zti Communications

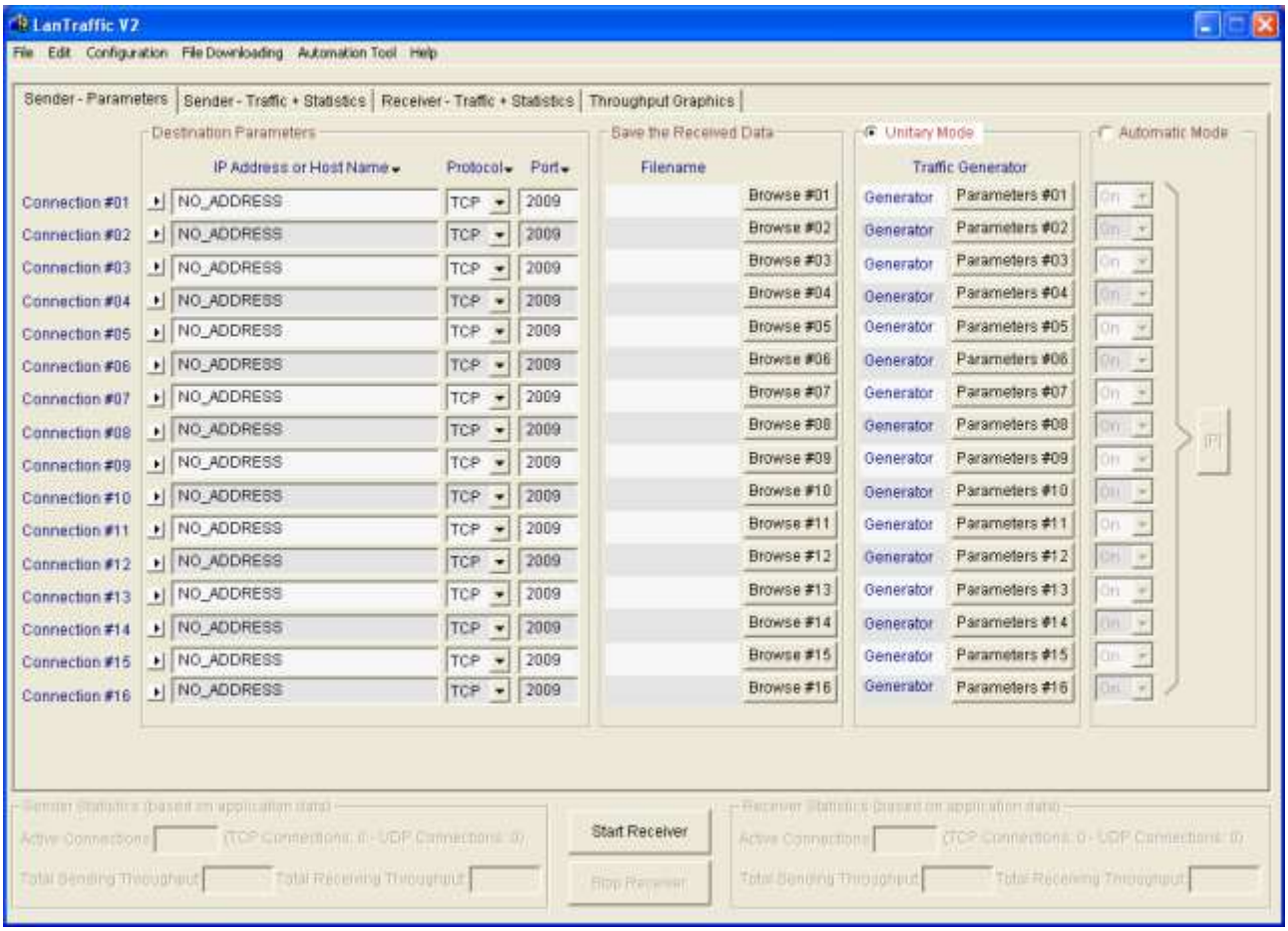
LanTraffic V2 Standard

LanTraffic V2 Enhanced

Versions 2.6

Traffic Generator for IP Networks (IPv4 & IPv6)

FTTx, LAN, MAN, WAN, WLAN, WWAN, Mobile, Satellite, PLC, etc.



