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WHITEPAPER

netX Network Technology and Application for Sensors, Motion, Remote I/O and Control

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1. INTRODUCTION

The world of industrial automation is complicated by the many network protocols in use—both traditional fieldbus protocols and industrial versions of the more recently adopted Ethernet protocol. This complexity creates a daunting problem for developers of industrial automation products and their distribution channel.

Altogether, there are at least 17 industrial network communications protocols in the installed base. Designing a product capable of communicating with each of these network protocols can be an expensive, time-consuming process, which distracts you from focusing on your core business.

Fortunately, Hilscher has made it easy to do this with its netX technology – networX-on-chip. netX network communications products enable you to create products with multiple communications protocol capability quickly and efficiently for the industrial automation market.

This white paper highlights the netX technology, netX chips, software, and services. Then this white paper overviews four netX applications – sensors, motion, remote I/O, and control – by relating the typical functions, implementation characteristics, and benefits in each market segment.

2. NETX PRODUCT DESCRIPTION AND BENEFITS

2.1. netX – networX-on-chip

netX is a scalable family of communications products which implements industrial network communications in a broad range of applications—from entry-level products such as simple communications to sensor interfaces to advanced controls. The heart of the netX family of products is the netX 10, netX 51, netX 52, netX 100, and netX 500 network controller chips.

2.2. netX Features

The highly integrated netX architecture is designed from the ground up for maximum flexibility, determinism, and performance for multi-protocol capability and low latency for short cycle times. The multi-core architecture features an ARM processor core, coupled with the xC (flexible communication) subsystem and a feature-rich set of on-chip peripherals for a variety of industrial applications.

The network communications protocols supported include all major industrial Ethernet (Real-Time Ethernet/RTE) protocols and traditional fieldbus protocols:

- Industrial, Real-Time Ethernet protocols, as master or slave: PROFINET, POWERLINK, EtherCAT, EtherNet/IP, Sercos III, Modbus TCP, and VARAN (slave only); and
- Traditional fieldbus protocols, as master or slave: PROFIBUS, DeviceNet, CANopen, Modbus, CC-Link (slave only), IO-Link (master only), and ASi (master only).

Each of these protocols can be implemented with Hilscher-supplied protocol stacks in the form of linkable object modules (LOM) or loadable firmware (LFW). Standalone solutions use LOMs. Standalone solutions are also referred to as “system on chip” or “SoC.” Companion solutions can use LOMs or LFWs, but LFWs are preferred. In some instances, the protocol stack may need to be created, either by Hilscher programming services or your team.

Using Hilscher-developed network communications protocol stacks allows your development team to focus on the important tasks of host application development and implementation. This path can result in a faster time-to-market for your product. Hilscher provides software services to help you implement existing protocol stacks in your system.

A striking feature of netX is that it is a very flexible, multi-protocol solution. With a single hardware and netX solution you can change the network communications protocol by loading new firmware into the netX chip and, if applicable, changing the hardware connector. This feature also enables you to switch from master to slave protocols and from slave to master protocols by just downloading alternate firmware into the netX chip.

One significant hurdle to implementing your industrial automation product is obtaining certification from the various industrial communications standards bodies. Using Hilscher pre-approved protocol stacks, protocol certification is easier.

Using Hilscher-provided protocol stacks also results in a uniform interface for your application to the netX system – a single driver is employed to interface between your application and the netX network protocol stack. Also, the Hilscher-developed protocol stacks share a consistent design and coding approach, which is hard to accomplish when you develop multiple stacks on your own.

