SOLUTION BRIEF

Small- and Medium-Sized Enterprise
SD-WAN

Telefónica Tests Open Source flexiWAN for New SD-WAN Service

flexiWAN SD-WAN software on Intel Atom® processor-based uCPE from Silicom delivers throughput of 569 Mbps[1]; test was done running flexiWAN data plane on a single CPU core without hardware encryption acceleration.

Telefónica is developing a new software defined wide area network (SD-WAN) service for small- and medium-sized enterprises (SME). The SD-WAN service development is being led by the company's Global Innovation Unit and is part of a bigger project that the multinational European communications service provider (CommSP) is undertaking to build a suite of SME communications services using open source software.

Telefónica considers the modular, open source flexiWAN SD-WAN software as a strategic investment that will open and democratize the branch networking market. flexiWAN allows third parties like Telefónica to create flexible and customized SD-WAN services that are differentiated from the competition.

This is possible because flexiWAN provides a complete feature set as well as a software development kit (SDK) and a comprehensive set of application programming interfaces (APIs) that will ease integration with other software components from CommSPs or any organization willing to enroll in the community.

Given the maturity of the software, the company is working to expand the flexiWAN community to make it sustainable for the long term. For that purpose, it is necessary that other CommSPs, vendors, and enterprises also enroll in this community and actively contribute to building innovation.

Demonstrating performance is the first step toward potential commercialization of the SD-WAN service. Teaming up with Intel and Silicom, Telefónica conducted performance benchmark tests with two universal customer premises equipment (uCPE) servers to demonstrate that its flexiWAN-based service can meet the performance needs of its customers.

The Growing Market for SD-WAN Services

SD-WAN services are growing very rapidly because they offer SME locations and large enterprise branch offices centralized control and automated provisioning of secure WAN connectivity to increasingly important cloud services using broadband internet access services. At the same time, SD-WAN services support legacy WAN connectivity back to a private data center.

SD-WAN services are implemented using software running on commercial off-the-shelf (COTS) Intel architecture-powered servers, in either bare metal mode or using network functions virtualization (NFV). Replacing a fixed-function appliance with general purpose hardware can make the SD-WAN software much less expensive to deploy. In an NFV deployment, additional services, such as routing or a firewall, can be deployed along with the SD-WAN to bring additional value to the customer.

See backup for configuration details. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks. Refer to http://software.intel.com/en-us/articles/optimization-notice for more information regarding performance and optimization choices in Intel software products.

Telefónica is focusing the SD-WAN solution on SMEs because the market is fast growing and customers require fewer capabilities in contrast with multinational companies. Additionally, large multinational companies typically specify their solution from a narrow range of software vendors through RFPs, which makes it difficult for Telefónica to differentiate its service offerings by introducing new products like flexiWAN.

Silicom and flexiWAN Tested for Suitability

Performance testing is one of the first steps in Telefónica's acceptance of the new flexiWAN-based SD-WAN service. Telefónica worked with Intel to develop and conduct performance tests using two Silicom uCPE servers that have been shown to be cost effective for SME deployments.

For the first system under test (SUT), Telefónica selected Silicom's Intel Atom® C2000 processor-based RCC-VE CPE Desktop Appliance. The RCC-VE2 is a compact, low-cost design with a two-core Intel Atom C2358 processor. The server used in the test features a compact design with six Gigabit Ethernet ports and optional modules for LTE and Wi-Fi connectivity (although the server was not configured with either of these wireless options for these tests). The SUT featured 4 GB of RAM and a 32 GB storage drive.

The Intel Atom C2000 system-on-chips (SoCs) are designed for uCPE applications and deliver optimal efficiency for lightweight small office workloads. Intel Atom C2000 processors offer performance for low-power, small-footprint devices targeted at the network edge.

The second SUT for the tests was Silicom's Nano network appliance based on the two-core Intel Atom C3338 processor. The SUT features four Gigabit Ethernet ports for LAN and WAN connectivity. The SUT supports optional LTE connectivity, but not for Wi-Fi. For the tests, it featured 4 GB of RAM with a 32 GB eMMC-based storage disk.

The Intel Atom processor C3000 product family is a highly integrated SoC that was created to address the growing needs for the emerging markets like microserver, cloud storage, and growing communication infrastructure market segments.

flexiWAN SD-WAN

flexiWAN SD-WAN is an open source VNF that supports SD-WAN routing of data flows as well as network management, orchestration, and automated deployment capabilities. Different from typical closed SD-WAN solutions, flexiWAN slices an SD-WAN service into horizontal layers that include a networking infrastructure layer and an application framework. More detail is in Figure 1.

