SIEMENS

Technical article

Data for the digital competition

Cloud connectivity concepts in production automation

A key benefit of the Industrial Internet of Things (IIoT) lies in the collection and analysis of data from the field level employing appropriate systems and algorithms, e.g., for predictive maintenance and its linking to the production planning. As a result, new strategic competitive advantages can be developed. However, in order to tap new relationships (correlations), as much data as possible has to be transmitted to the cloud, with minimal retrofitting costs for existing installations.

The direct connection of sensors and cloud often fails, because the vast majority of field devices lack suitable communication properties. For a connection to the IIoT, certain transmission parameters must be able to be set, which determine the semantic context on the one hand, and the concrete communication on the other. For the semantics, a machine-readable description of the sensor properties and the data points is required to not only receive the transmitted values on the cloud level, but also to be able to understand them. Thus, in addition to the actual value, a description of the device in question and its location in the plant must be supplied, as well as the sensor type, value range, sampling rate and much more. For the communication, destination addresses, transmission frequency, etc. are needed. Since there is a connection between sensor and cloud in this case, certain security characteristics are necessary as well. Typical sensor protocols, such as the 4 ... 20 mA current interface, are far from meeting these requirements.

PLC as aggregation level

In existing installations, it therefore makes sense to access the next higher aggregation level; this will usually be a programmable logic controller (PLC). The existing sensors are generally fully connected to the PLC, since this is where the lowest level of aggregation and processing takes place. Furthermore, the PLC also offers a certain degree of semantic description via its engineering. There, all data possess a defined data type and usually a symbolic name, which also provides a kind of object model through the integration

into data blocks. In addition, the sensor and the PLC itself usually have logical names or location designations, which simplify the assignment of the values to their plant context.

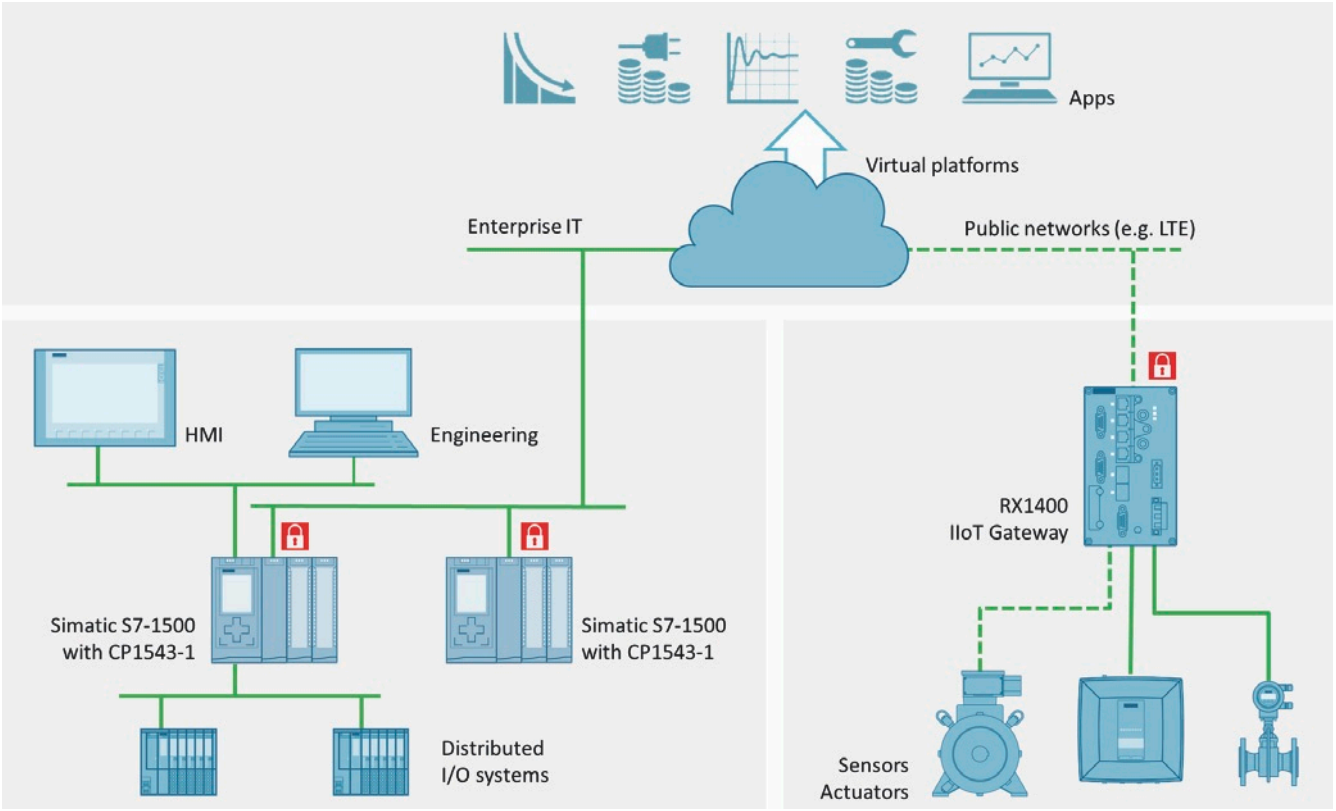
To now transport the data from the PLC to the cloud, so-called IIoT gateways are used, such as the RX1400 from Siemens. Such devices run special communication software, which cyclically queries the desired data from the PLC (for example, via S7 connections) and transports it to the cloud. The major advantage of this solution is that the existing automation solution does not need to be changed. Moreover, the free programmability of the RX1400 makes it possible for system houses with Linux know-how to incorporate their own protocols or processing algorithms.

