



Surveillance Impact Report

Audio Recorder - ShotSpotter, Inc. ("ShotSpotter")

San Francisco Police Department

As required by San Francisco Administrative Code, Section 19B, departments must submit a Surveillance Impact Report for each surveillance technology to the Committee on Information Technology ("COIT") and the Board of Supervisors.

The Surveillance Impact Report details the benefits, costs, and potential impacts associated with the Department's use of ShotSpotter, Inc. ("ShotSpotter").

DESCRIPTION OF THE TECHNOLOGY

The Department's mission is to protect life and property, prevent crime and reduce the fear of crime, by providing service with understanding, response with compassion, performance with integrity and law enforcement with vision.

In line with its mission, the Department uses ShotSpotter, Inc. ("ShotSpotter") which enables SFPD to be aware of gunshots in the absence of witnesses and/or reports to 911 of gunshots. The ShotSpotter system notifies SFPD of verified gunshot events, which expedites police and ambulance response rates to incidents involving illegal gunfire to help locate victims, witnesses, evidence (casings, bullets, firearms) and suspects.

It shall be the policy of the SFPD to properly utilize ShotSpotter to enhance the Department's ability to respond to and investigate violent crimes involving illegal gunfire.

SFPD shall use ShotSpotter, Inc. ("ShotSpotter") only for the following authorized purposes:

Authorized Use(s):

1. Gunshot detection: Record gunshot sounds and use sensors to locate the origin of the gunshots. Patrol Officers receive gunshot alerts to respond to crime scene.
2. Investigators use ShotSpotter Investigative Portal reports to find shell casing evidence on scene and to further analyze the incident.

All use cases not defined as an authorized use are prohibited.

A ShotSpotter alert will not, on its own, identify an individual, reveal racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, information concerning an individual person's sex life or sexual orientation. Recordings of ambient noise, or any other sound outside of verified gunshots shall be prohibited for use in any investigation and shall not cause police enforcement.

TECHNOLOGY DETAILS

The following is a product description of ShotSpotter, Inc. ("ShotSpotter"):

ShotSpotter Inc. is a California-based company that operates ShotSpotter Flex, a proprietary technology that uses sensors strategically placed in a geographic coverage area to detect, locate, and analyze gunshots, and notify law enforcement. ShotSpotter places acoustic sensors high above the street, typically on buildings. The sensors connect over a private commercial cellular wireless communications network in real-time to the ShotSpotter hosted servers. After a loud, impulsive sound is captured and located by 3 or more ShotSpotter Sensors, an incident is created and a short snippet of audio is sent to the ShotSpotter Incident Review Center (IRC) via secure, high-speed network connections for real-time verification that it is a gunshot. ShotSpotter professional reviewers analyze the audio soundwave visually, and listen to the sound to confirm whether it is gunfire or non-gunfire (e.g. fireworks, car back fire, helicopter, construction etc.). If it is validated as a gunshot, an alert is published and sent directly to the Customer's dispatch center, PSAP, mobile/patrol officers, and any other relevant safety or security personnel, as determined by the Customer (SFPD). The process from trigger pull to published alert takes on average 34 seconds.

Investigative Lead Summary ("ILS"): ShotSpotter provides an on-demand report for investigators available through the ShotSpotter Respond Application. The Investigative Lead Summary (ILS) provides useful details about the approximate location, timing, and sequence of each shot fired during an incident (similar to a DFR below, but not a court-admissible document)

Detailed Forensic Report ("DFR"): ShotSpotter will provide a DFR for any ShotSpotter-detected incidents, including Reviewed Alerts. The DFR is intended to be a court-admissible document used by attorneys as part of a court case for the exact, verified timing, sequence and location of each shot fired.

How It Works:

ShotSpotter uses acoustic sensors that are strategically placed in an array of approximately 20-25 sensors per square mile. These sensors are connected wirelessly to ShotSpotter's centralized, cloud-based application to reliably detect and accurately triangulate (locate) gunshots. Each acoustic sensor captures the precise time and audio associated with impulsive sounds that may represent gunfire. This data, from multiple sensors, is used to locate the incident, which is then filtered by sophisticated machine algorithms to classify the event as a potential gunshot. Expertly trained acoustic analysts, who are located and staffed in ShotSpotter's 24x7 Incident Review Center, then further qualify those highlighted incidents. These analysts ensure and confirm that the events are in fact gunfire. In addition, the analysts can append the alert with other critical intelligence such as whether a fully-automatic weapon was fired or whether multiple shooters are involved. This process typically takes no more than 45 seconds from the time of the actual shooting to the digital alert (with the precise location identified as a dot on a map) popping onto a screen of a computer in the 911 Call Center or on a police officer's smartphone or mobile laptop. There are three components to the ShotSpotter system:

