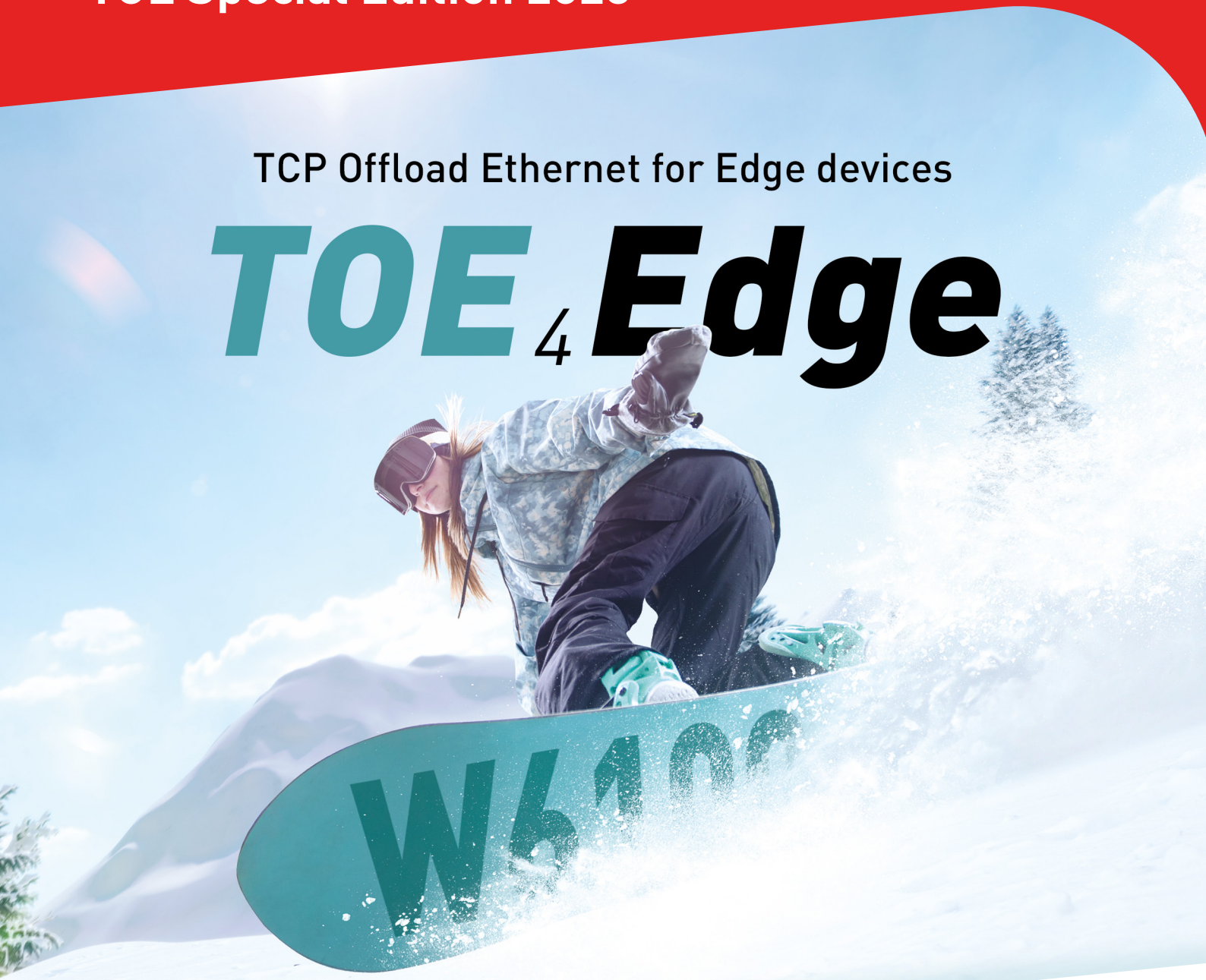
WIZNET MAGAZINE

WIZ Mag

TOE Special Edition 2023

TCP Offload Ethernet for Edge devices

TOE 4 Edge



maker.wiznet.io

WIZnet

1

WIZnet TOE

By Teddy

Real-world Performance of 80 MHz SPI Clock Implemented with STM32H723 and W6100 : Performance Measurement and Analysis through iPerf