Performance Characteristics on Fast Ethernet, Gigabit and 10 Gigabits networks

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Abstract

To measure performance of traffic generator software, one should consider multiple performance aspects. Major parameters are linked to:

A- Physical throughput that corresponds to the percentage of the data link usage

B- Number of packets sent per second

C- Application throughput.

Item C is the most important for the user because it determines the throughput available for other applications. This document summarizes performance results with **LanTraffic V2** and **LanTraffic V2 Enhanced** through the following configurations: a standard Fast Ethernet LAN and a Gigabit Ethernet configuration - copper based interface. Tests were performed at ZTI Test Lab. The performances that could be expected with **LanTraffic V2 Enhanced** on a 10 gigabits network are extrapolated from gigabit performances results.

1 Introduction

In this document, you get an overview of performance that can be expected from **LanTraffic V2** and **LanTraffic V2 Enhanced** with the same configurations as tested in our lab. User may achieve better performances than one presented in this document with a more powerful PC, with other Ethernet architectures or NICs, for example if the TCP stack is embedded into the NIC.

For reference tests, both PC Desktops and Servers were used. The reasons are:

- A Gigabit network needs fast PCs to make tests. We have included tests with Gigabit Ethernet boards. We selected PCs that guarantee efficient CPU, memory and disk subsystem architecture. These systems, we have installed Windows XP Pro with Service Pack 2 and Windows Seven.

- For Fast Ethernet tests, common PC desktops with Pentium IV have been used.

The operating system is one of the most important parameters of the test bed. Windows Seven offers a new IP stack (with IPv4 and IPv6), containing many enhancements and improvements. Tests were performed with the two IP versions.

The Fast Ethernet tests and the Gigabit tests have been done with Windows XP Pro Service Pack 2 and Windows Seven. The Ethernet NICs used were made by BroadCom (used for the Fast Ethernet tests) and Intel (used for the Gigabit tests). Please refer to the appendix to get the complete hardware details of all computers used.

The **LanTraffic V2** and **LanTraffic V2 Enhanced** version used is 2.6.0. Do not activate any software other than **LanTraffic V2** or **LanTraffic V2 Enhanced** and **Automation Tool for LanTraffic V2** or **Automation Tool for LanTraffic V2 Enhanced** to avoid decreasing the CPU availability.

Note that antivirus software and/or Windows Firewall should be shutdown in order to obtain the optimum performance.

Automation Tool for LanTraffic V2 *or* ***Automation Tool for LanTraffic V2 Enhanced*** *are used to run the performance scenarios provided with the software. This allows one to reuse configuration parameters in order to replay the same sequence of tests under different operating systems or different network architecture.*

This document is organized as follows:

- **Throughput Measurements Results on Fast Ethernet and Gigabit Network**

This section shows the results obtained in our test labs.

- **Throughput Performances that could be expected on 10 gigabits networks**

This section presents the performances that could be reached on a 10 gigabits network with **LanTraffic V2 Enhanced**.

- **Description of the three tests benches**

This section describes the architecture of the three tests benches used and the parameters used.

- **Appendix**

This section explains calculation method used to estimate the link usage rate and provides additional information regarding hardware configurations. It presents also an example of 10 gigabits hardware configuration that could be used with **LanTraffic V2 Enhanced.**

2 Throughput Measurements Results on Fast Ethernet and Gigabit Networks

2.1 Description of the results tables content

Different tables of results provided herein show all throughput measurements realized. These throughput measurements are based on the application level data, i.e. data without the MAC, IP and TCP or UDP headers. Data throughput measurements on Fast Ethernet Network are in (in Mb/s). Estimated link usage rate is given between in parenthesis.

