use commercially reasonable efforts to restore such functionality to Customer. In the event that SST is unable to substantially restore such functionality, Customer shall have the right to terminate the Agreement and receive a pro-rata refund of the annual Service fees paid under the Agreement for use of the Service which was paid for by Customer but not yet furnished by SST as of the date of such termination. Customer acknowledges that SST reserves the right to discontinue offering the Service at the conclusion of Customer's then current term. Customer agrees that SST shall not be liable to Customer or to any third party for any modification of the Service as described in this section.

E. OTHER RESTRICTIONS. You acknowledge and agree that the source code and internal structure of the Software, Data and Service, as well as documentation, operations manual and training material are our confidential property, and trade secrets, the value of which would be destroyed by disclosure to the public. Use by anyone other than you of the Service, documentation, and Data is prohibited, unless pursuant to a valid assignment under this Agreement.

3. LIMITED EXCLUSIVE WARRANTY. Provided that you comply with your obligations under the terms and conditions stated herein, we warrant that the Software (as defined herein) will be free of defects in workmanship which materially impair the functioning of the Service and Software in substantial conformity with the specifications documentation accompanying the Service.

The Software covered under this limited exclusive warranty consists exclusively of ShotSpotter Alert Console software and user interface, installed and operated locally on customer's computers and devices supplied by SST for your use by on and in connection with a ShotSpotter System, subject to the terms and conditions of the License between you and us.

A. REVIEWED ALERT SERVICE LEVELS. As regards to sonic event review and alert services, subject to the Customer's compliance with its obligations hereunder, and to the disclaimers and limitations set forth in Exhibit A, and in Sections 5(C), 6, 7, 13 and 15 of this Agreement, we agree to provide the service levels set forth in Exhibit A, attached hereto.

B. SYSTEM CONFIGURATION AND SERVICE LEVELS.

As regards to System configuration, subject to the Customer's compliance with its obligations hereunder, and to the disclaimers and limitations set forth in Exhibit B, and in Sections 5(C), 6, 7, 13 and 15 of this Agreement, we agree to provide the service levels set forth in Exhibit B, attached hereto.

C. OTHER WARRANTY. SST warrants that the Service, Data and Software shall be free of viruses, Trojan horses, worms, spyware, or other malicious code or components.

The limited exclusive warranties expressly set forth in this Agreement are the only warranties made to you and are provided in lieu of any other warranties (if any) created by any documentation or packaging, or otherwise express or implied. These limited exclusive warranties give you specific legal rights, and you may also have other rights which vary by jurisdiction.

4. SST SUPPORT. During the term of the Services, SST will make commercially reasonable efforts to promote Customer's successful utilization of the Service, including but not limited to providing Customer with user guides, online help, online training presentation, and online training sessions (as available). SST will provide reasonable efforts to respond via email to requests for support relating to incident classification within 8 hours of the request.

In addition, SST will use commercially-reasonable efforts to respond to other support requests within 24 hours of receipt of the request during the period of 8am to 5 pm Monday through Friday. The e-mail support specialist shall be responsible for receiving Customer reports of missed incidents, or errors in the Service, and, to the extent practicable over email or telephone, making commercially-reasonable efforts to assist the Customer in resolving the Customer's reported problems. In the event the problem cannot be resolved telephonically, then SST will use commercially-reasonable efforts to restore functionality of the Service to Service specifications within 72 business hours of receipt of the report.

A. FORENSIC REPORTS. SST, at the specific request of the customer, will produce and provide a reasonable quantity of detailed incident forensic reports for any ShotSpotter detected incidents, including Reviewed Alerts, if such information is deemed by the customer to be valuable to the customer for investigation follow-up, prosecutorial requirements, or after action review.

Such reports must be requested a minimum of 5 days in advance of when needed, and all such requests must be in writing and addressed to the SST Customer Service Department. Customer should expect delivery of these reports within 5 days after receipt of the request. This benefit shall only be available to Customer if Customer is fully current with payments due under this Agreement. In the case that Customer is not current with their payments, then forensic reports shall not be generated nor provided to Customer until Customer becomes current with its payment obligations.

