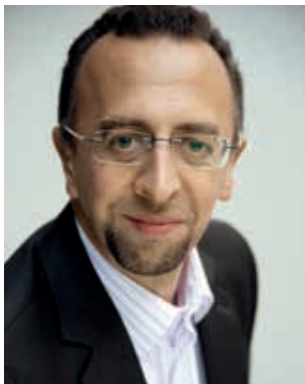


# Why mass warning and notification systems still need sirens

Mass or early warning systems are becoming increasingly important due to the rising number of natural disasters. The core of a mass or early warning system is the siren – despite modern technologies, sirens are the only component that reliably reaches everyone in the danger zone, if the power grid, mobile radio or Internet stop working.



**Martin Graf**

**M**ass warning and early warning systems are on the rise worldwide, mainly because of the increasing number of natural disasters. Existing systems are being brought up to date or completely new concepts are being implemented. If there is no instrument to reliably warn the population, the effects are often devastating. The tsunami in the Indian Ocean cost 230,000 lives in December 2004, and in Haiti 138,000 people died in an earthquake in 2010. In both cases, warning the public did not work efficiently.

The UN, which published these figures in autumn 2020, assumes an increasing number of natural disasters. They have almost doubled in the last 20 years, brought about by climate change. Despite increasing industrialisation

and investments in infrastructure, the effects are often devastating. Especially in rural and less-developed areas with high population density, the mortality rate remains high. Accordingly, many institutions are working on risk prevention and mitigation. The analysis by David Rogers and Vladimir Tsirkunov on the costs and benefits of early warning systems and public alert systems published by the World Bank in 2010 is well known. The two authors conclude that early warning systems are extremely important, especially in poorer areas where there is less investment in infrastructure. The term 'early warning

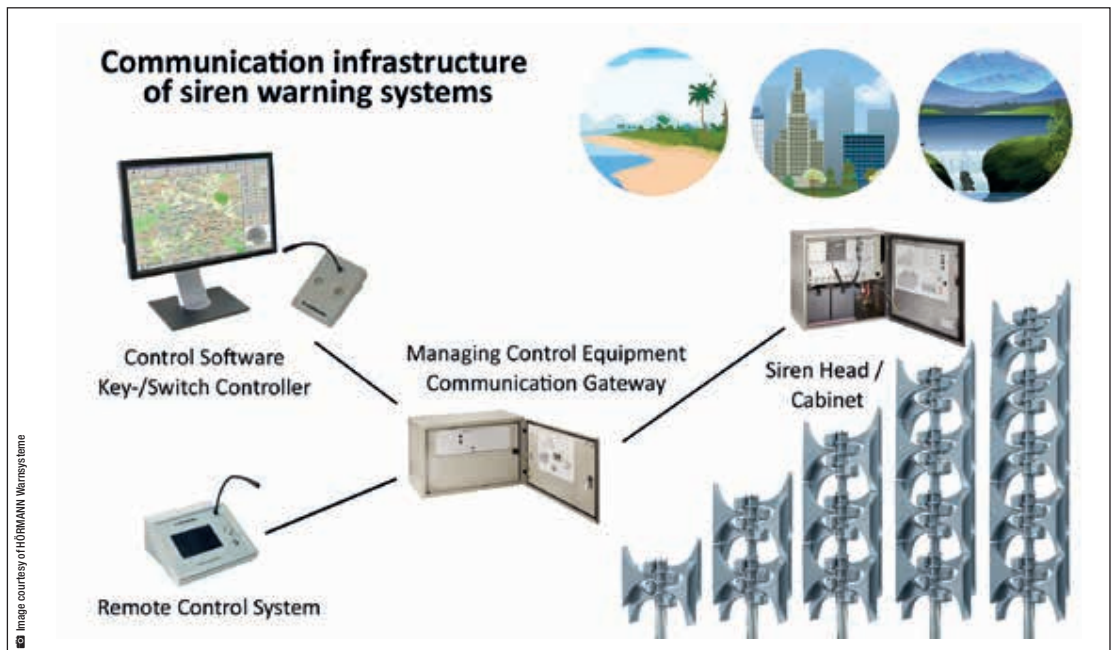
▼ Solar panels charging the battery ensure that a siren works reliably even in the case of a power failure.

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Image courtesy of HÖRMANN Warnsysteme

► Control stations communicate via at least two different communication channels (GPRS, TCP/IP, radio) via the MCE gateway with the siren control cabinet, to ensure the alarm is triggered reliably.



system' has become synonymous with mass warning system, especially in relation to systems to warn of events such as tsunamis, floods or earthquakes.

Mass warning systems are at the core of responsible disaster and risk management, as they provide the technology to warn people in time of a dangerous event and thus reduce the damage and possible fatalities. After all, one of the main tasks of a government and administration is to ensure the protection of its people, property and environment.

These hazards are very individual. While in the Pacific Ring of Fire and the Indian Ocean there is mainly the danger of tsunamis triggered by earthquakes; in other countries it might be hurricanes, volcanic eruptions, flooding due to heavy rain, dams or nuclear power plants, but also bush fires as in Australia and possible terrorist attacks that are included in the risk assessments. Warning centres often collect and evaluate information beyond national borders. One example is the Pacific Tsunami Warning Center in Hawaii, which monitors activities in the entire Pacific region and passes the information on to the national agencies of the riparian states.

This quickly makes it clear: there is no such thing as an off-the-shelf mass or early warning system. Each warning system is individually planned and tailored to the respective needs. Thus, in addition to the type of risks, the geographical conditions, existing infrastructure,

population density, etc. must also be taken into account. In a city, people are easier to reach than in the countryside and in remote coastal or mountainous regions. The premise, however, is that all people in the regions at risk must be warned as quickly as possible and must also know how to behave.

