SOLUTION BRIEF

QCT and netElastic Optimized vBNG Solution for Next Generation Central Office

An Integrated, Validated, and Flexible Solution for Network Service Providers

Market Trend and Challenge

- Global IP traffic and Internet video traffic rapidly increase.
- As bandwidth demands expand, conventional hardware-based BNG cannot be afforded.

Solution Benefit

With netElastic Virtual Broadband Network Gateway (vBNG) and QCT X86 servers, the solution can ensure the network performance with flexibility, scalability, and cost-effective values.

Executive Summary

As the internet traffic continues to increase exponentially and the demand of network bandwidth dramatically soars according to Cisco's Visual Networking Index[1], global IP traffic is forecasted to grow from 2017 to 2022, reaching 4.8 Zettabyte (ZB) per year by 2022. Conventionally, hardware-based BNGs lacks scalability, agility, and elasticity to keep up with rising bandwidth requirements. Network Function Virtualization (NFV) is a technology which can be adopted to transform network operation structure by decoupling network functions from proprietary appliances. Programmable infrastructure enables network service providers to independently deploy and operate complicated virtual network functions so as to fully utilize resources with great agility and efficient performance, and to lower total cost of ownership (TCO). With general-purpose infrastructure, software-defined Broadband Network Gateway (BNG) can be deployed on top of the Network Function Virtualization infrastructure (NFVi).

In QCT Next Generation Central Office (NGCO) project, netElastic is one of NFV ecosystem partners that QCT collaborates to deliver a disaggregated virtual Broadband Network Gateway (vBNG) solution. vBNG is deployed at the subscriber network edge to control internet access and management functions. QCT and netElastic team up to propose an NFV platform with virtualized network function, resource allocation, and performance optimization, allowing network service providers to shift away from expensive proprietary equipment and delivering more services on-demand. In this solution, QCT and netElastic enable Intel Dynamic Device Personalization (DDP) feature and utilize Intel Xeon Scalable family processors for high-performance vBNG solution. The throughput can successfully reach near line rate performance among different package sizes. Moreover, the solution with fully open protocol and features offers pay-as-you-go package to deploy scalable and flexible network.

vBNG System

netElastic provides multiple vBNG system packages for different system capacity. Each licensed package is designed to handle the throughput, corresponding to its subscriber number, as shown in Table 1. In general, a vBNG system is deployed to handle the traffic based on the initial number of regional subscribers. The license packages can be subsequently upgraded when the subscriber numbers increase. vBNG software can support the data plane capacity, ranging from 20Gbps to 120Gbps. In most cases, data plane capacity ranging from 40Gbps and 80Gbps is selected for deployment. In this solution brief, a flexible and cost-effective NFV server can provide at least 80Gbps throughput even when the advanced features (i.e. ACL and QoS) are enabled on the vBNG system.

Table 1. Capacity and feature of netElastic vBNG system.

License Package	**BNG-200**	**BNG-400**	**BNG-800**	**BNG-1200**
Data Plane Capacity	20 Gbps	40 Gbps	80 Gbps	120 Gbps
Subscriber Number	16,000	32,000	64,000	128,000
Access Type	PPPoE, IPoE, L2TP, and Leased line			
Routing Support	IPv4, IPv6, BGP, OSPF, IS-IS, and MPLS			
Security Feature	L2TP, VxLAN, GRE, IPSec, AAA, and ACL			
CGNAT Session	2 Million	2 Million	4 Million	4 Million
Interface	2x 10GbE	2x25GbE or 4x10GbE	4x25GbE or 8x10GbE	6x25GbE or 12 x10GbE
Management	Web GUI/CLI/NetConf/YANG			

[1] Cisco Visual Networking Index: Forecast and Trends, 2017–2022 White Paper
https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html

Solution Architecture

In the architecture of netElastic vBNG system, hyper-thread CPU feature is disabled and the physical cores are directly utilized for virtual instances. As shown in Figure. 1, the control plane (CP) and data plane (DP) run in the different virtual instances which are pinned to specified CPU cores. Control plane instance is in charge of user authentication, service configuration, subscriber's management, routing protocols, and other protocols processing while the data plane instance is in charge of packet processing. In the netElasitc's software design, the CP instances consume 10 CPU cores and supports up to 128K subscribers. The DP instances consume 2 CPU cores for system operation and 2 to 4 CPU cores per port are required for packet forwarding according to the services.

