

# THE NEW FREEDOM IN ENGINEERING: THE ctrlX AUTOMATION PLATFORM

**Nowadays, mechanical engineering means one thing: software development. In some machines, software accounts for over 50 percent of value creation. Software determines the flexibility, connectivity, availability and ease of operation of machines and systems. Automation technology must fit into information technology with as little effort as possible. This is much easier if automation systems use the same communication standards and programming environments as the IT world. This is why Bosch Rexroth has developed a new automation platform which combines automation, information technology and the Internet of Things in a completely open system.**

ctrlX AUTOMATION is based on an entirely new, open software architecture with app technology. A central result: the engineering outlay for new machines is reduced by between 30 and 50 percent. For a long time, automation-specific approaches and programs were adequate in mechanical engineering. As a result of connectivity with other machines and IT, more and more tasks outside the actual motion sequences must now be performed.

For example: robotics and handling are key disciplines in the manufacturing industry as a way of optimizing recurrent work processes, conserving resources and increasing reproducibility. However, they are the tasks which are most difficult to standardize in automation. It is often the case that Cartesian systems, delta or SCARA robots must be adapted individually to the particular work pieces and processes. This ties up considerable engineering resources which are required elsewhere. The lack of specialists in the area of PLC and G-Code programming further exacerbates the situation.

## AUTOMATION AND ECOSYSTEM ACCORDING TO THE SMARTPHONE MODEL

The new ctrlX AUTOMATION platform is the response to this and other challenges. Bosch Rexroth is entering new territory here. “When we started developing the system, we asked ourselves what automation would be like if it were reinvented by Google, Apple or some other digital company,” explained Steffen Winkler, CSO of Bosch Rexroth’s Automation & Electrification Solutions Business Unit. “The answer is obvious. Young specialists and developers are socialized with the Internet and smartphones. Our model was the smartphone with its highly integrated functions and flexible app technology which makes it easy for users to personalize their devices.”

Bosch Rexroth relies on an open software architecture with flexible app technology and the ability to work in a wide range of IT programming languages. Accordingly, ctrlX AUTOMATION is based on a completely new software and engineering approach and means the end of proprietary structures and systems. The automation platform includes all necessary software and hardware components for complete system solutions: high-performance control systems, compact drives,

safety, I/O modules and HMIs. The software flexibly takes over all tasks from simple handling applications to high-performance motion control. The system hardware and software are highly scalable.

In order to allow a significantly high degree of individualization, ctrlX AUTOMATION was developed as an open platform. This results in a new ecosystem for industrial applications. Software developers are now able to develop and make available industrial applications in all popular programming languages – quickly, easily and flexibly. Completely new degrees of freedom arise, making it possible to produce and individually combine functions in virtually any programming language while protecting know-how.

### THREE PILLARS FOR SOUND FOUNDATIONS

The new ctrlX CORE control hardware forms the basis for ctrlX AUTOMATION's broad range of applications. A new generation of multicore processors provides sufficient computing power for all automation tasks – from PLC applications and motion control to CNC and robotics. These high-performance CPUs can be integrated into embedded PCs (ctrlX CORE), into industrial PCs (ctrlX IPC) or directly into drives (ctrlX DRIVE). At the same time, there is ample performance to meet IT or IoT requirements when it comes to such a control system – requirements which are growing as a result of increasing digitalization and automation.

The ctrlX DRIVE system with an integrated control system opens up new degrees of freedom for innovative solutions. It is regarded as the world's most compact modular drive system and represents a new generation of servo drives. The drive combines optimum dynamics with maximum precision of position, speed and torque values. Not only does it offer space-saving dimensions and maximum scalability, it also boasts advantages such as virtually unlimited combination options for users, sophisticated engineering tools and high energy efficiency.



ctrlX DRIVE responds to the ongoing automation challenge of making smaller and smaller machines and control cabinets. The system is up to 50 percent more compact than the previous range and competitors' products. The integrated DC-bus connector technology reduces additional components and allows energy balancing via the DC bus. This optimizes power consumption and reduces power loss. With the end-to-end supply unit concept with single and dual-axis converters as well as power and regenerative supply units, users can combine any configurations. The ctrlX CORE control system can also be integrated with no need for additional space and used as a fully-fledged automation solution.

