

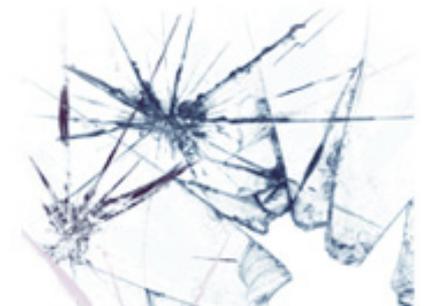
## STENTOFON ANALYTICS

### Introduction

The combination of audio analytics technology with STENTOFON intercom systems provides security personnel with a powerful tool to be able to act fast or even pre-emptively when a threat is detected. The combination allows STENTOFON intercoms and information/help points to automatically alert guards to car thefts or break-ins (car alarm detection), office or building break-ins (glass break detection), verbal and physical violence in hospitals, prisons, reception areas, (aggression detection), and firearm crimes (gunshot detection). These analytics will do what video can't: detect crimes and events by analyzing audio; detect off-camera events or areas where cameras are not located; and detect events regardless of lighting conditions.

The analytics technology is designed to recognize complex sounds by using advanced psychoacoustic modeling, the science behind how humans distinguish and understand the meaning of sound. The CoreLogger™ sound recognition software can detect a variety of sounds depending on the type of Sound Packs™ installed, even with high levels of ambient noise.

The STENTOFON analytics technology is licensed to Zenitel by Audio Analytic, a UK based company which specializes in sound detection and classification. The information in this whitepaper is provided in cooperation between Zenitel and Audio Analytic.



### The different analytics

Different sounds have different characteristics. Detecting these characteristics is the basis on which the analytics work; listening out for the specific characteristics that define the sound. These characteristics do not change, although the sound itself may sound differently to the human ear as this depends on the acoustical properties of the environment.

The characteristics of each type of sound are captured in specific Sound Packs™.

### Breaking glass

The glass break Sound Pack has been designed to allow detection of standard window glass being broken. Breakage of a range of different glass types can be detected, including laminate, plate, wired and tempered glass, as will be commonly found in commercial and residential buildings.

Breaking of glass is characterized by the initial sound of the window being broken, the impact, followed by the glass actually shattering.

Breakage of different thicknesses and sizes of glass have been characterized in the Sound Pack, as well as a range of different "implements" used to break the glass.

The Sound Pack is capable of detecting the following thicknesses and sizes of glass

- Plate: 2.4 mm – 10 mm
- Tempered: 3.2 mm – 10 mm
- Wired: 6 mm (thickness wired glass is typically supplied in)
- Laminated: 4.4 mm - 10.8 mm
- Minimum glass size, all types of glass 300 x 300 mm

The system can detect up to 10 meters from sound source using the microphone of STENTOFON IP-intercom stations. Note in the case of laminated glass protection is only provided if both panes of glass are broken and all types of glass must be mounted in a solid support such as a wall or door.

By using the microphone of a STENTOFON IP intercom station as the detector instead of dedicated glass break detectors there is an added advantage of there being a loudspeaker at that location. When the breaking glass triggers an alarm a guard is now able to warn off the intruders which will in many cases mean that the final damage will be limited to the broken window pane. When used in this way the glass break detection is a true perimeter protection mechanism as, unlike a PIR or motion sensor, it detects intrusion while the person is still outside the property.

This analytic is applicable to any end user application where there is a need to detect break-ins, including retail, commercial offices, hospitals, etc.

## Car alarms

The car alarm Sound Pack has been designed to allow detection of the seven standard types of car alarms used by major car manufacturers.

The seven major car alarms are characterized by looping progressions of specific tonal patterns.

It can operate up to 50 meters from the sound source using the microphone built into a STENTOFON IP intercom station.

In any location with a large number of parked cars, such as a car dealership's forecourt or a poorly lit office or hospital car park, there can be a problem that traditional video surveillance might not detect incidents of car break-in or theft, or conversely, motion detection using video analytics generates false alerts as a result of people moving quite innocently around the vehicles.

Use of audio analytics in such circumstances can greatly enhance system functionality, allowing security staff to be alerted to car break-ins at times when their cameras cannot detect the incidents.

This analytic is applicable to any location where there is a high density of parked cars: for example transportation hubs, stations, airports, car dealership forecourts, shopping malls, offices, hospital or college car parks, etc.

## Aggression

The aggression Sound Pack has been designed to allow detection of aggressive speech or shouting, symptomatic of a developing security incident where staff, customer or resident safety is likely to be compromised.

Aggression is characterized by the specific pitch, tone and intonation changes that occur in the voice patterns in response to someone getting aggressive.

It can operate up to 10 meters from sound source using the microphone of STENTOFON IP intercom stations.

