The Edge Controller –
Your Industrial IoT solution

Perfection in Automation

Content

More efficiency

Identify and utilize potential for optimization

More quality

Eliminate problems systematically with big data analysis

More security

Neutralize threats with the most modern security mechanisms

More flexibility

Select the perfect configuration for your needs

Tap the potential of the Industrial IoT

Operators of machinery and equipment continue to shift their focus toward the Industrial Internet of Things. For them to take full advantage of their IIoT-connected factories, the machinery and equipment must be able to connect to the cloud. This is achieved using what are known as edge devices.

Industrial processes are expected to achieve ever-increasing levels of effectiveness and efficiency. Energy consumption must be tracked, equipment must be quicker and easier to service, and it must be possible to measure and compare asset performance. The Industrial IoT promises all this and more with highly automated, ultra-connected machinery and production lines.

What is edge computing?

Industrial IoT solutions allow users to extract information from their machinery and equipment that extends far beyond simple alarms and event notifications. They can be informed, for example, when a component is showing signs of wear and when it can be expected to fail. Yet, studies have shown that the average plant only utilizes about one percent of the data it generates. This amount can be increased drastically through the use of edge computing. Edge computing is a method of collecting large volumes of data near its source so that it can be compressed and aggregated before being passed on to higher-level systems. An edge device is therefore the link between real-time systems at the machine and process level (OT = Operational Technology) and the world of IT.
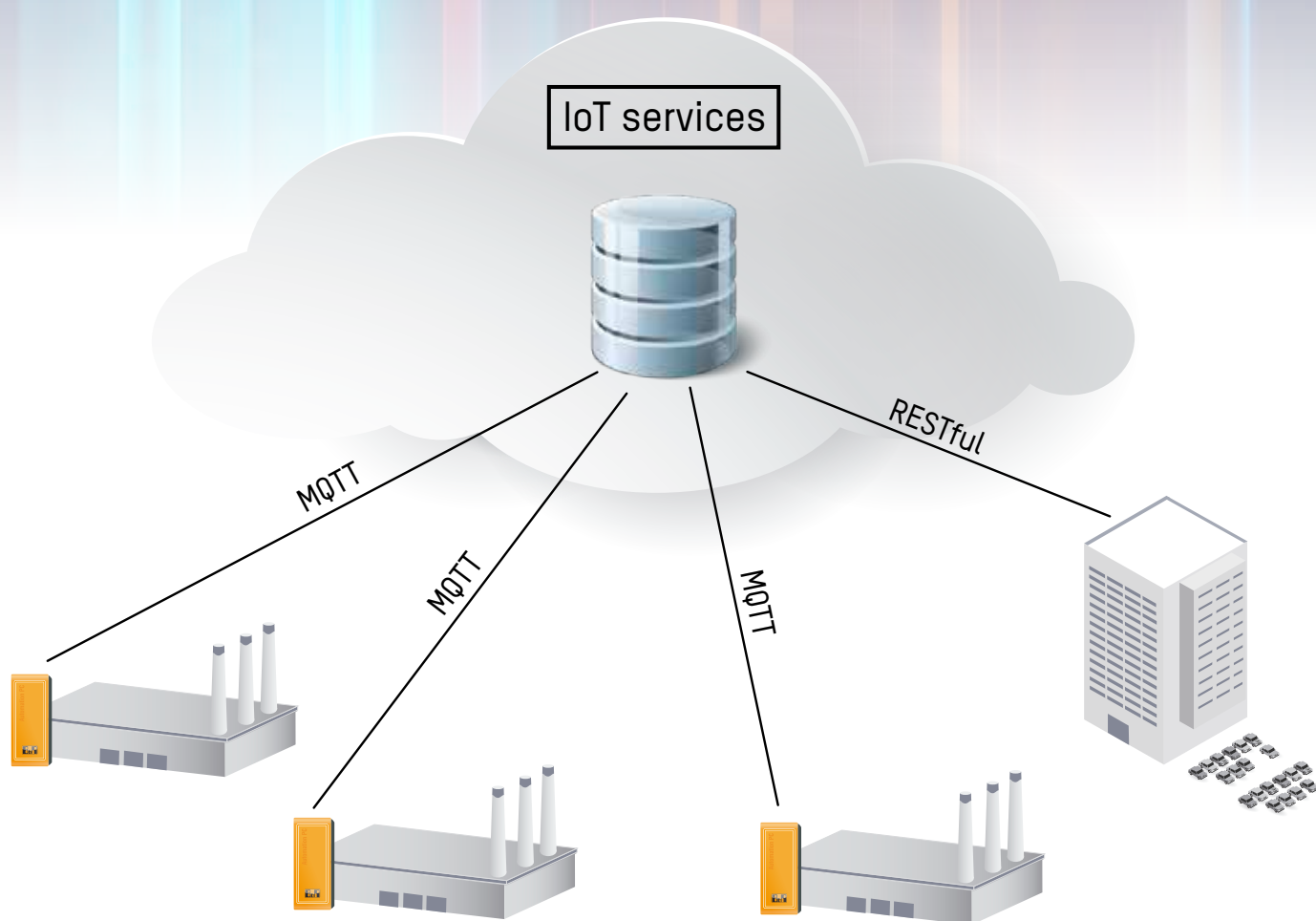
Edge devices from B&R

