rexroth
A Bosch Company

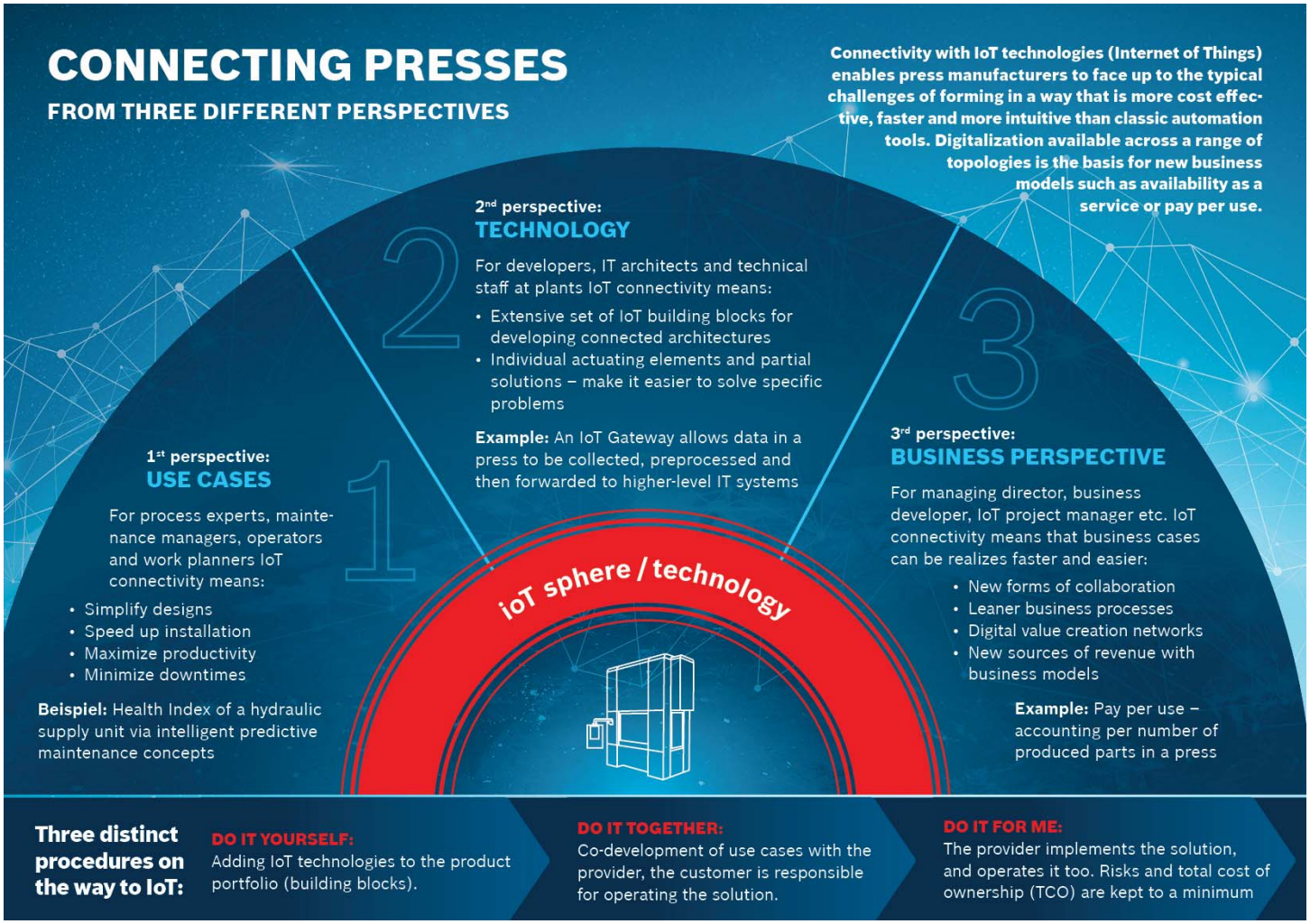
IoT and forming systems:
connecting presses – why and how?

Connectivity with IoT technologies (Internet of Things) enables press manufacturers to face up to the typical challenges of forming in a way that is more cost effective, faster and more intuitive than classic automation tools. Digitalization available across a range of topologies is the basis for new business models such as availability as a service or pay per use. What is already technically possible and what will the future be like?