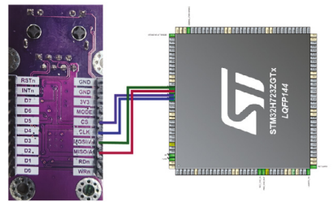
Introduction

The W6100 Ethernet controller, based on SPI (Serial Peripheral Interface), incorporates WIZnet's TOE (TCP Offload Engine) technology, theoretically allowing it to operate at up to 80MHz. WIZnet's TOE technology offloads the handling of the TCP/IP stack from the main processor, freeing up MCU resources for faster and more efficient network communication. However, theory and practice can differ. With the advent of MCUs like STM32H723, which allow SPI Clocks up to 80MHz, the opportunity has arisen to implement these theoretical limits in actual scenarios. In this context, we introduce the W6100 as a representative product utilizing TOE technology.

Experimental Environment and Configuration

Experimental Environment

MCU	STM32H723 - Based on the Arm Cortex-M7 architecture, it operates at a maximum frequency of 550MHz and provides an SPI Clock of up to 125MHz.
Ethernet Controller	W6100 - Supports IPv4/IPv6 dual stack and has a maximum 16Kbyte TX/RX socket buffer.
Protocol	SPI, clocked at 80MHz
Data Transfer Method	SPI DMA



Methodology

SPI Data Transfer Test	Data transfer was performed between the W6100 and STM32H723 at an SPI clock of 80MHz using SPI DMA.
Performance Measurement	An iPerf2 server was set up on a PC, and the iPerf client program was configured to measure the send performance.

Experimental Results

Send Throughput	The send throughput measured through iPerf was 49.8 Mbits/s.