In the fully configured standard drive, the STO safety function is available as a standard feature. The configurable ctrlX DRIVEplus also allows the use of additional cards for SafeMotion, multi-encoders and I/O extensions. Demanding process control systems often require large power reserves, which the PC-based ctrlX IPC automation solution provides – flexibly and scalably. The modular ctrlX CORE control platform can be integrated into the open ctrlX IPC portfolio via the PCIe

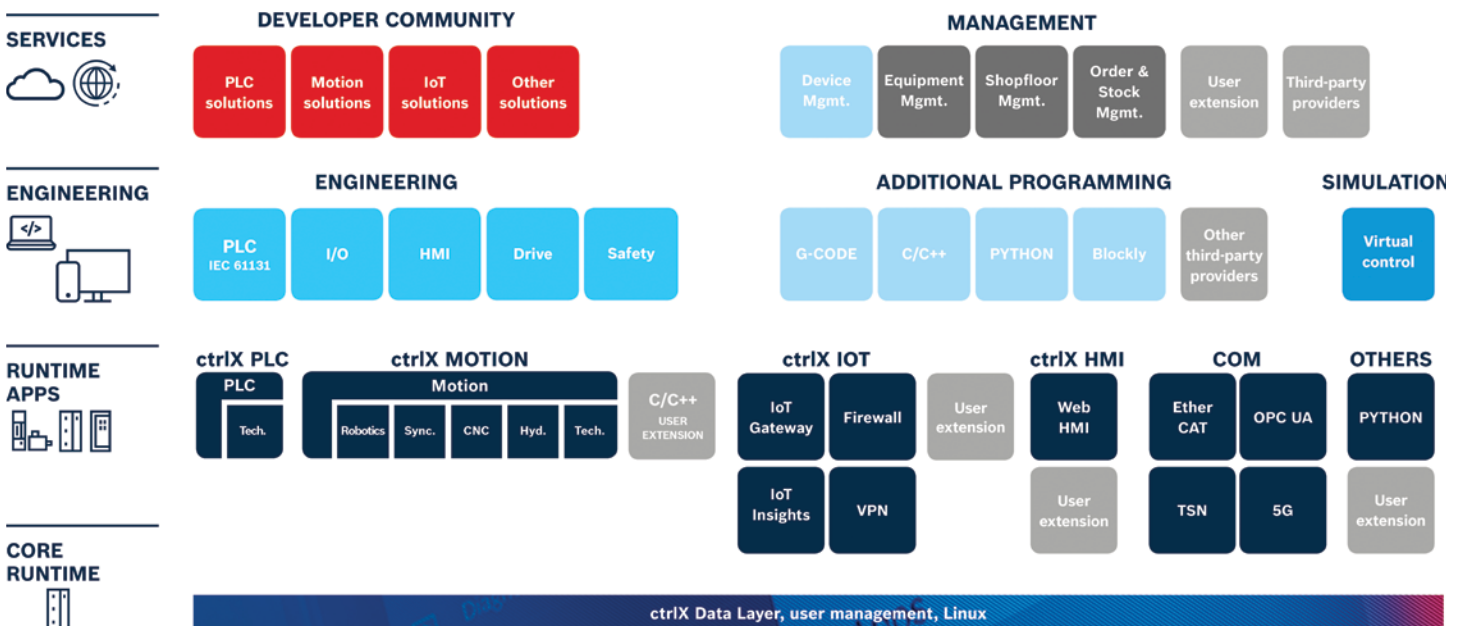
interface. This means that the system can be extended by adding standard components or open source software. Numerous interfaces are available for communication. ctrlX IPC forms the ideal interface between the field level and cloud, and ensures reliable and secure transmission of large quantities of data. The ctrlX CORE CPU is thus ideal for PC-based automation or edge solutions.

## MAXIMUM INDEPENDENCE WHEN PROGRAMMING

Because ctrlX AUTOMATION requires no special PC software, it can be commissioned and learned with ease. Thanks to the web-based system, users are guided logically through the basic configuration on HTML pages. They can work with the familiar automation languages in accordance with IEC 61131 or G-Code in order to create PLCopen processes in an efficient manner. However, more and more young specialists are not trained in these automation programming languages. In light of this, Bosch Rexroth allows individual functions to be created in programming languages like JavaScript, Python, low code programming languages, C languages or the open source software Node-RED while protecting know-how in the process.

