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Recommendations for the deployment of third-party servo drives with EtherNet/IP CIP Sync™

Whitepaper

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Through the integration of EtherNet/IP CIP Sync into third-party servo drives, it is possible to fulfill the requirements of the machine manufacturers for a rapid implementation of complex motion control applications. In this whitepaper, an explanation is provided on how EtherNet/IP CIP Sync-capable third-party devices are integrated into the machine control, and in which cases the deployment of CIP Sync servo drives is recommended. In addition, the integration of the servo drive simco® drive 2 into the Rockwell control environment Studio5000 is shown as an example.

Machine manufacturers from different industrial segments, such as machine tools and packaging machines, joining and assembly technology, as well as the electronics industry, have high standards for dynamic and precise motion control applications in real-time. In this respect, it may be necessary to move axes synchronously to each other, or to execute motion profiles very precisely, for example. To implement this as efficiently as possible in the machine, machine controls are equipped with technology functions. There are functions for a range of different applications in the machine, e.g. flying saw or electronic cam disc. These technology functions constitute prepared, parameterizable components by means of which the respective application can be programmed on a time-saving basis.
The individual servo drives are also connected using prepared axial components. In addition to the rapid configuration of complex motion control applications, this architecture also enables the necessary low cycle time as well as synchronous communication between the machine control and the servo drives. However, depending on the fieldbus used in the machine, it may be the case that third-party servo drives are not permitted in the architecture described. In such cases, if the machine manufacturer wishes to use a third-party drive due to its product advantages – such as its power density, the manufacturer will face major challenges.

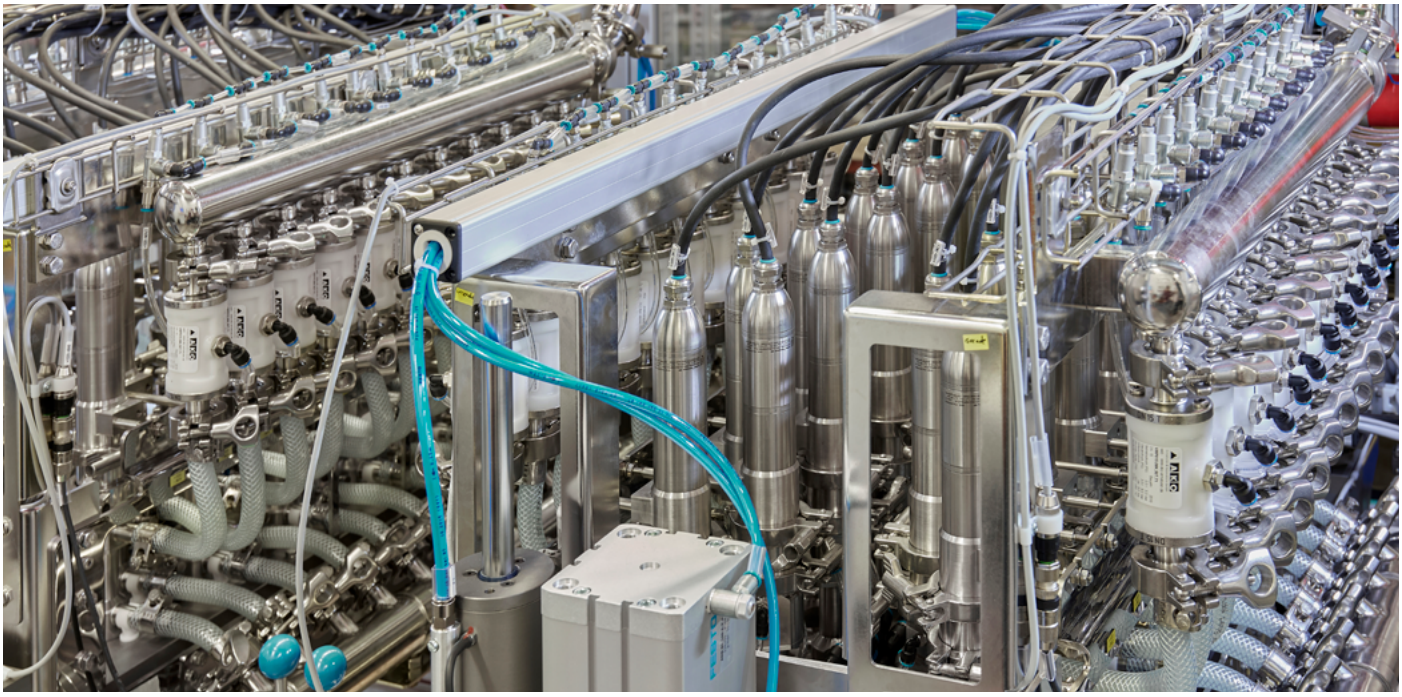

Figure 1: Filling and dosing applications in packaging machines are an area with high requirements in terms of high-precision and dynamic control [1].