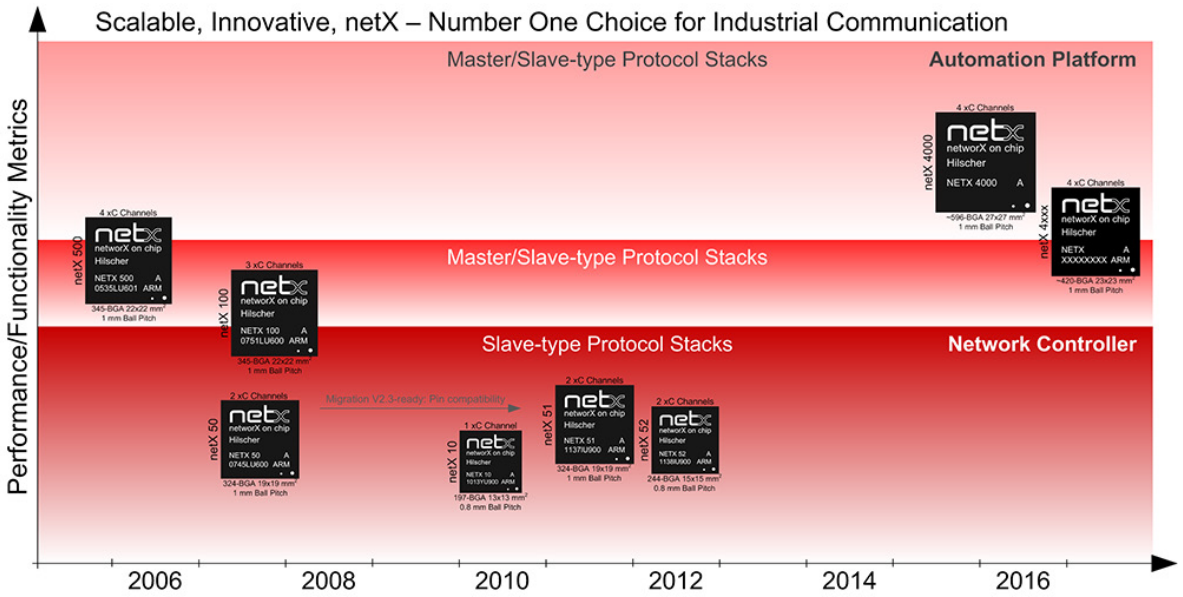
The netX technology is delivered in a range of form factors – from a compact ASIC (application-specific integrated circuit) chip, which can be tightly integrated into your product board, to a netX chip already on a Hilscher-supplied board to be inserted into your product. Once implemented in one form-factor, the netX solution can be migrated quickly to another form-factor.

The netX solution is implemented in your system either as a companion solution or as a stand-alone solution.

- With a companion solution, the netX chip works in coordination with your host processor and provides the network communications interface for your system. This arrangement takes that communications processing load off your host processor, which can increase the effectiveness of your host processor.
- With a stand-alone netX solution, netX handles both the application and the network communications tasks, such as device communications and data preprocessing.

2.3. Meet the netX chips

The netX family of network controller chips includes the netX 10, netX 51, netX 52, netX 100 and netX 500. Below is a roadmap of the netX chip family.



2.4. Typical netX Implementation Overview

Below are the netX network controller chips used for the high-level classifications of netX applications:

- Slave Interface (for traditional fieldbus protocols) – netX 10;
- Slave Interface (usually for Real-Time Ethernet) – netX 51 / 52;
- Master Interface (PLCs with master protocol requirements) – netX 100 / 500; and
- Complete Systems Solution (control, visualization and communication) – netX 500.

2.5. netX 51 and netX 52

netX 51 and netX 52 are among Hilscher's most recently released chips in the netX network controller family. They take the design of the legacy netX 50 chip and couple it with additional technology to create even more powerful network controller chips. Highlights of the netX 51/52:

- Are flexible, high-end, network controller chips equipped with a host interface for a companion solution or a stand-alone solution for a wide array of applications, such as digital I/O, gateway to IO-Link, encoders, and analog input with analog to digital conversion (ADC) connected to SPI;
- Include two communication channels for fieldbus protocols or Real-Time Ethernet protocols equipped with PHY;
- Contain xPIC, a second RISC (reduced instruction set computing) processor with deterministic processing and predictable interrupt latency, required for time-critical I/O tasks, such as electronic control and gateway functions;
- Have a very flexible interface between the host and the netX dual port memory; the interface is configurable either (1) as a DPM (dual port memory) interface for parallel access with address and data lines, or (2) as an SPM interface for high speed serial access, with write/read address commands for data exchange, using either SPI (serial peripheral interface) or Quad SPI;
- In the case of netX 51 only, provides a memory controller for an external SRAM/SDRAM; and
- Incorporate extended communication functions to support the PROFINET high - performance profile and IO-Link V1.1, in addition to other fieldbus and RTE protocols.

netX 51/52 have a dedicated SPM Controller with SPI slave communications, and command sequencer functions for DMA (direct memory access) to the netX internal DPM (dual port memory) RAM. The SPM controller enables the external host processor to have high-speed data access to the netX internal DPM RAM. Compared to a software solution, this reduces the load on the primary netX CPU, the ARM 966, by up to 75% so the ARM CPU can attend to other important functions.

Bypassing the ARM CPU via the SPM Controller can dramatically reduce data read/write times at 12.5 MHz (below 100 µs for 10 data bytes to about 225 µs for 240 data bytes). This path has a better throughput at 50 MHz (well below 60 µs for 10 data bytes to just around 150 µs for 240 data bytes). These are measurements of one complete cyclic exchange of input or output data, including status requests and handshakes, using the standard CIFX-netX Driver Toolkit for the host processor.

