WIZNET MAGAZINE

WIZ Mag

W6300: Next-Gen TCP Offload Ethernet Chip



Bringing high-performance Ethernet connectivity to embedded systems

maker.wiznet.io

WIZnet

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What is W6300

Brief Overview

By Theo



What is W6300? – Speed Meets Simplicity

W6300 is WIZnet's latest hardware-based Ethernet controller, integrating a **TCP/IPv4/IPv6 dual stack, 8-bit BUS with QSPI interface, and 64 KB internal buffer**. By offloading TCP/IP processing into hardware, it achieves **over 90 Mbps throughput** while minimizing MCU workload, enabling stable Ethernet communication without a software TCP/IP stack.

Key Advantages

Ultra-fast communication	Achieve 90Mbps+ at QSPI clock speeds of at least 40 MHz using **4-bit QSPI (Quad SPI)**
Proven stability	Built on WIZnet's reliable TCP/IP offload engine, immune to external processing load
Socket-less commands	Execute PING, ARP, and IPv6 auto-configuration without opening a socket
All-in-one integration	Ethernet MAC + PHY, TCP/IP stack, 8 sockets, and 64KB buffer (32KB TX + 32KB RX) in a compact 7x7mm package W6300 is more than just connectivity—it brings performance and simplicity together in a single solution for real-world embedded applications.

Comparison with other chips

Feature	W6300	W5500	W5300	W6100	W5100S
Supported Protocol	**IPv4/IPv6 dual stack**	IPv4 only	IPv4 only	IPv4/IPv6 dual stack	IPv4 only
Host Interface	**8-bit BUS, QSPI** (up to 150 MHz)	Fast SPI	8/16-bit BUS	8-bit BUS, Fast SPI	8-bit BUS, Fast SPI
Buffer Size	**64 KB** (32 KB TX + 32 KB RX)	32 KB	128 KB	32 KB	16 KB
HW Sockets	**8**	8	8	8	4
Max Throughput	**~91 Mbps**	~50 Mbps	~80 Mbps	~50 Mbps	~25 Mbps
Package / Size	**48-pin LQFP/QFN** (7×7 mm)	48-pin LQFP (7×7 mm)	100-pin LQFP (14×14 mm)	48-pin LQFP/ QFN (7×7 mm)	48-pin LQFP/ QFN (7×7 mm)

Real-World Applications & Versatility

W6300 is more than an Ethernet controller—
it's a high-performance networking platform built for speed, reliability, and scalability across diverse industries.



Industrial IoT & Automation

Delivers stable, real-time communication for factory automation, smart buildings, and edge controllers. High throughput and dynamic buffer allocation keep data flowing smoothly, even under heavy loads.

Video & Image Streaming

A 64KB buffer and fast transfer rates ensure smooth, lossless JPEG/MJPEG streaming—ideal for IP cameras, inspection systems, and drones.

IPv6-Ready Networks

Supports both IPv4 and IPv6 for compatibility with current and next-generation infrastructure, making it suitable for public and enterprise deployments.

Custom Networking Devices

Eight hardware sockets, flexible buffers, and direct PHY access enable handling of non-standard protocols and unique traffic patterns.

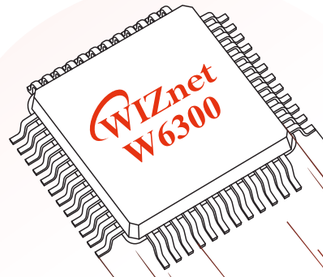
Embedded Web Servers

Works with compact MCUs to host full-featured IPv4/IPv6 web servers for configuration, monitoring, and control via a standard browser.

Strength Summary

From industrial control to multimedia streaming, W6300 combines high speed, reliability, and flexibility—offering a scalable solution for today's and tomorrow's networks.

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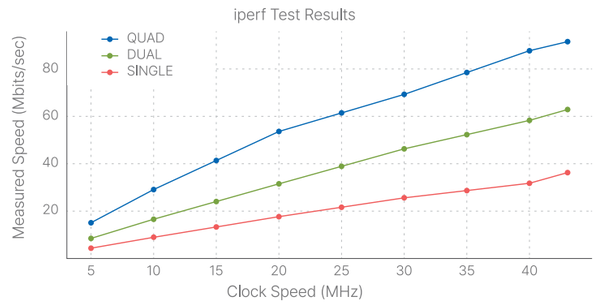
W6300 Speed

(iPerf3 Test)

By Lihan

Why Speed Matters in Embedded Systems

In embedded systems, limited MCU resources and constrained network bandwidth make efficient data transfer critical. When handling large datasets or running in real-time communication environments, insufficient network throughput can bottleneck the entire system. Whether it's high-frequency sensor data collection, remote control, or live streaming, maximizing network speed directly impacts responsiveness and overall performance.



