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# AMBERBOX

## Gunshot Detection

# WHITE PAPER

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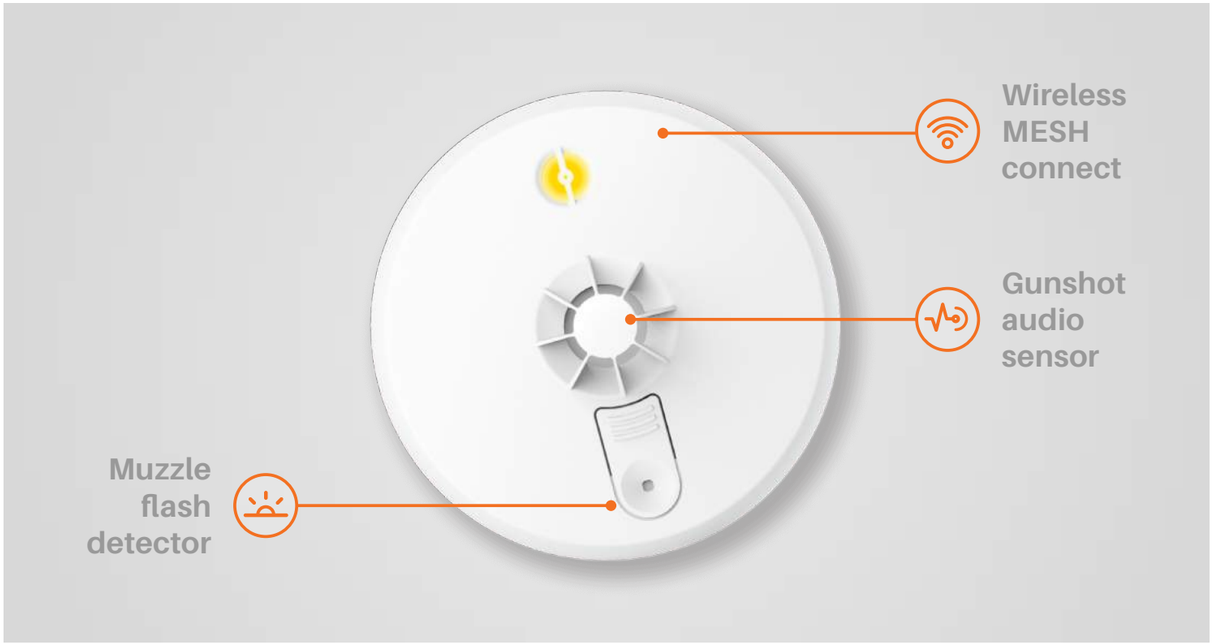



## ABOUT

AmberBox is a detection and response system designed to protect lives in the event of an active shooter incident. We automate the emergency process to significantly reduce response time and remove human error.

Through our patented tri-fractor authentication system, AmberBox identifies gunshots with a near-zero false alarm rate, automatically notifying law enforcement and building security representatives, providing vital information as events unfold.

The cloud based AmberBox Response Platform delivers real-time data on rapidly evolving active shooter incidents. It monitors locations, tracks perpetrator movement and responds immediately with pre-programmed security features anytime, anywhere.

# THE SCIENCE BEHIND AMBERBOX

## MUZZLE BLAST

There are two dominant acoustic characteristics of a gunshot: a “muzzle blast” and a “sonic boom.”

When a gun is fired, an explosive charge is ignited to propel the bullet from the barrel. The explosion produces a sound that emanates in all directions. “Muzzle blast” refers to this explosive shock wave and accompanying acoustic energy. The muzzle blast typically lasts less than 3 milliseconds, and the acoustic waves it produces propagate outward at the speed of sound.[1] Fig. 1 is a high-speed photograph showing the muzzle blast of a rifle.