Through an SDK, networking applications can be dynamically loaded to the flexiEdge router or flexiManage management. This allows Telefónica or another CommSP the ability to modify the core SD-WAN functionality, add or expand features to optimize traffic flows, or provide unique data security features.

The flexiWAN solution comprises the flexiEdge software that runs on a uCPE in a branch office and provides routing and SD-WAN services. flexiEdge can also be installed in the cloud for cloud-to-enterprise connectivity or service delivery. The centralized flexiManage software manages all of the flexiEdge instances and provides configuration, provisioning, software upgrade, and orchestration of flexiEdge devices and applications.

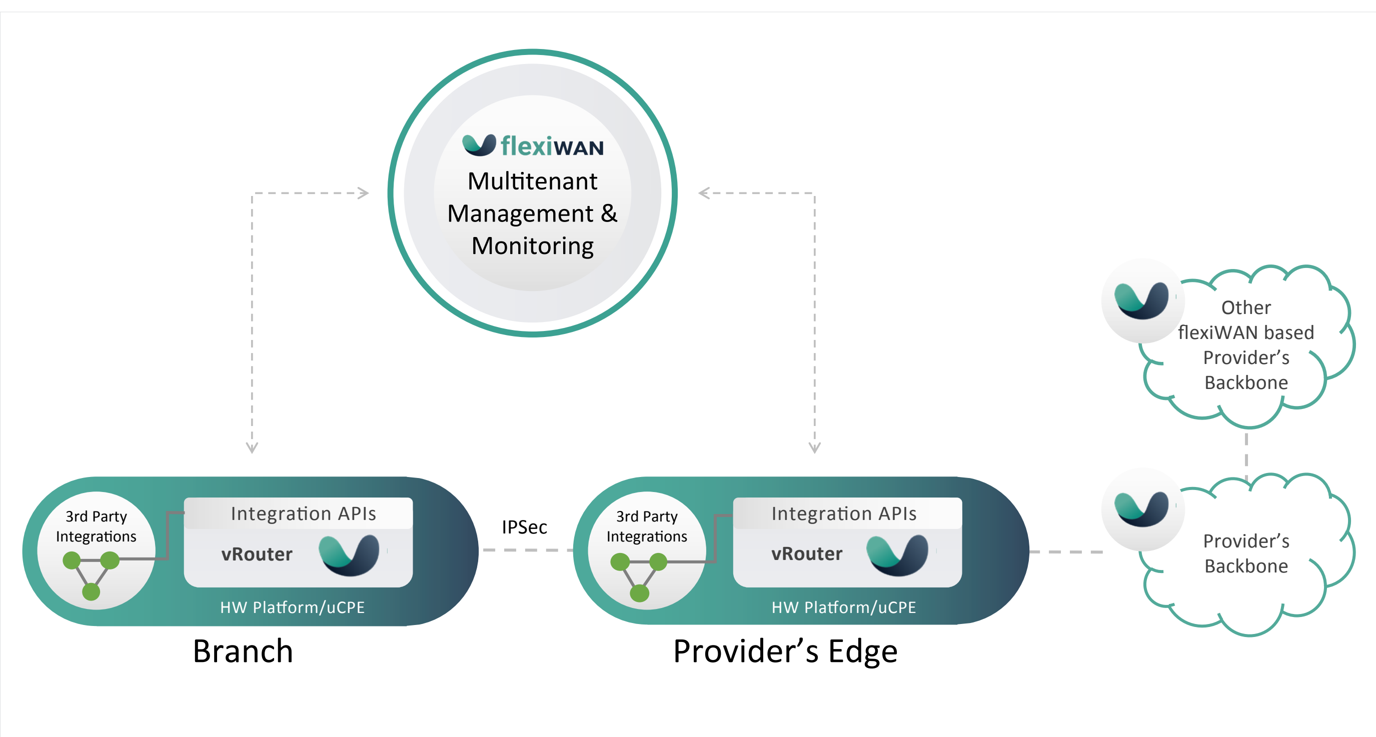

Figure 1. flexiWAN block diagram.[2]

Testing Configuration

The test setup included two of the same Silicom servers (tests were run with each of the server configurations mentioned previously) running flexiWAN GA release v1.1.41.

For all of the tests, the Data Plane Development Kit (DPDK) utilized one core on each of the servers. The configured servers were installed in a Telefónica lab and connected via the internet using an encrypted tunnel as shown in Figure 2.

