SOLUTION BRIEF

Service Providers
Data Center and Edge

Get Ready for 5G

Communications Service Providers can accelerate 5G network transformation with the F5 BIG-IP* platform running on the 2nd generation Intel® Xeon® Scalable processor

This solution brief describes how to solve business challenges through investment in innovative technologies.

If you are responsible for...

- **Business strategy:** You will better understand how F5 BIG-IP and 2nd Generation Intel® Xeon® Scalable processors will enable you to successfully meet your business outcomes.
- **Technology decisions:** You will learn how F5 BIG-IP and 2nd Generation Intel® Xeon® Scalable processors works to deliver IT and business value.

Authors

Neerav Dalal
Vice President
Intel Group

Godfrey Tan
Principle Solutions Engineer
F5 Networks

Executive Summary

5G promises to transform the way we live and work, from augmented reality on the go through to self-driving cars. For communications service providers (CoSPs), these new 5G services will place greater demands on the network in terms of peak data rates, connection density, and more. To meet these new requirements, CoSPs must ensure their network infrastructure is 5G-ready.

Running on the next-generation Intel® Xeon® Scalable processor with Intel® QuickAssist Technology (Intel® QAT), the F5 BIG-IP* platform enables CoSPs to rise to the 5G challenge. Packaged solutions, flexible deployment options, simplified management and orchestration, standards-based architecture and carrier-class performance simplify virtualized network environments from the core to the edge.

Figure 1. Assuring a great user experience for augmented reality applications with multi-access edge computing.

Solution Benefits

- **Flexible deployments.** For completely or partially virtualized networks migrating only certain network elements as virtual network functions (VNFs), BIG-IP* products and solutions support both virtual editions (VEs) as well as purpose-built hardware platforms
- **From the core to the edge.** F5 tools support the migration of VNF's from a centralized deployment in a data center cloud to one that is distributed at the edge like a MEC platform
- **On high-performance hardware.** Underpinning the F5 BIG-IP platform is the 2nd generation Intel® Xeon® Scalable processor optimized for networking workloads, together with Intel® QuickAssist Technology for security and compression hardware acceleration

Business Challenge: Getting ready for 5G

Expectations for 5G are high. Significantly faster mobile broadband speeds will enable augmented reality (AR) experiences, immersive online gaming, and more. Improved latency and reliability will facilitate massive machine-to-machine (M2M) communication, making industrial automation and self-driving cars a reality. Meanwhile, lower cost-per-application for the Internet of Things (IoT) will make many of today's more theoretical services like remote healthcare monitoring commercially viable.

For CoSPs, these new 5G services will place huge performance requirements on the network. Most critically peak data rates of up to 20 Gigabits per second (Gbps) on the downlink and 10 Gbps on the uplink and a connection density of up to 1,000,000 devices per square kilometer. To meet these performance goals, CoSPs must ensure their infrastructure is 5G-ready.

The key building blocks of the 5G network include:

- A flexible, modular and scalable **5G next-generation core network**
- **Network functions virtualization** (NFV), separating hardware from software so that cloud infrastructure can be deployed as and when it is needed
- **Software-defined networking** (SDN), separating the control and user planes, bringing the user plane closer to the edge of the network
- **Network slicing** to assure end-to-end quality of service (QoS) for different uses cases with varying network requirements
- **Multi-access edge computing** (MEC), which brings cloud computing to the network edge providing a much better user experience for 5G services that require ultra-low latency
- A more efficient **radio interface** (5GNR)

As CoSPs are tasked with offering more users with a much better user experience, they will need significant processing power for cloud computing in both the 5G core and at the network edge, which will be expected to securely handle gigabits of network traffic and a variety of workloads including load balancing, firewall, transport layer security, and more.

F5 virtual solutions for 5G-ready infrastructure

The F5 BIG-IP platform offers a rich portfolio of products and solutions for immediate deployment in NFV environments. For completely or partially virtualized networks migrating only certain network elements as virtual network functions (VNFs), the F5 portfolio of BIG-IP products supports both virtual editions (VEs – the F5 name for VNFs), as well as purpose-built hardware platforms.

