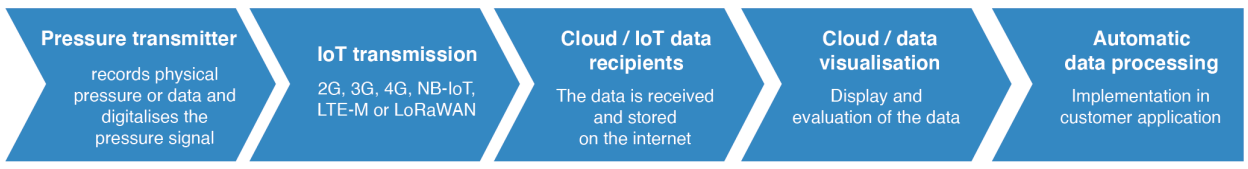
IOT MEASURING SYSTEM IN PRESSURE MEASUREMENT TECHNOLOGY FOR WATER LEVEL OR FILL LEVEL MONITORING AND GENERAL PRESSURE MEASUREMENT

All the talk seems to suggest we are heading towards complete digitalisation. But how do you get on this path and what is the right direction for your company?

Industry 4.0 and Smart City are technology drivers behind the digitalisation of pressure sensors and pressure measuring solutions. The intention and the need to make processes more efficient are at the heart of digitalisation.

The path towards digitalisation begins with recording data, mostly with sensors. Pressure sensors also record measured values. For machines or fill levels in containers and tanks, this takes the form of states. For lakes, rivers and groundwater, the levels are measured. The objects measured are connected to the Internet, save their data to a cloud and the data is mainly transmitted wirelessly via radio transmission. The latest technologies such as LoRaWAN or mobile communications (NB-IoT, LTE-M) are also used. The data can eventually be retrieved on all possible end devices such as computers, tablets or mobile phones. This entire Internet environment of and with objects is called the Internet of Things (abbr. IoT).



Comprehensive IoT service package

KELLER AG für Druckmesstechnik offers this comprehensive solution, as described, of an IoT measuring system, based on the latest technologies. This type of measuring solution allows the user to take an immediate step towards digitalisation, without much effort and at low cost:

- No software solutions or hardware need to be created.
- A working and tested measurement data recording system can be accessed.
- No separate, technically advanced training in the technologies is necessary.

KELLER's measuring system is designed in such a way that each part of the measuring chain has a specific interface. Thanks to the open and well-documented cloud API (Application Programming Interface), ③ the user can incorporate the measurement data processing system into their own information system and therefore start at exactly the point where the greatest benefits of digitalisation are revealed. KELLER makes available all individual interfaces so that users have free choice, in terms of implementation, as to whether they would like to set up the entire system or only parts of it, as required.

How deeply this vertical integration is implemented depends on the application and involves weighing the costs against the benefits. The lowest integration level is defining the pressure sensor signal. The following graph shows the individual integration levels from the pressure sensor series 9L up to the KOLIBRI Cloud web app:

Test Keller IoT measuring system now

- KOLIBRI Cloud web app: kolibricloud.ch
- Cost-effective water applications: keller-druck.com/en/industries/water-and-environment

Step-by-step digitalisation

including examples and KELLER products

1. Specify data recording points/measuring points for a POC (proof of concept)
   Available level measuring point
2. Define a suitable pressure transmitter based on requirements such as accuracy, compatibility of media, etc. ①
   Level sensor series 36XW for ground water levels
3. Select transmission technology LoRaWAN or mobile communications ②
   Remote data transmission unit ADT1-Tube for LoRaWAN or ARC1-Tube for mobile communications

