

Analyzing a Platform's TCP Performance and Compliance



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About TCP

- **One of the core protocols of the Internet protocol (IP) suite**
- **Provides reliable, in-order delivery of a byte stream**
- **Provides a communication service at an intermediate level between an application program and the IP**
- **Often referred to as "the TCP/IP suite"**

About Systems Running TCP

- **TCP is suitable for apps like file transfer and e-mail therefore, it plays a key role for:**
 - **Embedded processors and microcontrollers**
 - **Smart phones**
 - **Network attached storage devices and routers**
 - **Televisions**
 - **Industrial systems**
 - **And more....**

Applicability in a Wide Range of Applications

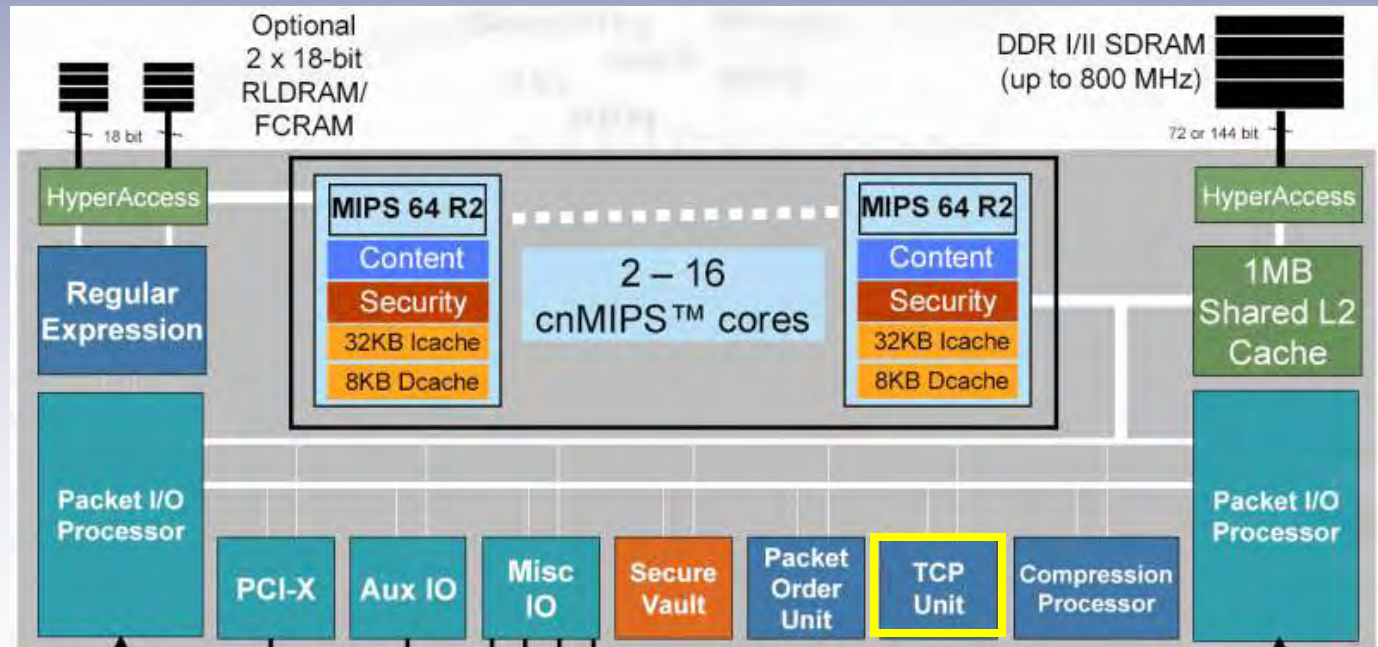
Reasons to Test TCP

- TCP was first introduced in 1974
- TCP is very ‘standardized’ so why the need to test it now?
 - Performance (e.g. sustained packets transferred)
 - Compliance
- Main reason depends on the platform