Use of the aggression analytic allows security staff to be alerted to an aggressive incident that video only systems are unlikely to spot. This allows security staff to be alerted to aggressive incidents early, before they develop into actual physical aggression, allowing security staff to provide early intervention and improve staff (or customer) protection and safety. Any location where there is regular interaction between people and where there is the possibility of aggressive behavior can benefit from this analytics capability, for instance a hospital accident and emergency reception desk, retail customer services desk, late night convenience stores or petrol stations, or, e.g. colleges, city centers, prisons, police custody centers, etc.

In addition, detection of aggressive speech/shouting can be used to trigger pre/post audio recording of the incident which can be useful for subsequent prosecution of the offender, and in particular might enable prosecution or exclusion of individuals due to racially or religiously motivated abuse, which would be impossible using video only security systems.

Legislation that prohibits audio recording in public spaces normally allows recording of audio if a security incident has been detected, and hence the audio analytic can provide significant value for staff/customer protection and offender prosecution, without compromising privacy issues. You are advised to check on specific legislation in your region to ensure that recording audio under such circumstances is permitted.

## Gunshots

The gunshot Sound Pack has been designed to allow detection of a range of firearms being discharged, covering the types of guns most commonly used in civilian gun crimes.

Gunshots are characterized by the unique muzzle blast associated with a range of weapons typically used in civilian gun crimes in the Americas, Europe, Middle East and Australasia. The types of weapons are

- Hand guns (including 9mm automatics and revolvers with and without muzzle diffusers)
- Shot guns (including 20-gauge, .410 and 12 Bore)
- Rifles (.22 and 7.62 mm bolt action)
- Automatic rifles (including AK-47, AR-15 and Uzi submachine gun)

Note that this Sound Pack detects the muzzle blast so protection is only provided as long as the weapon is not silenced which is not normally the case with civilian gun crime.

It can operate up to 100-200 meters from the sound source using the microphone built into a STENTOFON IP intercom station.

Incidents of gun crime are increasing throughout the world and systems to detect gunshots and alert security staff is already being deployed, although the majority of these systems are high cost with significant additional installed infrastructure required.

Use of the analytic integrated with the STENTOFON intercom system allows gunshots to be detected by for instance the help points on campuses or throughout city centers providing dual use for such help points. Also intercom stations within premises can be used for the detection of gunshots. This allows security staff to activate the most appropriate emergency evacuation procedures and also direct police to the relevant area of the site/building.

This analytic is directly applicable to college/university campuses, hospital accident and emergency reception areas, late night protection of lone workers in convenience stores, motels or petrol stations, or city centers.

## END USER USAGE SCENARIOS

### Alarm Receiving Centers (ARC)

Alarm receiving centers have a difficult and challenging task detecting and handling responses to break-ins, intrusions and vandalism at many types of locations.

STENTOFON's range of sound detection and classification products can detect specific sounds such as car alarms, glass breakage, aggression and gunshots that can be used to provide alerts to the ARC when one of these specific sounds is detected. This helps the ARC to reduce operational costs by driving down nuisance or false alarms to their monitoring centers while also allowing them to provide a further enhanced value added service driving sales of monitoring channels.

The technology can be used to trigger audio messages/audio talk down, video recording and transmission, alerts to operators as well as turn external safety lights on only when necessary to actively deter criminals.

### Car Forecourt and Auto Dealerships

Car forecourts/dealerships, new or second hand, are particularly prone to larceny, vandalism and damage and are typically monitored by alarm receiving centers out of normal business hours. Use of STENTOFON audio analytics can significantly improve security in these car dealerships, and also reduce nuisance or false alarms and hence reduce operating costs.

This is particularly true in full motion environments, such as a typical car forecourt, where it is required for members of the public to view the cars out of office hours without triggering nuisance alarms to the ARC for this common and benign occurrence; something a video only solution would struggle to do.

However, use of the car alarm Sound Pack allows alerts to still be sent to the ARC if a car alarm is set off in response to damage, vandalism or break in. Additionally a more effective security solution can be provided for non-public back-lots used for storing cars before public display or before delivery to customers. These back-lots typically have good perimeter protection but no lighting, and hence solutions such as thermal imaging cameras have been used to date. The car alarm Sound Pack provides a far more cost effective solution for providing this enhanced protection.

### Education

There are a number of the Sound Packs that can add tangible value to the security system within an educational environment such as a college campus.

Standard intrusion detection measures can be enhanced through use of the glass break Sound Pack to detect windows being smashed to gain access into buildings or in the case of malicious damage.

Vehicle crime in the college car park, including theft and vandalism, can also be mitigated through use of the car alarm Sound Pack, detecting the unique sound of a car alarm 50 meters from the source, even if the event is off-camera or in poor lighting.

In addition aggressive incidents between students or between students and members of staff can be more easily detected through use of the aggression Sound Pack, allowing early detection of such incidents and rapid intervention by security staff.

Incidents of gun crime in college buildings and campuses can also be quickly detected through use of the gunshot Sound Pack, allowing security staff to identify the area of the campus within which the gunshot has been detected, and direct emergency response teams and evacuation procedures accordingly.