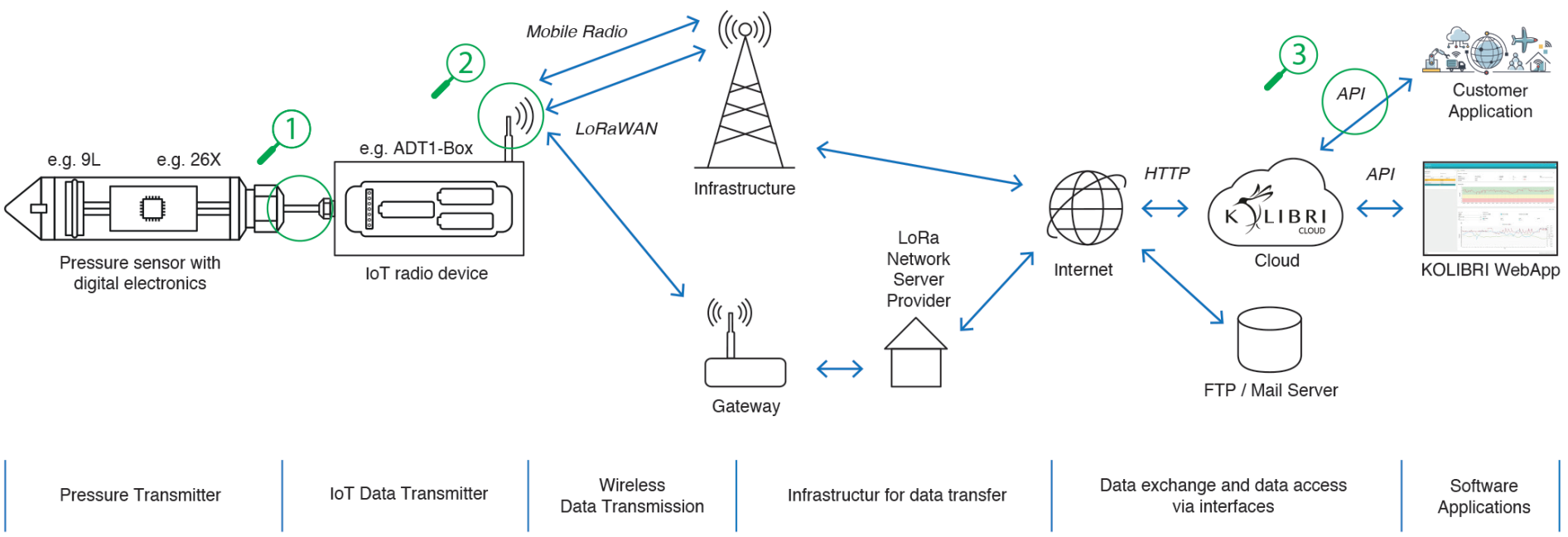
Note: Check which network coverage is available at the measuring point for the selected technology. The measuring points selected should be as close as possible to the person responsible for the system so the discrepancy can be found and remedied in the event of a fault on site. Verification of the measured values recorded should also be performed during operation at the measuring location.

4. Operate measuring points with the help of a graphical representation in a cloud for a few weeks and monitor closely
   KOLIBRI Cloud
5. Expand the measuring system (POC) with additional, possibly technically critical measuring points and close monitoring of any discrepancies
   Level measuring points, with poor reception or technical measuring issues