EEMBC and Ixia Collaborate to Deliver INDUSTRY-STANDARD TCP-IP Performance and Compliance Test

Embedded Processors and Microcontrollers

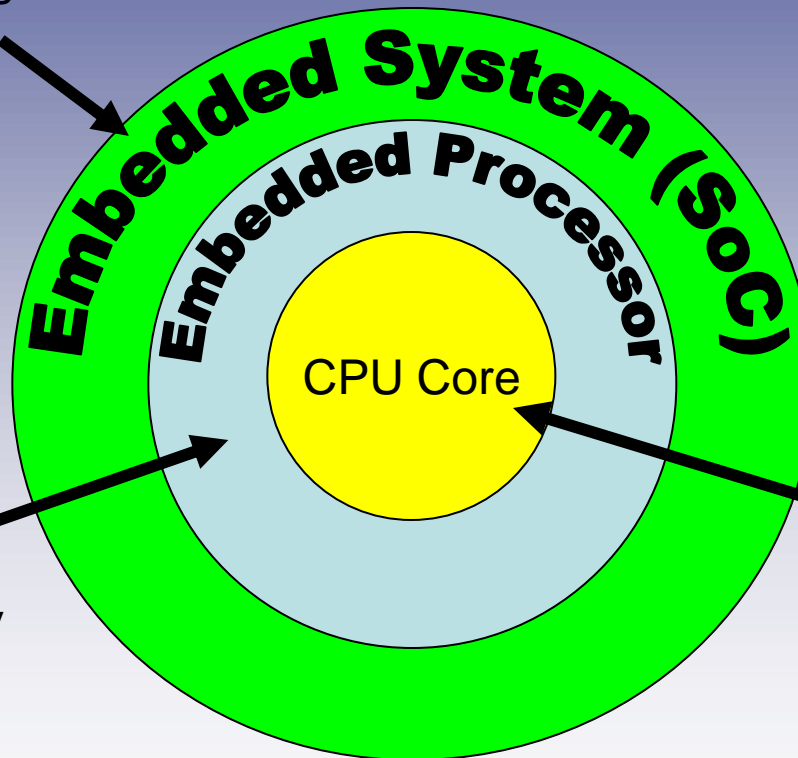
- Range from low-end to high performance
- Many with integrated TCP support
- Key to measure bandwidth, latency, and compliance
- Discover the platform limitations based on real-world loading



Traditional Embedded Processor Benchmarking

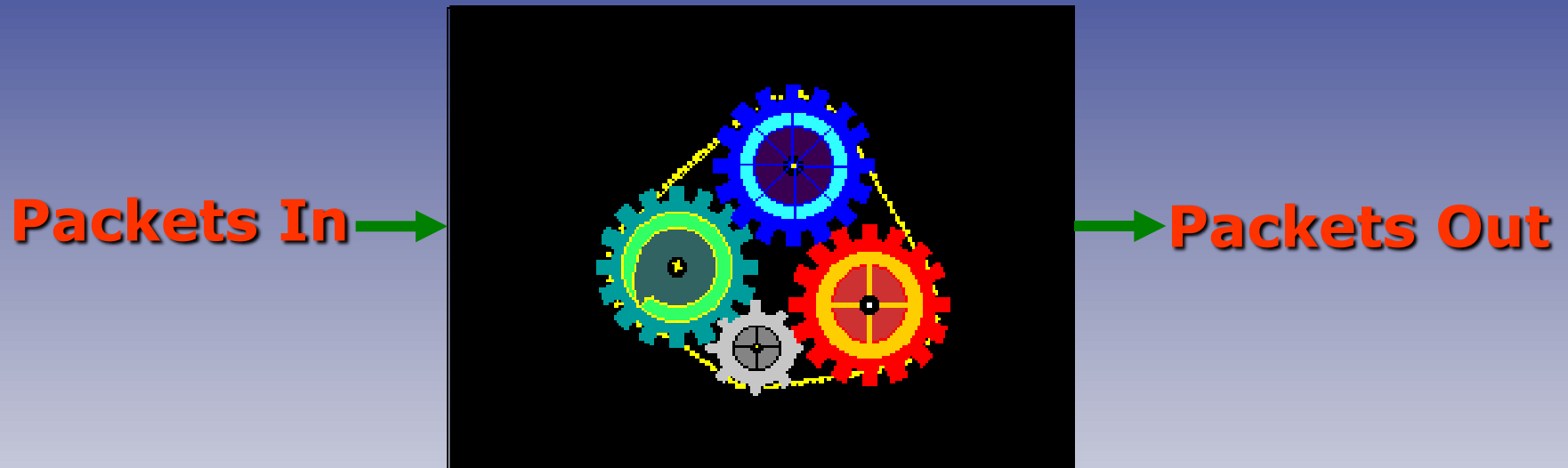
- Tests interaction of system elements
- I/O and peripheral testing
- Scenario-driven tests