### Hospitals and Government Buildings

Use of the aggression Sound Pack provides the means to protect front-line support staff in hospitals and government offices against violent and verbal abuse, and through triggering of audio recording in the event of aggression, allows collection of evidence to support prosecution in the event of racially or religiously motivated attacks not detectable with a video only system.

Zero tolerance abuse initiatives can be supported with compelling legally admissible voice recordings backing up your staff's reports, where necessary, for prosecution.

Standard intrusion detection measures can be enhanced through use of the glass break Sound Pack to detect windows being smashed to gain access into buildings or in the case of malicious damage.

Vehicle crime in car parks, including theft and vandalism, can also be mitigated through use of the car alarm Sound Pack, detecting the unique sound of a car alarm 50 meters from the source even if the event is off-camera or in poor lighting.

Incidents of gun crime, for example in the accident and emergency entrance area, can also be quickly detected through use of the gunshot Sound Pack, allowing security staff to initiate rapid emergency response and evacuation procedures.

### Lone Worker Situations

There are many situations where lone workers are vulnerable to attack, including staff working at late night convenience stores, gas stations or motel reception desks.

For these staff audio analytics can provide enhanced safety and more rapid response to criminal activity.

Glass break and car alarm detection can provide significantly enhanced perimeter and car park security, allowing police to be promptly dispatched in response to an alert being raised at the alarm receiving center.

## Police Custody Centers

In Police Custody Centers aggressive behavior towards police personnel and between detainees can develop easily. People can be under the influence of alcohol or drugs after an evening out and may not behave the same way in which they normally would, resulting in the use of aggressive language and verbal abuse. Other detainees may use threatening language to express their displeasure of having been picked up by the police.

In such cases aggression detection can provide an early warning of developing situations within the detention center, allowing staff to intervene before such situations develop into fights. Use of the aggression Sound Pack provides the means to protect staff against violent and verbal abuse, and through triggering of audio recording in the event of aggression, allows collection of evidence to support prosecution in the event of racially or religiously motivated attacks not detectable with a video only system.

Zero tolerance abuse initiatives can be supported with compelling legally admissible voice recordings backing up police reports, where necessary, for prosecution.

## Prisons

The use of aggressive language can easily develop into a fight between inmates in a prison. Aggression may be racially or religiously motivated, it may also simply be due to a dislike between people. Early detection of aggression can greatly help in preventing such fights or in any case make certain that staff is present as soon as possible to break up any fights which have started.

Aggression may also occur when the inmate is in the cell without anybody instigating this purely due to frustration which can result in self-harm. For early warning in such occasions, cell intercom stations can also be equipped with an aggression detection sound pack.

## Retail and Banking

A number of distinct values can be delivered within the retail and banking environment through use of audio analytics.

Protection of staff from aggressive confrontation by customers, or indeed vice-versa, can be improved through use of the aggression Sound Pack, alerting security staff to developing aggressive incidents or impending robberies, and also providing the means to trigger audio recording for subsequent analysis and evidential purposes.

Protection of premises is enhanced through use of the glass break Sound Pack, delivering traditional intrusion protection at a lower cost and with tighter system integration compared to separate standalone glass break sensors. Detection of gunshots can also enable rapid response police teams to be quickly and appropriately deployed, and allow security staff to initiate evacuation procedures relevant to the location of the detected gunshot.

Protection of car parks in shopping malls is also improved through use of the car alarm Sound Pack, providing greater levels of protection and more rapid security staff response in the event of car break-ins.

## Transport

Aggression detection can protect and support staff in ticket offices against violent and verbal abuse by collecting audio evidence, including racially or religiously motivated attacks that is not detectable with a video only system.

Also audio recording can be triggered for a short period as well as sending alerts when the unique sound signature of someone raising their voice is detected.

Zero tolerance abuse initiatives can be supported with compelling legally admissible voice recordings backing up your staff's reports, where necessary, for prosecution.

Car parks at transportation hubs can also benefit from enhanced security through the use of the car alarm Sound Pack, alerting security staff to thefts and vandalism.

## Performance and Operational Guidelines

STENTOFON's sound detection and classification products have been designed to operate using the microphone which is already available in its IP intercom stations. This enables audio detection within a wide area of the environments within which the intercom station has been installed.

For example, glass break detection operates up to 10m from the source. Aggression Sound Pack allows incident detection within 10m from the microphone, whilst car alarm and gunshot Sound Packs typically operate at ranges in excess of 50 to 200 m respectively.

All Sound Packs have been tested to work up to 30 dB SNR (signal to noise ratio).

In addition, the microphone fitted into a STENTOFON IP intercom station provides more than 120° coverage, subject to location and orientation, and provides the ability to detect sounds independent of lighting conditions or physical obstructions, overcoming many of the short-comings of traditional video based surveillance.

The Sound Packs and therefore the incident detection mechanisms work independently of each other but can use the same audio source. Systems where it is necessary to deploy several analytics in the same location can therefore use the same STENTOFON IP intercom station. Each Sound Pack can trigger its own action and multiple actions can be triggered from a single Sound Pack.