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WHITEPAPER

How “Industrial Cloud Communications” Delivers the Benefits of Internet-Connected Manufacturing

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How “Industrial Cloud Communications” Delivers the Benefits of Internet-Connected Manufacturing

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The Internet of Things is promising major operational benefits, although no one is quite sure where IoT will take manufacturing. IoT represents a closing of the gap between production and IT and is seen as the next big step for automation.
It is an opportunity for the data we generate for manufacturing control to be shared with Internet-based applications to bring enterprise-wide advantage. At the same time it promises to extend the reach of control networks right down to the lowest automation level, to make plant monitoring more efficient.
New ways of using the data will transform our Operational Technologies (OT) and integrate them more closely with enterprise Information Technologies (IT) and systems.
Hilscher encourages all manufacturers – vendors and users– to gain experience with IoT as soon as possible. We are leading the way by introducing a range of products that enable IoT deployment today at zero risk to existing systems and equipment.
The products range from embedded IoT interfaces for the lowest level devices up to gateways that share data over the internet and through to support services such as remote configuration and predictive maintenance. In addition, on-premise “local cloud” services are brought within reach of the control cabinet.
To make the assessment of IoT as easy as possible, Hilscher is establishing partnerships with cloud-based service suppliers. IBM Bluemix is the first of these. Others are expected during 2016. By purchasing services through these partners on as as-needed basis, access to IoT is made easier for users, and at a cost that can be easily justified.

1. INTRODUCTION

What is the Internet of Things?

The “Internet of Things” is a phrase of convenience describing how everything in the world could be connected via the internet, with a view to each and every “thing” interacting somehow with the rest. Clearly it’s a “catch-all” phrase that lacks clarity, but it’s become a useful brand label for what many people think of as “the future.”
In reality, the Internet of Things can mean anything to anybody. For example, in the domestic context, it can involve connecting household appliances – even vehicles - to a home hub and having some kind of central intelligence control how the house operates.
For example, if a stove senses that a car is on its way back to the house, it can turn itself on to start cooking a meal. Or the alarm system can be turned off, or the heating turned up and the garage doors opened just as we arrive. And if some of these systems can be connected centrally to fire or police authorities, then further benefits can arise too.

Applications

Home automation was an early example of IoT hype in action. It is faltering now because of an issue that we automation users have known since the dawn of digitalization – a lack of standards leading to market fragmentation.
A better example is health, where you and I may become “things” on the network. If our health records can be monitored centrally, and our doctors can access our personal data live while talking to us over the internet, then both the health and the economic benefits could be massive.

Railways, street lamps and similar applications have been quoted as other examples of IoT in action. In manufacturing automation the examples are few at the moment but, ironically, automation is where "Industrial IoT" may well catch on quickest. That's because we're perfectly at ease with monitoring our equipment and systems already.

Data flies around our networks continually, all of it available for a variety of uses beyond automation control. We've been doing it for decades and concepts like remote machine diagnostics and predictive maintenance are widely practiced today. If we extend these benefits and add more, then the outcome could indeed be world-changing.

In effect, Industrial IoT represents the integration of (OT) Operating Technologies and (IT) Information Technologies. In automation, the benefits could include higher efficiencies, greater up times, faster repairs, and higher quality. More significant benefits could arise however if IoT can deliver fresh insights into how our plants work and enable us to operate them in better ways.

New business models become possible, opening up new opportunities for vendors and customers. For example, it may be possible for devices and systems to be marketed under leasing or pay-per-use concepts, or for vendors to reach new target groups.

Key elements of IoT

The Industrial IoT is broadly made up of the following elements:

- *The Cloud*: The physical systems in cyber-space on which IoT depends. These can be company-owned, though currently there's more emphasis on outsourcing. This brings immediate benefits because it passes the financial and operating responsibilities to a third party. Amazon was one of the first suppliers to offer this capability. Users send their data into "the cloud," and hence the processing and security of that data also rests with the third party. In automation, the controls vendors have a natural interest in providing cloud services and we'll probably see im portant developments from them in due course. Many existing MES, ERP and similar IT-level systems will migrate to the cloud.

