White Paper

Telecom

With Latest CPUs, Casa Boosts Virtual Cable Platform Capacity by 65%[1]

As fiber network infrastructure investment grows, Axyom® delivers a virtualized CCAP solution optimized for 4th Gen Intel® Xeon® Scalable processors that offers scalability, cost savings, and flexibility for cable providers

Investment in infrastructure to connect people in every corner of the U.S. via fiber networks is top of mind for cable multisystem operators (MSOs) and the U.S. government. This paper details how Casa System's Axyom® virtual Converged Cable Access Platform (vCCAP) provides a virtualized web scale solution that delivers cost savings, and service flexibility. The software takes advantage of new features and higher performance in the newest 4th Gen Intel® Xeon® Scalable processors for a 65% throughput capacity improvement[1].

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Cable MSO Challenge: Broadband Investment

While there is an ever-growing demand for more bandwidth for video streaming, cloud gaming, and augmented, virtual and mixed reality, many parts of the U.S. remain unserved or underserved by fiber networks.

By 2027, the U.S. government aims for broadband internet access services to reach all American homes where either there is no connectivity or connectivity speeds are below 100 Mbps for download and 20 Mbps for upload. The 2021 Infrastructure Investment and Jobs Act (IIJA) allocated $65 billion for enhancing broadband coverage, adoption, and affordability nationwide.[2]

Both federal and state governments and cable MSOs recognize that broadband services in homes—not just smartphone connectivity—is essential to daily life, work, entertainment, learning, and even healthcare.

Consumer behavior is also shifting, with increasing numbers of people becoming content creators and viewers. Forbes estimates that more than 50 million people are content creators across all social media platforms.[3] The broadband demands for content creation exceed even those of video streaming: Not only is the content bandwidth rich, but it also needs cloud bandwidth and storage.

Incumbent cable MSOs are also facing competition from fiber overbuilders seeking market share.

To meet this exploding demand and mandate for growth and to stay ahead of the competition, cable MSOs need to upgrade their networks. Legacy cable modem termination system (CMTS) appliances are not as scalable or efficient as next-generation virtualized CMTS. Evolution to the Converged Cable Access Platform (CCAP) helps, offering a denser, more powerful, and space-saving architecture that combines edge QAM modulators and CMTS functions to provide a platform for handling data, video, and voice over IP.

But now, the era of virtualization represents a paradigm shift that cable MSOs must embrace to keep up.

The Benefits of CCAP Virtualization for Cable MSOs

Virtualization moves cable MSOs from fixed-function appliances with finite capacity to virtualized software-based network functions running on Intel® architecture processor-based servers.

A primary goal for cable MSOs is to lower the cost per bit over the network while preserving performance and reliability of existing services and technology. By moving from hardware to virtualized software, cable MSOs can greatly accelerate the speed of innovation. Virtualization is also the best way to conserve space and power while growing the network.

Certainly, some purpose-built infrastructure will always be needed. But adding more server virtualization and software-defined networking–based deployments is key to driving network scale and agility while reducing total cost of ownership.

Casa System's Axyom Virtualized CCAP Solution

Intel® Network Builders Program member Casa System's Axyom vCCAP delivers a web scale solution, cost savings, and service flexibility. It provides full CCAP functionality, allowing cable MSOs to easily deploy both Axyom CCAP and integrated CCAP as they migrate their networks. It is deployable in virtual machines, containers, or on bare metal servers powered by the latest 4th Gen Intel Xeon Scalable processors.

Developed for the cloud from the ground up using a microservices-based design, Axyom vCCAP is an open solution that supports full interoperability with third-party orchestrators and Distributed Access Architecture (DAA) nodes. Axyom also has a built-in scheduler, forwarding engine, and protocol stack for VPN.

The Axyom vCCAP supports seamless scaling with containers using Kubernetes orchestration (see Figure 1).