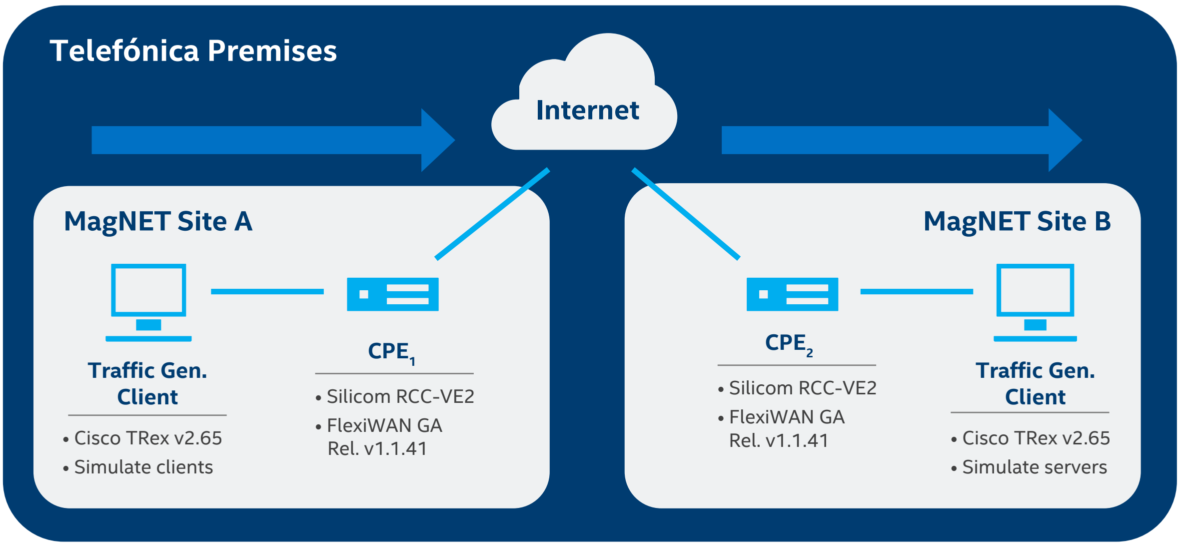

Figure 2. uCPE test configuration.

Throughput was tested at layer 2 and layer 3 using unidirectional traffic from client to server. Measuring traffic performance on each interface is important for analyzing how the SD-WAN service behaves depending on packet size and traffic bandwidth.

The traffic measurement and generation tool used in the test was TRex, a Cisco open source traffic generation tool. The tests utilize TRex stateless (STL) mode to build custom packets that included custom headers and payloads. This enabled fixed packet-size L2/L3 data streams. This mode was used in the L2/L3 tests to specify a desired throughput.

For each uCPE server, multiple independent tests were executed with different traffic types, throughput, and packet sizes. Data was analyzed on both of the network interfaces of the uCPE, on the TRex client transmission interface, and on the TRex server reception interface.

The test parameters for each of the tests are shown in Figure 3.

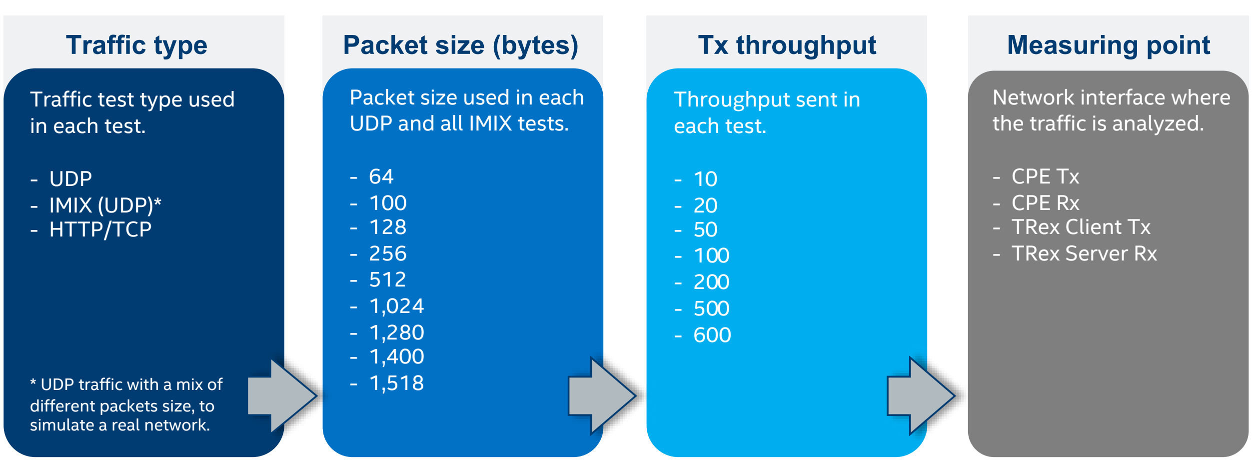

Figure 3. Test parameters.