To meet the diverse needs of different applications, B&R offers three types of edge device: Edge Controller, Edge Embedded and Edge Connect.
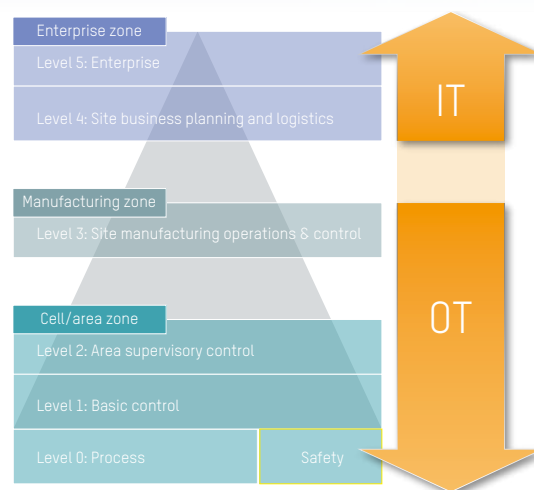
Highlights

➔ Make effective use of data
➔ Reduce costs
➔ The right edge device for your application

IoT services

MQTT

MQTT

MQTT

RESTful

To take full advantage of IIoT-connected factories, machinery and equipment must be able to connect to the cloud.

B&R Edge Controller
Robust and high-performance

B&R's Edge Controller is based on the robust Automation PC 910, whose high-performance variant is equipped with an Intel XEON processor able to handle resource-intensive tasks like machine learning.

The Edge Controller runs a hardened operating system used to preprocess the data. This general purpose operating system (GPOS) is an enterprise Linux distribution with guaranteed long-term support.

Two independent operating systems
B&R Hypervisor makes it possible to simultaneously run a real-time operating system on the Edge Controller. The hypervisor makes it possible to uniquely assign all hardware in the industrial PC to one of the operating systems. This prevents the systems from interfering with one another.

The edge device is a full-fledged industrial controller with cycle times in the millisecond range. Real-time programs can be written in any of the IEC 61131 languages, making it easy to implement even the most complex rules. An unlimited number of I/O modules or controllers can be connected via the POWERLINK Industrial Ethernet protocol or other fieldbus systems. In the future, this will also be possible with OPC UA TSN.

Other edge devices
In addition to the Edge Controller, B&R offers two other edge devices: Edge Embedded and Edge Connect.

Edge Connect
Edge Connect is an OPC UA bus controller that enables OPC UA communication directly from the sensor level to the ERP level. Edge Connect is the right choice if the volume of data is small and on-site control logic is not required – perfect for tasks such as monitoring a pipeline with sensors.

Edge Embedded
Where larger volumes of data are involved, it is worthwhile to first aggregate the data on the machine. This has two advantages: firstly, it reduces bandwidth requirements and costs for cloud services; secondly, it provides a sufficient buffer to prevent data from being lost in the event of a connection error. Standard B&R PLCs serve as the Edge Embedded hardware, and are simultaneously able to execute the machine logic in real time in addition to sending data to the cloud.

Automation PC

ABB Ability

AWS **Microsoft AZURE**

OPC UA/ANSL

Operating
GP
System

Operating
RT
System

Edge Controller

Operating
RT
System

Automation PC based controller

Operating
RT
System

X20 based controller

Operating
RT
System

Power Panel based controller

Fieldbus Fieldbus Fieldbus Fieldbus

The Edge Controller connects the real-time system to higher-level systems.

Functions

→ Collect and compress data

→ Archive data

→ Analyze data

→ Visualize information

→ Control

→ Security

→ Connectivity

→ Cloud connectivity

Collect and compress data

In order for data analysis to provide useful information, it must be based on operations and production data that is collected seamlessly and centrally. The Edge Controller's process data acquisition (PDA) function allows you to collect a full array of raw data in real time.

