SICK UK WHITEPAPER

IO-LINK PROCESS DATA IN THE CLOUD - A CROSS-MANUFACTURER SOLUTION

2019-08

AUTHORS

Charlie Walker
Product Specialist
at SICK (UK) Ltd, St Albans, UK

Tony Deane
Technical Manager
at Phoenix Contact, Telford, UK

PHOENIX CONTACT

SICK
Sensor Intelligence.

CONTENTS

Introduction 3
Smart Sensors and Industry 4.0 4
IO-Link 4
Transparency 5
Connectivity across manufacturers 6
Phoenix Contact Cloud Connectivity via PROFICLOUD 6
PROFICLOUD 6
MODBUS 6
The Phoenix Contact Cloud IOT Gateway 6
Case Application example using a SICK Ultrasonic Sensor 7
- Configuration 7
- Connecting to PLC 8
- Configuring the Modbus Server 9
- Configuring the PROFICLOUD Gateway 9
- Monitoring Data in the Cloud 10

Conclusions 11

Introduction

This White Paper is designed to provide guidance to engineering teams working in the Phoenix Contact control environment on how SICK Smart Sensors can be connected into the Phoenix Contact PROFICLOUD cloud platform solution.

Our aim is to demonstrate that there are no barriers to achieving cross-manufacturer integration and to illustrate the benefits to Phoenix Contact users of SICK Smart Sensor integration.

This document is useful for:

- Control engineering and production managers
- System Integrators and machine builders
- Existing users of Phoenix Contact who wish to communicate data from SICK smart sensors into the PROFICLOUD system.

Smart Sensors and Industry 4.0

Industry 4.0 promises to sweep away the last dark corners of an organisation with the bright light of digitisation, so that all processes are visible, data is available, and workflows are optimised across an interconnected universe.

Smart Sensors of every type, from photoelectric cells to process sensors, from distance sensors to rotary encoders, are tireless workers ‘at the coalface’ on the edges of this world. They collect the data to initiate and drive processes and provide vital information right from the heart of a machine about its efficiency and condition.

Intelligent sensors are the ‘things’ in the Industrial Internet of Things (IIOT) without which Industry 4.0 would simply not be possible. Not only are they the ‘eyes and ears’ of every process, they have now become smart enough to think and act for themselves.

Enabled by IO-Link, Smart Sensors communicate bi-directionally with other devices at the field level, making decentralised, edge computing possible and taking processing load away from higher-level controls. Field level processes can therefore respond more dynamically to changes in production, as well as delivering a wealth of diagnostic information.

Integrated logic functions inside the sensor itself can be also used create decentralised “Smart Tasks”, creating clusters of sensors and actuators, sometimes linked via a sensor integration machine, to perform field-level functions and send added-value data to the control.

IO-Link

IO-Link has been a breakthrough technology that has rapidly gained widespread acceptance as an internationally-recognised, standard non-proprietary protocol to enable communication with sensors and actuators in industrial environments (IEC 61131-9).

IO-Link has helped join the dots for industrial processes on the road towards Industry 4.0, helping organisations to achieve a gradual transition to a more connected world. It has opened up a gateway to the data provided by sensors and actuators, enabling greater process control and responsiveness, increased diagnostic insights and reduced machine downtime.

IO-Link is a point-to-point serial communication protocol that links higher-level control systems via an IO-Link master to the IO-Link devices (slaves). Different types of IO-Link master are available. In most cases, they are remote fieldbus gateways or input cards for the backplane bus of the control used.

