



AKUT[®] Acoustic Tunnel Monitoring

Incident recognition in less than 1 second!



AKUT[®] revolutionises tunnel monitoring using AI-based intelligent microphones.

A critical event is recognised in less than 1 second!

Benefits



Incident recognition in less than 1 second



Automatic activation of the relevant camera



Tunnel stop lights can be immediately activated



Fewer tunnel occupants require evacuation



Localisation of people in the tunnel even with poor visibility



Operator is able to direct tunnel occupants to safe areas even if the cameras are blind



Emergency services can be guided around dangerous areas to rescue people via safe escape routes



Timely warning is preventing traffic congestion in the event of an incident

Detected Incidents

Crash



Tyre Burst



Tyre Squeal



Horn



Door Slamming



Voices



Principle of Acoustic Monitoring

Microphones installed in the tunnel **detect acoustic anomalies** such as collisions, tyre bursts, voices and shouts, etc. **AI-based acoustic detectors** recognise and localise the abnormal sounds in real-time and allocate them to predefined noise classes.

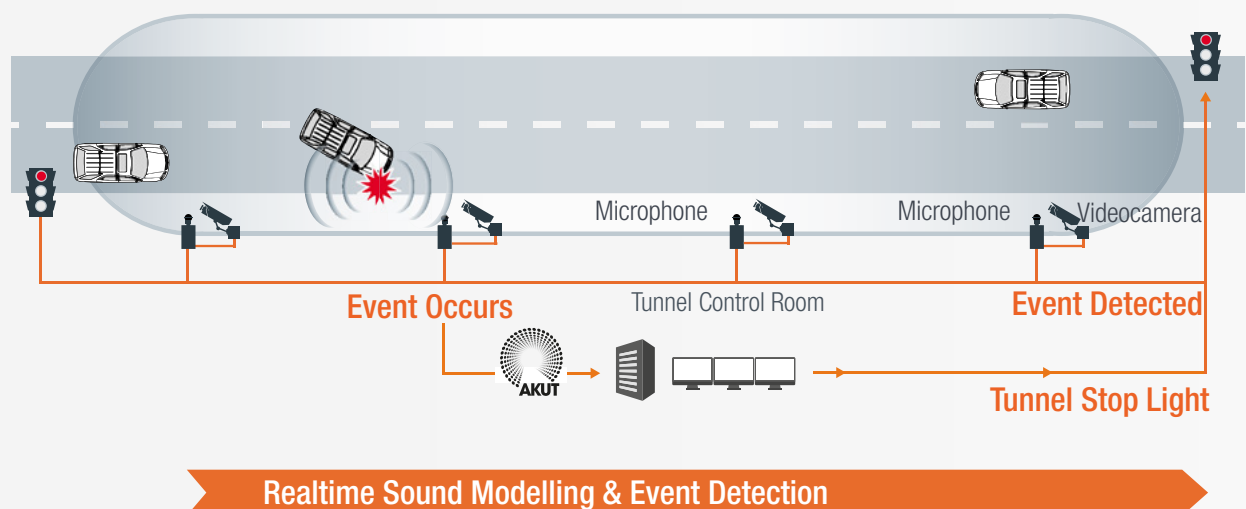
Accidents and other critical incidents in the tunnel are always accompanied by distinguishable sounds. These **sounds occur at the instant in time** of the incident - not after a delay - and can be detected immediately.

The **huge advantage** of acoustic detection is that **AKUT can react directly** to the critical incident (e.g. accident noise after a collision). This means that AKUT can **trigger an alarm** in the traffic management centre just **1 second after the incident**.

Other safety systems usually recognise the consequences of an accident indirectly (e.g. slow drivers, queues, etc.) and hence require a longer amount of time to trigger an alarm.

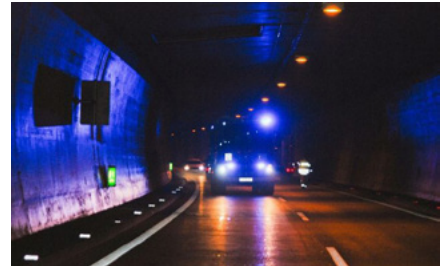
Therefore **acoustic detection** of an incident allows measures to be immediately and **automatically activated**. For example, the system may trigger an alarm in the tunnel control room and **display the video camera image** of the affected section on a central screen giving the tunnel operator a real-time overview of the situation. This **saves valuable time** in **providing first aid** to people involved and in alerting drivers approaching the scene of the accident.

Schematic Diagram



Microphones are installed in the tunnel at a maximum distance of 125 m. AKUT can be installed completely self-sufficiently or in combination with other safety systems. If e.g. a video system is installed, it is advantageous to

install the microphones at the same locations as the video cameras, as costs for cables, optical fibers and the power supply can be saved.