The PDA browser reads all of a B&R controller's data points as well as their structure. PDA blocks make it possible to define an SQL table structure automatically using a block diagram – there's no need for an IT specialist with SQL expertise. A trigger on the PDA block saves a data set to the SQL table.

Reduced memory requirements
The amount of data collected is usually too large to store on site, yet also too large to send to higher-level systems. Instead, it must be processed continuously as it is generated. There are a variety of ways to do this. It is possible to store raw data only when a value has changed, or to store only statistical values such as the minimum, maximum, mean and median. These methods greatly reduce the amount of memory and bandwidth required.

The next step is aggregation. This involves reading data from a database, linking it together, and sending the results on to the next level. Since memory resources on site are limited, this is generally done cyclically. The UCB server integrated in the Edge Controller calls scripts automatically at defined times or triggered by specific events.

Acquisition

Analysis

Reporting

Visualization
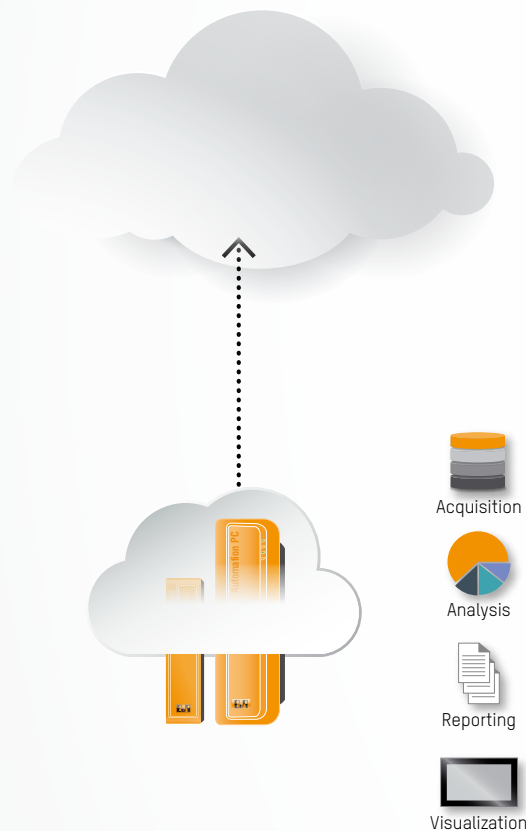
Highlights

➜ Acquire data in real time
➜ Transform data into information
➜ Conserve bandwidth

Archive data

The Edge Controller is equipped with a NoSQL database (APROL ChronoLog) to record continuous signals and events. The user also has an SQL database at their disposal (MariaDB) for use with the application.

Data buffering
Local buffering is essential to avoid data loss when there are disturbances in the infrastructure. The Edge Controller supports buffering in the DRAM of the real-time operating system, in the file system and in the databases.

SQL database interface
An SQL server interface provides read access to the data in the historical archive. External write access is prohibited to prevent tampering.

The data lifecycle
The lifecycle of data in an Edge Controller can be broken down into three phases: data-in-use, data-in-transit and data-at-rest. A high level of security can be achieved over the entire lifecycle by implementing the appropriate measures in each phase (encryption of communication, file system or database).

Highlights

→ Comprehensive database functions
→ Data buffering for network failure
→ Protection against tampering

ChronoTrend   ChronoLog   Application

Historical archive

Maria DB

NO SQL

SQL

SQL interface   SQL interface

The Edge Controller features a NoSQL and an SQL database.

Analyze data

The B&R Edge Controller offers numerous options for analyzing collected data. The functions are provided in the form of control modules, which allow you to pick and choose the appropriate functionality for your application.

Control Performance Monitoring for PID
The Edge Controller makes it easy to assess control loop performance. The CPM control module provides a variety of statistics that can be used to optimize the efficiency of manufacturing processes. Changes to certain parameters over time can indicate that a controller needs to be retuned.

There are more than 30 parameters available, including some that are calculated conditionally, such as the percentage of time that a controller has been operated manually. This can provide insight into whether the controller is tuned properly or needs attention.

Monitor pumps and heat exchangers
Asset Performance control modules allow continuous monitoring of manufacturing assets. Operating personnel can receive critical information about degree of heat exchanger fouling, gauge hydraulic losses in transport lines and identify the cavitation-critical operating point of a centrifugal pump. This helps reduce maintenance costs and downtime due to failure – in some cases dramatically – while optimizing the availability and utilization of machinery and equipment.