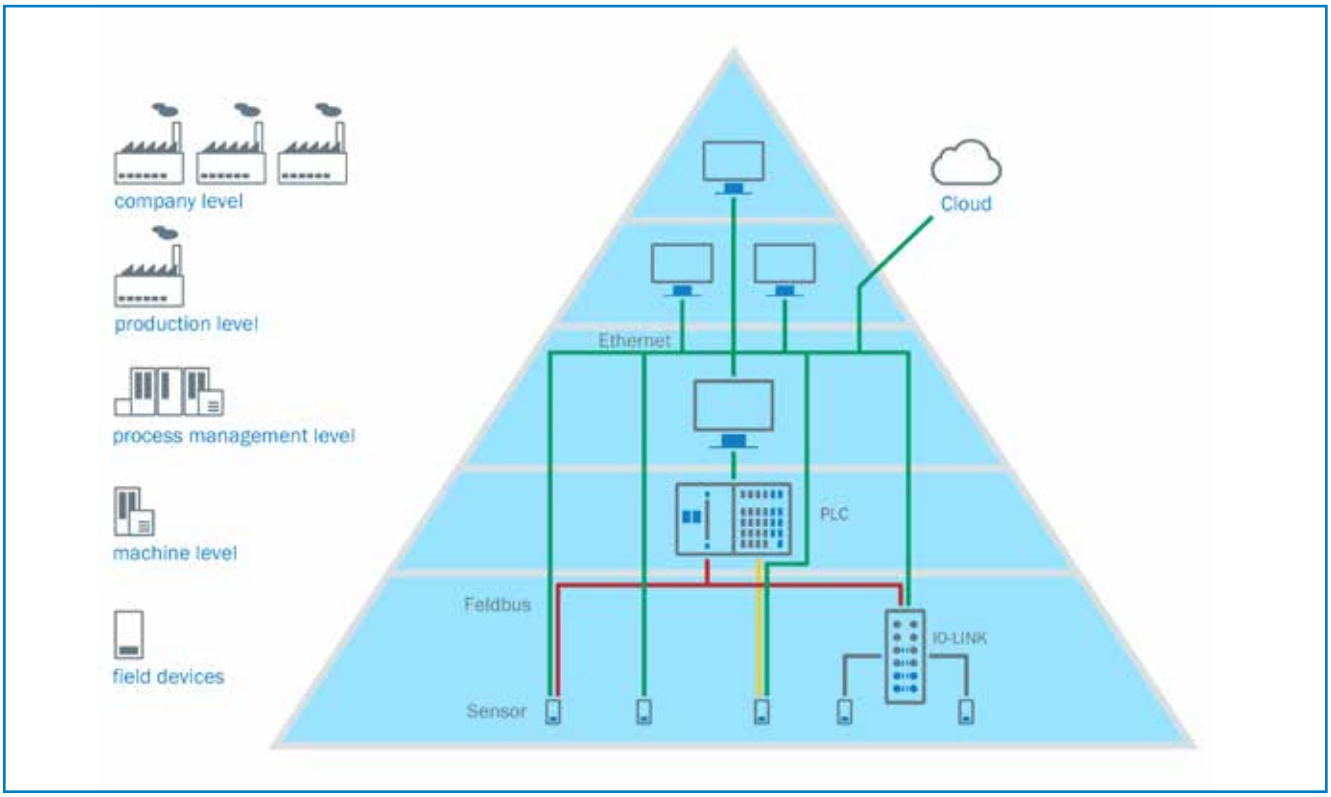
Smart Sensors include an IODD (IO Device Description) to identify the device and provide information about its parameters, process data and diagnostic data. The use of function blocks ensures that the IO-Link sensor can be easily integrated into the control program, making it easier to read and write the individual sensor parameters and provide support when it comes to interpreting the process data supplied by the IO-Link sensor.

At the same time, opportunities are presented to access data via mobile phones, to enable real-time monitoring of process quality and condition monitoring on the move, as well as to receive timely alarm and alerts.

Transparency

Armed with IO-Link, and with increased intelligence and processing power on ever-smaller devices, Smart Sensors from SICK can gather a wide variety of different types of data, depending on the process, and share them via a factory control system, or in the cloud.

At the same time, traditional control hierarchies have been broken down so that a wealth of data is visible by higher control levels, as well as via cloud-based systems. At the same time a host of opportunities are created for manufacturers to realise many more distributed machine solutions more simply, and often more cheaply than before.



Using IO-Link within a typical automation hierarchy

If sensors are the eyes and ears of automated production environments, then the logical next-step is to enable Industry 4.0-ready transparency in the cloud in a way that is easy to access and use.

As an alternative, or enhancement, to traditional SCADA control hierarchies, many cloud-based solutions offer the facility to access user-friendly GUI dashboards, from any secure system, via a laptop, home device – or indeed anywhere in the world.

At the same time, opportunities are presented to access data via mobile phones, to enable real-time monitoring of process quality and condition monitoring on the move, as well as to receive timely alarm and alerts.

Connectivity across manufacturers

To achieve data transparency and achieve distributed automation, increasingly requires integration of devices and systems from different manufacturers.

