115 questions for Paul Greene:

1. Where are you employed?

   SST Incorporated, Newark, CA

2. In what capacity?

   Lead customer support engineer and lead forensic analyst

3. How long have you been employed by this company?

   7 ½ years

4. Please describe some of your formal education, training, and experience in this field.

   On the job training, college education, 7 years as electrician, commercial IT experience

5. Please explain what the Shot Spotter System is.

   Shot spotter acoustic gunshot detection and location system

6. As part of your duties, are you responsible for conducting forensic analyses of acoustic gunfire data generated by the Shot Spotter system?

   Yes

7. Approximately how many forensic analyses have you performed while employed with Shot Spotter?

   400

8. During your tenure with SST, have you ever testified as an expert witness in the forensic analysis of gunfire acoustic analysis related to detections by Shot Spotter systems?

    a. Please list some (need not be all) of the jurisdictions in which you have qualified. (In the case of courts outside of California, just the state in which you qualified will suffice.)

    Yes, over 20, Contra Costa, Alameda, Beloit, Wisconsin, Rochester, NY, Boston, Mass

9. How does this system work?

    -Triangulation

    -Consists of microphone sensors placed in exact known locations

    -Specified geographical area by customer

    -When gun discharged, the sound of muzzle travels at speed of sounds outward in all directions

    -Will reach individual sensors at different times

    -Sensors report when they receive each sound and report to central location

    -Central location is where the times are housed

    -Takes time differences and is able to compute a hyperbola, plots curves on map and where the curves intersect is where the gunshot is located

    -After the location is located, the location server tries to classify the sound as gunfire or not gunfire.

    -After classification, it notifies the shot spotter operator

    -10-15 seconds to compute

10. What is triangulation, and what part does it play in the system

    -Using known points to find an unknown point, using time difference of arrival

    -Shot spotter uses time difference in receiving sound pulses to triangulate

-Using speed of sound multiplies by time and generates a radius, distance x times and where circles intersect they get the location.

11. Can you explain the difference between gunfire detection and gunfire location?

   -Each sensor has a microphone and GPA receiver and memory card and radio and digital signal processor

   -Sensor always on, always listening

   -Digital signal processor set with a set of parameter called pulse features

   -Microphone picks everything around it, detects sounds preprogrammed pulse features, uses time from GPS receiver to timestamp it, uses the radio to transmit

   -Location happens on location server gathers all of the pulses from each sensor and match them up, has enough pulse data it attempts to locate it by triangulation.

12. In terms of the Shot Spotter system's accuracy in detecting the occurrence of gunfire in an area where its systems are set up, what is the level of accuracy in detecting the occurrence of gunfire?

   - **SST will guarantee locate 80% of detectable gunfire to within 25 meters**

   - **In practice, the locations are 10 meters**

13. What are some of the means by which Shot Spotter verifies this degree of detection accuracy?

   - **Customer reporting back on location accuracy**

   - **Live Fire test, ensure system is accurate and to determine if the customer should add sensors**

14. What are some of the factors that affect the ability of the system to detect gunfire?

-System detects gunfire using air and sound, environmental factors can modify or defeat system

-Lack of sensors that receive sound, buildings, traffic noise, construction noise, weather, edge or past of array

15. In terms of the system's accuracy in identifying the location of where the gunfire occurred, what is the geographic margin of accuracy (i.e., within how many meters of where the firearm was discharged)?

    25 meters is geographic accuracy

    Depends on environment up to 1400 meters

16. For the system to detect and locate a shooting incident, how many sensors are required?

    Four sensors for single gunshot

    Multiple gunshots, three sensors

17. Is the system set up in a way so as to accurately and automatically record the gunfire acoustic data at the time it is detected by a sensor(s)? Please explain.

    YES, all pulse data from sensors the location servers determines is gunfire

18. Once the data is recorded, is the system set up in a way so as to accurately preserve it and prevent any tampering or alteration in its content? Please explain.

    YES, once its recorded to location server, assigned an MD-5 hash number, if there is a difference in MD-5 hash there has been a tampering.

