From Multi-Protocol Chip to Multi-Cloud Connection

netIOT – Industrial Cloud Communication

for Industrial Internet and Industry 4.0

www.hilscher.com
Hilscher Gesellschaft für Systemautomation mbH was founded in 1986. Today, the company has more than 250 employees at 11 locations worldwide. With the philosophy of continuous growth based on our company’s own resources, we are a reliable partner to our customers.

For more than 25 years, our focus has been on industrial communication, and our range covers all fieldbuses and all Real-Time Ethernet systems.

Our technology takes the device data of encoders, IP67 I/Os, RFID controllers, drives and valve islands and manages the data exchange with the control system via the various Real-Time Ethernet systems.

This makes us at home wherever data is generated in the production plant.

Together with the corresponding metadata, this information needs to be transported into the cloud in order to generate added value within the context of the Internet of Things. We are experts in this regard and we see it as an extension of our core technology. Depending on the scope, the technology can be retrofitted in existing devices by means of software and integrated into new designs with additional security functions.

We collect device information on the network via so-called Edge-Gateways and transfer it to the cloud using special services, independent of the PLC.

Thus we generate considerable synergies which allow us to deliver, in a single design, all Real-Time Ethernet systems and an end-to-end IoT system automation solution together with the Edge-Gateway.
The industry is facing a paradigm shift worldwide – and Hilscher has always been a forerunner of significant changes. We were there when fieldbus technology replaced parallel wiring and were instrumental in the breakthrough of the soft PLC with PC cards for industrial communication. With our netX network controller, we developed the first multi-protocol chip for all Real-Time Ethernet systems.

For us, the Industrial Internet and Industry 4.0 are the fourth industrial revolution, one which requires end-to-end communication from the sensor into the cloud. We call this Industrial Cloud Communication, and netIOT is our technology that complements it. Based on global standards, comprehensive and just as determined, as always we stand completely behind something.

However, this time things will be even more comprehensive and complex – with multiple new technologies, we go far beyond the dissolving classical automation pyramid with all its layers.

You can count on our netIOT technology and our netIOT Service: the interaction between mechanical engineering, automation providers and information technology supports new business models, increased productivity and the production of batch size 1. Join Hilscher and make a successful entry into the future of industrial IoT technology.

“"We don’t know your business models of tomorrow, but we can already provide you with the technology you need for it today.”" - Hans-Jürgen Hilscher, CEO
With netIOT, Hilscher supports RAMI 4.0 integration of reference architecture layers, communication and information. At these layers, netIOT mines, forwards and pre-processes data. In terms of hierarchical layers, the netIOT solution with the netIOT Interface product line covers the field device layer. netIOT Edge-Gateways are at the controller layer and, together with the offering of netIOT Service, send the information to the stations and higher layers. Consideration of the life cycle of products and systems is a key component in the RAMI 4.0 model. The fundamental differentiation between type and instance is a main element of this consideration.
A gateway of an Industrial Internet system, on the one hand, forms a bridge to a higher-level or larger network and, on the other hand, isolates the local network with the corresponding communication nodes.

In actual practice, the Edge-Gateway ensures connectivity to the access network. This establishes communication to the access layer of the controller layer, on which all production-relevant software packages, e.g. “analytics” and “predictive maintenance”, are consolidated. This layer is connected to the company layer via the service network. The ERP functionalities and company-wide systems are united in this access layer.

“IIRA: Industrial Internet Reference Architecture

RAMI 4.0 und IIRA are reference architectures for the Industrial Internet / Industry 4.0 which have established themselves in USA / Germany.

“The Industrial Internet is steering the next industrial revolution. The IIC is working on testbeds, use cases, and the definition of the reference architecture and frameworks to discover disruptive new products and services, and support future standards to drive this revolution. Hilscher is helping to lead the revolution.”