A functional communications architecture is needed to monitor and manage the information generated. While SICK provides its own cloud-based solutions for process control and diagnostic monitoring, it is also sometimes necessary for sensors to integrate with legacy proprietary cloud platforms.

PHOENIX CONTACT cloud connectivity via PROFICLOUD

In this paper, we use the Phoenix Contact's PROFICLOUD system to demonstrate how connectivity can be achieved. In this example, the end user already has an established Phoenix Contact PROFICLOUD environment and there is an opportunity to track the SICK sensor-generated data in the cloud.

PROFICLOUD

Phoenix Contact's PROFICLOUD is a platform for IoT-based automation that has two distinct services: The first extends PROFINET to the cloud while the second service, Time Series Data or TSD, can be used as a platform for integrating new and existing systems without additional engineering costs. Sensor and process data can be collected, processed, monitored and analysed in the PROFICLOUD. In addition, alarms using text and email can be used to inform users when thresholds are breached. Data can be shared with third party cloud services using MQTT to pull data from PROFICLOUD.

In this example we have used the Time Series Data service.

PROFICLOUD can be used to set up flexible, optimized processes and to integrate with third-party applications. Based on an open platform, manufacturing companies and service providers can establish their own web applications, as well as develop and operate services and mobile applications.

Modbus

Integration with PROFICLOUD can be achieved thanks to simple process connections using protocols such as Modbus/TCP, Modbus RTU and CAN.

Modbus is a commonly used serial communication protocol developed by Modicon in 1979 for use with its programmable logic controllers (PLCs). In simple terms, it is a method used for transmitting information over serial lines between electronic devices. The device requesting the information is called the Modbus Master and the devices supplying information are Modbus Slaves. In the application that we discuss today the Phoenix Contact device is configured as a Master (Client) and the Siemens PLC as a Slave (Server).

The PHOENIX CONTACT Cloud IOT Gateway

The Phoenix Contact Cloud IOT Gateway connects new and existing devices without impacting the automation logic of the host system. It collects and processes the data from the devices and transmits it to the PROFICLOUD where it can be utilised.

Case Application example using a SICK Ultrasonic Sensor

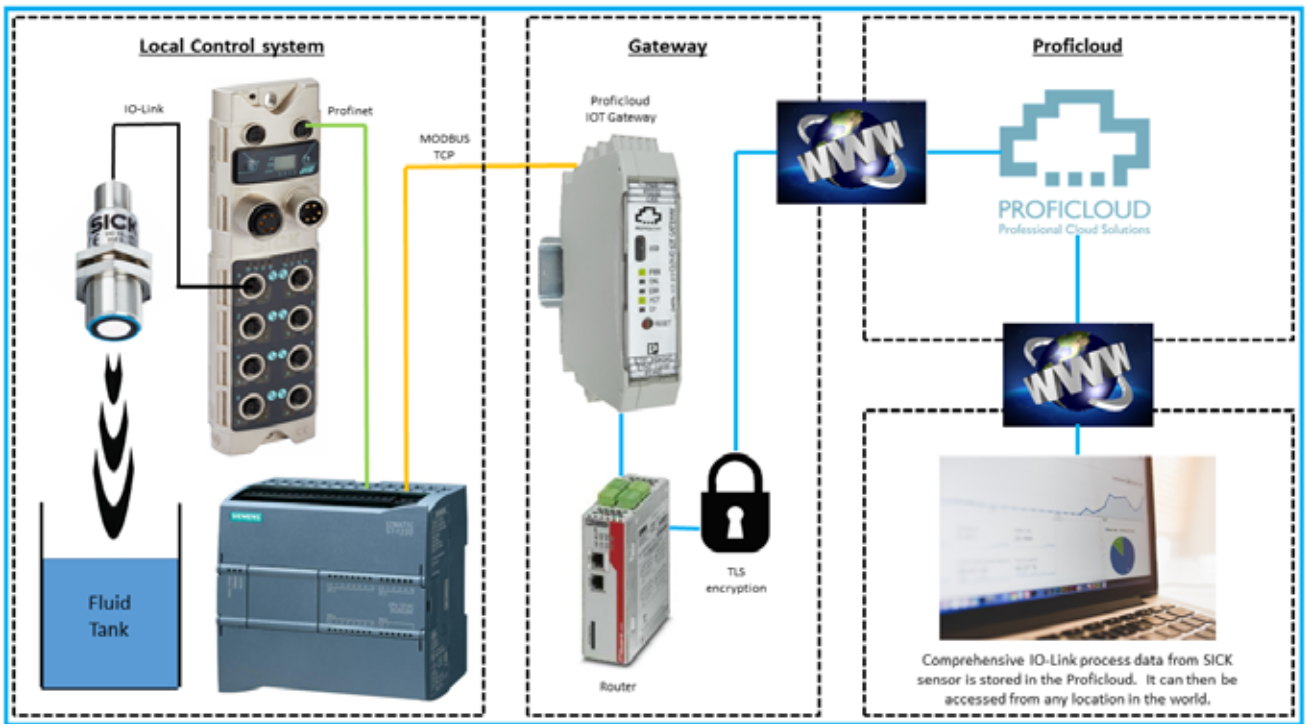
In this collaboration between SICK and Phoenix Contact, the task was to transfer data from a SICK IO-Link ultrasonic distance sensor into a cloud based system so that the process data could be observed and analysed globally. The SICK Ultrasonic Sensor (UM18-21212A211 – 6048396) is a smart, IO-Link enabled device. It enables detection, measurement and positioning of dark, shiny or transparent materials, as well as level regulation of liquids and bulk materials, and diameter checking of metal, paper, and plastic coils. It can also be used for continuous detection of fabrics and wire grids and for collision avoidance in automated vehicles.