2.2 Data Throughput Measurements (in Mb/s)

These tests use the configuration 1 (Fast Ethernet tests. Refer to *§ 3.1*) and use the configuration 2 (Gigabit tests. Refer to *§ 3.2*)

Number of cnx	Windows XP	Windows Seven
1 UDP	95.4 Mb/s (98.4 %)	**95.7 Mb/s (98.7 %)**
1 TCP	94.6 Mb/s (98.3 %)	**94.9 Mb/s (98.6 %)**
16 UDP	**95.7 Mb/s (98.7 %)**	**95.7 Mb/s (98.7 %)**
16 TCP	94.7 Mb/s (98.4 %)	**94.9 Mb/s (98.6 %)**

*Table 1 - Fast Ethernet measurements with **IPv4***

Number of cnx	Windows XP	Windows Seven
1 UDP	**94.4 Mb/s (98.6 %)**	**94.4 Mb/s (98.6 %)**
1 TCP	**93.6 Mb/s (98.7 %)**	**93.6 Mb/s (98.7 %)**
16 UDP	**94.4 Mb/s (98.6 %)**	**94.4 Mb/s (98.6 %)**
16 TCP	**93.6 Mb/s (98.7 %)**	**93.6 Mb/s (98.7 %)**

*Table 2 - Fast Ethernet measurements with **IPv6***

Number of cnx	Windows XP	Windows Seven
1 UDP	905.7 Mb/s (93.4 %)	**942.4 Mb/s (97.1 %)**
1 TCP	911,4 Mb/s (94.7 %)	**940.7 Mb/s (97.7 %)**
16 UDP	944.4 Mb/s (97.3 %)	**952.1 Mb/s (98.2 %)**
16 TCP	**923.0 Mb/s (95.9 %)**	918.1 Mb/s (95.4 %)

*Table 3 - Gigabit measurements with **IPv4***

Number of cnx	Windows XP	Windows Seven
1 UDP	863.8 Mb/s (90.3 %)	**938.3 Mb/s (98.1 %)**
1 TCP	894.6 Mb/s (94.3 %)	**930.6 Mb/s (98.1 %)**
16 UDP	933.8 Mb/s (97.6 %)	**939.2 Mb/s (98.1 %)**
16 TCP	**922.1 Mb/s (97.2 %)**	911.6 Mb/s (96.1 %)

*Table 4 - Gigabit measurements with **IPv6***

UDP connections are more efficient than TCP connections to fill the network link.

Tables show that the best link usage rate is reached by using UDP connections especially on Gigabit network. With Windows Seven, even a single UDP connection has a link usage rate higher than multiple TCP connections. This confirms that UDP protocol should be used when maximum performance is required: the TCP connection measure is much lower than the worst UDP connection.

Performance with Windows Seven is better than with Windows XP for single connections.

As shown in Table 3 and Table 4, performance under Windows Seven is higher than with Windows XP for a single connection. For multiple connections performance is very close.

2.3 Packets Throughput Measurements

The table 5 shows the maximum number of UDP packets per second that LanTraffic V2 can send. Such values are useful for VoIP (Voice over IP) tests.

	*Windows XP**	*Windows Seven**	*Windows XP***	*Windows Seven***
Fast Ethernet IPv4	**55309 packets/s**	55308 packets/s	58532 packets/s	**58963 packets/s**
Fast Ethernet IPv6	**50813 packets/s**	50808 packets/s		
Gigabit IPv4	100290 packets/s	**131655 packets/s**	160447 packets/s	**236852 packets/s**
Gigabit IPv6	116966 packets/s	**129728 packets/s**		

Table 5 - Packets per second measurement

* These tests use the configuration 1 (Fast Ethernet) and the configuration 2 (Gigabit) (refer to *§ 3.1* and *§ 3.2*)

** These tests use the configuration 3 (Fast Ethernet and Gigabit) (refer to *§ 3.3*)

In these tests performance on Gigabit and Fast Ethernet networks are very close on both operating systems except on Gigabit network.

Hardware components quality is crucial for optimum performance

For all tests the type of bus used by the NIC is the first and most important parameter. That is the main difference between Fast Ethernet and copper gigabit configurations.

CPU and bus type are critical elements

The number of CPUs and the hyperthreading systems help to handle interruptions generated by packets exchanges. The capacity to handle interruptions limits the number of packets that can be exchanged. This might explain why performance is better on Gigabit test bed rather than on the Fast Ethernet test bench.

3 Throughput Performances that could be expected on 10 gigabits networks with LanTraffic V2 Enhanced

By using the same software parameters than the one used with the gigabit configuration (Gigabit tests. Refer to *§ 3.2*), the performances below could be expected on a 10 gigabits network.