The app technology in ctrlX WORKS is a key part of ctrlX AUTOMATION. Standard functions such as a data gateway to production planning systems or the IT connection, firewall, VPN client or OPC UA are available as ready-to-use apps on the control system and do not need to be programmed separately. Developers can select the required apps from the ctrlX WORKS software toolbox or use any open source software.

### ctrlX WORKS – The software and engineering toolbox



They can also program applications themselves or download third-party apps, e.g. from the GitHub development platform. With more than ten million registered users, GitHub is an established global developer community. It offers machine manufacturers and end users access to a virtually unlimited library of written functions, e.g. for handling and robotics. With Git – the basic technology for version management – Bosch Rexroth also offers a version control facility and collaborative engineering.

Bosch Rexroth also provides numerous pre-defined functions for specific requirements. These include features, which improve the productivity of handling systems and robots. With ctrlX COREvirtual, ctrlX WORKS is available in completely virtual form so that programming can be carried out even without hardware. As a result, users can develop and test new handling systems without blocking the machines and stations to be automated. With the new possibilities, users reduce their engineering outlay considerably and can set themselves apart from competitors with functions they have developed themselves.

## CENTRAL ACCESS TO REAL-TIME AND NON-REAL-TIME DATA

ctrlX AUTOMATION is based on the Linux real-time operating system, probably the most stable and secure operating system of its kind. Thanks to the operating system's container technology, programmers can reproduce all functions and applications with separate apps and combine them as required.

The ctrlX Data Layer is an important architectural element. It ensures central, authorized access to all real-time and non-real-time data for the installed apps. Data generated by an app can be used by other apps as well. As the central nervous system, the ctrlX Data Layer receives and distributes all data and values and gives them clear addresses. Measurements show that up to eight million accesses per second are possible. The automation platform also generates a real-time process image and thus puts in place everything needed for machine learning applications for example.

The new control generation is thus completely different from previous industrial control systems. After all, users never had access to core functions, and they have to execute applications on additional hardware either individually or subsequently. At the same time, data are stored at different locations and need to be configured in order to be exchanged – a time-consuming process. This increases complexity when it comes to interfaces and data exchange and significantly increases the engineering outlay. With the ctrlX Data Layer, it is immaterial whether applications are installed as runtime apps on a ctrlX CORE or are executed as engineering apps and services on a PC, smart device or in the cloud.

## OPEN COMMUNICATION THANKS TO CONNECTIVITY

ctrlX AUTOMATION is currently the most connectible, future-proof system available on the market. It takes care of all automation with absolute openness. In field communication, Bosch Rexroth relies on established standards with ctrlX AUTOMATION. The control system master interfaces support primarily EtherCAT and, possibly Profinet, Ethernet/IP and Sercos. Using digital nameplates, the intelligent automation components and peripheral devices identify themselves automatically to the control system. This significantly reduces the commissioning outlay.

For communication with IT and the IoT, the new control systems also offer a wide range of installed protocols and standards. The platform supports more than 30 standards and protocols for data exchange with IT systems. ctrlX AUTOMATION is also ready for future communication standards such as TSN and 5G.

## INTEGRATED NORM-COMPLIANT SAFETY TECHNOLOGY

Safety too is a key aspect with ctrlX AUTOMATION. The integrated ctrlX SAFETY technology combines safe logic and motion, and simplifies the implementation of norm-compliant machine safety. Norm-compliant safety technology is standard for machine manufacturers. With ctrlX SAFETY, companies can stand out from the competition in this area too. After all, a safety reaction which is ten times quicker than that with conventional fieldbuses is possible. Developers can set machine movements much more dynamically and with greater safety – thus increasing productivity.

## CONCLUSION

ctrlX AUTOMATION reduces the engineering outlay and the space required for machine manufacturers and integrators by between 30 and 50 percent – and increases productivity by up to ten percent. With the automation platform from Bosch Rexroth, users can put individual solutions into operation much more quickly than before and program and provide functions easily and flexibly in any language. This reduces outlay and conserves resources.



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