Applications and Conclusion

Applications	This result enhances the applicability of the W6100 across various domains, including IoT, industrial automation, data centers, and IPv6 network environments. Regarding IPv6 potential, it offers various functionalities such as improved connectivity for IoT devices, enhanced security, and flexibility in network configurations.
Conclusion	The combination of STM32H723 and W6100 shows stable performance even at the theoretical maximum SPI clock of 80MHz. This experiment serves as an important indicator for verifying real-world applicability and extends the performance boundaries of MCUs and Ethernet controllers.

```
[  4] local 192.168.15.7 port 5002 connected with 192.168.15.111 port 50000
[  4]  0.0- 0.1 sec   713 KBytes  49.8 Mbits/sec
[  4] local 192.168.15.7 port 5002 connected with 192.168.15.111 port 50001
[  4]  0.0- 0.1 sec   713 KBytes  49.7 Mbits/sec
[  4] local 192.168.15.7 port 5002 connected with 192.168.15.111 port 50002
[  4]  0.0- 0.1 sec   713 KBytes  49.7 Mbits/sec
[  4] local 192.168.15.7 port 5002 connected with 192.168.15.111 port 50003
[  4]  0.0- 0.1 sec   713 KBytes  49.7 Mbits/sec
[  4] local 192.168.15.7 port 5002 connected with 192.168.15.111 port 50004
[  4]  0.0- 0.1 sec   713 KBytes  49.6 Mbits/sec
[  4] local 192.168.15.7 port 5002 connected with 192.168.15.111 port 50005
[  4]  0.0- 0.1 sec   713 KBytes  49.7 Mbits/sec
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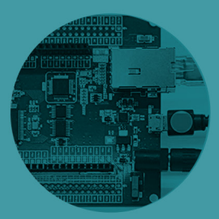
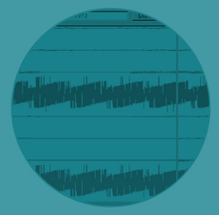
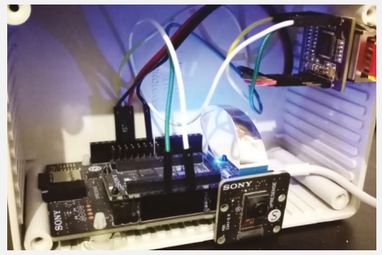
TOE Projects







IPv6 Web Camera Powered by WIZ610io

By Manuel Alejandro Iglesias Abbatemarco

Introduction

A web camera that sends QVGA images to client browsers using either IPv4 or IPv6, powered by the new WIZ610io module by WIZnet.

How it works

This project showcases the new module from WIZnet, Wiz610io, in a web camera application using the Spresense technology by Sony. The new W6100 device from WIZnet offers advantages like IPv6 support and a more robust SPI interface compared to its predecessor, the W5100. The project uses the Sony Spresense board, which doesn't have an Ethernet peripheral, so the Wiz610io module is used to provide this functionality. The camera streams images to a web server, which can be accessed via a browser. The server also offers the ability to change camera filters through a basic HTML form.

Components

Hardware components

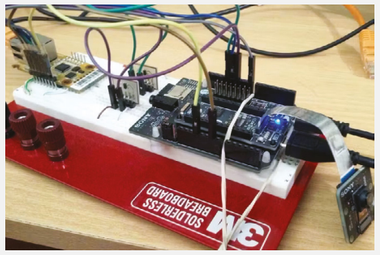
WIZnet - WIZ610io X 1

Sony - Sony Spresense boards (main & extension) X 1

Sony - Sony Spresense camera board X 1

Software Apps and online services

Arduino - Arduino IDE X 1



A Better Web Camera Powered by Sony

By Manuel Alejandro Iglesias Abbatemarco

Introduction

This project aims to leverage the various capabilities of Sony Spresense and utilize an innovative MCU (Microcontroller Unit) to offer a robust camera module to the developer community. The project was initiated to demonstrate the ability to develop products with distinctive features using Sony Spresense technology in a short timeframe.

Sony Spresense

Sony Spresense is an open-source IoT (Internet of Things) development platform developed by Sony. This platform consists of compact hardware boards and software tools, facilitating the development and implementation of diverse IoT projects.