Test Method

- **Clock Speed**: 5MHz ~ 43MHz
- **Communication Modes**: QSPI SINGLE/DUAL/QUAD
- **Measurement Tool**: iperf 3

Key Results

SINGLE Mode: Up to **36.32 Mbits/sec**

DUAL Mode: Up to **62.53 Mbits/sec**

QUAD Mode: Up to **91.2 Mbits/sec**

Source: https://youtu.be/A1epeyEtsTc?si=gXbdujf85pEJIlgD

QSPI-Driven Performance

The W6300's standout feature is its support for **QSPI (Quad SPI),** which eliminates the bottlenecks of traditional single SPI. Supporting Single, Dual, and Quad modes, the W6300 achieves efficient, high-speed data exchange with the MCU—reaching up to **95 Mbps effective throughput.**

Leveraging the Full 100 Mbps Ethernet

With an integrated 100 Mbps Ethernet PHY paired with QSPI, the W6300 can use nearly the full available bandwidth. It operates reliably in **100 Mbps full-duplex environments** with minimal performance degradation.

Keys to Speed Optimization

To fully utilize the W6300's 95 Mbps capability:

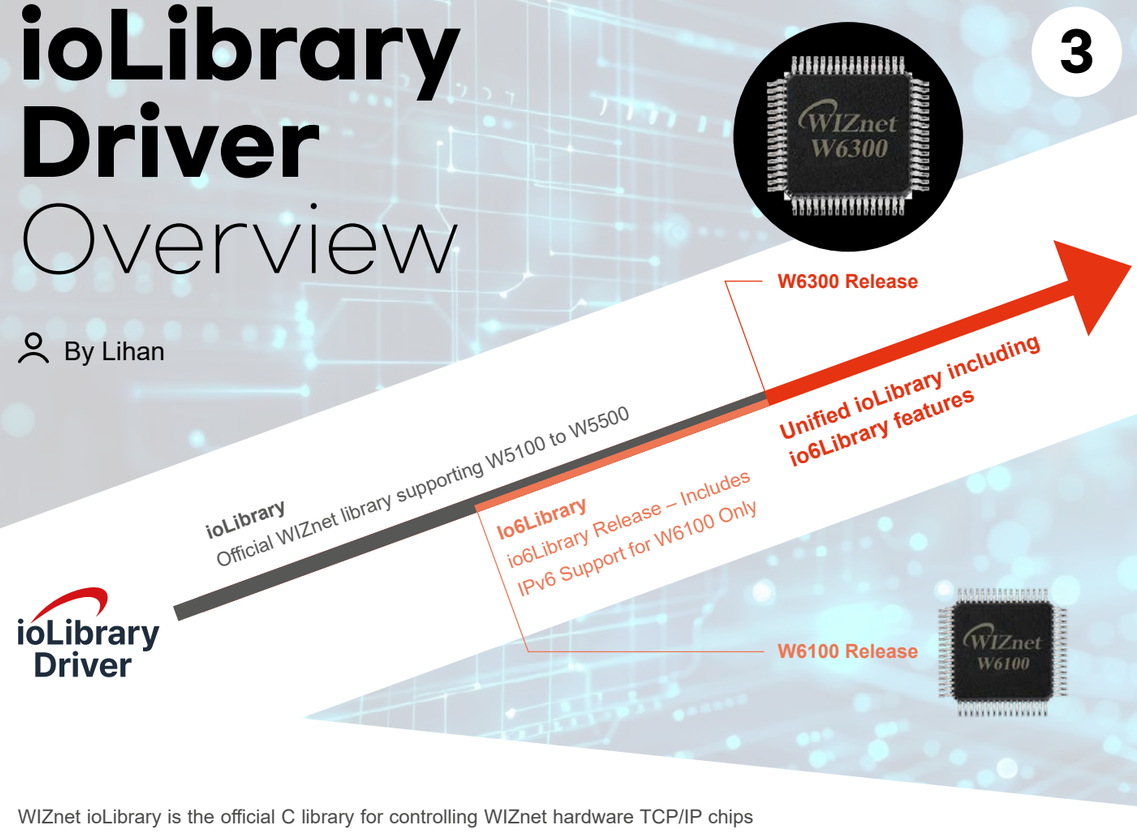
- **Use QSPI Mode**: Quad mode for maximum transfer rate
- **Integrate MCU DMA**: Ensure continuous high-speed transfers
- **Optimize the Driver**: Streamline packet-handling logic