In the factory of the future, everything will be connected. In this “intelligent space”, virtually everything will be mobile and flexible. How does this fit in with forming methods with stationary presses? They too could become more flexible, more productive and more available if manufacturers make more consistent use of “IoT-ready” components, system solutions and architectures.

What are the benefits of connectivity?

The potential offered by connectivity can be seen from three perspectives.



1: Visual representation of the three perspectives

1st perspective: implementing use cases

From a use case perspective, process experts, maintenance managers, operators and work planners focus on four typical challenges in particular:

- simplifying designs
- speeding up installation
- maximizing productivity and
- minimizing downtimes.

These four challenges are not new. In many cases, OEMs and end users have faced them for decades. What is new, however, is the potential offered by IoT technologies. They allow the desired effects to be achieved much more quickly, more easily and more cost effectively than previous technologies did. Technologies, technology operation and services can already be combined to produce specific solution sets which allow system availability to be improved and unplanned downtimes to be avoided. One example of this is Bosch Rexroth's Online Diagnostics Network ODiN.

2nd perspective: solving technical challenges

From a technology perspective, the added value lies in an extensive set of technological building blocks for developing connected architectures. These IoT building blocks – individual actuating elements and partial solutions – make it easier for developers, IT architects and technical staff at plants to solve specific problems. An IoT Gateway is one such building block – it allows data in a press to be collected, preprocessed and then forwarded to higher-level IT systems.

3rd perspective: realizing business cases

From a business perspective (managing director, business developer, IoT project manager etc.), the charm of IoT technologies lies in the realization of business cases. These include new forms of collaboration, leaner business processes, digital value creation networks and new sources of revenue with business models such as pay per use. When working with a provider, three distinct procedures are possible:

1. Input and output-technologies	Which interfaces, protocols and semantics should be used to connect individual modules within the architecture?
2. Storage	How and where does the architecture get its “memory”, i.e. buffers and data memory for raw and aggregated data?
3. Data Intelligence	What procedures are used to obtain information from data? This opens up a broad field, ranging from rules and trends to extensive analysis algorithms involving large quantities of data.
4. User Interface	Where and how should interaction points between software systems and users be put in place?

Evaluation of networked components in an electrohydraulic press (examples)

• Do it yourself: This approach adds IoT technologies to the product portfolio. These additional building blocks broaden the range of technological tools available to the customer.

• Do it together: The provider (for example Bosch Rexroth) works with the customer to develop a joint understanding of challenges and use cases and implements a suitable solution architecture. However, the customer is responsible for operating the solution.

• Do it for me: The provider (for example Bosch Rexroth) not only implements the solution, butoperates it too. The key benefit for the customer is that risks and total cost of ownership (TCO) are kept to a minimum.

The architecture: connectivity over five levels

In the past, anyone who wanted to make a press connective without IoT technologies would be faced with the classic automation pyramid – with all its interfaces and dependencies. It is possible to achieve connectivity via this route – but it is extremely time-consuming and therefore an unattractive prospect in many cases. Data evaluations and processes become more complicated and, as a result, unnecessarily expensive. In contrast, an IoT approach allows direct, straightforward data collection, analysis and evaluation – for individual components, part-systems or the press as an overall system depending on the use case.

When coming up with IoT solution architectures, five levels should be considered and it should be discussed which functionality should be implemented where.