To ensure this, a mass warning system usually consists of a mix of different communication media. First and foremost, the siren is a reliable medium for alerting and informing. This is supplemented by telephone and mobile phone networks, radio and TV, Internet with corresponding apps, email, social media, etc., public display boards or loudspeakers.

With the increasing spread of the Internet and the high availability of GSM networks, it seems simple and logical to rely on these communication media first. However, it often turns out that neither the reliability is given nor can everyone be reached. Indeed, a side effect of natural disasters is that the power supply collapses in many cases. Radio, TV, Internet, telephone and often the mobile network no longer work. Or people didn't turn it on. It is imperative to also use components that are operational independently of the power grid and work without relying on the public to have this item activated. That is why, despite all the technologies that seem more modern at first glance, nothing works without sirens. They operate on battery power, warn the population reliably even in the event of a possible power failure and are therefore

an indispensable component of a mass warning system. Sweden, to name just one example, has a nationwide public warning system with approximately 176 siren control centres and 4,380 sirens, which are mounted on fire brigade buildings or housed in fire stations, among other places.

While the earlier sirens could only produce the typical wailing sound, modern electronic sirens work with digital amplifiers. They not only produce the typical alarm sounds, but are also able to play recorded messages or live announcements, thus not only alerting but also informing the population. Especially in the remote and sparsely populated areas of South America, the Pacific or Asia, sirens are therefore indispensable. High battery capacities ensure that the alarm signals and information can be triggered at any time and also reach the people on the ground safely.

When it is necessary to warn people, the following sequence is common. First, a siren wails. This alarm sound creates a so-called wake-up effect. Afterwards, people are given further information on how they should behave, such as being told to leave the area. Loudspeakers or predefined or live voice announcements via the sirens but also means such as telephone, TV, radio, etc. are used here.

At the centre of a mass or early warning system is the communication centre. This is where all the information comes in and where the warning means are controlled, including the sirens. This



◀ The island state of Vanuatu warns its population with sirens in case of a tsunami.

is one of the key points why the siren is so indispensable. To ensure that the siren can be triggered in any situation, Ecuador even uses four independent communication media through which each siren can be addressed as desired: TCP/IP, digital radio, GPRS or satellite. At least two are always recommended.

The UN is making great efforts to support countries at risk from natural disasters in setting up population warning systems. But mass warning systems are also considered an important investment in the safety of the population outside of earthquake- and tsunami-prone areas.

In Germany, for example, responsibility for civil protection and thus for warning the population lies with the federal states. Only civil protection in the event of war or defence is the responsibility of the federal government. However, the federal government provides a Germany-wide infrastructure called MoWaS, which connects the individual systems. One focus here is on the warning app NINA and the service KATWARN, which warn the population via modern communication media such as mobile and the Internet. In addition, the classic information channels such as TV and radio are integrated. Many municipalities also operate sirens to alert the voluntary fire brigade or industries at risk in the vicinity of major accidents.

In the course of the ever-increasing spread of the Internet and mobile telephony, the question arises again and again: does a population warning system still need the siren as a means of alerting at all? Mass and early warning systems must function in an emergency. That is why multi-channel communication has proven its worth. However, these modern technologies have the disadvantage that they rely on every person having the appropriate devices and access to them and also having them switched on 24/7. If the network breaks down, even those who have their devices ready to receive are no longer reached. Sirens are unaffected. Independent of the power grid, they reliably alert and inform people in any situation.

control infrastructure for the sirens exists in many different forms: centralised, decentralised, hierarchical, etc. It is important that the triggering of the sirens, as the most important warning system on the front line, is reliable and targeted. Regardless of how the control infrastructure is set up, the alerting can always be controlled in such a way that it triggers only individual sirens or sirens in specific regions. Further, it is important for reliability that there are at least two different channels for controlling a siren, such as TCP/IP, radio, GPRS, etc.

Ecuador, for example, protects its population with a very comprehensive tsunami and flood warning system that is controlled and managed by two main control centres and four regional control centres. Electronic measuring devices on the seabed (DART buoys) and on land monitor seismic activity and water levels. Then 182 electronic sirens alert the population to imminent danger. These are supplemented by loudspeaker announcements. Signposted assembly points and escape routes are intended to ensure that the population reaches higher safety zones in good time.

The sirens are located not only along the coast but also along the danger zones of dams. The ideal locations and the power required depend on the terrain. The flatter the terrain, the better the sound

propagates. Buildings or vegetation also have an effect. For example, a forest has a very dampening effect, a tall building creates a sound shadow behind it. Thus, the sound pressure values dB(A)/30m mean the volume measured at a distance of 30m from the sound source. The volume decreases logarithmically with increasing distance. Background noise also has an effect on perceptibility. Thus, not only in Ecuador but in tsunami warning systems in general, it is important that the sirens can still be heard even by fishermen near the coast.

Sirens reach a volume of up to 123dB(A)/30m. The sound is produced by a digital amplifier in conjunction with up to 20 siren horns, which are usually arranged at 180 degrees. The shape of the horn design makes use of Huygens' principle of slit diffraction: although the siren horns appear to emit sound in only two opposite directions, an omni-directional sound wave is generated and the siren signal is audible 360 degrees.

Electronic sirens have the advantage over their predecessors in that they do not necessarily have to be connected to the mains. The siren is powered by a battery. The battery, in turn, can be charged from various sources, such as solar, wind, generator or the mains. The batteries always buffer enough energy for an evacuation scenario. This

Image courtesy of HOERMANN Warnsysteme

▶ For more information, go to [www.hoermann-ws.de/en](http://www.hoermann-ws.de/en)