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## NETWORK-INDEPENDENT DATA LOGGING

The demand for dense measurement data networks in water and wastewater facilities increases rapidly. Rising fees, legal requirements, the monitoring of special structures as well as flood protection measures constantly push the expansion of the necessary measurement points. In order to gain an overall view it moreover is required to additionally consider measurement data from regions with poor infrastructure and unavailable energy networks.

Systems for network-independent data logging shall be considered apart from network-powered facilities during selection, planning and operation.

The following guideline highlights the possibilities the network-independent data logging will provide considering the lack of power supply on the measurement point, the risk of vandalism, the transmission of measurement data and the commissioning of the measurement system from a practical perspective.

The conclusion shows an example of the total costs of a measurement system. It quickly becomes clear that a mere comparison of purchasing costs does not represent the real costs over the entire operating period.



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# NETWORK-INDEPENDENT DATA LOGGING

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## 1 INTRODUCTION

Growing awareness for the economic and ecologic use of resources as well as a high number of legal provisions which, among other demands, require to completely prove the efficiency of water protection measures and special constructions, call for the use of a highly dense measurement data network. Moreover the demands for early-warning systems for the monitoring of flood protection facilities, rivers and groundwater levels are increasing. In order to make full use of all choices of action the recorded measurement data must be immediately and reliably available.

Mains-powered monitoring of measurement systems does not cause any problems in wastewater systems with existing infrastructure and can be carried out by using standard components. Operating measurement systems in non-urban areas however is an enormous challenge. Planners and operators are confronted with the following problems:

- lack of power supply
- poor accessibility of measurement points
- risk of vandalism
- transmission of measurement data
- personnel required for commissioning and operation of facilities
- structural / optical standards such as in landscape conservation areas
- handling of the increasing volumes of measurement data

## 2 PLANNING CRITERIA

### 2.1 Power supply

The first question to clear when planning a measurement place without power supply is the question of alternative power sources. Meanwhile there are many options available on the market ranging from solar cells through wind power stations to fuel cells. In general, however, such an approach turns out to be not practicable due to high costs and disproportionate effort. The goal is to operate the required measurement systems with built-in standard or rechargeable batteries in the long run with lowest possible maintenance requirements.

Meanwhile there are systems available on the market which have been optimized for minimum energy consumption. In this case the complete system however must be considered, where the interaction of transmitter and sensors is very important. Connecting radar sensors e.g. which require measurement times of up to 30 seconds to an energy-optimized transmitter is not very effective. It therefore makes sense to use tailor-made ultrasonic sensors featuring a measurement time of only 3 seconds. In contrast to using standard sensors this results in a 10 times longer lifetime.

## 2.2 Protection against vandalism

The risk of vandalism cannot be eliminated completely. However there are approaches helping to minimize the risk of being a potential target. It is generally recommended to use measurement systems which enclose all components required for sensor supply, signal evaluation, data storage, data transmission and energy supply in one enclosure featuring a minimized size. The use of more than one enclosure, the appropriate wiring as well as the higher space requirements significantly increase the risk potential.

The drawing below shows an example of a measurement system with directly connected sensors and all required components being housed in one enclosure.

By selecting the appropriate measurement system it is very rarely necessary to support the rechargeable batteries used with additional solar cells. In this case the formula "the more energy-efficient the measurement system, the smaller the solar cells needed and the smaller the risk of theft" applies.

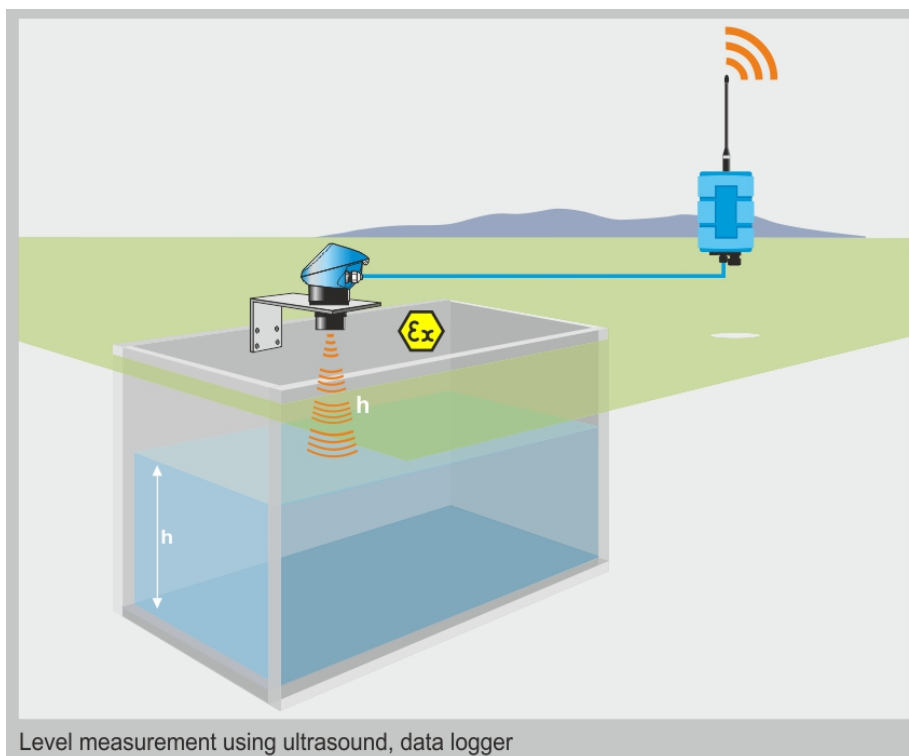


Fig. 1 Example of a measurement system with data transmission via GPRS and built-in rechargeable battery