1. Gunshot Location Detection (GLD) Sensors: Sensors are installed in different coverage areas in San Francisco.

2. ShotSpotter Incident Review Center (IRC): Sensors send acoustic information to the cloud where computer-based machine-learning algorithms are used to analyze the sound. If the sound and visual audio signature match gunfire, the incident file is then passed along to the IRC. Acoustic experts at the IRC review incidents within seconds and provide additional information (e.g. multiple shooters, high caliber weapon, automatic weapon). Confirmed gunshots are pushed out to Communications (dispatch) as well as to the SFPD ShotSpotter software system within seconds.

3. ShotSpotter User Software: SFPD authorized personnel can receive ShotSpotter alerts and access historical gunshot incident details for more in-depth investigative analysis using desktop-based, web-based or mobile applications.

All data collected or processed by ShotSpotter, Inc. will be handled or stored by an outside provider or third-party vendor on an ongoing basis. Specifically, data will be handled by ShotSpotter to ensure the Department may continue to use the technology.

IMPACT ASSESSMENT

The impact assessment addresses the conditions for surveillance technology approval, as outlined by the Standards of Approval in San Francisco Administrative Code, Section 19B:

- A. The benefits of the surveillance technology outweigh the costs.
- B. The Department’s Policy safeguards civil liberties and civil rights.
- C. The uses and deployments of the surveillance technology are not based upon discriminatory or viewpoint-based factors and do not have a disparate impact on any community or Protected Class.

The Department’s use of the surveillance technology is intended to support and benefit the public safety of visitors and residents of San Francisco while minimizing and mitigating all costs and potential civil rights and liberties impacts of residents.

A. *Benefits*

The Department’s use of ShotSpotter has the following benefits for the residents of the City and County of San Francisco:

<input type="checkbox"/> Education	
<input type="checkbox"/> Community Development	
X Health	Quicker response and medical assistance for victims of gun violence which is believed to have more positive survival outcomes
<input type="checkbox"/> Environment	
X Criminal Justice	ShotSpotter notifications help make the department aware of gunfire events they would have otherwise not have known about. In 2019, only 15% of SF gunfire incidents were called into 911. ShotSpotter alerts enable a fast, precise officer response to unreported gunfire to render aid to victims of a gunshot, secure critical evidence, and apprehend armed individuals.

- Jobs
- Housing
- Other

Additional benefits include:

The Crime Gun Intelligence Center (CGIC) program: CGICs are an interagency collaboration among local police departments, the U.S. Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), and other partners such as state and local prosecutors, to identify perpetrators of gun crime for immediate investigation, apprehension, and prosecution. The SFPD CGIC partnership reduces turnaround times for evidence analysis and improve SFPD's capabilities for connecting guns to crimes that may appear unrelated and more effectively identified guns used in multiple and cross jurisdictional shooting incidents. The Urban Institute has shown that ShotSpotter significantly improves the collection of evidence in the form of shell casings for gun crimes. These casings can be fed into the ATF's NIBIN database to connect gun crimes and identify potential suspects.

B. Civil Rights Impacts and Safeguards

The Department has considered the potential impacts and has identified the technical, administrative, and physical protections as mitigating measures:

ShotSpotter acoustic sensors use ordinary microphones that are similar to ones found in cellphones. They are placed high above the street and are not positioned, tuned or specialized to pick up human voices. The sensors "listen" for gunshot-like sounds and trigger only when detecting an impulsive sound that is instantaneous and sharp. When at least three different sensors detect a gunshot-like sound at the same time and determine a location, they send a short audio snippet to ShotSpotter headquarters that includes 1 second of sound prior to the incident (to establish a baseline of ambient noise), the incident itself and 1 second after. Upon detecting a likely gunshot, trained ShotSpotter personnel listen to a short computer-generated audio snippet of the gunfire to double check that it is actually gunfire. It is highly unusual for a human voice to be included in a snippet. For this to occur, the voice must be loud enough to be heard over the gunfire. In addition, there is no personally identifiable information in any audio snippet.