2.6. netX Product Details

For a more detailed overview of the netX network controller chips and a selection of Hilscher products based upon the netX chips, please see Attachment 1 of this white paper. The netX network controller chips include: netX 51/52, netX 10, netX 100/500, and the netX 4000, which is the next generation netX chip designed for automation control. The selected Hilscher products are netIC, comX, netRAPID, and netJACK.

An overview of the technical specifications for the netX family of network controllers appears in Attachment 2 of this white paper.

2.7. netX Software and Services

2.7.1. Hilscher netX Services. Hilscher offers a wide array of services to help you create your product, including:

- Appropriate netX product selection;
- Design-in services to help you to integrate the selected netX product into your hardware/software solution;
- netX Guided Services: from concept to certified device, including custom design services and production services;
- Customer design validation services; and
- Ongoing software support services.

In addition to highly trained local Hilscher personnel, there is a team of expert Hilscher engineers in Germany to back them up. The local team provides initial guidance in selecting the appropriate products. The team in Germany performs services such as design-in, coding, and support. The local team facilitates communications with the team in Germany.

2.7.2. netX Software – License and Support Packages. Hilscher primarily offers two license and support models:

License Model A LFW — Loadable Firmware:

- Software as loadable firmware (LFW);
- Limited support services; and
- Simple licensing agreement.

License Model B TUA — Technology User Agreement:

- Software as a Linkable Object Module (LOM) (linkable object library);
- Support services;
- Slave software in source code;
- Source code software escrow;
- Participation in regular netX Technology Meetings; and
- Software license and maintenance contract.

Additional options and accessories are available:

- Driver library;
- Board support package;
- Configuration software;
- Soft PLC and visualization;
- Design guides; and
- Automated manufacturing tests.

3. NETX APPLICATIONS FOR SENSORS, MOTION, REMOTE I/O AND CONTROL

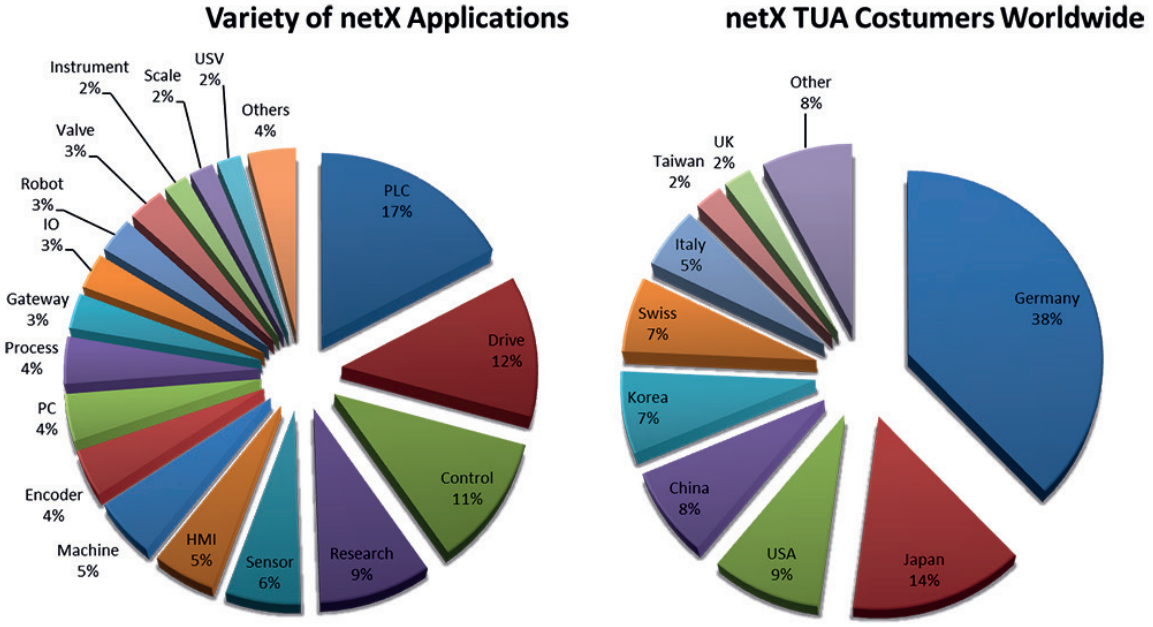
3.1. netX Benefits and Applications

3.1.1. netX Benefits. The netX network controller family is the intelligent solution for implementing all tried-and-tested fieldbus and Real-Time Ethernet systems in a tiny space.
Across the board, netX has many significant benefits for customers:

- One source for your industrial communications network interface platform—hardware, software protocol stacks, and implementation and support services;
- A broad set of pre-certified software protocol stacks for major fieldbus and Real-Time Ethernet variants, so all networks are accessible with a single controller;
- Reduced development effort for you, resulting from pre-certified solutions and consistent interfaces for hardware and software across multiple platforms;
- Implementation of master or slave protocol in a companion chip application or a stand-alone application;
- Minimal interface footprint in your product;
- Onboard PHYs reduce the number of additional components needed;
- Operating temperatures available up to 85 °C;
- A standardized, easily configured interface to the host application device;
- Deterministic capabilities to improve accuracy and increase system efficiency;
- Reduced latency to improve response times;
- Reduced product, storage, and administrative costs;
- Access for you to a broader range of factory automation markets; and
- Easier migration for your future product generations.