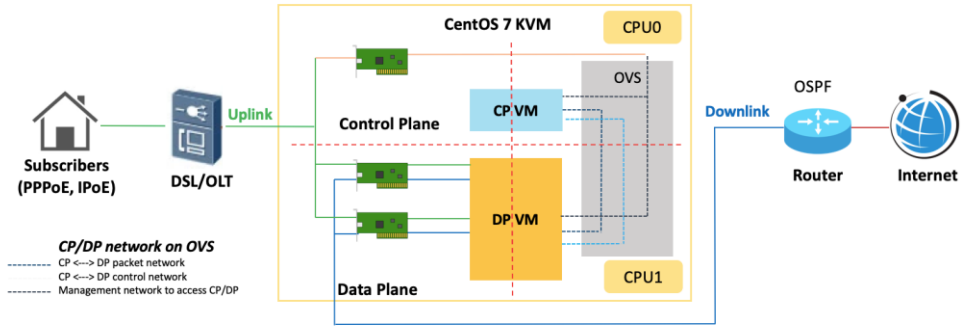

Figure 1. netElastic vBNG system architecture.

CPU pinning is a technology adopted to bind CPU cores, ensuring the stable performance when the vBNG system simultaneously processes the control plane tasks and the data plane traffic forwarding. 2 to 4 CPU cores are pinned to each data plane port, as shown in Figure 2.

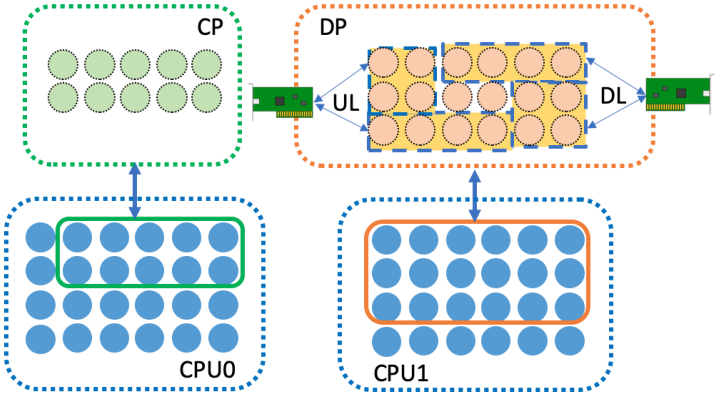

Figure 2. CPU pinning for CP and DP.

In data center networking, 25G Ethernet has gradually become the mainstream technology. In this solution, QCT and netElastic leverage Intel XXV710 25GbE network interface card and Intel Dynamic Device Personalization (DDP) technology to fully utilize the 25G bandwidth. By parsing the packet header with loaded DDP profile, additional protocols such as PPPoE and GTPU are classified and the packets are distributed to specified queues on the binding interface, as shown in Figure. 3[2]. These packets are evenly loaded to each queue and CPU core so that the CPU resources can be fully utilized to obtain the maximum throughput.

[2] OSN Bay Area Feb 2019 Meetup: Intel, Dynamic Device Personalization - Journey Continues
https://www.slideshare.net/LuminaNetworks/osn-bay-area-feb-2019-meetup-intel-dynamic-device-personalization-journey-continues

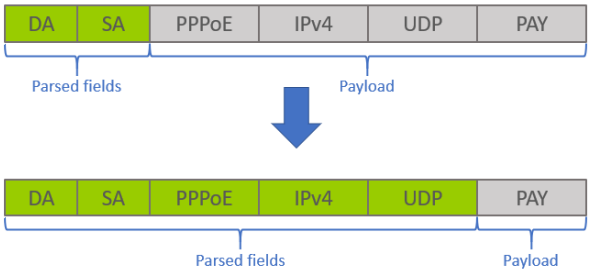

Figure 3. Packet classification with DDP feature enabled.

netElastic vBNG system can enable basic features such as subscriber access (i.e. PPPoE and IPoE) and routing protocols (i.e. OSPF, BGP, and MPLS), and advanced features (i.e. QoS and ACL). When more features are enabled, the system consumes more CPU resources. Basically, one CPU core with basic features (i.e. PPPoE and OSPF Routing) enabled can handle 10Gbps packet processing. With advanced features enabled, up to 4 CPU cores per port are required to handle packet forwarding to fully utilize the 25G bandwidth. To achieve 80Gbps throughput performance with all features enabled, 18 CPU cores in total are utilized in data plane, in which 16 CPU cores are dedicated for handling packet forwarding and 2 CPU cores for system operation.

