CORE
TECHNOLOGIES

Advantage™

Platform-based control system design service

- **Flexible**
- **Cost-effective**
- **Powerful**

An alternative to custom controller design

Modern automation industry is faced by a number of challenges. The market demands high loop rates, advanced control algorithms and tight integration into the enterprise network.

Programmable logic controllers (PLCs) are useful only for relatively simple controlling tasks.

Design of a custom controller from the scratch can address these problems, but it is costly and time-consuming.

The better approach is to design a controller on the basis of a motion control platform based on FPGA (a chip with reprogrammable hardware structure). This approach has several advantages:

- **ultimate freedom** (implement any control algorithms and interfaces)
- **high performance**
- **flexibility** (reprogrammable at any time without costly hardware redesign)

1-CORE Technologies provides semi-custom controller design services based on the **Advantage** FPGA-based platform.

Overview

Advantage is a flexible control engineering platform designed to perform advanced control functions where standard PLCs (programmable logic controllers) fail. It is a cost-effective alternative for custom controller design.

The heart of the Advantage platform is an FPGA-based SoC (system-on-chip) that is assembled using the pre-designed IP (intellectual property) component library. The Advantage platform flexibility allows the system integrator to utilize it for any application **with no restrictions**.

This approach makes it possible to design control systems of any complexity while maintaining relatively short time-to-market and reasonable project costs. In addition, it allows the designer to use virtually any number of bus protocols and to control any number of drives simultaneously.

Our services

- **Platform-based semi-custom controller design** (based on Advantage plaftorm). A controller can be implemented on the basis of a ready off-the-shelf board (further reducing expenses), or on the basis of a specialy designed board targeted to a particular application.
- **Turnkey design of an entire automation system**, combining off-the-shelf components with Advangate-based controllers to achieve maximum effectiveness with low costs.

Features

Flexible

FPGA-based core can be configured to perform any set of tasks. This approach provides ultimate freedom (contrary to the conventional CPU-based controllers):

- Employ any control algorithms (including resource-intensive).
- Sustain any system-level changes without costly hardware replacement (whereas standard products can turn out to be unusable in the new environment).

Streamlined

Implementing industry-standard **embedded CPU core** on the basis of an FPGA allows the developer to use **standard programming languages and development methods**.

Furthermore, Advantage-based controller can use any industry-standard bus protocol (Modbus, Profibus, PROFINET, Ethernet Powerlink and other).

Powerful

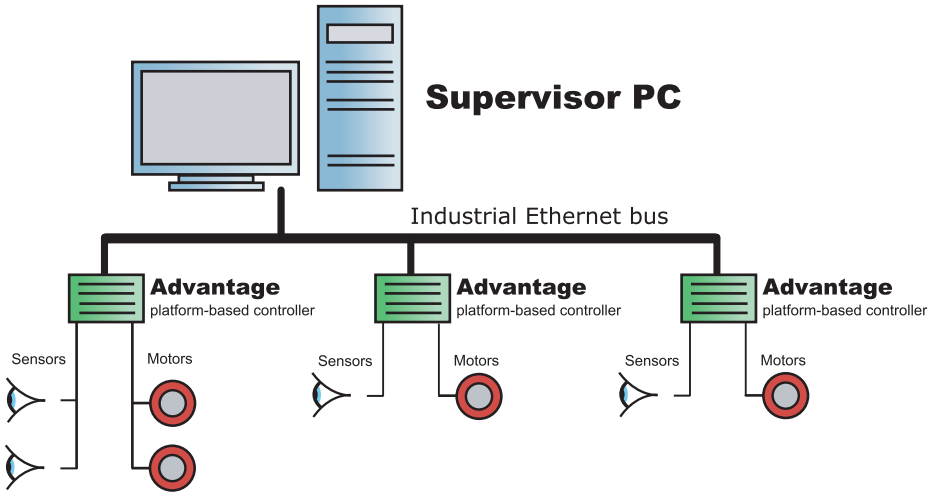
- Can be used for **precision motion control** applications.
- Highly **synchronous motion** can be achieved.
- Use any filters and control algorithms.

Cost-Effective

- Extensive use of the pre-designed components **reduces costs and time-to-market** as compared to from-the-scratch design.
- Our experience in the design of control systems helps to avoid common problems and **reduce overall costs**.