B. EXPERT WITNESS SERVICES. SST offers reasonable expert witness services. The Customer will be responsible for all travel and per diem reimbursement. At the specific request of the customer, SST will provide individual(s) for the purposes of expert witness testimony for any ShotSpotter detected incidents, including Reviewed Alerts, for which the incident information is deemed by the customer to be valuable to the customer's prosecutorial requirements. Customer understands that SST undertakes to provide individuals whose qualifications are sufficient for such services, but does not warrant that any person or his or her opinion will be accepted by every court. SST requires at least fourteen (14) days prior notice of such a requirement in writing from the Customer. Customer must include dates, times, specific locations and a point of contact for SST personnel. Due to the nature of legal proceedings, SST cannot guarantee that its services described in this section shall produce the outcome, legal or otherwise, which Customer desires. Payment for expert witness services described shall be due and payable when services are rendered regardless of the outcome of the proceedings.

5. TERM, RENEWAL

A. TERM AND COMMENCEMENT. The Service term shall be specified in the Purchase Document and will commence on the date that the Service is available to the Customer via the Alert Console.

B. RENEWAL. The Service may be renewed for successive periods of one year each, in accordance with the following procedure. Not later than thirty (30) days prior to the expiration of the Service term then in effect, Customer shall issue a purchase order and tender payment in full for the next annual renewal (unless otherwise agreed in writing by SST), and the term shall be renewed for another year. SST shall provide Customer with renewal fees, terms and conditions for the next successive renewal term upon Customer's request but no later than 90 days from the expiration date. Customer acknowledges that the Service fees, terms and conditions and service levels hereunder are subject to change and that such fees, terms and conditions, and service levels may vary from those applicable to this Agreement in successive renewal terms.

If Customer fails to renew in a timely manner and hence allows the Service term to expire then the Service will terminate in accordance with Section 2. C. At its discretion, SST may remove the ShotSpotter Gunshot Location System and any components from the coverage area at that time. If SST does not remove the ShotSpotter Gunshot Location System from the coverage area, Customer may reinstate the Service at a later date by renewing, however Customer will not have access to any Reviewed Alerts that they would have had access to during the lapsed period.

C. COMMERCIAL CARRIER DATA SERVICES. The ShotSpotter Gunshot Location System may use wired, wireless or cellular wireless acoustic sensor communications which necessitates the existence of a real-time data communications channel from each sensor to the hosted servers via a commercial carrier. The unavailability or deterioration of the quality of such wired, wireless or wireless cellular communications may impact the ability of SST to provide the Service. In such circumstances SST will use commercially reasonable efforts to obtain alternate wired or wireless cellular communications or adjust the coverage area as necessary. In the event SST is unable to do so, SST will terminate the Service and refund a pro-rata portion of the annual Service fee to Customer.

6. IP INFRINGEMENT; EXCLUSIVE REMEDY. Subject to the terms and conditions hereof, SST agrees to defend and indemnify Customer (provided it is the actual End-user Customer of the Service) from and against losses, suits, damages, liability and expenses (including reasonable attorney fees) arising out of a claim asserted in a lawsuit or action against the end-user customer by a third party unrelated to the customer, in which such third party asserts a claim that the Service and/or Software, when used in accordance with SST's specifications and for the purposes intended, infringes any United States patent which was issued by the U.S. Patent and Trademark Office, or United States copyright which was registered by the U.S. Copyright Office, as of the effective date of Customer's agreement to purchase the ShotSpotter Flex System.

Provided, however, that SST shall have the right to choose counsel to defend such suit and/or action, and to control the settlement (including determining the terms and conditions of settlement) and the defense thereof, and that Customer shall provide SST with reasonably prompt written notice of any such suit or action, and of any oral, written or other communication or other information or circumstances of which Customer becomes aware that could reasonably be expected to lead to such a suit or action (including any and all cease and desist demands or warnings, and offers or invitations to enter license agreements), and shall provide SST all reasonable assistance and information in connection with SST's investigation and defense of any claim of infringement.

Further provided, however, that this section shall not apply and SST shall have no obligation to defend and indemnify Customer in the event the Customer or a reseller, integrator, service provider or supplier modifies, alters, substitutes, or supplements any of the Service, or Software, or to the extent that the claim of infringement arises from or relates to the integration, bundling, merger or combination of any of the same with other hardware, software, systems, technologies, or components, functions, capabilities or applications not licensed by SST as part of the Service, nor shall it apply to the extent that the claim of infringement arises from or relates to meeting or conforming to any instruction, design, direction or specification furnished by the Customer, nor to the extent that the Service or Software are used for or in connection with any purpose, application or function other than detecting and locating gunshots exclusively through acoustic means.

