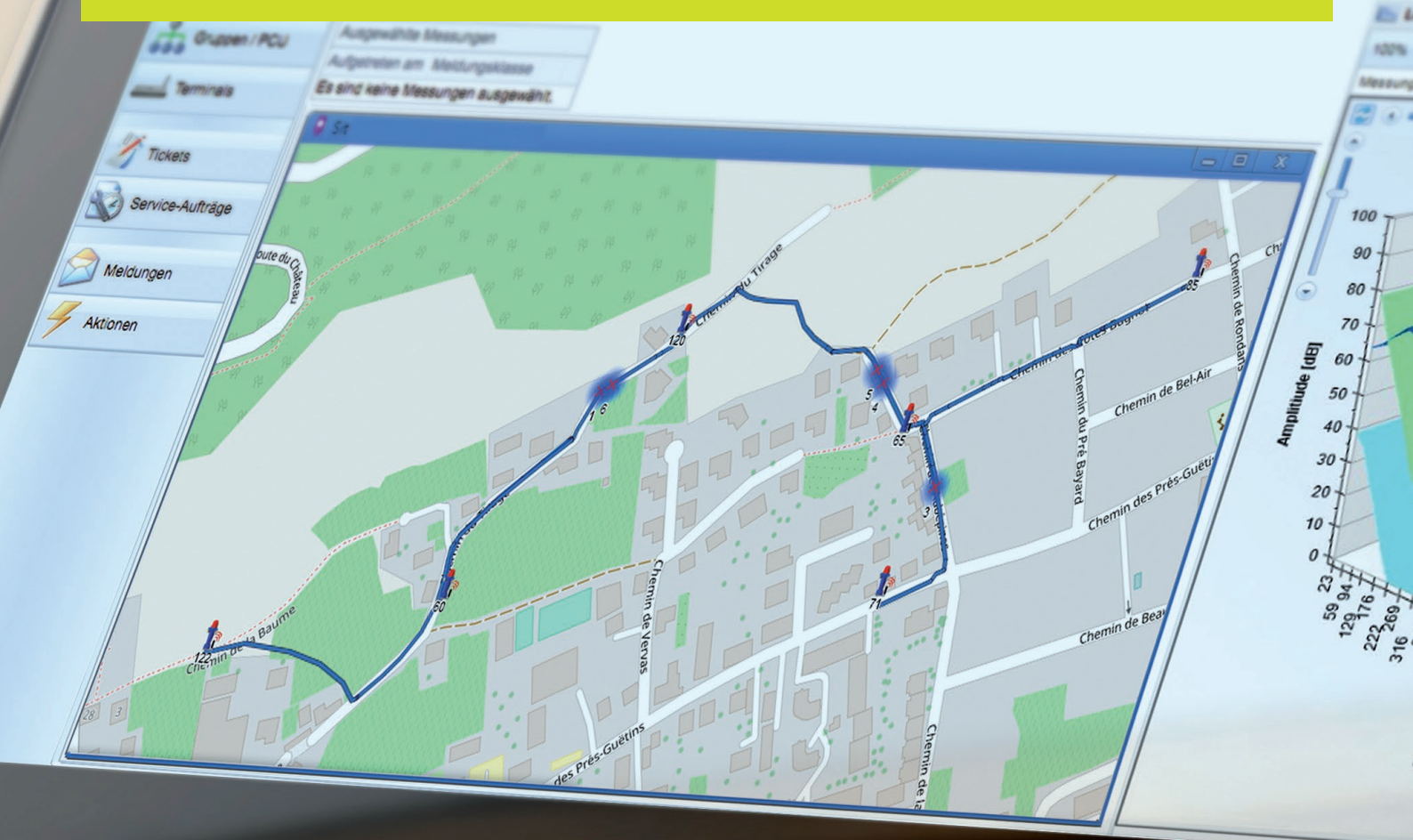# Intelligent monitored water networks

Hinni
Infra Services

BKW

INFRA SERVICES

# Focus on network security: the LORNO control system

LORNO is an automated, permanent, 24/7 leak detection system that monitors and controls the drinking water network of a water utility by means of sensors, electronics, data transmission, and software.

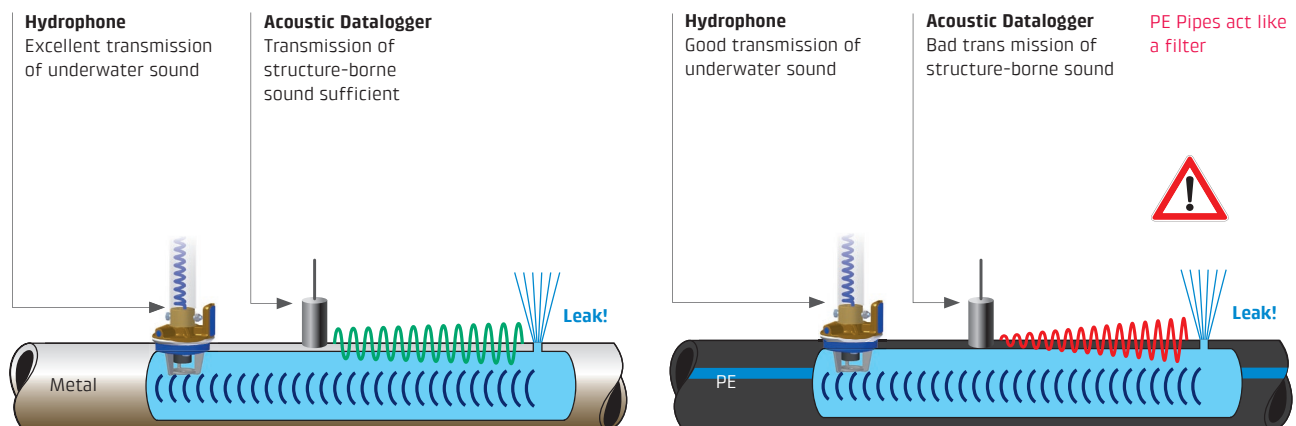**Thanks to LORNO, you can detect and locate leaks early and reduce costs.**

The LORNO control system offers targeted support for the security of the water network.

– Prevention of infrastructure damages
– Reduction of water loss
– Civil works and investment decisions can be planned and coordinated earlier
– Reduction of unauthorized water retrieval. Improper operation can be identified and corrected quickly

hinni.ch
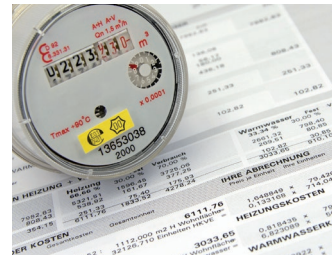
Modular technology:
LORNO makes the difference

The specific modular-conceived technique, consisting of a wired hydrophone and an electronic unit, can be integrated in various hydrants and saddle clamps.

Hydrophone
Excellent transmission of underwater sound

Acoustic Datalogger
Transmission of structure-borne sound sufficient

Leak!

