Edge Computing

Automation meets IT with CDP Studio
Build fast, distributed control systems on industrial computers.

- No hardware lock-in
- Integrated with major remote i/o vendors
- Linux embedded devices
- Distributed systems
- IIoT data processing

Summary

Industry 4.0, IIOT, new intelligent sensors and data volume, has led to an increasing overlap between industrial IT and industrial automation. Industrial computers are already used for applications where additional processing, number crunching, logging, vision recognition or simply protocol conversion is required. A new trend is the introduction of small price competitive controllers with a Linux application environment.

Processing power and flexibility beyond the PLC is required closer to the machine and sensors to meet the new industry challenges, it is called Edge Computing.

CDP Studio IDE (Integrated Development Environment) is a comprehensive tool for developing distributed automation and control systems on industrial computers, as well as small controllers.

Distributed edge power

There is a growing volume of new data, like complex data from intelligent devices or even video, mainly generated due to increased need for more production related data to MES (Manufacturing Execution System) towards Industry 4.0, ZDM (Zero Defect manufacturing) etc and CBM (Condition Based Maintenance). CBM is about reducing unplanned downtime and remove unnecessary maintenance, while MES is about connecting the factory together for better production monitoring and planning. This is
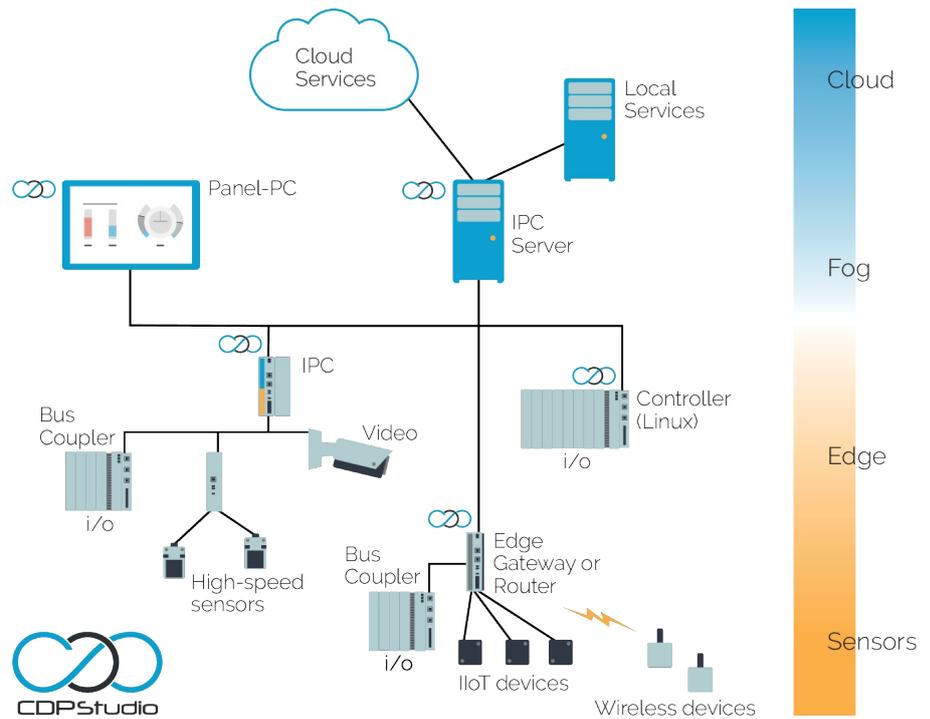
where solutions coming from the IT side of the industry makes sense, as this is more data processing than pure automation. Still, putting a PC next to the PLC with a collection of unrelated software tools does not work either, it is messy, unreliable, and expensive to develop and maintain. This is where applications built with development systems like CDP Studio makes a substantial difference; the flexibility and power of IT tools combined with automation functionality, structure and real-time capability.

Figure 1 illustrates the different elements discussed with the edge computing nodes marked with the CDP logo.

An edge gateway shape and process data to reduce bandwidth, standardise data properties and provides services as wireless connectivity and protocol conversion.

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The next layer is an IPC as sufficient power to run extensive processing of data is required. Data intensive sensors like vision, vibration and sound would interface directly here. Real-time transformation of high-speed data into data-sets or virtual values that is digestible by the higher-level analytics services, either in the cloud or fog (local at company/enterprise level). The task is to keep the essential information value, while reducing most of the bandwidth. Aircraft engine vendors has been doing this for years; processing monitoring data locally and sending the trending data via low speed satellite links back to the factory while the aircraft is inflight.

The term Fog computing is often used for the upper level of edge computing, as your industrial computer (or server) is still relatively close to the production machinery, but do more powerful computing. Fog computing may be the edge of the analytics systems, where some of the applications are tightly linked to the higher-level system or cloud services. These border lines do have grey zones.

Powered by Linux (and Windows)

Industrial computers (IPC) are entering the industry as prices have dropped and confidence has been improved. These open up a new world of possibilities as applications can be built on general operating systems. CDP Studio is addressing this new trend; supporting both Linux and Windows run-time systems. You may even mix Windows and Linux in the same system by e.g. run Linux on the controllers, but use Windows panel-PCs for the operator displays.

The industrial computer (IPC) is a rather generic term, but ranging from powerful industrial servers to small DIN-rail modules. The small ones are very well suited for edge computing. For headless (no screen) computers, Linux is now finding more and more acceptance. Linux is already powering most of the worlds webservers and cloud services, so finding use in "Fog computing" should not be a surprise. IPCs are now available from multiple vendors, and is posing competition to the big "Automation companies". The IPC for edge computing is just a flexible controller with one or two ethernet interfaces. The hardware vendor lock-in has completely disappeared as applications run on top of standard operating systems. Remote i/o from the automation world hooks nicely up with Linux computers from the IT world, typically via Modbus TCP. CDP Studio comes with a choice of several pre-configured buscouplers and i/o modules from different of vendors like Phoenix Contact, Wago, Weidmüller, and Beckhoff.