Dr. Richard Soley
Executive Director of Industrial Internet Consortium
FROM THE FIELD LEVEL INTO THE CLOUD – VERTICAL INTEGRATION

INDUSTRIAL CLOUD COMMUNICATION

WITH THE EXISTING COMMUNICATION INFRASTRUCTURE, INDUSTRIAL INTERNET AND INDUSTRY 4.0 INFORMATION IS TRANSMITTED WITHOUT SIDE EFFECTS AND IN PARALLEL WITH REAL-TIME ETHERNET DATA AND COLLECTED, COMPRESSED AND PASSED ON TO A HIGHER-LEVEL CLOUD VIA THE NETIOT EDGE-GATEWAY

1. Industrial Cloud Communication
2. Integration of smart sensors via IO-link
3. netIOT Interface with netX and associated firmware
4. Implementation for cloud specific services
5. Local information and service access point
6. Remote information and service access point
Real-Time Ethernet systems have replaced fieldbus technology. They connect intelligent components with the controller and further, via the cell level, with control and company levels. Parallel to hard, real-time communication, these systems allow for time-uncritical transmission of TCP/IP or UDP telegrams via the same cables. The Industrial Internet uses this for the transfer of information via MQTT. In the case of Industry 4.0, the OPC UA protocol is frequently used. The Edge-Gateway forwards this information to the cloud via specific services and makes these applications available for access worldwide.

This information level will establish itself without side effects and in parallel with the control level – vertically and horizontally across all intelligent sensors, actuators, I/Os and further automation components. The expert opinion today is no longer “whether” but “when” this will become a reality.

With Hilscher’s netPROXY technology, the manufacturer defines the device data and passes it on to the netIOT Interface. Here it is mapped to various Real-Time Ethernet systems and transmitted to the controller. Parallel to this, web servers, MQTT or OPC UA allow access to the device data transmitted into the cloud from the Edge-Gateway. The netIOT Interface automatically integrates sensors with an I/O link interface in this functionality. A netIOT implementation in the device enables communication via various Real-Time Ethernet systems and provides access to the cloud via the Edge-Gateway. Today, it already supports IBM’s Bluemix cloud platform. HANA from SAP and Azure from Microsoft are already on the Hilscher road map.

With this architecture, netIOT creates two main access points to the field level as a whole which are dependent neither on the network nor on a special controller: remotely via the cloud using Internet and firewall or locally via USB, Ethernet, WiFi or Bluetooth directly at the Edge-Gateway.

The netIOT Edge-Gateway makes it possible for OEMs to configure and diagnose their devices, as well as access device and system data and optionally brand-label this via a customer-specific app. The device and system information as well as analysis and diagnostics programs are available in the cloud as a netIOT Service. This requires the corresponding security functions to be available and enabled. Our netIOT Edge-Gateway takes account of this with Intel’s Moon Island platform and its integrated security functions from McAfee.

This meets all the prerequisites for implementing future market requirements in new business models.

Industrial Internet / Industry 4.0 makes it possible for manufacturers of automation components to develop devices and services that make life easier for the user and production more efficient. Those able to fulfill the wishes of their customers with greater ease and individuality with transformed or new digital offerings, products and services will be more successful in the future.
The visions of the Industrial Internet and Industry 4.0 are marked by two clear demands: on the one hand, the wish to connect automation devices to a cloud and, on the other hand, the objective of generating data in field devices that goes beyond pure I/Os, e.g. diagnostics, analysis and state data. This information serves as a foundation for all further services and business models. Both requirements have their basis in the field device at the sensor level. In order to meet these requirements, Hilscher developed the DIL-32 Communication IC and equipped it with future-oriented IoT functions.

For IoT communication, the transport of data from the field device into the cloud, there are two proven protocols: MQTT and OPC UA. As an initial representative of the netIOT Interface solutions, the netIC IOT is equipped with an OPC UA server and an MQTT client, in addition to the communication component. This makes it possible to access the field device data via the TCP/IP channel of the Real-Time Ethernet protocol using the same physical cables – without side effects and without PLC involvement.

“netIC IOT is the first IoT-enabled communication module for field devices.”

Christof Hunger
Product Manager
The fastest way to bring the Industrial Internet / Industry 4.0 to field level

In addition to the new functions, a successful IoT device needs to provide an upgrade path for existing systems. netIC IOT is designed in such a way that the OEM can simply adapt the DIL-32 pinning to individual requirements. Preconfigured profiles enable a fast launch. Existing netIC customers who cannot change their hardware and still want to use IoT functions can use “backward compatible” pinning. A pin layout with a fast SPI connection to the host is available for everyone else. No matter how, with netIC IOT, device manufacturers are ideally armed for the fourth industrial revolution – with simultaneous investment security for their product development.