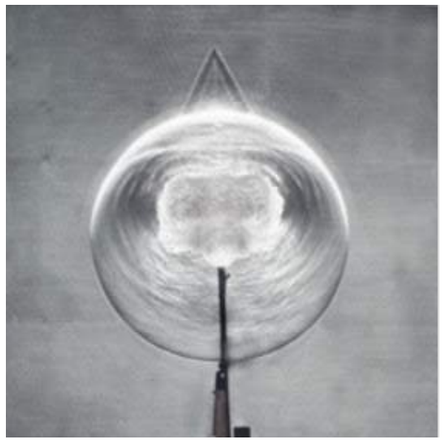


Figure 1. Muzzle Blast from a Rifle
(Settles, 2006) High Speed Imaging of Shockwaves

## SONIC BOOM

The other major characteristic of a gunshot is the acoustic shock wave, or “sonic boom,” produced by the bullet as it travels through the air at supersonic velocity. This shock wave propagates outward from the bullet’s path at the speed of sound. It expands in the shape of a cone trailing the bullet, as shown in Fig. 1.

[1] (Maher, 2007) Acoustical Characterization of Gunshots



## EXAMPLE GUNSHOT DATA

Fig. 2 shows acoustic data from a Winchester .308 rifle. In this case, the bullet’s trajectory was toward the microphone, and because the bullet was traveling faster than the speed of sound, the shock trailing the bullet reached the microphone first. Both the first shock wave and the muzzle blast are followed by reflections of lower amplitude.

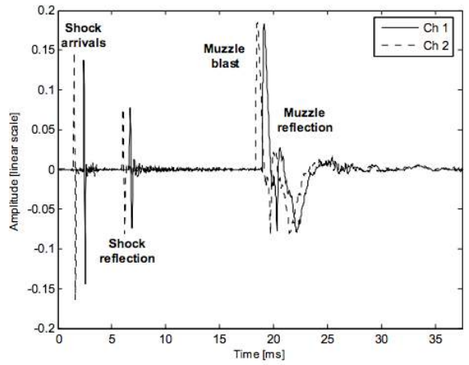



Figure 2. Two-channel gunshot recording, $M$=2.54, oblique trajectory toward the microphones.
(Maher, 2007) Acoustical Characterization of Gunshots

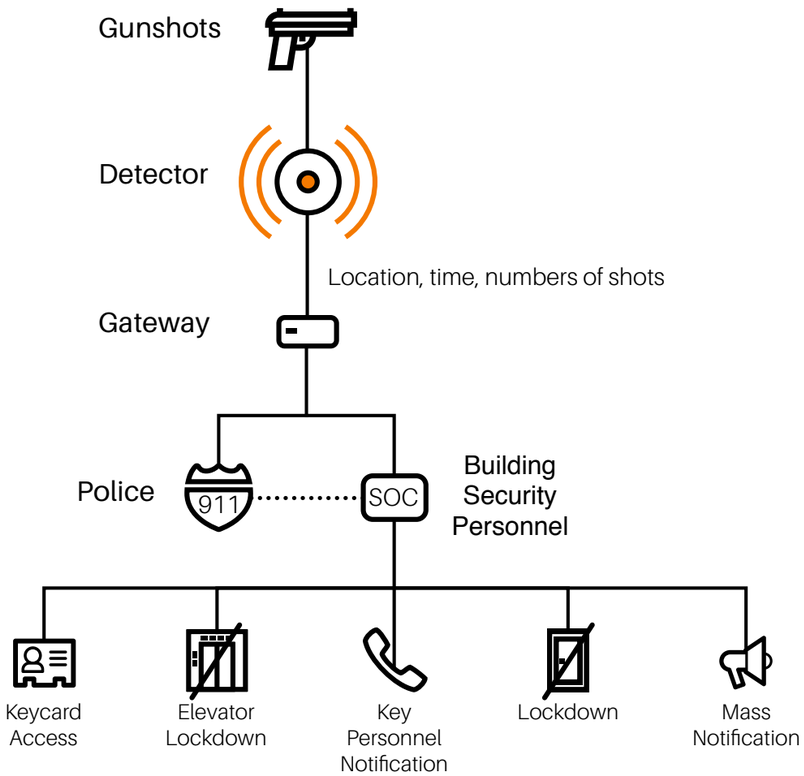
## AMBERBOX GUNSHOT ANALYSIS

AmberBox uses tri-factor authentication to deliver rapid detection of gunshots, with a near-zero false alarm rate. In addition to infrared muzzle flash and percussion sensing, the system also utilizes machine learning sound analysis. Each detector incorporates such patented machine learning analysis, comparing sound detected against a database of over 3,000 gunshot samples stored on every detector. This delivers fast and reliable detection at the detector head, without the transmission of any real time audio data across the network. All of this is calculated in under 3.6 seconds.