The CIP Network Protocol for demanding motion control applications

The media-independent network protocol Common Industrial Protocol (CIP) encompasses a full range of messages and services for communication via networks in the industrial environment [2].
If this protocol is used for data communication via the fieldbus in the machine, the CIP Motion component serves the rapid connection and configuration of the individual axes. By means of the CIP Sync component, a time synchronization can be implemented between the servo drives and the machine control.
By using CIP Sync and CIP Motion in the industrial fieldbus EtherNet/IP – together with the technology components stored in the machine control – highly dynamic and precise motion control applications can be implemented in the machine in a short time.

Integration of EtherNet/IP CIP Sync-capable third-party devices into the machine control

The CIP Motion component, however, is the reason for the lack of compatibility of the third-party providers, as this component is not available to them for the relevant machine control for integration into their servo drives. Despite this, by integrating CIP Sync into the servo drive and supplying a command set and a coupling function block, it is possible to provide a functional and performance scope that approaches that of EtherNet/IP CIP Motion.

To this end, what is referred to as the virtual axis can be used. This is generally used as a master for other axes or for simulation purposes, and is not initially suitable for controlling servo drives. To enable this, the virtual axis must be made capable of communicating with a servo drive via a fieldbus interface.
For this, a coupling function block must be developed by the third-party manufacturer that carries out the communication tasks between the servo drive and the virtual axis. Since the virtual axis was not developed for operation with real drives, a few other functions required to control the servo drive are still lacking. These include enable and error reset functions. These are also to be developed and provided by the third-party device manufacturer.
The other technology and motion functions available in the control can be used unchanged.

