SMART WATER
DIGITAL MONITORING

AVK

CONTENT:

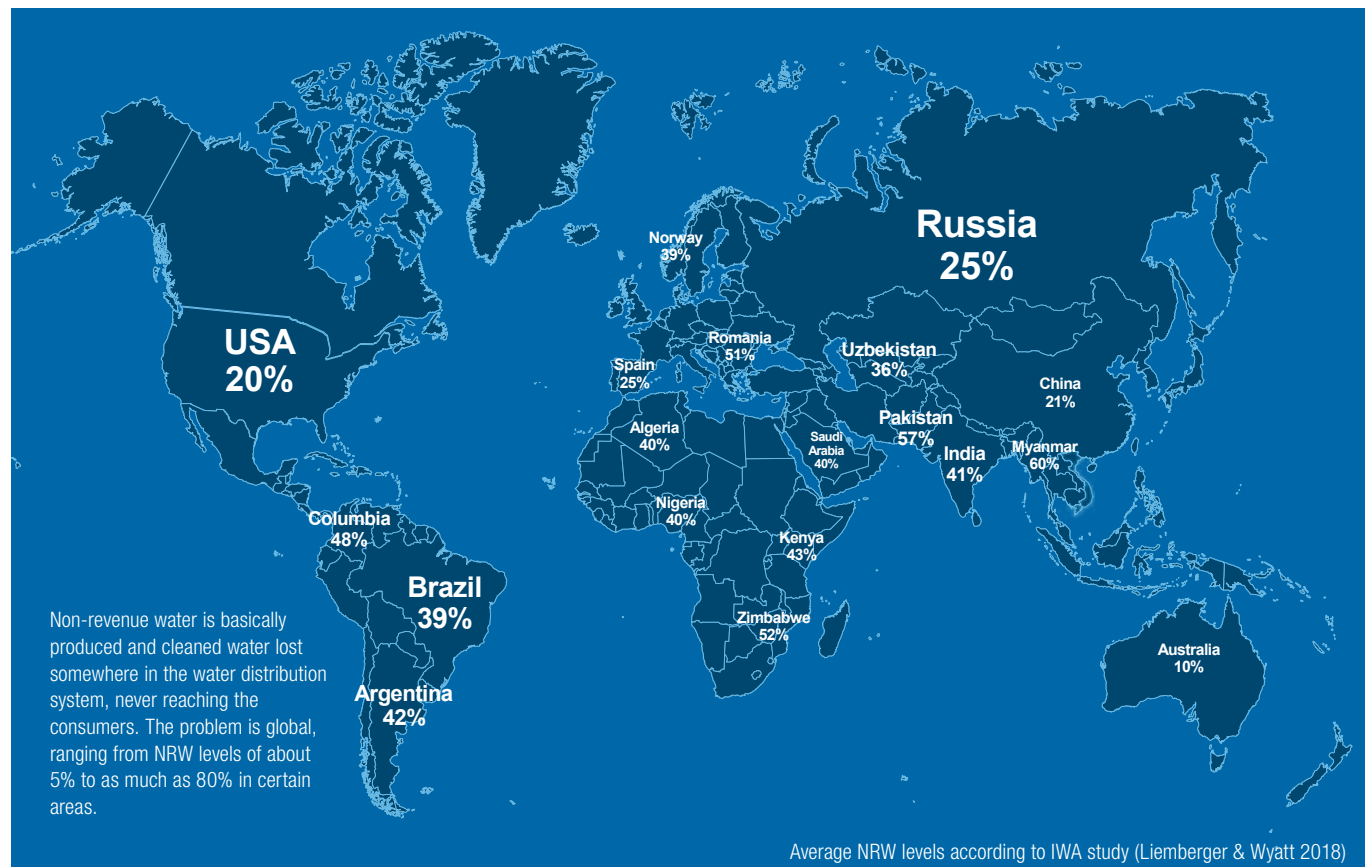# WHY DO WE NEED DIGITAL MONITORING FOR WATER MANAGEMENT?

The overall goal for water utilities is to ensure safe and clean drinking water for their consumers. And in order to be able to do so, they have an even more important task, which is to always ensure full operation and functionality of the water distribution network.

It can be challenging to know exactly where to invest time and money as the distribution network is typically buried in the ground across a large area. That makes it essential to have digital monitoring of the network with sensors located at strategic points in the system.