Metal

Hydrophone
Good transmission of underwater sound

Acoustic Datalogger
Bad trans mission of structure-borne sound

PE Pipes act like a filter

Leak!

PE

600 m

Each LORNO measuring point acoustically controls a radius of about 150 – 300 m depending on the material, the diameter of the pipe, and the topology.
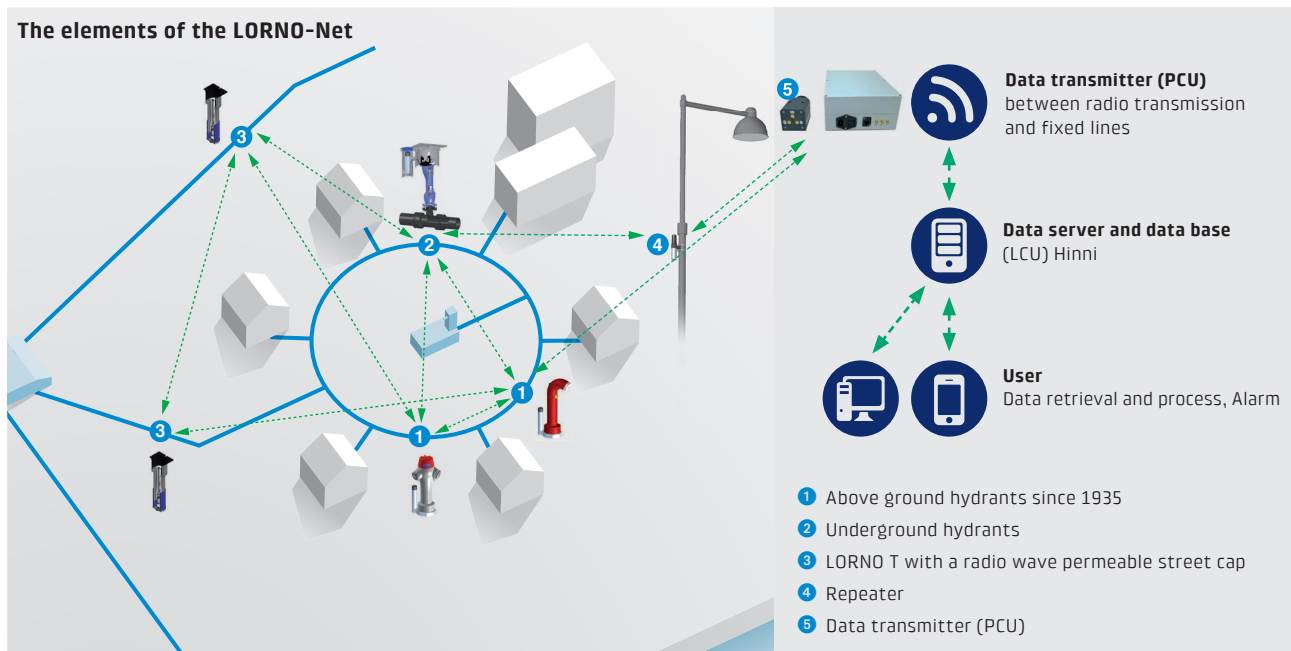
LORNO is applicable for all pipelines, dimensions and pipe materials (Steel , GGG, Eternit , PE, ...)

The material of the pipeline is mostly insignificant. Why? Because the integrated hydrophone does not measure the sound waves on the pipe, but instead directly in the medium water. This works in the same way with metal as well as with plastic pipes.

LORNO®)))

Bidirectional radio transmission: the structure of the LORNO system

The bidirectional, self-organising radio data network (LORNO-Net) connects the equipped hydrants and repeaters. It transmits reports to the local data transmitter (PCU) and from there on through mobile data transmission or the internal network (Ethernet) to the server (LCU). Optionally, data can be sent to the server from the measuring point directly through mobile data.

The elements of the LORNO-Net

Data transmitter (PCU)
between radio transmission and fixed lines

Data server and data base
(LCU) Hinni

User
Data retrieval and process, Alarm

1 Above ground hydrants since 1935
2 Underground hydrants
3 LORNO T with a radio wave permeable street cap
4 Repeater
5 Data transmitter (PCU)

The data transmitter represents the gateway between the radio data transmission network and the server. It is able to connect up to 50 measuring points and is installed on public buildings.

In the server, the messages are saved to a database and users can access them through a web application. All functions of the server are actuated from the workstation. The only requirement is a computer with a web browser and access to the internet.

In case of emergency, the server automatically forwards the message to the responsible office, as well as via email or SMS. A communication network that is free of charge is advantageous for future needs.

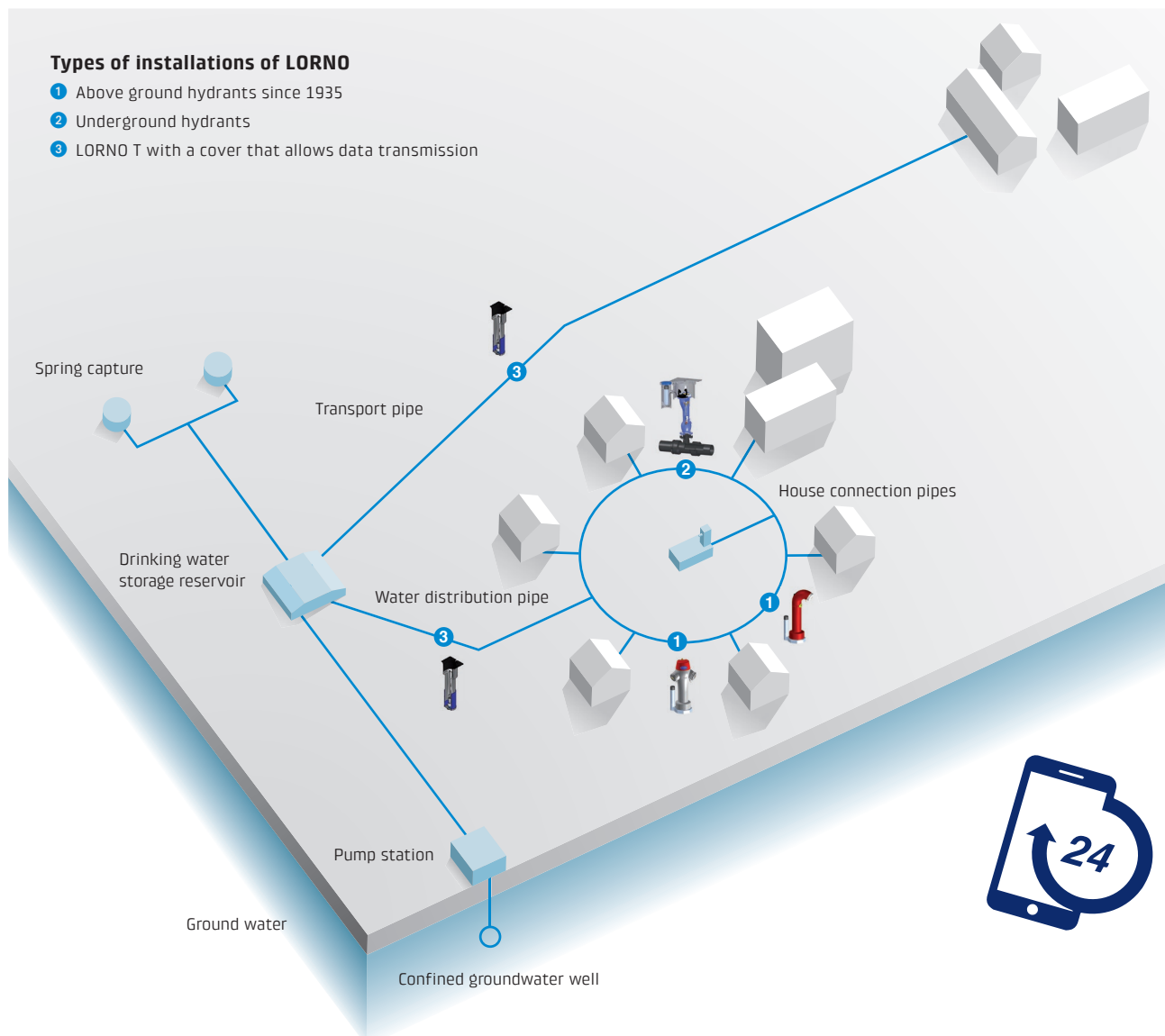# Automated push system: permanente network monitoring