How it works

In this project, hardware components such as the Sony Spresense board, expansion board, WIZnet wiz550io, Texas Instruments SN74AHC1G125, and jumper wires are utilized. The software is implemented using the Arduino IDE.

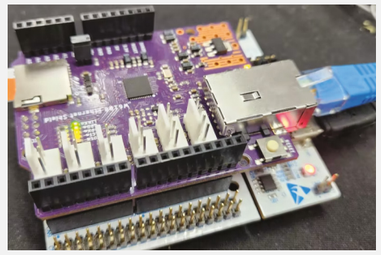
The project involves implementing a webcam using a camera module. Since the Sony Spresense board lacks Ethernet connectivity, the Wiznet module is employed to provide Ethernet connectivity. The advantage of using the Wiznet module lies in its ease of implementation in terms of both hardware and firmware.

The author of this project chose to incorporate the Wiznet module based on prior project experience, wherein it was found that using alternative solutions to the Wiznet chip led to more significant bottlenecks in video streaming implementation.

Components

Hardware components

WIZnet - wiz550io X 1



FTP Server with W6100 and SD card

By Teddy

Introduction

We developed an FTP server using a Nucleo-F401 microcontroller and W6100 Ethernet Shield. A micro SD card serves as storage, and we successfully tested file transfers using WinSCP.

How it works

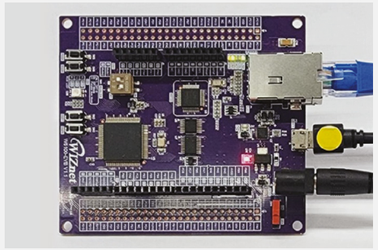
The system is built around the Nucleo-F401 microcontroller and W6100 Ethernet Shield, which handle all networking and server functions. A micro SD card serves as the storage medium. We implemented the FATFS library from STMicroelectronics to manage the file system on the SD card. For testing, we employed WinSCP to verify successful file uploads and downloads, confirming the system's reliability.

Components

Hardware components

STMicroelectronics STM32 Nucleo-64 Board X 1

WIZnet w6100-ethernet-shield X 1



Loopback server using W6100 and STM32F103

By Scarlet

Introduction

The project demonstrates how the W6100 chip can be effectively utilized to create a stable and versatile loopback server, capable of handling both IPv4 and IPv6 protocols. It's an excellent example of how W6100 can be integrated into projects requiring robust networking capabilities.

How it works

The project uses STM32CubeMX with W6100-EVB to create the loopback server. The W6100 chip is central to the project, enabling both IPv4 and IPv6 functionalities. The project involves a series of steps, from preparing the software and hardware to setting up the loopback example and finally building and running the project. The W6100 chip's capabilities shine throughout these steps, offering a stable and efficient networking solution

Components

Hardware components

	WIZnet - W6100-EVB	X 1

Wired Ethernet Radio

By Yves Bourdon

Introduction

In the ever-evolving world of technology, the demand for stable and high-quality internet radio is on the rise. While the Wired Ethernet Radio project is an extension of Elektor's previous ESP32 Radio, what sets it apart is its option for a wired Ethernet connection via the W5500 chip. This feature addresses the common challenges users face with unstable connections, making it a significant advancement in the field.

How it works

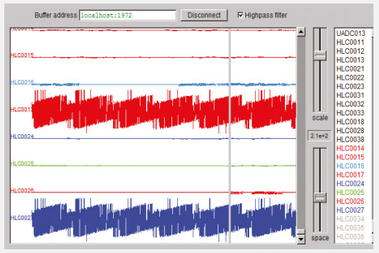