Condition monitoring
The goal and challenge of maintenance is to improve product quality and increase system availability while at the same time minimizing costs. Conventional maintenance strategies are severely limited in their ability to achieve this.

The Edge Controller makes it easy to implement advanced maintenance concepts.
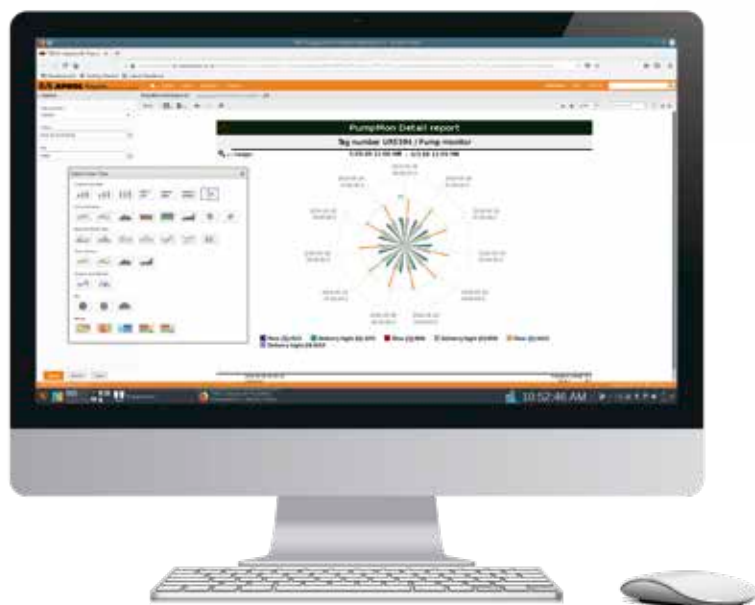
That's why B&R offers convenient tools for implementing condition-based maintenance. By identifying when and where maintenance is actually required, condition monitoring helps avoid replacing healthy components prematurely, while at the same time ensuring that worn components are replaced before they fail and cause unexpected downtime. The Edge Controller offers a comprehensive set of options from B&R's APROL ConMon solution for condition-based maintenance.

Energy management
Comprehensive monitoring of energy consumption provides the foundation for an energy management system that successfully reduces energy costs. In addition to numerous other functions for optimizing energy consumption, the Edge Controller offers a Load Shedding

control module that can forecast the average power consumption over the course of a billing period and prevent peak loads by connecting and disconnecting loads.

Trend system

The Edge Controller's integrated trend system continuously records process data in a high-performance, maintenance-free database. Sophisticated compression substantially reduces the volume of data to be stored in the historical archive or sent to the cloud – an absolute necessity when sampling input signals at high speed. Analysis results can be viewed at any time using the TrendViewer.

Generate and manage alarms

The alarm system is based on a multilevel alarm concept (message, alarms not requiring acknowledgment, alarms requiring acknowledgment, alarms requiring text acknowledgment) and logs all of the significant information for each alarm (operator name; alarm master data; timestamps for clock-in, clock-out, acknowledgments and comments). Process data can also be collected. Alarms can be grouped. On the Edge Controller, alarms can be generated and acknowledged via the control logic, allowing machines to continue operating without operator intervention in the event of non-critical alarms.

Highlights

➜ Modular functions
➜ Extensive analysis options
➜ Can be combined as needed

Clear graphical overviews make it easy to compare shifts.

Integrated business intelligence

The **B&R Edge Controller contains an integrated Business Intelligence Suite, providing clearly organized dashboards and ad hoc reports that can be viewed on any web-enabled device using a BI server. The web-based tools allow the average user with no previous experience to create their own customized reports.**

The Business Intelligence Suite includes native apps for Android and iOS, making the interactive reports and dashboards available on smartphones and tablets as well.

Reports generated from the Business Intelligence Suite can also be made available via a simple URL request. A high-performance REST v2 API is integrated for this purpose.

