White Paper

Network Buying Centers, Principal Architects, Chief Technology Officers
Communication Service Providers

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6WIND Demonstrates 400GbE Virtual Security Gateway Throughput[i]

The 6WIND Virtualized Security Gateway demonstrated performance scalability up to 400Gbps (iMIX) in tests using 3rd Generation Intel® Xeon® Scalable processors and Intel® 800 Series Ethernet Network Adapters.

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Virtualized Networking Software

Introduction

Communications service providers (CoSPs) are investing in security gateways to provide IPsec virtual private network (VPN) services to customers. Software-based, virtualized solutions allow for reduced costs, flexible service deployments and power efficiency for sustainability. But can they keep up with today's fastest networks? In this paper, 6WIND and Intel test the virtualized security gateway product of the 6WIND Virtual Service Router (VSR) family running on Intel® architecture-based servers to demonstrate its ability to process 400Gbps IMIX encrypted data streams.

By combining the benefits of virtualization, the performance of 6WIND VSR products, and the openness and cost reduction brought by COTS servers, service providers can build efficient network solutions that allow replacing traditional vendor-specific hardware appliances.

Demand rising for IPsec VPN services

Virtualized security gateways answer a communications service providers (CoSP) need for secure virtual private network (VPN) services that are cost effective, flexible, and power efficient. But network speeds keep growing and security gateways need to keep up with that growth.

A September 2022 report from Dell'Oro Group shows that the U.S. market for service provider routers and aggregation switches was driven by the ramp up in 400 GbE networks[i]. The data point is relevant because security gateways are a subset of the service provider router market and are critical elements in a service provider network.

As more people work from home, enterprises are concerned about an increase in cyber security attacks that exposes sensitive data. The need for VPN platform scalability and performance combined with flexibility and cost reduction are paramount.

6WIND, an Intel® Network Builders ecosystem member is using the compute power of servers based on 3rd Generation Intel® Xeon® Scalable processors and 100GbE network connections from Intel® 800 Series Ethernet Network Adapters to deliver a scalable IPsec virtual security gateway. Tests described in this paper show the gateway delivering up to 400 GbE throughput with an Internet MIX (iMIX) traffic profile.

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6WIND Virtual Service Router

The 6WIND vSecGW is part of the 6WIND VSR product family, a high-performance and scalable virtualized software router. Other services the router offers include:

- **Virtual carrier grade network address translation:** reduces the number of IPv4 addresses needed for a network by translating internal addresses to external addresses.

- **Virtual border router:** delivers Border Gateway Protocol (BGP) routing for upstream traffic and Open Shortest Path First (OSPF)routing to downstream traffic.

- **Virtual provider edge router:** provides a network edge service for delivering highly available internet services over IP/MPLS.

- **Virtual cell site router:** provides aggregation and backhaul transport of traffic from a RAN to the operator's core network.

- **Universal customer premises equipment (uCPE) router:** provides a small footprint virtual router for cost effective and highly efficient branch office routing and security services.

The 6WIND VSR product family has an architecture and built-in features that enhances network efficiency by reducing power consumption.

Virtual Router Delivers IPsec VPNs

The 6WIND Virtual Service Router (VSR) is a high-performance and scalable virtualized software router for CoSPs that can be used as a Virtualized Security Gateway (vSecGW). Using the 6WIND vSecGW, network operators can replace legacy physical security gateways with a virtual one running on COTS servers in hybrid environments and delivering superior deployment flexibility, a rich feature set, carrier-grade performance, and high availability at a fraction of the cost.

The 6WIND vSecGW can run as a virtual network function (VNF) with industry leading virtualization hypervisors, as a container network function (CNF) in a Kubernetes/docker container orchestration system or in a bare metal deployment.

The 6WIND vSecGW supports a dual network stack (IPv4 and IPv6) along with a rich set of routing protocols. For its layer 3 VPN, the software supports two public key certificate standards: X.509 certificates and the Internet Key Exchange (IKE) v1/v2 pre-shared keys. The vSecGW functionality has been engineered to support a wide range of network applications, including fixed wireline, wireless or converged networks. Some of the use cases include:

Mobile Security Gateway (CoSP): The 6WIND vSecGW can be deployed in a 4G network to deliver end-to-end encryption and to terminate VPN tunnels initiated at macro cells or small cells. In a 5G network, the vSecGW can be deployed to secure the connectivity on the midhaul and backhaul between the radio area network (RAN) centralized units (CU) and the distributed units (DU) or between the CU and the 5G core network.

Remote Access IPsec VPN (CoSP & Enterprise): Remote access IPsec VPN services are a classic VPN use case allowing CoSPs to offer services to securely connect remote workers and branch offices to the enterprise headquarters or regional network. The 6WIND vSecGW provides encryption and interoperability capabilities allowing aggregation of VPN connections issued by native VPN desktop and mobile device client solutions. The service can be built in a high-availability configuration that increases resiliency and reliability without impacting performance or scalability.

