NVGRE Offload for Windows Server 2012 R2

High Performance Network Virtualization with Terminator 5

Executive Summary

NVGRE is a key component of network virtualization, a technology that is revolutionizing network infrastructure, much like system virtualization did to server infrastructure. By encapsulating user traffic within a set of Ethernet, IP and NVGRE headers it is possible to decouple the physical infrastructure from logical networks atop it, providing enhanced control, flexibility and manageability. However, the encapsulation of user frames means that hardware offloads within most network adapters are no longer operational. Chelsio's T5 based adapters are uniquely capable of offloading the processing of NVGRE encapsulated frames such that all stateless offloads are preserved, resulting in line-rate TX and RX operation at 10 Gb speeds. This paper presents benchmarks results for Windows Server 2012 R2 that demonstrate the benefits of Chelsio's NVGRE offload capability, providing up to 4x the performance of regular adapters.

Overview

The Terminator 5 (T5) ASIC from Chelsio Communications, Inc. is a fifth generation hyper-virtualized Unified Wire server adapter engine, providing simultaneous offload for storage, compute and networking traffic. T5 also implements full support for stateless offload operation for both IPv4 and IPv6 (IP/TCP/UDP checksum offload, Large Send Offload, Large Receive Offload, Receive Side Steering/Load Balancing, VMQ Offload, and flexible line rate filtering).

Furthermore, T5 is fully virtualized with separate configuration and traffic management for 128 virtual interfaces, and an on-board switch that accelerates the hypervisor v-switch. All features and offloads are available to virtual NICs and can be leveraged within hosted virtual machines.

Chelsio's T5-based adapters excel at server network adapter functionality, providing high packet processing rate, high throughput and low latency for all network applications. Chelsio is releasing NVGRE offload support for Windows Server 2012 R2 in order to extend this rich server adapter feature set and high performance to virtualized network environments. T5 encapsulation offload preserves all the stateless offloads (checksums, LSO, LRO, VMQ and filtering) for encapsulated traffic, resulting in significant performance benefits compared to non-offloaded adapters.

This paper provides benchmark results that demonstrate T5's performance within a Windows Server 2012 R2 virtualized environment, using the T520-LL-CR 2x10Gbps server adapter.

Test Results

The following graph compares single port **unidirectional** throughput achieved with NVGRE Offload enabled and disabled, while varying the I/O sizes, using the **ntttcp** tool.

The results clearly show the benefits of NVGRE Offload, giving line rate throughput even at small I/O sizes, with up to 4x the performance of the non-offloaded case.
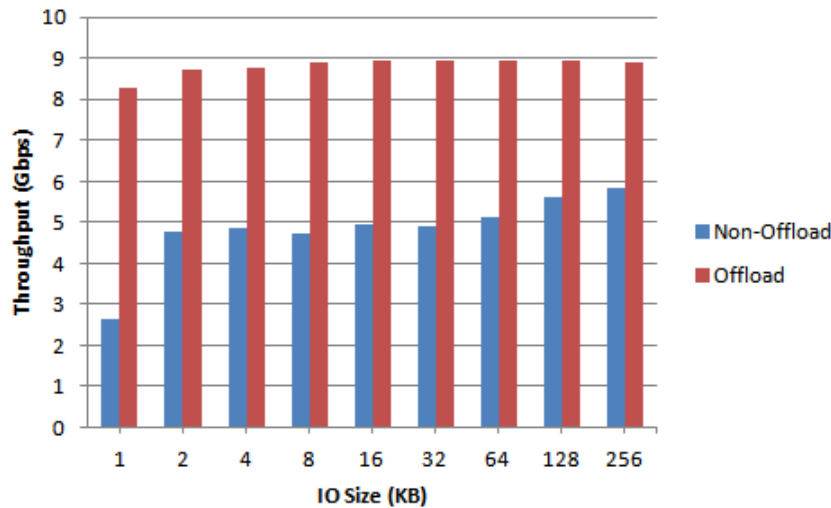

Figure 1 – NVGRE Offload Throughput vs. Regular NIC

The following graph compares the single port **unidirectional** throughput of Chelsio T520-LL-CR and Mellanox CX-3 Pro adapters at 64KB I/O size, varying the VM count. Only Chelsio's adapter is capable of providing consistent line rate performance even with a single VM in action.
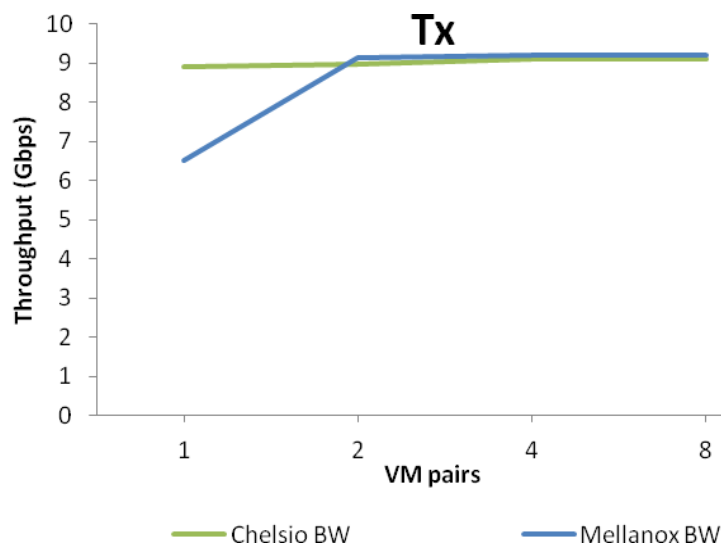