- *Big Data:* As more and more plant data is made available to the cloud its volume, velocity and' variety increases. Conventional database technologies can no longer cope, so new ways of handling the data must be found. Apache Hadoop and Spark are just two of the open source solutions being implemented by major cloud suppliers.

- *Web Services:* Cloud suppliers have responded to the demand for powerful new applications with a range of web services that are bought on an "as-needed" basis. Fundamental to automati on are the analytics needed for discovering those "fresh insights" that will lead to better plant ope rations. How these services develop will depend on the suppliers. IT-centric companies who've been supplying services to business for years are reaching into this marketplace now. Control system vendors who have considerable automation applications experience are introducing web-based solutions. Exciting developments can be expected as competitive pressures drive innovation.

Existing Strategic Initiatives

Various “communities” around the world are looking at how Industrial IoT can enhance the manufacturing industries. Here is an overview:

- *Industry 4.0:* The Platform Industry 4.0 project is centred on German-speaking countries. Industry 4.0 has at its heart the concept of Cyber Physical Systems (CPS), whereby automation systems are based partly on the plant floor and partly in the cloud. It requires new thinking being thrashed out behind the scenes now. It is a technical approach and we can expect exciting developments as the ideas are fully explored.

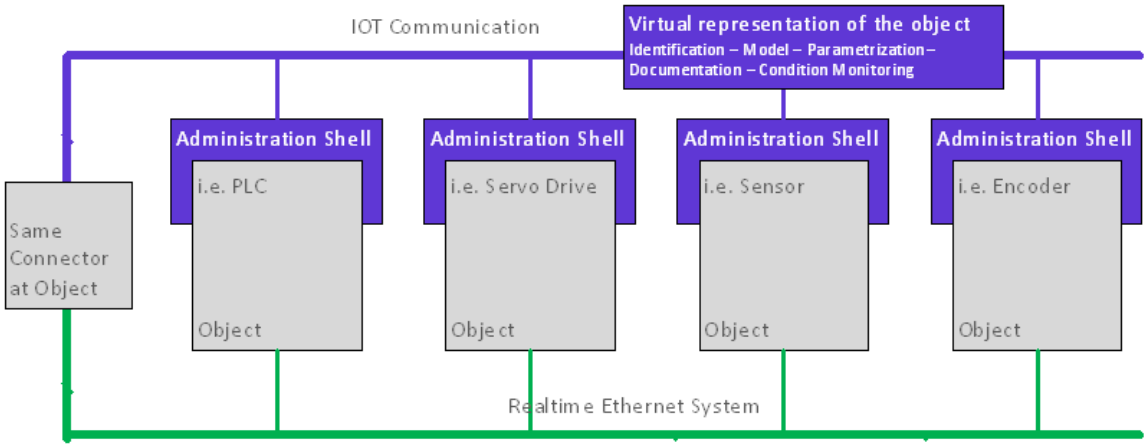


Figure 1: CPS Model

- *The Industrial Internet Consortium (IIC):* IIC is a North American initiative to define how Industrial IoT can be implemented. This is taking a more conceptual top-down approach. It avoids defining standards, and bases its conclusions/recommendations on established ways of working. It recently completed a working document and has established test beds for better assessing how things can work. Cyber Physical Systems are encompassed by IIC too.

- *Asian Interests:* China and Japan have both established national initiatives to address IoT. China has “Made in China 2025” its national strategy. Japan’s is named the “Industrial Value Initiative,” or IVI, aimed at re-building that country’s manufacturing base. Big company interests may take precedence in that country however. The recent announcement of collaboration between the German-based PI organization (representing PROFINET and PROFIBUS) and the CC Link Partners Association (CCLP) suggests that the Japanese and European strategies may converge.

Hilscher is engaged in all of these initiatives, working alongside industry leaders towards common goals.