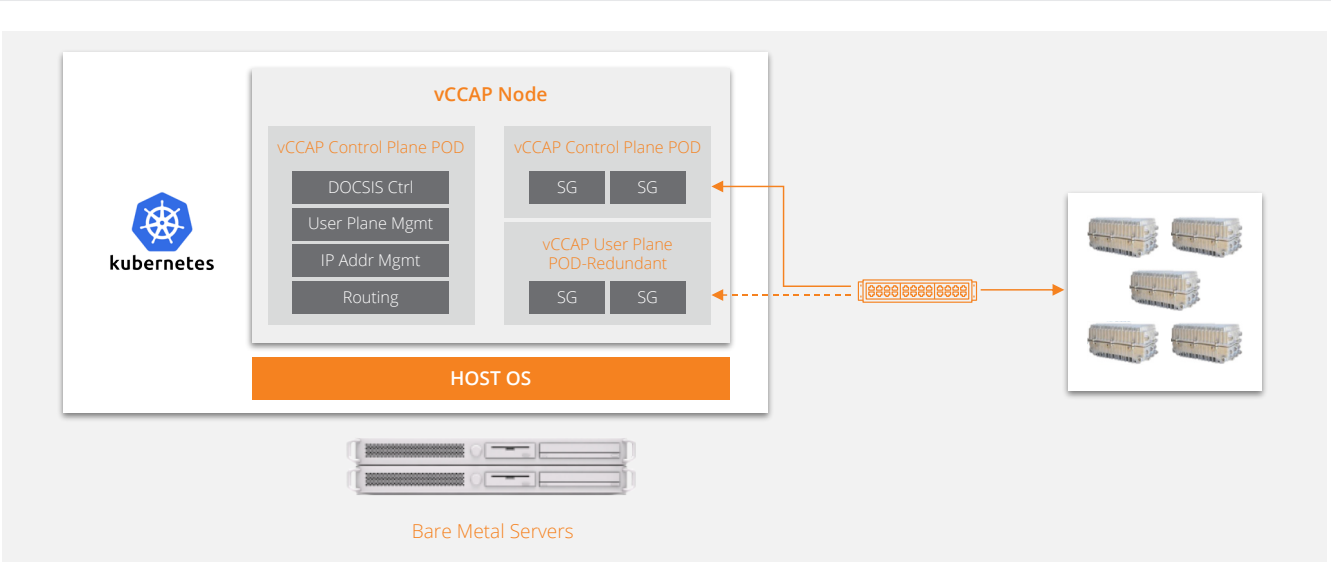

Figure 1. Casa's vCCAP solution is implemented using containers with Kubernetes orchestration.

Casa's virtual network functions are optimized for a virtual compute environment to deliver significant increases in throughput per vCPU compared to leading competitors' stated throughput. By using CPU more efficiently, Axyom pushes server hardware to its limit and enhances the performance of 4th Gen Intel Xeon Scalable processors.

Axyom Optimized for 4th Gen Intel Xeon Scalable Processors

4th Gen Intel Xeon Scalable processors offer a new microarchitecture designed to address dynamic and demanding workloads delivering fast query throughput, data movement, and data compression with better CPU utilization.

These processors provide more performance per watt, offering more sustainable CPUs by reducing the number of watts required for the same workloads. They can have up to 52 cores in addition to six built-in accelerators to help maximize performance efficiency (see Figure 2).

Some of these accelerators are uniquely beneficial to help vCCAP systems meet DOCSIS standards.

First, Intel® QuickAssist Technology (Intel® QAT) accelerates data encryption and compression. Intel QAT saves cycles, time, space, and cost by offloading compute-intensive workloads, such as DOCSIS-required encryption, to free up capacity. Crypto packet processing dominates workflows for broadband; when Intel QAT offloads encryption workloads, the broadband pipeline is faster.