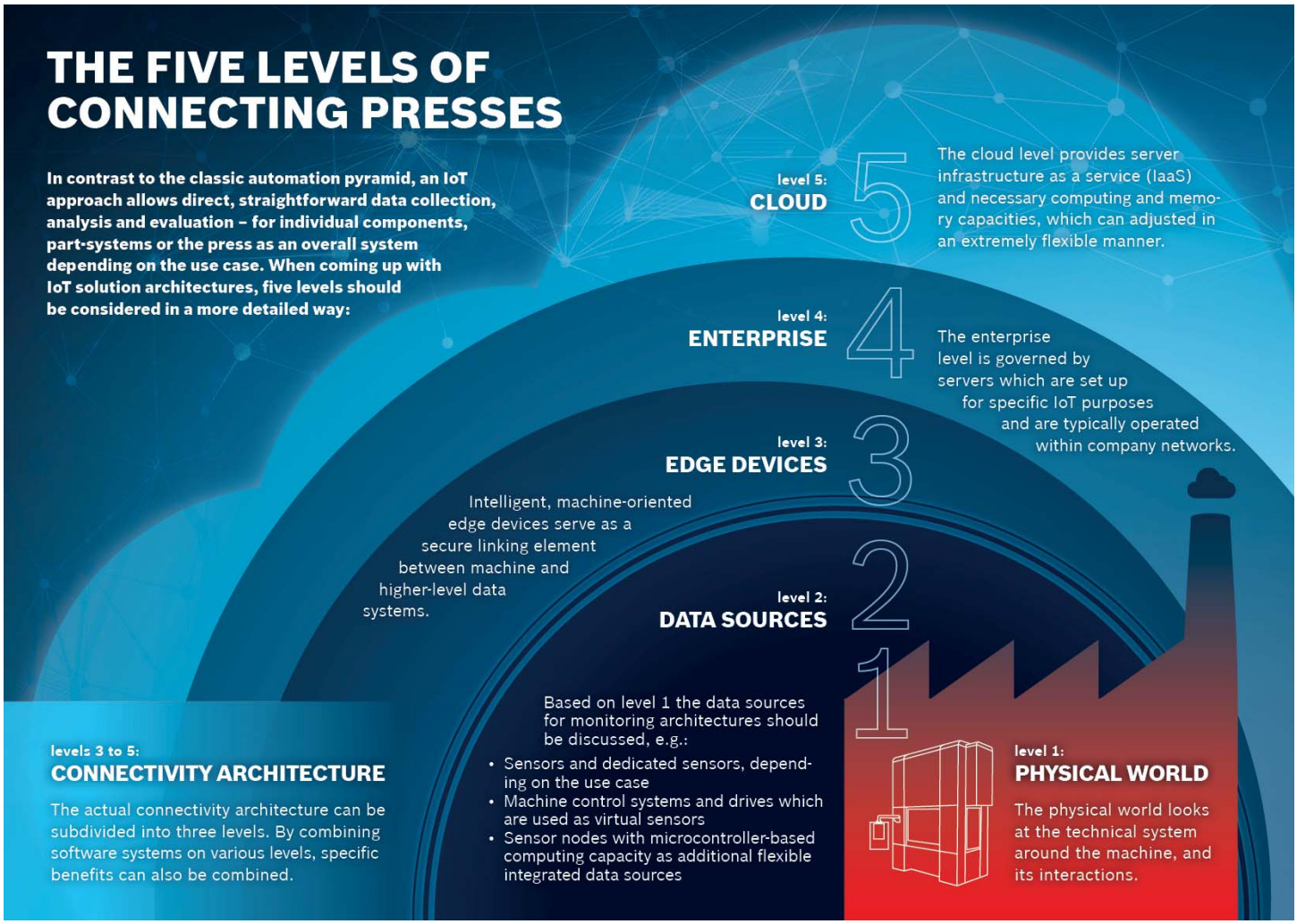
Physical world (level 1) and data sources (level 2)

The physical world (level 1) looks at the technical system and its interactions. On this basis, the data sources (level 2) for monitoring architectures should be discussed. Depending on the use case, these can include not only dedicated sensors, but also machine control systems and drives which are used as virtual sensors. Data that are automatically produced in control and automation systems can then be used for other applications. Sensor nodes are also relevant here. These are sensors that are combined with microcontroller-based computing capacity and, typically, wireless technologies in order to easily and flexibly integrate additional data sources.

Connectivity architecture (levels 3 to 5)

The actual connectivity architecture can be subdivided into three levels: machine-focused with the help of edge devices (level 3), on dedicated servers on an enterprise level (level 4) and on a cloud level (level 5). Here, it is important to weigh up typical time frames (e.g. sampling rates) as well as the available data memory and computing capacities. By combining software systems on various levels, specific benefits can also be combined.