Crucially, by analyzing a combination of these factors, AmberBox does not require line of sight to trigger.

## HOW DOES THE AMBERBOX SYSTEM WORK?

After gunshot verification, achieved through tri-factor authentication, AmberBox detectors send an alert signal through a wireless MESH network to the building gateway. An automatic call is made to 911 via our E911 certified telecommunications platform, and simultaneously connects to building security representatives, to reduce response times by an average of 5 minutes, stopping threats faster.



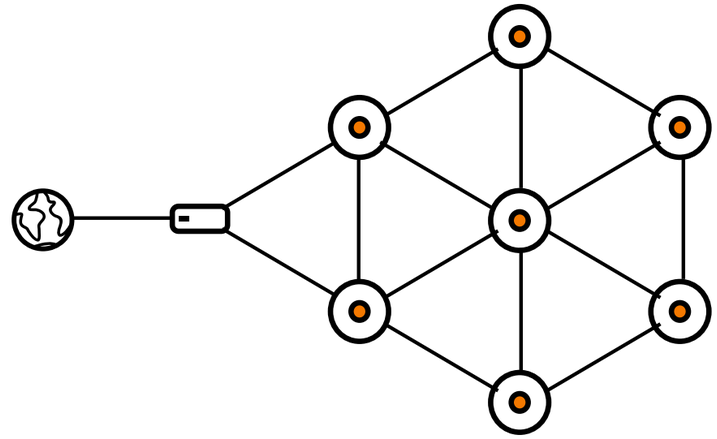

Upon detection of a gunshot, alerts are issued by call, SMS and email to designated security representatives. Security personnel are then jointly connected to law enforcement via a conference call. Real-time data on precise gunshot locations, movement of shooter, gunshot times and total number of shots fired can be viewed through the web or mobile platform. AmberBox can seamlessly integrate with a range of security systems.



## WIRELESS MESH NETWORK

Detectors communicate utilizing a proprietary wireless MESH network, where data is hopped between devices to a base gateway. AmberBox detectors do not need to connect to, or interfere with, existing corporate wired or wireless internet networks.

The system of plug- and-play wireless detectors is designed to be easily installed, requiring minimal labor costs.



## DETECTION CAPABILITIES

Each device has a range of 60-90 feet, covering approximately a 5000-7500 sq ft area, and can detect through walls. The range of detection can be affected by wall thickness.

## UPDATES

Detectors are automatically updated “over-the-air”, every time a new firmware release occurs. This is a key part of the service offering. New updates are released on average every two weeks, to improve reliability, resilience and features.

The hard drive of the detector is partitioned, as a result, half of the hard drive is updated, whilst the second half continues to monitor as normal, uninterrupted.  Once the update is completed, if the detector does not register a fully functioning operating system within 45 seconds, it reverts to the original firmware version and an error report is passed to the command panel.

## AMBERBOX RESPONSE PLATFROM

### RESPONSE PLATFORM

The AmberBox Response Platform provides the ultimate tool to remain constantly informed and respond quickly to a developing active shooter incident.

Logging onto the cloud based platform instantly presents vital intelligence, to monitor locations, track perpetrator movement and respond immediately to an active shooter incident, with pre-programmed security features, via desktop or mobile. This facilitates accurate coordination of the emergency response, to maximize effectiveness.

The AmberBox Response Platform offers you superior command over your entire risk management strategy in relation to active shooter preparedness. AmberBox provides a central platform where all integrated security systems can be maintained, monitored and activated.

### MAINTENANCE

The overview screen details a summary of the health status of each detector, ensuring that they are operational. The platform will highlight if a detector is offline or requires attention.

A key feature of the AmberBox system is that it can self-diagnose any detector faults or maintenance required. AmberBox maintenance checks are performed every 30 seconds, so you can be assured that the system is constantly up to date and operational. Should a detector require replacement, AmberBox will dispatch a new detector immediately upon verification of the fault.


### WHY NOT BOOK A DEMO?

Ready to see the AmberBox Response Platform in action? Click here to book a demo:

DEMO

# PRIVACY AND DATA SECURITY

## WIRELESS MESH NETWORK

With AmberBox, all detection and machine learning analysis is conducted at the detector head, with no real-time audio data sent across the network. This is crucial to maintain privacy.

