Technology Brief

Telecom and Compute Products

Intel® Virtualization Technology for Connectivity

The growing adoption of virtualization in the datacenter enables a more efficient use of server resources that have historically left compute power underutilized by the model of running a single application on a physical server. With server performance scaling by a factor of ten in the last decade, the opportunity to consolidate multiple applications on one server utilizing virtualized resource management has created a more cost-effective alternative for datacenter deployments.

Today's virtualization-enabled datacenter solutions also enable flexible allocation of resources to handle unexpected changes in required workloads. With these tools, many IT organizations have lowered both capital and operational costs associated with server hardware, while simultaneously improving datacenter agility. The rapid adoption of virtualization-enabled servers has also created a major increase in I/O overhead affecting the overall server performance. Hence, a balanced platform approach that addresses virtualization enhancements with hardware assists even at the I/O and networking device level is essential.

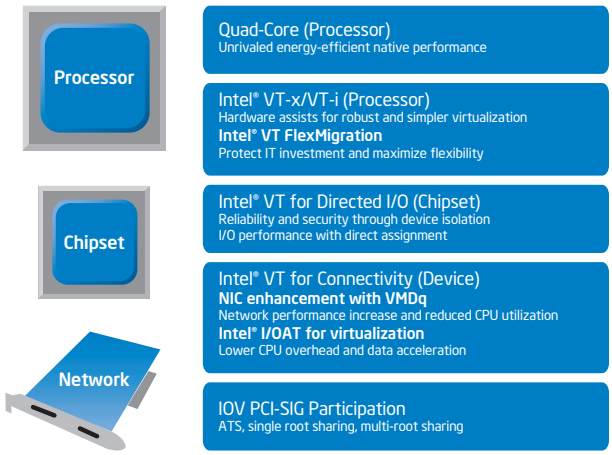
Intel® Virtualization Technology

Intel has addressed the rise in virtualization demand by creating Intel® Virtualization Technology[1] (Intel® VT for Connectivity), a suite of powerful enhancements to Intel® processors, chipsets, and I/O devices enabling hardware-assisted virtualization support from the core platform architecture. The hardware assists that Intel VT provides to the virtualization software helps hypervisor providers to deliver more simple and robust code, decreasing software overhead and its potential impact to solution performance.

Intel VT comprises:

- Intel® Virtualization Technology for IA-32, Intel® 64 Architecture[2] and Itanium® processors (Intel® VT-x and Intel® VT-i)
- Intel® Virtualization Technology for Directed I/O
- Intel® Virtualization Technology for Connectivity

The Intel Advantage: Virtualization Innovation



Introducing Intel® Virtualization Technology for Connectivity

Intel's latest addition to its suite of virtualization technologies is Intel Virtualization Technology for Connectivity (Intel® VT for Connectivity). This new collection of I/O virtualization technologies improves overall system performance by improving communication between host CPU and I/O devices within the virtual server. This enables a lowering of CPU utilization, a reduction of system latency and improved networking and I/O throughput. Intel VT for Connectivity includes:

- Virtual Machine Device Queues (VMDq)
- Intel® I/O Acceleration Technology
- Single Root I/O Virtualization (SR-IOV) implementation in Intel® devices

Virtual Machine Device Queues (VMDq)

In today's traditional virtualization implementation, hypervisor abstracts the I/O device and shares that hardware resource with multiple virtual machines. To route the packets coming from that shared I/O device, hypervisor sorts the incoming packets based on the destined virtual machine and then delivers the packets accordingly. This sorting and grouping done in the hypervisor consumes CPU cycles, thereby impacting the overall virtual server performance.

VMDq technology enhances networking performance and reduces CPU utilization in the virtualized environment. It reduces I/O overhead on the hypervisor in a virtualized server by performing data sorting in the network silicon. VMDq technology makes use of the multiple queues technology in the network device. With VMDq, as data packets enter the network adapter, they are sorted, and packets to the same destination get grouped together. The packets are then sent to the hypervisor, which directs them to their respective destinations. Relieving the hypervisor of packet filtering improves overall CPU utilization and throughput levels.