A special breed of IPCs, is the new remote i/o controllers from companies like Wago (PFC 100/200) and Phoenix Contact (PLCnext), which in essence are Linux boxes where third-party applications may be added in a protected environment. CDP Studio has taken this a step further, as you will have direct access to the bus i/o on these systems. Adding i/o is a matter of drag and drop, no need to dig into addresses or registers.

In a similar way has industrial communication vendors added a Linux environment to their edge routers; the Cisco IR829/809 and the MRO/MRX/SCR series from INSYS icom are typical examples. As CDP applications run with a small footprint, even a humble router can do additional processing, saving hardware. Routers are also an important part of network security and management. Data flowing to and from IIoT devices need protection and restriction, and the first layer of protection is in the edge gateway.

A new trend is also what you could call Raspberry Pi derivatives, the Raspberry Pi is a fantastic device, but not really suited for the industrial environment. The Revolution Pi from Kunbus and the MyPi Edge Gateway from Embedded Micro Technology, are both examples of using the Raspberry Pi compute module in an industrial rugged device. This would have been unthinkable just a few years ago.

Run-time applications built with CDP Studio works on most of the above devices, which mean you can easily get access to device specific interfaces or hardware functions.

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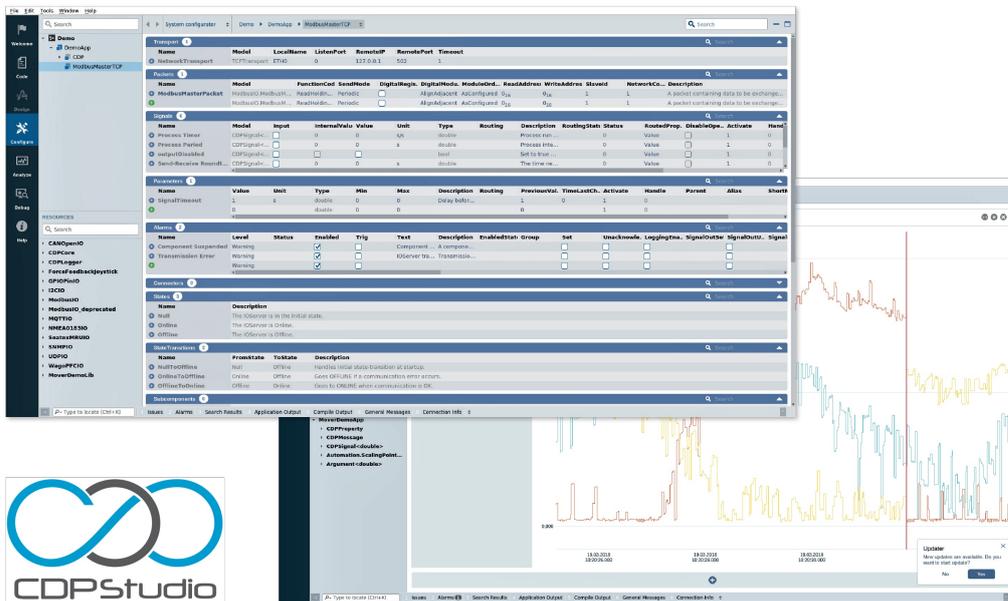
Efficient control system development

The data processing in the edge/fog is where the flexibility of the IT world is useful, a lot of the resources are even open source. The solution is however not complete without some control system functionality. Pre-processing of sensor data also imply losing data resolution, one of the most important additional functions for the edge computing is to provide means for high resolution logging to retrieve "crash-data" for detailed incident analysis. The processing of sensor data may also result in warnings, alarms or even actions, so automation protocols, control loops, and remote i/o is relevant as well. Finally, you probably need a local display showing real-time state of the local system or any warnings. All this comes ready built into CDP Studio; after all it is a control system design platform.

The freedom and power of software based control systems is usable in industrial applications only if the development process is structured and the solution as such is possible to maintain and modify for the lifetime of the system. CDP Studio has addressed these challenges by combining a library of software components with a graphical parameter driven configuration of interfaces and signal routing. There is an extensive library of common interface protocols and functions for signal processing including functions like a PID regulator and Kalman filter. Additional third-party libraries may be imported to handle specific functionality. GUI design is fully integrated in the system and comes with a rich library of pre-made customizable widgets, themes and it is easy to upload your own.

Automation integrators typically have one or more specialist areas, or application verticals, where deep application knowledge and custom designed solutions is the business value. These solutions may involve calculations and algorithms coming from years of experience. With CDP Studio you can transform your application knowledge into function components as building blocks in your system design. It does not matter if your speciality is "Active Heave Compensated offshore cranes" or "High speed sampling of vibrations data", your knowledge can be distilled into your own library of CDP Components and reused as configurable functions without modifying the component C++ code.

The framework of a development tool like CDP Studio is important, as the developers should be "helped" into a common design structure, to safeguard quality and make the solutions better maintainable. Team collaboration is also a part of this to enable sharing and re-use of components, as well as speeding up large projects. A comprehensive tool like CDP Studio, where the complete tool is released and updated as one package, is closer to an industrial mindset than handling a suite of independent tools. Industrial computing still differs to IT systems by longer update cycles and expected lifetime.

CDP based systems are used from dynamic real-time applications in the maritime industry, running thruster control on offshore supply ships, process systems and to other mission critical systems. This heritage combined with the IT open source world is the real power of CDP Studio: Automation meets IT.