VNFs available on the BIG-IP platform include virtual firewall, virtual Gi LAN/N6, virtual application delivery controllers, virtual policy manager, virtual DNS and more.

To enable the transformation to a 5G-ready infrastructure, F5 can support the migration from a centralized deployment in the data center cloud to one that is distributed at the edge, like a multi-access edge compute (MEC) platform. Applications are moving closer to the network edge. The MEC environment needs to provide significantly reduced network packet latency and jitter for the applications hosted in the new environment. F5 is well positioned to support data center-like functionality in the MEC environment as it is similar to traditional IT and managed service provider (MSP) functions. F5 offers core services such as firewall, traffic optimization, transport layer security (TLS) and encryption offload in the new high-performance, distributed MEC environment - see figure 2.

F5's solutions work closely together to achieve this edge migration – for example, the F5 VNF Manager* provides lifecycle management, configuration management, auto-scaling and auto-healing for F5 VNFs for easy management, deployment or withdrawal of VNFs from the infrastructure. Once VNFs are deployed by the VNF Manager, BIG-IQ* automatically allocates licenses so the VNFs can perform their function in the MEC platform. F5 also has automation toolkits – e.g. cloud templates, declarative on-boarding scripts, and a specially-developed declarative application service AS3*, as well as telemetry streaming to applications like Splunk*, which generate statistics on the performance of the VNFs in the MEC platform.

Figure 3 illustrates how a large North American CoSP is using BIG-IP VEs in both its core and edge network. In the 5G Core, the BIG-IP VE is providing DNS caching, security, GI firewall and carrier-grade network address translation (NAT) functions.

