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Requires a system with Intel® Turbo Boost Technology. Intel Turbo Boost Technology and Intel Turbo Boost Technology 2.0 are only available on select Intel® processors. Consult your PC manufacturer. Performance varies depending on hardware, software, and system configuration. For more information, visit http://www.intel.com/go/turbo

Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, and virtual machine monitor (VMM). Functionality, performance or other benefits will vary depending on hardware and software configurations. Software applications may not be compatible with all operating systems. Consult your PC manufacturer. For more information, visit http://www.intel.com/go/virtualization

The original equipment manufacturer must provide TPM functionality, which requires a TPM-supported BIOS. TPM functionality must be initialized and may not be available in all countries.

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Needs by Segment

Enterprise
Deliver business value as fast as possible with lowest total cost of ownership

Cloud Service Providers
Scale and maintain SLAs in face of shifting customer demands while optimizing cost of service delivery

Telco
Reduce network cost of operation and enable business innovation to drive incremental revenue

Technical Computing
Plan ahead for maximum scale while driving most efficient performance for applications

Pressing need for Flexible, Responsive and Efficient Infrastructure
Today’s Network Infrastructure

- WAN
- ISP A Router
- ISP B Router
- Internet
- Mobile Clients
- External Clients
- Intrusion Detection
- Load Balancer
- Web Services Firewall
- SSL Acceleration
- Local Caching...
- Back End Servers and Storage
- Stateful Firewalls
- Routers/SWs
- Fixed Function Hardware based on Multiple Disparate Architectures
Network Function: Hardware – Fixed Functions
Network Functions: Scaling Problem
Network Functions: Specialized Server

x86 CPU + SW wrapped in sheet metal
Network Function: Virtualized

More homogeneous network

NF as a VM
SDN + NFV is Driving Architectural Transformation

**From This...**
- Traditional networking topology
- Monolithic vertical integrated box
- TEM proprietary solutions

**To This...**
- Networking within VMs
- Standard IA CPU COTS HW
- Open SDN standard solutions

**From This...**
- Firewall
- VPN
- Intrusion Detection System

**To This...**
- VM: Firewall
- VM: VPN
- VM: Intrusion Detection System

**From This...**
- TEM/OEM Proprietary OS
- ASIC, DSP, FPGA, ASSP

**To This...**
- IA CPU
- NIC Silicon
- Chipset Acceleration
- Switch Silicon
- Wind River Linux + Apps

**Hypervisor**
SDI: The Evolution of Infrastructure

A world where the application defines the system

One application per system

One application per virtual system

Applications DEFINE the system

Traditional Hardware

Abstracting the Hardware

Abstracting the Datacenter
Software Defined Infrastructure

**Services Delivery**

- Application A
- Application B
- Application C
- Application D

**Orchestration Software**

**Infrastructure Attributes**

- Power
- Performance
- Security
- Thermals
- Utilization
- Location

**Resource Pool**

- Storage
- Network
- Compute

**SERVICE ASSURANCE**

Policies and intelligent monitoring trigger dynamic provisioning and service assurance as applications are automatically deployed and maintained.

**PROVISIONING MANAGEMENT**

Orchestration provisions, manages and optimally allocates resources based on the unique requirements of an application.

**POOLED RESOURCES**

Network, Storage and Compute elements are abstracted into resource pools.
SDI: Network Transformation

**HARDWARE DEFINED**
- 1 box per application
- Physical connections
- Manual provisioning

**VIRTUALIZED**
- Separate hardware and software
- Increased agility
- Manual provisioning

**SOFTWARE DEFINED**
- Orchestrated connectivity
- Automated provisioning
- Automated network management

Network applications
- VPN
- Firewall
- Other

Network function virtualization
- VPN
- Firewall
- Other

Network function and control
- High Volume HW

Data Transport

Network virtualization

Network Pools

Resource Pool
Network
## SDI: Network Transformation

**VIRTUALIZED NETWORK**
- Separate physical network from virtual connectivity
- Multi tenant, individual network control

**VIRTUALIZED NETWORK, FUNCTIONS**
- Break out of the appliance box
- Separate hardware and software
- Increased pace of innovation
- Standards based ecosystem

**SOFTWARE DEFINED NETWORKING**
- Software based networking controller programs and provisions the network
- Orchestrated connectivity
- Automated provisioning
- Automated network management
Network Transformation – Intel SDN/NFV Ingredients

**Intel® Architecture**
- Intel® VT-X
- Intel® VT-d
- Intel Data Direct I/O

**Intel® Network Acceleration**
- Intel® Communications Chipset w/Quick Assist
- Intel® Ethernet w/SRIOV
- Intel® Ethernet Switch
- Small Cell SoC
- L1 - Signal Processing

**Intel Open Source Software Solutions**
- Intel Data Plane Development Kit
- Intel DPDK Accelerated OvS
- Intel Open Network Software