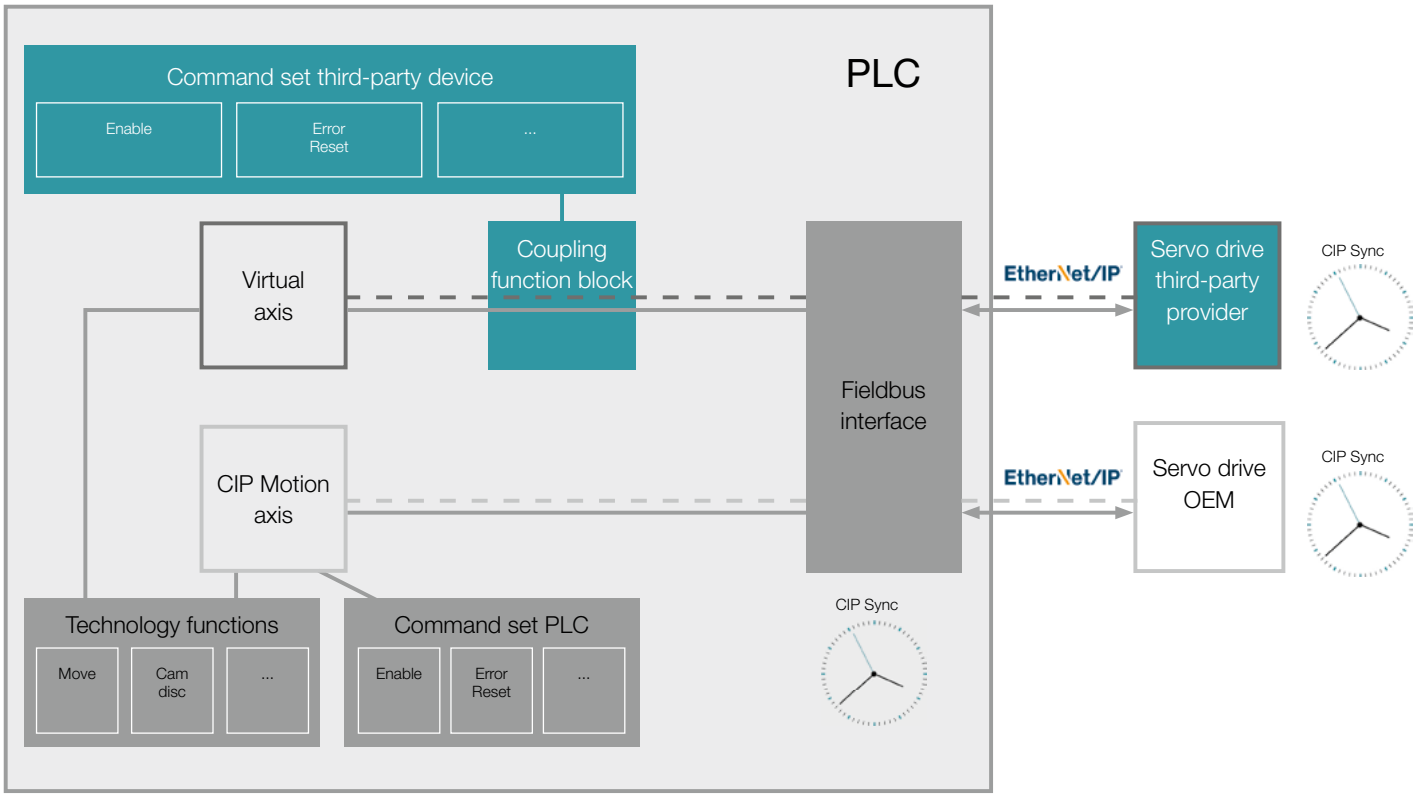

Figure 2: The integration of a command set and a coupling function block means that the technology functions of the machine control (PLC) can also be used in connection with third-party servo drives.

Recommendations for the deployment of EtherNet/IP CIP Sync

In addition to the EtherNet/IP CIP Sync and CIP Motion variants described, third-party servo drives can also be used without a synchronization mechanism and a coupling function block. In this case, only a command set of the third-party manufacturer has to be supplied, which is integrated into the machine control and therefore enables simple, non-synchronized point-to-point communication via EtherNet/IP – referred to hereinafter as EtherNet/IP I/O – between the servo drive and the machine control. Exactly when EtherNet/IP CIP Sync or CIP Motion or EtherNet/IP I/O are to be used depends on the motion control application to be implemented. The key features that distinguish the variants from each other are listed in table 1.

Application features	EtherNet/IP I/O	EtherNet/IP CIP Sync	EtherNet/IP CIP Motion
Integration workload servo drive	moderate	moderate, knowledge of virtual axis required	low
Use of the PLC motion functions	X	✓	✓
Use of the PLC technology functions	X	✓	✓
Interface user program	fully specific to the third-party manufacturer	marginally specific to the third-party manufacturer	not specific to the third-party manufacturer
Compatibility with PLC	simple PLC	Motion Control PLC	Motion Control PLC
Compatibility with PLC software	third-party manufacturer-dependent	may not be available for older versions	complete

Table 1: Distinguishing features between EtherNet/IP I/O, CIP Sync and CIP Motion as the basis for their deployment

The implementation of applications using EtherNet/IP I/O is appropriate for simple axis movements, such as for controlling adjustment or feed axes.
The integration can be completed relatively quickly using the command set provided by the third-party provider. For such applications, no technology functions are generally required and the command set of the third-party provider only needs a low storage capacity, so that simple machine controls can be used.

If comprehensive motion control applications with several axes are to be implemented, the use of EtherNet/IP CIP Sync is to be recommended in the case of third-party servo drives, as long as CIP Motion is not available for the preferred drive system. Isochronous communication is enabled by means of CIP Sync and the coupling function block, so that the technology functions of the PLC can be used in full. This also applies to the motion functions of the PLC, so that the machine control can be programmed in the usual way and the command set of the third-party provider is significantly smaller than in the case of the I/O variant. Only the control commands such as homing functions or enable commands are specific to the third-party manufacturer. However, due to the use of the virtual axis, a further step is required with the integration of the servo drive. It should also be checked as to whether the use of the virtual axis is supported by the software version of the machine control used.

If a mixed operation of simple and demanding motion control modules is planned in the machine, it may be sensible to develop all the axes according to the CIP Sync mechanism. In this way, the axis integration approach is identical and the reduced command set is sufficient, as the motion components of the control can be used.