3.1.2. netX Applications. netX technology has been applied to a broad range of industrial applications across the globe, including PLC, drives, control, research, sensors, HMI, machine, encoder, PC, process, gateway, I/O, robot, valve, instrument, scale, USV, and other applications.

The graphics respectively display the distribution of netX applications and the distribution of Hilscher's TUA (Technical User Agreement) customers worldwide.



This white paper focuses on the netX applications and unique benefits in the sensor, motion, remote I/O, and control market segments.

3.2. netX Applications for Sensors[1]

3.2.1. Sensors in Motion-Control and Process-Control Applications. Automation of motion-control and process-control applications requires sensors to measure variables in the manufacturing system and provide feedback to a controller.

3.2.2. Implementation of netX for Sensor Applications. For the implementation of sensor applications, Hilscher recommends:

- netX 10, netX 51, or netX 52 – for sensors generally;
- netX 51 or netX 52 – for encoders or transducers; or
- netIC – for simple field devices such as barcode readers, identification systems, or valve islands via a slave connection.

For sensor applications, netX is used as a stand-alone chip or as a companion chip to a host processor, depending upon the application requirements.

3.2.3. netX Benefits for Sensor Applications. In addition to the overall benefits of netX shown in Section 3.1.1, the key advantages of utilizing the netX network controller in sensor applications are:

- A set of on-chip peripherals for connectivity to interface sensor-specific ICs;
- Suitable for application designs that require small form factors/housings;
- One hardware network interface for all industrial Ethernet protocols; and
- Short network cycle times coupled with precise synchronization.

3.2.4. netX Sensor Applications. netX technology can be effectively implemented for many types of sensors, in a wide spectrum of sensor applications and functions.

3.2.4.1. Industrial Detection Sensors.[2] Industrial detection sensors detect the absence, presence, or distance of an object from a reference point. Examples of these sensors are limit switches, proximity detectors, Hall-effect sensors, photoelectric sensors, and ultrasonic sensors.

Applications and functions of detection sensors include determining the:

- number of gear teeth to compute rotational speed;
- number of products transferred on a conveyor;
- product size;
- material level in a tank; and
- material thickness.

3.2.4.2. Motion Control Sensors.[3] Motion control sensors measure displacement, position, speed, acceleration, and deceleration. They include optical encoders, tachometers, potentiometers, resolvers, and transducers.

Applications and functions of motion-control sensors include:

- measuring the depth of a bored hole;
- sensing workpiece position in a milling operation;
- measuring the acceleration and speed of a robotic arm;
- detecting a stall condition;
- controlling the amount of material dispensed by an injection molding machine, a crude oil pump jack, or a printer; and
- positioning a hydraulic cylinder or a floodgate.

3.3. netX for Motion Applications[4]

3.3.1. Motion. A motion control system converts input commands into controlled mechanical movements – linear, rotary, or a combination. These movements are produced by both open-loop systems and closed-loop systems.[5]

Motion control drive systems, whether they are in machines or robots, require a fast and flexible interface to a state-of-the-art communication system. Communication cycle times in microseconds and precise synchronization are essential for maintaining exact path accuracy. Real-Time Ethernet meets those requirements and is in the process of becoming the dominant communication platform for the future.

3.3.2. Implementation of netX for Motion Control Applications. Network communications can be integrated into your motion control product using either a netX chip or one of Hilscher's pluggable modules with an onboard netX chip. Hilscher's products are used as the master in PC based controllers and as slaves in servo amplifiers.
For motion control, Hilscher recommends the following choices:

- netX 51, netX 52, netX 100;
- netRAPID;
- netJACK; and
- comX.

3.3.3. Benefits for Motion Control Applications. In addition to the overall benefits of netX shown in Section 3.1.1, the key advantages of utilizing the netX network controller in motion control applications are:

- Directionality scalable from 2 to 128 axes;
- Scalable control performance for servo axes as well as handling devices;
- Robust network communications capabilities;
- High-performance host interface with an impressive data throughput;
- Hardware features to synchronize the network cycle with the motion device; and
- Software solutions to provide a web server to configure the motion drive.