In this case, the SICK sensor is used to monitor the level of fluid in a tank. By monitoring the fluid levels, operators can keep track of when the tank needs to be refilled, and the system enables early detection of motor wear and maintenance requirements, as fill times vary over the life of the system.

If the fluid reaches a 'low level', a pump adds more fluid, if the fluid reaches a 'high level' the pump is turned off. Critical levels are set to trigger alarm sequences for both 'empty' and 'overfill' situations. Alarms are generated in the form of emails and texts when either of the critical levels are breached.

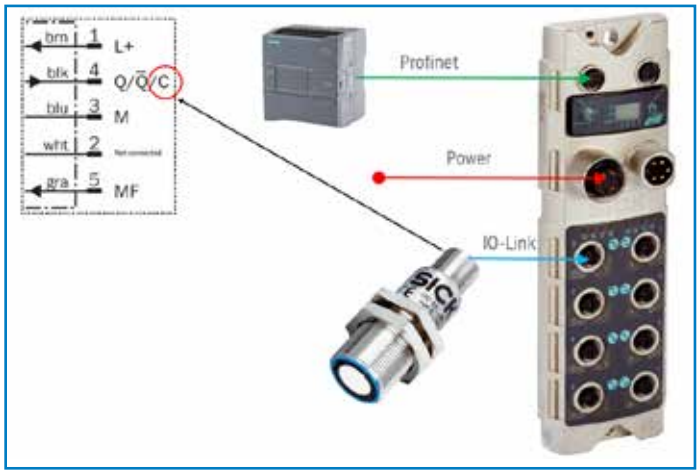
Configuration

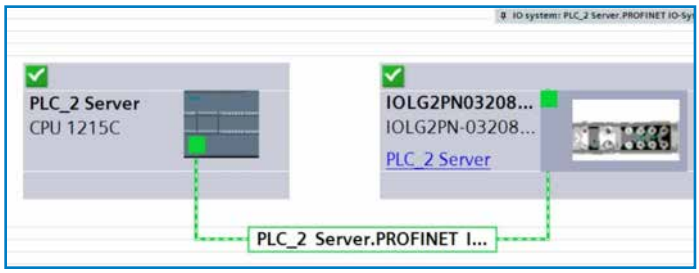
The SICK IO-Link Ultrasonic Sensor was connected to a SICK IO Link Master and then into a Siemens S7-1200 PLC via Profinet. From here the Phoenix Contact Cloud IOT Gateway was used to extract the process data from the PLC via Modbus TCP with Modbus function calls and then send the data to the PROFICLOUD.