LORNO is a bidirectional push system. In case of emergency, the server transmits the message automatically to the responsible office.

LORNO continually monitors:

– The water network for leaks
– The water level of the hydrants
– Water withdrawals and / or incorrect hydrant operations
– The operational readiness of the individual system components

Measuring points can involve above ground or underground hydrants as well as LORNO T equipment (water mains).

If desired, they can all be built into a common network. Additionally, with the SIM option, individual measuring points are able to communicate with the server through mobile data transmission. Via the LORNO web application, measuring points can be managed with either a radio data transmission network or through communication via mobile data.

Types of installations of LORNO
1 Above ground hydrants since 1935
2 Underground hydrants
3 LORNO T with a cover that allows data transmission

Spring capture

Transport pipe

House connection pipes

Drinking water storage reservoir

Water distribution pipe

Pump station

Ground water

Confined groundwater well

24

Acoustic measuring method: leak detection

After the LORNO measuring modules are installed into the pipe network, the noise measurement will commence. The measuring module registers the acoustic environment in the water pipe (rate, amplitude and frequency of the measured noises) for several days (for example, one week) according to a selection algorithm.

As a result of these selected measurements, the parameterization of the leak detection function is carried out. The individual background noise is calculated for each measuring point and saved to the measuring module through reference spectra (light blue/green). Additionally to the background noise, we define a leak threshold (yellow) that is dependent on the pipe material.

When the leak detection module is activated, the measuring modules automatically take noise measurements in freely configurable day and night time intervals.

The measuring module registers the measurements through a selection algorithm and then the system compares the measurements with the reference spectra.

Deviations which lie outside of the reference spectra lead to a leak decision after a parameterizable time.

The measuring and repeating module then automatically sends a leak report, which contains detailed information (spectra) about the leak decision to the server. In case the noise rises abruptly, the system triggers an early alarm within 6 hours.
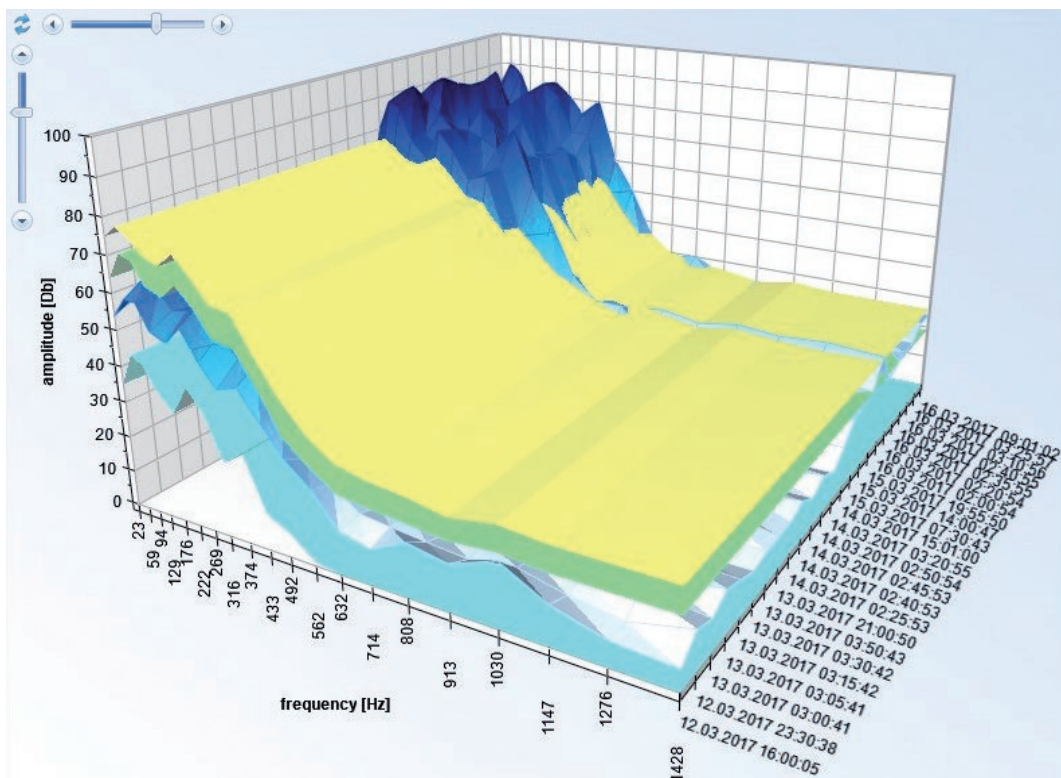

Spectrum-time view

■ Initial noise measurement   ■ Maximal background noise   ■ Minimal background noise   ■ Leak threshold