3.3.4. netX Motion Applications. netX technology can be effectively implemented for many types of motion devices.
Applications and functions of motion devices include:

- manufacturing positioning equipment, such as industrial robots;
- equipment requiring high speeds, high peak torque capacity and quick acceleration or deceleration, such as material handling equipment and grinders;[6]
- machines that place electronic parts onto a printed circuit board;[7] and
- machine tools that need constant speed under variable load conditions.

3.4. netX for Remote I/O Applications[8]

3.4.1. Remote I/O. Field devices, such as smart transmitters, control valves, and variable speed drives, can be connected to a network inside the plant and in remote locations.

Remote I/O systems are highly integrated gateways between the field device connection, their communication standard, and the discrete I/O area communication standards. I/O-decentralized automation (remote I/O) involves the replacement of discrete, hard wiring with fieldbus or industrial Ethernet communication systems.

3.4.2. Implementation of netX for Remote I/O Applications. Hilscher recommends:

- netX 51
- netX 52.

3.4.3. netX Benefits for Remote I/O Applications. In addition to the overall benefits of netX listed in Section 3.1.1, above, the key advantages of utilizing the netX network controller in remote I/O applications are:

- Local I/O signals controlled by the netX peripheral control unit from IP20 up to IP67;
- Connection of digital and analog signals to the external network; and
- Low latency and a high number of I/O connections on modular devices.

3.4.4. netX Remote I/O Applications. netX technology is designed to implement Remote I/O communications effectively.
Applications and functions of Remote I/O devices include:

- I/O modules for remote monitoring and alarm applications, such as temperature sensors for a wastewater treatment system and tank gauging for an oil storage facility;
- Communications devices which easily retrofit a fieldbus device by acting as an intermediary between the legacy field device(s) and newer industrial Ethernet communications systems;
- Using software specifically designed for industrial networking, programming and calibrating devices remotely and providing diagnostic data to assist with troubleshooting[9]; and
- IO-Link gateways.

3.5. netX for Control Applications[10]

3.5.1. Controls. All types of control architectures require and include communication solutions such as Real-Time Ethernet or fieldbus communications.

Due to the continuous increase of data to be exchanged between the control level and field devices (such as Human Machine Interfaces (HMI) or I/Os), the requirement profile is changing for machines and plants. Device manufacturers are integrating more and more intelligence into single network devices to meet requirements such as high data volumes, the fast update of I/O data, and network overlapping exchange of diagnostic data.

3.5.2. Implementation of netX for Control Applications. For control applications, Hilscher recommends:

- netX 100;
- comX; and
- netJACK.

3.5.3. netX Benefits for Control Applications. In addition to the overall benefits of netX shown in Section 3.1.1, the key advantages of utilizing the netX network controller in control applications are:

- A powerful CPU to run PLC functionalities based on a CODESYS implementation, in addition to pure communications tasks.

3.5.4. netX Control Applications. netX technology is designed to implement control applications effectively.
Applications and functions of control devices include the:

- extension of programmable logic controllers (PLCs) for industrial network communication;
- selection of modular and scalable network connections; and
- creation of flexible connections between industrial networks for any backplane system.

3.6. Other netX Applications

Hilscher has product offerings utilizing the netX architecture for other applications such as HMI (human machine interface) and safety systems with SIL3 certification.

4. NETX - THE INTELLIGENT CHOICE FOR NETWORK COMMUNICATIONS

Today nearly twenty communications protocols are used in the industrial automation market. Hilscher's netX technology—networX-on-chip—eases the pain involved in making your product function with multiple communications protocols.

netX is a scalable family of communications products which implements industrial network communications in a broad range of applications—from entry level products to advanced controls. The focus of this white paper is the application of netX products and services to the sensor, motion, remote I/O, and control segments of the industrial automation market.

The key features of netX are flexibility, determinism, and performance for multi-protocol capability and low latency for short communications cycle times. The multi-core architecture has an ARM processor core, coupled with the xC (flexible communications) subsystem, and a feature-rich set of on-chip peripherals to facilitate the implementation of a variety of industrial applications.

The core of the netX family of products is the netX 10, netX 51, netX 52, netX 100, netX 500, and soon the netX 4000, network controller chips. You can incorporate them into your product in two ways. The simpler method is to use a netX chip already on a Hilscher board and one of Hilscher's pre-certified, loadable firmware protocol stacks. The alternative is to use the netX chip, design it into your board, and develop the software using Hilscher's loadable object modules as a starting point. This approach involves more time and effort, but it can deliver an even smaller footprint and tighter integration between your product and the netX chip.

