

# Mango NetworkBoost™ TCP

Maximize Server Efficiency and Performance  
with Our World-class TCP Offload Engine



## EXECUTIVE SUMMARY

Mango NetworkBoost™ - TCP enables high-performance, low-overhead TCP networking by fully offloading the TCP stack from the CPU to the FPGA hardware accelerator. By offloading the TCP stack to hardware, Mango NetworkBoost™ - TCP offers higher TCP throughput with fewer CPUs for various data center applications such as web servers, AI inference, and distributed storage systems.

Mango NetworkBoost™ - TCP offers two PFs, each supporting up to 100 Gbps line rate and 50K concurrent connections. It fully offloads the TCP stack, including stateful TCP processing compliant with the latest TCP specification (RFC 9293), a diverse range of TCP options (e.g., window scale, MSS), and other advanced features such as ECN or jumbo frame.

The conventional data center infrastructure can be easily integrated with Mango NetworkBoost™ - TCP. It provides a POSIX-compliant socket API that enables seamless integration of existing applications without any modification. It is also fully compatible with commercial networking infrastructures such as Ethernet switches and NICs.

The architecture of Mango NetworkBoost™ - TCP is flexible and fully customizable to easily support user-defined or advanced TCP features. It also provides hardware interfaces for integration with various Mango or third-party FPGA IPs for storage, network and security.

## HIGHLIGHTS

### HIGH PERFORMANCE, LOW-OVERHEAD TCP OFFLOAD SOLUTION

- Each network port provides line-rate performance (up to 2x 100GbE)
- Near-zero CPU overhead in TCP processing
- Full-stack TCP offloading compliant with RFC 9293

### SEAMLESS INTEGRATION WITH EXISTING INFRASTRUCTURE

- No application modification required via standard POSIX socket API hooking
- Easy-to-use solution for seamless integration into existing systems
- Fully compatible with commercial Ethernet switches and NICs

### FLEXIBLE AND CUSTOMIZABLE DESIGN

- Easy support for user-defined or advanced TCP features
- Integration with various Mango or third-party IPs for storage, network and security

## SPECIFICATIONS

### USE CASES

- HTTP web server (e.g., Nginx)
- AI inference server (e.g., Triton)
- Distributed storage system (e.g., Ceph)
- NVMe Over Fabrics using TCP

