

Designing a Short-Term Noise Monitoring Service

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Quite often, noise monitoring is required for shorter durations in connection with environmental impact assessments, limit compliance investigations, troubleshooting, etc. This requires rapid response and deployment of equipment for shorter periods at new locations where the system needs to be set up for correct data acquisition in accordance with the legislation, standards and location-specific issues for the sources under investigation. At the same time, it is beneficial to have secure, real-time storage and real-time access to data from any monitoring device to allow the user to monitor both the noise being measured and the status of the equipment. To reduce operating costs and to optimize investment, today's technology offers new services that can offer savings if they can be made scalable to fit a wide range of applications over a wide geographical range. Available technology includes cloud-based solutions, web-based ordering and system administration, and the use of smart phones. Such a solution must meet several challenges, including rapid deployment and setup, ease of access (ordering/shipping, setup and return to base). This article describes some technical, logistical and other challenges for providing a global professional, cost-effective solution for on-demand noise monitoring and describes recent progress.

Noise monitoring services have increased in importance and availability over recent years, driven by developments in the Internet and mobile communications and resolution of the four main challenges of noise monitoring – operation, measurement, technology and financial.¹ We have previously published conference papers¹ on how these challenges can be met by noise monitoring services from specialist service providers who offer the benefits of a professional solution that eases the task of noise monitoring, provides high-quality results and simplifies financial matters.

Initially, many of these services are delivered as projects with the involvement of specialist staff to ensure prompt and accurate delivery of the service and offer high levels of service that, in turn, often involves significant resources for setup. To be commercially viable, this has meant that managed service contracts must be multi-year.

However, noise monitoring is also required for shorter durations in connection with environmental impact assessments, limit-compliance investigations, troubleshooting, etc. This can be accommodated in this situation provided that the user/client is willing to commit to multi-year contracts and that the instrumentation is frequently used, thus optimizing the cost per hour of data. However, there is a need for providing the benefits of a managed service for shorter contracts to match short-duration noise monitoring projects.

Short-duration noise monitoring often requires rapid response and deployment of equipment for shorter periods at new locations where the system needs to be set up for correct data acquisition in accordance with the legislation, standards and location-specific issues covering that particular application. At the same time, it is beneficial to have secure, real-time storage and real-time access of data from any portable device to enable the user to monitor both the noise being measured and the status of the monitoring units. If the service can be made scalable to fit a wide range of applications over a wide geographical range, based on input from a user's existing or easily leased equipment, today's technology can also offer additional savings, reducing operating costs and optimizing investments. However, there are several challenges specific to short-term, multi-use solutions, including rapid deployment and setup, and ease of access (ordering/shipping, setup and return to base).

The challenge is to develop a global service for on-demand noise

Operation	Measurement	Technology	Financial
<ul style="list-style-type: none"> • Staff • Skills • Management 	<ul style="list-style-type: none"> • Location • Source contamination • Weather 	<ul style="list-style-type: none"> • Instrumentation • Power • Communications 	<ul style="list-style-type: none"> • Total cost of ownership • Startup costs

Figure 1. Main challenges of continuous noise monitoring programs.

monitoring for both existing and delivered hardware for shorter durations while maintaining a professional, cost-effective solution that meets the requirements shown in Figure 1. The authors have previously published conference papers on how these particular challenges are met.² Since then, further experience has been gained, and commercial solutions have developed further.

User and Supplier Requirements

The users' requirements for short-term monitoring can be summarized in eight steps:

- Quick delivery
- No stock maintenance required
- No financial risk
- Any potential project
- Easy ordering/deployment/setup
- Remote access to data and system status
- Professional reporting/analysis
- Professional and efficient solution

As well as meeting these specific user requirements, the supplier must meet the operation, measurement, technology and financial demands of any noise monitoring and management system.¹

Aside from meeting these user requirements, the supplier must meet the operation, measurement, technology and financial demands of any noise monitoring and management system. To get benefits of scale that will reduce costs, the solution chosen must be able to globally provide:

- Quick response (easy ordering, delivery and setup)
- Reduced overhead (project management and duration)
- No long-term or major commitment (startup costs are low and the minimum duration is short term)

These user and supplier requirements are both described in more detail in previously published papers.² Figure 2 shows a web-based solution to meet these requirements.