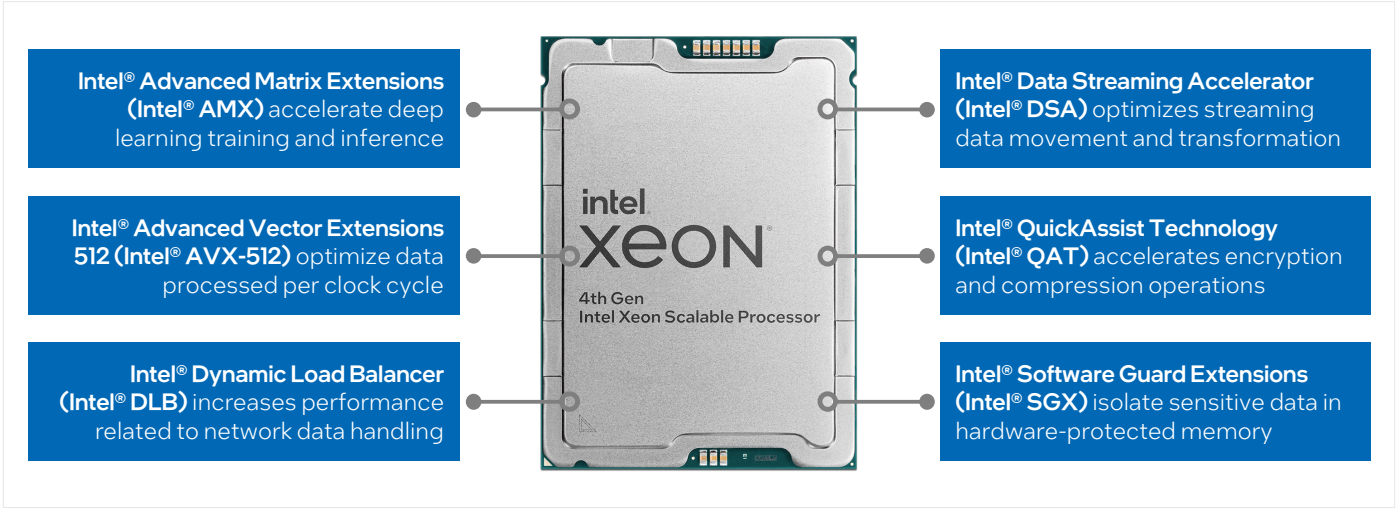

Figure 2. The 4th Gen Intel Xeon Scalable processor features six accelerators and up to 52 cores for performance.

Additionally, Intel® Advanced Vector Extensions 512 (Intel® AVX-512) is an instruction set that can accelerate performance for the most demanding computational workloads. For cable MSOs, Intel AVX-512 accelerates cyclic redundancy check (CRC) calculations, a function that is required for every network packet.

Furthermore, the Axyom vCCAP specifies Data Plane Development Kit (DPDK), a set of Intel-developed open-source software libraries that accelerate virtualized packet processing. Using Axyom vCCAP software on 4th Gen Intel Xeon Scalable processors results in performance gains that ultimately serve more broadband customers and provides a more fault-tolerant system of distributed storage.

4th Gen Intel Xeon Scalable processors also feature the 100GbE Intel® Ethernet Network Adapter E810. Its innovative and versatile capabilities optimize high-performance server workloads such as network functions virtualization, storage, high performance computing AI, and hybrid cloud. Its high throughput can carry intensive network traffic without impeding data speed.

And the 4th Gen Intel Xeon Scalable processors also have new instructions for better performance per watt for networking applications, including the WAITPKG instruction set. In tests conducted by Casa, the Axyom vCCAP running on a server powered by a 4th Gen Intel Xeon Scalable processor is able to deliver more than seven times the number of service groups while reducing power by 1/3 or 33% when compared to the company's C100G CCAP completely filled with second generation Bi-Directional Modules (BDM2). And it does it all in a very small footprint with 70% less rack units compared to the C100G.

Performance Testing Configuration

The performance of Axyom vCCAP was tested on systems under test (SUT) powered by 4th Gen Intel Xeon Scalable processors (4th Gen SUT) and compared to performance of the same tests on 2nd Gen Intel Xeon Scalable processor-based servers (2nd Gen Baseline SUT). The tests measured performance in two applications to show the percentage improvement.

The test configuration for both SUTs is shown in Figure 3. On the left is the Axyom vCCAP host server connected to the rest of the test environment through a 100 Gbps Ethernet connection to a top of rack (ToR) switch. The test environment supports a total of 26 remote PHY devices (RPD) from both Casa and three other vendors. Spirent test systems were used to measure the throughput.