If, in SST's opinion, the Service, or Software may, or is likely to become, the subject of such a suit or action, does become the subject of a claim asserted against a customer in a lawsuit which SST is or may be obliged to defend under this section, or is determined to infringe the foregoing patents or copyrights of another in a final, non-appealable judgment subject to SST's obligations under this section, then SST may in full and final satisfaction of any and all of its obligations under this section, at its option: (1) procure for Customer the right to continue using the affected Service or Software, (2) modify or replace such Service or Software to make it or them non-infringing, or (3) refund to the purchaser a pro-rata portion of the annual Service price paid for the Service System

The foregoing section states the entire liability of SST and customer's and its suppliers' exclusive remedy for or relating to infringement or claims or allegations of infringement of any patent, copyright, or other intellectual property rights in or to the system, system components, and software. This section is in lieu of and replaces any other expressed, implied or statutory warranty against infringement of any and all intellectual property rights.

7. LIMITED WARRANTIES EXCLUSIVE; DISCLAIMERS *IMPORTANT; PLEASE READ CAREFULLY*

To the maximum extent permitted by applicable law, the limited warranties expressly set forth above are exclusive, and in lieu of all other warranties, whether written, oral, express, implied or statutory. There are no warranties that extend beyond those expressly set forth herein, and no prior statements, representations, or course of dealing by any SST representatives shall vary, expand or modify these warranties.

To the maximum extent permitted by applicable law, all other representations or warranties, express, implied, or statutory, including without limitation, any warranties of non-infringement, quality, suitability, merchantability, fitness for a particular purpose or otherwise of any services or

any goods provided incidental to the services provided under this agreement are hereby expressly disclaimed and superseded by the exclusive limited express warranty and disclaimers set forth herein.

Without limiting the generality of the foregoing limitations and disclaimers, while the Service is not designed, sold, or intended to be used to detect, intercept, transmit or record oral or other communications of any kind, SST cannot control how the Service is used, and, accordingly, SST does not warrant or represent, expressly or implicitly, that use of the Service will comply or conform to the requirements of federal, state or local statutes, ordinances and laws, or that use of the Service will not violate the privacy rights of third parties. You shall be solely responsible for using the Service in full compliance with applicable law and the rights of third persons.

Further, regardless of any prior statements, representations, or course of dealings by any SST representatives, we do not warrant or represent, expressly or implicitly, that the Service or its use will: result in the prevention of crime or hostile enemy action, apprehension or conviction of any perpetrator of any crime, military prosecution of any enemy force, or detection or neutralization of any criminal, combatant or threat; prevent any loss, death, injury, or damage to property due to the discharge of a firearm or other weapon; in all cases result in a Reviewed Alert for all firearm discharges within the designated coverage area;; or that the SST-supplied network will remain in operation at all times or under all conditions.

SST expressly disclaims, and does not undertake or assume any duty, obligation or responsibility for any decisions, actions, reactions, responses, failure to act, or inaction, by Customer as a result of or in reliance on, in whole or in part, any Services or Reviewed Alerts provided by SST, or for any consequences or outcomes, including any death, injury, or loss or damage to any property, arising from or caused by any such decisions, actions, reactions, responses, failure to act, or inaction. It shall be the sole and exclusive responsibility of the Customer to determine appropriate decisions, actions, reactions or responses, including whether or not to dispatch emergency responder resources. The Customer hereby expressly assumes all risks and liability associated with any and all action, reaction, response, and dispatch decisions, and for all consequences and outcomes arising from or caused by any decisions made or not made by the Customer in reliance, in whole or in part, on any Services provided by SST, including any death, injury, or loss or damage to any property.

Any and all warranties, express or implied, of fitness for high risk purposes requiring fail-safe performance are hereby expressly disclaimed.

You and we each acknowledge and agree that the Service is not a consumer good, and is not intended for sale to or use by or for personal, family or household use.