Challenges

The supplier has a range of challenges to face and resolve. Overall, the goal is to automate as much administration and first-level support as possible to ensure fast handling of simple, repetitive processes. This has to ensure professional and efficient operation, making it easy to use and error free. Here, experience of delivering and deploying noise monitoring terminals for actual customer projects is invaluable in designing suitable and efficient procedures and tools. However, to make this investment for the supplier worthwhile, there needs to be sufficient scale of use, ruling out local systems in favor of global solutions.

To be able to deliver instrumentation within a few working days, a sufficiently large enough pool of equipment has to be built up in locations where the instrumentation can be quickly delivered directly to the monitoring location or the consultant's office. This will require sufficiently staffed regional depots. A system that could provide immediate feedback on instrument availability would ease the consultant's response to his clients and set realistic expectation levels. Note that, for some countries, due to customs/shipping/

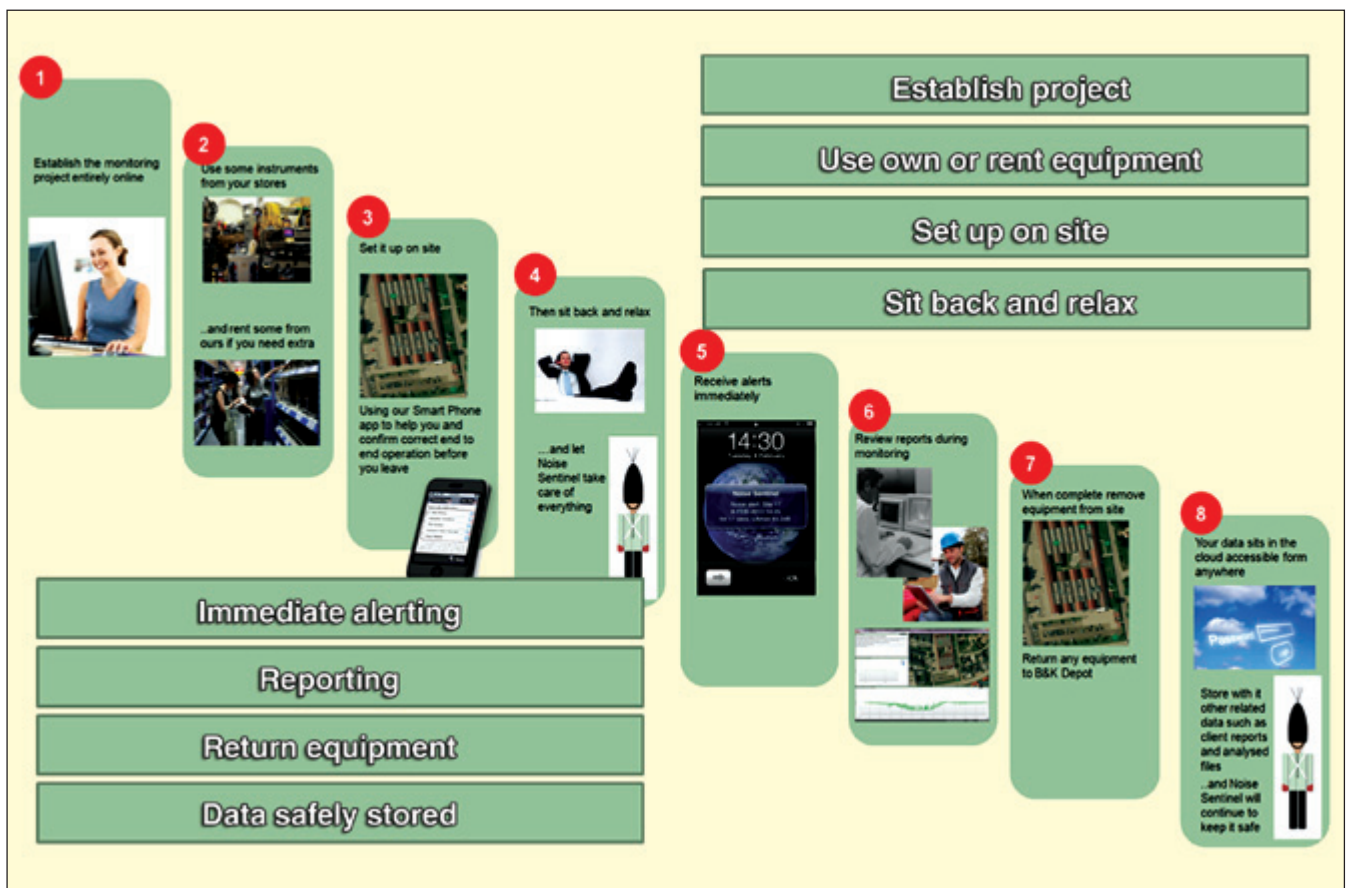


Figure 2. A web-based solution resolves short-duration noise monitoring from start to completion in eight steps.

import procedures that can cause longer delivery times, there may be a need for national depots or longer delivery guarantees. This depot requires professional stock management tools to ensure that returned equipment is checked, recalibrated and refurbished ahead of redeployment.