**Intel Commercial Software Solutions**
- Intelligent Network Platform
- Open Virtualization Profile
- Carrier Grade Comms Server
- Intrusion Protection System
- NG Firewall

**Intel® Open Network Platform Reference Architectures**
- Intel® ONP Server
- Intel® ONP Switch

**Intel® Network Builders**

* Other brands and names may be claimed as the property of others.
Enable “Best in Class” SDN and NFV solutions on Intel products:

- Open Standard and Open Source based software solutions
- Telecom, Cloud, Enterprise
- Scale Intel ONP based solutions via Intel Network Builders
Intel® DPDK Virtualization, Intel® VT Hardware Assists

Unmodified Data Plane Application Virtualization

- Intel® VT for Directed I/O (Intel® VT-d)
- Intel® VT for IA-32, Intel® 64 and Intel® Architecture (Intel® VT-x)
- Intel® Virtualization Technology (Intel® VT)
Re-Architect Servers

POOLED RESOURCES

Evolve servers - break down silos

App

Application-driven allocation of resources that can be orchestrated
Rack Scale Architecture (RSA): Optimized for SDI

Discrete Components, Self-Integration

Composable set of pooled and disaggregated resources

- Enables pooled and disaggregated compute, network and storage resources
- Hardware attributes exposed upward to the provisioning management layer
- Enables software to compose a system based on the requirements of a specific application

Today

RSA

Flexibility - Capital Efficiency - Lower TCO
Rack Scale Architecture Timeline

Server disaggregation enable rack level pooled resources

Today

Physical Aggregation
- Shared power
- Shared cooling
- Rack Management

> 2014

Fabric Integration
- Modular Refresh
- Configurable network architecture
- Interconnect fabric

Future

Subsystem Aggregation
- Pooled Compute
- Pooled Storage
- Pooled Memory
- Shared boot

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance.

1. Improvement based on standard rack with 40 DP servers, 48 port ToR switch, 1GE downlink/server and 4x10GE uplinks. Cables: 40 downlink and 4 uplink vs. rack with 42 DP servers, SiPh patch panel, 25Gb/s downlink, 100Gb/s uplink, Cables: 14 optical downlink, and 1 optical uplink. Actual improvement will vary depending on configuration and actual implementation.


Rack Scale Architecture Timeline
Configurable Storage Architecture

- Node managed storage & POD wide storage model
- Increase flexibility, lower TCO across range of workloads
- Aligned with software defined storage implementation
# SDI: The Evolution of Infrastructure

A world where the application defines the system

<table>
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<th>TODAY</th>
<th>POOLED RESOURCES</th>
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<td>SYSTEM &lt;br&gt;S N C &lt;br&gt;S N C &lt;br&gt;S N C</td>
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</tr>
</tbody>
</table>

Optimized for: Flexibility, App Requirements, SLA & Efficiency
Software Defined Infrastructure: Result

Agility

Automation

Efficiency
Intel® Infrastructure Builders Program
Accelerate Proven Software Defined Infrastructure Solutions
Across Server, Storage, and Network

Intel® Infrastructure Builders is a new umbrella program for the Ecosystem
Focused on Software Defined Infrastructure from the Cloud to Network Edge encompassing:

- Intel® Cloud Builders
  - Software Defined Storage (SDS)
- Intel® Network Builders
  - Software Defined Networking (SDN)
  - Network Function Virtualization (NFV)
Intel® Network Builders Program: Accelerate SDN and NFV Solutions

Program Objectives

Demonstrate ecosystem readiness across SDN and NFV solutions

Drive preference of solutions that are powered by Intel products and technologies

Raise awareness of Intel’s leadership role in these transformative network technologies

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http://networkbuilders.intel.com – Solution Library
Snapshot inside DPDK vSwitch REFERENCE ARCHITECTURE

Applications->System Tools->Virtual Machine Manager.

5.2.2 Guest OS Installation
For our tests, virtual machine images need to be created and configured with additional packages including kernel build tools.

5.2.2.1 Create VM Disk and Start the VM for OS Install
We reuse the Ubuntu 12.04.2 Server ISO image used for Guest OS installation.

A disk file of 20 Gigabyte is made using qemu-img command:

```
# qemu-img create -f qcow2 Ubuntu-12-04-mp.qcow2 20G
```

There are many variations of startup scripts. In this case the ISO install disk is on the hard disk as a file and passed to the VM as a cdrom device.

The host has 1 bridge, br-mgt. Assuming the br-mgt is bridging the primary control network and assigning a non-conflicting address for the VM interface on br-mgt, the VM should be able to reach the Internet if the host interface of the bridged management interface can reach the Internet, which is useful for updating packages on the VM from the Internet.

```
# cat ubuntu_12.04.2_vm_install.sh
#!/bin/sh
vm=/vm/Ubuntu-12-04-mp.qcow2
vm_name=Ubuntu_Test_VM
vnc=-f
nl=tap44
br=br-mgt
dn_scrap=/vm/vm_c1xbr-mgt-ifdown
mac0:00:00:14:42:04:29
cd=/root/Downloads/Ubuntu-12.04.2-server-amd64.iso
if [ ! -f $vm ];
then
echo "VM $vm not found!"
else
```

Source Code of DPDK vswitch is free to download. http://01.org
Intel® Data Plane Development Kit
Intel® DPDK: Data Plane Development Kit

dpdk.org

What it is

Intel® DPDK is a set of libraries and drivers for fast packet processing on x86 platforms. It runs mostly in Linux userland.