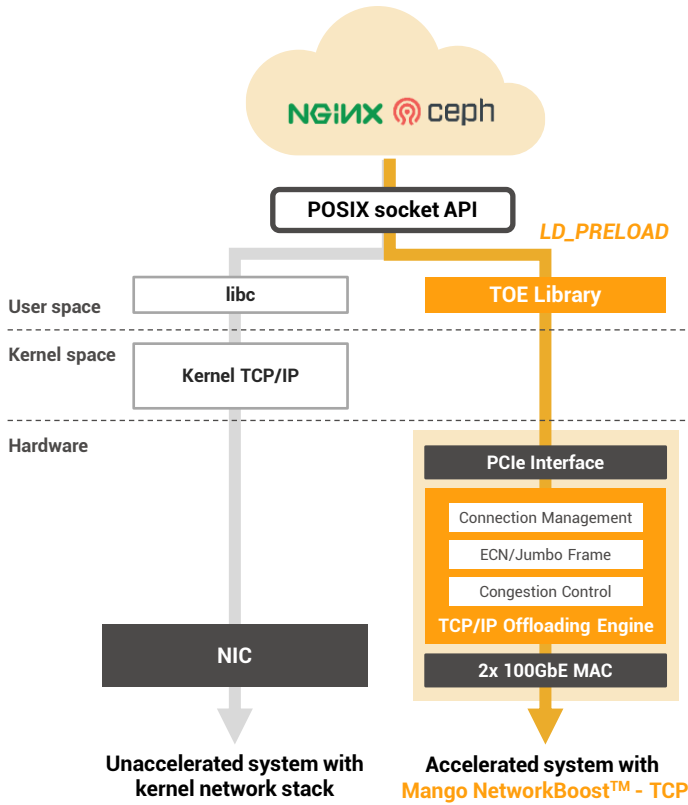
### CAPABILITIES

- Full-stack TCP offloading
  - > RFC 9293 compliant
  - > IPv4, ARP offloading for TCP stack
- 2x 2K TCP connections (can be scaled up to 2x 50K)
- Customizable CC algorithm (e.g., Tahoe, New-Reno)
- Explicit Congestion Notification (ECN)
  - > RFC 3168 compliant
- Jumbo frame (up to 9000B)

### INTERFACE CONFIGURATION

- PCIe Interface
  - > PCIe 3.0 x16 or PCIe 4.0 x8
- 2 Physical Functions
- Ethernet Interface
  - > 2x 100GbE QSFP28
- Portable Design
  - > AMD/Xilinx Alveo™ FPGAs
  - > Intel/Altera Agilex™ FPGAs
- User-space POSIX socket API for lightweight software integration
- POSIX-like hardware API for FPGA IP integration
- Usable as a generic network interface for non-TCP use cases

## DESIGN OVERVIEW



**Mango NetworkBoost™ - TCP** consists of the hardware TCP/IP Offloading Engine and the software user-level TOE library.

### TCP/IP Offloading Engine

The TCP/IP Offloading Engine processes TX/RX packets using per-connection TCP metadata such as TCP state, sequence number, and window size. All TCP-related operations, including connection management, reliable data transfer, congestion control, and packet creation, are fully offloaded to the hardware accelerator. Users can customize it to support more advanced TCP features or user-defined TCP algorithms.

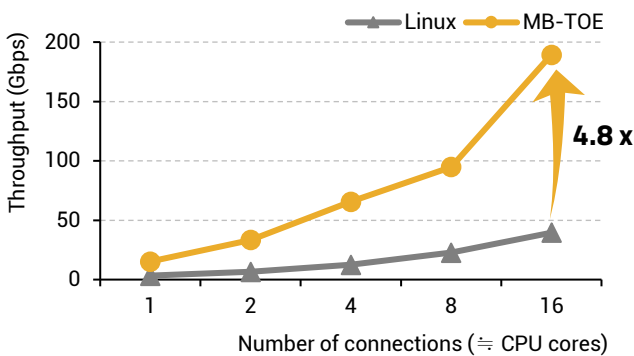
### TOE Library

The user-level TOE library acts as a bridge between the TCP/IP Offloading Engine and the user application. The library hooks POSIX socket API calls from the user application using LD\_PRELOAD and controls the TCP/IP Offloading Engine accordingly. Users can offload the entire TCP/IP stack in the Linux kernel using this library without modifying the applications.

## EVALUATION RESULTS

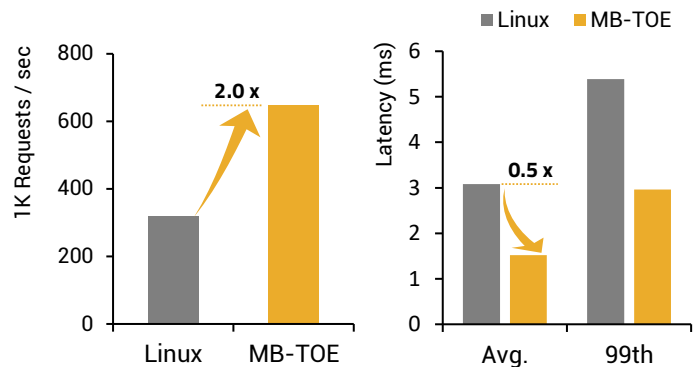
### Network Throughput Test

2x100G TCP/IP offload with iPerf network benchmark



### Web Server Performance

1K HTTP connections with NGINX web server



\* All the results were measured on Xeon Gold 6338

### DISCLAIMERS

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