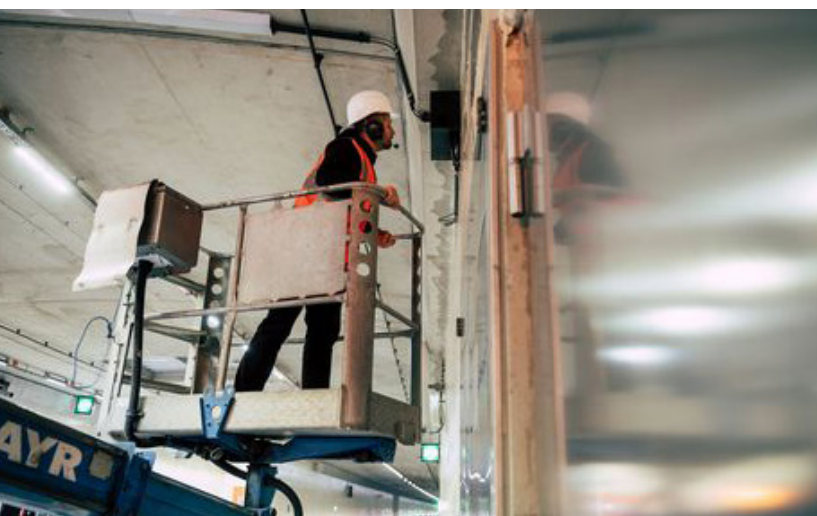


AKUT® Voice Scan

The voice scan is a powerful tool in AKUT for the **detection of people in tunnels**. In the case of a tunnel fire or smoke, even when cameras are already blind, the microphones can detect any kind of speech, screams and voices. The voice scan is **activated in the case of a critical event** by the operator. In this case, all microphones in the tunnel simultaneously scan for speech, voices or shouting people within the signals. In the traffic management system, the operator receives an overview of the entire tunnel and each person detected in the tunnel is

shown on the display. This gives the operator an **immediate overview of the exact locations of people** in the tunnel. Based on this information the operator can **direct the rescue teams** to the exact position of the people.

The **overview display is continuously updated** so that the operator can also see where people are moving in the tunnel even with smoke and poor visibility in the tunnel.



Installation

The microphone is usually installed on the wall **at a height of 3-4 meters**. Wall mounting makes it easier to carry out any maintenance work later. Depending on the profile of the tunnel, the microphone can also be mounted on the ceiling. A rapid commissioning of the system as well as an **extensive acceptance test guarantees the full functionality of the entire system** - starting with the microphone in the tunnel to the rapid alarming and activation of the correct camera image in the control center.