Communications, Networking and Standards

Hilscher's interests lie mainly in the communications infrastructure of IoT. This Whitepaper focuses on those in particular.
No current protocol standards are threatened by IoT. IoT functionality will by-pass control systems and PLCs so legacy equipment and systems will not be obsoleted. IoT capitalizes on the data available from existing networks. In effect IoT systems become extensions of our Industrial Ethernet and fieldbus systems.

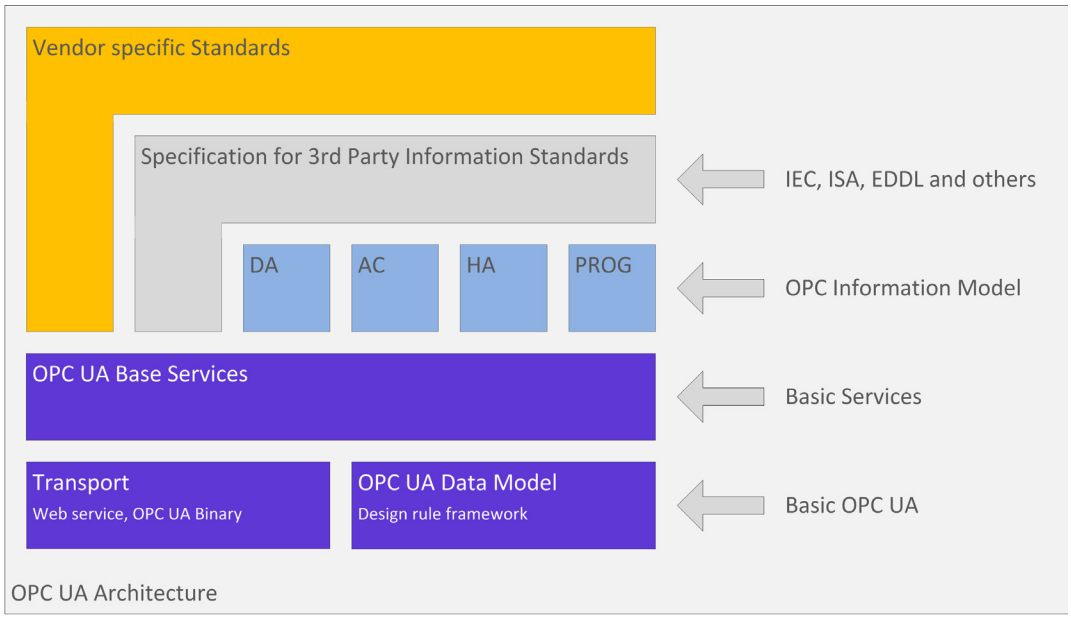


Figure 2: OPC UA will play a big role in IoT, particularly in the Industry 4.0 context

Some standards overlap. For example, OPC UA is likely to be favored in the Industry 4.0 context. Where fresh standards are needed, for example in transmitting data to the Cloud, well-proven standards from other sectors will be adopted. MQTT, a low overhead protocol used in lightweight M2M communication, is one example. There are other candidates, such as DDS. Hilscher has long been associated with connectivity solutions for the popular protocols found on the factory floor. Our own netX chip was designed with that in mind. It turns out that netX is an ideal interface for IoT too.