Water management today

Nowadays, most utilities have installed smart consumer meters that can measure water consumption, which is very important for correct billing. In addition, it helps reduce non-revenue water (NRW). But between smart meters and waters pumps, there are very few or no data collecting sensors at all. A terrible waste, as the distribution network holds great potential with thousands of points from where useful data can be retrieved.

This underlines the need to monitor the distribution network using sensors. Digital monitoring is an important part of the solution to challenges that utilities are facing today. It enables the utilities to base their actions on the best knowledge instead of guesswork and assumptions. And installing digital sensors at strategical points in the network can gain an understanding of where to direct efforts as for example leak fixing, and what parts of the water network do not work as efficiently as wanted.

Norway 39%

Russia 25%

USA 20%

Romania 51%

Uzbekistan 36%

Spain 25%

China 21%

Algeria 40%

Saudi Arabia 40%

Pakistan 57%

India 41%

Myanmar 60%

Columbia 48%

Nigeria 40%

Kenya 43%

Brazil 39%

Zimbabwe 52%

Australia 10%

Argentina 42%

Non-revenue water is basically produced and cleaned water lost somewhere in the water distribution system, never reaching the consumers. The problem is global, ranging from NRW levels of about 5% to as much as 80% in certain areas.

Average NRW levels according to IWA study (Liemberger & Wyatt 2018)

INTERNATIONAL REQUIREMENTS
UN GOALS AND EU DIRECTIVE

Local water utilities have the responsibility to ensure a safe water distribution for the consumers. However, it is a global challenge to take care of our water resources and ensure clean drinking water for all. Therefore, sustainable water supply is on the international political agenda.

UN goals for sustainable development
The 17 UN Sustainable Development Goals (SDGs) are designed to lead the world in a more sustainable direction. A digitised distribution network allows the water utilities to increase efficiency and reduce water loss – and thereby ensure protection of our resources. This way, it contributes significantly to the UN SDGs 6, 9 and 17 to ensure clean water and sanitation, industry, innovation and infrastructure and partnerships for the goals.

EU Drinking Water Directive requirements
Digitalisation of the distribution net not only provides the transparency needed to support making the right decisions. It may also prove necessary to meet the efficiency requirements in international legislation.

The purpose of the EU Drinking Water Directive is to ensure safe and clean drinking water. It concerns materials in contact with the drinking water and limit values to be accepted in water distribution, and it focuses on risk management and lowering water loss.

In case of leakages and pipe bursts, there is a risk that contamination enters the pipe system. Therefore, each member state must evaluate and set targets to reduce this type of water loss. New technology can efficiently support utilities in meeting these targets by improving the way pressure can be managed, leakage can be monitored, and theft can be detected and avoided.

Member states must ensure that the complete distribution network is subject to a risk-based approach. A proper risk assessment includes considering how all access points to the water is managed and protected. Any risk assessment should also consider the risk posed by inappropriate pressures in the distribution network. Too low pressure entails risk on intrusion of contamination while too high pressure means higher leakage level and increased risk of bursts. Pressure and temperature sensors in the network and remote monitoring of hydrants and gate valves will ensure managing the risks the best possible way.

TRUST YOUR NETWORK THROUGH
DIGITAL MONITORING

In many countries, utilities responsible for delivering clean water to consumers use data to control and monitor their distribution network. Smart meters are installed in many households, so consumers can be billed based on their actual consumption.

However, between the water works and the consumers, there are so few sensors installed that this area sometimes is considered a black box. In that area, it is next to impossible to know exactly what is going on because the area is huge, and most assets are installed in the ground. This leaves you with uncertainty about the position of valves, difficulties locating leaks and challenges with acquiring data in a sufficient quality.

But in the network, there are thousands of valves, fittings, combi-crosses and hydrants installed, and each of these assets is an ideal point to collect data from. AVK Smart Water makes it possible to collect this data by providing intelligent sensors that can be installed in the distribution network, and data aquired from these assets can be used to turn the black box into a more transparent water network.