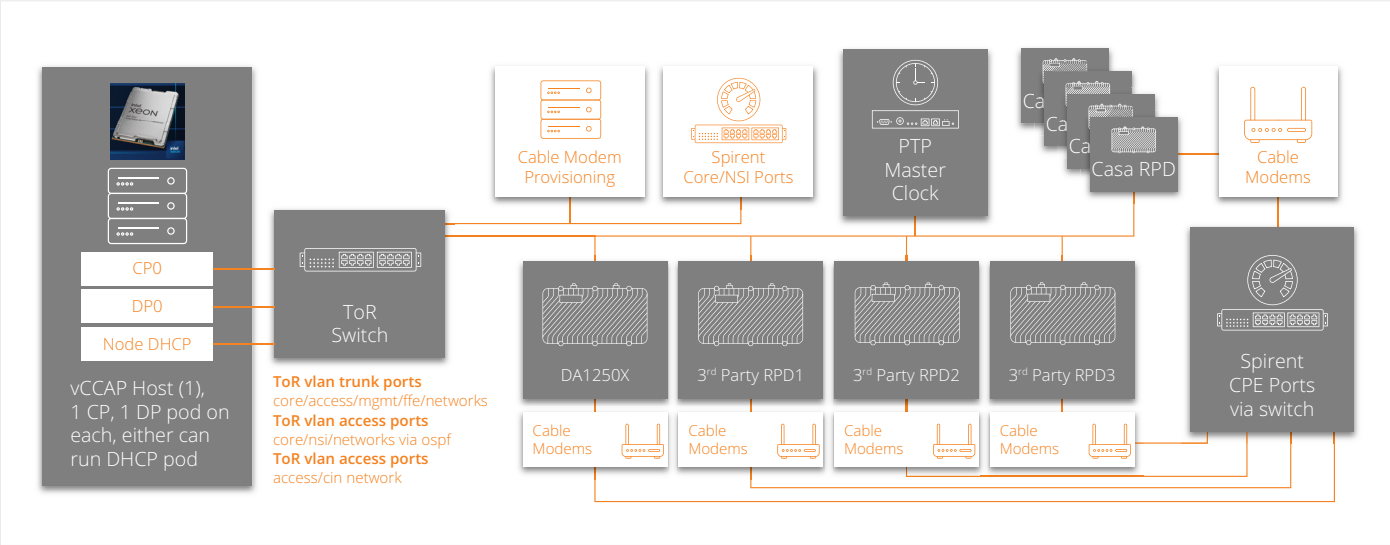

Figure 3. vCCAP test configuration.

Test Results

The first test measured downstream bandwidth using a mix of packet sizes (iMIX) with an average packet size of 1436 bytes. This test was designed to show max throughput in a single direction. A second test was also run that divided the data flow between downstream and upstream, carving out 12% of the bandwidth for the upstream flow. This is a more real-world application. The average iMIX packet size was 1436 bytes for downstream and 260 bytes for upstream.

In both test configurations, the 4th Gen SUT delivered a 65% performance increase over the performance of the 2nd Gen Baseline SUT.

This performance increase offers MSOs a system that can keep pace with fast growing bandwidth demands. The test results could have been higher with a higher speed network connection. The testers noticed that at maximum throughput, only about 60% of the 4th Gen SUT compute power was being used.

Conclusion

As exploding user demand and government mandates for growth drive major broadband infrastructure investment, cable MSOs must upgrade their network infrastructure. Virtualization can move cable MSOs away from fixed-function appliances to a software-based solution that conserves space and power while accelerating growth. Casa System's Axyom vCCAP delivers a web scale solution, cost savings, and service flexibility. It is deployable in virtual machines, containers, or on bare metal CPUs, including the newest 4th Gen Intel Xeon Scalable processors. These 4th Gen processors dramatic improvements in performance that make the solution a good fit for cost-effectively meeting the needs of bandwidth hungry consumers.

Learn More

Casa Systems Axyom Virtual CCAP

Casa Systems Bringing the Power of Virtualization to Cable Service Operators

4th Gen Intel® Xeon® Scalable processors

Intel® QuickAssist Technology

Intel® Advanced Vector Extensions 512

Data Plane Development Kit

100GbE Intel® Ethernet Network Adapter E810

Intel® Network Builders

[1] 4th Gen SUT: Tested by Casa Systems on May 16, 2023. 1-node, 2x (only one CPU was used) Intel Xeon Gold 6438N Processor (32 cores/socket, 64 threads/socket) on QuantaGrid D54Q-2U with 235 GB (4800MHz) total DDR5 memory, HT on, Turbo on, Intel E810-C 2x100G (only 1x100G used), 436GB of storage. OS was Ubuntu 22.04, kernel 5.15.0, Casa VCCAP 10.8.1, GCC 11.3.0 compiler, GLIBC 2.35 library. Other software used: DPDK 22.11.1, MLNX-OFED-5.8.2, ICE-1.9.11, IAVF-4.5.3, containerd 1.6.8, Kubernetes 1.20.11.