8. YOUR OBLIGATIONS. You acknowledge and agree that SST's duties, including warranty obligations, and ability to perform its obligations to you shall be predicated and conditioned upon your timely performance of and compliance with your obligations hereunder, including, but not limited to:

A. You agree to pay all sums due under the purchase agreement or order as and when they are due pursuant to the terms of such agreement or order. Actual access and use of the SST Service shall constitute evidence that the Service is active and the final payment is due.

B. You agree to use your best efforts to timely perform and comply with all of your obligations allocated to you in the Purchase Documents and/or other contract documents, including, without limitation, provisions regarding assisting SST in obtaining sensor site permissions from premises owners or lessors, in locations reasonably acceptable to SST, which obligations are incorporated by reference and made a part hereof. Unless the Statement of Work or other contract documents signed by SST allocates such obligations to SST expressly, customer shall be responsible for securing from premises owners or lessors all rights necessary to enter onto their premises to install sensors, and to place, operate and maintain such sensors on such premises. SST's duties, including warranty obligations to you shall be predicated and conditioned upon your timely performance of and compliance with your obligations set forth herein, and in the Purchase Documents.

C. You shall not permit any alteration, modification, substitution or supplementation of the SST Service or web portal, or the combining, connection, merging, bundling, or integration of the SST Service or web portal into or with any other system, equipment, hardware, software, technology, function or capability, without our prior written consent.

D. Unless otherwise expressly agreed in advance in writing by SST, you shall not resell, transfer, distribute or allow access to the Service or web portal or any portion thereof, to any person other than the specific end-user previously identified to SST in the Purchase Documents, and shall not authorize or appoint any contractors, subcontractors, original equipment manufacturers, value added integrators, systems integrators or other third parties to operate, have access to, or sublicense the Products.

E. Customer Must Have Internet Access. In order to use the Service, Customer must have or must obtain access to the World Wide Web to enable a secure https connection from the customers work station to SST's hosted services. , either directly or through devices that access Web-based content. Customer must also provide all equipment necessary to make such (and maintain such) connection.

F. Passwords and Access. Customer may designate up to the number of users under Customer's account which corresponds to the access required by assigning unique passwords and user names. Customer will be responsible for the confidentiality and use of Customer's password and user names, and agrees that sharing passwords and/or user names with unauthorized users is prohibited.

G. You shall comply with all applicable laws, rules and regulations relating to the goods and services provided hereunder.

9. INTELLECTUAL PROPERTY RIGHTS; LIMITED LICENSE. We or our licensors retain all ownership of all intellectual property rights in and to all data, software, computer programs, related documentation, technology, knowhow and processes embodied in or made available to you in connection with the Service, and Software, including, without limitation, all patent rights, copyrights, trade secret rights, trademarks and service marks. Your rights to install and use the Data and Software are limited, and shall be strictly in accordance with the License set forth in Section 2 hereof. Any and all rights not granted expressly in such License are hereby reserved.

10. EXPORT CONTROL. You acknowledge that the ShotSpotter Flex System is the subject of a Commodity Jurisdiction determination by the United States Department of State, and has been determined to be a controlled commodity, software and/or technology subject to the United States Export Administration Regulations of the U.S. Department of Commerce. Accordingly, no part of the Data, Software, ShotSpotter Flex System or any GLS System component thereof may be transferred, consigned, shipped, delivered, received, exported or re-exported, nor may any technical data directly relating to any of the same or the underlying information or technology be disclosed, downloaded, uploaded, transmitted, received, furnished, or otherwise provided, to, by or through any person, government, country, or to any end-user, or for any end-uses, except in compliance with applicable U.S. export control laws administered by the U.S. Government, and any other applicable U.S. laws, including the sanctions laws administered by the U.S. Department of Treasury, Office of Foreign Assets Control (OFAC), the U.S. Anti-Boycott regulations, and any applicable laws of your country. In this respect, no resale, transfer, or re-export of any ShotSpotter Flex System exported to you pursuant to a license from the U.S. Department of Commerce may be resold, transferred, or reported without prior authorization by the U.S. Government. Customer agrees not to export, re-export or engage in any "deemed export," or to transfer or deliver, or to disclose or furnish, to any foreign (non- U.S.) government, foreign (non-U.S.) person or end-user, or to any U.S. person or entity, any of the ShotSpotter Flex System, GLS System components, Data, Software, Services, or any technical data or output data or direct data product thereof, or any service related thereto, in violation of any such restrictions, laws or regulations, or without all necessary registrations, licenses and or approvals. Unless otherwise agreed and so specified in the Purchase Documents, you shall obtain and bear all expenses relating to any necessary determinations, registrations, licenses and/or exemptions with respect to its exportation, re- exportation or "deemed export" of the ShotSpotter Flex System, Data, Software or any GLS System Components or Services, as well as with respect to the disclosure or furnishing of any technical data or other information and services relating to any of the same.