The benchmark is established to test the throughput performance of vBNG system with DDP enabled and disabled on QCT server. With DDP enabled, the performances among 2 to 4 CPU cores per port are compared to obtain the optimal performance configuration.

Solution Performance Validation

For the performance benchmark, Spirent TestCenter with four 25G ports is selected to emulate the network scenario and generate the packet for testing throughput performance. In the testing scenario, the tester and vBNG configuration are configured to simulate the real business traffic model, as shown in Table 2.

Table 2. Configuration of traffic model.

Item	Entries/Unit
PPPoE Session (Basic)	16K/UL Port
OSPF Routing Entry (Basic)	500K/system
ACL (Advanced)	4K/system
QoS (UL) (Advanced)	1.5Mbps/ User UL
QoS (DL) (Advanced)	1.5Mbps/ User DL
Packet Size	256, 384, 512, 768, 1024, and 1420

Two test cases are conducted in this solution brief. First, 4 CPU cores per port either with DDP feature enabled or disabled are configured to compare the maximum throughput. Second, 2 to 4 CPU cores per port with DDP feature enabled are configured to compare the maximum throughput. Both two configurations, including vBNG system with either basic features or advanced features, are tested in the two cases. The packet size ranges from 256 to 1420 bytes.

When the basic features are configured on the vBNG system with DDP enabled, the performance is improved approximately 90% at 256 bytes packet size, compared to the system with DDP disabled. Moreover, when the advanced features are configured on the vBNG system with DDP enabled, the throughput can still achieve four times better performance at the 256 bytes packet size. Therefore, the DDP is regarded as the key factor to influence the throughput, as shown in Figure 4.

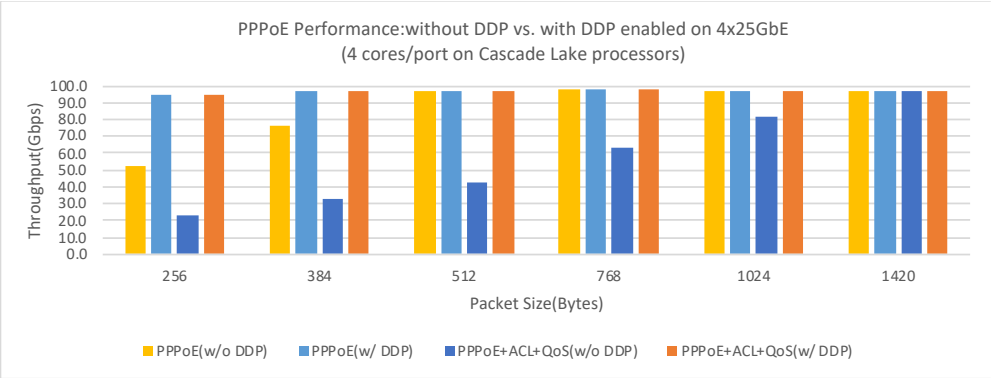

Figure 4. Performance optimization with DDP feature enabled.

If it is dispensable to enable advanced features on the vBNG system, network service providers can adopt relatively fewer CPU cores for saving hardware and power resources. In this brief, the performances among 2, 3, and 4 cores per port are compared. When the advanced features are enabled on the vBNG system with 4 cores per port leveraged, the performance is 62% and 18% better than those of the performances with respectively 2 and 3 cores leveraged in 256 packet size, as shown in Figure. 5. However, when only basic features are enabled on the vBNG system, the performances among 2, 3, and 4 cores show no significant difference. The test results reveal that with advanced features enabled in the field deployment, the utilization of 4 cores per port can guarantee the best performance. On the other hand, when the advanced features are disabled, the network service provider can reduce CPU resources from 4 cores to 2 or 3 cores per port to obtain the same performance. Therefore, the vBNG system can release the hardware resources and save the power consumption according to the demand.