The entire financial system needs to be optimized for leasing using credit cards and/or invoicing with pre-approved economic vetting. To simplify ordering and the leasing process, the minimum duration and resolution needs to be defined and made known to interested parties at the appropriate time. Leasing in units of one month are probably the most practical, especially since the instrumentation needs to be checked, including acoustical calibration, and potentially serviced on return to the depot. Providing cost estimates and instrument availability during the ordering process, using an ordering configurator will greatly reduce costs as long as the equipment can meet measurement demands.

The instrumentation needs to cover all suitable applications in all geographical regions and, importantly, needs to be easily set up by the consultant or his technicians for the task in hand. Here, guidance for the inexperienced user to ensure safe and secure setup needs to be developed, enabling users, who may only be technical assistants or even electricians, to be able to set up the instrumentation and ensure that data are collected and transferred before leaving the site. An important aspect of this is ensuring communications through pre-installed and configured wifi/router/SIM cards that operate immediately while avoiding costly roaming charges. Since 99% of all applications will require only a small, but usually slightly different part of the system and instrumentation's setup capabilities, the process needs to rapidly guide the user through this setup.

In addition, if customer-owned equipment is to be used, the system must be able to confirm compatibility and provide information on what changes are required. This may be a simple software upgrade or update or the need for specific peripherals or accessories such as IP communication. This is described further in this article under the section titled "Recent Developments."

Web services need to be developed to provide professional and

robust remote access to data and system status for a range of devices that are expected to be supported. Professional reporting tools that are implemented in long-duration noise monitoring systems are suitable for providing clear results and the possibility to dig into more detail when investigating issues of interest or troubleshooting a client's site. A solution that ensures the data are stored in the cloud means that it is accessible anywhere, 24/7. The solution must support secure data access through authorized user accounts. A decision on which platforms to support needs to be taken, since some users may prefer iPads and others Android smartphones. Still others might want traditional computers, but the more platforms supported, the bigger the development and maintenance tasks.

On-line help, if designed correctly, is the fastest and most efficient support and provides immediate response while optimizing costs. However, it will not always be sufficient. So helpline support needs to be available to the user if the system doesn't work according to expectations. Support via chat, mail, VOIP, etc., needs to be available both in and outside office hours, since monitoring tasks are not limited to office hours and require adequately trained personnel – something that requires a sufficient number of clients to be efficient.

Initial Experiences

The first experiences after implementing such solutions commercially have highlighted additional issues that should be addressed.

Choice of Network Supplier. Communication network providers are currently primarily national and do not have good international subscriptions – either they are expensive or have poor coverage. So depots need to have sufficient SIM cards for multiple countries and instrumentation/routers, and regional depots need to be able to be quickly and easily reconfigured for use in different countries, adding cost to the supplier. The coverage of one communications network supplier is shown in Figure 3.

Localization. A common error is to think of localization as only providing the user interface, documentation and support in local languages where necessary. However, there is much more; tasks include the identifying a suitable instrument depot, the optimal

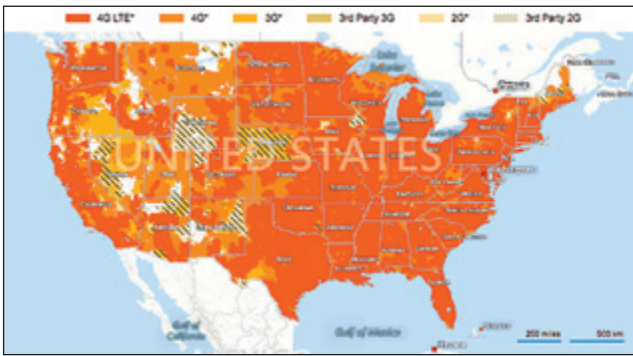


Figure 3. Communications coverage of AT&T's data network in most of USA.³

communication network provider and acquiring enough SIM cards for cost-effective utilization.