- The domain for traditional EEMBC benchmarks (i.e. AutoBench, DENBench)
- Tests for CPU and memory subsystem
- Includes MultiBench



CoreMark domain

TCP Testing for Embedded Processor



- Methodology defines the workload, the inputs, and expected outputs
- Important to measure performance AND compliance
 - Shortcuts are possible to enhance performance. E.g. ignore TCP timers on local storage server. This must be captured to enable comparison between devices.

TCP Performance Requires Traffic Generation



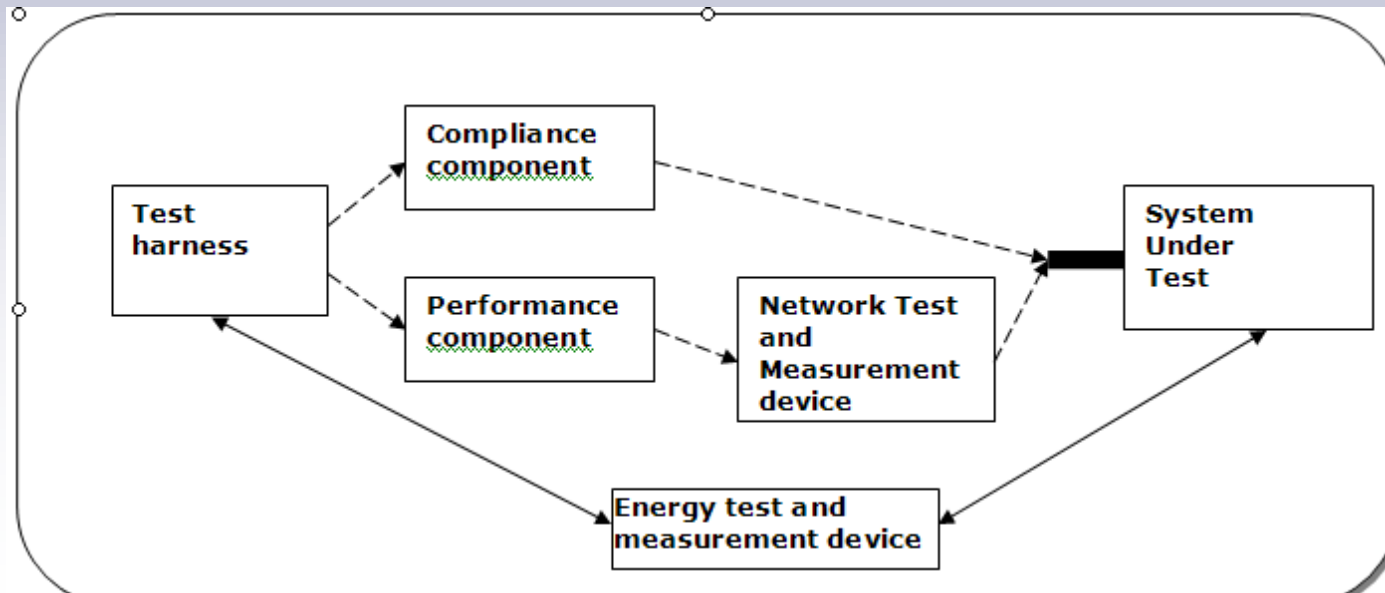
- Why do we need to do system-level testing?
 - No standard for measuring performance (similar to MPG in cars or PPM in printers – only true under certain assumptions).

