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FRAUNHOFER INSTITUTE FOR EMBEDDED SYSTEMS
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# Harvesters joining the Internet of Things

The advantage of predictive maintenance is that maintenance or service requirements are identified before the need actually arises. That saves time and more importantly reduces downtime for expensive machinery. In a joint project, equipment manufacturer Holmer, telecommunications manufacturer Huawei and Fraunhofer ESK succeeded in transferring the predictive maintenance method to a fleet of highly-complex harvesting machines. To date, it has been used in conjunction with wind turbines and production systems.

The technique involves the use of various sensors that monitor key areas of the machine, such as the drive train. The sensor data is transmitted via a mobile phone network to a central maintenance service in the cloud, which utilizes online analysis methods to detect irregularities and trigger an alarm far in advance. Rather than being restricted to individual machines, this approach is designed to support a globally-operating fleet.

One issue that had to be solved was the fact that stable, high-speed wireless connectivity is not always available, or is possible only with significant engineering effort. In order to reliably and seamlessly monitor the activities of the harvesters if real-time connectivity to the Internet cannot be guaranteed, part of the necessary intelligence from the Internet was relocated to the communication gateway at the machine. Depending on the application, this edge cloud makes it possible to locally process the data from the harvester and carry out important partial analyses without having to transmit information to a central Internet of Things (IoT) cloud.

Apart from contributing methods to optimize the joint project, Fraunhofer ESK focused its engineering activities on edge cloud

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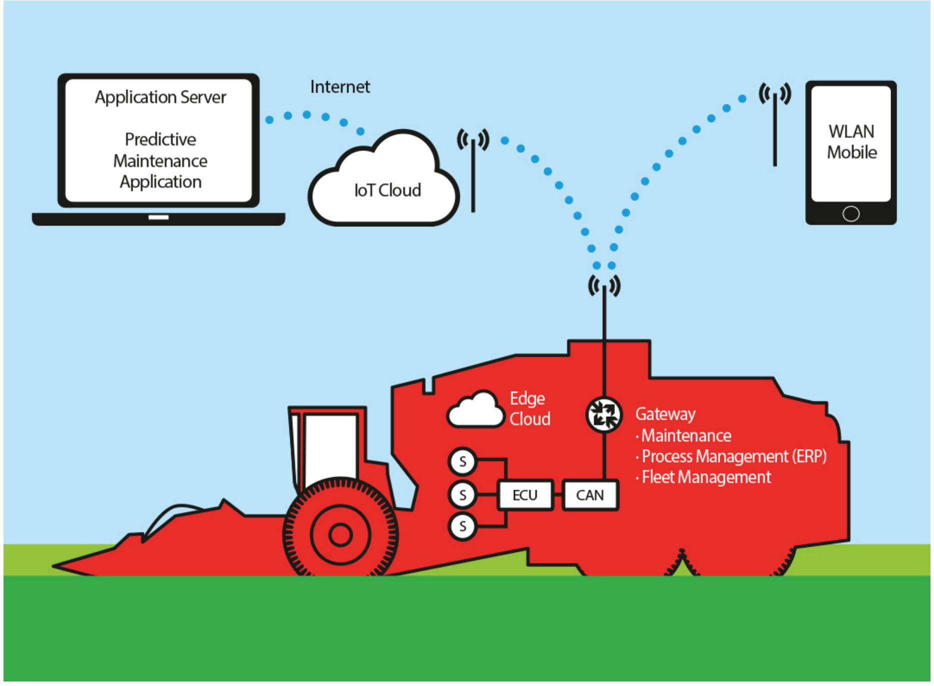


*How predictive maintenance for harvesters functions.*

solutions and the connectivity between the gateway and the existing sensors via the CAN bus.

In this concept, ESK envisages the ideal expansion of the cloud technologies as a means to implement practical, future-proof infrastructures for the Internet of Things. The edge-cloud approach also allows the machine data to be analyzed in a cooperative fashion, meaning within a network of several machines that communicate directly with one another or in conjunction with a cloud provider.

Fraunhofer ESK is focusing its project activities on the selection, testing and implementation of the machine-to-machine-(M2M) protocols, as well as interfaces for the manufacturers of IoT-capable products.

## Methods and technologies for integrating IoT

The overall architecture design follows the method developed by Fraunhofer ESK for integrating IoT technologies in existing products, which consists of six steps. This process begins with analyzing the application scenario, defining the anticipated key improvements and determining the communication and IT architecture requirements. After evaluating the technology, the anticipated improvements are analyzed in a pilot project.

## IoT interfaces

The goal is to ensure the greatest possible long-term interoperability of the communicating components. For this reason, ESK is promoting the use of current web technologies for the communication architecture and for the development of distributed IoT applications. This provides the flexibility to adapt the distributed applications to the resources of the participating devices.

## Web technologies

Fraunhofer ESK is pursuing the edge cloud approach, as well as the use of web technologies and M2M protocols in predictive maintenance applications, for more than just harvesting machines. Production systems offer further potential for this technique. The assumption is that after the era of conventional programmable logic controllers (PLC) and software-based systems for controlling production systems, the industry will move toward web-based services. A key issue here is how fast the sensor information has to be processed and which response times are required for optimal control of the system. This provides the flexibility to determine where and how the data is processed for each task depending on these variables. The underlying architecture here is based on Java script environments on the client and server side, as well as web protocols such as websocket, HTTP2 and Web RTC.

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