Fox option:
Localisation of leaks trough correlation

Due to the continuous development and the modular design of LORNO, we can offer the Fox option in addition to the leak detection. The Fox option allows leak localisation through correlation; therefore the system is configured accordingly.
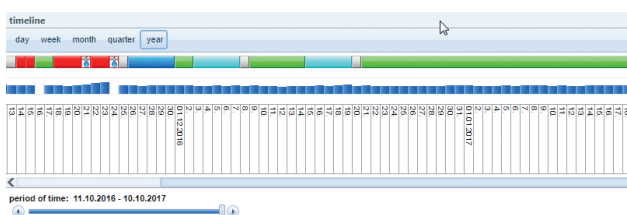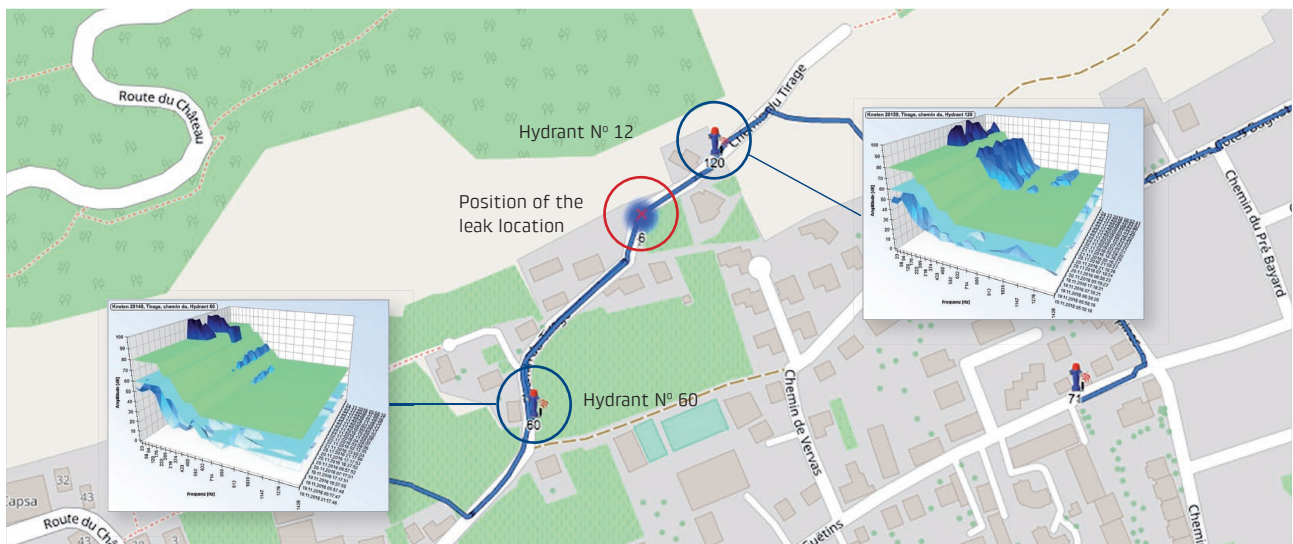
If the LORNO Fox option is installed, the system is able to perform automatic leak localisation through cross-correlation.

After an incoming leak report, LORNO automatically starts a correlation to the leak detection (at 3 a.m. after an incoming leak report).

Due to significance and analysis of the correlation measurement, the injected GIS data, and pipe material, one or more possible leak locations are shown on the map. Accuracy is up to 5% of the length of the pipe section between the measuring points.

Required conditions for a successful leak localisation:

– Complete and exact GIS data. The more accurate the GIS data, the more accurate the correlation.
– Information about the pipe material as well as the diameter of the pipe.

Access throug the internet: the LORNO Web application

The user can access the information that is registered by the system at any time over the internet.
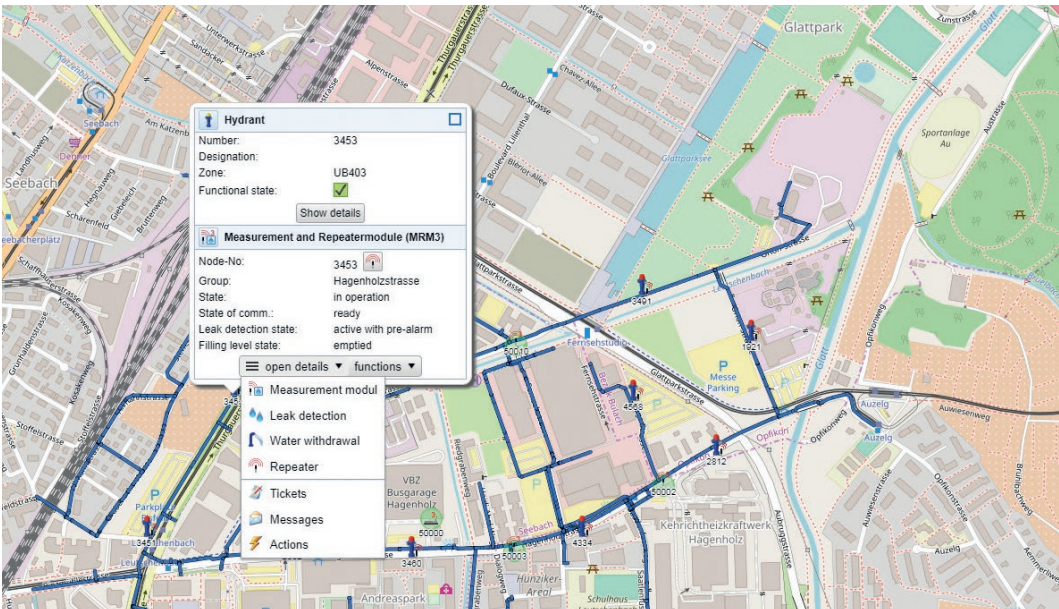
System access via LORNO map view

At a glance, the map view displays an overview of all the existing measuring modules and allows the user to consult, edit and send reports or actions with a single click on a measurement without having to be present onsite.

Access to the system through the list view

The leak, water withdrawal, or battery reports are sorted according to type and are shown chronologically. They can be edited by clicking on the appropriate icon and processed directly via the ticket system.

Saving the edited information also enables the user to track planned and completed tasks.

If the LORNO system registers a disturbance or any event in the water network at the equipped measuring points, the system automatically sends a report to the server, which is shown on the web application and can also reach the user as either an email or SMS (push system).

Illustration of reports

The reports of leak detections can be illustrated and edited in different ways.
The 3D spectral time image visualises an incoming leak detection report on a 3D frequency-/amplitude- and time-axis. This shows the beginning and the profile of the leak. In many cases, the indicated frequency range can give clues as to which material is used (low frequency: PE; high frequency: cast iron).

Every incident (alarms, reports) is automatically transmitted to the person in charge:
Through access to our software's web application as well as by email or SMS.