Built on an ESP32WROOM-32D module, the device features a 128x64 OLED display and offers the option of a W5500 Ethernet interface. The W5500 chip is the star, providing a stable and high-speed connection that elevates the device's capabilities.

Components

Hardware components

	ESP32WROOM-32D Module	X 1
	OLED Display	X 1
	WIZnet - W5500	X 1

TOE Projects



Streaming realtime EEG data to and from Arduino

By FieldTrip toolbox

Introduction

The project is a real-time EEG data streaming system. It utilizes Arduino devices and the FieldTrip toolbox to capture, transmit, and visualize brainwave data for various applications. A WIZnet W5100 Ethernet shield is used on one of the Arduino devices to enable network connectivity.

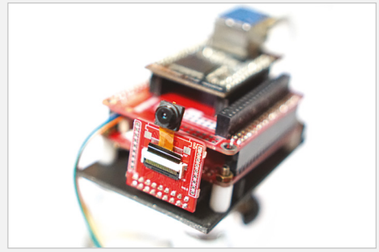
How it works

Data flows through a network of Arduino devices and laptops. Arduino 1 reads from a gravity sensor and sends data via Bluetooth. This data is visualized on a laptop running the FieldTrip buffer. Arduino 2 comes into play. Arduino 2 connects to the network via a WIZnet W5100 Ethernet shield and reads the stored data from the FieldTrip buffer. and sends it to RFM12b, a low-power wireless communication module. Arduino 3 receives this data from RFM12b and processes it to control a series of LEDs, making them blink in a pattern that represents the incoming data.

Components

Hardware components

	Arduino - Arduino Pro Mini	X 3
	WIZnet - W5100 ethernet shield	X 1



OV2640 Transmitting Image via W5300 Web Server

By nexp (Engineer's LAB)

Introduction

This is a blog post by WIZnet Chip user, nexp.
He designed the STM32F4-RP board using the STM32F417Z and transmits images to a web server via the W5300, utilizing the OV2640 camera.

How it works

Nexp, has designed a board named STM32F4-RP using the STM32F417Z. Initially, a web server was implemented on this board through the W5300, followed by the integration of the OV2640 camera module to provide images.
Through this article, you can learn how to use the OV2640 on the STM32 series and how to transmit images via the W5300 web server.
The author has written about transmitting images in both JPEG and RAW formats.
The source code is made available on Github, and video have also been produced on YouTube for a more detailed overview.

Components

Hardware components

	WIZnet - W5300	X 1
	STMicroelectronics - STM32F147Z	X 1
	OMNIVISION - OV2640	X 1

Software Apps and online services

	STMicroelectronics - STM32CubeIDE	X 1

3 TOE Design Contest

By Sophia

TOE Design Contest

The TOE Contest has brought together the brightest minds in the IoT realm to showcase their skills and creativity. With the formidable W5300 network controller chip or W5300-TOE-Shield, participants have harnessed its power to breathe life into their IoT visions like never before.

One of the standout features of TOE (TCP/IP Offload Engine) lies in its ability to provide Internet connectivity without the need for a separate embedded system software stack. This not only conserves precious memory resources but also guarantees consistent performance in various network environments. Unlike software-based TCP/IP stacks, which are susceptible to network fluctuations, DDoS attacks, and flooding, TOE's independent Ethernet controller ensures robust and stable Ethernet performance.