With QSPI and ~90 Mbps throughput, the W6300 redefines high-performance Ethernet for embedded applications.

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ioLibrary Driver Overview

By Lihan



WIZnet ioLibrary is the official C library for controlling WIZnet hardware TCP/IP chips and Ethernet modules from MCUs.
Supporting the W5100, W5500, W6100, and the latest W6300, it lets developers implement TCP/UDP, DHCP, DNS, IPv4/IPv6 with just a few lines of code—removing the need for a custom TCP/IP stack and reducing setup and maintenance costs.

Evolving with the W6300 — Unified Driver

With the W6300 launch, WIZnet merged the separate ioLibrary and W6100-specific io6Library into one unified library.
Now a single codebase supports all functions, including IPv4 and IPv6, providing a consistent development experience across the product line.

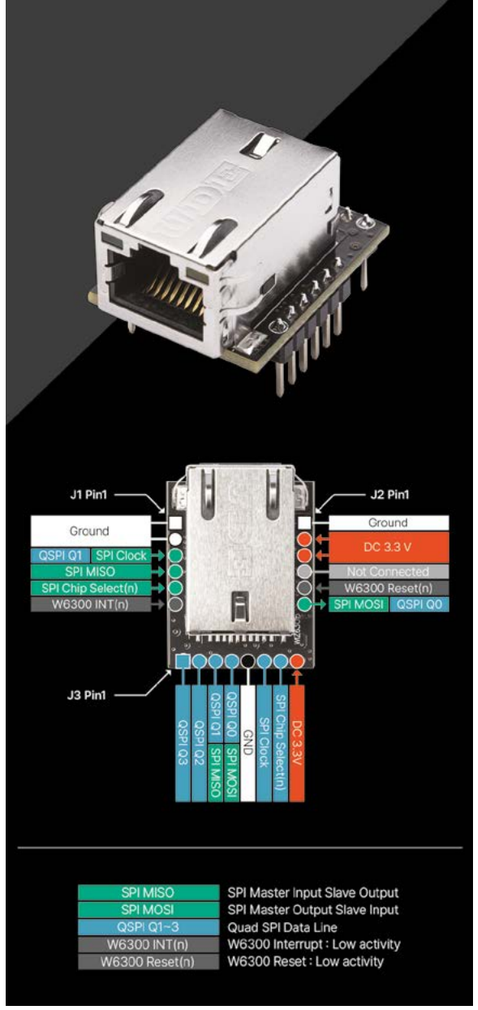
Why Two Libraries Existed

The W5x00 series and W6100 required different libraries due to structural differences. W6100's IPv6 support was incompatible with the original ioLibrary, necessitating the io6Library and resulting in multiple codebases.

Practical Benefits of Integration

The biggest advantage is backward compatibility—W5x00 or W6100 applications run on the W6300 without code changes. Just swap the chip for better performance and features, reducing development risk and upgrade time.

A single ioLibrary now covers all WIZnet chips—more than a merge, it's a step forward in developer convenience, maintainability, and scalability.



W6300 ioModule

WIZ630io: High-Performance Ethernet Module

By Bruno

The WIZ630io is WIZnet's fully integrated Ethernet module, designed to deliver both high performance and backward compatibility. Built on the W6300 hardware TCP/IP chip, it introduces a Quad SPI (QSPI) interface, enabling significantly faster data transfers compared to traditional single SPI.

For existing WIZnet IO module users, the WIZ630io can be swapped in without altering the PCB layout, allowing an immediate boost in speed and expandability without additional hardware modifications.

Key Advantages

QSPI Support (Extra Rear Pins) — The QSPI interface, with its four data lines, delivers substantially higher transfer rates than single SPI. It is particularly beneficial in applications that demand high-speed data transmission, such as video streaming, high-frequency sensor acquisition, and industrial logging.