Hilscher's expert team of professionals offers you a spectrum of services to support your selection, implementation, and use of the netX technology, hardware, and software. Those services include product selection, design-in integration, custom design, production, design validation, and software support services.

netX offers you some impressive benefits which can increase your success, such as:

- One source for your industrial communications network interface platform — hardware, software protocol stacks, and implementation and support services;
- A broad set of pre-certified software protocol stacks for major fieldbus and Real-Time Ethernet variants, so all networks are accessible with a single controller;
- Reduced development effort for you, resulting from pre-certified loadable firmware, loadable object modules available as a starting point for your development, and consistent interfaces for hardware and software across multiple platforms;
- Implementation of master or slave protocol in a companion chip application or a stand-alone application;
- Minimal interface footprint in your product;
- Onboard PHYs to reduce the number of additional components needed;
- A standardized, easily configured interface to the host application device to facilitate communications between your host device and netX;
- Deterministic capabilities to improve the accuracy and increase the efficiency of your system;
- Reduced latency to improve response times;
- Reduced product, storage, and administrative costs to increase profits;
- Access to a broader range of factory automation markets; and
- Easier migration for your future product generations.

Hilscher offers netX technology for device manufacturers, including development services and customized module manufacturing. In this field, Hilscher is recognized as a system partner of major manufacturers. The company‘s customer base also includes a variety of engineering firms, solution providers, and system integrators.

Also, Hilscher is represented in all fieldbus and Real-Time Ethernet standards organizations. Due to the benefits of netX network controllers and Hilscher's quality software and services, more than 150 well-known device manufacturers use the netX products as a basis for the implementation of own communications interfaces.

For more information about Hilscher and netX technology, products, software, and services, visit www.hilscher.com and www.hilscher.com/netx/.

Attachment 1. Technical Highlights of the netX Family of Network Controllers

1. MEET THE NETX FAMILY OF NETWORK CONTROLLER CHIPS

1.1. netX 51 and netX 52 – Among the most recent releases[11]

netX 51 and netX 52 are among the most recently released chips in the netX network controller family. They take the design of the legacy netX 50 chip and implement new technology to create even more robust network controller chips. Features of netX 51 and netX 52 include:

- Flexible high-end network controller chips equipped with a host interface or stand-alone solution for digital I/O;
- Two communication channels for Real-Time Ethernet equipped with PHY or fieldbus;
- Extended communication function support, including, the PROFINET high- performance profile and IO-Link V1.1;
- Second RISC CPU for time-critical I/O tasks;
- Fast SPI host interface with read/write functions; and
- Memory controller for external SDRAM (netX 51 only).

Real-Time Ethernet systems are successfully used in many applications. The demands on the resources and functionalities of network controllers are increasing. netX 51/52 network controllers are based on the legacy netX 50 communication architecture, which features considerably more internal storage capacity and additional function units.

The netX 51 chip and the netX 50 chip have compatible hardware. netX 52 consists of the same silicon, but does not have an external memory bus and is more cost-effective due to its smaller housing. These components are optimized for designing modular or compact slaves, or as the Real-Time Ethernet device for a high-performance CPU. The communication channels meet all existing and future requirements of the PROFINET high-performance profile. Also, use of the new PHYs manufactured by Renesas ensures faster throughput times and expanded diagnosis properties.

In connection with a small QSPI Flash, the internal memory of more than 670 KBytes enables very compact solutions exceeding twice the performance of the netX 50. xPIC, second RISC CPU, is provided for processing fast IOs. It works in parallel with the ARM CPU and significantly reduces the demands on the ARM software during short bus cycle times. Typical applications are IO-Link Master Gateways. When using gateways, the xPIC handles the IO-Link data transfer, so the ARM CPU is fully available for processing the transmission protocol to the master.

A third Ethernet interface to connect a PC for diagnosis and configuration purposes is implemented. Alternatively, it can be used to connect netX to a host CPU. On this MII interface, the netX will behave as a PHY. Some Real-Time Ethernet systems use the CANopen object models on the communication services with Ethernet/IP and DeviceNet. This selection makes it necessary to connect CAN to the Real-Time Ethernet system as a "legacy network". As an alternative, a dedicated CAN controller is available now.

In summary, the netX 51/52 network controller chip is significantly more than just a Real-Time Ethernet interface chip equipped with a dual port memory.

1.2. netX 10[12]

netX 10 is a cost-effective, compact, single-chip solution for automated devices with a network connection, such as sensors, drives, motion controllers, intelligent IO-Link controllers, or PLC cores with CoDeSys. Features of netX10 include:

- Triple core architecture with a central 32-bit/100 MHz ARM CPU, a 32-bit/100 MHz RISC controller as a communication system for fieldbus protocols or as an Ethernet port, and an xPIC 32-bit/100 MHz RISC chip;
- Flexible Peripheral Interface Controller (xPIC) is user programmable and enables fast signal processing;
- Memory bus can be configured as a dual port memory for connection to a host CPU, as memory controller for SRAM and SDRAM or as straightforward PIOs;
- SPI mode of the DPM´s enables fast serial access to internal memory; and
- Requires only one serial Flash EPROM.