In addition to compliance with the foregoing, and without limiting the generality thereof, Customer shall not disclose, discuss, download, ship, transfer, deliver, furnish, or otherwise export or re-export any such item(s) to or through: (a) any person or entity on the U.S Department of Commerce Bureau of Industry and Security's List of Denied Persons or Bureau of Export Administration's anti- proliferation Entity List; (b) any person on the U.S. Department of State's List of Debarred Parties; (c) any person or entity on the U.S. Treasury Department Office of Foreign Asset Control's List of Specially Designated Nationals and Blocked Persons; or (d) any other end-user or for any end-use prohibited by law or regulation, as any and all of the same may be amended from time to time, or any successor thereto.

11. PROTECTION OF CONFIDENTIAL INFORMATION. Unless either party (the "Receiving Party") obtains prior written consent from the other (the "Disclosing Party"), the Receiving Party agrees that it will not reproduce, use for purposes other than those expressly permitted herein, disclose, sell, license, afford access to, distribute, or disseminate any information: i) obtained from the Disclosing Party in connection with the System purchase, installation or operation, and designated by it from time to time as confidential; ii) the documentation, use and operations manuals; and output data created or compiled by the ShotSpotter Flex System; iii) your use of the ShotSpotter Flex System or technology, your deployment methodology, results, or related facts; iv) the contractual terms and payment terms applicable to the purchase of the ShotSpotter Flex System or technology, except as required by local law (collectively, "Confidential Information") Unless a section of the Purchase Document(s) specifically identifies the identity of Customer as Confidential Information, the fact that Customer is a customer of SST shall not itself be

considered Confidential Information, nor shall the name of any city in which the ShotSpotter GLS System is deployed be considered confidential information. Recipient's obligations under this section shall not apply to any of Discloser's Confidential Information that Recipient can document: (a) was in the public domain at or subsequent to the time such Confidential Information was communicated to Recipient by Discloser through no fault of Recipient; (b) was rightfully in Recipient's possession free of any obligation of confidence at or subsequent to the time such Confidential Information was communicated to Recipient by such Discloser; (c) was developed by employees or agents of Recipient independently of and without reference to any of Discloser's Confidential Information; or (d) was communicated by Discloser to an unaffiliated third party free of any obligation of confidence. A disclosure by Recipient of any of Discloser's Confidential Information (a) in response to a valid order by a court or other governmental body; (b) as otherwise required by law; or (c) necessary to establish the rights of either party under this Agreement shall not be considered to be a breach of this Agreement by such Recipient; provided, however, such Recipient shall provide prompt prior written notice thereof to such Discloser to enable Discloser to seek a protective order or otherwise prevent such disclosure. Receiving Party shall use reasonable controls to protect the confidentiality of and restrict access to all such Confidential Information to those persons having a specific need to know the same for purposes expressly authorized herein, and render unreadable prior to discarding, all records containing our Confidential Information. In any event such controls shall not be less protective than those Receiving Party uses to secure and protect its own confidential, but not "Classified" or otherwise Government-legended, information.

12. NOTICES. Any notice or other communication required or permitted to be given under this Agreement shall be in writing at such party's address or number or at such party's last known address or number. The party's addresses may be changed by written notice to the other party as provided herein.

