

Smoke Alarm Devices and Smart-home Systems

How will a Shared Future look like?

Ulrich Rabe

VdS-Schadenverhütung, Cologne, Germany

Abstract

The past few years have seen rapid developments in smoke alarm device technology. Particularly their integration in smart-home systems is a current and important topic. However, while technology has developed considerably, the corresponding standards and guidelines have not significantly changed since 2005.

This paper looks at the additional requirements that smoke alarm devices which are integrated in such smart-home systems have to fulfil. These requirements are also the main topic of the soon-to-be-published part 3 of VdS guidelines 3438, which sets out to close to some extent the gap between what is technically possible what is actually covered by the guidelines.

Keywords: Vds 3438 part 3, smoke alarm devices in home protection management systems, smoke alarm device as network component

Market perspective

As the last federal state, Berlin has now also decided to make the installation of smoke alarm devices mandatory [1]. Germany thus follows the example of other countries to make it a legal requirement for private households to install smoke alarm devices [2]. The primary aim of this requirement is to protect citizens in the case of fire by increasing the chances for self-rescue, also during sleep. The Sulzburg study about the mandatory installation of smoke alarm devices [3] shows that the legal requirement to install these devices leads to significantly positive results.

A side effect of the nationwide legal requirement to install smoke alarm devices is the creation of an enormous market for these products.

As the functional principle and the sensor technology of smoke alarm devices are well known and are technically sophisticated,

manufacturers now try to add additional benefits to their systems to differentiate themselves from competitors by connecting smoke alarm devices to other home technology applications and/or devices. These networks are also called home protection management systems [4] or smart-home systems. According to various studies, this market will see a double-digit growth in the next years not only in Germany, but worldwide [5][6]. This topic thus gains in importance on a global level.

Legal perspective: Standardisation and approval

Within the European Union and with that in Germany, smoke alarm devices are categorised as construction products and are thus covered by the EU's construction products regulation. According to this directive an independent body has to test the products and confirm compliance with the requirements of the harmonised standard EN 14604:2005. This is a prerequisite for receiving the CE-mark and thus being allowed to be sold in EU markets [7].

The currently valid product standard for smoke alarm devices dates back to 2005. However, the last 12 years have seen a rapid development in the networking of devices and in the creation of new applications. In the current version of this standard, smoke alarm devices are considered as independent devices, without connected indication and control devices. The standard explicitly allows the interconnection of smoke alarm devices but remains very vague on all further function possibilities. While it allows to provide for connections to external ancillary equipment (e.g. remote indicators, control relays, cross-linking equipment), it clearly states that open and short circuits are not allowed to impair the correct functioning of the smoke alarm device [8]. This description leaves much room for interpretation, especially concerning the testing for compliance with this requirement, as it does not include a description of the test procedure.

Up to now all additional functions have been viewed with suspicion and have only been accepted if they have no repercussions on the smoke alarm device. Having no repercussions in this context means that these additional functions and devices are not allowed to impair the correct functioning of the smoke alarm device. Fault and alarm signals must not in any case be disabled.

Only cross-linked smoke alarm devices are allowed to, or rather have to, transmit alarm and fault signals to each other - as required in VdS guideline 3515. Strictly speaking, this means that the function of a smoke alarm device is influenced by another device (in this case by another smoke alarm device), as it emits an alarm although it has not itself detected a fire. However, in this case this influence is legitimate, as it regards the signalling of a fire alarm [8][9].

Technical perspective

What are the future developments of smoke alarm devices?

Today smoke alarm devices can be cross-linked in a network in which fault and alarm signals can be transmitted to all participants. This ensures that all persons can be alerted in an opportune time in the case of fire, even if the fire is in infrequently accessed areas (e.g. attic, basement) [8]. Even though this is not a legal requirement in Germany, owners often opt for this measure. It is also currently possible to monitor smoke alarm devices via an application which allows for example to monitor the battery status or to transmit an alarm signal to a mobile terminal. In this context smoke alarm devices are also integrated into a network with other building technology components which avoids having to equip each network participant with an individual application. However, the current guidelines and standards do not include any requirements or tests methods for these applications.