Connecting to PLC

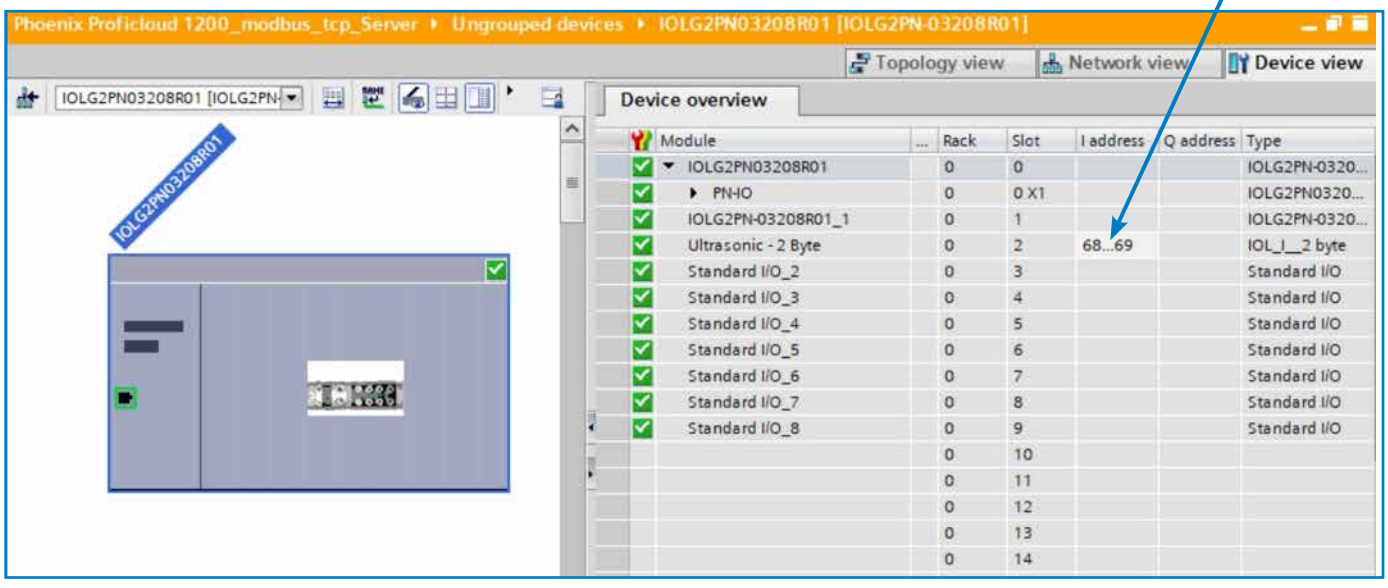
The sensor provides data to a Profinet-enabled SICK IO-Link Master, which links to a Siemens S7-1200 PLC.





The SICK IO Link Master is connected via Profinet to the PLC.

Process data which includes a 15 bit distance and a switched bit from the sensor is assigned to a specific memory location in the PLC (input bytes 68... 69).



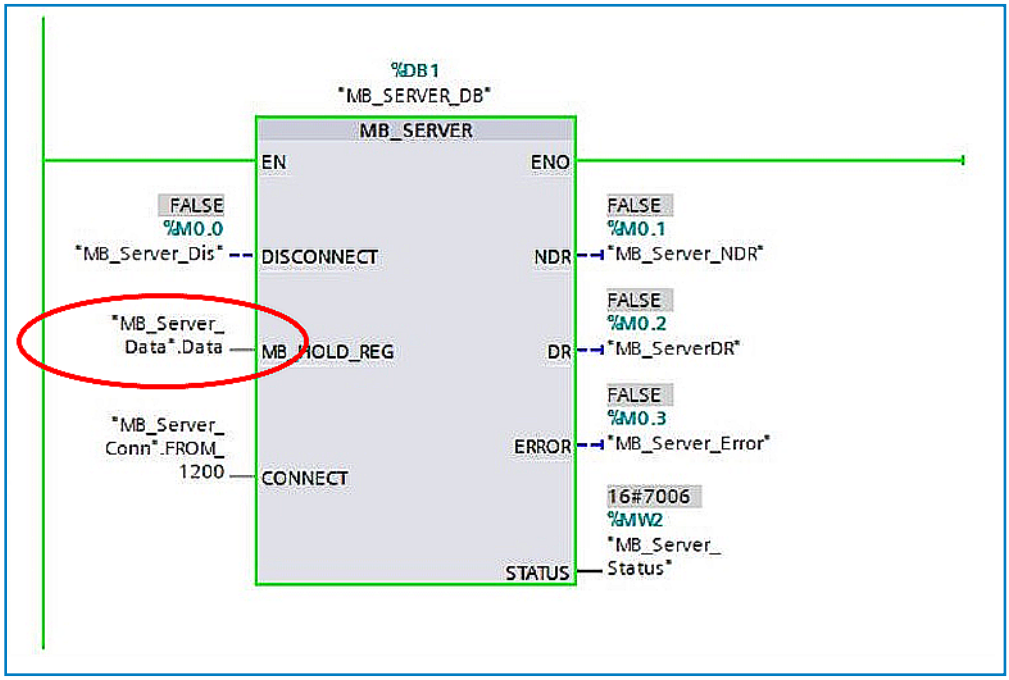
The data undergoes some minor manipulation within the PLC and is then stored in a new memory location, in this case a global memory variable – MD10. This represents the actual distance value that is being detected by the ultrasonic sensor. This is now a real (float) value, stored in the form of a 32-bit double word.