Secure Multi-Cloud Access (Enterprise): The secure multi-cloud access service allows enterprises to securely extend private networks to public cloud services where they can access cloud-hosted services, assets, and applications. The 6WIND vSecGW works in any public cloud network with the same features and functionality.

Enterprise site-to-site and network-to-network security: The 6WIND vSecGW solution supports highly scalable dynamic multipoint virtual private network (DMVPN) capabilities. A DMVPN allows all sizes of enterprises to securely create site-to-site, network-to-network or light SD-WAN networks over agnostic wireline and wireless transport access.

Intel Processors and Ethernet Adapters Deliver Performance

For this performance test, 6WIND specified servers using 3rd Generation Intel Xeon Scalable processors. These processors offer a balanced architecture that delivers built-in AI acceleration and advanced security capabilities that extend from the edge to the cloud.

More specifically, the 6WIND vSecGW makes use of the features in network-optimized (N SKUs) 3rd Gen Intel Xeon Scalable processors, that are designed to support high throughput virtualized network software. The Intel® Advanced Vector Extensions 512 (Intel® AVX-512) were used for crypto operations.

For network connections, the testers used Intel 800 Series Ethernet Network Adapters, which are designed for 25GbE or 100 GbE connections. The network adapters feature Dynamic Device Personalization (DDP) pipeline programmability along with flow director and RSS features to optimize the steering of upstream and downstream traffic to the receive software threads.

6WIND Security Test Bed

The testbed (see Figure 1) shows a UE, 4G/5G core and a RAN simulation device used to load the device under test (vSecGW) with encrypted traffic from the RAN to the core and clear traffic the way back. Three servers were used to build the test bed; one for the traffic generation (UE and 4G/5G core simulation), one for the RAN simulation to initiate traffic encryption on the RAN, and one to host the device under test (vSecGW).
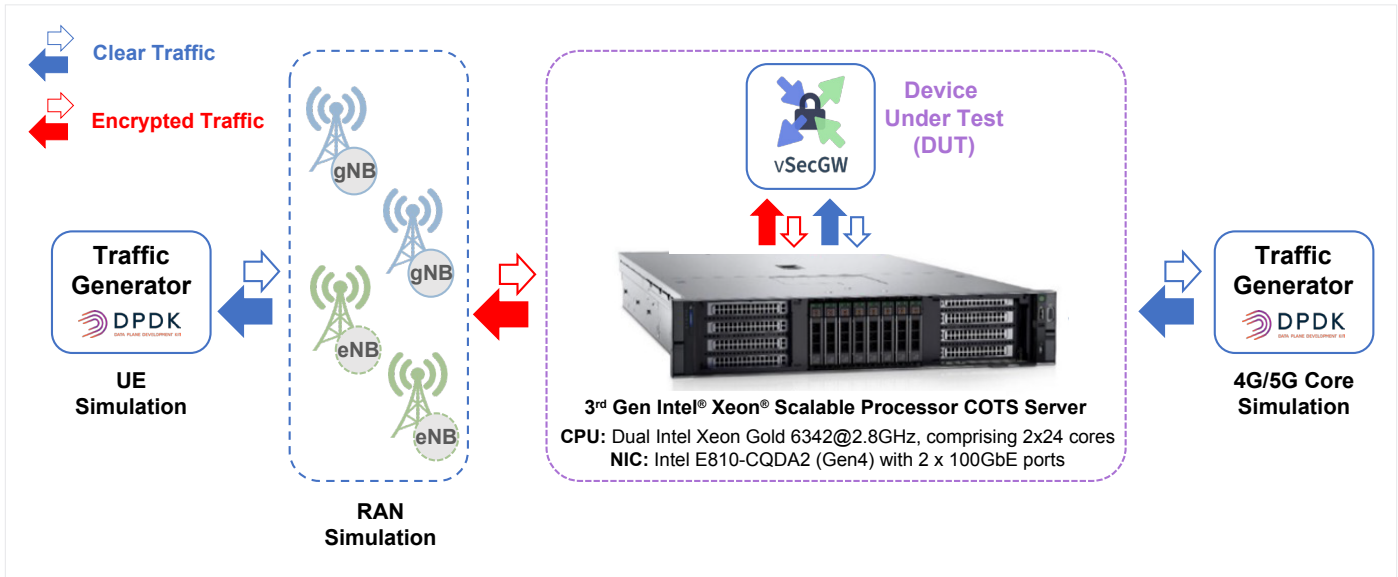
Figure 1. Test Setup with vSecGW running as a VM on 3rd Gen Intel Xeon Scalable Processor Server.