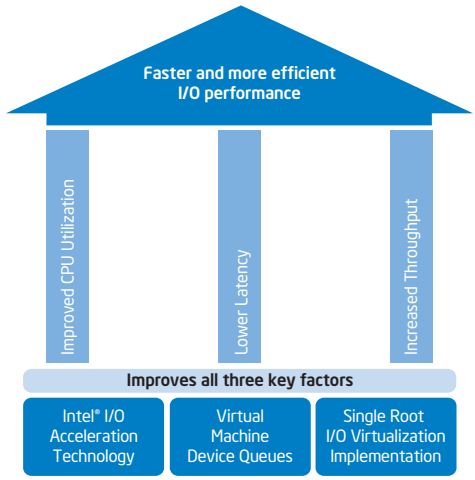
Intel® I/O Acceleration Technology

Intel I/O Acceleration Technology (Intel® I/OAT) is a suite of features which improves data acceleration across the platform, from I/O and networking devices to the memory and processors which help to improve system performance. The different features include Intel® QuickData Technology, Direct Cache Access (DCA), MSI-X, low latency interrupts, and Receive Side Coalescing (RSC). Intel QuickData Technology moves data copy from the CPU to the chipset and DCA enables the CPU to pre-fetch data, thereby avoiding cache misses and improving application response times. MSI-X helps in load-balancing I/O network interrupts, and low latency interrupts automatically tune interrupt interval times depending on the latency sensitivity of the data. RSC provides lightweight coalescing of receive packets, which increases the efficiency of the host network stack.

Single Root I/O Virtualization (SR-IOV) Implementation

Single Root I/O Virtualization (SR-IOV) is a Peripheral Component Interconnect Special Interest Group (PCI-SIG) specification. Intel is actively participating along with other industry leaders within the PCI-SIG working group to define new standards for enhancing virtualization capabilities of I/O devices. SR-IOV provides a standard mechanism for devices to advertise their ability to be simultaneously shared among multiple virtual machines. SR-IOV allows for the partitioning of a PCI function into many virtual interfaces for the purpose of sharing the resources of a PCI Express* (PCIe) device in a virtual environment. Intel plans to support SR-IOV specification in its networking devices.

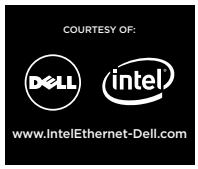
Intel® Virtualization Technology for Connectivity (Intel VT for Connectivity)



Future Datacenter

- Improved data acceleration across the platform
- Hardware assists in the I/O silicon to improve data processing
- Continued investment in providing hardware assists and offload technologies to improve I/O performance

Each virtual function can support a unique and separate data path for I/O-related functions within the PCI Express* hierarchy. Use of SR-IOV with a networking device, for example, allows the bandwidth of a single port (function) to be partitioned into smaller slices that may be allocated to specific virtual machines, or guests, via a standard interface. A common methodology for configuration and management is also established to further enhance the interoperability of various devices in a PCIe hierarchy. Such sharing of resources can increase the total utilization of any given resource presented on an SR-IOV capable PCIe device, potentially reducing the cost of a virtual system.



[1] Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM) and, for some uses, certain platform software enabled for it. Functionality, performance or other benefits will vary depending on hardware and software configurations and may require a BIOS update. Software applications may not be compatible with all operating systems. Please check with your application vendor.

[2] 64-bit computing on Intel architecture requires a computer system with a processor, chipset, BIOS, operating system, device drivers and applications enabled for Intel® 64 architecture. Performance will vary depending on your hardware and software configurations. Consult with your system vendor for more information.

Printed in USA 0907/BY/OCG/HOP/750 Please Recycle 318245-001US