Since 2012, only authorized ShotSpotter employees have access to audio from sensors. They can only access it under a strict set of conditions and can only provide police a short audio snippet. In 2019 ShotSpotter commissioned an independent privacy audit by the Policing Project at NYU Law School. This end-to-end assessment conducted by objective privacy professionals concluded that ShotSpotter presents an "extremely low risk of audio surveillance". The Policing Project based this finding upon the short amount of audio that is temporarily stored on sensors, the short length of audio snippets that are permanently stored as evidence and the internal controls the company uses to restrict access to audio for authorized employees only.

Human voices and street noise will never trigger a sensor because they do not produce an instantaneous sharp sound and they are not loud enough to be picked up by three or more sensors. That being said, street noise that can include human voices could be captured by a sensor temporarily. All sensor audio, however, is permanently deleted after 30 hours and never

heard by a human unless it was accompanied by a loud, impulse sound thought to be a gunshot. Live streaming of audio is not possible.

Technology and operational mitigations:

- ShotSpotter, not SFPD, is responsible for determining the location(s) for installation of acoustic sensors. Sensors are placed high above the ground typically on top of buildings or sometimes lampposts. At this height, there is more limited ability to pick up street level sounds clearly.

Determining locations: ShotSpotter works with police agencies using their historical crime data on shootings to determine the desired physical boundaries of the coverage area for the gunshot detection technology. Once the coverage area is set, trained ShotSpotter operations personnel, who are experienced with wide-area array sensor design, use an analytical process to determine how many sensors are needed and where they should be placed in order to achieve reliable detection throughout the area. Factors that go into final sensor location selection include:

- Desired sensor density based on the unique geographical, topographical, and ambient acoustic features of the coverage area
 - Relative distance and spacing between other sensors
 - Height of building or structure (to better “hear to the horizon” and thus minimize acoustic signal attenuation from far away gunfire)
 - Availability of reliable power
 - Adequate cellular coverage, signal strength and latency for communications
 - Written permission from the property owner to install a sensor
- The sensors are not capable of audio streaming – neither ShotSpotter nor SFPD can listen in on street level sounds in real-time.
 - The system permanently deletes all audio that is temporarily stored on the sensor after 30 hours.
 - The system only triggers an incident to send downstream when 3 or more sensors hear a loud, impulsive sound. Sensors cannot be triggered by human voices because voices are not impulsive enough or loud enough to be heard by 3 sensors which may be 800 meters or more apart. Thus, the audio of a human voice that may be captured by 1 sensor would be permanently deleted after 30 hours and no police or ShotSpotter employee will have heard that sound.
 - If a sound is loud enough and sharp enough to possibly be a gunshot and is detected by 3 or more sensors and a location is able to be determined, the system pulls a short audio snippet of the sound plus 1 second of ambient noise prior to the incident and 1 second after. This audio is interpreted by a machine at first and then reviewed by an acoustic analyst at ShotSpotter Headquarters who is only presented with the audio snippet and is under significant time pressure to process the incident as either a gunshot or to dismiss as a non-gunshot and get on to the next incident. All incidents, whether determined to be a gunshot or non-gunshot, are permanently and securely stored in the cloud to serve as both evidence and to train the machine classifier in the future.

- ShotSpotter security protocols also mitigate gunshot detection data access. ShotSpotter does not provide extended audio to SFPD or any police agency; they will not provide this access even if requested. Additionally, ShotSpotter does not provide actual precise locations of the sensors to SFPD.
- As previously mentioned, the sensors are constantly listening for gunshot-like sounds and storing what is captured for 30 hours (was 72 hours before July 2019), and then deleting the data unless triggered to send the data to the ShotSpotter Cloud for analysis. The 30-hour buffer allows SFPD to request data within 24 hours in cases where gunshots have been identified by police but not picked up by the system or if there is a need to verify if there were other gunshots prior to the authenticated event.
- ShotSpotter policy stipulates that only a limited number of authorized forensic engineers can access the storage buffer of a sensor to retrieve prior recorded data within that 30-hour window and search for other gunshot impulsive sound events. To avoid listening to recorded data on a sensor in a haphazard way, the search for a missing gunshot is first done visually through a secure interface looking for the prevalence of electrical “pulses” strong enough to be a gunshot that occurred around the time of the incident in question.
- Upon receiving a gunshot alert SFPD authorized personnel may find that a voice has been recorded along with gunshot sound, but such voice data is only associated with the actual gunshot data and has no personally identifiable information built in. There is no way to tag any voice audio that is unintentionally recorded when connected to a gunshot.
- SFPD takes data security seriously and safeguards GDT System data by both procedural and technological means. Only authorized and trained personnel are permitted access to the system. The system always requires user and password ID for login. Furthermore, only personnel specifically designated by the Chief or Chief-designee have access to the system desktop applications which provide access to any historical downloadable data.
- ShotSpotter data collected by SFPD shall not be used for the enforcement of Immigration Laws. SFPD complies with SF Admin Code Section 12H and 12I.