The obvious next step is to enable smoke alarm devices to not only emit fire alarms, but also alarm signals from other network participants: If there are intruder protection products like glass-break detectors in addition to smoke alarm devices, the sounding device of the smoke alarm device can, if necessary, be triggered to acoustically signal a burglary.

The German Electrical and Electronic Manufacturers' Association (ZVEI) is currently discussing the usage of smoke alarm devices in civil protection, e.g. in the event of disasters. The idea is to enable the smoke alarm device by means of an additional chip to emit an alarm in the case of events that lead to major damage [10].

This function may even be improved by voice output. Instead of only emitting an alarm sound, the smoke alarm devices may then actually speak, thus being able to effectively warn people of dangers or alert them of faults. This feature becomes even more important as networks become more complex with a large variety of different components. It would allow for a more precise differentiation and therefore better localisation of alarm and fault signals.

As voice control technology has become more and more sophisticated in recent years, the application of these modules in smoke alarm devices is a foreseeable step. If voice control modules are combined with a speaker system, home owners can interact with their house technology and, for example, request the regulation of room temperature or the operation of blinds and shutters. As building technology systems can be connected to the Internet, the data transfer is not limited to the building. However, this in turn involves the risk of external interference.

Unlike other building technology components, smoke alarm devices already have a sound-emitting component, which is essential for a voice-control-based dialogue. It is therefore more cost-efficient to use a smoke alarm device than to retrofit other components. As an installed smoke alarm device is now a legal requirement in Germany, each household is now equipped with at least two devices. This makes smoke alarm devices particularly suitable for this technical development.

How does this impact guidelines?

In view of this potential and all the technical developments we should not forget why the installation of smoke alarm devices has become a legal requirement: Their purpose is the detection and warning of fire. This remains and must be their primary and mandatory function while all other functions and components are secondary. It has to be guaranteed that a smoke alarm device always fulfils its primary and mandatory function and that this always has the highest priority. After all, it is a matter of life and death. Compared to the other components of smart-home systems, smoke alarm devices always have the highest safety relevance (see figure 1), and this always has to be taken into consideration.

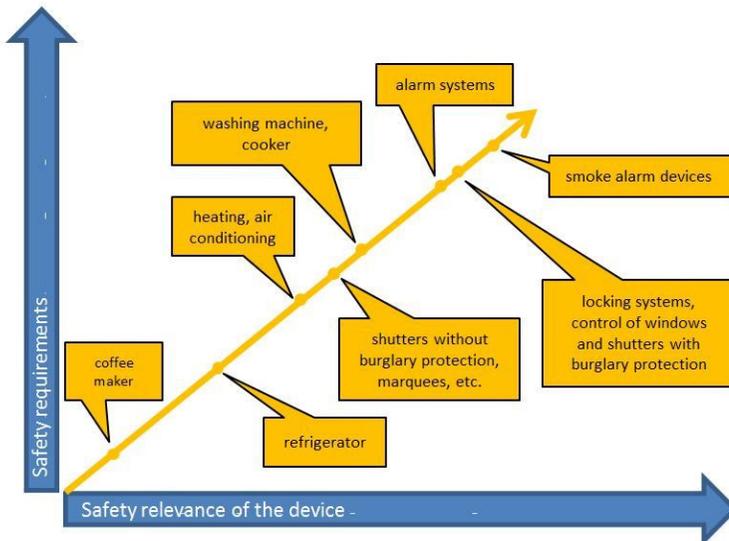


Figure 1. Safety relevance of smart home device.

As described above, the existing standard is of not much help if we want to look at the use of smoke alarm devices beyond their core function. In the current version of the standard, smoke alarm devices are regarded as independent functional units and the above-described development is not taken into consideration. However, it became clear

that due to technical and functional developments smoke alarm devices now often take on the function of a network component. This results in additional requirements which are described in the following paragraphs with regard to smoke alarm devices on the one hand and with regard to the network on the other hand.

How does this impact smoke alarm devices?