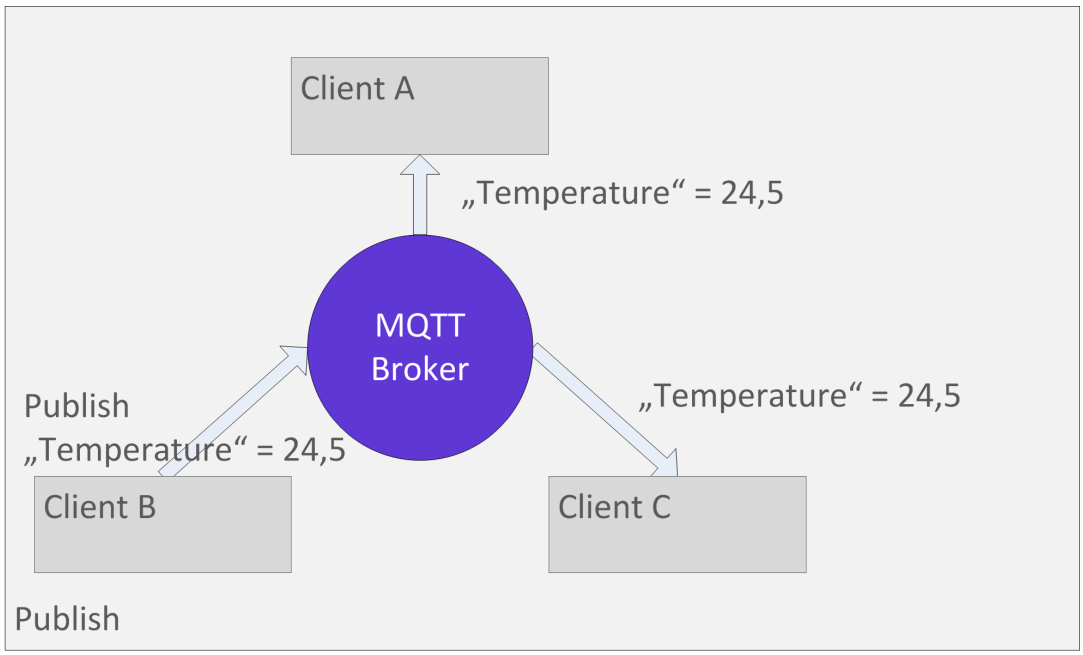


Figure 3: MQTT, a lightweight protocol for machine to machine applications is ideal for IoT use, from embedded devices to the Cloud

Terminology:

You'll probably realize from the above that IoT and Industrial IoT are parts of a bigger picture. From an automation standpoint, the "Industrial Internet" is probably the best way of naming what's really happening. For our purposes, we use "IoT" as a generic term covering all the different aspects. Individual solutions or strategies are specifically named when relevant.

2. HILSCHER'S STRATEGIC VIEW

Figure 4: netX, a universal protocol converter/gateway for networking, will play a vital role in IoT.

As a leading supplier of connectivity solutions to the automation industries, Hilscher began investigating the role of IoT in automation several years ago.
Historically, Hilscher's netX chip family was developed to provide easy interfacing to the many different networking protocols we see on our plants today. It supports 17 network protocols with 33 different master and slave stacks, all utilizing a com mon software and hardware interface, making it simple to integrate Fieldbus and Ethernet networks.
With netX, vendors and OEMs don't have to worry about the different technologies or how they are implemented. They simply pick the required protocol (or gateway combinations) and fit the solution into their equipment. From a hardware perspective, IoT is just another "gateway" challenge. During 2015, many companies introduced IoT gateway products and considered themselves market leaders. The trouble was that none of these products answered the most pertinent questions, such as: Why do I need to do this? How do I determine what data to pick? How do I pick it? What do I do with that data when it's in the cloud?

No supplier company can answer all these questions by itself. End users, SIs and OEMs know the specifics of their production machines and systems and they alone can optimize the effectiveness of IoT. It is already clear that using IoT in automation may require new skills and disciplines beyond those of controls engineering.

Hilscher can, however, provide the tools to tackle the challenges.

Hilscher's approach is based on three levels of IoT engagement, from sensor level to the cloud.