C. Fiscal Analysis of Costs and Benefits

The Department’s use of ShotSpotter, Inc. yields the following business and operations benefits:

Benefit	Description
□ Financial savings	
X Time savings	If a 911 caller reports a gunshot incident, it usually takes several minutes to capture and relay the information to officers often with imprecise data on the exact location. With ShotSpotter, officers receive alerts within 60 seconds of trigger pull with closest address data enabling a faster response to a crime scene to potentially save victims.

X Staff safety Officers can approach a crime scene more safely with ShotSpotter alerts knowing the precise location and time of the event and whether there are multiple shooters or high capacity weapons being used.

X Improved data quality Only 15% of gunshot incidents in SF have an accompanying 911 call (2019). Without ShotSpotter there would be no police response to 85% of gun crime representing over 850 incidents. However, with ShotSpotter, virtually all incidents are captured with an exact location enabling the department to better protect and serve the community.

Other

The total fiscal cost, including initial purchase, personnel and other ongoing costs is

FTE (new & existing)	-		
Classification	-		
	Annual Cost	Years	One-Time Cost
Total Salary & Fringe	\$0	-	-
Software	\$0	-	-
Hardware/Equipment	\$0	-	-
Professional Services	\$545,938	4	-
Training	\$0	-	-
Other	\$0	-	-
Total Cost [Auto-calculate]	\$ 2,183,752		
2.1 Please disclose any current or potential sources of funding (e.g. potential sources = prospective grant recipients, etc.). ^{SIR, ASR}			
SFPD operational budget			

The Department funds its use and maintenance of the surveillance technology through SFPD operational budget.

COMPARISON TO OTHER JURISDICTIONS

Sample results reported from other cities:

- Oakland, CA: ShotSpotter Policy approved by the Oakland Privacy Commission in November 2019.
- Las Vegas Metro Police pilot report indicates 342 gunshot incidents were identified by ShotSpotter in first 9 months of use that the PD would not have known about and a 26% reduction in violent crime. Expanded coverage area to all known hotspots.¹
- Cincinnati cites a 48% reduction in shootings²
- Newport News reports a 13% reduction in shootings with ShotSpotter³
- Greenville, NC reports a 33% reduction in gun violence injuries using ShotSpotter⁴
- Chicago cites a drop of over 40% in shootings in the Englewood District in the first year after installation⁵
- Camden County, NJ—46% reduction in homicides by shooting⁶
- Denver—103 arrests and 84-gun recoveries over the course of 3 years⁷
- Bakersfield—22 arrests in first 9 months⁸
- Pittsburgh – 48 arrests and 83 victims found with help of ShotSpotter in 3 years⁹

¹https://www.youtube.com/watch?v=bK8_oEjQ-gs&t=23s

² <https://www.wcpo.com/news/crime/shootings-down-nearly-50-percent-in-cincinnati-this-year-police-say>

³ <https://www.dailypress.com/news/crime/dp-nw-newport-news-police-2019-year-20200128-p6z2jetrkfd7jhw6cvblfopxe-story.html>

⁴ <https://www.witn.com/content/news/Greenville-Police-credit-Shot-Spotter-for-lower-crime-stats--567247521.html>

⁵ <https://www.chicagotribune.com/news/breaking/ct-met-superintendent-eddie-johnson-chicago-violence-20171116-story.html>

⁶ <https://www.phillymag.com/news/2015/04/02/camden-reduces-gunfire-by-48-percent/>

⁷ <https://www.thedenverchannel.com/news/crime/denver-police-to-test-shotspotter-system-in-4-different-neighborhoods-with-live-gunfire>

⁸ <https://bakersfieldnow.com/news/local/is-shotspotter-working-in-bakersfield>

⁹ <https://www.post-gazette.com/local/city/2018/03/14/Pittsburgh-City-Council-ShotSpotter-expansion-Wendell-Hissrich-North-Side-Jason-Lando-Darlene-Harris-Deborah-Gross/stories/201803140183>

APPENDIX A: Surveillance Impact Report Requirements

The following section shows all Surveillance Impact Report requirements in order as defined by the San Francisco Administrative Code, Section 19B.