13. FORCE MAJEURE. In no event shall SST be liable for any delay or default in its performance of any obligation under this or any other agreement caused directly or indirectly by an act or omission of Customer, or persons acting under its direction and/or control, fire, flood, act of God, an act or omission of civil or military authority of a state or nation, strike, lockout or other labor disputes, inability to secure, delay in securing, or shortage of labor, materials, supplies, transportation, or energy, failures, outages or denial of services of wireless, power, telecommunications, or computer networks, acts of terrorism, sabotage, vandalism, hacking, natural disaster or emergency, war, riot, embargo or civil disturbance, breakdown or destruction of plant or equipment, or arising from any cause whatsoever beyond SST's reasonable control. At SST's option and following notice to Customer, any of the foregoing causes shall be deemed to suspend such obligations of SST so long as any such cause shall prevent or delay performance, and SST agrees to make and Customer agrees to accept performance of such obligations whenever such cause has been remedied.

14. DEFAULT; REMEDIES. Upon the occurrence of any default by or breach of your obligations, we may at our option, effective immediately, either: (i) terminate our future obligations under this agreement, terminate your License to use the Service and Software, or (ii) accelerate and declare immediately due and payable all remaining charges for the remainder of the agreement and proceed in any lawful manner to obtain satisfaction of the same. In either case, you shall also be responsible for paying court costs and reasonable attorneys' fees incurred by or on behalf of us, as well as applicable repossession, shipping, repair and refurbishing costs.

15. LIMITATIONS ON LIABILITY. In no event shall either party, or any of its affiliates or any of its/their respective directors, officers, members, attorneys, employees, or agents, be liable to the other party under any legal or equitable theory or claim, for lost profits, lost revenues, lost business opportunities, exemplary, punitive, special, or consequential damages, each of which is hereby excluded by agreement of the parties, regardless of whether such damages were foreseeable or whether any party or any entity has been advised of the possibility of such damages.

In any event, except for its IP infringement indemnity obligations under section 6 hereof, SST's cumulative liability for all losses, claims, suits, controversies, breaches or damages for any cause whatsoever (including, but not limited to, those arising out of or related to this agreement) and regardless of the form of action or legal theory shall not exceed two times the amount paid to SST under this agreement, or the amount of insurance maintained by SST available to cover the loss, whichever is greater. The foregoing limitations shall apply without regard to any failure of essential purpose of any remedies given herein.

16. GENERAL PROVISIONS.

A. NO AGENCY. Neither SST nor any of its employees is an agent or representative of Customer and the Customer is solely responsible for obtaining any required authorizations from any governmental agency, body or commission and for compliance therewith.

B. COMPLIANCE WITH LAWS AND TAXES. You shall comply with all applicable laws, statutes and regulations relating to the sale, distribution, and use of the Service and the performance of your duties and obligations

hereunder. All prices are exclusive of all tariffs, customs duties, imposts, national, federal, provincial, state, and local VAT, excise, sales, use and similar taxes. You will be pay and be responsible for paying any and all such taxes and tariffs, when applicable.

C. EQUAL OPPORTUNITY CONTRACT CLAUSE. SST is committed to the provisions outlined in the Equal Opportunity Clauses of Executive Order 11246, (41 CFR 60-1.4), section 503 of the Rehabilitation Act of 1973, (41 CFR 60-741.5(a)), section 402 of the Vietnam Era Veterans Readjustment Act of 1974, (41 CFR 60-250.5(a)), and, the Jobs for Veterans Act of 2003, (41 CFR 60-300.5(a)) as well as any other regulations pertaining to these orders.

D. SEVERABILITY AND INTERPRETATION. If any provision, in whole or in part, of this Agreement and/or the Purchase Documents of which it is a part is held invalid or unenforceable for any reason, the invalidity shall not affect the validity of the remaining provisions, and there shall be substituted for the invalid provision a valid provision which most closely approximates the intent and economic effect of the invalid provision. No part or provision shall be interpreted in favor or against any party because such party or its counsel drafted the relevant provision. No course of dealing, usage, custom of trade, or communication between the parties shall modify or alter any of the rights or obligations of the parties under this Agreement and Purchase Document(s).