Configuring the Modbus Server

To allow the distance value to be collected by the Phoenix Contact IOT Gateway, it must first be mapped to a specific area of memory in the PLC which is assigned to the MODBUS function block 'MB_SERVER_DATA'.
A Modbus server is configured and the process data from the sensor is mapped into the created array of Modbus TCP Registers (MB_SERVER_DATA or a name of the user's choice).

Phoenix Contact IOT Gateway

The PROFICLOUD IOT Gateway acts as the Master / Client and polls the PLC that has a function block 'MB_SERVER', which acts as the Server / Slave. The frequency of the polling is set by the Phoenix Contact IOT Gateway.



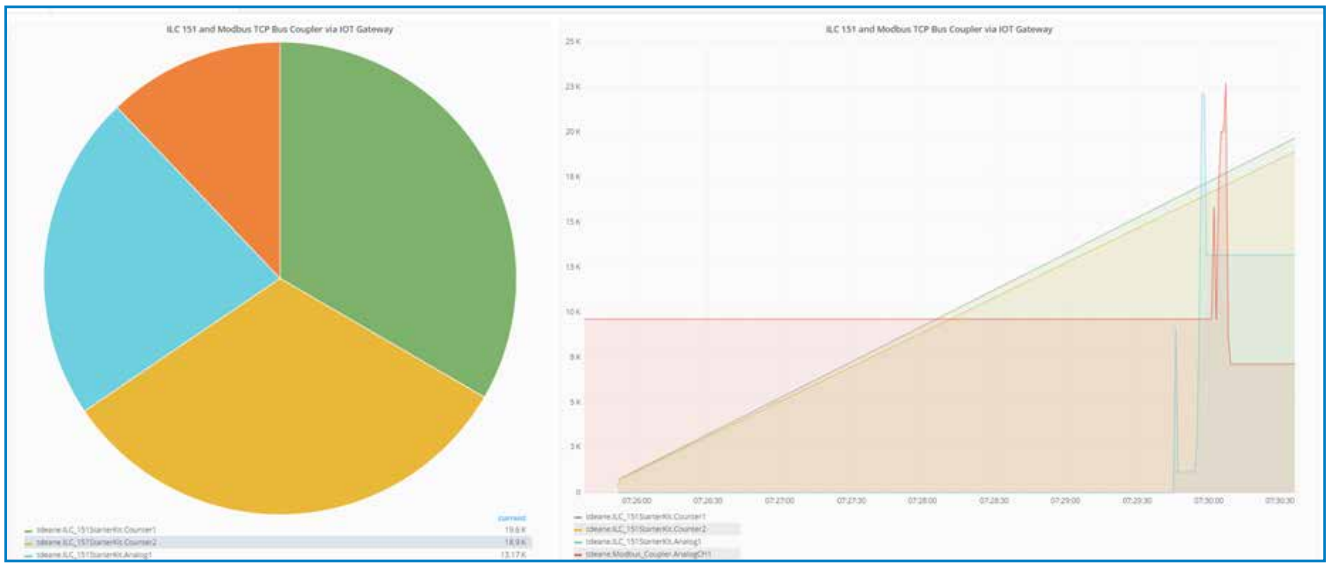
The relevant data from within MB_SERVER_DATA is transmitted from the PLC to the Phoenix Contact IOT Gateway, acting as a MODBUS Master / Client. It is then sent to the PROFICLOUD for storage via a 3/4G router or LAN Internet connection. This means that the solution can be employed in remote and mobile applications as well as standard factory-based environments.