– Detection of leaks in the water pipeline system
– Localisation of the leaks in case of a leak report (Option Fox)

Additional service in case of hydrant control:
– Water withdrawal from the hydrants (indication of location, time and duration)
– Draining of hydrants and leaking main valves

The timeline delivers information about the monitoring history of the module and its possible state changes. Leak reports are shown in red. By clicking on a red section of the timeline the 3D spectral time image or the correlation data (optional) can be retrieved.
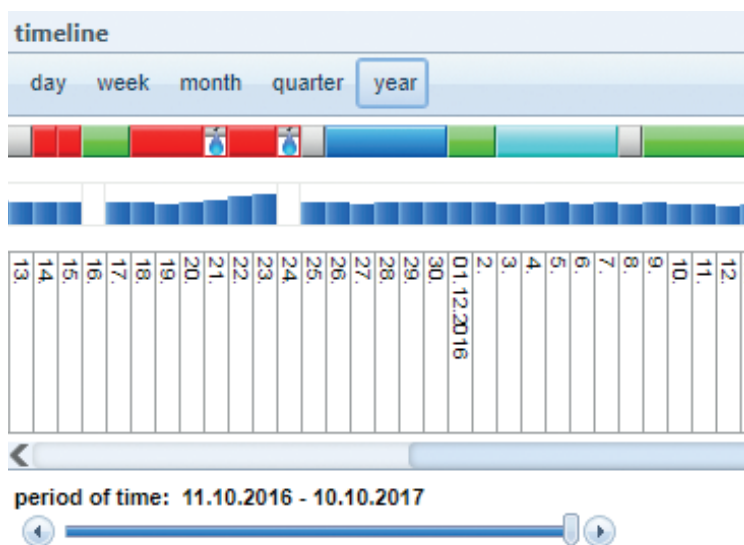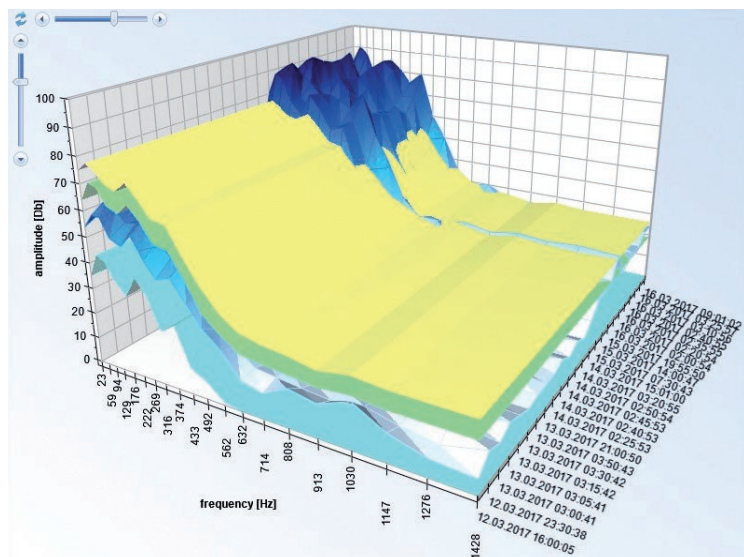
Communication through mobile data transmission: SIM Option

The data transmission to/from the server is performed
by the LORNO-Net or optionally by mobile data transmission
(SIM Option).

Possible variations of LORNO installation

Time synchronisation via GPS
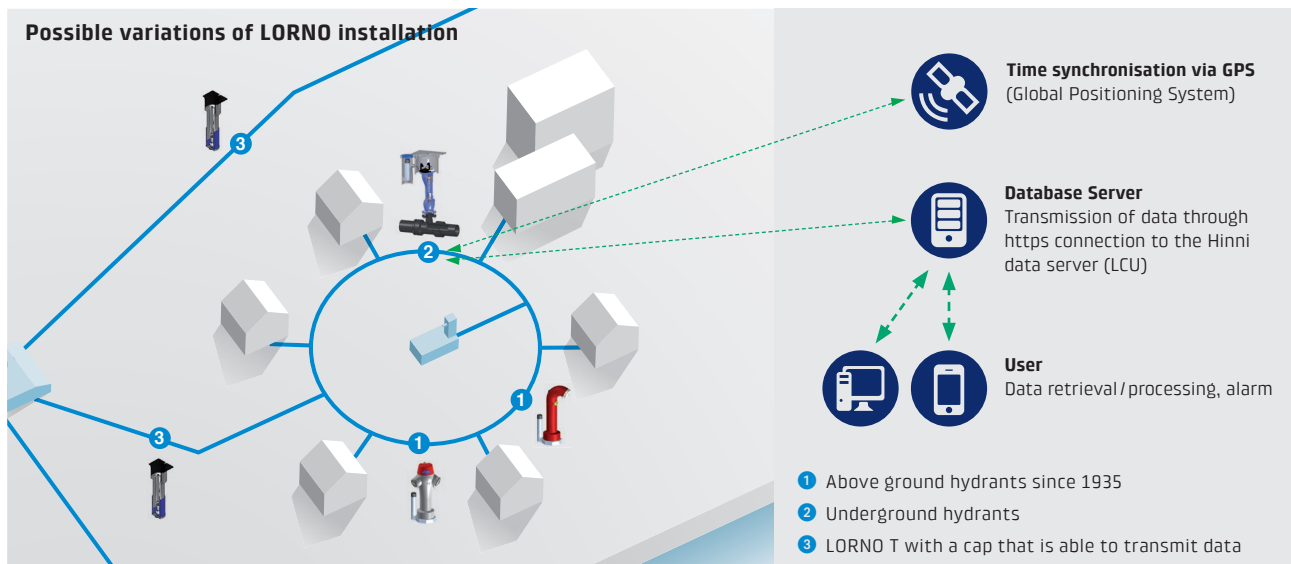(Global Positioning System)

Database Server
Transmission of data through
https connection to the Hinni
data server (LCU)

User
Data retrieval / processing, alarm

1 Above ground hydrants since 1935
2 Underground hydrants
3 LORNO T with a cap that is able to transmit data

With the SIM option, communication between the measuring point and the server takes place via a secure https connection. The data packages that are sent correspond to the information contained within the radio data transmission and can be adjusted individually for each measuring module. This is possible via the mobile data transmission network.

The module reports to the server in adjustable intervals (at least once per day) in order to execute any actions that may be pending (bidirectional connection). The intervals in which the module reports can be configured to suit the user's wishes. Alarm notifications, on the other hand, are transmitted separately and always immediately.

Every measuring point, via direct connection to the server, fulfils the same characteristics as the data transmitter of the radio network and is therefore able to execute the same tasks.

The processing of reports on the web application is the same as for a measuring point from the data network.

The requirement for successful data transmission is a SIM card with mobile roaming data enabled (500 MB) and sufficient coverage.

Hydrophone and electronic unit: LORNO hardware components

ZIn order to monitor the water network, the measuring point needs two hardware components: the hydrophone sensor and the battery-equipped autonomous electronic unit with an antenna.

The hydrophone receives the water sound waves, transforms them into measuring signals and transmits them to the electronic unit.

The electronic unit includes the measuring and repeater module which evaluates the measured signals and sends the status reports and alarms. The integrated battery ensures an autonomous system operation.