1.3. netX 100 and netX 500[13]

Both netX 100 and netX 500 are flexible, highly integrated, single chip network controllers with system architecture optimized for the application, communication, and maximum data throughput. Features of netX 100 and netX 500 are listed below.

- Based on the 32-bit CPU ARM 926EJ-S clocked at 200 MHz, netX 100/500 has a memory management unit, caches, DSP, and Java extensions.
- The internal memory of the 144 KByte RAM and the 32 KByte ROM that contains the boot loader is sufficient for smaller applications.
- For Windows CE and Linux, the internal memory is supplemented externally with SDRAM, SRAM or FLASH via the 32-bit memory controller.
- Data is exchanged with the host system via the dual port memory interface, which is also configurable as a 16-bit extension bus for stand-alone applications.
- Extensive peripheral functions, serial interfaces such as UART, USB, SPI, I2C, and the integrated graphic controller enable a large variety of applications.
- One unique feature is the central data switch. It connects the ARM CPU and the communication, graphic, and host controllers with the memory or the peripheral units via five data paths. The controllers transmit data in parallel, unlike traditional sequential, single bus architecture.
- Another distinguishing feature is multiple (three on netX 100 and four on netX 500) intelligent communication channels, individually configurable as a Real-Time Ethernet or fieldbus interface. Each channel has a dedicated ALU and a special logic unit with microcode loadable for the selected communications protocol. Two channels also have an integrated PHY for Ethernet. With the intelligent communication ALUs, netX can implement diverse protocols and protocol combinations and synchronize them regardless of CPU reaction time.

1.4. netX 4000 – Future Automation Platform[14]

The upcoming netX 4000 from Hilscher enables more integration in a smaller space to fulfill the requirements of the industrial automation market. Features of netX 4000 are listed below.

- The netX 4000 design brings together a Cortex™-A9 dual-core process with an infrastructure for highly advanced user-facing applications and a Cortex™-R7 processor with an underlying netX technology for real-time control of industrial communications and applications.
- The netX 4000 from Hilscher is the ideal system-on-chip (SoC) for your automation platform in the field of visualization, industrial control, and real-time communication.
- The netX 4000 is the path forward from netX 100 and netX 500.

2. MEET SOME NETX-BASED HILSCHER PRODUCTS

2.1. netIC[15]

netIC is designed for simple field devices such as barcode readers, identification systems, valve islands, or I/O blocks which require a slave connection to fieldbus or Real-Time Ethernet systems. netIC was developed to enable legacy systems with MODBUS communications to communicate with other fieldbus or newer Real-Time Ethernet systems. netIC features are listed below:

- These devices have low data throughput, so netIC uses a serial connection, such as UART and SPI, as the host interface.
- netIC is a complete single chip module with the compact dimensions of a Dual-In-Line (DIL) 32 pin plugin module.
- netIC is based on the netX network controller and contains all components of a fieldbus or Real-Time Ethernet interface with an integrated 2-port switch and hub.

2.2. comX[16]

The comX communications module is designed to easily and quickly integrate a high-performance network interface into automation devices, such as robot controllers, PLCs, or drives. comX features include:

- Incorporates a netX chip onto a small board complete with physical communications connections;
- Supports all of the significant Real-Time Ethernet protocols as master or slave and covers all network-specific demands in a single module;
- Available as a universal (master/slave selectable) module or a slave-only module;
- Process data is exchanged with the host processor via a dual port memory (DPM) accessed either by an 8/16-bit bus interface or a fast 50 MHz SPI interface;
- Equipped with two onboard Ethernet ports, to support a line topology;
- All communication tasks are executed within comX, independent of the target device processor;
- All comX modules have the same dimensions and are pin-compatible to one other; so you can cover the whole range of network protocols with one baseboard design.

2.3. netRAPID[17]

netRAPID is the rapid and secure alternative to developing your own slave communications module, using a communications controller. Some netRAPID features are listed below:

- Because the netX chip carrier is the size of a stamp, it is integrated into your hardware in the same manner as a QFP part.
- It is designed for automated SMD series production as well as for rapid prototyping.

2.4. netJACK[18]

netJACK is an end-user exchangeable module which is a universal solution for upgrading devices with master or slave functionality. Some netJACK features are listed:

- All of the designs have the same mechanics and an identical software interface.
- netJACK is a closed IP 40 housing which can easily be installed by the user without tools.