Configuring the PROFICLOUD Gateway

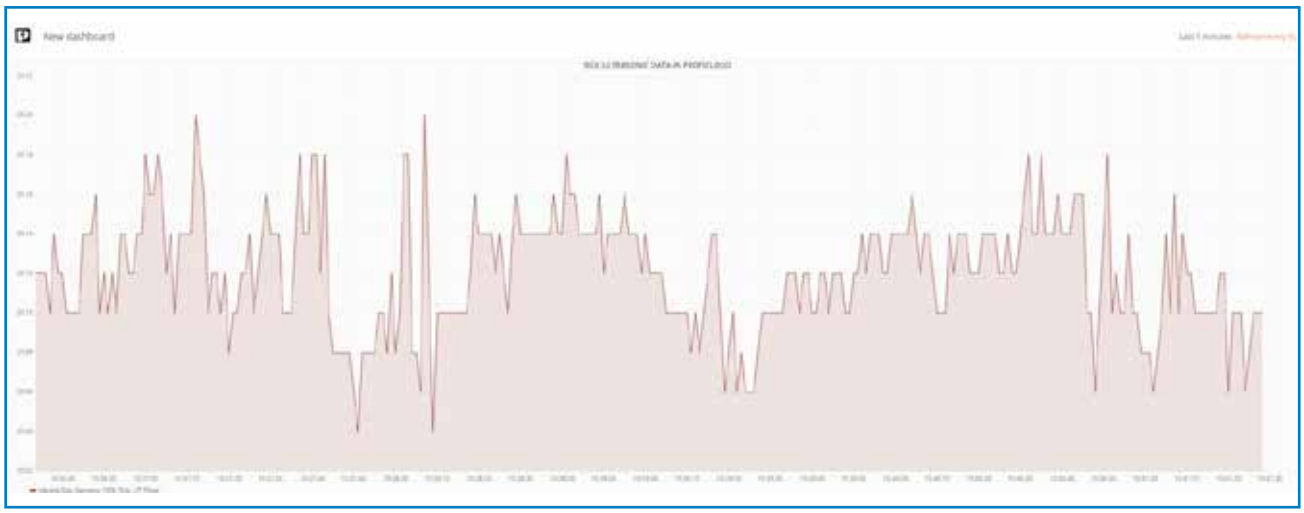
The user configures the PROFICLOUD IOT Gateway via an onboard webserver with a simple and intuitive graphical user interface. This is achieved by simply referencing the Modbus registers containing the relevant data derived from the SICK UM18 Ultrasonic Sensor.

Monitoring Data in the Cloud

The Grafana front end which comes as a feature of a PROFICLOUD account enables the user to select a number of different methods of viewing data for analysis, for example graph, pie chart, etc.



The values are stored in the system and can be accessed at any time. As the values for the distance measured by the sensor are received, the PROFICLOUD dashboard displays the historical values of the measurements made by the SICK UM18 Ultrasonic Sensor.



The user can therefore analyse patterns in the data. In this case, the customer is monitoring the performance of the pump fill-time sequence. If the fill-time exceeds the time taken to empty the vessel, a situation could occur where the ‘high level’ will never be reached and the pump will run indefinitely before failing completely.
Alarm thresholds can also be configured to trigger the sending of a text or email message to specified mobile phone numbers or email addresses.

Conclusions

By configuring a Modbus server function block within the PLC, access to SICK sensor data can be provided in the PROFICLOUD.

The solution is applicable to any SICK Smart Sensor or IO-Link enabled device, and our example demonstrates how easily analogue measurement data from sensors can be made globally available for process analysis.

This White Paper demonstrates that by implementing Phoenix Contact's PROFICLOUD, cloud analytics becomes achievable with relative simplicity. Process data can be stored and analysed, providing the capability to monitor trends and act on identified areas of concern to optimise process efficiency.

Links to further information:

SICK: Communication at the Sensor level via IO_Link
PHOENIX CONTACT: Time Series Data Cloud
GRAFANA LABS: Grafana Open Platform for Analytics and Monitoring

REFERENCES

→ www.sick.com

Phoenix Contact | Telford | United Kingdom | www.phoenixcontact.com

SICK UK | St Albans | United Kingdom | www.sick.com

Sensor Intelligence.