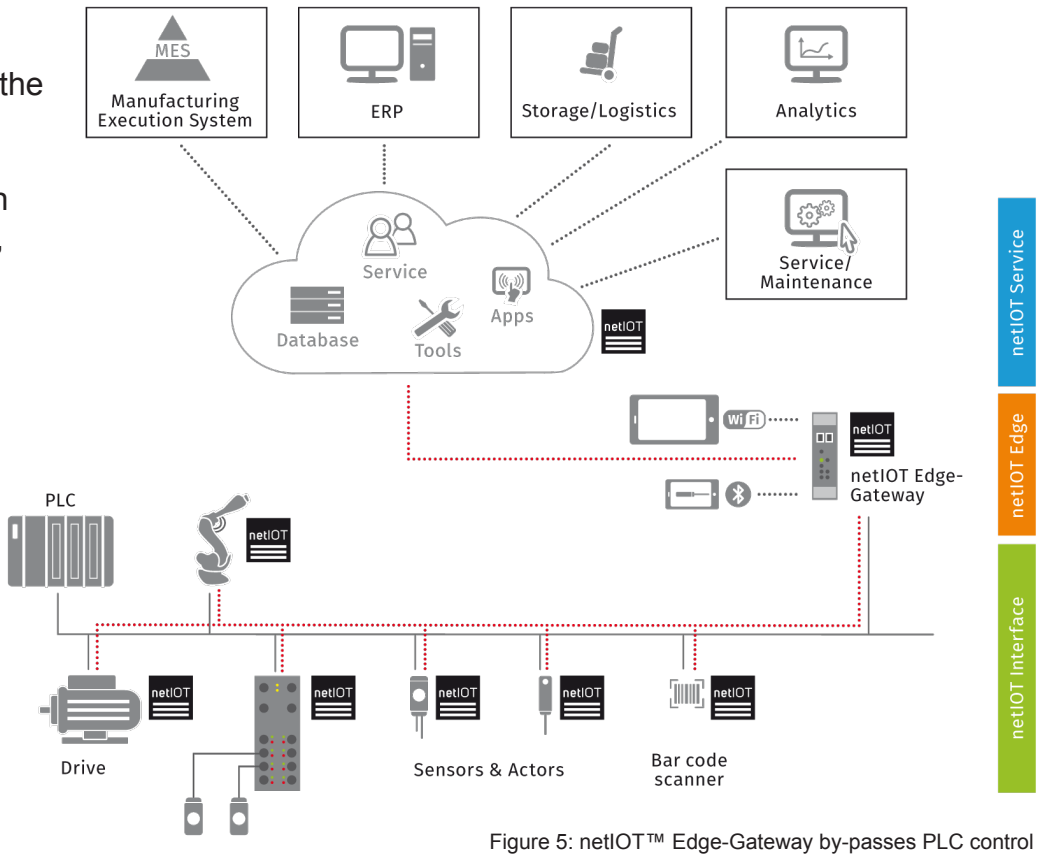


Figure 5: netIOT™ Edge-Gateway by-passes PLC control operations to link network data to internet applications

In summary they are:

- *netIOT™ Interface:* A chip-based module allowing IoT data to be gathered directly from the lo west level devices such as field sensors.
- *netIOT™ Edge:* Gateways for securely transmitting data from existing networks into the cloud.
- *netIOT™ Service:* Applications based on partnerships with IT-centric cloud-based suppliers sup plying remote processing capabilities.

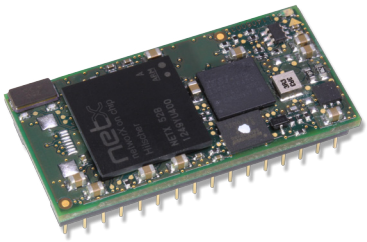
Hilscher's tools make IoT transparently available to all users today. They are the most sophisticated third-party approach to Industrial Internet yet seen in automation and they make the benefits of IoT readily accessible to anyone.

Hilscher encourages all vendors and users to gain experience with IoT as soon as possible. We are leading the way by introducing a range of products that enable IoT deployment today at zero risk to existing systems and equipment.

3. THE netIOT™ PRODUCT FAMILY IN DETAIL

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 our approach "Industrial Cloud Communication" and netIOT™ is the family name for our IoT products and services.

DEVICE INTERFACE



netIC IOT: A DIL-32 embedded module for field sensors and instrumentation. It is the first IoT-enabled communications module for field devices and it places IoT functionality right at the point of measure ment. It is equipped with an OPC UA server and an MQTT client in addition to its communications components. This makes it possible to access a field device via the TCP/IP channel of an Industrial Ethernet network using the same physical cables but without PLC involvement. It provides users with the foundation of cloud-networked data manage ment.