E. INTEGRATION, AMENDMENT AND WAIVER. This Agreement, and the Purchase Document(s) of which it is a part, together with any other exhibits or appendices thereto, constitute the entire understanding between SST and you. No other documents or representations shall be used in interpreting it. Any and all written or oral agreements heretofore existing between the parties are expressly cancelled and/or superseded. Any other document, proposal, specification, statement of work, marketing collateral, or representation which may vary, alter, amend or supplement these terms and conditions will not be binding unless agreed to in a writing signed by appropriate representatives of both SST and Customer. No modification, variance, amendment or waiver of any part of Agreement or Purchase Document(s) shall be binding upon either party, whether written, oral, or in any other medium, unless made in writing and signed by authorized representatives of both parties. All the parties' rights and duties are material and time is of the essence; no waiver of any rights hereunder shall be deemed effective unless in writing executed by the waiving party; no waiver of either party's breach of any provision of this Agreement or Purchase Documents shall constitute a waiver of any prior or subsequent breach of the same or any other provision, and no failure to exercise, and no delay in exercising, any right(s) hereunder on either party's part shall operate as a waiver of any such right; all of the parties' rights are cumulative; and, no single or partial exercise of any right hereunder shall preclude further exercise of such right or any other right.

F. BENEFIT AND BURDEN; ASSIGNMENT. Subject to the following provisions, this Agreement and the Purchase Documents of which they are a part shall be binding upon permitted successors and assigns and shall inure to the benefit of the parties and their respective permitted successors and assigns only. Notwithstanding that the Service and Software, and its output data may be used for law enforcement, military, public safety, and force protection purposes, there are no third party beneficiaries intended to benefit from these general terms and conditions of sale, or the agreement or order of which they are a part. Customer may not assign or transfer this Agreement and the Purchase Documents of which they are a part, or any of the rights granted therein, in whole or in part, by operation of law or otherwise, without SST's express prior written consent. SST may assign or transfer this Agreement and the Purchase Documents and/or SST's rights and obligations hereunder, in whole or in part, to any third party without the necessity of obtaining Customer's consent. No assignee for the benefit of Customer's creditors, custodian, receiver, trustee in bankruptcy, debtor in possession, sheriff or any other officer of a court, or other person charged with taking custody of Customer's assets or business, shall have any right to continue or to assume or to assign these without SST's express consent.

G. GOVERNING LAW AND DISPUTE RESOLUTION. The validity, performance, and construction of this agreement shall be governed by the laws of the laws of the State of California, without giving effect to the conflict of law principles thereof. The United Nations Convention on Contracts for the International Sale of Goods is expressly disclaimed and shall not apply. If the parties disagree as to any matter arising under this Agreement or the relationship and dealings of the parties hereto, then SST and Customer shall promptly consult with one another and make diligent, good faith efforts to resolve the disagreement, by negotiation. Should the dispute not be resolved within a reasonable time after commencement of such negotiations, it shall be mediated before one or more mediators mutually acceptable to both parties. Costs of mediation will be allocated as part of the resolution in mediation, but absent such resolution, shall be paid equally by the parties. If such effort is unsuccessful, any controversy or claim arising out of or relating to this Agreement or the validity or breach of any of the provisions thereof, or the relationship, dealings, rights, and obligations of the parties, or use of the Service, shall be settled by binding arbitration, before three arbitrators, in or as near as possible to Newark, California, United States of America, or in such other location as the parties may agree, in accordance with the Commercial Rules of the American Arbitration Association in effect on the date of this agreement. Such arbitration shall be conducted before

three arbitrators. The parties acknowledge and agree that this agreement involves a commercial transaction in commerce and that arbitration and award hereunder shall be governed by the federal Arbitration Act. Judgment upon the award rendered by the arbitrator(s) may be entered in any court having jurisdiction thereof. In addition to any other remedies to which it may be entitled, the prevailing party shall be entitled to recover its reasonable attorneys' fees and costs (including expert witness fees and costs) incurred in connection with enforcing its rights or defending itself.

All parties hereby irrevocably waive any and all rights they may have to a trial by jury in any judicial proceeding involving any claim relating to or arising under this agreement or any other agreement between the parties hereto.

EXHIBIT A - Reviewed Alert Service Levels

The ShotSpotter Flex System detects loud impulsive incidents, classifies them as gunfire, fireworks, or other, and sends them to the SST Incident Review Center. Within 15 seconds of receiving the incident audio download, SST review personnel will begin analysis of the incident, which will include observing sensor audio wave files and listening to sensor audio. The outcome of this review is intended to confirm or change the System's classification of the incident type, and, depending on the reviewer's confidence level that the incident is or may be gunfire, will result in an alert ("Reviewed Alert") sent to the Customer's Alert Console, based on the following criteria:

Incident Type	Action
High confidence incident is gunfire	Reviewed Gunfire Alert sent to Customer Alert Console
Uncertain if incident is gunfire or not	Reviewed Possible Gunfire Alert sent to Customer Alert Console
Low confidence incident is gunfire	No alert will be sent; incident available for customer review in the incident history available through the Customer Alert Console

Reviewed Alerts are sent to the Customer Alert Console. Information in a Reviewed Alert will include the location of the incident, the reviewer's qualitative assessment of the confidence level that the incident is or may be gunfire, along with other pertinent information and data.