With a transparent water network, you can localise leaks faster, extend lifetime of assets, save resources by minimising truck rolls and save energy by only pumping the needed amount of water. These are just a few of the advantages of introducing the AVK Smart Water solution in the water network.
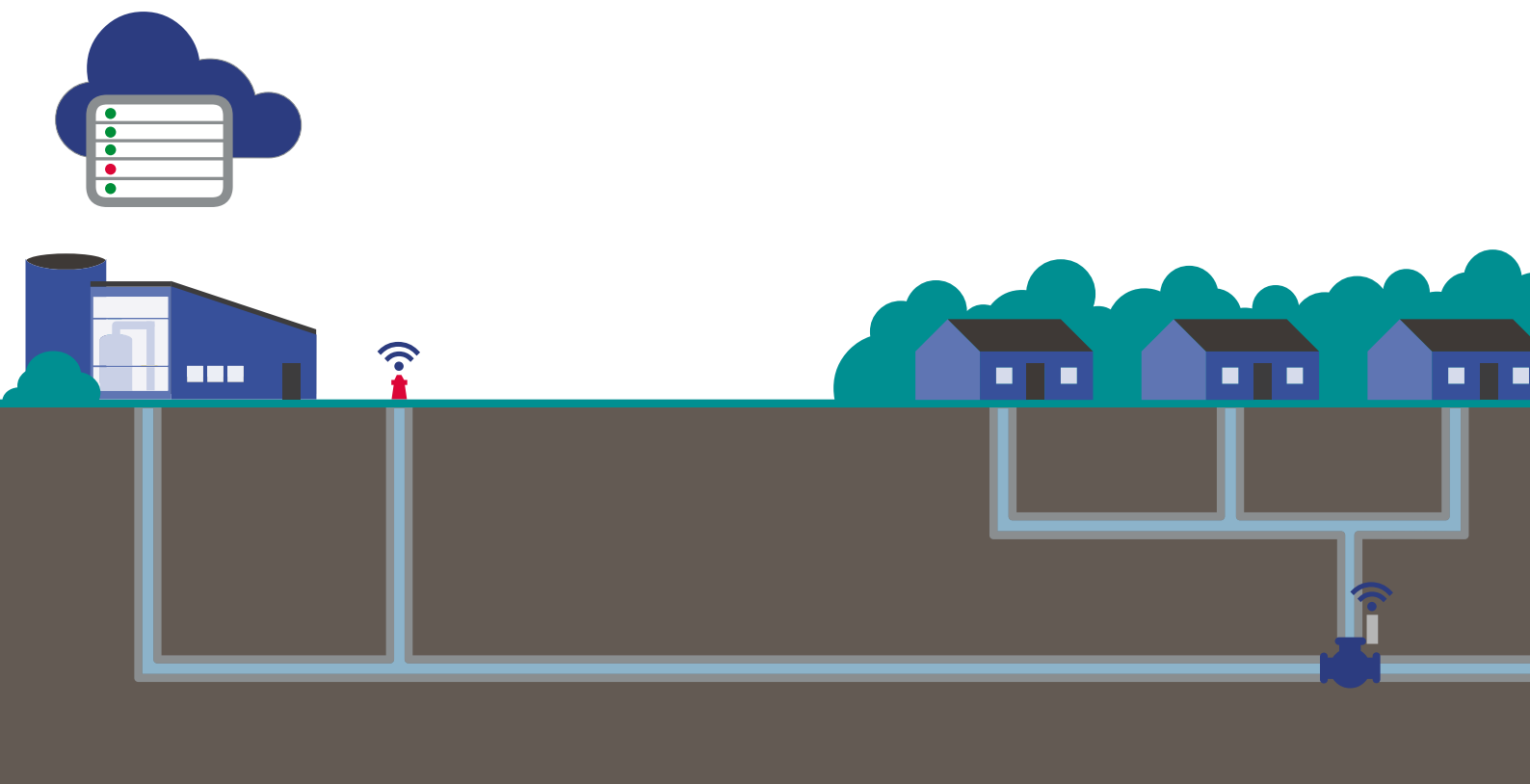
GLOBAL VOLUME OF
NON-REVENUE WATER
HAS BEEN ESTIMATED TO