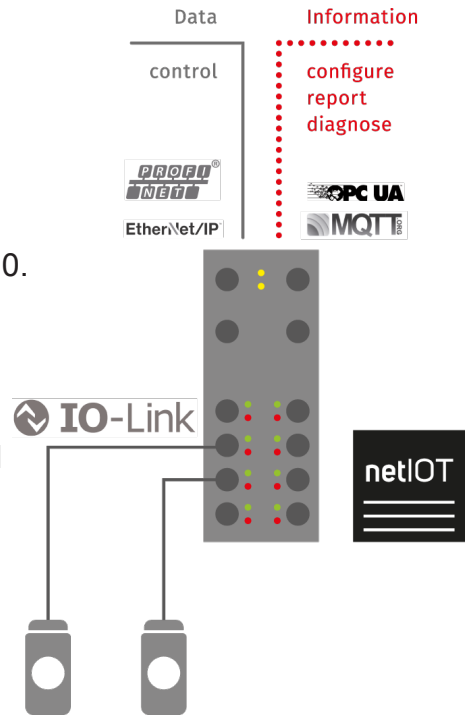
GATEWAYS

netIOT™ Edge-Gateways: These securely couple automation net works to a cloud. They are also the main configuration element for netIOT™ field devices – e.g. for the parameterization of sensors and actuators. netIOT™ Edge-Gateways also offer easy access for diagnostics. Web-based monitoring is supported and wireless connec tivity opens up remote access to mobile devices, so it becomes poss ible to read and load configurations using mobile devices such as tablets and smart phones. Software solutions supporting data extrac tion and processing - either locally or in the cloud - are in hand. As I/O devices, they can cyclically exchange data with the PLC. Thanks to "drag&drop" there is no need for programming, just configuration and wiring. On-Premise Processing: One version of netIOT Edge has enough CPU capacity to support "on-premise" processing of data. This offers a "local cloud" option for end users wanting to process data inside their own operating environment, to avoid any security concerns resulting from the use of a third party remote cloud.

APPLICATIONS

Hilscher has recognized the need to provide IoT users with ways to gain experience easily at the lowest possible cost. With that in mind, a series of partnerships with major cloud-based suppliers is being established.
The first is with IBM's Bluemix solution, which delivers a range of cloud-based applications. netIOT™ Edge-Gateways are already configured to work with Bluemix applications. Information from the field devices is transmitted to Bluemix by means of a Node-RED interface. Shorter time to market and ongoing maintenance are the most important advantages. By purchasing services only on as as-needed basis, access to IoT is made easy, and at a cost that can be controlled by the end user.