Insurance. Typically, the equipment is covered by the user's own insurance; this is often the most cost-effective solution. Global insurance coverage for undefined, open usage is expensive and unlikely to be successful.

Measurement Capability. To have a cost-effective pool of equipment, the measurement instrumentation must cover the parameters required by the wide range of individual local legislations and standards. These are often regional rather than national and also different from application to application, resulting in a large number of potential compliance parameters to be supported. At the same time, it must be flexible, enabling it to be quickly and easily reconfigured to meet individual requirements. It has proven necessary for professional solutions to incorporate a combination of instrumentation configuration and server-side processing to meet this challenge.

Additional Battery Life. The battery life is limited on one hand by the power draw due to the router and analysis capability of the instrumentation. But it is also limited by the size of the environmental protection. Shipping additional batteries from central depots is not cost effective due to weight; so local solutions are recommended, sometimes with recommended local suppliers close to the site where the equipment is to be used.

Transport of Lithium-Ion Batteries. These types of batteries have become the preferred energy source for a wide variety of goods due to their high power/weight ratio. Although widely used, they are rated as dangerous goods and are, as such, subject to transport regulations.⁴ The regulations limit the maximum number of batteries and cells per package and the maximum mass per package, and define labelling that is to be visible on shipping packages.⁵ Provided the supplier meets these requirements, and takes care of return shipment, the user does not have to worry about these issues.

Solar Power Support. This is an alternative to providing additional batteries. However, solar panels are bulky, fragile and difficult to transport.

Calibration. Local regulations often require that the instrumentation used has accredited calibration. Usually the accreditation institutes are either national or regional and are not available in parallel. Recalibration takes some time and requires specialist facilities and skills. So regional depot stocks need to be professionally managed, including the handling of the pipeline of equipment needed so that enough equipment can be made available while the promised delivery times are kept.

Solutions to all of these issues have to take into consideration the requirement to be globally suitable and, where possible, automated to reduce operational costs of the solution and help ensure that it is commercially viable.

Recent Developments

There have been recent developments in commercial solutions to environmental noise monitoring.⁶ A sample instrumentation compatibility flow chart is shown in Figure 4.

Use Your Own Equipment. Since this is a new commercial concept, consultants often have stocks of owned equipment that they use for short-term monitoring. In principle, these instruments can be reused to better exploit a consultant's previous investment.

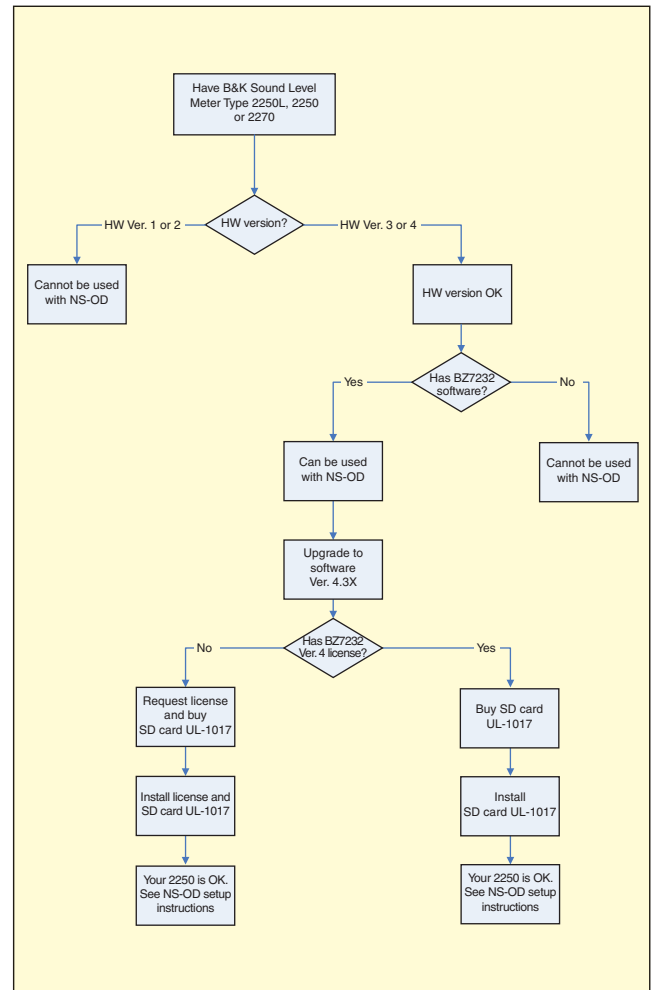


Figure 4. Example of instrumentation compatibility flow chart.