Highlights

➜ Highly efficient analysis options
➜ No expert knowledge required
➜ Reports and dashboards on any end device
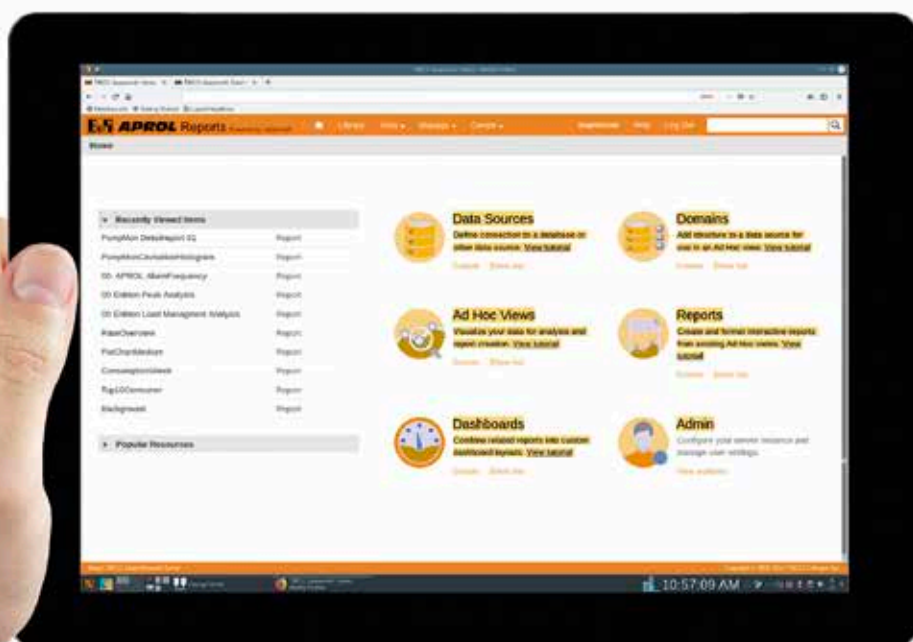
Orchestration

The goal of an edge computing architecture is to ensure that the algorithms process the machine's data in real time, with cycle times in the millisecond range, regardless of the status of the infrastructure. At the same time, all of the functions of a state-of-the-art control system must be available for use in the application. Since the B&R Edge Controller is also a full-fledged industrial controller, that's no problem at all.

Line control

Thanks to its real-time operating system, the Edge Controller can be used for real-time control of a machines in a line. If the machines lack the necessary fieldbus systems to achieve millisecond cycle times, it is possible to connect remote I/O modules to the Edge Controller to integrate status and control signals.

With all of its data archiving and evaluation capabilities, the Edge Controller can also be used to implement a line management system for tasks such as:

→ Assessment of overall equipment effectiveness (OEE)
→ Product and batch traceability
→ Line visualization
→ Asset condition monitoring
→ and more...

Rule-based control

The Edge Controller is a full-fledged controller, allowing rules to be defined in all IEC 61131 languages as well as C/C++. Even complex rules are easy to implement.

Easily simulate process models

A variety of predefined models are available on the Edge Controller for representing dynamic systems. A configurable filter can be used to suppress noise, dampen resonant frequencies and more. Interfaces for a variety of simulation tools, such as MATLAB, allow you to develop highly complex models and then apply them in the control program. Rules and programs can be tested extensively via hardware-in-the-loop emulation before being activated on critical equipment.

Advanced process control

For processes with complex interdependencies, the Edge Controller can rely on its Advanced Process Control function. This applies a method known as model-based predictive control (MPC). The controller determines the optimal control parameters based on a model of the process, automatically minimizing control errors.

Highlights

→ Orchestration of machines and subsystems
→ Cycle times in the millisecond range
→ Easy-to-implement line management

Visualize information

The Edge Controller can also be used to view data, results and reports. The integrated web-based real-time HMI solution – mapp View – makes it easy to create HMI pages. Because mapp View is based on HTML5, CSS3 and JavaScript, the resulting HMI applications are platform independent and can be viewed on any web-enabled device.

An extensive library of ready-made graphical elements, or widgets, allow you to create interactive HMI content quickly and without any specialist training in web design.