Consumer solar systems generally are not very robust since the glass surfaces are not protected against external forces. Meanwhile solar systems particularly for measurement data recording in non-urban areas featuring IP 68 protection in rugged, impact-proof die-cast enclosures are available with the solar cell being additionally protected through armoured glass.

In order to reduce the risk potential as well as for easy installation all necessary components (e.g. measurement signal evaluation, buffer batteries, charging control etc.) have been integrated into the solar cell housing. Therefore the required sensors can be connected directly to the solar module (see Fig. 2).

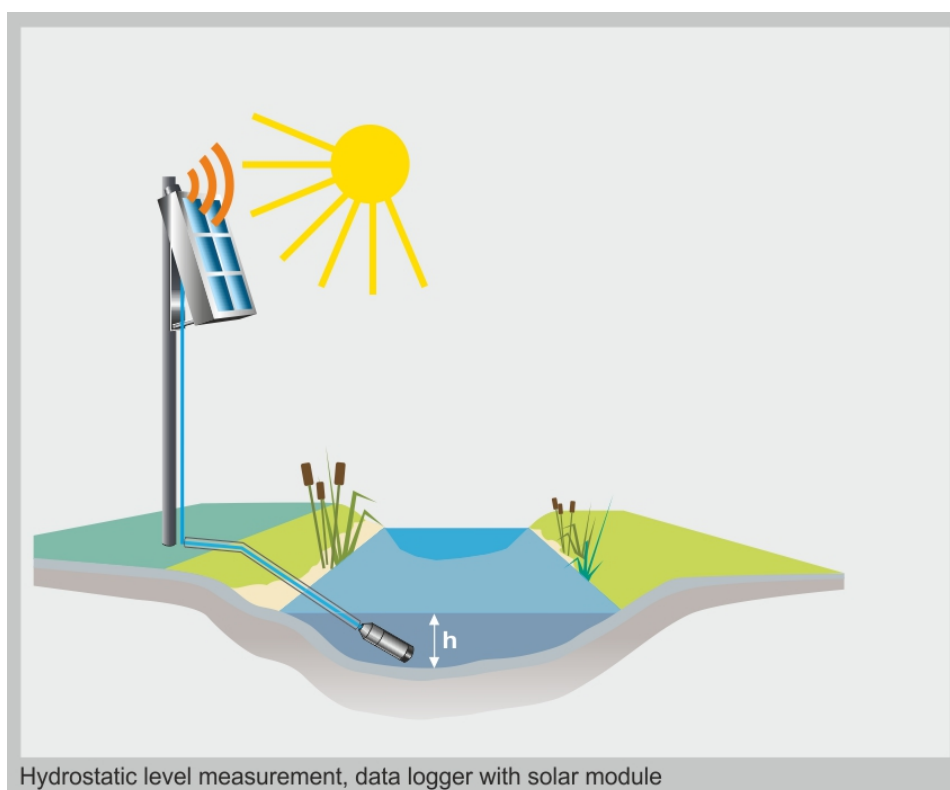


Fig. 2 Example of a robust solar-powered system with data transmission via GPRS

### 2.3 Transmission of measurement data

The lack of infrastructure at the measurement point during the planning stage raises the question how to transmit the measurement data. The growing number of measurement points and a shortage of staff very often reveal significant discrepancies. Being on site in order to read out data from the measurement points requires considerable investment of time and labour. One more essential shortcoming with this method is that there never are real time data available which can be used for planning purposes or to adequately respond to certain events. Merely historic data sets can be used for evaluation.

For some time past the transmission of measurement data via GPRS (**G**eneral **P**acket **R**adio **S**ervice as service within GSM networks) has been established as transmission method. This service is available from all common GSM network providers. The measurement system must be equipped with a GPRS modem. Such modems meanwhile can be obtained in all types and sizes for any kind of applications. Measurement systems with built-in modem are suitable for use with network-independent data recording. This helps to avoid cross wiring.



Fig. 4 Modem with SIM card slot



Fig. 5 Complete system with integrated modem and plugged SIM card

In order to use GPRS services a telecommunications contract needs to be concluded with the selected network provider specifying billing as well as other requirements. The network provider then provides a SIM card which must be plugged into the measurement unit. Common GPRS modems are equipped with an appropriate SIM card slot.

The required agreement confronts operators with important questions such as:

- Which provider is best?
- Which network is available on the measurement point?
- What is the expected data volume and what are the costs?
- How can I manage the telecommunications contracts?
- How can I avoid cost explosion?
- How can I manage the required SIM cards?
- How can I deal with recurrent payment flows?
- How can I handle running costs within the cost plan?