Thanks to their modular design, these two components can be integrated into different fittings, depending on the desired installation version and data transmission:

– CH – Above ground hydrants, since 1935
– Underground hydrants
– Specially conceived system elements through tapping saddle

The data transmission then takes place either:
– Through wireless radio transmission
– (LORNO-Net)
– Or optionally through mobile data transmission (SIM Option)

Electronic unit with antenna

Hydrophone sensor
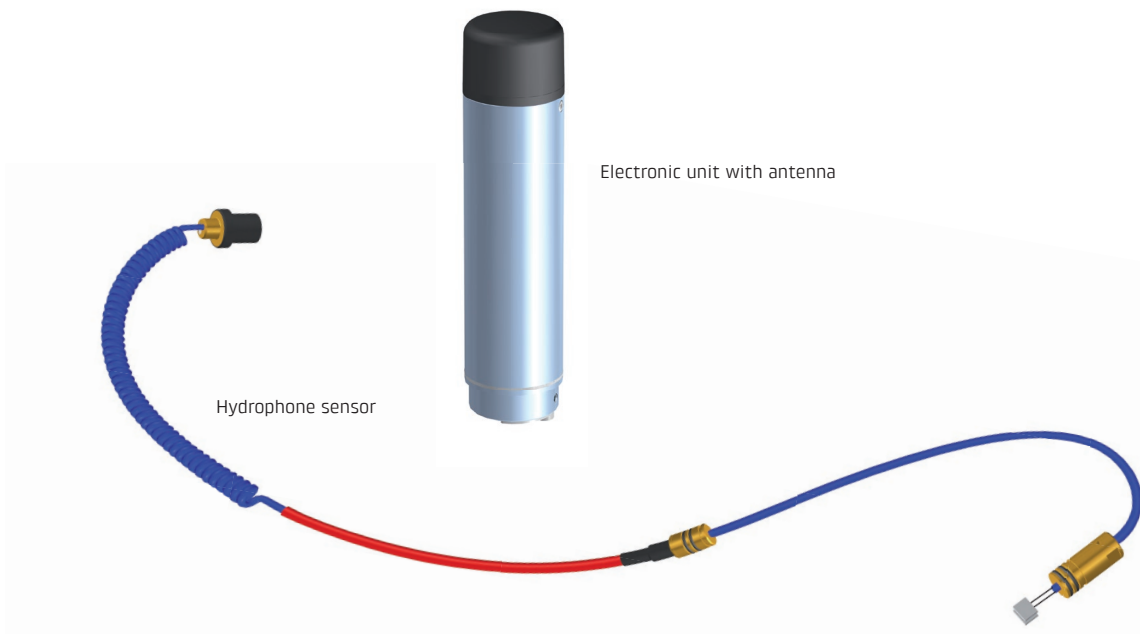
Elements of the system in the drinking water network: possible variations of installation

The hydrophone is inserted through the valve rod
into the pipe system.
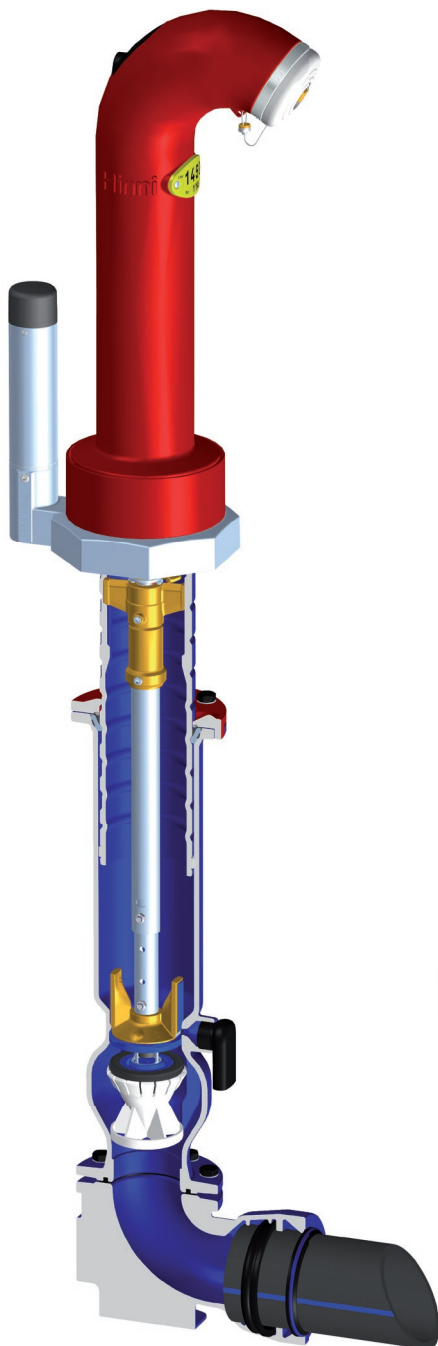
LORNO in an above ground hydrant

The electronic unit is installed with an intermediate ring that is equipped with a float switch. The intermediate ring is installed between the upper part and the lower part of the hydrant and serves additionally as an external interface between the hydrophone and electronic unit. LORNO can be installed in Swiss hydrants from 1935 onwards.

Additional performances to the leak detection function:
– Reports of water withdrawals at hydrants equipped with LORNO (information about location, time and duration)
– Drainage of the hydrants (level control) and leaking main valves.
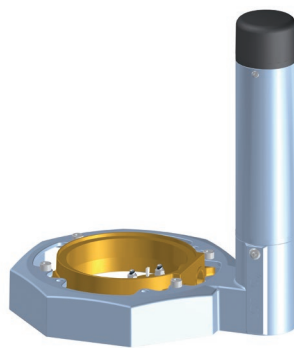
Interface intermediate ring

Upper Part – 6006 with intermediate ring, double closing lower part
and duck foot bend.

Underground
hydrant

Street cap made out of cast iron with radio
wave permeable plastic cap (blue)

Hydrophone system in a
compact telescope shaft
system

Hydrophone system
for existing shafts

LORNO in an underground hydrant

The underground hydrant is, in addition to the
valve rod, equipped with or without an interme-
diate ring depending on the model (CH or Export).
The float switch is in any case integrated so that
the additional LORNO functions can also be
offered for all underground hydrant models.

The electronics unit is integrated in a specially-
designed street cap and can be connected to
the hydrophone through a linked tube. The high
quality plastic cover complies with the DIN EN124
standard and allows radio transmission.

The street cap for underground hydrants is made
of cast iron and complies with DIN EN124. The
construction ensures simple, safe, and secure
installation and use.

LORNO in the transport main

The modular system of LORNO is also applicable
for transport mains. For this purpose, a specially
developed hydrophone system is installed
through a closable tapping saddle either:

– Into an already existing manhole or
– Into a shaft system specifically designed for
  this case

The radio-permeable plastic cap allows communi-
cation to the server in both variations.

LORNO with an intermediate flange

For new installations or as a retrofit, the hydrophone can also be inserted into the mains network via an intermediate flange.