The real-time HMI application is seamlessly integrated in the Edge Controller's engineering tool. Data communication occurs via OPC UA, so third-party devices can also be connected directly to the HMI system. VNC applications can also be integrated via a VNC client widget.
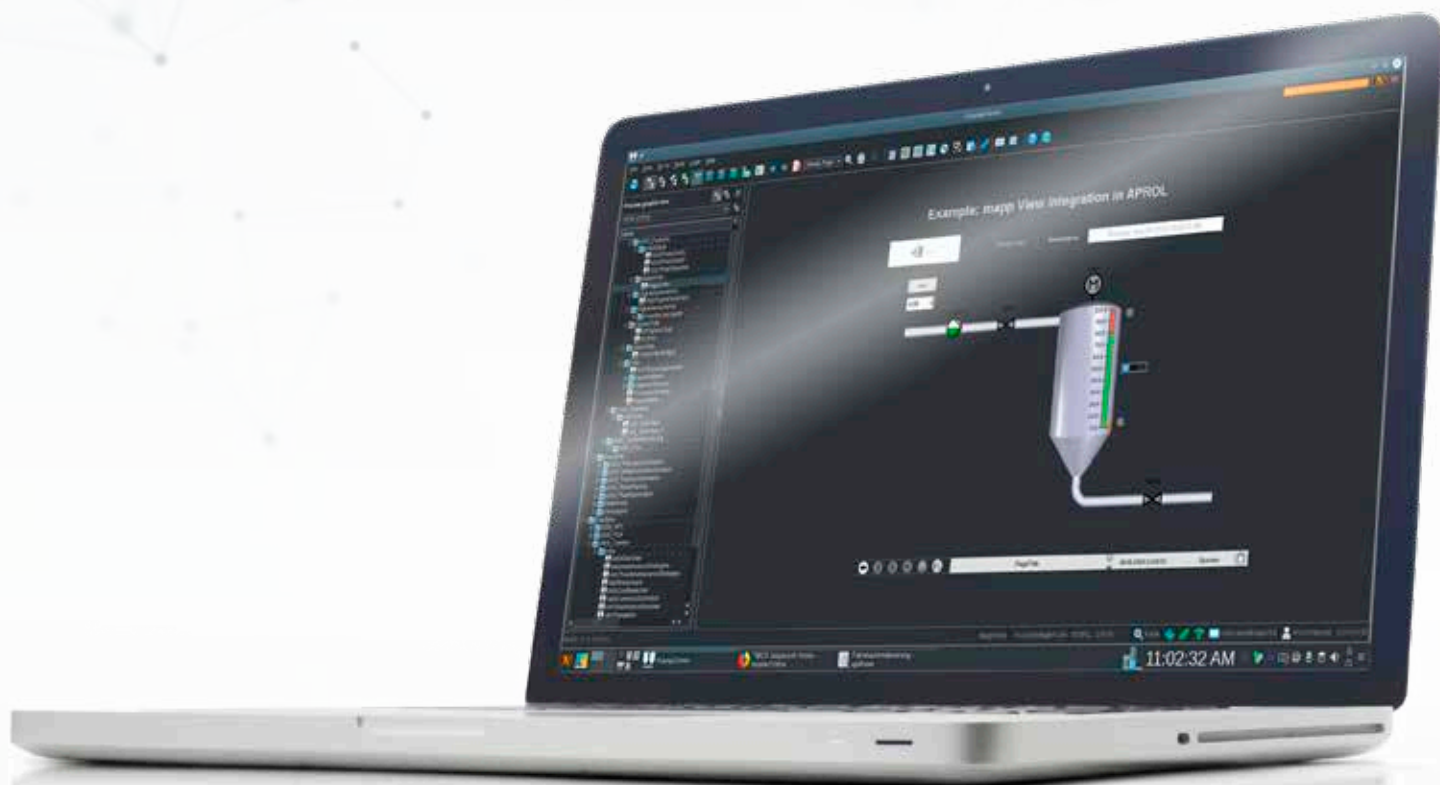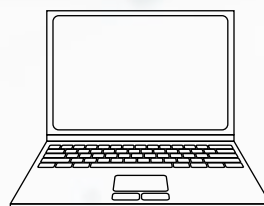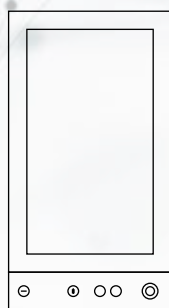
Highlights

→ Platform-independent HMI
→ Runs on any display device
→ Easy HMI design

mapp
VIEW

Industrial security

Edge devices sit at the threshold between IT and OT, making them a prime target for hackers looking to gain entry into these systems. That's why B&R's Edge Controller features multiple layers of protection against cyber threats.

The Edge Controller is based on SUSE Linux Enterprise Server, which offers numerous security certificates and features. These include a UEFI secure boot protocol, self-configuring firewalls, a specially hardened operating system, LDAP, TLS encryption and a Trusted Platform Module 2.0 for setting up a trusted computing platform. Where necessary, an SUSE antivirus software can also be installed on the Edge Controller.

Long Term Service Pack Support (LTSS) from SUSE is available, offering five years of support for service packs and up to 13 years of support for major versions. These measures achieve a product life cycle that meets the real demands of industrial applications.

B&R provides monthly operating system updates to ensure long-term security. Updates are subjected to extensive testing prior to distribution to ensure that no Edge Controller functions are negatively affected.