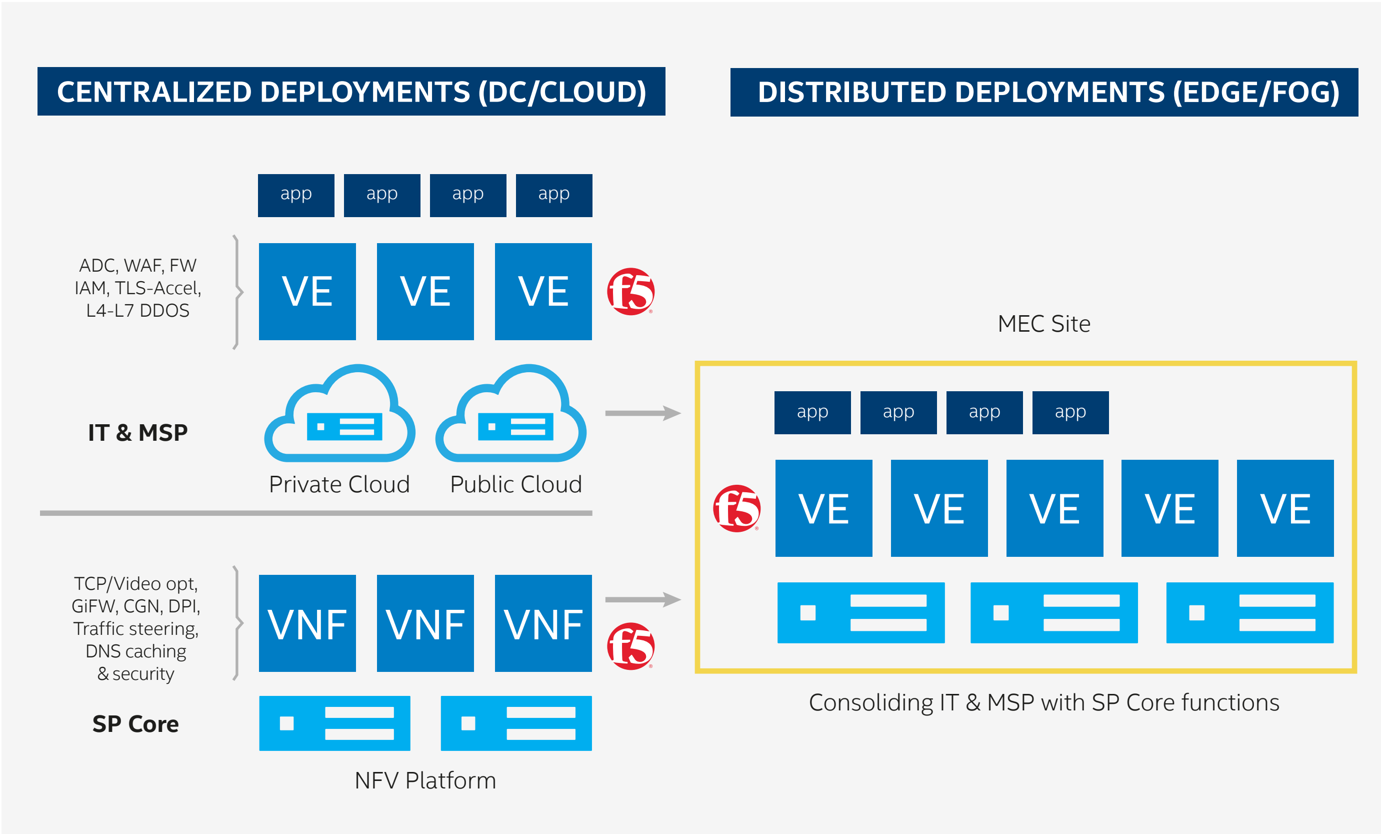

Figure 2. Bringing together network functions and applications for multi-access edge (MEC) computing.