EEMBC EETCP Benchmark

- Benchmark to evaluate a system's ability to act as a TCP/IP server
- To emulate system behavior using realistic TCP/IP client scenarios
 - Assumptions for client behavior
 - Definition of scenarios to apply these assumptions
 - A mechanism supported by the benchmark to emulate those scenarios
- Traffic generation provided by IxLoad
- Performance measured using IxLoad TCL interface

EETCP Goals

- Test DUT (software and hardware implementation) in TCP/IP server and proxy mode
- Core TCP/IP operations are exercised (e.g., connection setup, tear down and data transmission)
 - Connections setup and tear down per second with specific parameters (clients, networks).
 - Transactions/sec with specific parameters (clients, networks, packets sizes)
- Traffic profiles based on client scenarios and not necessarily real traffic
- Traffic profiles are defined to cover TCP/IP functionality and client and network conditions emulation



DUT Details

- The Device Under Test (DUT) is the combination of hardware and software that provides the TCP/IP Server or proxy application
- The DUT is provided by hardware/software vendors
- The DUT performs
 - TCP/IP stateful proxying that forwards TCP/IP packets between clients and servers
 - TCP/IP server that receives, processes and responds to client requests

Hardware/Software for Packet Delivery

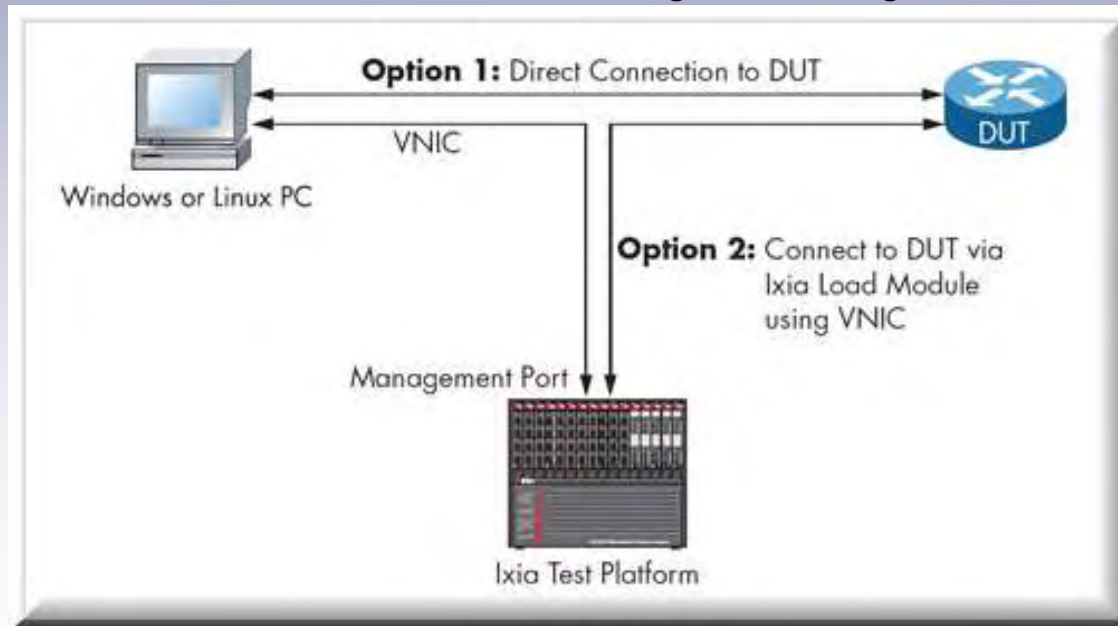
- Ixia's IxANVL (Automated Network Validation Library)
- Testing conformance of networks and devices to validate Internet protocol specifications
- Flexible test automation capabilities
- Includes many protocol libraries and utilities, including testing for MPLS, IPSec, FCoE, and SAN conformance