Edge devices refer to network components on the edge of the network via which the machine gains access to higher-level networks. Intelligent edge devices such as the Rexroth IoT Gateway serve as a secure linking element between machine and higher-level data systems. The enterprise level is governed by servers which are set up for specific purposes and are typically operated within company networks. The cloud level provides server infrastructure as a service (IaaS). As a result of this, the necessary computing and memory capacities can be provided and adjusted in an extremely flexible manner.



2: Visual presentation "The five levels of networking"

Functional design aspects

Press manufacturers and other machine manufacturers can now discuss the following functional design aspects:

IoT vs. classic automation – the opportunities

The IoT's modular and flexible network approach makes solutions significantly cheaper, but also quicker and more intuitive than classic automation. With the help of modern web technologies, users can build user-oriented interfaces/HMIs, such as a dashboard or a ticket system for predictive maintenance, quickly and without expert help. Possible quality problems or new requirements as regards energy efficiency can be addressed more quickly by adding or enabling extra sensors and evaluating the data they provide. For example, acceleration sensors can be used to monitor components and processes for vibrations. A frequency band analysis can then be used to detect wear.

With the flexibility offered by IoT technologies, the end user's vision of the factory of the future seems much more feasible. At the same time, OEMs benefit from complete process monitoring as it allows greater contact with the customer together with the provider. As a result, existing business relationships can be strengthened and new business models can be developed. Conceivably, the user could purchase "availability as a service" or even a certain productivity which the OEM would provide as an overall package. In order to manage possible failure risks, new business models between the OEM and insurance companies are also emerging.

What is connectivity like in reality?

Interested OEMs and users no longer have to fear technological challenges. Nowadays, all topologies can be fully connected. When it comes to digitalization and cost effectiveness, hydraulic presses provide the same basis for the use of IoT technologies as electro-mechanical presses do. Users can therefore choose the drive technology which matches their application. Electric hydraulics is particularly attractive as it combines the benefits of hydraulics and electrical drive technology in one. A few examples:

A new generation of hydraulic power units with integrated intelligence, sensor technology and condition monitoring improves flexibility, energy efficiency and above all availability. New design approaches increase the available power in the smallest of spaces while the footprint and noise emissions are significantly reduced. The fact that the hydraulic supply unit can now be positioned right next to the machine results in new levels of freedom when designing machines.

Another state-of-the-art example is Bosch Rexroth's new onboard electronic system for control valves. It reduces the 200 (mainly analog) variants currently available to a single cross-technology platform. This system is are integrated in the new WRC-4X range of directional cartridge valves, which can be commissioned via Multi-Ethernet. At the same time, the CFD-optimized design (Computational Fluid Dynamics) allows improved dynamics with the same flow. This allows for a smaller size to be used, thus reducing investment costs.

What does the future have in store?

Through the use of modern IoT building blocks and solution sets, use cases in forming can be achieved much more easily, more intuitively and at lower cost. Thanks to the modular network architecture, OEMs and end users can set up, convert or retrofit intelligent systems quickly. The data needed to increase the overall equipment effectiveness (OEE) can be directly and flexibly collected for specific applications – regardless of the press technology used. As a result, new business models such as pay per use are also technically possible. With suitable billing models and business processes, OEMs will be able to sell productivity and availability as a service, for example as "uptime as a service" in conjunction with an insurance partner.

Another scenario which could be achieved at short notice: the end user purchases from the OEM a specific supply volume instead of a hydraulic power unit and benefits from reduced procurement costs and more flexible investment costs.

The future starts now

After today's condition monitoring systems, self-learning systems represent the next evolutionary step. Backed up by machine learning and artificial intelligence, the press will work independently and make its own decisions. It will act adaptively in accordance with overriding optimization criteria in order to increase productivity, ensure availability or improve energy efficiency.

The technical basis for all this and new business models is already in place and forming technology is making clear progress on the way to the factory of the future. With the right partner, OEMs can get started right away, exploit the potential of IoT technologies and – as an important step towards maintaining competitiveness – develop futuristic new business models.

To find out more about the specific opportunities and how the technologies are implemented, visit Bosch Rexroth at the EuroBLECH (Stand D08, Hall 11).

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