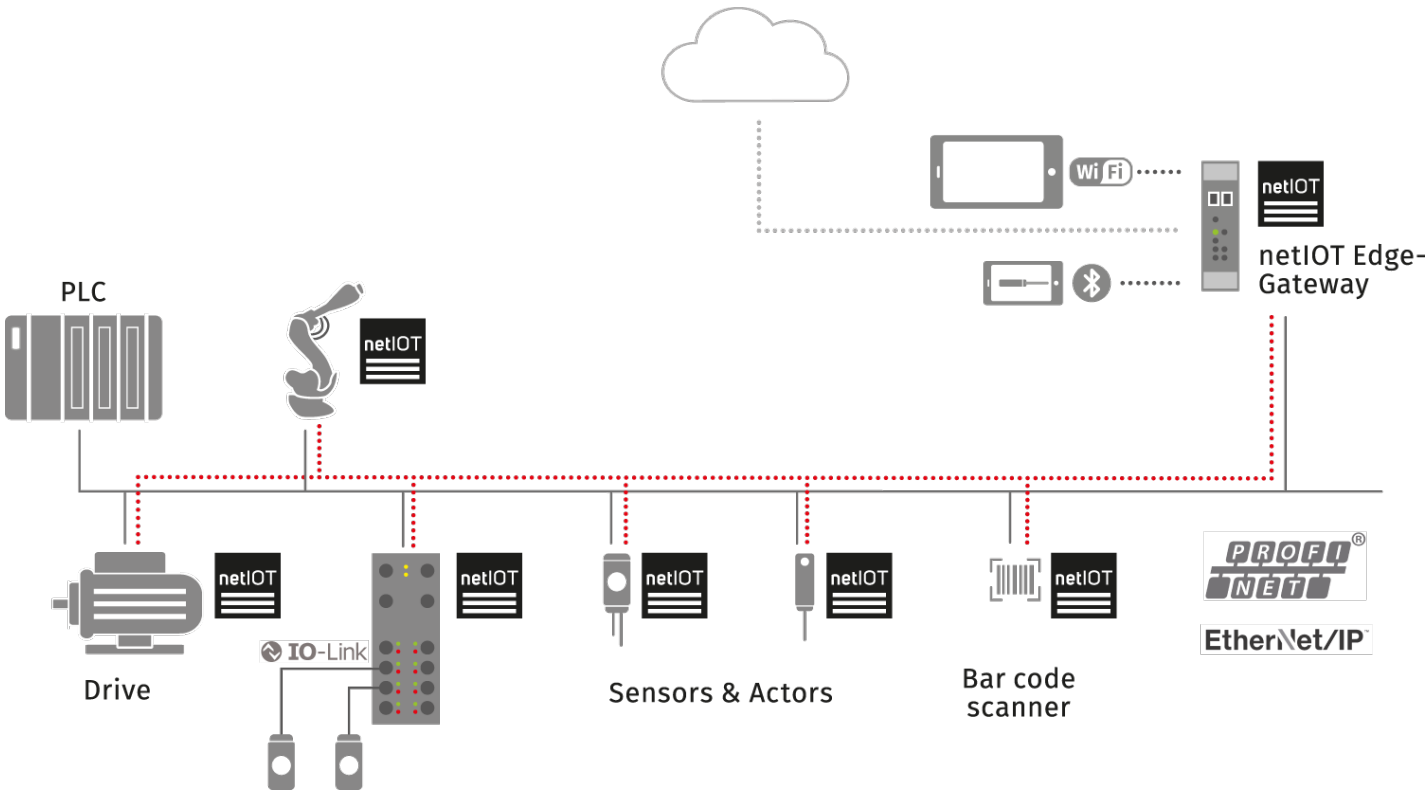
4. netIOT™ OPPORTUNITIES



For Device makers: The challenge for sensor manufacturers today lies in making devices ready for the IoT environment. IoT depends on data, and acquisition has to happen at source: i.e. over the "last mile" and right in the field devices. With netIC IOT and IO-Link Hilscher paves the way to more intelligent field devices that communicate better, ensuring end-to-end networkability that meets the needs of the Industrial Internet and Industry 4.0. Here are some of the benefits:

- You can report telemetry data - in addition to classic I/O data - via MQTT and OPC UA.
- You can provide customers with the foundation for cloud-networked data management.
- You can integrate the right technology now, giving customers the option of using "the cloud" when they are ready.
- You can integrate your own features without changing the functions required by the control system or network. This allows device differentiation and the chance to beat the competition.
- For manufacturers of larger equipment, e.g. large drives, new business opportunities will open up. Devices could be marketed with leasing or pay-per-use concepts and new target groups could be reached with new investment models.