Features



Detection of incidents within 1 second



Localisation of incidents by assignment to nearest microphone



Alarm in the tunnel control room with category, event and camera image



Detection and localization of people through their voices/shouts



Live streaming of sounds and voices from the tunnel

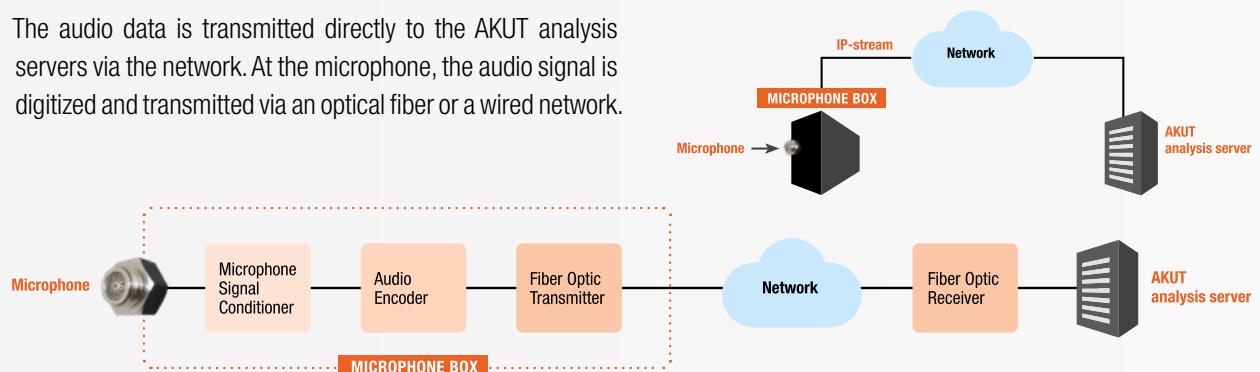


Ring buffer for all microphone signals

System Setup

Option 1: AKUT as Standalone System

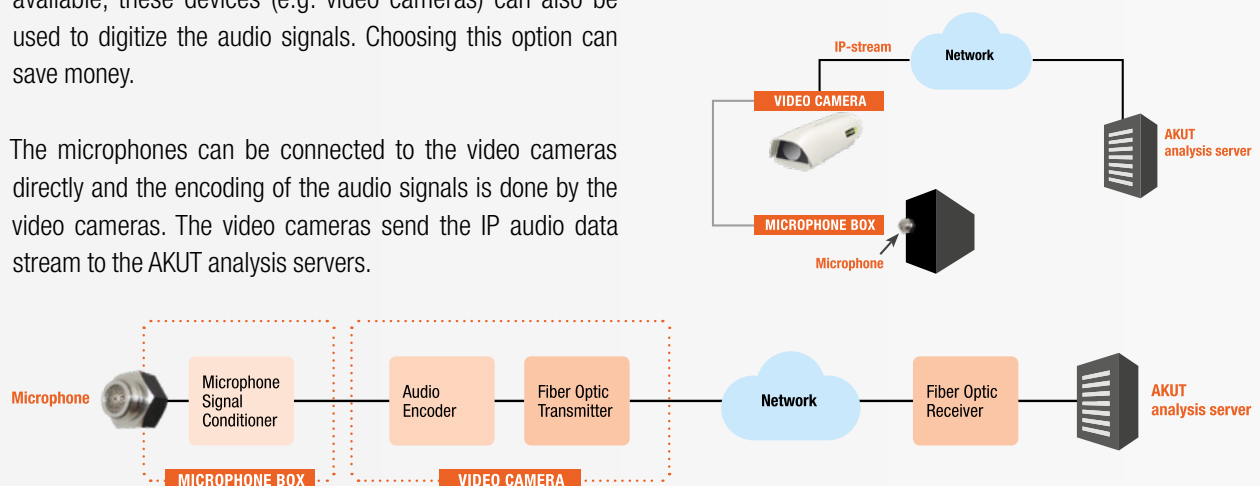
The audio data is transmitted directly to the AKUT analysis servers via the network. At the microphone, the audio signal is digitized and transmitted via an optical fiber or a wired network.



Option 2: Video camera with Audio Encoder

If other devices with an integrated audio encoder are already available, these devices (e.g. video cameras) can also be used to digitize the audio signals. Choosing this option can save money.

The microphones can be connected to the video cameras directly and the encoding of the audio signals is done by the video cameras. The video cameras send the IP audio data stream to the AKUT analysis servers.





1.800
microphones
are currently in
tunnels in **24/7**
operation



140 km of tunnels in Europe
are **equipped with AKUT®**

Highlights



Longest tunnel equipped with AKUT

Arlberg tunnel

15,516 m



Shortest tunnel equipped with AKUT

Pernau tunnel

268 m



Tunnel with the largest number of microphones

Plabutsch tunnel

282 microphones



Tunnel with highest DTV

Kaisermuehlen tunnel

DTV: 110,000

References

2010

Kirchdorf tunnel (pilot system)
2,807m, 49 microphones

2015

Ehrentalerberg tunnel
3,345, 75 microphones

Lendorf tunnel
800m, 20 microphones

Trettnig tunnel
450m, 12 microphones

Falkenberg tunnel
1,090m, 26 microphones

Bosruck tunnel
5,505m, 122 microphones

Götschka tunnel
4,435m, 86 microphones

Pernau tunnel
245m, 4 microphones

Neumarkt tunnel
1,970m, 38 microphones

Lest tunnel
545m, 12 microphones

2016

Oswaldiberg tunnel
4,302m, 119 microphones

Kroislerwald tunnel
679m, 19 microphones

Liefering tunnel
503m, 14 microphones

Flirsch tunnel
1,126m, 19 microphones

2017

Arlberg tunnel
15,516m, 175 microphones

Gleinalm tunnel, 1st tube
8,436m, 119 microphones

Wilten tunnel
509m, 13 microphones

Klaus-Spering tunnel
2,031m, 46 microphones

Dalaas tunnel
1,810m, 19 microphones

2018

Southwick tunnel
490m, 10 microphones

Kollmann tunnel
633m, 16 microphones

Kaisermühlen tunnel
2,134m, 97 microphones

Wald tunnel
2,826m, 65 microphones

Spering tunnel
2,870m, 62 microphones

2019

Plabutsch tunnel
9,989m, 282 microphones

Gleinalm, 2nd tube
8,426m, 118 microphones

Mils tunnel
1,752m, 42 microphones

2020

Amras tunnel
845m, 24 microphones

BinderMichl tunnel
1,065m, 58 microphones

Niedernhardt tunnel
580m, 22 microphones

2021

Rannersdorf tunnel
1,630m, 68 microphones

Voesendorf tunnel
901m, 36 microphones

Amberg tunnel
3,125m, 75 microphones

Kirchdorf tunnel
2,807m, 49 microphones

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