The servers were connected through a 100GbE switch. Each of the servers featured dual Intel® Ethernet Network Adapters E810-2CQDA2 that feature 2 x 100GbE ports for a total aggregate throughput of 400GbE per server.

Server-1 hosts an instance of the TGen traffic generator that is used to load the setup with line rate mobile device traffic. It emulates the user equipment (UE) on one side and the 4G/5G core (Core) on the other side. Server-2 hosts the RAN Simulation instance, which emulates 4G/5G base station (e/gNB) functionality to encrypt and decrypt up to 400Gbps IPsec traffic that emulates the traffic patterns and packet sizes of a typical 4G/5G mobile network. Server-3 runs the 6WIND vSecGW (v3.4.5) that encrypts and decrypts traffic exchanged between UE and core.
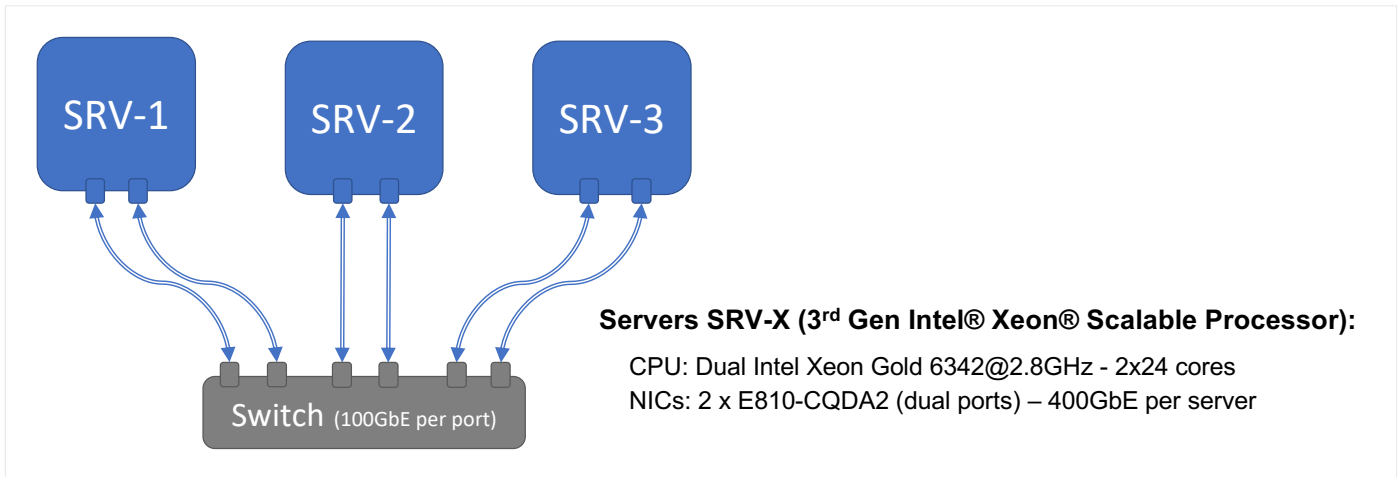

Figure 2. Lab setup

The servers feature dual Intel® Xeon® Gold 6342 processors running at 2.80 GHz, with 36MB of cache memory. Each CPU includes 24 cores with hyperthreading turned on resulting in 48 threads per socket and a total of 96 virtual core per server.

The 6WIND vSecGW (v3.4.5) instance was deployed in a VM with 8G of RAM and single root I/O virtualization (SR-IOV) was used to connect to the physical Ethernet adapters. Tests were conducted using increasing numbers of dedicated vCPU to demonstrate performance scalability.

The tests showed performance for each of four different packet sizes - 64 bytes, 350 bytes, 700 bytes and 1400 bytes. The 350-byte and 700-byte packets were iMIX data streams that incorporated a variety of packet sizes that average out to the stated packet sizes. The 700-byte iMIX data stream is best aligned with real-world mobile network data flows. The other variable in the test was the number of cores dedicated to processing this data traffic, which doubled from one core to 32 cores and then to 40 cores. The remaining eight cores were used for operating system and virtualization processing.