1. Information describing the Surveillance Technology and how it works, including product descriptions from manufacturers.

ShotSpotter uses acoustic sensors that are strategically placed in an array of approximately 20 sensors per square mile. These sensors are connected wirelessly to ShotSpotter's centralized, cloud-based application to reliably detect and accurately triangulate (locate) gunshots. Each acoustic sensor captures the precise time and audio associated with impulsive sounds that may represent gunfire. This data, from multiple sensors, is used to locate the incident, which is then filtered by sophisticated machine algorithms to classify the event as a potential gunshot. Expertly trained acoustic analysts, who are located and staffed in ShotSpotter's 24x7 Incident Review Center, then further qualify those highlighted incidents. These analysts ensure and confirm that the events are in fact gunfire. In addition, the analysts can append the alert with other critical intelligence such as whether a fully automatic weapon was fired and whether the shooter is on the move. This process typically takes no more than 45 seconds from the time of the actual shooting to the digital alert (with the precise location identified as a dot on a map) popping onto a screen of a computer in the 911 Call Center or on a police officer's smartphone or MDT (vehicle mobile display terminals) There are three components to the ShotSpotter system:

1. Gunshot Location Detection (GLD) Sensors: Sensors are installed in different coverage areas in San Francisco.

2. ShotSpotter Headquarters (HQ): Sensors send acoustic information to HQ where computer-based machine-learning algorithms are used to analyze the sound. If the sound and visual audio signature match gunfire, the incident file is then passed along to the Incident Review Center (IRC). Acoustic experts at the IRC review incidents within seconds and provide additional information (e.g. number of gunshots, number of guns, types of guns). Confirmed gunshots are pushed out to Communications (dispatch) as well as to the SFPD ShotSpotter software system within seconds.

3. The SFPD ShotSpotter Software System: This system is cloud-based and desktop-based; SFPD authorized personnel can use internet browsers to connect to the ShotSpotter system via SFPD computers. Certain authorized personnel use desktop applications that connect to the ShotSpotter system for more in-depth gunshot analysis.

ShotSpotter Inc. ("SST") is a California-based company that operates ShotSpotter Flex (hereafter referred to as "ShotSpotter"), a proprietary technology that uses sensors strategically placed around a geographic area to detect, locate, and analyze gunshots, and notify law enforcement. ShotSpotter is the most widely used gunshot detection technology in the United States, currently operating in more than 100 jurisdictions. SST's primary customers are local law enforcement agencies. ShotSpotter is gunshot detection technology that uses sophisticated acoustic sensors to detect, locate and alert law enforcement agencies and security personnel about illegal gunfire incidents in real-time. The digital alerts include a precise location on a map (latitude/longitude) with corresponding data such as the address, number of rounds fired, type of gunfire, etc. delivered to any browser-enabled smartphone or mobile laptop device as well as police vehicle MDC or desktop. This information is key to better protecting officers by providing them with increased tactical awareness. It also enables law enforcement agencies to better connect with their communities and bolsters their mission to protect and serve. The ShotSpotter system employs acoustic sensors strategically placed in specified areas (commonly referred to as a "coverage area.") When a gun is fired, the sensors detect the firing of the weapon. The audio triangulation of multiple installed sensors then pinpoints a gunfire location and sends the audio file and triangulation information to

ShotSpotter Headquarters (HQ) for gunshot verification. Verified gunshots and related information are then sent to SFPD in real-time so that SFPD may notify responding officers where guns were fired.

2. Information on the proposed purpose(s) for the Surveillance Technology.

The ShotSpotter system enables SFPD to be aware of gunshots in the absence of witnesses and/or reports of gunshots. The ShotSpotter system notifies SFPD of verified gunshot events, which allows SFPD to quickly respond to gunshots and related violent criminal activity. ShotSpotter expedites police and ambulance response rates to incidents involving illegal gunfire which expedite the location of victims, witnesses, evidence and suspects.

The Crime Gun Intelligence Center (CGIC) Unit conducts a re-cavass of ShotSpotter notifications when multiple gunshots are detected and cartridge cases are not recovered. Returning the following day to re-cavass the neighborhood may encourage witnesses to come forward and provide information as opposed to immediately following the shooting incident. The increased attention to the investigation of shots fired in the neighborhood may aid in building community trust.