Utilization of the process context

However, to also utilize the process context of a PLC, an intrinsic cloud capability of the PLC is important, that is, the ability of the PLC system to send the desired information to the cloud by itself. For instance, a machine may be in standby mode so that the temperature values recorded are actually of no interest. A pure gateway solution, however, lacks this contextual information so it still transmits the sensor data in the predetermined cycle – resulting in data noise without useful information. In the case of an intrinsic communication, the transmission frequency can also be adapted to the present program sequence. If special communication modules are then used in the PLC, the requirements for security will also be met by means of firewall mechanisms and strict network separation.

How can such a solution look in practice? In a machine, distributed I/O modules of the type SIMATIC ET200SP are used, to which the sensors for temperature, vibration etc. are connected. Also not missing is an optical code reader, such as the SIMATIC MV440, to identify the respective workpiece via a data matrix code. As higher-level station, a SIMATIC S7-1500 is employed, which keeps ready the decentrally connected sensor values in its process image for the PLC programmer. The communication with Siemens MindSphere takes place via special blocks – the MindConnect FBs. Through appropriate integration into the PLC program, a control of the communication can be implemented. For the network connection, a communication processor CP1543-1 is used, which transmits the data over a special network strand. The advantage: The automation network as well as the PLC are reliably protected from attacks.

The application for such a configuration could be, for example, the collection and analysis of quality data. At the individual processing stations, quality data is captured and then used for controlling the respective production step. At the same time, these quality parameters together with the unique product identifier in the data matrix code are sent to the cloud, which now can perform higher-level analyses and check for correlations with any conceivable information – going far beyond the context of the actual processing machine to include the evaluation of inspection reports by suppliers, the measurement data of returned defective parts, etc. For the quality management, this opens up entirely new possibilities.



Typical configurations for cloud connectivity utilize the PLC as aggregation level (left) or special IIoT gateways (right)

As IIoT gateway, the RX1400 can be adapted to any protocol and requirement thanks to its free programmability

Step-by-step to the digital solution

For companies to develop their own competitive advantages from the cloud connectivity, a step-by-step approach is recommended. On the one hand, the own solution architecture should be sketched and tested in small pilot projects. In doing so, especially the data model must be designed as uncompromisingly as possible to be able to later scale it to a whole operation or even across different sites. On the other hand, attention should be paid early on to network structures suitable for industrial communication. A modern industrial network not only features high performance and high availability, but also is of sufficient flexibility to support present and future IIoT solutions. Simply put, anyone wanting to transport data must also take care of the appropriate data highway in a timely manner.

Finally, it is recommended to obtain a technology partner so as to not having to reinvent the wheel in your own company. Firms such as Siemens offer a comprehensive portfolio of components and systems, and also possess the know-how to create new solutions from them. For instance, customers receive services as needed to analyze, plan and implement network infrastructures, as well as to train and certify their own personnel. In a concrete example project, Siemens and Würth Industrie Service developed an RFID-based e-Kanban system that not only ensures a more targeted supply of so-called C-parts to Würth customers, but also provides Würth with a renewed digital business model. Thanks to this strategic innovation, Würth considers itself optimally positioned for competition – even in these times of digital disruption.

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions only form one element of such a concept. For more information about industrial security, please visit **http://www.siemens.com/industrialsecurity**

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