Number of cnx	*Gigabit performances*	*Expected Performances on 10 Gb/s Network*
1 UDP	**942.4 Mb/s**	**Up to 4.7 Gb/s**
1 TCP	**940.7 Mb/s**	**Up to 4.7 Gb/s**
16 UDP	**952.1 Mb/s**	**Up to 4.8 Gb/s**
16 TCP	**918.1 Mb/s**	**Up to 4.6 Gb/s**

*Table 6 – Expected performances with **IPv4***

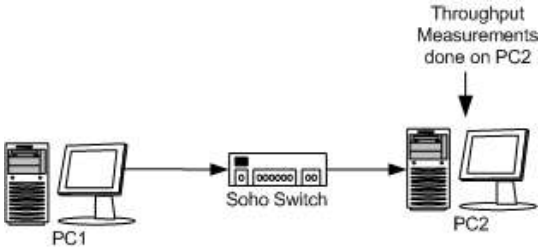
Number of cnx	*Gigabit performances*	*Expected Performances on 10 Gb/s Network*
1 UDP	**938.3 Mb/s**	**Up to 4.6 Gb/s**
1 TCP	**930.6 Mb/s**	**Up to 4.6 Gb/s**
16 UDP	**939.2 Mb/s**	**Up to 4.6 Gb/s**
16 TCP	**911.6 Mb/s**	**Up to 4.5 Gb/s**

*Table 7 - Expected performances with **IPv6***

4 Description of the three tests benches

4.1 Configuration 1: Performance Measurements on a Fast Ethernet network

On the Fast Ethernet test bed PC1 sends data to PC2. PC1 and PC2 are linked by a SOHO switch. CAT5 cables are used to link the NICs to the switch ports.



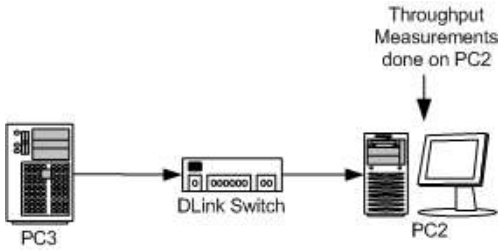
The **LanTraffic V2** Unitary Testing Mode is selected and the default values (menu File/new) are kept except for these particular values listed herein:

	TCP Data Size	UDP Data Size
IPv4	*1460 bytes*	*1472 bytes*
IPv6	*1440 bytes*	*1452 bytes*

These are the required maximum data size to prevent from IP fragmentation which could decrease the performance. Packet throughput evaluation uses a default UDP data size of 160 bytes (with a single connection).

4.2 Configuration 2: Performance Measurements on a Copper Gigabit network

On the Gigabit Ethernet test bed, the PC3 sends data to the PC2. PC2 and PC3 are linked by a DLink Gigabit Switch. Category 6 draft 10 cables are used to link the copper gigabit NICs to the switch ports.



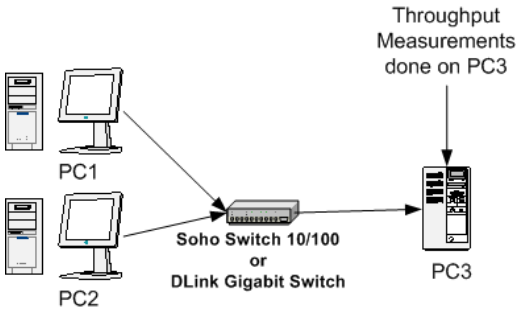
The **LanTraffic V2** Unitary Testing Mode is selected and the default values (menu File/new) are kept except for these particular values listed herein:

	TCP Data Size	UDP Data Size
IPv4	*1460 bytes*	*1472 bytes*
IPv6	*1440 bytes*	*1452 bytes*

The packets throughput evaluation uses a default UDP data size of 160 bytes (with a single connection).

4.3 Configuration 3: Additional Performance Measurements for packets throughput

The PC1 and the PC2 send data to the PC3. On Gigabit network, the PC1, PC2 and PC3 are linked by a DLink Gigabit Switch and use Category 6 draft 10 cables to link the copper gigabit NICs. On Fast Ethernet network, the PC1, PC2 and PC3 are linked are by a SOHO switch and use CAT5 cables to link the Fast Ethernet NICs to the switch ports.



The packets throughput evaluation uses a default UDP data size of 160 bytes (with a single connection per computer).