More on IxANVL

- Runs using minimal hardware
 - PC with Linux or Windows
 - Ethernet card
- Designed to operate on Ixia's test and analysis platform via a VNIC (Virtual Network Interface Card) driver
- Supports all industry-standard test interfaces, from 10/100/1000 to 10G

IxANVL Setup

- Uses EEMBC suite executable with IxANVL to test compliance
- Performance measured using IxLoad TCL interface
- EEMBC framework configures platform for specific conditions, measures performance using standardized run rules
 - Run rules automatically followed using script built into framework
 - Framework relies on IxLoad Tcl API to configure traffic generator/analyze traffic



Benchmark Infrastructure Application

- The benchmark infrastructure application is responsible for conducting the tests
- Benchmark infrastructure consists of Client, Server and Control Applications
- The control application performs the following tasks
 - Maintains profiles for scenarios
 - Controls multiple client generators to run various traffic profile
 - Collects results from client and server applications
 - Generates report about the run based on the collected data and expected data for the specific profile (s)
- Simple reference server code in C for Linux provided

Clients and Servers

- Clients serve two purposes
 - To validate the functionality of TCP/IP server
 - To generate stress tests based on the profiles
- Following App or devices are used as Clients
 - ANVL or similar application for functionality testing
 - Ixia traffic generators for load testing
- Servers used to test proxy mode of DUT
 - Servers can be standard TCP/IP Linux applications or traffic generators

Benchmark Covers 24 Scenarios

Ethernet

Technology Summit

- Scenario 1 - Three way handshake PASS
- Scenario 2 - Simultaneous open PASS
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- Scenario 7 - Re-Assembly PASS
- Scenario 8 - Slow Start and Congestion Avoidance FAIL
- Scenario 9 - Sliding Window Protocol PASS
- Scenario 10 - Silly Window Syndrome Avoidance FAIL
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-
-
- Scenario 20 - Timestamp Option FAIL
- Scenario 21 - PAWS PASS
- Scenario 22 - TCP Connection setup and teardown 1.3e6
Connections/sec
- Scenario 23 - TCP bandwidth measurement 1e4 Bytes/sec

* Actual certification also include hardware and software details. The benchmark includes complete description of each individual scenario being tested.



- Due to focus on embedded systems, defined minimum compliance requirements.
 - RFCs 793, 1122, 1323, 2018, 2581, 2582
- Actual compliance is part of the benchmark report – performance results alone are not comparable or sufficient!

- Performance scenarios for connections/sec and throughput.
- Everything defined and standardized
 - IP address and Netmask
 - Client MAC addresses
 - TCP handshake protocol options
 - Actual content of packets expected
 - Etc...

Certified TCP Testing

- EEMBC certification to verify full compliance to standardized run rules
- The EEMBC Technology Center (ETC) offers independent benchmark testing services including full system configuration and setup
- Utilizes Ixia's iSimCity as a base for EETCP test validation operations
 - Proof-of-concept lab that helps enterprise, equipment vendors and carriers use extreme scale test beds to validate scaled equipment performance and deployment models

Eliminate Doubts – Use EETCP

- Available for use by EEMBC's members
- Licensed by non-members
 - Free to any non-member with proof of ownership of the required IXIA equipment
 - EEMBC Technology Center offers official certifications for prices starting at \$6000 for platforms supporting 1-48 ports of 1 Gigabyte Ethernet (1GbE) or 9-16 ports of 10GbE

Prove Your Product's Credibility for TCP Performance and Compliance