126 BILLION M^3
PER YEAR

(LIEMBERGER & WYATT, 2018)
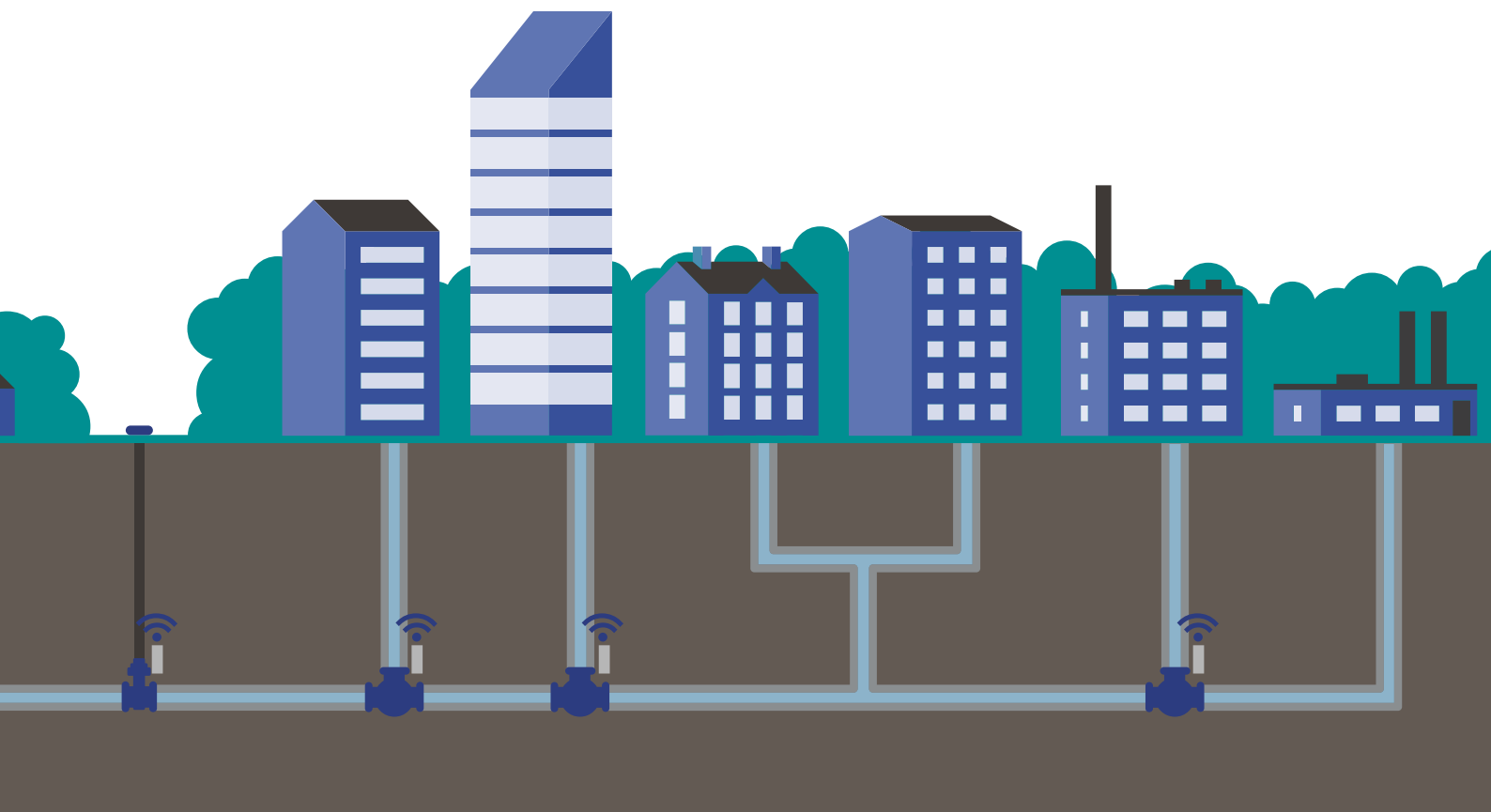
AVK SMART WATER SOLUTIONS
FOR WIRELESS DIGITAL MONITORING

The AVK Smart Water concept consists of battery-operated wireless IoT sensors for data collection directly from the network. The complex data is turned into valuable insights when integrated into either the existing IT system or into AVK Smart Water's dedicated software platform VIDI Cloud.

AVK battery-operated wireless IoT sensors deliver reliable data from the distribution network directly into the utilities' preferred IT system. By installing digital sensors at strategical points in the network, utilities can gain an understanding of where to direct their efforts.

Monitoring with state-of-the-art technology
By installing AVK Smart Water sensors in the distribution network, utilities can achieve a transparent network that makes it possible to remotely monitor and diagnose problems, prioritise and manage maintenance issues, and optimise efficiency of the entire network.

AVK Smart Water sensors include:
- VIDI Positioner indicating valve position
- VIDI Cap sensor for fire hydrants
- VIDI Open/Close sensor
- VIDI Flow, VIDI Pressure and VIDI Temperature sensors
- VIDI Level sensor

We provide data in an easy and accessible way through an API that makes it easy to integrate and combine data for creating a complete overview of the distribution network. We also offer a range of software solutions for visualisation and analysis.