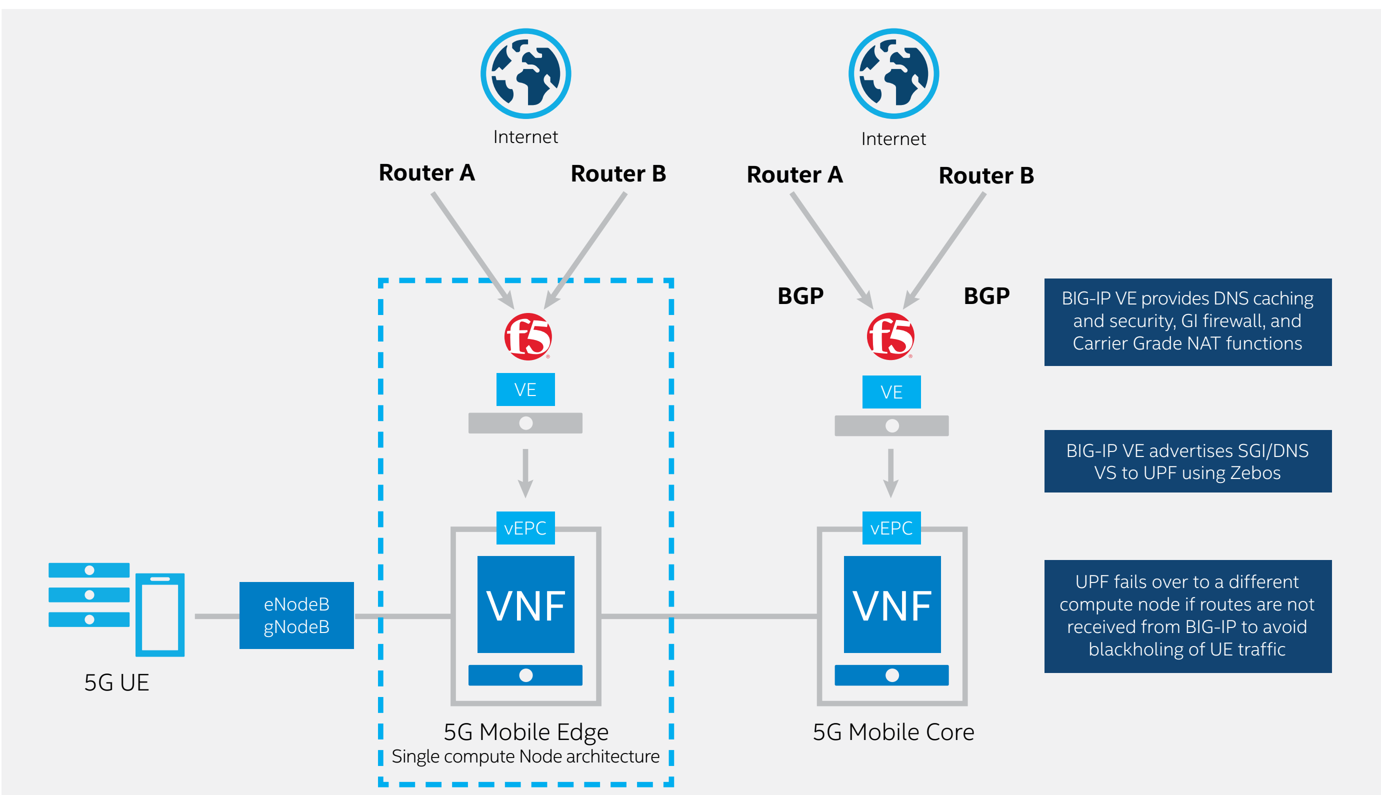

Figure 3. A large North American CoSP is using BIG-IP VEs in both its 5G Core and edge network.

Solution Value: Simple, flexible network virtualization

Packaged solutions. F5 makes network virtualization easier with fully automated packaged NFV solutions. These are ready-to-install solutions, purchased as consumption-based options from five to 50 Gbps increments, which greatly simplify network planning, sizing and purchasing. These packaged VNF services include the F5 VNF Manager, which enables a fully automated solution with full lifecycle management from service instantiation to auto-scaling to decommission.

Flexible deployment options. All F5 solutions are built on top of the traffic management operating system (TMOS), allowing for the seamless transition of networks from the F5 VIPRION* chassis and BIG-IP appliances to VNFs. CoSPs can maintain a hybrid network architecture that can be tailored and customized based on their network requirements and NFV migration roadmap while providing a high quality of service for their subscribers.

Standards-Based Architecture. F5 is a member and actively participates in ETSI NFV, IETF, Openstack Forum, Open Networking Foundation, and other NFV/SDN standards bodies and consortia, ensuring that F5 solutions can be integrated within the NFV network architecture.

Carrier-Class Performance. F5 VNFs can be scaled out to 40 Gbps and support x86 architectures that provide equal or better performance than purpose-built hardware. With a hybrid network approach, CoSPs can maintain key functionality on hardware while evolving VNFs in the same network. This also enables them to place ADCs in front of VNFs - effectively scaling them out and providing high network availability.

Solution Architecture: F5 BIG-IP* with Intel® Xeon® Scalable processor

Underpinning the F5 BIG-IP platform is the 2nd generation Intel Xeon Scalable processor with Intel QAT – see figure 4. Working together with Intel, F5 was able to optimize the BIG-IP platform to provide the performance required by 5G networks.

Offering 1.25 – 1.58x NFV workload performance improvements[1], the 2nd generation Intel Xeon Scalable platform is optimized to run specific networking workloads – for example, the 5G user plane function (UPF), IP Sec termination points in the infrastructure, virtual routing and some TLS capabilities. Additional processing headroom delivers enhanced virtual machine (VM)/ VNF capacity and density, enabling CoSPs to handle greater subscriber capacity and mobile services and reduce bottlenecks for fixed and mobile 5G networks.

Intel QAT offers encryption and compression hardware acceleration to enable secure network communication to applications and services no matter where they reside on the network. Using Intel QAT, F5 was able to increase secure socket layer (SSL) performance from 7,500 transactions per second (Tps) with a 100 percent utilization rate to 30,000 Tps with a reduction in utilization[2].