This version cannot be removed or installed under full water pressure. Separate gate valves must ensure that there is no water pressure during installation and removal for this type of installation.
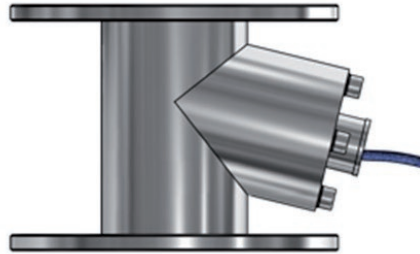
Intermediate flange

LORNO under license
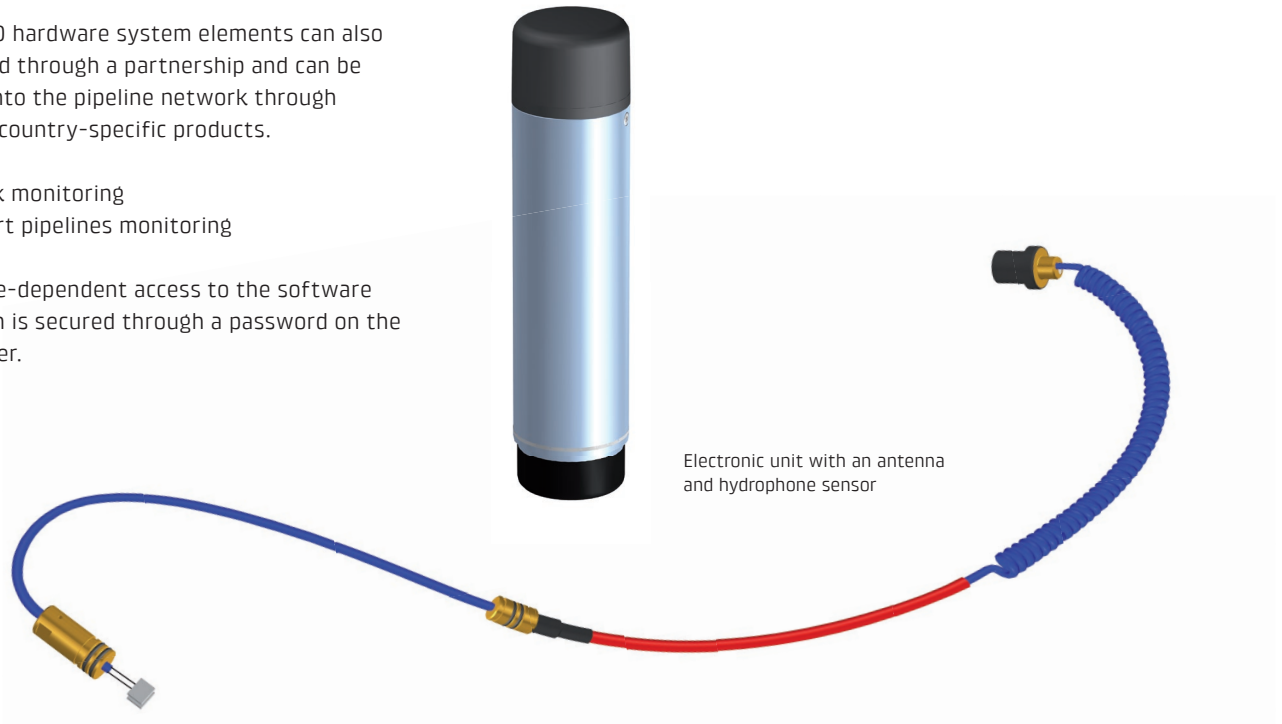
The LORNO hardware system elements can also be acquired through a partnership and can be inserted into the pipeline network through different /country-specific products.

– Network monitoring
– Transport pipelines monitoring

The license-dependent access to the software application is secured through a password on the Hinni server.

Electronic unit with an antenna and hydrophone sensor

Optional service packages:
LORNO services

When the system is handed over, the customer is trained accordingly and can manage the monitoring of the reports and alarms independently. The supervision of these tasks can also be delegated to Hinni, in which case we will manage the system and inform you personally in case of tasks that need to be executed.

We offer the following additional services for our customers:

User-Plus package

With this option, the configuration of the network is executed by qualified staff from Hinni but the operation of the network monitoring is executed by the customer.

Configuration of the network monitoring
– Check the leak detection parameters of the measuring modules every 3 months and, if necessary, raise a ticket to request the customer to conduct clarifications in the field
– Recalculate and configure parameters after consultation with the customer
– A report in form of a PDF file is sent to the client by email

Maintenance contract

The customer may, upon request, agree a global service / maintenance contract with Hinni AG which lists all the contractually-agreed work and services to be executed.

LORNO makes the difference: characteristics of LORNO

Leak detection independently of pipe material thanks to direct sound wave monitoring in the water.

Automatic measuring (parameterizable)
Provides information about the state of the water pipeline system 24/7.

Leak detection (proactive and reliable)
Depending on the material of the pipes (Steel, GGG, Eternit, PE, …) a comprehensive surveillance of the water pipeline system is possible from an equipment density of approx. 30% of the existing hydrants. The standard version supports the leak detection by confining the area and pre-localising the leakage.

Automatic data transmission (push system)
The control system delivers the reports automatically through LORNO-Net to the Hinni server. Wireless, bidirectional data transmission, license-free/free of charge (868 MHz), self-organising, and highly energy-saving.

Secure data access/retrieval/processing
At any time on any PC (with web browser and internet connection).

Data and webserver
The server includes the web application specifically developed by Hinni, which allows user-specific access to the system data. Additionally, the server includes the Hinni database and offers an interface to Web-GIS.

Characteristics of LORNO for Hydrants

Retrofit of hydrants with LORNO
Lower parts of hydrants from 1935 onward can be retrofitted (above ground and underground models).

Water level control (water withdrawals and drainage)
Through the float switch in the intermediate ring, the equipped hydrants are constantly monitored for water withdrawals and level control.