Figure 2 – Tx Throughput vs. VM count

The following graph similarly compares the two adapters in receive performance with NVGRE Offload enabled, at 64KB I/O and varying the number of virtual machines.
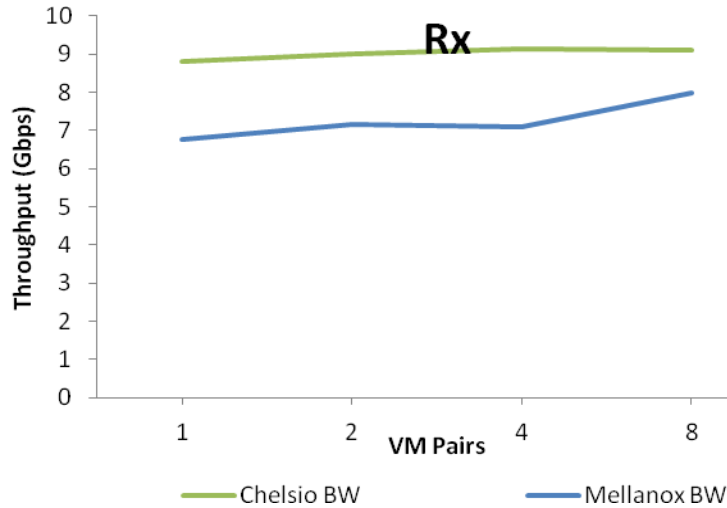

Figure 3 – Rx Throughput vs. VM count

The Chelsio adapter provides line rate throughput even with a single active VM pair, whereas the Mellanox adapter fails to reach line rate even with 8 active virtual machines on each host.

Test Configuration

The following sections provide the test setup and configuration details.
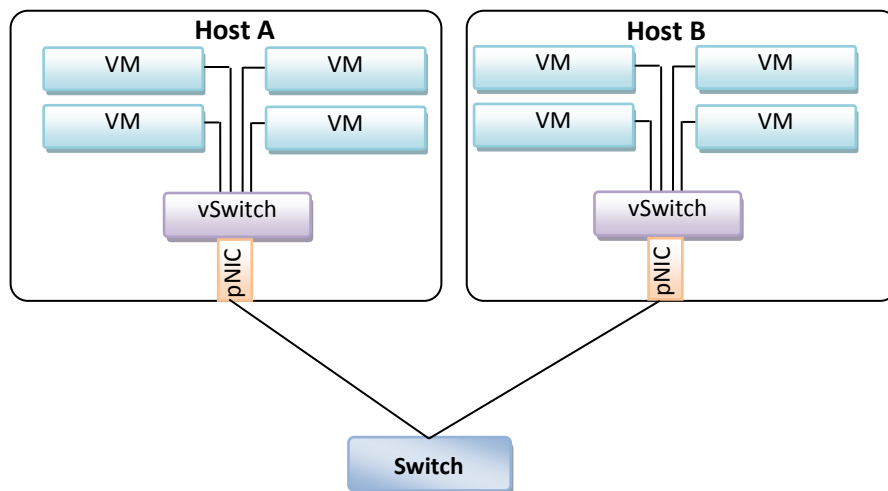

Figure 4 – Test Topology

Network Configuration

The test configuration consisted of 2 identical machines: each with Intel Xeon CPU E5-1660v2 6-core processor running at 3.70GHz and connected to a switch using a single 10Gbps link. Standard MTU of 1500B was used.

The Chelsio setup used one T520-LL-CR adapter installed in each system with Chelsio Network driver v5.3.3.0, whereas the Mellanox setup used one ConnectX3-Pro adapter installed in each system, with Mellanox Network driver v4.70.10126.0.

GRE task offload was enabled in Device Manager, and relevant customer and provider network settings were configured on both hosts.

I/O Benchmarking Configuration

ntttcp was used on the VMs to measure network throughput. This test used sample IO sizes varying from 1KB to 256KB.

Commands Used

On the Sender machine:

```
C:\Users\Administrator> ntttcp -s -m 4, <processor num>, <remote IP> -sb 512k -
t <time> -l <io size>
```

On the Receiver machine:

```
C:\Users\Administrator> ntttcp -r -m 4, <processor num>, <Local IP> -rb 512k -t
<time> -l <io size>
```

Conclusion

This paper demonstrates the significant performance benefits of NVGRE Offload in Chelsio's T5 adapters. Benchmark results show how T5 delivers wire-rate throughput, up to 4x that of regular adapters, with a performance profile that is superior to competing NVGRE Offload adapters.

Chelsio's implementation is uniquely capable of preserving all stateless offloads for encapsulated traffic, including LRO, LSO, RSS, filtering and VMQ support, providing line rate transmit and receive performance even with a single active virtual machine.

Related Links

Windows Server 2012 R2 40G NIC Performance
FreeBSD NIC at 40Gbps