3. If applicable, the general location(s) it may be deployed and crime statistics for any location(s).

Sensors are currently in the following neighborhoods: Bayview, Western Addition, Sunnydale/Visitation Valley, Bernal Dwellings/Bernal Heights, Potrero Hill and South of Market

4. An assessment identifying any potential impact on civil liberties and civil rights and discussing any plans to safeguard the rights of the public.

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5. Whether use or maintenance of the technology will require data gathered by the technology to be handled or stored by a third-party vendor on an ongoing basis.

Handled by third-party vendor, ongoing: true

Vendor name:

Special data handling required: true

6. A summary of the experience, if any, other governmental entities have had with the proposed technology, including information about its effectiveness and any known adverse information about the technology such as anticipated costs, failures, or civil rights and civil liberties abuses.

Sample results reported from other cities:

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APPENDIX B: SFPD District Stations Included in ShotSpotter Service Area

Southern Station (Company B)
Bayview Station (Company C)
Mission Station (Company D)
Northern Station (Company E)
Ingleside Station (Company H)
Tenderloin Station (Company J)

APPENDIX C: Firearm Homicide by District Station, year over year 9/20/2020

District	2019	2020
Central	0	1
Southern	1	1
Bayview	7	7
Mission	3	4
Northern	3	0
Park	0	0
Richmond	0	0
Ingleside	1	4
Taraval	0	0
Tenderloin	2	5
Total	17	22

APPENDIX D: Violent Crime Zone Identification, 2008 Report

In 2008, SFPD's Crime Analysis Unit (CAU) identified five zones where the majority of violent crimes were taking place. The below five zones are included in the ShotSpotter Service Area.

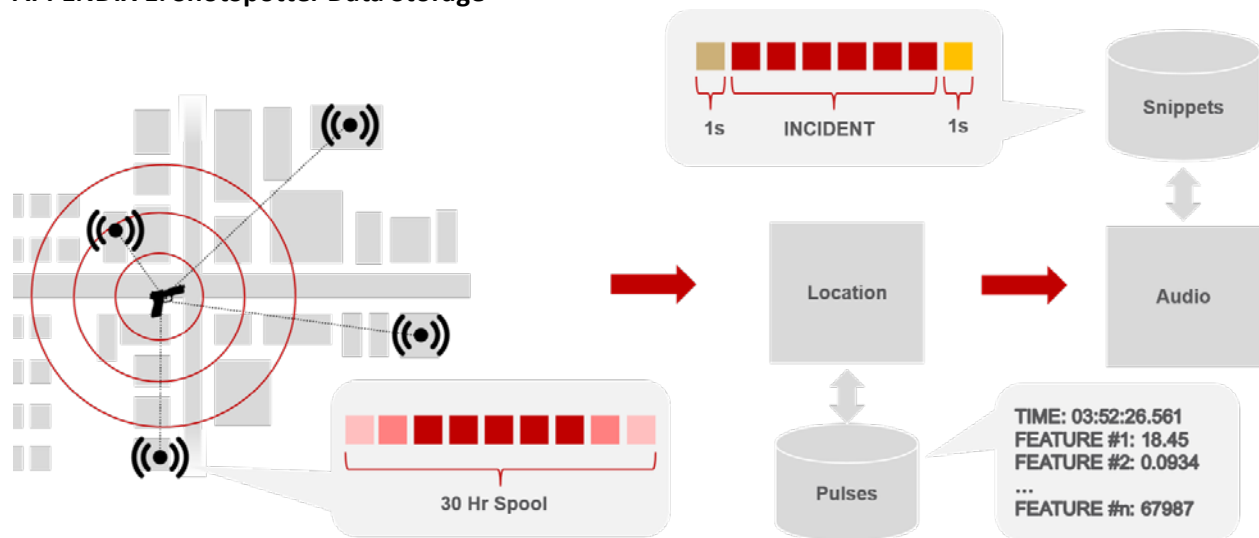
- Zone 1: Tenderloin/SOMA
- Zone 2: Western Addition
- Zone 3: Mission District
- Zone 4: Bayview District
- Zone 5: Visitacion Valley

SFPD VIOLENT CRIME REDUCTION ZONES



Source: Violent Crime Reduction Strategy
Prepared by Crime Analysis Unit
08/20/2008

APPENDIX E: ShotSpotter Data Storage



APPENDIX F: ShotSpotter Real Time Operating Model