19. What steps, if any, are used by this system to accurately note the time when a gunfire incident occurred?

Every sensor as well as servers are synchronized to GPS time, server is synchronized to atomic clock at national institute of standard and technology NIST

20. Is the system set up in a way to ensure that the sensor(s) which detected the gunfire is working properly? Please explain.

Yes, SST monitors each sensor constantly, status packet, every 30 seconds, if sensor no longer sends status packets they send a tech to repair or replace

21. What is post-processing?

SST forensic exam, take all available data and recreate incident, shot spotter browser, step through process, visualize audio wave form, lets us account for echoes and other noises present in audio file.

22. Are sensors' acoustic data and the related meta-data (date/time, location, etc.) customarily made and kept by Shot Spotter in the regular course of business?

Servers on site in Richmond. Until customer requests review, stays on Richmond servers, then can be uploaded to the main company server.

23. As part of your duties, are you responsible for authenticating such records in court?

YES

24. As part of your duties, do you directly interact with the law enforcement agencies which use Shot Spotter in their jurisdictions?

YES

25. Approximately how many cities currently have Shot Spotter installed?

70 plus world wide

26. Based on your personal knowledge as well as your review of files kept in the course of business by Shot Spotter, was Shot Spotter installed in the city of Richmond, California, prior to June of 2013?

YES, 2009

27. Prior to today, did you have occasion to review records pertaining to reported gunfire activity occurring in the city of Richmond in June of 2013?

    YES

28. Did you have occasion to conduct forensic analysis of the Shot Spotter acoustic data for two separate dates: June 21, and June 23?

    Three spate incidents, June 21 has one, June 23 had two

29. In the 6/21/13 incident, did the Shot Spotter records reflect the time (Pacific Time) for when that incident in question occurred?

    YES

    b. When did it occur?

    2331:26

30. In the 6/21/13 incident, did you analyze that data to determine the location of the event?

    YES

31. Please briefly explain the process by which you did that.

    User interface, open incident, retrieve data, looked at date and time and location as represented by the system and with a map, then open shot spotter browser and load audio clips from sensors, browser will then make an initial location. Match the data to audio wave forms, listen to the audio clips for echoes, add time stamps for pulses with no time stamps, remove ones that are not gunfire, then refine the location of shooting.

32. Is this method generally accepted in the forensic scientific community?

    YES

33. How many Shot Spotter sensors were activated by that event?

34. Did you review the audio files of the acoustic data related to that event?

    YES

35. Was the acoustic data consistent with the discharge of a firearm?

    YES

36. Based on your review of the data, how many discharges (shots) were there?

    One

37. Based on your review of the data, what was the location of the discharge, including the error-radius?

    2989 Pullman Ave, behind complex, adjacent to Carlson Blvd

38. In the 6/23/13 incident, did the Shot Spotter records reflect the time (Pacific Time) for when that incident in question occurred?

    YES, two incidents

    c. **When did it occur?**

    0159:28

    0159:38

39. In the 6/23/13 incident, did you analyze that data to determine the location of the event?

    YES

40. How many Shot Spotter sensors were activated by that event?

    # 76571   159:28   9 sensors

    #76572   159:38   5 sensors

41. Did you review the audio files of the acoustic data related to that event?

    YES

42. Was the acoustic data consistent with the discharge of a firearm?

YES

43. Based on your review of the data, how many discharges (shots) were there?

   #76571   3 shots

   #76572   2 shots

44. Based on your review of the data, what was the location of the discharge(s), including the error-radius?

400 Main Ave, corner 4th/Main

45. Are you aware of any challenges to the Spot Spotter system in court related to Kelly-Frye/Daubert (Generally accepted principals).

   Yes, Troy, New York, St. Louis, MI and Omaha, all admitted shot spotter evidence

46. Are you aware of any successful challenges to the shot spotter in court

   -No successful challenges

47. Have you ever personally testified in court with regards to a challenge to Spot Spotter under the grounds it was not generally accepted in the scientific community

   -Twice, St. Louis and Omaha

48. Has long has Shot Spotter been in existence?

   1995, first installation was Redwood City in 1996