Attachment 2. Technical Specification of the netX Family of Network Controllers[19]

Controller	netX 10	netX 52	netX 51	netX 100	netX 500
CPU models*	ARM 966 / xPIC	ARM 966 / xPIC	ARM 966 / xPIC	ARM 926 + MMU / -	ARM 926 + MMU / -
CPU clock	100 MHz	100 MHz	100 MHz	200 MHz	200 MHz
RAM / ROM	396kB / 64kB	672kB / 64kB	672kB / 64kB	144kB / 32kB	144kB / 32kB
Host Interface Functions**	DPM / SPM / EXT / MEM	DPM / SPM / EXT / MEM	DPM / SPM / EXT / MEM	DPM / - / EXT	DPM / - / EXT
Memory I/F Parallel / Serial	- / SQI XiP	- / SQI XiP	8, 16, 32 Bit / SQI XiP	8, 16, 32 Bit / -	8, 16, 32 Bit / -
xC Channels***	1	2	2	3	4
IEEE 1588 Sys Timer/ EthernetPHY (10/100 Mbps)	1 / Single-PHY	2 / Dual-PHY	2 / Dual-PHY	1 / Dual-PHY	1 / Dual-PHY
12C / SPI / UART	1 / 1 / 2	2 / 1 / 3	2 / 1 / 3	1 / 1 / 3	1 / 1 / 3
CAN / MAC / LCD	- / - / -	1 / 1 / -	1 / 1 / -	- / - / -	- / - / 1
IO-Link / ADC Channels	4 / 2 x 8	4 / -	8 / -	- / 2 x 4	- / 2 x 4
USB Device / Host	D / -	D / -	D / -	D / H	D / H
WDC / Timer Counters	2 / 7	2 / 10	2 / 10	1 / 5	1 / 5
MMIO / GPIO / PIO****	0 / 8 / 24	40 / 32 / 62	48 / 32 / 62	0 / 16 / 84	0 / 16 / 84
Package Size (mm) / Type (Pins)	13 x 13 / BGA (197)	15 x 15 / BGA (244)	19 x 19 / BGA (324)	22 x 22 / BGA (345)	22 x 22 / BGA (345)

Endnotes

[1] "Sensor," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/applications/sensor/.

[2] Terry Bartelt, Industrial Automated Systems: Instrumentation and Motion Control, (Clifton Park, DELMAR Cengage Learning, 2011) 278-90, 421-65.

[3] Ibid., 611-35.

[4] "Motion," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/applications/motion/.

[5] Bartelt, Industrial Automated Systems, 591.

[6] Ibid., 600.

[7] Ibid., 594.

[8] "Remote I/O," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/applications/remote-io/.

[9] Bartelt, Industrial Automated Systems, 666.

[10] "Controls," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/applications/controls/.

[11] "Network controller for fieldbus and Real-Time Ethernet slaves with memory controller—NETX 51," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/en/products/product-groups/network-controller/asics/netx-51/. Also, "Network controller for fieldbus and Real-Time Ethernet slaves—NETX 52," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/en/products/product-groups/network-controller/asics/netx-52/.

[12] "Network controller for fieldbus slaves—NETX 10," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/en/products/product-groups/network-controller/asics/netx-10/.

[13] "Network controller for Real-Time Ethernet and fieldbus master and slaves—NETX 100," Hilscher Gesellschaft für Systemautomation mbH, accessed December, 2015, http://www.hilscher.com/en/products/product-groups/network-controller/asics/netx-100/. Also, "Network controller for Real-Time Ethernet and fieldbus master and slaves with display controller—NETX 500," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/en/products/product-groups/network-controller/asics/netx-500/.

[14] "Introduction," Hilscher Gesellschaft für Systemautomation mbH, accessed December, 2015, http://www.hilscher.com/netx/introduction/.

[15] "DIL-32 Communication IC," Hilscher Gesellschaft für Systemautomation mbH, accessed Dec. 2015, http://www.hilscher.com/en/products/product-groups/embedded-modules/dil-32-communication-ic/.

[16] "Communication Module," Hilscher Gesellschaft für Systemautomation mbH, accessed Dec. 2015, http://www.hilscher.com/en/products/product-groups/embedded-modules/communication-module/.

[17] "netX Chip Carrier," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/en/products/product-groups/embedded-modules/netx-chip-carrier/.

[18] "IP40 Exchangeable Module," Hilscher Gesellschaft für Systemautomation mbH, accessed Dec.2015, http://www.hilscher.com/en/products/product-groups/embedded-modules/ip40-exchangeable-module/.

[19] "netX Family," Hilscher Gesellschaft für Systemautomation mbH, accessed December 2015, http://www.hilscher.com/en/netx/netx-family/.

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