System Architecture

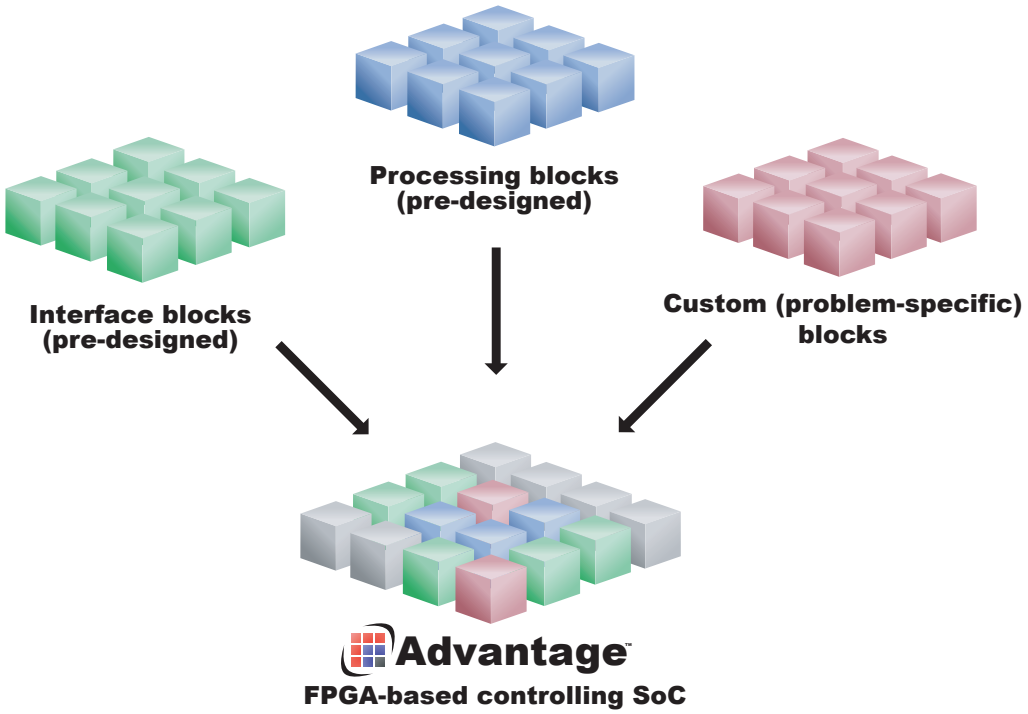
The Advantage-based controller is usually supervised by a master PC (industrial PC), but can also operate autonomously. A supervisor maintains control over slave Advantage-based devices via an industry-standard bus (several bus protocols can be implemented).



The core unit in the Advantage-based controller is an FPGA (field-programmable gate array) based SoC (system-on-chip) which can be loaded with the problem-specific controller design, assembled from the pre-designed standard components (interface modules, processing units) and the custom components created specifically for the certain task.

The Advantage-loaded FPGA can be placed both on a ready off-the-shelf board (reducing costs) and on a custom board (more targeted to the particular application).

The reprogrammability of the FPGA ensures smooth support process and ability to improve the device fucntionality without redesigning hardware.



Proven system modules

Advantage platform include a number of pre-designed modules for FPGA that are frequently used in control engineering.

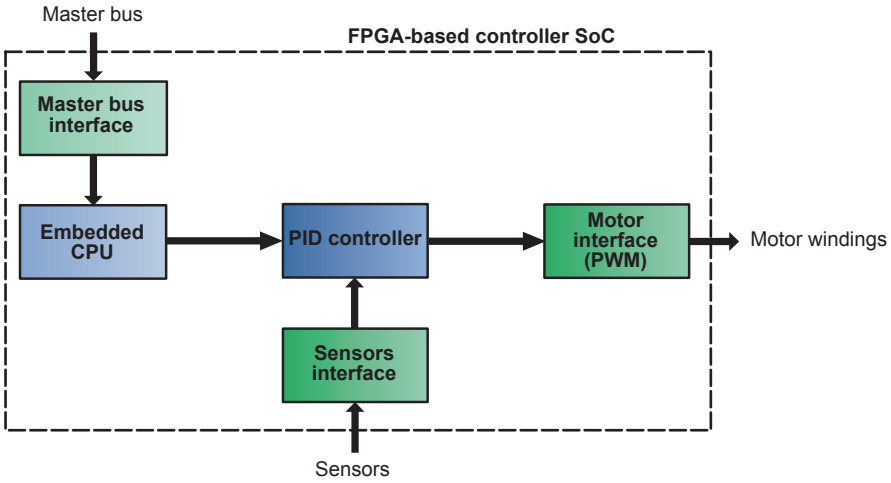
Embedded CPU core wrapper	Wraps a lot of open-source and proprietary CPU cores (see the next page for the list)
PID controller core (simple)	Compares generated value with the actual one and tries to eliminate difference by driving the output. Contains three terms: proportional, integral and differential
PID controller core (advanced)	Like previous, but the PID output is calculated on a small CPU core that makes it possible to utilize more advanced filtering.
CORDIC core	A coprocessor for trigonomethric function calculation. Useful when driving servo motors.
Industrial Ethernet interface core	Provides an interface to the master bus.
Incremental encoder interface core	Interfaces with the incremental sensors.
SPI interface core	SPI interface is commonly used to access ADCs (analog-to-digital converters).
UART interface core	General-purpose UART core is able to implement asynchronous interfaces such as RS-232, RS-422 or RS-485.