LORNO Options

Fox: Localisation of leaks through correlation (parameterizable)
Automatic leak localisation as soon as a leak report is received. The accuracy of the location depends on the quality of the GIS data, the structure of the mains network, and pipe material.
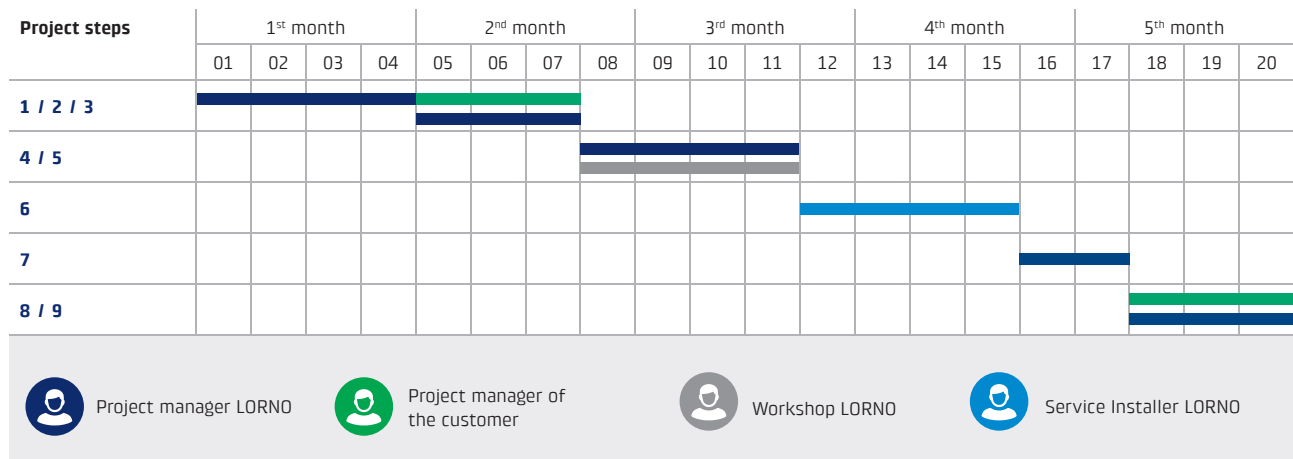
SIM: Transmission through mobile data (parameterizable)
Individual measuring modules, as well as whole systems, can be equipped with an integrated data SIM card: the bidirectional data transmission is directly sent to the server for each module (no radio data network needed).

And now? What's next?
LORNO project management

In order to be able to comprehensively supervise a water distribution network, it is sufficient to equip only some of the installed hydrants. The determination of the optimal equipment density of equipped hydrants depends on various factors, for example pipe material, distance between the hydrants, and the topology of the environment.

Project steps	1st month				2nd month				3rd month				4th month				5th month			
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
1 / 2 / 3																				
4 / 5																				
6																				
7																				
8 / 9																				

Project manager LORNO
Project manager of the customer
Workshop LORNO
Service Installer LORNO

Project schedule

1 System Planning
2 Creation of a procedure, agenda and task plan
3 Identifying of the LORNO measuring modules and the data transmitter in cooperation with the customer
4 Server setup (software, application, database, access- and user-rights)
5 Configuration and parameterization of the radio data network modules in the workshop
6 Installation of the hardware of the measuring points and carrying out the acoustic sound measurement
7 Parameterization of the leak detection function as well as the possible options
8 User instruction and training
**9** Handover of the system to the customer

Example with ca. 30% equipped hydrant density
Minimum requirement for leak detection in a water mains network or zone (dependent on material and topology). Total stock is 200 hydrants, of which 60 are equipped with LORNO.

Distributors

Hinni AG belongs to BKW Infra Services, which manages the field of network services as part of BKW. In total, the company employs more than 1,000 members of staff via BKW Infra Services.

We provide customers across Switzerland with comprehensive services in the energy, telecom, transport and water sectors. Urbanisation, population growth and rising mobility are increasing the importance of an efficiently planned and integrated network infrastructure. BKW Infra Services is thinking and planning for tomorrow today thanks to our network of specialists in this field.

3 IMBEMA GROEP / Haarlem

HINNI AG / Biel-Benken

1

TRAITAL S.R.L / Milano

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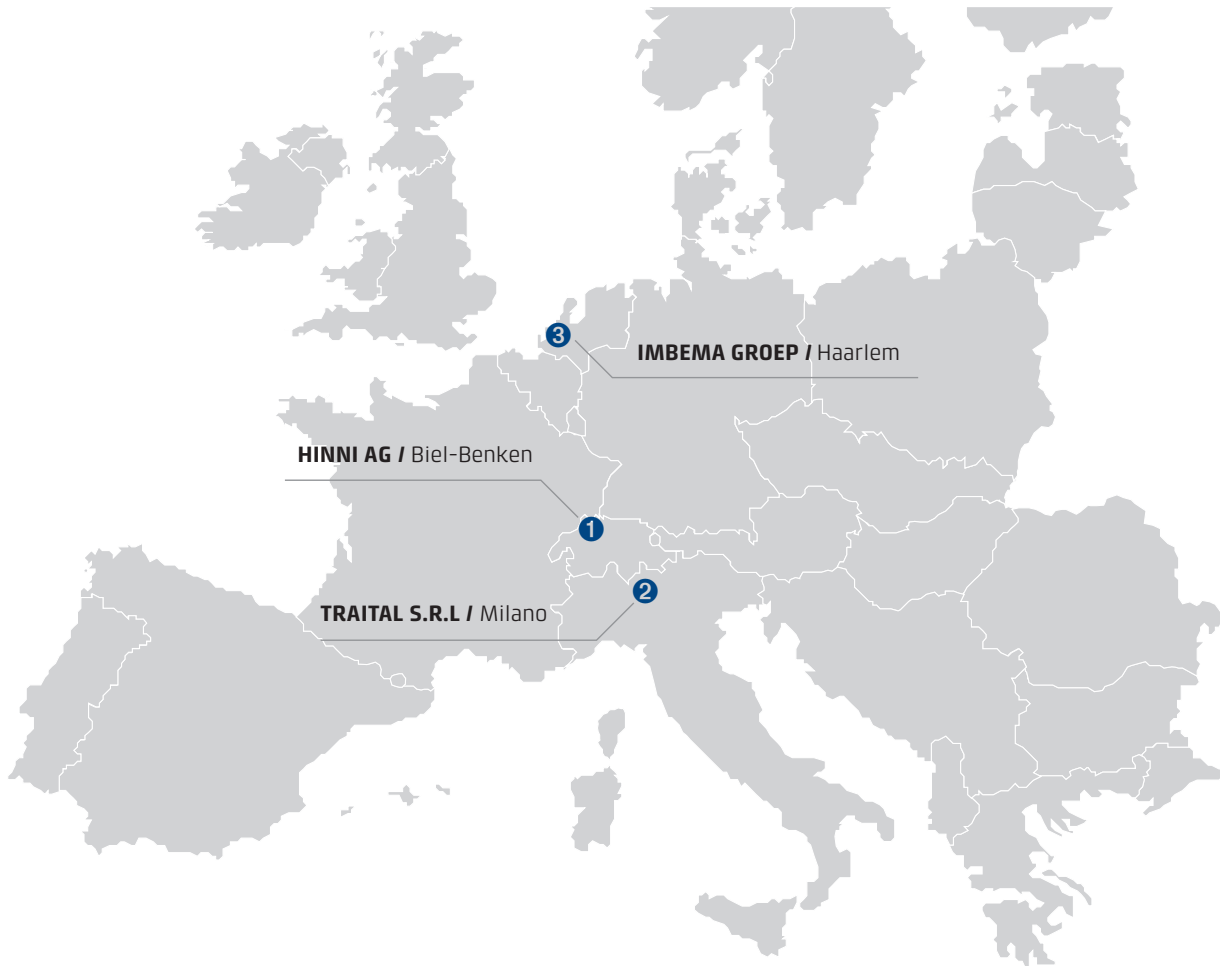
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