Through digital monitoring, AVK Smart Water paves the way for reduced water loss from leaks, increased workflow efficiency and a clearer overview of network conditions.

Effectively lower water loss
One of the most efficient methods to reduce background leakage and bursts is pressure management. VIDI Pressure sensors provide the data needed to efficiently manage pressure, which will help utilities minimise leaks throughout the distribution network.

In addition, with the leak detection feature in VIDI Cloud, advanced algorithms use data from VIDI Flow sensors to monitor leakage levels. This will enable utilities to prioritise resources and reduce leak run-time.

With VIDI Caps on hydrants and VIDI Positioners on valves, utilities will receive an alarm when assets are operated. That way, utilities can limit the water loss due to tampering and theft from hydrants and publicly accessible gate valves.

Increase workflow efficiency
Intelligent pressure sensors from AVK Smart Water will provide utilities with the data needed to manage pressure throughout the distribution network. This will result in less truck rolls as there will be fewer bursts to repair and lower energy consumption for pumps as the set point can be reduced, and generally it will extend the lifetime of your assets.

VIDI Pressure and VIDI Temperature provide the transparency needed to efficiently support customers' calls as all relevant network information is ready at hand. Utilities will thus be able to improve customer service while spending less time on support.

VIDI Positioners and VIDI Caps eliminate time wasted on investigating status of valves and hydrants while streamlining maintenance work. The solutions automatically keep track of the latest use and increase efficiency throughout the distribution management.

Better overview of network conditions
There are many risks related to water distribution. Low pressure entails a risk of intrusion of polluted water and poses a serious health risk for consumers. With VIDI Pressure sensors, utilities will be warned if pressure falls below a certain set point.

Hydrants and publicly accessible gate valves are potential entrances for pollutants either by mistake or intentionally. VIDI Caps for hydrants and VIDI Positioners for gate valves help manage this risk by alerting utilities if hydrants or valves are opened.

The overall solution from AVK Smart Water keeps track of the current state of the water network. VIDI sensors register changes in the hydraulic setup, e.g. when a valve is opened or closed or when pressure, temperature or flow is abnormal in the network. With such misconfigurations, there is a risk of loss in hydraulic performance and pressure, which can result in increased energy costs for the utilities.

Due to the wireless nature of IoT, the pressure sensors can be installed at any critical point in the distribution network.

Underground gate valve with VIDI Positioner that detects when the valve is operated.

Hydrant with VIDI Caps installed. The use of a hydrant affects the pressure in an area. Therefore, it is important for the utility to know when the hydrant is being used in order to distinguish between a pressure drop coming from regular use or from a pipe burst.

INCREASE RELIABILITY OF NETWORK MEASUREMENTS
WITH VIDI POSITIONER

Valves are a very important part of the water distribution network, and utilities have thousands of them installed. They all serve a variety of crucial functions such as dividing and isolating subsections and controlling pressure and water flow.

Most valves are buried in the ground, which makes it difficult to know exactly where they are, whether they are opened or closed, and whether they are damaged or not. Worst case scenario, a wrongfully opened or closed valve can influence other measurements such as flow or pressure, and thereby give incorrect information about the distribution network's real condition. This can affect the utility's ability to ensure a fully functional water network and the best service for consumers.

Optimise operation by checking the quality of measurements
VIDI Positioner will provide utilities with valuable insights by monitoring the position of valves digitally. VIDI Positioner is a battery-operated device that detects the open/close position of the valve.

By monitoring boundary valves, you can ensure that they are rightfully opened or closed, and thereby avoid misleading flow and pressure measurements. This way, you can perform more efficient leak detection as well as pressure management and reduce time spent on searching for anomalies caused by a wrongly positioned valve.

INCREASE WATER SUPPLY EFFICIENCY WITH VIDI PRESSURE

Water utilities supply water in different terrain, which can lead to pressure differences and high fluctuations in pressure level across the water distribution network. Especially for an aging infrastructure, this is a challenge that potentially increases the leakage level.

Pressure fluctuations can put stress on pipes throughout the network as it forces the pipes to continually expand and contract which potentially results in leakages or bursts. That is why pressure monitoring is an important tool in the efforts to lower water loss.

Fight water loss with pressure management
Adjusting pressure to consumption will balance out pressure fluctuations, increase the lifetime of pipes and optimise the amount of energy used by pumps.