Planning, research, comparison of costs, organisation and handling of all administrative efforts in many cases goes beyond the limits of the actual measurement task such as simple level measurement.

In contrast to common modems there are innovative solutions available, where thanks to using so-called SIM modules it is no longer necessary to use SIM cards. The SIM modules are installed firmly on the electronics board of the measurement unit.

Oxidation of SIM card contacts and accompanying communication failures hence can be avoided. The SIM modules are an integral part of the devices and are provided as units. Thus, there is only one contact person for operators who no longer need to jump between device manufacturer and network provider in case of requests.

Being independent from a certain network provider is a major advantage. The system will log in with the most powerful GSM network available at the measurement place. It therefore is no longer necessary to search available network providers from measurement place to measurement place. This method additionally provides the highest availability since in case of network overload or failure the system automatically will switch to the next available network.

The use of SIM modules allows to use GPRS services without the need to conclude a telecommunications contract. Due to this it is no longer necessary to search an appropriate network provider, to survey contractual deadlines, to compare services and much more.

One of the most important basics for decision-making when it comes to choose an appropriate provider is absolute cost control regarding transmission fees. When using SIM modules there are fixed prices and billing models available similar to pre-paid solutions. Based on the expected utilisation, such models use data packages which contain all costs covering a certain period. In this case it is not relevant for operators which service provider has been chosen by the SIM module at the measurement place.

The costs are paid as one-off payment at the beginning of the contractual period. A crucial benefit e.g. in case of being used in conjunction with government-subsidised projects is that only the purchasing costs are subsidised, however not the operational costs. Thanks to the pre-paid solution it is possible to transfer the running transmission costs into the purchasing costs and to additionally save monthly payments as it is the standard with common telecommunications contracts.

The method is using the same principle anywhere in the world and hence can be used without problems even in close vicinity to country borders.

## **2.4 Commissioning of measurement systems with data transmission via GPRS**

Wiring measurement sensors and electric connections is meanwhile a part of daily business. Setting the parameters for remote data transmission via GPRS however is a considerable challenge for many plant operators. In addition to technical obstacles there is the fear to be confronted with high transmission fees in case of faulty settings, which very often surpass the purchasing costs of the unit many times over.

In common systems transmitter and SIM card need to be adjusted to each other which can be achieved by setting provider-specific parameters on the transmitter. This requires additional equipment, software tools and hence appropriate know-how. During the commissioning of measurement systems for settings, tests and the search for the correct parameters (e.g. APN, PIN etc.) normally one or two working hours need to be scheduled.

*Connect sensors – plug battery – done!*

Utilising measurement systems with integrated SIM modules is as simple as it sounds since no more settings are required. The benefits reveal particularly in case of failures since the units can be easily exchanged even by personnel without programming skills or knowledge on the according SIM card settings.

## **3 ECONOMIC EFFICIENCY ANALYSIS**

When it comes to choosing a measurement data logging system far too often only the purchasing costs are taken into consideration. It however is essential for operators to obtain an overview on the total system costs (Total Cost of Ownership) covering the entire lifetime. The graph below outlines an example of the most important cost areas.

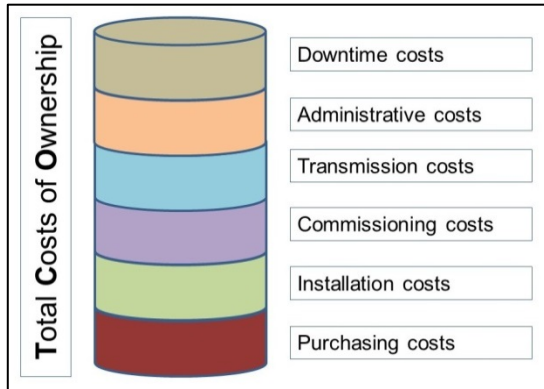


Fig. 6 Overview on total operating costs

Compared to common GPRS devices the purchasing costs of measurement units featuring built-in SIM modules are initially higher. Considering the complete lifetime as well as the total costs however these units will reveal clear cost advantages due to savings within the remaining cost areas.

#### 4 PROCESSING OF MEASURED DATA

Apart from choosing the best possible measurement system for network-independent data logging, the processing of measured data represents the second pillar for the conception of the complete system. There are various systems available on the market for these purposes. It is mandatory to adjust the choice to the operator's requirements and existing systems. Solutions are emerging as favourites which can be set up and operated without the need for programming skills and which moreover provide universal interfaces to be connected to existing control systems.



## 5 SUMMARY

Meanwhile there is a great variety of technical solutions for network-independent data logging available, but there are some hurdles and important points which need to be considered right from the start. Innovative complete solutions such as the development of SIM modules and energy-efficient measurement systems however allow operators to look at essentials. Essential here is the reliable, ecologic and economic facility operation rather than the administration of telecommunications contracts or investing a lot of manpower.

When choosing the appropriate network-independent measurement system it shows that the initially cheapest solution is not necessarily the most cost-efficient solution.