This project tracks the Intel® DPDK and includes all major public contributions. The most recent patches and enhancements, provided by the community, are available in master branch.

Main libraries

- multicore framework
- huge page memory
- ring buffers
- poll-mode drivers

Usage

These libraries can be used to:
- receive and send packets within the minimum number of CPU cycles (usually less than 80 cycles)
- develop fast packet capture algorithms (tcpdump-like)
- run third-party fast path stacks

For example, some packet processing functions have been benchmarked up to 160 Mbps (million frames per second, using 64-byte packets) with a PCIe Gen-2 NIC.

www.intel.com/go/dpdk

Packet Processing on Intel® Architecture

Consolidate workloads. Boost performance. Reduce total cost of ownership

Overview

With Intel® processors, it’s possible to transition from using discrete architectures per major workload (application, control, packet, and signal processing) to a single architecture that consolidates the workloads into a more scalable and simplified solution. As a result, developers may be able to eliminate special-purpose hardware such as network processors (NPs), co-processors, applications-specific integrated circuits (ASICs), and field-programmable gate arrays (FPGAs).

This, notably, due to the Intel® Data Plane Development Kit (Intel® DPDK), a set of software libraries that can improve packet processing performance by up to ten times. As a result, it’s possible to achieve over 80 Mbps throughput on a single Intel® Xeon® processor and double that with a dual-processor configuration. Read the product brief.

This solution is ideal for telecom wireless infrastructure evolved packet core (EPC) applications and other network elements. Packet processing while executing other workloads on an Intel processor reduces hardware costs, simplifies the application development environment, and reduces time to market. The Intel DPDK is also playing a critical role in software-defined networking (SDN) and network functions virtualization (NFV). Read more.

Another way to cut system costs is to do away with various add-on acceleration modules. Instead, use the acceleration modules that are already on Intel processor-based platforms with Intel® QuickAssist Technology and the Intel DPDK.

Examples of Ecosystem Vendors Using the Intel DPDK

dWIND provides packet processing software. Learn more about their solution.

Calsoft Labs provides virtual network function development, NFV orchestration, systems integration, and operations support services. Learn more about their solution.

Tieto is a research and development consultancy company with a strong background in packet processing. Learn more about their solution.
Intel® Data Plane Development Kit

- Libraries for network application development on Intel Platforms
  - Speeds up networking functions
  - Enables user space application development
  - Facilitates both run-to-completion and pipeline models

- Free, Open-sourced, BSD Licensed
  - http://www.intel.com/go/dpdk
  - Git: http://dpdk.org/git/dpdk

- Scales from Intel Atom to multi-socket Intel Xeon architecture platforms

- About two dozen pre-built example applications
Intel® DPDK Roadmap

**Silicon Support**
- Ivy Bridge Server
- Rangeley

**Intel® DPDK**
- Multi-threaded KNI
- Virtualization: VirtIO, SR-IOV Switching for VM-VM via 10GbE
- 1GbE VMDq support
- Vectored ACL
- Libpcap based PMD
- Use of fork() to demonstrate application resiliency

**Q1 '14 (v 1.4) - Done**

**Intel® DPDK**
- FreeBSD* 9.2 OS
- KVM Virtualization: Virtio Userspace vhost switch
- Xen Virtualization: Intel® DPDK runs on Dom0 without hugepages, PMD in guest domain
- QEMU IVSHMEM
- VMXNET3 driver for device presented to VMs by VMware* ESXi
- Support for basic Netmap applications on Intel® DPDK
- Vectored PMD
- Early Prototyping for Fortville 40GbE Gen3 PMD

**June ‘14 (v 1.7) - Done**

**Silicon Support**
- Coleto Creek

**Intel® DPDK**
- Fortville Gen3 40GbE PMD
- Packet Framework
- Link Bonding
- VFIO driver
- ACL and Vector PMD
- KVM Virtio improvements

**2H ‘14 (v 1.8) - Roadmap**

- More advanced features are coming

**DPDK Release 1.7 is now available**
A one-day technical event that brings together the DPDK open source community for technical presentations and dialogue
Summary

• Global opportunities and challenges across Cloud, Telecom and Enterprise
  • *We are in a period of almost unparalleled change and disruption*

• Intel is investing with partners across the industry to lead the transformation
  • *This is opportunity for some, challenge for others*

• The data center is being completely re-architected

• Open Source and Open Standards are vital to unlocking the transformation
  • *Presents a great opportunity to reducing legacy support costs, improve agility and focus on business transformation*