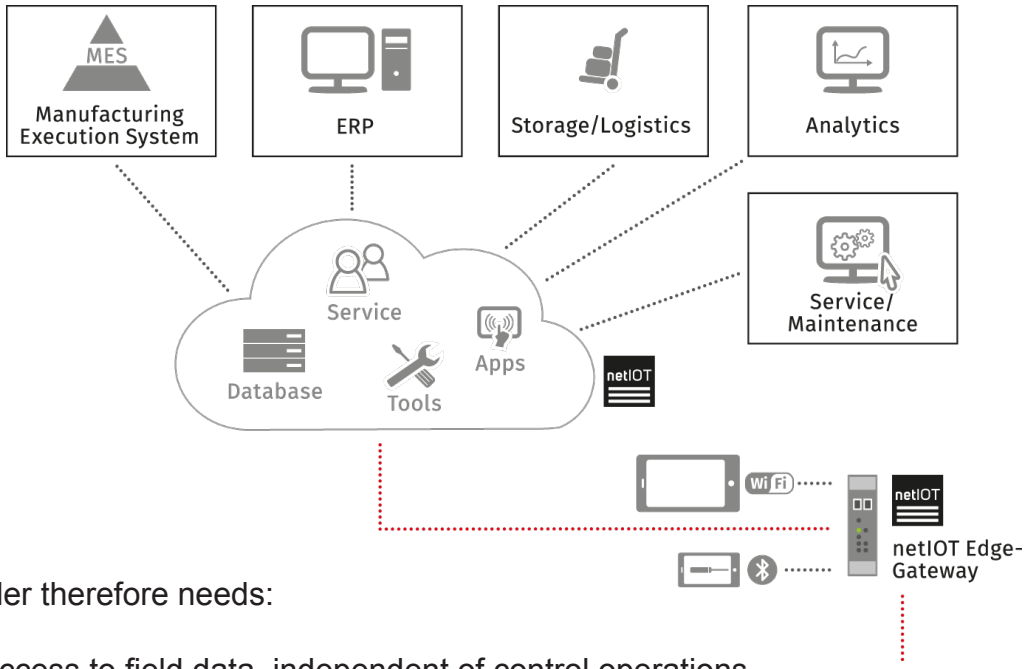
For Machine and Plant Engineering Vendors:
In coming years, Industry 4.0 and the Industrial Internet will be a reality in plants, so IoT functionality will be demanded by the market. Since the service life of machines and plants is often longer than ten years, netIOT™ offers the opportunity to cover these future smart factory requirements now.



- Direct data transmission to a mobile device by means of IoT telegrams enables consistent processes despite different customer systems.
- 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.
- Access to the cloud system is enabled from any point. PLC-independent bus diagnostics can be made during commissioning and field device data can be directly accessed.
- Sensors can be precisely adjusted on site without special coupling modules.
- Manufacturer-independent diagnostics and commissioning run independently of the PLC.
- Intelligent sensors connected to IP67 modules via I/O link allow for direct data querying.
- Remote configuration and diagnostics are possible. This gives mechanical and plant enginee ring companies unprecedented potential for optimization.

For System Providers: Future systems and equipment will rely heavily on IoT. The real advantage of the Industrial Internet is that it enables cloud applications that are functionally more enriched, as well as new business models.

The Industrial Internet will generate a mass of valuable data from sensors and actuators at field level – big data that will lead to greater added value. From that data will arise new opportunities, some not yet apparent. System providers will increasingly be asked to implement IoT functionality and deliver the capability to operate within an Industrial Internet infrastructure.



A system provider therefore needs:

- Good access to field data, independent of control operations
- MQTT and OPC UA support to extend Industrial Ethernet communication at field level.
- Easy access to whatever cloud platform is selected.
- Cloud applications that use the data to generate greater added value.
- An infrastructure solution that has been coordinated and tested with the cloud platform provi der.

With many business IT vendors already shaping a multi-cloud landscape, system suppliers must react now. For Hilscher's netIOT™ Edge-Gateways, there is already a connection to IBM's Bluemix cloud platform offering a range of powerful applications options. More connections will be formalized soon.

About Hilscher Gesellschaft für Systemautomation mbH and Hilscher North America

Hilscher specializes in products, technologies and services at the leading edge of industrial communications. Core products include gateways, PC cards, embedded modules, chips, controllers and supporting software stacks. Hilscher's netX system-on-a-chip solution is a highly integrated network controller optimized for communication and maximum data throughput. netX provides support for 33 different master and slave stacks and 17 industrial protocols, including DeviceNet, PROFIBUS, CANopen, IO-Link, CC-Link, EtherNet/IP, PROFINET, Modbus TCP and EtherCAT, among others. With universal network connectivity, netX is the backbone of the company's extensive family of network interface products and custom solutions. www.hilscher.com

Hilscher North America, based in a Chicago suburb, is a wholly owned subsidiary of Hilscher Gesellschaft für Systemautomation mbH. www.na.hilscher.com

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