Full Pin Compatibility — The left and right interface pin layouts are identical to existing WIZnet IO modules, ensuring direct replacement with no redesign required.

Instant Performance Upgrade

Retain the stability and compatibility of your current product while enhancing throughput and future-proofing your design.

Design Tip

When QSPI line length exceeds 5cm, take measures to ensure signal integrity. For reliable implementation, refer to the official circuit design guidelines. (https://docs.wiznet.io/Product/ioModule/wiz630io)

Additional Insight

For embedded system designers, the WIZ630io can be a pivotal upgrade path. It modernizes the networking layer while preserving the existing product line, enabling performance gains without a complete redesign. This advantage is especially valuable for industrial products requiring long-term supply stability.

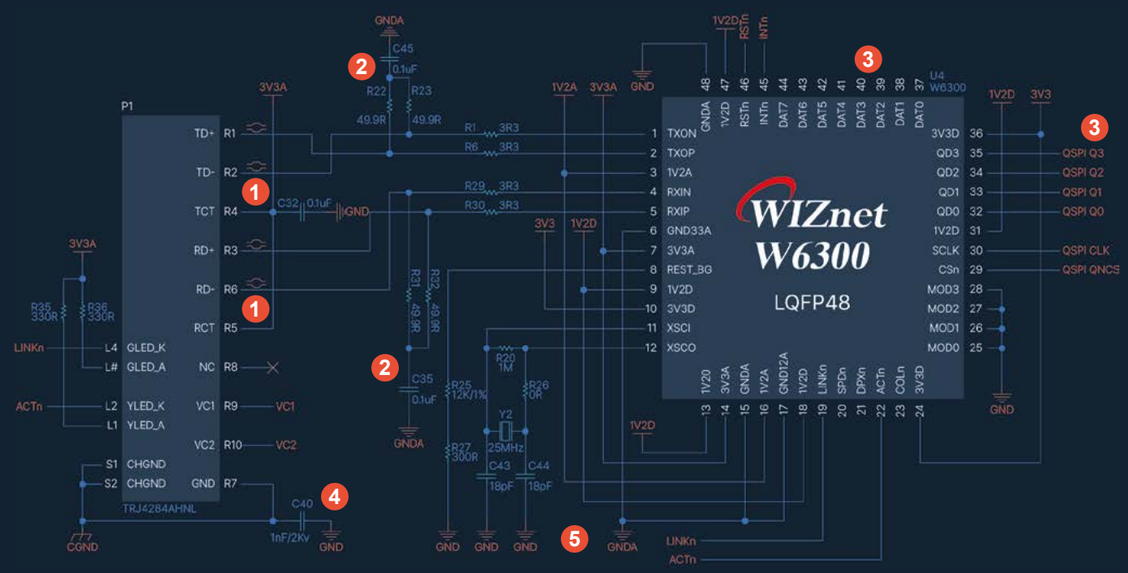
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By Alan

W6300 HARDWARE DESIGN TIPS

Laying the Groundwork for Reliable Ethernet Performance

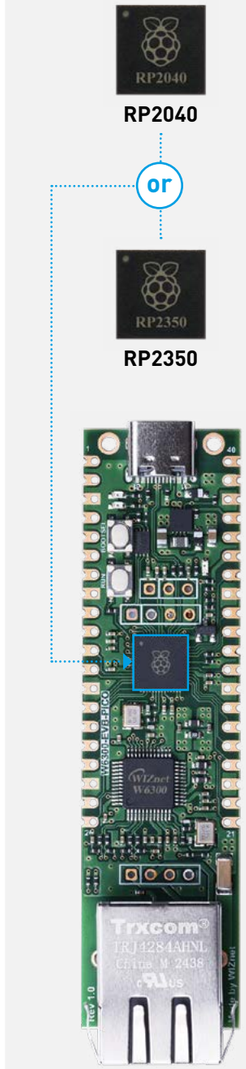
Designing with the W6300 goes beyond placing it on a PCB—hardware choices determine stability and speed.
High-speed QSPI and multiple communication modes require careful planning for power, signal integrity, and routing.
Follow these five proven tips from WIZnet to ensure dependable Ethernet without costly redesigns.