Remote diagnostics
The Edge Controller offers convenient, comprehensive diagnostics with the integrated, web-based System Diagnostics Manager. Users are provided extensive information, such as the status of trend data forwarding, details about MariaDB server installation, current availability of the DNS server, port status or external port scans, complete documentation of the system software and much more. The configuration overview showing open and required ports is especially helpful during integration into the company network.

The system software on the Edge Controller is released along with a defined operating system version. Following a new installation or update, the CheckInstallation report allows you to verify that all applications, libraries and packages have been installed correctly on the device. This minimizes the risk of unintended changes.

Remote access
B&R's Secure Remote Maintenance solution makes it simple to diagnose and maintain the Edge Controller. This is done via a certificate-secured and encrypted VPN connection between the Edge Controller and a gateway (GateManager). Alternatively, an external device, the SiteManager, can be connected to the Edge Controller.

A continuous connection can be set up via drag-and-drop and does not require any special IT know-how. Routing, firewalls or VPN tunnel configurations are unnecessary. The connection established in the event of remote maintenance does not interrupt an ongoing continuous data connection.

Highlights

➔ Hardened operating system
➔ Trusted Platform Module 2.0
➔ Typical product lifecycle 8 years

TLS 1.2

Connection via MQTT

The Edge Controller offers numerous communication options, making it easy to connect with third-party devices and systems.

Shop floor communication can occur via Profibus DP, ProfiNET, ANSL or Modbus TCP to collect real-time data from all different machines and systems.

Cloud communication / Device services
For communication with higher-level systems, an OPC UA server and client as well as an MQTT client are included on the Edge Controller as standard features.

Its small code footprint and low bandwidth requirements have established MQTT as the standard protocol for cloud service providers. The event-based push approach of MQTT differs from the request/response approach of the HTTP protocol. It is data-agnostic, meaning that it can be used for all types of data. It works on top of TCP and transmissions are encrypted via SSL/TLS.

An MQTT client block enables the Edge Controller's individual control modules to send data directly to the cloud. The user only needs to specify in the respective control module which data should be sent to the cloud.
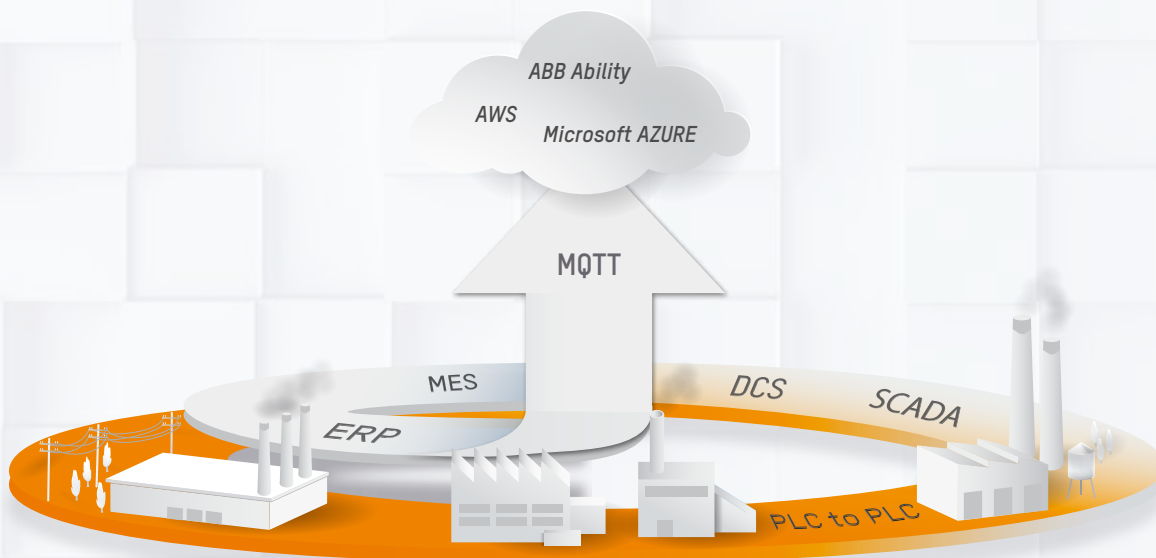
Highlights

➜ SSL/TLS encryption
➜ Easy cloud connection via MQTT
➜ All commonly used fieldbus systems
   supported

Cloud architecture

Standalone solution

As a standalone solution, the Edge Controller allows network data to be collected and processed more securely and inexpensively. In this case, the device is used for data acquisition, analysis and orchestration, so the top priorities are latency and real-time data processing for analysis.