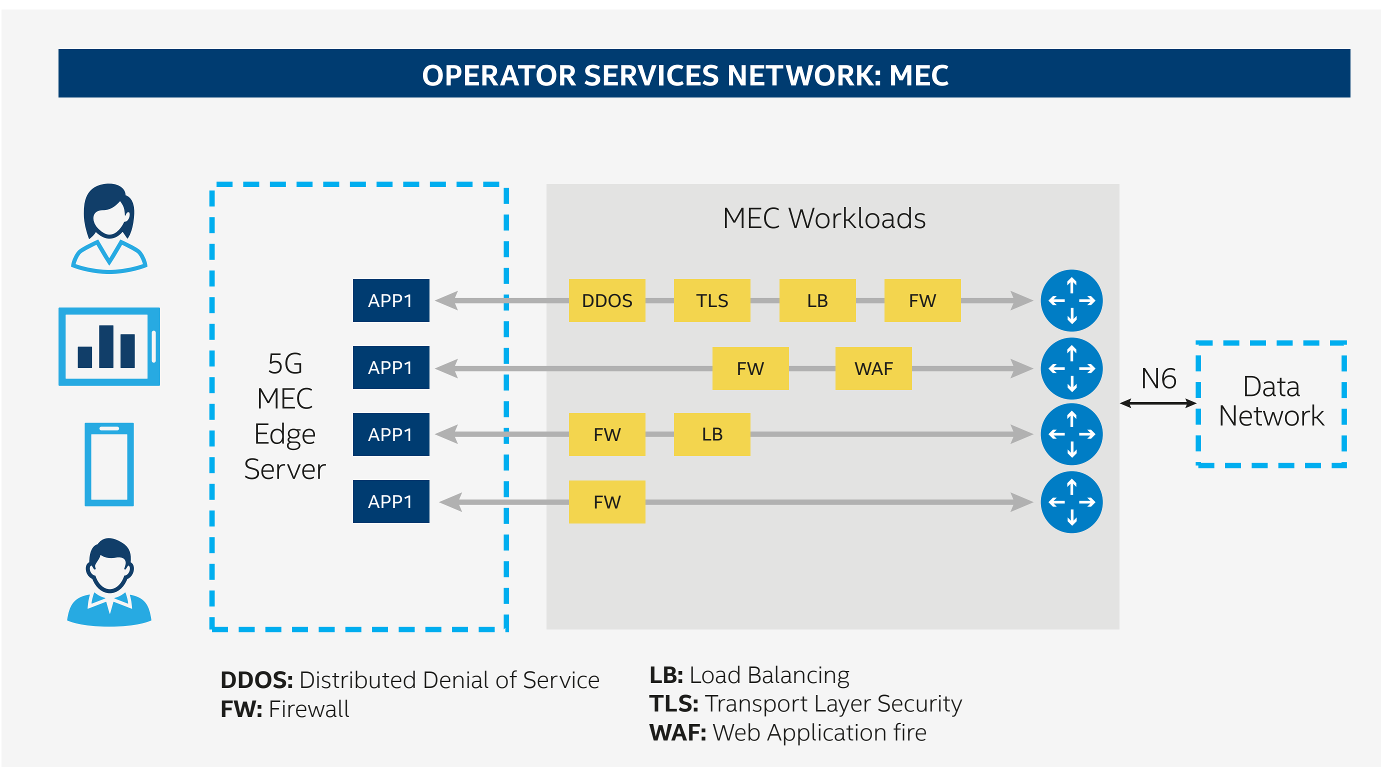

Figure 4. The multi-access edge compute (MEC) operator services network running on Intel® processor technology.

Conclusion

5G aims for a peak data rate of 20 Gbps in the downlink and 10 Gbps in the uplink, with a connection density of one million devices per square kilometer. Furthermore, services are changing and have a significant increase in delay sensitivity, throughput, and storage of data. The hardware used for the 5G Core and MEC platforms needs to be able to support these new performance requirements. The 2nd generation Intel Xeon Scalable processor with Intel QAT is enabling CoSPs using F5's BIG-IP platform to rise to this 5G performance challenge.

Solutions Proven By Your Peers

Intel Solutions Architects are technology experts who work with the world's largest and most successful companies to design business solutions that solve pressing business challenges. These solutions are based on real-world experience gathered from customers who have successfully tested, piloted, and/or deployed these solutions in specific business use cases. Solutions architects and technology experts for this solution brief are listed on the front cover.

Learn More

Intel® Xeon® Scalable Processors: https://www.intel.com/content/www/us/en/products/processors/xeon/scalable.html

Intel® QuickAssist Technology: https://www.intel.com/content/www/us/en/architecture-and-technology/intel-quick-assist-technology-overview.html

F5 BIG-IP* Platform: https://www.f5.com/solutions/service-providers/5g

Find the solution that is right for your organization. Contact your Intel representative or visit **www.intel.com/networktransformation**

Or get more information to help guide conversations and decisions with your team about optimizing infrastructure to support 5G readiness in the FAQ sheet, **Transitioning to the 5G core network**.