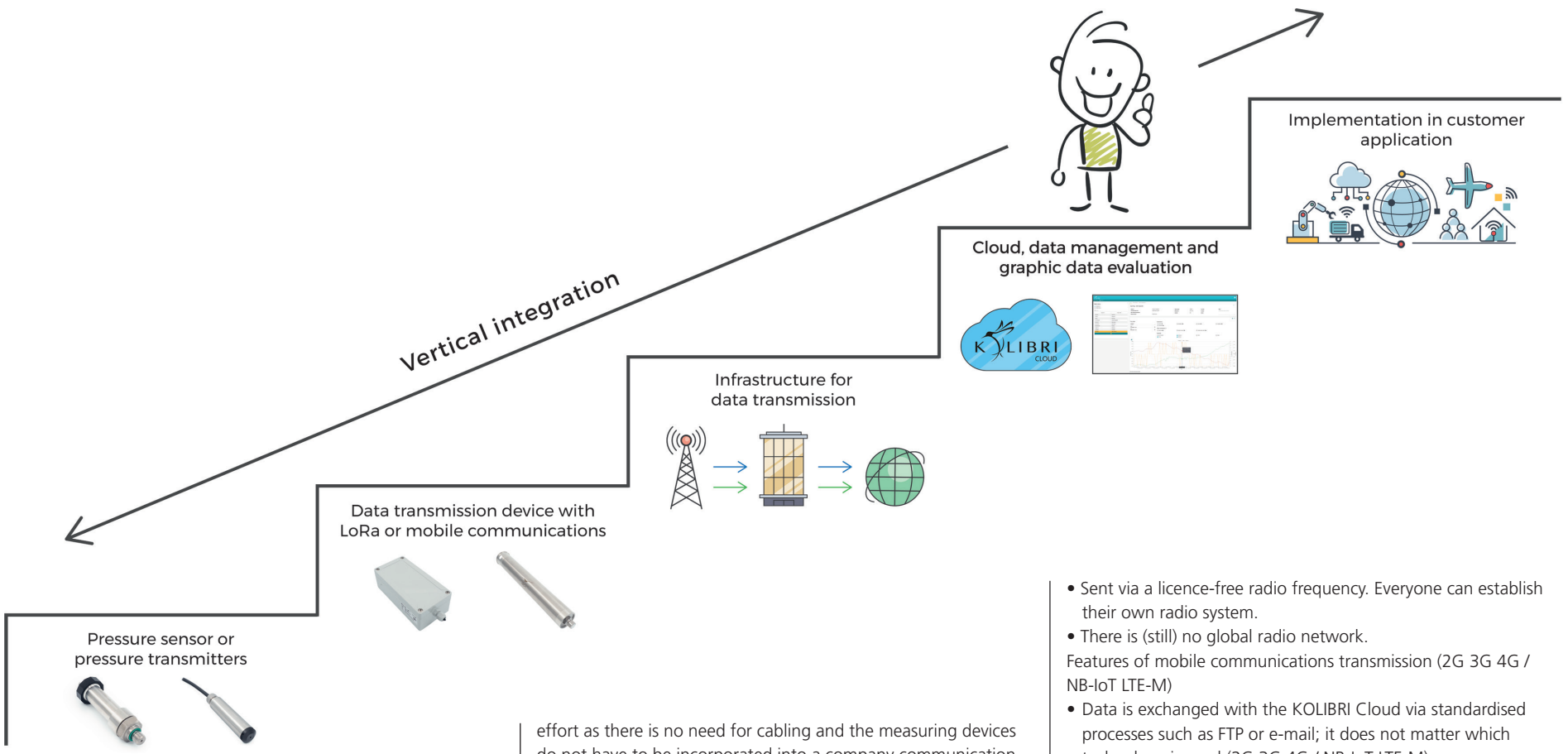
Status quo:

According to this expanded concept, the entire system is to be fundamentally evaluated and assessed with regard to whether the results correspond to expectations.
Up until this stage, the IoT measuring system from KELLER was able to be used with little investment. It must now be assessed whether the system is to be kept as it is and, as such, the digitalisation project concluded, or whether a deeper integration of the system into the company's software is desired.

6. Automatic data synchronisation between the measuring system and the company's own cloud
   API software interface ③
   Note: The service providers of the company's own software often do not know the process of generating IoT measurement data. KELLER's many years of experience helps here to establish clear and concrete functional requirements for the measurement data it records in an external system.
7. Complete vertical integration
   Pressure sensor or transmitter, remote data transmission unit, KOLIBRI Cloud



Grafic IoT service package



Open interfaces for all components of the entire measurement chain

Digitalisation of the pressure sensor signal

The pressure sensor signals are processed and digitalised using an electronic circuit. This means they are converted into a number (pressure) that can be retrieved via an interface. Other useful information can also be taken from the pressure sensor in addition to pressure and temperature.

In many cases, too little attention is paid during the initial process considerations to the importance of an accurate, stable and reliable sensor. The sensor that records the data is one of the most important parts of the system because decisions are made and actions taken based on this sensor data:

- Switch off the machine
- Fill up the tank
- Ground water level too low = signals no supply of drinking water!
- Ground water level too high = signals flood!

Consequently, the sensor, which is at the start of the entire measuring chain, has the greatest influence on the quality of the data and must be selected or designed according to the requirements of the measuring system.

KELLER offers specifically developed and tested pressure sensors for the respective application and requirement. For the use of pressure transmitters with the user's own hardware to transmit the measured data, KELLER provides the communication protocols for the RS485 or I2C interfaces. ① For applications that are meant to use a pressure sensor without a standardised output signal, the calibration data is supplied to the sensor.

Remote transmission

Another important part of digitalisation is transmission of the recorded data. Often sensors are located in places that are far away from the central collection and evaluation point, or the sensors cannot be connected to a local communication network.

