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Current Trends in Environmental Noise Monitoring in Europe

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Abstract

This paper briefly describes the state of the art of environmental noise monitoring development in Europe, including the needs, standards, legislation, data, technology, techniques and tools. This paper will concentrate on the following areas:

- How Imagine and the development of ISO 20906 and ISO 1996 affect noise monitoring systems
- The need and role of professional databases and the move towards noise management
- How modern technology affects the design of state-of-the-art noise monitoring systems
- Important design factors in noise monitoring terminals

Keywords: noise monitoring systems

1 The Effect of New Standardization on Noise Monitoring Systems

1.1 Overview

The Imagine project [1] and the development of ISO 20906 aircraft noise monitoring [2] and ISO 1996 environmental noise assessment [3] standards affect noise monitoring systems.

1.2 The Imagine Project

One of the work packages in the European Imagine project, due to be completed at the end of 2006, will define measurement methods that can be used to demonstrate the reliability of calculated noise maps using measurements. The harmonized noise mapping indicators, L_{DEN} and L_{Night}, are long-term (annual) average levels due to a specific source category (road, rail, aircraft or industry) at 1.5 or 4 m height, corrected to average weather conditions [4]. This affects how levels are measured:

- Noise monitoring must be used in order to measure statistically representative long-term levels, e.g. weekday night-time levels, weekday rush hour levels, etc, even when shorter measurement periods are used. These can be combined to provide annual average levels. If operation conditions (e.g. traffic flows) vary, then they also may need recording while measuring noise.

- As the levels required are source-specific, residual noise (i.e. noise from other sources) must be insignificant, placing demands on measurement position, or removed in some qualified and documented way. Specific noise extraction can be done in several ways, the most well-known of these being event detection triggered by the actual acoustic signal
- The measured levels must represent long-term average weather conditions (i.e. weather conditions that are typical over a 10 year period). Unless close to the major source, this will require weather data, representative of both the average and for the actual measurement period so that noise levels can be corrected to be representative. This data could come from local meteorological stations, if available, but may need to be measured at the noise monitoring site

A cost-effective mobile system could cover several positions over a year. Automated position reporting, based on GPS technology, would be beneficial and reduce the risk of human error.

1.3 ISO 20906 Aircraft Noise Monitoring and ISO 1996 Environmental Noise Assessment

The ISO 3891 airport noise monitoring standard from 1978 is being revised as ISO 20906 to match modern requirements and possibilities. It is currently available as a Committee Draft. Although only for airports, the standard contains a range of guidance suitable for all noise monitoring applications and for other event-dominated sources (e.g. railways). It identifies, among other things, instrumentation compliance requirements, the requirement for regular system integrity checks such as Charge Injection Calibration (CIC), and minimum requirements for noise source classification.

The ISO 1996 standard is also under revision. Part 1 that covers definitions is already published while Part 2 that covers the actual assessment techniques is currently a Draft International Standard. As a general purpose standard, it does not specifically cover long-term measurements but identifies several overriding aspects that place demands on noise monitoring systems including microphone positioning, quantifying the uncertainty of environmental noise measurements, requirements to documentation (of the system, the site and the measurement conditions), and determination of favourable propagation conditions including brief guidance on what weather data to measure.

2 Noise Management

Increasing noise exposure is today a serious problem for most cities and, high focus is currently put into monitoring and calculating actual noise exposure levels to understand the size of the actual problem. So far, most cities have been either monitoring or calculating noise exposure levels but the trend today is to combine the results from both worlds. Today, combining measured and calculated noise values is a slow, manual process. Therefore, an increasing need for systems to improve these work processes resulted in development of the concept of noise management systems [5].

The basic idea of a noise management system is to have a single system enabling management of environmental noise data and interaction between measured and calculated noise data [6]. Thus a typical noise management system will have functionality for handling the attached noise acquisition devises (set-up, download, etc), storage and retrieval of noise data in database, post-processing and reporting tools, and finally easy import/export of data from/to noise calculation software. The many features and amount of data handled put high requirements to the design and implementation of the system. In the following sections some of the different implementation aspects will be discussed.

2.1 Design of Noise Management Systems

A number of aspects like software architecture and implementation design/technologies are important when developing new noise management systems [7]. These aspects are normally not visible for the end user, but can be crucial for securing the future development of a system.

Software architecture is the general splitting of code in different logical units. Although this sounds simple and straightforward, designing the right software architecture is not a trivial task. A modern software architecture, on the other hand, gives a number of advantages, e.g.:

- Improved security handling
- Easier to maintain and extend the functionality of the system
- Scalable system
- Easier customization

Fig. 1 shows an example of the overall architecture for a 3-tier solution including a database. In a 3-tier solution, the database layout is completely hidden for the client. Consequently, if properly implemented, it will be possible to make changes in the database layout without affecting the client implementation. Due to its importance, good architecture should be designed at the beginning of the overall development process and the design continuously updated.