Deep packet inspection (DPI) was not used in the testing. While DPI is used extensively for certain capabilities and applications (for example, next-generation firewalls), Telefónica customer insights indicate that such capabilities are not widely needed within SME customers. However, integration of DPI functions will be explored later for customers who can benefit from more advanced capabilities.

Benchmark Performance Results

Tests were conducted with flexiWAN data plane running on a single CPU core for flexiEdge and without utilizing Intel® QuickAssist Technology (Intel® QAT) for hardware encryption acceleration. With the use of Intel QAT, it is anticipated performance can be further scaled.

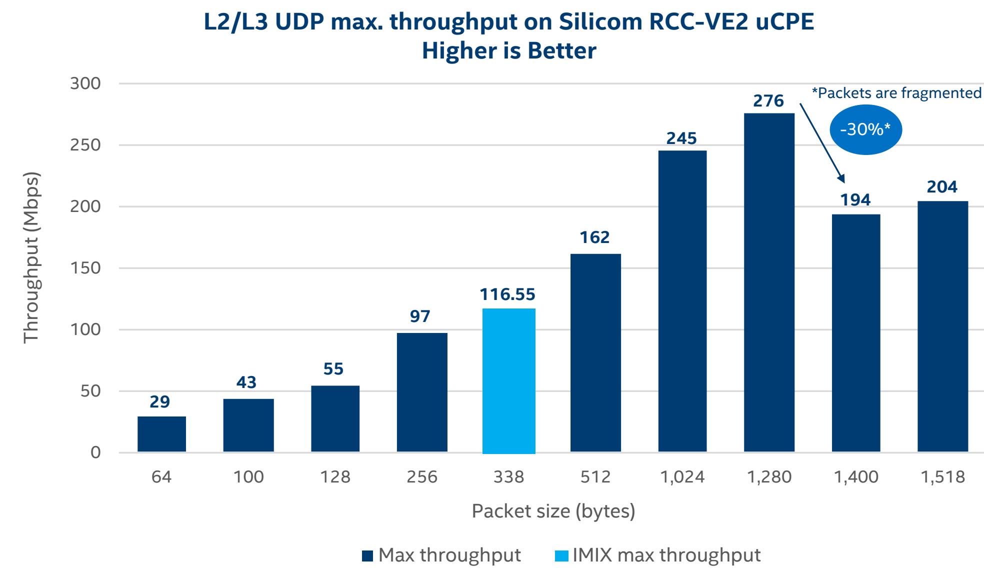

Figure 4. Layer 2/3 test results for Silicom RCC-VE2 version 1 uCPE.[1]

The results shown in Figure 4 represent L2/L3 UDP packet performance for the RCC-VE2 v1 uCPE, powered by the two-core Intel Atom C2358 processor. In the tests, encrypted throughput maxed out at 276 Mbps with 1,280-byte packets.[1] Note that performance at larger packet sizes in all of the tests showed a decline due to packet fragmentation by flexiWAN. (By design, the flexiWAN maximum transmission unit (MTU) is 1,360 bytes.) The packet fragmentation impact was greater in the RCC-VE2 servers, where packet performance dropped by up to 30% at higher packet sizes.

The most likely real-world performance of this uCPE is 116.55 Mbps (encrypted traffic) as demonstrated by the IMIX testing. IMIX is a representation of the packet size mix seen in typical internet traffic depending on the network scenario. In this test, the standard packet size was 338 bytes, and made up of 64-byte packets for 58% of traffic, 590-byte packets for 33% of traffic, and 1,280-byte packets for 9% of traffic.