With VIDI Pressure, you can get an overview of the pressure levels in the distribution network, which makes it easier to discover fluctuations. With the information from VIDI Pressure sensors, you will know when to regulate pressure, and thereby:
• Reduce stress on infrastructure
• Extend asset lifetime
• Minimise maintenance costs
• Reduce water loss
• Minimise risk of water contamination
• Reduce energy consumption

MONITOR USE OF HYDRANTS
WITH VIDI CAPS

Hydrants are meant to be resilient and durable. They appear everywhere in the streets and in industrial areas, and they are expected to always work. But if not taken care of, hydrants are likely to be out of order when they are really needed.

It has not been easy to monitor fire hydrants at a regular basis, other than by slow costly inspections, meaning vandalism and water theft can go unnoticed for long periods of time. To get a better overview of what is going on with fire hydrants in the distribution network, it is beneficial to install intelligent sensors.

Detect when hydrants are operated
Hydrants are often spread out across the distribution network, which makes it difficult to monitor them manually. With VIDI Cap sensors installed on aboveground hydrants, utilities will know when a hydrant is being used.

VIDI Cap sensors register when the caps are removed from their couplings, and a cross check with the fire department and contractors in the area will help water utilities identify vandalism or water theft with data directly from the hydrants. With sensors installed on fire hydrants, it becomes easier to distinguish between real water loss and necessary use of water.

In addition, monitoring fire hydrants can help control the risk of contamination.

UNBOX FULL NETWORK POTENTIAL
## WITH IOT SENSORS

Monitor water flow at strategic points with VIDI Flow. Every day, millions of cubic meters of water flow through the water distribution network with the sole purpose to be delivered to consumers. However, it is no longer enough to produce water to meet the general demand. It is also important to control the effectiveness of the water supply, and minimise the water lost during production and transportation to the consumers.

By continuously monitoring how much water flows through the distribution network, water utilities will be able to detect anomalies, and they can decide what measures need to be taken.

Detect anomalies to discover leakages faster
VIDI Flow provides a regular set of data telling how much water is flowing in or out depending on where it is installed. By using VIDI Flow to measure the water flow, utilities can detect anomalies earlier and improve the resilience of the distribution network. When anomalies are discovered faster, utilities can also minimise water losses, decrease costs related to leaks and increase consumer satisfaction.

In order to detect leakages and bursts, it is important to measure water flow at strategic points in the distribution network on an ongoing basis. By installing VIDI Flow at section (DMA) inlets, it is easier to detect even small leaks as well as narrow down the search area.
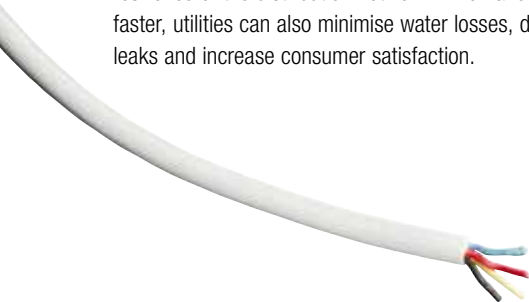
Improve level measurements with VIDI Level. There are often certain risks related to drainage pipes, as they can be subject to sludge or clogging. Sand traps are supposed to protect against this from happening. Over time sand traps are slowly being filled with sand; thus, it is important to empty the traps continuously to avoid flooding.

Reduce the risk of intrusion and deterioration from flooding
Level sensors are needed in sand traps, where the medium rise over time. In relation to large water flows, full sand traps can lead to floods and cause damages to properties or pollution of the environment.

VIDI Level makes it possible to remotely monitor sand traps. Thus, utilities can avoid unnecessary inspections of sand traps, as it will provide a clear view of the sand level.

A level sensor can be used in different applications measuring:
• Level of sand in sand traps
• Level of water or wastewater in buffer tanks or basins
• Level of water in pits, wells and chambers
• Level of water in lakes and streams

Monitor your valve positions with VIDI Open/Close. In the water distribution network, many valves serve crucial functions such as controlling the pressure and flow in the network and serving as boundary valves at each section in the distribution network.

Information about these key assets is often based on assumptions, as they are typically buried in the ground. Not knowing the open/close position of the valves can affect the level of water loss and the overall operation of the water distribution network.