By using these pre-designed, pre-verified modules we are able to deliver control engineering solutions much faster than from-the-scratch design.

When we use any of our pre-designed modules in a project, you need not to obtain any additional license from us. However, in some cases you will need to obtain a license for a 3rd-party proprietary CPU core if you choose to use such a core.

Typical controller structure

A typical Advantage FPGA-based controller SoC includes an embedded CPU, a PID controller and certain modules to interface with sensors, motors and a master bus.



Embedded CPU core

An embedded CPU core receives commands from the master controller and generates designated actuator trajectories that are then used by the PID controller to drive the actuator's windings.

A CPU core fetches commands either from the internal FPGA memory or from the external Flash module. The software for the CPU is written using conventional development methods (like ladder logic or C programming language) and can be easily maintained.

A number of CPU options are available, depending on customer preferences and system requirements, ranging from tiny to large and powerful.

8-bit CPU cores	32-bit CPU cores
Xilinx PicoBlaze	Xilinx MicroBlaze
Lattice Semiconductor LatticeMico8	Altera Nios II
Open-source AVR compatible cores	Lattice Semiconductor LatticeMico32
	ARM-based Cortex-M1

Other CPU cores can also be utilized when necessary.

PID controller

A PID controller is a module that compares the designated actuator position and/or velocity with the actual one (obtained from the sensors), generating control signals for the motor. These control signals are calculated using the industry-standard PID (proportional-integral-derivative) algorithm.

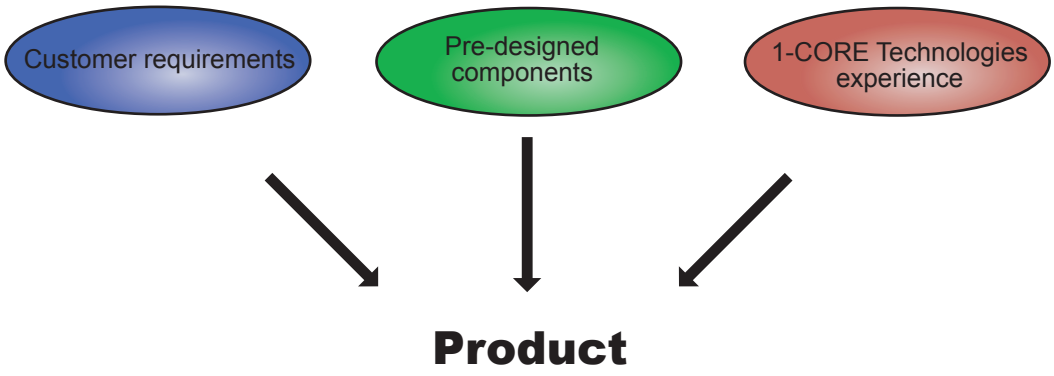
The Advantage platform presents two pre-designed PID controllers:

- a tiny hardwired PID controller, occupying less area;
- a more flexible PID controller based on small CPU core with a hardware multiplier.

Design flow

A typical design flow for an Advantage-based controller is presented below. When a customer contacts us, we proceed with the stage **I**, which puts no obligations on the Customer. Other stages are performed after all conditions have been negotiated.

I	We discuss the requirements with the Customer, perform necessary studies and prepare a formal requirements specification document. The price and schedule are also negotiated during this stage.
II	We develop the necessary hardware and software. This stage can be further divided into substages. All intermediate documents are available for review by the Customer at any time.
III	We perform internal verification and validation in order to ensure that the resulted design meets the requirements.
IV	The resulted design is tested using methods and checklists developed together with the Customer.



Contact us

Feel free to contact us with any questions regarding our control system design services.

Information web page: http://www.1-core.com/solutions/industrial/

Webform for questions and enquiries: http://www.1-core.com/contacts/

E-mail: sales@1-core.com

Tel./Fax: +7 (495) 921-79-91

Fax (USA): +1 (206) 888-46-14

Headquarters: 24 Radio str., Moscow, Russia, 105005

We will be glad to help you to achieve market success for your products.