**With a cloud connection**

The Edge Controller collects data and sends it to the cloud using the MQTT protocol. Data analysis occurs in the cloud over long sampling periods, and huge volumes of data (big data) must be processed. The results of the analysis are then used to optimize manufacturing system performance. Changes to parameters and setpoints are returned to the Edge Controller via the MQTT protocol.

Highlights

➜ Adapt to any requirement
➜ Flexible and scalable
➜ Secure MQTT communication

Communication between Edge Controllers

Edge Controllers are also able to communicate with one another in real-time, forming what is known as a fog architecture. Each of the Edge Controllers can also exchange data with the cloud.

Edge controller

FOG
COMPUTING

Edge controller

Edge controller
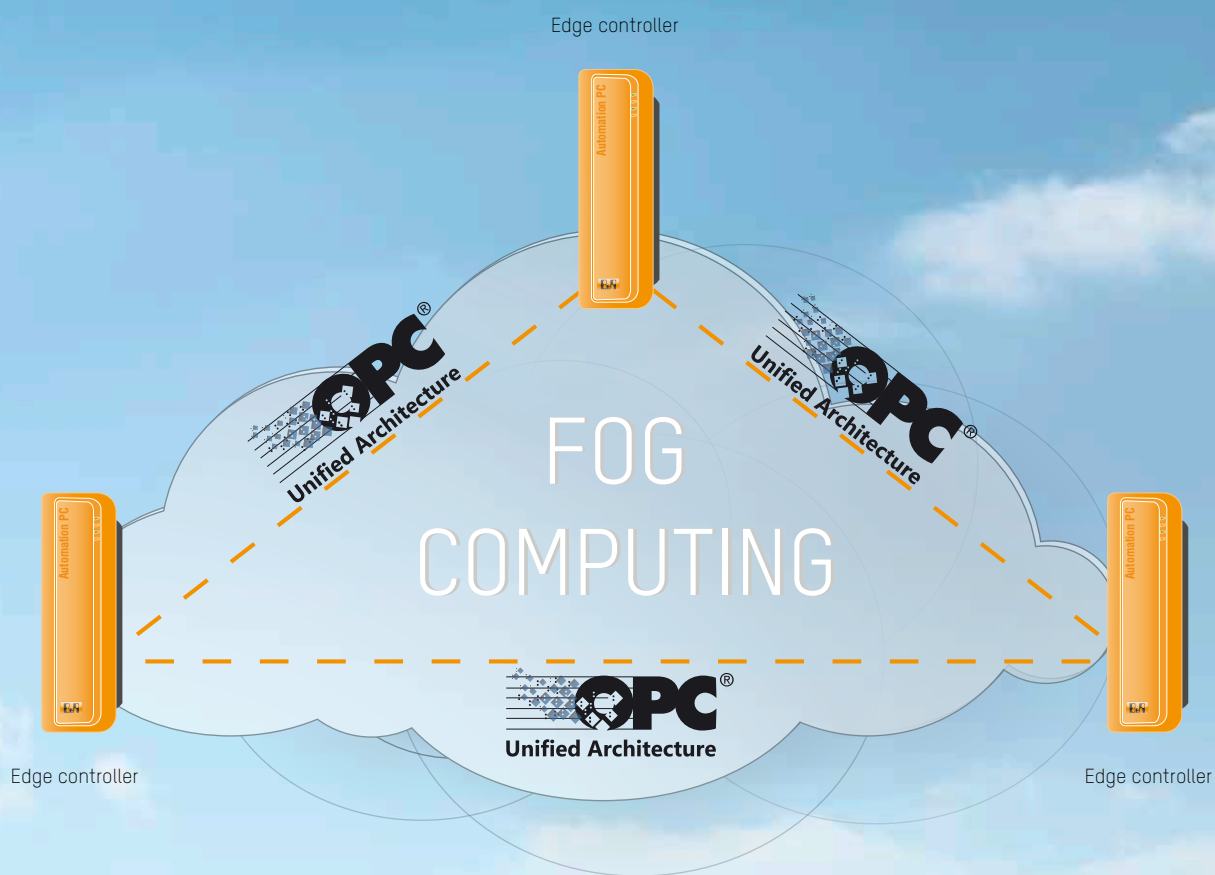
Edge controller

Edge Controllers are able to communicate with one another in real-time, forming a fog architecture.

Integrated automation
Global presence
Solid partnership

ETHERNET
POWERLINK

open
SAFETY