Optimise the distribution network and prolong asset lifetime
VIDI Open/Close can be used with several valve types, e.g. on a regular gate valve with a handwheel or on a swing check valve with a lever. The most beneficial place to install an open/close sensor is on critical valves that needs monitoring 24/7. With the VIDI Open/Close sensor installed on these key assets, utilities will receive regular and reliable information about the open/close position of these assets.

VIDI Open/Close provides the necessary data to monitor key assets continuously. With this reliable information, water utilities can optimise their general operation of the network and extend asset lifetime.

Track water conditions with VIDI Temperature. Supplying consumers with clean and safe drinking water is the main goal for water utilities. Therefore, they are met with high expectations and demands to ensure that the drinking water is of the highest quality.

An important part of ensuring clean drinking water depends on a controlled temperature all the way from supplier to consumer. Water temperature is known to influence the network both when the temperature is too high causing a risk of bacteria or too low causing a risk of bursts of blocked pipes.

Reduce risks of bacterial growth or pipe bursts
If the temperature increases, the risk of bacterial growth increases as well. VIDI Temperature will give a clear indication of the temperature in the network, and if it increases, utilities can make informed decisions based on data directly from the water pipes. That way, water utilities can ensure that safe drinking water is delivered to the consumers.

At the same time, if the water temperature drops, VIDI Temperature provides the exact temperature, and the utilities can decide when action needs to be taken. So, if the water temperature drops below freezing temperature, utilities know that they must be aware of pipes bursting or clogging.

USE LEADING TECHNOLOGY FOR
SUPERIOR COVERAGE

AVK Smart Water uses the wireless IoT technology NB-IoT (Narrowband Internet of Things) for all sensors to ensure great radio performance, long battery life and high data security. NB-IoT makes the sensors simple to install and easy to operate. Once sensors are installed, the only expense for utilities is a small subscription fee, and data is delivered as a service. AVK Smart Water sensors are also available for the LoRaWAN® communication protocol to support customers only having access to the LoRa® technology.

To make digital monitoring of assets more convenient for utilities, all AVK Smart Water sensors use API (Application Programming Interface) for easy integration of data directly into any preferred IT system.

Utilities have different requirements in relation to reading and using data. AVK Smart Water ensures that utilities do not have to worry about changes in protocols or security systems. The API handles the complexity of IoT and smart products for the utilities, and they can focus their efforts on their core tasks.

WHAT IS NB-IOT?

Narrowband Internet of Things (NB-IoT) is a wireless communication standard using the existing telecommunication infrastructure.

Due to its wide coverage, improved indoor coverage and its energy efficiency, NB-IoT is suitable for wireless devices installed in areas with poor coverage and for devices that demand maximum battery lifetime.

# TAKE CONTROL OF YOUR ASSETS
WITH AVK ASSIST

Most utilities highlight asset mapping and network management as ongoing issues in the daily operation of the water network. AVK Assist can make a major contribution on the journey towards a resolution.

AVK Assist is an application made up of four key elements:
• AVK Insight
• AVK Toolbox
• AVK AR (augmented reality)
• About AVK

AVK Assist's many features will help customers fully record, track and identify exactly where all their assets are located, including alternative products to AVK products. It will enhance traceability of products by using digitally recorded quality and test data from the point of production. AVK Assist provides customers with a variety of calculators for common industry activities, and a virtual reality tour of selected AVK products.

As a result, utilities will have better insight into their distribution network and assets.
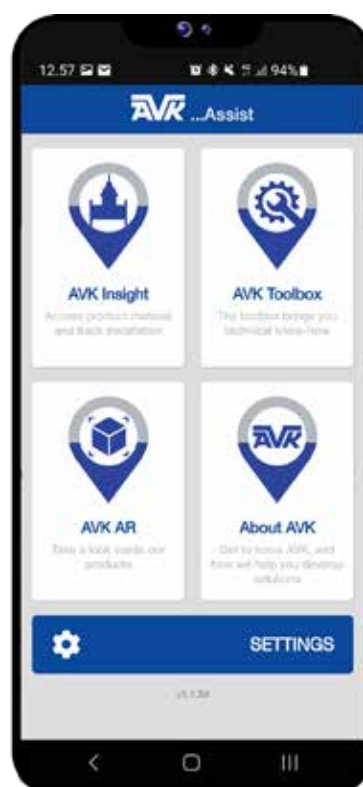
CONVERT DATA INTO VALUABLE INSIGHTS

AVK Smart Water offers software solutions that include a dedicated web platform for data visualisation and software packages with different features to cover individual needs.