The results were nothing short of remarkable. The contest received an overwhelming response, with participants from diverse backgrounds and industries. The innovation showcased through the projects was a testament to the prowess of the W5300 chip and the participants' dedication.

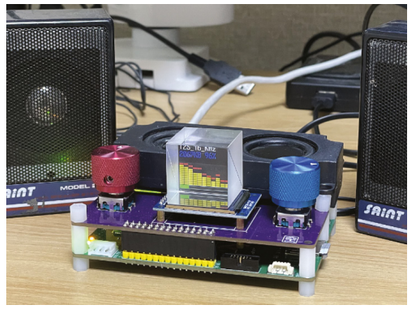
The WIZnet TOE Contest has been a journey of innovation, exploration, and collaboration. It has showcased the potential of IoT to revolutionize industries and redefine the way we interact with the world around us. As the IoT ecosystem continues to evolve, the legacy of the WIZnet TOE Contest will inspire future innovators to push boundaries and reshape the technological landscape.

Contest Award Winners

For more details on all projects please check following link

URL: http://maker.wiznet.io/contest/toe-design

WIZNET-IOT-SPEAKER



Hancheol Jo

The WIZ-IOT-SPEAKER project utilizes WIZnet's W5300 chip for real-time audio streaming from a PC to a speaker. It focuses on custom board design, extensive documentation, and multiplatform compatibility. Key requirements include efficient data transmission and bidirectional communication, with considerations for custom board features and development tools like Visual Studio Code and STM32CubeH7.

https://maker.wiznet.io/chcbaram/contest/wiznet-iot-speaker-1/

AI-driven IoT Shopping Assistant w/ ChatGPT

Kutluhan Aktar

An AI-driven IoT shopping assistant integrates AI into physical store shopping without changing local businesses' infrastructure. It uses barcodes for product identification and connects to a web app for AI-based recommendations. This cost-effective solution enhances the shopping experience by blending e-commerce features with traditional retail. The project involves developing a web app in PHP, HTML, JavaScript, CSS, and MySQL to facilitate communication and data retrieval.

https://maker.wiznet.io/kutluhan_aktar/contest/ai-driven-iot-shopping-assistant-w-chatgpt/

Generative kAiboard - Beyond Typing with Generative AI

Pamungkas Sumasta

The Generative kAiboard is an internet-connected keyboard powered by ChatGPT, integrating a virtual assistant and more. It's inspired by the transformative potential of generative AI and aims to merge keyboard input with AI capabilities. The project is a culmination of technical prowess and artistic inspiration, serving as a testament to human creativity and innovation. The creator expresses gratitude to Wiznet for hosting the design contest that motivated this endeavor.

https://maker.wiznet.io/sumasta/contest/generative-kaiboard-beyond-typing-with-generative-ai/

4 TOE Design Contest

Contest Participant Interview

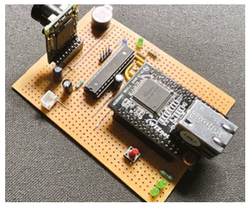
By Sophia

Name Jaroslaw Juda

Project Name W5300 IP 3D Camera over Single Pair Ethernet

WiIP camera built on the basis of ToF (Time of Flight) matrices for and using the W5300 internet coprocessor chip. It provides an 3D images.

Q	A
Tell us a bit about yourself. (Name, age, location, job/profession, etc.)	Jaroslaw Juda, 56, Poland, Hardware designer
How did you find out about our contest?	The Elektor Magazine email
How would you rate your overall experience in the contest?	A very pleasant experience. But you required to specify the components and applications that I use. But they weren't on the list. My request to create new components was created but no one took care of it.