[1] 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. For more complete information visit www.intel.com/benchmarks

Configurations: Up to 1.25 to 1.58X NVF Workload Performance Improvement comparing Intel® Xeon® Gold 6230N processor to Intel® Xeon® Gold 6130 processor.

VPP IP Security: Tested by Intel on 1/17/2019 1-Node, 2x Intel® Xeon® Gold 6130 processor on Neon City platform with 12x 16GB DDR4 2666MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYDCRB1.86B.0155.R08.1806130538, ucode: 0x200004d (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.15.0-42-generic, Benchmark: VPP IPSec w/AESNI (AES-GCM-128) (Max Gbits/s (1420B)), Workload version: VPP v17.10, Compiler: gcc7.3.0, Results: 179. Tested by Intel on 1/17/2019 1-Node, 2x Intel® Xeon® Gold 6230N processor on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.PFT.0569.D08.1901141837, ucode: 0x4000019 (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: VPP IPSec w/AESNI (AES-GCM-128) (Max Gbits/s (1420B)), Workload version: VPP v17.10, Compiler: gcc7.3.0, Results: 225.

VPP FIB: Tested by Intel on 1/17/2019 1-Node, 2x Intel® Xeon® Gold 6130 processor on Neon City platform with 12x 16GB DDR4 2666MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYDCRB1.86B.0155.R08.1806130538, ucode: 0x200004d (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.15.0-42-generic, Benchmark: VPP FIB (Max Mpackets/s (64B)), Workload version: VPP v17.10 in ipv4fib configuration, Compiler: gcc7.3.0, Results: 160. Tested by Intel on 1/17/2019 1-Node, 2x Intel® Xeon® Gold 6230N processor on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.PFT.0569.D08.1901141837, ucode: 0x4000019 (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: VPP FIB (Max Mpackets/s (64B)), Workload version: VPP v17.10 in ipv4fib configura¬tion, Compiler: gcc7.3.0, Results: 212.9.

Virtual Firewall: Tested by Intel on 10/26/2018 1-Node, 2x Intel® Xeon® Gold 6130 processor on Neon City platform with 12x 16GB DDR4 2666MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 4x Intel X710-DA4, Bios: PLYDCRB1.86B.0155.R08.1806130538, ucode: 0x200004d (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.15.0-42-generic, Bench¬mark: Virtual Firewall (64B Mpps), Workload version: Opnfv 6.2.0, Compiler: gcc7.3.0, Results: 38.9. Tested by Intel on 2/04/2019 1-Node, 2x Intel® Xeon® Gold 6230N processor on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.PFT.0569.D08.1901141837, ucode: 0x4000019 (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: Virtual Firewall (64B Mpps), Workload version: Opnfv 6.2.0, Compiler: gcc7.3.0, Results: 52.3.

Virtual Broadband Network Gateway: Tested by Intel on 11/06/2018 1-Node, 2x Intel® Xeon® Gold 6130 processor on Neon City platform with 12x 16GB DDR4 2666MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYDCRB1.86B.0155. R08.1806130538, ucode: 0x200004d (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.15.0-42-generic, Benchmark: Virtual Broadband Network Gateway (88B Mpps), Workload version: DPDK v18.08 ip_pipeline application, Compiler: gcc7.3.0, Results: 56.5. Tested by Intel on 1/2/2019 1-Node, 2x Intel® Xeon® Gold 6230N processor on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.PFT.0569.D08.1901141837, ucode: 0x4000019 (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: Virtual Broadband Network Gateway (88B Mpps), Workload version: DPDK v18.08 ip_pipeline application, Compiler: gcc7.3.0, Results: 78.7.