2nd Gen Baseline SUT: 1-node, 2x (only one CPU was used) Intel Xeon Gold 6258R Processor (28 cores/socket, 56 threads/socket) on Dell R640 with 190 GB (2933 MHz) total DDR4 memory, HT on, Turbo on, Mellanox Connect X5 (1x100Gbps), 500GB of storage. OS was Ubuntu 18.04, kernel 4.15.0, Casa VCCAP 10.6.5, GCC 7.5 compiler. Other software used: DPDK 19.11, Kubernetes 1.18.

[2] https://www.bbcmag.com/community-broadband/broadband-expansion-under-the-infrastructure-investment-and-jobs-act

[3] https://www.forbes.com/sites/johnkoetsier/2020/10/05/2-million-creators-make-6-figure-incomes-on-youtube-instagram-twitch-globally/?sh=38220dd23bec

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Workloads and Configurations

4th Gen SUT Server Configuration

Testing conducted by Casa Systems on May 16, 2023

The server configuration (QuantaGrid D54Q-2U) is presented below:

- Processor:
  - Model: Intel@ Xeon @Gold 6438 CPU;
  - Number of processors / Physical cores per processor: 1 / 32
- Memory:
  - Type / Amount: DDR5 / 240GB (15x16GB)
- Disk Size / Type: 436GB / SSD
- Network Cards:
  - Intel E810-C 2x100G (only 1x100G used)
- BIOS configuration:
  - Hyper-Threading: Enabled
  - SpeedStep (Pstates): Disabled
  - Boot Performance Mode: Max Performance
  - Energy Efficient Turbo: Disabled
  - Turbo Mode: Enabled
  - Hardware P-States: Disabled
  - Enable Monitor Mwait: Disable
  - CPU C1 Auto Demotion: Disabled
  - CPU C1 Auto unDemotion: Disabled
  - Enhanced Halt State (C1E) Disabled
  - CPU C6: Disabled
  - Package C State: C0/C1 state
  - Dynamic L1: Disabled
  - Power Performance Tuning: OS Controls EPB
- Workload/Software Configuration:
  - OS was Ubuntu 22.04, kernel 5.15.0
  - Casa VCCAP 10.8.1
  - GCC 11.3.0 Compiler
  - GLIBC 2.35 library
- Other software used:
  - DPDK 22.11.1
  - MLNX-OFED-5.8.2
  - ICE-1.9.11
  - IAVF-4.5.3
  - Containerd 1.6.8
  - Kubernetes 1.20.11

2nd Gen Baseline SUT Server Configuration

Testing conducted by Casa Systems on May 16, 2023

The server (Dell R640) configuration is presented below:

- Processor:
  - Model: Intel@ Xeon® Gold 6258R CPU;
  - Number of processors / Physical cores per processor: 1 / 28
- Memory:
  - Type / Amount: DDR4 / 192GB (12x16GB)
- Disk Size / Type: 500GB / HDD
- Network Cards:
  - Mellanox Connect X5 (1x 100Gbps)
- BIOS configuration:
  - Hyper-Threading: Enabled
  - SpeedStep (Pstates): Disabled
  - Boot Performance Mode: Max Performance
  - Energy Efficient Turbo: Disabled
  - Turbo Mode: Enabled
  - Hardware P-States: Disabled
  - Enable Monitor Mwait: Disabled
  - CPU C1 Auto Demotion: Disabled
  - CPU C1 Auto unDemotion: Disabled
  - Enhanced Halt State (C1E) Disabled
  - CPU C6: Disabled
  - Package C State: C0/C1 state
  - Dynamic L1: Disabled
  - Power Performance Tuning: OS Controls EPB
- Workload/Software Configuration:
  - OS was Ubuntu 18.04, kernel 4.15.0
  - Casa VCCAP 10.6.5
  - GCC 7.5 Compiler
- Other software used:
  - DPDK 19.11
  - Kubernetes 1.18