Open for the cloud – and still secure

One new aspect of plant automation is that it is now necessary to also include field device security as part of the system design. Whether the company’s own IT infrastructure is adequate or additional security is required must be considered extensively and integrated in the system concept. Ideally, fundamental security mechanisms are already integrated in the field device. netIC IOT is already a step ahead with this integration. Thus, the device manufacturer can connect a TPM chip via SPI. This will enable future extensions of the netIOT Interface with new security mechanisms, e.g. “secure boot”.

Transforming simple data into information

The core of netIC IOT is Hilscher’s netPROXY technology. The foundation for this is a device-oriented object interface and service interface between applications and communication. This abstraction layer counter-balances the complexity as well as the various protocol APIs and allows for cyclic and acyclic data exchange with a few simple services. The I/Os are arranged in objects and can be simultaneously enriched with analysis, diagnostics or state information. Device manufacturers only need to integrate the generic object interface in their applications and netPROXY independently implements the objects in corresponding network services. OEMs consequently create their applications with complete separation from protocol-specific requirements and end up with genuine multi-protocol devices.

“IoT Communication will also be available on netX technology platforms in the future.”

Sebastian Hilscher
Manager netX Technology
“netIOT Edge-Gateways not only raise the simple automation network to the level of cloud computing, but are also the main configuration element of netIOT field devices – this makes it possible to parameterize sensors and actuators after installation.”

Armin Beck
Product Manager
netIOT Edge-Gateways securely couple automation networks to a cloud. As I/O devices, they cyclically exchange data with the PLC and also communicate directly with IoT-enabled field devices. This key field-level data, exchanged in real time, can be transmitted from and to the cloud.

**Device security**

**MAXIMUM SECURITY ON THE BASIS OF INTEL’S MOON ISLAND PLATFORM**
- The physical separation of automation and the IT network prevents undesired access.
- The exclusive startup of signed software protects against manipulation and protects device integrity.
- Encryption processes in accordance with the latest standards provide security against electronic eavesdropping and data theft.

**Easy wiring of applications**

**EASY GENERATION OF APPS AND DATA COLLECTION PROFILES**
- Thanks to drag&drop, there is no need for programming, just configuration and wiring.
- Considerable decrease in the construction time as a result of preassembled function blocks.
- Functions encapsulated in nodes prevent the creation of malware.

**Direct access to the field level**

**DIRECT COMMUNICATION WITH THE FIELD DEVICES VIA IOT PROTOCOLS**
- For devices with MQTT and OPC UA protocol support.
- Past the PLC and in parallel via a direct communication channel.
- Data semantics simplify further processing in the cloud.
netIOT Service

THE INTERFACE FOR ADDED VALUE IN THE CLOUD
Vertical communication into the cloud

IBM’s Bluemix cloud application works with open standards as a cloud-based platform for applications. Information from the field devices is transmitted to the Bluemix-based applications by means of the corresponding Node-RED interface. Shorter time to market and ongoing maintenance of cloud applications are the most important advantages.

Smart apps with cloud support for field devices

netIOT Edge-Gateways offer ideal access for device configuration and diagnostics. With mobile devices, it is possible to read and load configurations. In addition, the full diversity of cloud applications can be used throughout the entire life cycle of the devices at field level.

netIOT network monitoring

Web-based communication network monitoring is enabled on the netIOT Edge-Gateway. Topology, device representations and statistical evaluations can be provided locally and also used for further processing for cloud applications.
Hilscher paves your way to “intelligent” field devices and thus ensures end-to-end networkability for your components.

- Implement your device solution with a high-performance Hilscher netX network controller or complete network module.
- Report important telemetry data on your device in addition to classical I/O data via the IoT protocols MQTT and OPC UA.
- Provide your customers with the foundation for cloud-networked data management.
In view of the usual service life of intelligent sensors and actuators, today, netIOT makes it possible for device manufacturers to assure their customers that the technology for the Industrial Internet and Industry 4.0 is already integrated in their devices. Thus they can offer their customers the option of using the extended functionality of the cloud any time it is required or desired.

netIOT opens up a wide variety of opportunities to device manufacturers for integrating their own features and information functions in their devices without changing the functions required by the system controller or industrial Ethernet communication. This allows device manufacturers to differentiate themselves from the competition by integrating additional functions in the device software which can be accessed via IoT telegrams.