Example: Integration of the servo drive simco® drive 2 into a Rockwell control using EtherNet/IP CIP Sync

Figure 3 shows all the relevant components to implement an EtherNet/IP CIP Sync connection between a simco® drive 2 and a Rockwell control. An EDS file is available for integrating the simco® drive 2 into the Rockwell control environment Studio5000 and communication via EtherNet/IP. The simco® drive 2 appears in the fieldbus structure tree along with the other devices connected to the fieldbus (cf. point 1 and 2 in figure 3). The integration of the manufacturer-specific command set for the simco® drive 2 takes place using Add-On Instructions (AOI) provided by WITTENSTEIN cyber motor (cf. point 3 in figure 3). Additionally, the coupling function block is delivered by WITTENSTEIN cyber motor, which must be integrated into the program flow (cf. point 5 in figure 3). A Rockwell servo drive is connected to the control by means of a CIP drive axis. In contrast to this procedure, the simco® drive 2 is coupled with a virtual axis in Studio5000 (cf. point 4 in figure 3).

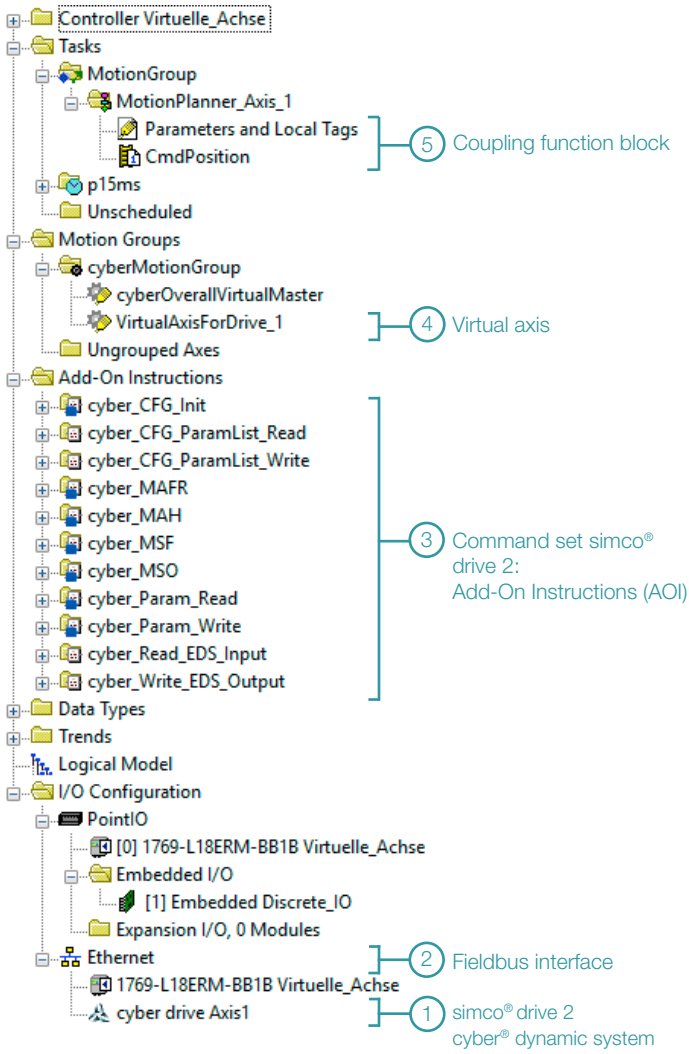

Figure 3: Structure tree of an example program in Studio5000

Conclusion

With the integration of EtherNet/IP CIP Sync into third-party servo drives, a functional and performance scope can be achieved that corresponds approximately to that of EtherNet/IP CIP Motion. Together with the provision of a further, simple command set to implement an EtherNet/IP I/O communication, the complete range of integration options is available to the machine manufacturer in order to realize both simple and complex motion control applications with third-party servo drives in a short time. Due to their EtherNet/IP CIP Sync interface and an I/O command set provided, the second generation of the servo drive simco® drive as well as the motor-integrated variants of the cyber® dynamic system offer these diverse integration options, therefore providing for maximum flexibility in the machine design and a time-saving during the machine programming.

Sources

[1] WITTENSTEIN cyber motor GmbH
[2] EtherNet/IP ODVA TECHNOLOGY OVERVIEW SERIES: CIP on Ethernet Technology, March 2016

Further links

Website: WITTENSTEIN cyber motor GmbH

Microsite: The new generation of the small servo drive system

Youtube: Start-up video EtherNet/IP CIP Sync

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