When a smoke alarm device becomes a component in a network, it receives a wealth of additional information which needs to be processed, i.e. fault or alarm signals from other network participants. Naturally, not all the information can be processed simultaneously, but must be arranged in a sequence. For smoke alarm devices the detection and warning of fire always has the highest priority, and this also applies to the processing of information. Smoke alarm devices must be able to differentiate between incidents and must make sure that fire incidents always have priority over any other incident and fire alarms always take precedence over other information. Fire alarms must never be displaced by other signals. The opposite is true for all alarms and signals that do not concern fire: They must be displaced by fire alarms; e.g. a burglar alarm signal must be overruled by a fire warning. After all, everyone present must be warned of a fire, including burglars.

This also means that fire alarms must always be clearly distinguishable from all other acoustic signals. It is absolutely necessary to ensure that fire alarms can always be identified as such. An alarm signal that is mistaken could in the worst case induce people to go into the danger zone instead of evacuating it. Without breathing protection this could quickly lead to carbon monoxide poisoning, which would be counteractive with regard to the smoke alarm device's protection objective.

Furthermore, smoke alarm devices must continue to function independently. This means that even if the whole network collapses and all participants are disconnected, smoke alarm devices must remain operational. In some fire detection and alarm systems in accordance with EN 54-13 the detector is only responsible for providing data and not for its evaluation with regard to the existence of fire, which is realised via control and indicating equipment. This however, is not allowed for smoke alarm devices that are integrated in smart-home systems. As smart-home systems are not required to have a redundant power supply, a power failure could lead to a complete breakdown of the entire network. Only smoke alarm devices that have their own independent and verifiable power supply can remain operational in the case of a network failure. Another aspect that needs to be considered is the lack of exclusive transmission paths in smart-home systems. It is therefore not guaranteed that information can always be received [12].

How does this impact networks?

Smoke alarm devices are increasingly used as components in a network. But what kind of network is this? It is clearly not a fire detection and alarm system in accordance with EN 54-13, because - as shown above - some decisive characteristics are lacking, e.g. an exclusive transmission path [13]. In fact, it is a building network which can be accessed from anywhere in the world via the Internet. This also means that the topic of sabotage, e.g. hacker attacks, has to be addressed. While a disabled burglar alarms system primarily puts material assets at risk, the consequences of a disabled smoke alarm device can be fatal.

Conclusion and outlook

It is absolutely necessary that standards and guidelines keep up with the rapid technological development. However, the reality looks quite different: Already today there is a big gap between the theoretical world of the guidelines and the actual practice. Guidelines which are in line with the state of the art are needed to guarantee consumers that the smoke alarm device which they purchase in order to be protected against fire still fulfils this function and can be relied on. VdS Schadenverhütung has now addressed this task and will soon publish part 3 of VdS guidelines 3438, which deals precisely with the integration of smoke alarms devices in home protection management systems. From our point of view it is wrong to categorically rule out the possibility of cross-linking smoke alarm devices with other home protection products. This, however, was the case until now, while the cross-linking of smoke alarm devices to each other has already been allowed. This is why the new guideline not only looks at networked smoke alarm devices as providers of information, but also takes into account the possibility to use the devices' alarm transmitter for intrusion protection.



Figure 2. Scope of VdS 3438 part 3 [11]

Here the requirements are basically as already described above:

- The detection and signalling of fires always has the highest priority.
- The fire alarm must always be clearly distinguishable from all other signals.
- Smoke alarm devices must under any circumstances continue to function independently.

The basic product requirements as stipulated in EN 14604 or the corresponding VdS guideline VdS 3131 remain unaffected [8] [14]. Our aim was to somewhat reconcile guidelines with the state of the art, nevertheless proceeding with caution. The focus must always be on the protection target.

We will certainly gain further insights, also with regard to the integration of conventional fire detection and alarm systems in building technology systems. The topic of protection against unauthorised access and sabotage also needs to be addressed. Either way, the publication of VdS guideline 3438 is the first approach to combine a fire protection product with security technology products. The task ahead now is to gather experience and to look at and eventually include more components - while always focussing on the protection target. Only then can the gap between the state of the art and the guidelines be gradually closed.

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