Specifically, information provided in a Reviewed Alert may include any or all of the following:

- "Dot on the map" and closest parcel address denoting the location of the incident
- Qualitative Confidence that the incident is gunfire: High or Uncertain
- Qualitative Severity: Single shot, multiple shots, drive by shooting, full automatic
- Comments (if any)

The majority of incidents will be processed within 45 seconds of the System notifying the SST Incident Review Center of an incident and 90% of the incidents will be processed in less than 60 seconds. In the unlikely event that the review center loses connection to the hosting facility or the review center is unable to process the incident within approximately 60 seconds for some reason, the system will automatically route unreviewed incidents directly to the customer based on the systems classification of the incident. In the event the reviewed incident data reveals information that will aid in responder situational awareness, SST may (but is not obligated to) include this information as Comments in the Reviewed Alert.

During major holidays such as in the case of New Years Eve, Independence Day, and Cinco de Mayo, most communities experience a large increase in firework activity. During these periods, usually at least 48 hours in advance of the holiday, during the holiday and 48 hours following the holiday, SST will put the system into fireworks suppression mode so that the reviewers can focus their response to incidents classified as gunfire. SST will inform the customer prior to the system being placed in fireworks suppression mode and when fireworks suppression mode is disabled. The actual timing of fireworks suppression mode being active is determined by the review center based on the level of fireworks being discharged. While in fireworks suppression mode, fireworks incident alerts are not sent to the reviewer nor the customer alert console, however all firework incidents continue to be stored in the data base should any of this information be needed at a later time.

The purpose of the Reviewed Alert Service is to provide incident data to the Customer, reviewed, analyzed and classified in the manner described above, in situations where the analyst's qualitative confidence that an incident is or may be gunfire meets the criteria set forth above. However, it is the sole responsibility of the Customer to interpret the data provided, and to determine any appropriate follow-up reaction or response, including whether or not to dispatch emergency responder resources based on a Reviewed Alert. SST does not undertake any obligation, duty or responsibility for reaction, response, or dispatch decisions, which are solely and exclusively the responsibility of Customer, or for the consequences or outcomes of any decisions made or not made by the Customer in reliance, in whole or in part, on any services provided by SST.

The Incidents & Reports Portal provides the Customer with full and immediate access to all incident history including the same information SST uses in its internal review process. This information includes, among other things, the initial incident classification and any reclassifications of an incident, incident audio wave forms, and incident audio files. This enables the Customer to perform its own incident reviews and run various reports. This data access is available as long as the Customer is under active subscription.

EXHIBIT B - System Configuration and Service Levels

SST will deploy or have deployed a ShotSpotter Flex system over the agreed upon coverage area. The system will be designed to detect at least 80% of the unsuppressed outdoor gunfire, with a location accuracy to the shooter's location within 25 meters, after sensor calibration. These performance levels are predicated on the deployment of sensors at all such sites, the foregoing performance levels may be compromised.

The sensors send incident information to a server in a SST hosting facility via third party cellular, wireless or wired networks. SST is not responsible for outages on the third party networks. SST will be responsible for installation and maintenance of the sensors and cost of the sensor communications to the hosted location server. The hosted server infrastructure (exclusive of communications networks) shall be maintained at 99.9% application availability exclusive of scheduled maintenance that SST will make reasonable efforts to coordinate with the customer.

The connection between the reviewer's console and the Customer's Alert Console is secured using a secure message protocol over http connection, where individual messages are encrypted using the same Public Key Infrastructure ("PKI") as a secure VPN connection.

Providing local access to the internet for the Alert Console is the responsibility of the Customer, as is providing a work station with access to the internet. The Customer may choose to set up multiple sessions of Alert Consoles as a form of redundancy.