1. The W6300 operates in current mode for both TX and RX. A 3.3V voltage must be applied to both the TCT (Transmit Center Tap) and RCT (Receive Center Tap) of the transformer.
2. 49.9-ohm resistors are placed on both the TX and RX lines. This is to match the Ethernet impedance of 100 ohms.
3. The W6300 supports Ethernet communication via SPI, QSPI, and parallel BUS interfaces. Since the pin configuration varies depending on the selected interface, please take care when designing your hardware. For more details, refer to the datasheet.
4. Connect CGND and GND using a high-voltage capacitor. Depending on the situation, you may also add a bead or resistor.
5. If the area for GND or GNDA on the PCB is not sufficiently large, it is acceptable to combine GND and GNDA. This can be effective in reducing EMI radiation.

6 W6300-EVB-PICO 1&2

By Matthew



WIZnet introduces two evaluation boards that make hardware-based Ethernet integration effortless on Raspberry Pi Pico platforms: W6300-EVB-PICO and W6300-EVB-PICO 2. Both feature the new W6300 TCP/IP offload chip,
enabling high-performance Ethernet without the need for a software stack—ideal for time-critical or resource-constrained applications.

Built for the Tools You Already Use

Compatible with Arduino, C/C++ SDK, MicroPython, and CircuitPython, these boards fit right into existing development workflows. Whether you're adding Ethernet to an existing Pico project, teaching networking in the classroom, or building a connected product, the W6300-EVB-PICO series brings full TCP/IP offload in a familiar form factor—with no extra components required.

RP2040 vs RP2350 - Core Performance

Board	MCU	Performance
EVB-PICO 1	RP2040	Dual Cortex-MO+ @133MHz, 264KB SRAM
EVB-PICO 2	RP2350	Dual Cortex-M33 @150MHz, 520KB SRAM, TrustZone®

Both boards offload TCP/IP processing to W6300 via QSPI (GPIO 15–22), freeing up the MCU for application logic. In testing, the setup achieves over 90Mbps throughput, ensuring responsiveness even in real-time systems.

Highlights

- ✓ Full TCP/IP offload: IPv4/IPv6, TCP/UDP, ICMP, PPPoE
- ✓ 8 hardware sockets, up to 64KB internal buffer
- ✓ Integrated 10/100 Ethernet PHY with RJ-45
- ✓ USB-powered, 40-pin Pico-style DIP layout
- ✓ Compact form factor, approx. $12 USD

The W6300-EVB-PICO series is more than just an evaluation board—it's a practical drop-in solution for building fast, secure, and connected devices on the Pico platform.

7 Quick Start with W6300-EVB-Pico 2

By Matthew

Everything you need to begin—right where you need it

For many developers, the first hurdle when working with embedded Ethernet isn't the hardware—it's setting up the environment. WIZnet has streamlined this process for W6300-EVB-PICO and W6300-EVB-PICO 2 by providing a full set of resources tailored to both beginners and experienced users.

GitHub
WIZnet-ioNIC

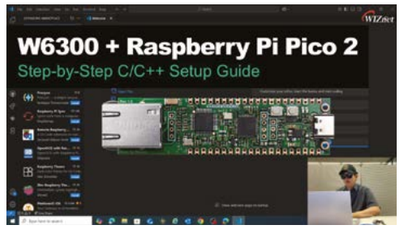
1 Start with the official GitHub documentation

The WIZnet ioNIC GitHub repository is the central hub for all board-related documentation.
There, you'll find environment-specific guides covering C/C++ SDK, Arduino, and more—complete with toolchain setup instructions, driver structure, and working examples. It's the best place to understand the architecture before diving into development.



2 Follow step-by-step tutorials on the Maker site

Once you're ready to build, the WIZnet Maker site offers hands-on tutorials for both W6300-EVB-PICO and PICO 2. These guides simplify each step of the setup and example execution process—ideal for rapid prototyping or getting started without the guesswork.



3 Watch it in action on YouTube

Prefer a visual guide? Head to WIZnet TV on YouTube for a complete walkthrough on setting up the C/C++ SDK with Raspberry Pi Pico 2.
The video is designed to mirror the GitHub flow, making it easier to follow and implement.

Set up. Run. Iterate.

With official documentation, beginner-friendly tutorials, and video support, the W6300-EVB-PICO 2 offers one of the most developer-accessible Ethernet experiences available.

