# Real-time Ethernet for Embedded Systems

REDBUS® solution

REDBUS® is a patented communication interface based on standard Ethernet physical transport. It provides a robust and high-speed communication interface for applications like motor control, lighting, fast I/O, and, in general, distributed peripherals on embedded systems.

The REDBUS® MAC allows the interconnection of multiple devices arranged in a ring topology. It instantly repeats the incoming Ethernet traffic to the adjacent system in the ring chain.

The data is organized in time slots and is exchanged on each addressed device during payload transit.

REDBUS Topology

A standard Ethernet PHY device implements the physical layer between the cables and the MAC. This unique topology eliminates the need for external switches. In addition, the simplicity of the software stack enables a wide range of microprocessors with minimal impact on CPU performance.
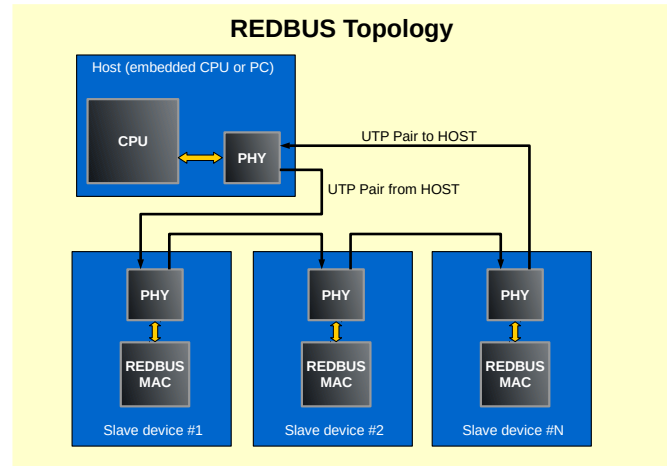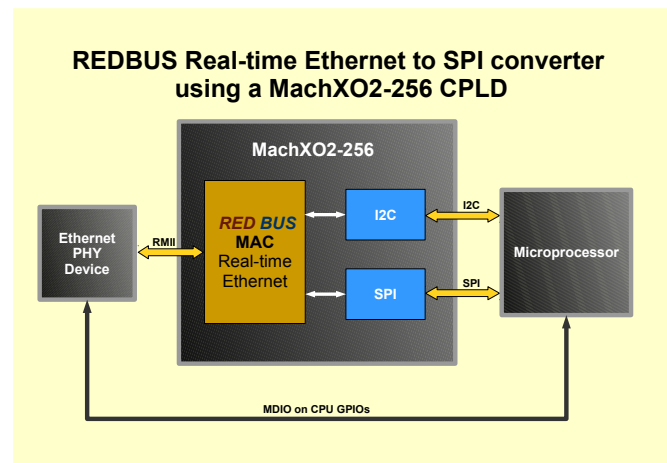
Features

- **High Speed, real-time.** The 100 Mbps deterministic communications make it ideal for time-critical applications.
- **Robust and reliable.** It provides high noise immunity and low EMI, up to 100 meters.
- **Cost-effective.** It uses only one Ethernet PHY device per node and does not require Ethernet switches. Different kinds of information can be transported in just two pairs of small cables, simplifying wiring.
- **Versatile.** The interfacing and integration simplicity with processors makes it suitable for use in a large variety of contexts. REDBUS is FPGA-based. It can be optionally combined with your logic on the same device.
- **Compact.** The REDBUS IP has a low logic density, starting from just 250 Logic Elements.

REDBUS® Ethernet to SPI converter MAC

The REDBUS® Ethernet to SPI converter MAC is an IP-Core for CPLD or FPGA that provides a simple solution for real-time data exchange with distributed microprocessors. The very small IP-Core requires less than 300 LUT so that it can be placed, for example, into a MACHXO2-256 device, the smallest CPLD of the Lattice Semiconductors™ family "MACHXO2". A host system (SOM, Embedded CPU, etc.) can exchange data with a plurality of REDBUS® devices using its standard Ethernet interface. The data packet is organized to allow serialization at a lower rate.


REDBUS Real-time Ethernet to SPI converter using a MachXO2-256 CPLD

REDBUS® MAC Features

- RMII standard PHY interface.
- Bidirectional real-time data exchange.
- I2C interface for MAC registers access.
- It may address up to 8128 devices.
- Starting from a minimum of 3.125 MHz SPI clock.
- MAC Unique ID, readable by the I2C interface.
- The host controller can be any CPU board equipped with a standard 100Mbps Ethernet port.
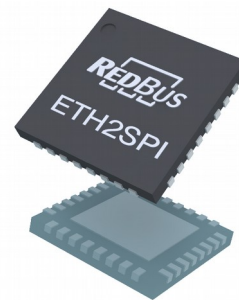
Example: Stepper Motor Control Board

This stepper driver board uses a REDBUS® MAC to interface a Cortex-M4 small processor to a Host controller. Ethernet data is exchanged through a synchronous serial interface with a period of 50 microseconds. The host processor has complete control of the position and trajectory algorithm. Positions are generated every 50 microseconds, which gives very high accuracy in motion control. Several driver boards may be connected to the same host with very simple wiring.

MOSFET driver bridge
REDBUS® MAC
Ethernet PHY
Cortex-M4 processor
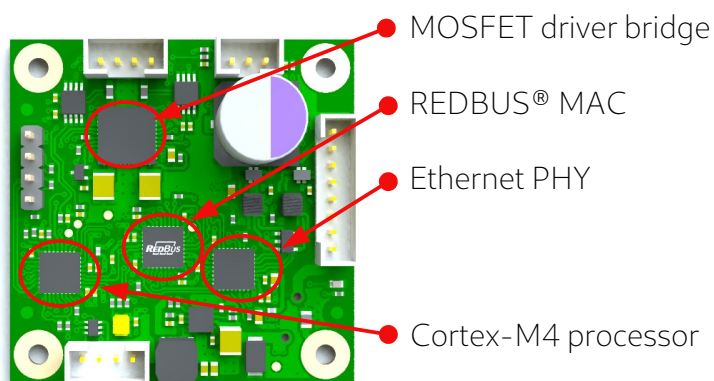
The position data is sent to up to 32 driver boards inside a single Ethernet frame, generated by the Host microprocessor using its own standard Ethernet MAC. Data from driver boards return to Host immediately, in the same Ethernet frame. Windings current, speed, acceleration, torque, and all the motors' real-time parameters are sent back inside a single Ethernet frame.

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