VCMTS: Tested by Intel on 1/22/2019 1-Node, 2x Intel® Xeon® Gold 6130 processor on Supermicro*-X11DPH-Tq platform with 12x 16GB DDR4 2666MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 4x Intel XXV710-DA2, Bios: American Megatrends Inc.* version: '2.1', ucode: 0x200004d (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: Virtual Converged Cable Access Platform (iMIX Gbps), Workload version: vcmts 18.10, Compiler: gcc7.3.0 , Other software: Kubernetes* 1.11, Docker* 18.06, DPDK 18.11, Results: 54.8. Tested by Intel on 1/22/2019 1-Node, 2x Intel® Xeon® Gold 6230N processor on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.PFT.0569. D08.1901141837, ucode: 0x4000019 (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: Virtual Converged Cable Access Platform (iMIX Gbps), Workload version: vcmts 18.10 , Compiler: gcc7.3.0, Other software: Kubernetes* 1.11, Docker* 18.06, DPDK 18.11, Results: 83.7.

OVS DPDK: Tested by Intel on 1/21/2019 1-Node, 2x Intel® Xeon® Gold 6130 processor on Neon City platform with 12x 16GB DDR4 2666MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 4x Intel XXV710-DA2, Bios: PLYXCRB1.86B.0568.D10.1901032132, ucode: 0x200004d (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.15.0-42-generic, Benchmark: Open Virtual Switch (on 4C/4P/8T 64B Mpacket/s), Workload version: OVS 2.10.1, DPDK-17.11.4, Compiler: gcc7.3.0, Other software: QEMU-2.12.1, VPP v18.10, Results: 9.6. Tested by Intel on 1/18/2019 1-Node, 2x Intel® Xeon® Gold 6230N processor on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.86B.0568.D10.1901032132, ucode: 0x4000019 (HT= ON, Turbo= OFF), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: Open Virtual Switch (on 6P/6C/12T 64B Mpacket/s), Workload version: OVS 2.10.1, DPDK-17.11.4, Compiler: gcc7.3.0, Other software: QEMU-2.12.1, VPP v18.10, Results: 15.2. Tested by Intel on 1/18/2019 1-Node, 2x Intel® Xeon® Gold 6230N processor with SST-BF enabled on Neon City platform with 12x 16GB DDR4 2999MHz (384GB total memory), Storage: 1x Intel® 240GB SSD, Network: 6x Intel XXV710-DA2, Bios: PLYXCRB1.86B.0568.D10.1901032132, ucode: 0x4000019 (HT= ON, Turbo= ON (SST-BF)), OS: Ubuntu* 18.04 with kernel: 4.20.0-042000rc6-generic, Benchmark: Open Virtual Switch (on 6P/6C/12T 64B Mpacket/s), Workload version: OVS 2.10.1, DPDK-17.11.4, Compiler: gcc7.3.0, Other software: QEMU-2.12.1, VPP v18.10, Results: 16.9.

Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

[2] Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors.

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F5 Networks* Gi-Lan: Configuration #1: 2x Intel® Xeon® Gold E5-6230N Processor on Neon City Platform with 192 GB total memory (12 slots / 16GB / DDR4 2667MHz), ucode 0x4000019, Bios: PLYXCRB 1.86B.0568.D10.1901032132, uCode: 0x4000019 on CentOS 7.5 with Kernel 3.10.0-862, KVM Hypervisor; 1 x Intel® QuickAssist Adapter 8970, TLS1.2: AES128-GCM-SHA256 2K key with 3x QAT Physical Functions (End-Point); 1 x Dual Port 40GbE Intel® Ethernet Network Adapter XL710; Application: BIG-IP Virtual Edition (VE) v14.1 (BETA Version with QAT Enabled); Configuration #2: 2x Intel® Xeon® Gold E5-6230 Processor on Neon City Platform with 192 GB total memory (12 slots / 16GB / DDR4 2667MHz), ucode 0x4000019, Bios: PLYXCRB 1.86B.0568.D10.1901032132, uCode: 0x4000019 on CentOS 7.5 with Kernel 3.10.0-862, KVM Hypervisor; 1 x Dual Port 40GbE Intel® Ethernet Network Adapter XL710; Application: BIG-IP Virtual Edition (VE) v14.1 (BETA Version with no QAT); Results recorded by F5 on 3/27/2018.

Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

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