The bandwidth used by each detector is minimal - 9 kb/s. As a result, the network is physically incapable of sending real-time audio, which mitigates this significant privacy concern.

The system operates on an IEEE 802.11 certified wireless protocol, boosted by our own proprietary network layer. Our stack is designed with security as its primary focus, and all communications are transmitted with AES 256-bit bank-grade encryption. It operates within a 2.4 GHz frequency band.

The MESH network functions on a completely different channel to WiFi, so there is no interference.

# INTEGRATION

## INTEGRATIONS TO AMBERBOX

The AmberBox system, in standalone form, delivers all the critical functionality you need to detect gunshots, notify law enforcement and provide operational intelligence on an unfolding situation. However, by integrating other security mechanisms with AmberBox, you can build a powerful and reliable response and recovery system. AmberBox can integrate with a wide variety of security products, including:

- Access control
- Video management systems
- Physical security information management (PSIM) software
- Mass notification

AmberBox is manufacturer agnostic, allowing you the flexibility to integrate with almost any security system currently installed.

## HOW AMBERBOX INTEGRATES

AmberBox uses the same integration method as fire alarms and other life safety systems, due to its universal nature. Each gateway has multiple I/O ports, that can be programmed to trigger in the event of an activation. These can be used to connect to:

- Closed contact relay switches – link directly to another hardware-based security system control panel
- TCP/IP relay input modules – link to any security software application, by converting the relay output to a network based response

These provide the easiest and most robust route to universal integration into security systems.

# INSTALL AND TESTING

## INSTALLING THE GATEWAY

The gateway can connect to the AmberBox Response Platform via ethernet, WiFi or cellular.

For an ethernet setup, the gateway only requires a single public, static IP address. As a result, the gateway does not require connection to internal corporate networks, mitigating InfoSec concerns.

## INSTALLING THE DETECTORS

No wired data connection is required for the detectors. Only a standard 100-220V AC or 12-48V DC electrical connection is needed.

Your integrator receives the detectors with a sheet listing each detector location. Each detector has a sticker tag attached to it showing the detector's network address.

For each detector:
1. The detector is mounted on a wall or ceiling.
2. Radio connection is confirmed by checking for a flashing green light.
3. The sticker tag is removed from the detector and attached to the installation sheet next to the location where the detector is mounted.
4. The installation sheet is scanned and sent to us.
5. Each detector is tested to ensure that the address corresponds to the correct location.

AmberBox detectors can be fitted on ceilings or walls, typically at 3ft spacings away from any other electronic or lighting fixtures.

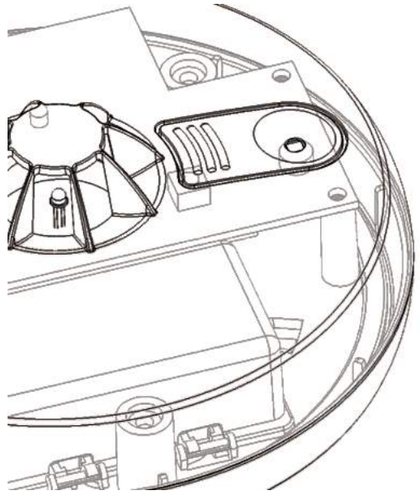


## TESTING

The system self checks every 30 seconds. It runs a diagnostic code to test the detector and sends a positive "heartbeat" signal to the gateway. Each detector internally simulates a gunshot periodically to test the detection algorithms. In the event of a fault or if the gateway does not receive a heartbeat, the system automatically sends call/text/email notifications to key personnel and AmberBox for fault diagnosis and replacement, if necessary. This will also signal in the event of tampering.

A further element of the testing is its ability to check that all integrations and response procedures function correctly. The system can be placed into a "Test" mode, and each detector has a test button, similar to a smoke alarm. Pressing this button, when in test mode, will trigger a test response of the whole system and its integrations.

# HARDWARE



### Detector specifications

**Dimensions**
Width: 125mm
Height: 46mm
Weight: 155g

**Casing**
Color : White
Material: ABS Plastic
V0 - UL Listed Fire Retardant

**Electronics**
100-220V AC / 12-48V DC 4W Supply
IEEE 802.15.4 2.4GHz Wireless Mesh
UL / CE Power Supply
FCC Listed Wireless Module

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