Everything you need to get started is already online—just pick your path.

8 W6300 Applications

Reference designs that reveal what the W6300 makes possible

By Matthew

Ethernet connectivity is increasingly essential in modern embedded systems across industries. The W6300 TCP/IP offload chip empowers developers to build robust, low-power, and high-performance networked devices—without the overhead of a software stack. To showcase its potential, WIZnet has released hands-on application projects via its Maker Site, illustrating practical use cases with real hardware and open-source firmware.

1. Dual Ethernet on RP2350Project: 2-Port Ethernet Setup on the RP2350



Repo: https://maker.wiznet.io/Lihan__/projects/w6300-based-2-port-ethernet-setup-on-the-rp2350-loopback-example/

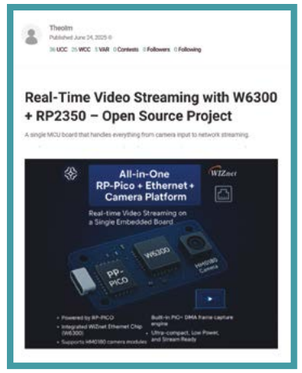
By integrating two W6300 chips with one RP2350 MCU, this project enables independent dual Ethernet ports on a bare-metal platform. It's ideal for industrial gateways or protocol bridges, showing how embedded multi-port Ethernet can be achieved without complex software stacks.

Why it matters:

Expands Pico-class hardware into multi-port Ethernet applications with minimal hardware.hardware.

2. Real-Time Video Streaming with W6300Project: W6300 + RP2350 + HM01B0 Camera

Repo: https://maker.wiznet.io/TheoIm/projects/real-time-video-streaming-with-w6300-rp2350--open-source-project/



Capturing grayscale QVGA frames via PIO/DMA and streaming over UDP, this lightweight design delivers real-time video using only an MCU and W6300. It highlights W6300's capacity for offloading high-throughput data even in resource-limited systems.

Why it matters:

Enables simple vision-based IoT systems without OS, GPU, or external RAM.

Together, these projects demonstrate the W6300's role in enabling high-efficiency, application-specific networking in embedded platforms.

3. Secure Cloud Connectivity with AWS IoT Core



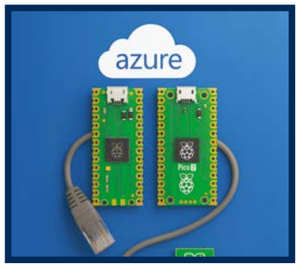
Repo: WIZnet-PICO-AWS-C (https://github.com/WIZnet-ioNIC/WIZnet-PICO-AWS-C)

Security is a non-negotiable feature in today's connected systems—but TLS and MQTT are heavy for most microcontrollers. This example offloads all TCP/IP and TLS workloads to the W6300, leaving the MCU to handle core logic and credentials. With built-in certificate handling and MQTT messaging, it offers a ready-to-extend foundation for secure telemetry products.

A complete, production-aware template for secure IoT deployments—smart meters, asset trackers, and beyond.

4. Azure IoT Hub Integration on Bare-Metal

Repo: WIZnet-PICO-AZURE-C (https://github.com/WIZnet-ioNIC/WIZnet-PICO-AZURE-C)



Targeting Azure-connected infrastructure? This example simplifies Azure IoT SDK usage to work on bare-metal RP2040 or RP2350 platforms. Without RTOS dependencies, it enables direct device-to-cloud messaging and registration via W6300. A lean setup with full cloud compatibility.

For engineers in Azure ecosystems, it bridges embedded hardware with enterprise-grade telemetry pipelines.

5. Real-Time Ethernet with FreeRTOS



Repo: WIZnet-PICO-FREERTOS-C(https://github.com/WIZnet-ioNIC/WIZnet-PICO-FREERTOS-C)

Concurrency meets connectivity. This repository demonstrates how W6300 integrates into task-oriented FreeRTOS applications—managing socket communication in sync with real-time logic. From queue handling to modular socket tasks, the structure suits systems that must balance timing, reliability, and multiple connections.

Applicable to machine controllers, networked sensors, and any time-sensitive embedded system.

These open-source examples are more than starter templates. They're proven approaches for embedding Ethernet into real-world designs—with the W6300 simplifying the complex and expanding what's possible in compact, connected hardware.



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