AVK Smart Water offers different software packages:
- VIDI Basic
- VIDI Advanced
- VIDI Premium

Simple and user-friendly

VIDI Basic is the simple and basic tool for visualising data and monitoring assets in the network. It provides a map-based overview of the data from AVK Smart Water IoT sensors. It is intuitive as it provides a quick overview of the most important information for daily operation such as abnormal conditions.

More functions, more possibilities

VIDI Advanced offers all the same features as VIDI Basic. In addition, it provides alarm dispatching, which gives the utility the opportunity to react instantly, minimise water loss and optimise the general maintenance of the distribution network.

Through the alarm dispatching feature, users can set up multiple notification messages in case of specific events. Notifications can be dispatched by both e-mail, text message and/or automated Telegram bot to a specific crew member. The given crew member can then interact with the alarm by either acknowledging or ignoring it. If the alarm is not responded to, it will reappear within a time frame predefined by the utility.

The complete package

In addition to the features of VIDI Basic and VIDI Advanced, VIDI Premium offers a complete package with monitoring, visualisation and asset management in one platform. VIDI Premium also provides a leakage detection module that analyses the water balance for each District Metered Area (DMA), offering DMA reports based on individual DMA thresholds.

By visualising the trends in consumption, utilities will have an instant indication of potential leaks and bursts. In addition, the module considers the water consumption related to seasonal changes and public holidays.

IMPROVE NON-REVENUE WATER CALCULATIONS AND SUPPORT ACTIVE LEAKAGE CONTROL WITH VIDI POSITIONER

As part of the LEAKman project, VIDI Positioners are installed on sectioning valves to ensure reliable data for water balance and non-revenue water level calculations. The purpose of the LEAKman project is to implement state-of-the-art solutions for water distribution with the overall goal of minimising water loss.

The LEAKman partners did at an early stage identify the need for knowing if and when DMA boundary valves are operated, as a wrongfully opened or closed valve commonly influences non-revenue water (NRW) management and often leads to false results when conducting water balance assessment and minimum night flow monitoring.

Monitoring boundary valves increases reliability of data
Flow meters on DMA inlet pipes and shut-off valves on the pipes connecting DMAs enable water balance calculations at DMA level. Accurate water balance calculations rely on robust, precise and complete data where all water entering and leaving a DMA is monitored and measured.

Such calculations highly depend upon valid information confirming that all boundary valves are closed during the water balance assessment period. It is a well-known problem, that if the boundary valves have been opened during maintenance work, they are sometimes not brought back to closed position afterwards. In other words, monitoring the open/closed position of boundary valves can help prevent unmeasured flow between DMAs and thereby ensure more reliable data and calculations.

VIDI Positioners contribute to improved overview
HOFOR, the largest utility company in Denmark, has approximately one million customers in Greater Copenhagen. They have divided the area into 65 DMA zones allowing for, among other things, calculating the water balance and monitoring water loss – one of the most cost-effective ways to spot leaks and thereby reduce NRW.

To ensure reliable data for water balance calculations, VIDI positioners have been installed as part of the LEAKman demonstration facilities at HOFOR, at three strategically important shut-off valves acting as boundary valves between DMAs. The VIDI Positioner is an IoT sensor that indicates in percentages how much the valve is open, and it reports any operating activities opening or closing the valves. Data is automatically sent to HOFOR at regular intervals and whenever the valve is operated. Through API, data is integrated with the GIS (geographic information system), so that the entire operation and maintenance staff automatically have direct access to the valve status information.

The valve position data is further integrated with the management information system HOMIS and directly connected with the hydraulic model where the hydraulic simulations then automatically will reflect the change in valve position. HOMIS will also utilise the information coming from the VIDI Positioners to disable water balance calculations during periods where the DMA boundary valves are open. This way, the VIDI Positioners ensure precise information about valve positions and allow for a better overview and automated knowledge sharing.

LEAKman

The LEAKman project intends to demonstrate Danish solutions to reduce water loss and to pave the way for new Danish water technology.

The goal is to establish guidelines that can be implemented globally and help ensure efficient water distribution all over the world. Nine partners are working together on the project and besides AVK these are HOFOR, NIRAS, Grundfos, Kamstrup, DTU, Schneider Electric, Novafos and Leif Koch.

FACTS ABOUT HOFOR

• Approx. one million customers in Greater Copenhagen

• 2,000 km pipes for drinking water supply

• 65 DMA zones

VIDI Positioner installed in a plastic surface box.