The Internet of Things (IoT) is a global network that enables the exchange of data via the Internet. This means that sensor data, for example, that has been generated at different locations around the world can be amalgamated in one system (cloud). A prerequisite for this function is that the device, the machine or the sensor has access to the Internet. For the measuring solution from KELLER, we use autonomous, battery-operated IoT devices that transmit data via various radio interfaces.

One advantage is that these devices can be installed with little effort as there is no need for cabling and the measuring devices do not have to be incorporated into a company communication network. So that the devices and their batteries have a service life of several years, standardised radio technologies (LoRaWAN as well as mobile communications 2G, 3G, 4G, NB-IoT, LTE-M) with low energy consumption and a long transmission range of 15 km and over are used alongside an intelligent, energy-saving electronics system. Whether LoRaWan or mobile communications are used depends on the requirements for the data recording or on the type of radio coverage available on site.

Data can be exchanged bidirectionally in both radio systems. Not only does this mean that measured values can be sent from the measuring point to the central collection point (cloud), but communication from the central collection point to each measuring point is also possible too. Communication to the device is used for configuration notifications, which, for example, change a measuring interval from a distance. The communication interface from KELLER devices with LoRaWAN (ADT1) as well as mobile communications devices (ARC1) ② is well documented and a software sample code is available for integration into the company's own application.

All devices are designed so that a software update can be installed on the devices. This is extremely helpful in the context of the extension of radio technologies or modifications of wireless protocols. The electronics of the ARC1 mobile communications device for data transmission have a modular design and allow replacement of the radio module in the event of future technology changes so that the transmission device can be adapted again to the latest mobile communications generation with a small intervention and without having to replace the entire device.

Features of LoRaWAN transmission

- The data is exchanged via gateways (antennas) that are connected to the network server over the Internet. The measurement data is forwarded from the network server to the KOLIBRI Cloud or the application accesses the data from the network server. Individual measured values are transmitted at the shortest possible intervals of approximately 10 minutes.
- The transmission normally takes place without confirmation of whether it was successful.
- With LoRaWAN, radio transmission takes place via public networks (often belonging to mobile communications providers), private networks (a city has its own network) or an open network such as The Things Network (TTN).
- Transmission distances of up to 15 km or over, depending on the conditions on site.
- Operation without a SIM card / transmission device must be registered to a network.
- Sent via a licence-free radio frequency. Everyone can establish their own radio system.
- There is (still) no global radio network.

Features of mobile communications transmission (2G 3G 4G / NB-IoT LTE-M)

- Data is exchanged with the KOLIBRI Cloud via standardised processes such as FTP or e-mail; it does not matter which technology is used (2G 3G 4G / NB-IoT LTE-M).
- Lots of measured values can be recorded in a short interval (1 minute) Data is mostly transmitted in data packages that contain several measured values.
- Data is always transmitted with acknowledgement of receipt. The transmitter will see whether the transmission was successful.
- Radio transmission only uses networks of mobile communications providers.
- Transmission distances of 15 km and over, depending on the conditions on site.
- Operation with a SIM card.
- Sent via licensed radio frequencies. Only mobile communications providers may operate these radio networks.
- Worldwide communication system

Security

The data is transmitted in encrypted form for LoRaWAN and mobile communications, from the measuring point to the cloud. Current cryptographic processes are used here. The encryption can be stronger for mobile communications as a result of the higher data throughput and the choice of encryption types available.

KOLIBRI Cloud – kolibricloud.com

KOLIBRI Cloud by KELLER offers simple and convenient access to the measurement data with your own personal login and SSL encryption. With the KOLIBRI Cloud web app, data is available without the need to set up and maintain a database. Measurement data can be displayed in graphic form in no time at all and the export function allows you to download your data as Excel or CSV files. Measuring points are effortlessly and efficiently monitored with the integrated alarm system. For instance, a warning can be triggered via e-mail if there is an increase in the water level or a battery is running low.

The cloud software interface (API) allows measured values from another software system to be called up in a standardised JSON format via HTTPS. This way, the data can be continuously transferred into the company's own software system, therefore making processes more efficient, which is the goal of digitalisation with IoT.

KELLER provides software developers with extensive documentation on the API.

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