For manufacturers of larger automation equipment, e.g. large drives, new business models are possible that open up new offerings and clientele. The ability to access device data via netIOT, independent of the active controller program, makes it possible for such devices to also be marketed with leasing or pay-per-use concepts and reach new target groups with new investment models.

“The information provided by sensors also plays an important role in Industry 4.0. The challenge for us as a sensor manufacturer lies in efficiently making the wide variety of sensors and interfaces ‘ready for industry 4.0’. OPC UA offers the ideal basis in this case as it ensures secure, reliable and manufacturer-neutral transportation of raw data and preprocessed information. Baumer relies on this scalable, platform-independent solution with its open architecture, which can be adapted to future requirements, for support in the evolution already taking place.”

Dr. Michael Schneider
Head of Product Management, Motion Control, Baumer Electric AG – Frauenfeld
As a mechanical or plant engineering company, you benefit directly from the new IoT functionality of netIOT Edge-Gateways. All information belonging to the coupled PLC network can be accessed via the usual and cost-effective IT infrastructure. The diagnostics data and bus topology are read from the field devices by the Edge-Gateway and transmitted to tablets or smartphones with a WiFi connection via browser or app.

Starting now, you have the opportunity to deliver your machines with the basis for cloud connection that will be required for future automation.
The familiar controller architecture remains in place and access to the higher-level cloud system, which is PLC-independent, is enabled at any point in the machine/plant. PLC-independent bus diagnostics can be made during commissioning and field device data can be directly accessed. Simple sensors can be precisely adjusted directly on site without any special coupling modules.

Consistent, manufacturer-independent diagnostics and commissioning systems run independently of the PLC used. Direct data transmission from the field devices to the mobile device by means of IoT telegrams enables consistent processes despite different customer systems. Intelligent sensors connected to IP67 modules via I/O link allow for direct data querying.

Additional benefit is provided as a result of the functions for configuration and diagnostics of the netIOT Edge-Gateway. It is possible to communicate with sensors and configure them directly via the Edge-Gateway during system commissioning. This benefit gives mechanical and plant engineering companies such potential for optimization that, for this reason alone, using netIOT technology pays off. The basic functions of the connection to the cloud are available at all times — today and in the future.

“In forthcoming years, Industry 4.0 and the Industrial Internet won’t just be a reality in plants, but the IoT functionality of devices will also be required by the market. Since the service life of machines and plants is frequently longer than ten years, with netIOT we offer mechanical and plant engineering companies the technology to cover these future smart factory requirements today.”

Stefan Körte
Director Sales and Marketing
Intelligent connection and automation device interaction in machines and plants on a common data basis give IT system providers new opportunities for fast, efficient and considerably more flexible production.

One thing is certain: The Industrial Internet / Industry 4.0 will generate a multitude of interesting data from sensors and actuators at field level – big data that then generates added value. Especially in the USA and Europe, proven technologies are available for IoT Communication with MQTT and OPC UA. Although the actual value creation is as a result of MES software and cloud software functions, the entire system can only generate added value if it has access to the field device data, independent of current control cycles. IoT Communication with MQTT and OPC UA supports extension of Real-Time Ethernet communication at field level. In the cloud, with IBM, Microsoft, Oracle and SAP as well as Amazon, providers have established themselves with their platforms and will thus shape a multi-cloud landscape in the future. For Hilscher’s netIOT Edge-Gateways, there is already a connection to IBM’s Bluemix cloud platform.

The product line of netIOT Edge-Gateways will also support further cloud architectures in the future.
The Industrial Internet and Industry 4.0 are key drivers for further development for smart factory automation technology.

netIOT enables the use of further security mechanisms such as “Secure Boot” and end-to-end device identification. Data from the field level is made accessible to the system provider, simply and without complex software development. Cloud applications can use the extensive data to generate additional advantages for the user. The user has the security of a complete solution that has been coordinated and tested by Hilscher and the cloud platform provider. Many manufacturers of automation devices use the netIOT solution and are therefore able to benefit from cloud applications for the configuration and diagnosis of their devices.

“The real advantage of Industry 4.0 and the Industrial Internet is the result of vertical communication, which enables cloud applications that are functionally more enriched as well as new business models. Field device manufacturers now have the opportunity to access their devices locally and from the cloud. This will improve device availability and the maintainability.”

Armin Pühringer
Business Development Manager