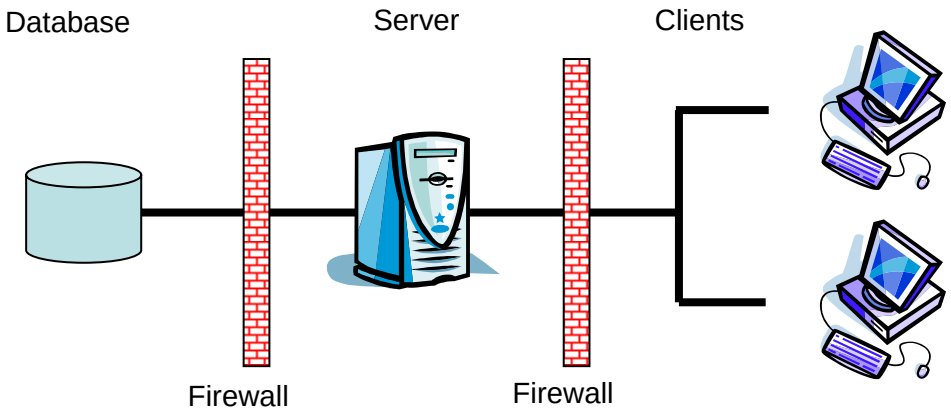

Fig. 1. Modern 3-tier client-server architecture

It is also import to adapt to the latest implementation technologies, e.g. the .NET from Microsoft®. The use of the latest technologies enables access to the latest features and benefits (e.g. .NET gives a high number of implementation and deployment benefits) but the cost is often increased development time and cost especially when using the first generations of the new technology.

2 .2 Databases in Noise Management Systems

A professional database, handling all the data from the attached acquisition devices, is an essential part of any modern noise management system. Besides having the needed functionality of a modern database it is important that the database vendor has an evolution path for continuous development of the database technology. Without this, future upgrades of the noise management system for better functionality and performance will be difficult.

In the past, the communication between the noise monitoring terminals and the noise management system was the bottleneck in most systems but the latest communication technologies now makes it possible to download a lot of information. Thus, it is important that the system handles data efficiently, without significant performance degradation with increasing amounts of data.

Easy customization is another important aspect of modern noise management systems. This means a flexible database design enabling additional customer specified information elements. Although inclusion of additional information elements in the database sounds straightforward, it can be difficult and, in some implementations, require major redesign of the system.

The last but not least important part of the noise management systems database implementation is the security handling. In the future, there will be an increasing need to have remote access or even public web access to some of the data making security handling crucial. Therefore it is important to have an advanced security model implemented enabling control of the user access rights to the data in the database. This reduces the risk of access to sensitive data without proper authorization.

2.3 Noise Monitoring Terminals

An important part of noise assessment is the actual measurement of the noise levels done using noise monitoring terminals (NMTs). A NMT is basically a sound level meter that is optimized for longer-term unattended measurement, protected from interference and the environment inside an enclosure usually together with independent power, remote control and download facilities.

There are many, often conflicting requirements to the ultimate NMT. Analysis capability requires power that may not be available at the desired monitoring location. Protection against climate and interference may also conflict with the desire for a small, inconspicuous, possibly portable unit. The list of possible requirements is long, made more complex by the myriad of different applications. There are also some significant trends affecting their design:

- The acoustic requirements to and analysis capabilities of NMTs are increasing. At the same time, there is an increasing and opposing demand on increasing the number of simple NMTs
- The size and power consumption of noise measurement and analysis tools is decreasing
- Analysis is becoming more software based
- The cost of custom-built cabinets is becoming lower

With increasingly capable, low-power platforms available due to mobile phone and PDA developments, NMTs themselves can be much smaller. On the other hand, many analyses, for example for source identification, still require larger, more power-hungry systems, or space for additional accessories. With software-extendable analysis platforms, a modular concept, also for hardware becomes attractive. Provided the number of units produced is large enough, a modular cabinet concept, dedicated to solving the major issues of protection against interference and the climate, that can cope with different protection, analysis, communication, accessory and mounting needs while keeping size and weight to a minimum, becomes commercially viable [8].

3 Conclusion

This paper has briefly described the state of the art of development of environmental noise monitoring in Europe, concentrated on the following areas:

- How Imagine and the development of ISO 20906 and ISO 1996 affect noise monitoring systems
- The need and role of professional databases and the move towards noise management
- How modern technology affects the design of state-of-the-art noise monitoring systems
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The importance of data management and the use of professional, integrated tools is expected to increase due to the needs to ensure data security and the efficiency of tools, data and resources, and the desire to efficiently exploit the potential offered by improved data and result quality.

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