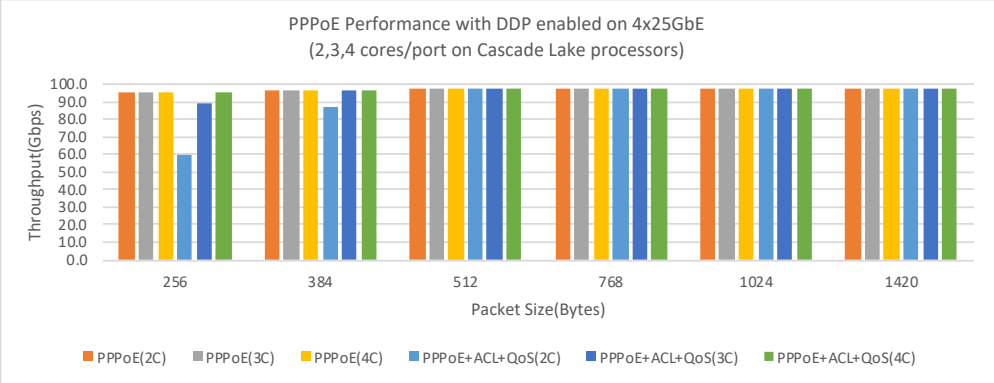

Figure 5. Performance comparison among 2 to 4 CPU cores per port.

Key Values

- Pre-integrated hardware and software
- Performance optimization
- Pre-validation in Factory
- Reduced total cost of ownership

Hardware Suggestion

QCT QuantaGrid D52BQ-2U server is selected to test the throughput performance since the server model can support both Intel 1st and 2nd generation Xeon SP processors, Skylake and Cascade Lake. The server is an ultimate compute and storage server equipped with fast socket interconnect 1.5x memory bandwidth and 2x FLOPs peak performance capability, as shown in Table 3. Meanwhile, up to 5 and 10 PCIe expansion slots can provide more scalability for network functions. Hot swappable and tool-less design can enable administers to efficiently install and easily maintain the components such as PCIe, HDD, and fan. With pre-validated and integrated infrastructure, network service providers can save considerable time on verifying hardware performance and put less effort into tuning configurations.

In Figure 5, as the test result shows, 2, 3, and 4 CPU cores per port are respectively configured to deliver 60, 80, and 100Gbps throughput performance, indicating the total CPU cores of the whole system are respectively 10, 14, and 18 cores for different data plane capacity. The CPU model suggested for 80G throughput is Xeon Scalable Processor – Cascade Lake 6240. If the near line rate performance is necessary, the CPU model Xeon Scalable Processor – Cascade Lake 6252N is suggested.

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Table 3. Recommended hardware for vBNG solution.

Item	Spec.	Qty
Server	QuantaGrid D52BQ-2U 	1
CPU	Intel Xeon Scalable Family Processor (Gold)	2
RAM	16GB DDR4-2666	12
NIC	Intel XXV710-DA2	2
Onboard NIC	Intel X527 PHY	1
Storage	Intel 480GB SSD	2
PSU	800W AC	2

Conclusion

QCT partners with netElastic to deliver a pre-validated and pre-integrated solution with optimized throughput performance. According to the test results, the vBNG solution can achieve near line rate performance, up to 100 Gbps throughput performance, even when the system is enabled with advanced services by utilizing the power of Intel DDP technology on 25G NIC. To reduce the deployment time and installation cost, QCT and netElastic pre-validated the solution to guarantee the optimal performance on QCT NFV platform. That is, the pre-integration service is implemented in factory side before shipment. With the QCT optimized server and netElastic superior software, the solution with virtualized and network function technologies can ensure the network performance with flexibility, scalability, and cost-effective values.

ABOUT QCT

Quanta Cloud Technology (QCT) is a global data center solution provider. We combine the efficiency of hyperscale hardware with infrastructure software from a diversity of industry leaders to solve next-generation data center design and operation challenges. QCT serves cloud service providers, telecoms, and enterprises running public, hybrid and private clouds.

Product lines include hyperconverged and software-defined data center solutions as well as servers, storage, switches and integrated racks with a diverse ecosystem of hardware components and software partners. QCT designs, manufactures, integrates and services cutting-edge offerings via its own global network. The parent of QCT is Quanta Computer, Inc., a Fortune Global 500 corporation.

http://www.QCT.io

ABOUT netElastic

netElastic is an innovative software company providing high-performance routing solutions for carriers and service providers. Built on its extensive experience in NFV and software-defined networking (SDN) technologies, netElastic delivers carrier routing solutions that are optimized for high availability, security, efficiency, and networking performance. For more information, please visit www.netelastic.com