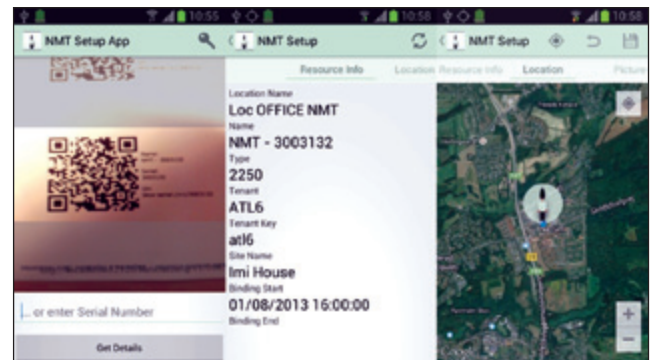


Figure 5. Android OS smart phone interface showing QR code scan (left) and resulting unit identification (mid) as well as location identification using the phone's inbuilt GPS (right).

However, different instrument types, configurations and software versions need different support. Therefore, commercial systems have compatibility matrices where the instrumentation supported is listed. Professional solutions include automated instrumentation compatibility checklists and functions to give the consultant up-front information on compatibility prior to subscribing to the solution. In addition, since there are far fewer practical issues concerning pre- and post-usage checking and service of instrumentation for accredited calibration and, importantly, shipping, then commercial agreements can be shorter than for leased equipment. This enables subscriptions with resolution down to, for example, one day provided that order-handling costs can be covered.

Support of Leased Weather Stations. Leased weather stations enhance analysis and reporting in accordance with ISO 1996 and related standards.⁷

(continued on page 12)

Support of Smart Phones. Smart phones enable consultants to utilize GPS and camera functions to ease setting up and documenting locations on site. A sample app is shown in Figure 5. Some solutions include real-time updating of the system so that changes and documentation are immediately secured. By adding QR codes⁸ or near-field communication (NFC)⁹ to the system can provide rapid, noncontact methods to enhance the setup procedure by identifying the unit and setup configurations from QR or NFC tags attached to the instrumentation. In addition, the smart phone's GPS can be used to help locate the noise monitoring terminal for reporting and visualization purposes; however, for accurate reporting, manual fine tuning is required due to the inherent accuracy of the GPS system¹⁰ and professional solutions must incorporate this functionality. For documentation, the smart phone's camera can be used to take photographs of the measurement location. These can then be stored with the data and used for reporting purposes. For widespread use, the three leading operative systems – iOS, Android and Windows – need to be supported and apps developed and placed on Google Play, iTunes and Windows Phone Store.

Quoting. Typically, a consultant will pass on costs to clients. Including cost quoting functionality in the solution enables a consultant to professionally document costs to their clients prior to purchase whenever they need it without waiting for the supplier to respond.

Conclusions

As well as meeting the operation, measurement, technology and financial demands of any noise monitoring and management system, the supplier must meet these specific user requirements concerning shorter-duration noise monitoring.

- Quick response (easy ordering, delivery and setup)
- Reduced overhead (project management and duration)
- No long-term or major commitments, since the start-up costs are low and the minimum duration is short-term


The challenge is to develop a global service for on-demand noise monitoring for both existing and delivered hardware for short dura-

tions while maintaining a professional, cost-effective solution that meets requirements – that is, a solution that provides equipment, data and services with the following advantages:

- Avoiding capital outlay for the user; subscription-based.
- No instrument ownership, depreciation, obsolescence, or maintenance, since they are leased as part of the service.
- Dynamically sized instrumentation pool depending on scope of current work; leased as required
- Simple and efficient to use; saves time and worry
- Data accessible anywhere, 24/7; it is retained in the cloud

Professionally implemented solutions with focus on the main business issues promise more efficient noise monitoring for consultants, provided the challenges, some of which are described here, are met. First experiences of implementing such solutions commercially have highlighted additional issues that need to be resolved. Recent developments include the use of smart phones to help ease setting up systems and the support of owned equipment.

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