Reaching 400Gbps Throughput

As seen in Figure 3, the 6WIND virtual security gateway throughput increased proportionately across all packet sizes with the number of cores allocated to the VM. Full line rate (400Gbps) throughput was achieved with 700-byte packets using 32 cores.
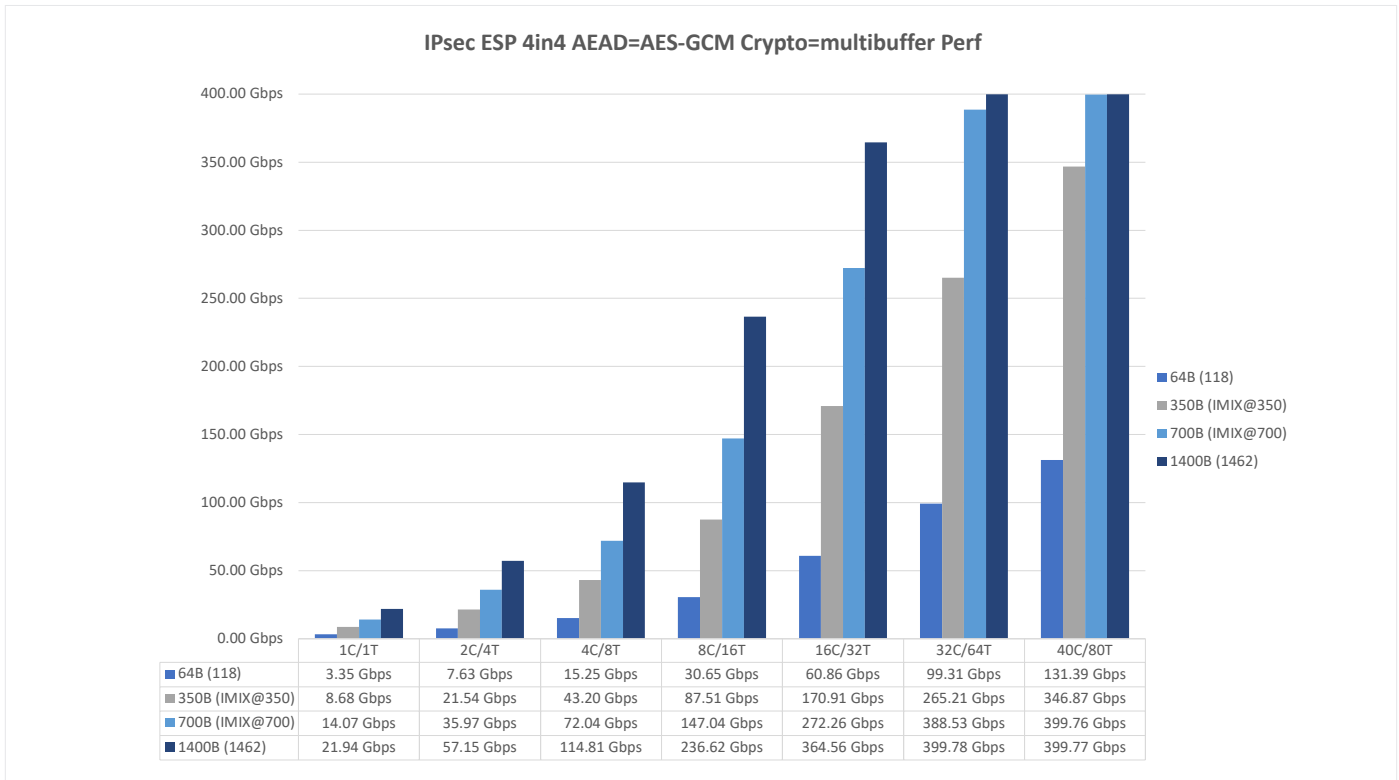
IPsec ESP 4in4 AEAD=AES-GCM Crypto=multibuffer Perf

	1C/1T	2C/4T	4C/8T	8C/16T	16C/32T	32C/64T	40C/80T
64B (118)	3.35 Gbps	7.63 Gbps	15.25 Gbps	30.65 Gbps	60.86 Gbps	99.31 Gbps	131.39 Gbps
350B (IMIX@350)	8.68 Gbps	21.54 Gbps	43.20 Gbps	87.51 Gbps	170.91 Gbps	265.21 Gbps	346.87 Gbps
700B (IMIX@700)	14.07 Gbps	35.97 Gbps	72.04 Gbps	147.04 Gbps	272.26 Gbps	388.53 Gbps	399.76 Gbps
1400B (1462)	21.94 Gbps	57.15 Gbps	114.81 Gbps	236.62 Gbps	364.56 Gbps	399.78 Gbps	399.77 Gbps

Figure 3. 6WIND VSR security gateway performance based on number of cores and packet sizes (higher is better). Results may vary. See footnotes for configuration details.

Conclusion

Demand for VPN services is growing to protect the data of an increased number of remote workers. And at the same time CoSPs are building higher bandwidth networks, with 400GbE growing quickly. Virtualized IPsec-based security gateways are a good VPN solution that offers flexibility to cover the most important use cases. But it's also important to demonstrate the software can serve the highest performance applications. The 6WIND vSecGW running on 3rd Generation Intel Xeon Scalable processors with Intel 800 Series Ethernet Network Adapters showed it could fill a 400Gbps pipe using 700-byte packets. This performance means the solution can meet the growing bandwidth needs of CoSPs.

Learn More

6WIND VSR (Virtual Service Router)

6WIND Virtual Security Gateway (6WIND vSecGW)

6WIND Website

Intel® Network Builders

3rd Generation Intel® Xeon® Scalable processors