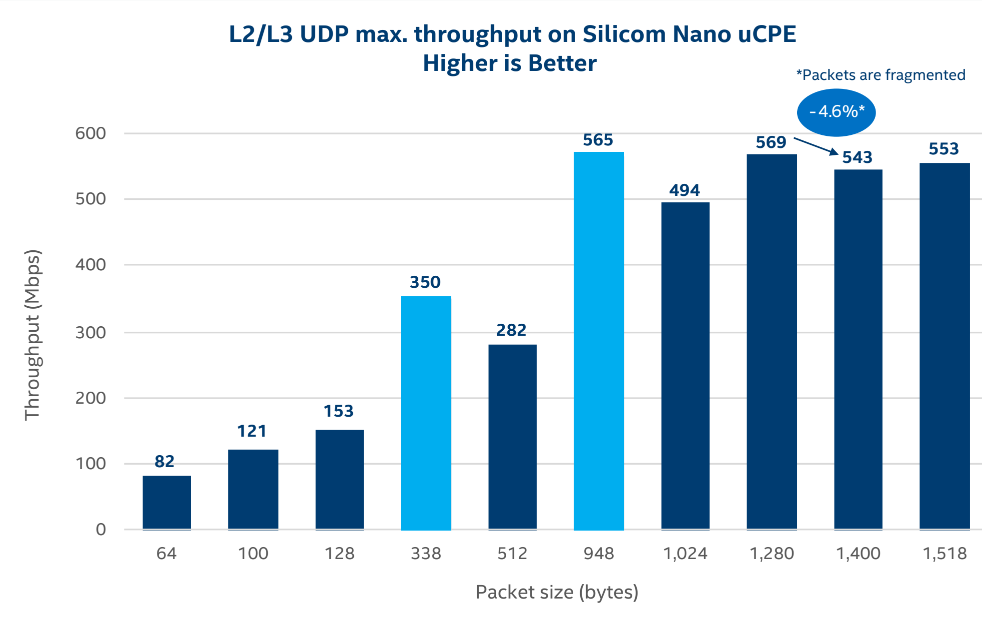

Figure 5. Layer 2/3 test results for Silicom Nano uCPE.[1]

The results shown in Figure 5 measure L2/L3 UDP packet performance for the Nano uCPE, powered by the two-core Intel Atom C3338 processor.[1] In the tests, throughput maxed out at 569 Mbps with 1,280-byte packets. To consider a real customer scenario, IMIX traffic was used. As the IMIX traffic can be considered differently depending on the scenario, for the tests of Nano uCPE, two approaches were considered:

- IMIX – 1 (338 bytes): represents a traffic pattern in which voice traffic is the 58% of the total traffic. This is the worst-case scenario.
- IMIX – 2 (948 bytes): represents a traffic pattern in which multimedia and file transfer traffic is 58% of the total traffic.

The 338 byte IMIX stream that was utilized for the other test reaches 350 Mbps encrypted traffic, and for the 948-byte average, this server gets 565 Mbps encrypted traffic.

Conclusion

The performance tests—especially those using the IMIX data flows—demonstrate that a flexiWAN-based service will be able to deliver between 100 Mbps and 600 Mbps of one-way encrypted throughput depending on the uCPE device deployed.[1] Many customers in this market segment have WAN speeds below 100 Mbps, making flexiWAN well suited for potential commercial scenarios. As such, Telefónica is advancing its collaboration with Intel, Silicom, and flexiWAN, including several proofs of concept (PoC) on real customer networks.

More Information

Telefónica and Silicom are members of the Intel® Network Builders ecosystem: http://networkbuilders.intel.com

The Intel Atom® processor family: www.intel.com/atom

Silicom RCC-VE2 uCPE:
https://www.silicom-usa.com/pr/edge-networking-solutions/edge-cpes/rcc-ve-cpe-desktop-appliance

Silicom Nano uCPE:
https://www.silicom-usa.com/pr/edge-networking-solutions/edge-cpes/intel-atom-c3000-cpe-network-appliance

flexiWAN: https://flexiwan.com

Notices & Disclaimers

[1] Testing conducted by Telefónica in January 2020: RCC-VE2 server powered by two-core Intel Atom C2358 (microcode: 0x12d) with 4GB of RAM and 32 GB of storage with hyperthreading turned on and turbo turned off. Bios version is RCCVE2-01.00.00.07. Network interface is Intel® Ethernet Controller I211.

Nano server powered by two-core Intel Atom C3338 (microcode: 0x2e) with 4GB of RAM and 32 GB of storage with hyperthreading turned on and turbo turned on. Bios version is ADI_DNVNANO-01.00.00.03. Network interface is 88E1543 Quad.

TRex Server: TRex v2.65. Server powered by two-core Intel Atom C2358 (microcode: 0x2e) with 4GB of RAM and 32 GB of storage with hyperthreading turned on and turbo turned on. Network interface is Intel 88E1543 Quad.

Software for both RCC-VE2 and Nano: Operating system Ubuntu 18.04.4 LTS (Bionic Beaver); Kernel: 4.15.0-76-generic v18.04. flexiWAN GA release v1.1.41.

[2] Figure provided courtesy of flexiWAN.

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