Were the contest rules and guidelines clear? How would you rate the organization of the contest?	The rules were clear. Thank you for extending the submission deadline, otherwise I would not have made it.
What did you think about the product in the contest?	A very powerful and useful chip. What I like the most is its bandwidth and the presence of two interfaces to choose from
What were some difficulties you faced using our product in the contest?	The API could be a bit clearer, but I managed.
What inspired you to use the product the way you did?	I've been looking for an Ethernet chip for some time that could provide classic PHYs and single pair PHYs directly or by MII



Name Ravi Butani

Project Name Wiz IoT Cam using W5300 TOE and 8051 limited resource uC

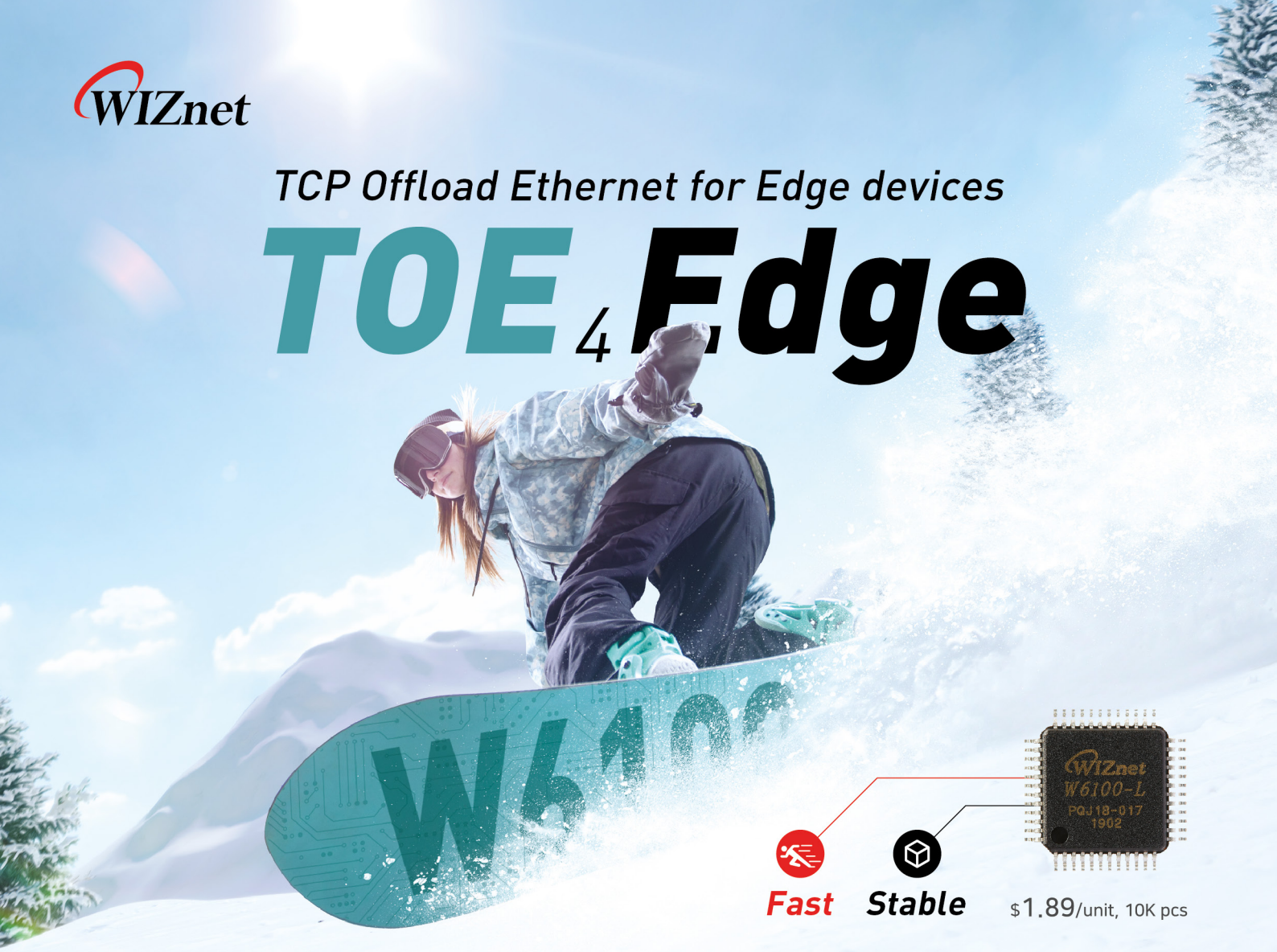
To show W5300 capability as TCP Offload Engine to interface it with 8051 core based MG8218D16 simple uC and OV2640 Camera with MQTT

Q	A
Tell us a bit about yourself. (name, age, location, job/profession, etc…)	Name Ravi Butani, 38Yrs age, from INDIA, Educator and Maker
How did you find out about our contest?	Via email
How would you rate your overall experience in the contest?	Overall contest experience was amazing.
Were the contest rules and guidelines clear? How would you rate the organization of the contest?	Contest rules and guidelines clear were very clear. Organization of contest was also excellent
What did you think about the product in the contest?	W5300 ToE is great chip to tap high speed network capability in limited resource embedded device.
What were some difficulties you faced using our product in the contest?	In this contest I have used 8051 core based low cost MG82F6 megawin microcontroller, unfortunately no direct support available for w5300 on 8051 uC so I have to develop entire firmware from scratch without any third party libraries and having only reference of w5300 datasheet..
What inspired you to use the product the way you did?	Goal of my project is to show capability of W5300 TOE chip to interface it with low cost (0.2$) limited resources 8051 core based MG82F6D16 uC and develop IoT based camera to capture and transfer image via MQTT using onboard ARDUCAM 2MP camera to Wizcam android application running anywhere in world. (Without having luxury to use Arduino IDE and 3rd party libraries for W5300, Arducam OV2640 and MQTT :))
Would you recommend our products to anyone?	Yes W5300 ToE is only Solution available for High Speed Ethernet connectivity
What aspects do you think could be improved for future events?	Editing project documentation may be more interactive.
Any other thoughts or suggestions you'd like to share?	Looking forward for 2024 Wiznet Contest edition with some cool Wiznet products.

WIZnet

TCP Offload Ethernet for Edge devices

TOE 4 Edge



Fast **Stable** $1.89/unit, 10K pcs

CoreMark Score

TOE Chip	■■■■■■■■■■	173.34
SW TCP/IP	■■■■■	84.9

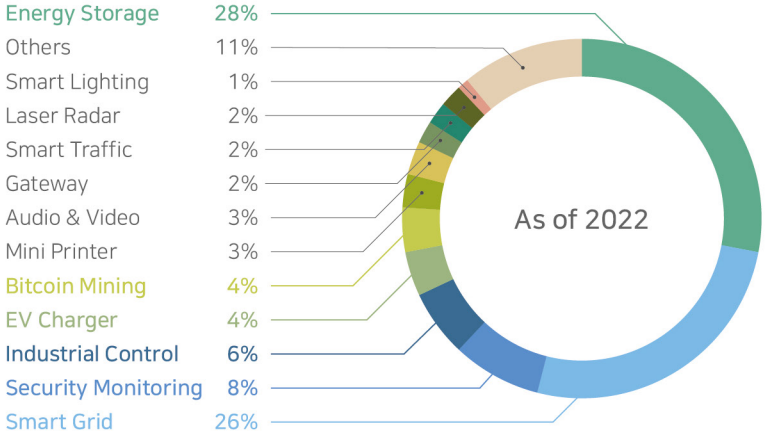
Tested on a Cortex M0+ by continuously sending and receiving TCP data from an echo server

Iperf performance (Mbps)

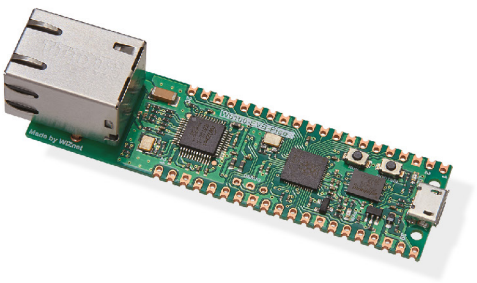
W6100	■■■■■■■■■■	50
SW TCP/IP	■■■■■	25

Tested by Iperf at SPI 60Mhz

TOE Chip Applications



W6100-EVB-Pico



Powered by Raspberry Pi

$9.95