5 Appendix

5.1 How the link usage rate is calculated

The tables of results give an estimated value of the link usage rate calculated from the throughput measurements which is obtained as follows:

The formulas with IPv4 for the Fast Ethernet tests are:
- For UDP: UDP payload throughput * 1.038
- For TCP: TCP payload throughput * 1.039

The formulas with IPv6 for the Fast Ethernet tests are:
- For UDP: UDP payload throughput * 1.054
- For TCP: TCP payload throughput * 1.046

The formulas with IPv4 for the Gigabit tests are:
- For UDP: UDP payload throughput * 0.1038
- For TCP: TCP payload throughput * 0.1039

The formulas with IPv6 for the Gigabit tests are:
- For UDP: UDP payload throughput * 0.1054
- For TCP: TCP payload throughput * 0.1046

These coefficients are the ratios of each packet, between the transport payload and its size on the Ethernet. This can be possible by adding to the TCP or UDP payload size:
- the TCP or UDP header size
- and the IP header size
- and the Ethernet header size.

With IPv4, the coefficient has been calculated as follows:
- TCP coeff. = (1460+20+20+18)/1460
= 1518/1460
= 1.039
- UDP coeff. = (1472+8+20+18)/1472
= 1518/1472
= 1.031
- Where:
  - UDP header size = 8 bytes
  - TCP header size = 20 bytes
  - IPv4 header size = 20 bytes
  - Ethernet header size = 14 bytes + 4 bytes for CRC, so a total of 18 bytes

With IPv6, the coefficient has been calculated as follows:
- TCP coeff. =(1440+20+40+18)/ 1440
=1518 / 1440
=1.054
- UDP coeff. =(1452+8+40+18) / 1452
=1518 / 1452
=1.045
- Where:
  - UDP header size = 8 bytes
  - TCP header size = 20 bytes
  - IPv6 header size = 40 bytes
  - Ethernet header size = 14 bytes + 4 bytes for CRC, so a total of 18 bytes

For IPv6, the hypothesis is that no IPv6 extension header is located between the IPv6 general header and the TCP or UDP header.

5.2 Hardware of the computers used for Fast Ethernet and Gigabit networks

PC1

- Manufacturer: DELL OptiPlex GX280
- Operating Systems:
  - Windows XP Professional Version 2002, Service Pack 2
  - Windows Seven
- CPU: Intel Pentium 4 - x86 family 15 Model 4 Stepping 1 GenuineIntel~3 Ghz with Hyper threading activated
- RAM: 1 GB
- NIC: Broadcom NetXtree 57xx Gigabit Controller (Embedded): Fast Ethernet Tests

PC2

- Manufacturer: DELL OptiPlex GX745
- Operating Systems:
  - Windows XP Professional Version 2002, Service Pack 2
  - Windows Server 2003 R2
  - Windows Seven
- CPU: Intel Dual Core 2 E6600 2.4 Ghz
- RAM: 1 GB
- NIC:
  - Broadcom NetXtree Gigabit adapter (Embedded) used for the Fast Ethernet tests.
  - Intel Pro/1000 PT Server Adapter (PCI Express) used for the Gigabit tests.

PC3

- Manufacturer: DELL PowerEdge 1900
- Operating Systems:
  - Windows XP Professional Version 2002, Service Pack 2
  - Windows Server 2003 R2
  - Windows Seven
- CPU: 2 Intel Xeon Dual Core 5140
- RAM: 1 GB (667 Mhz)
- NIC: Intel Pro/1000 PT Server Adapter (PCI Express): used for the Gigabit tests

SOHO Fast Ethernet switch

- Ethernet/Fast Ethernet auto-sense
- Full duplex Fast Ethernet capabilities
- 8 ports 10/100 Mbps

DLink Gigabit switch DGS 1004T

- Ethernet/Fast Ethernet/Gigabit Ethernet auto-sense
- Full duplex 10/100/1000 capabilities
- 4 ports 10/100/1000 Mbps

5.3 Example of hardware that could be used on 10 Gigabits networks

- Manufacturer: DELL PowerEdge 2950 III
- Operating System: Windows Server 2003 R2 64 bits
- CPU: 2 Intel Xeon Dual Core 5140
- RAM: 2 GB (667 Mhz)
- NIC: Nexen NXB-10GCX4 Intelligent NIC