TCO Solution Brief

Communications Service Providers
Virtualized Cable Modem Termination System (vCMTS)

Lowering TCO for Multi-System Operators with Cloud-Native Distributed Access Architecture

Moving to cloud-native distributed access architecture (DAA) by deploying vCMTS on Red Hat® OpenShift® can reduce total cost of ownership (TCO) by more than 60% on CapEx and facilities costs as well as in operating costs over three years.[1]

The ongoing massive growth in consumer demand for bandwidth shows no signs of abating. Consumers continue to acquire new screens, including mobile phones, tablets, IOT devices and televisions, while media services proliferate to compete for their attention. Comcast reports that video now accounts for 71% of total downstream internet traffic,[2] and the increased demand for over-the-top streaming video content represents a changing landscape for multi-system operators (MSOs). Their subscribers increasingly expect to receive that content with quality equivalent to that of traditional broadcast.

In the face of exponentially increasing traffic volumes, increased competition and flat average revenue per user (ARPU), pressure is mounting on MSOs to innovate their approach to broadband connectivity so they can achieve greater efficiency and agility. To compete, they must continually increase the speed, reliability and quality of subscriber experiences while reducing the cost per gigabyte delivered.

Cloud-native DAA is a primary strategic trend across the industry, as multi-system operators transition away from hosting network functions such as cable modem termination system (CMTS) on specialized, purpose-built appliances, in favor of containerized services on standards-based general-purpose servers. These software-defined dynamic network topologies help reduce costs and increase platform efficiency by optimizing resources to meet customers' demands on the network. With cloud-native architecture, operators can pivot quickly and introduce new services with rapid time to market, opening new revenue streams without delay.

This document contains an analysis of the total cost of ownership (TCO) and the benefits of deploying vCMTS on Red Hat OpenShift compared to legacy purpose-built CMTS hardware, including CapEx, facilities costs and OpEx over three years. The analysis models a network serving 1.5 million subscribers and uses a three-part structure:

- **Part 1: CapEx and facilities costs.** Savings of more than 60% were achieved in CapEx and facilities costs for the Red Hat OpenShift implementation compared to a legacy hardware-based CMTS.[3]
- **Part 2: OpEx.** The Red Hat OpenShift infrastructure also provides a TCO advantage of more than 60% in OpEx,[1] compared to legacy hardware CMTS. This savings is provided by automation and other advantages of Red Hat OpenShift and Red Hat ecosystem software solutions.
- **Part 3: Economies of Scale in Converged Networks.** TCO advantages can be enhanced by migrating additional proprietary solution stacks to the cloud-native Red Hat OpenStack® environment, transforming the network more broadly for a more agile, cost-effective future for MSOs. That convergence can include workloads such as PON, CDN and wireless services, along with DOCSIS.

Part 1: CapEx and Facilities Cost Comparison

The continued proliferation of high-bandwidth online and streaming subscriber services has put stress on the traditional reliance on fixed-function CMTS hardware located at headend facilities. That equipment paradigm was not designed for today's unprecedented expandability demands for broadband distribution capacity. The challenge is being met by shifting the CMTS workload from dedicated hardware to software-based vCMTS running on Red Hat OpenShift using general-purpose Intel® architecture-based servers.

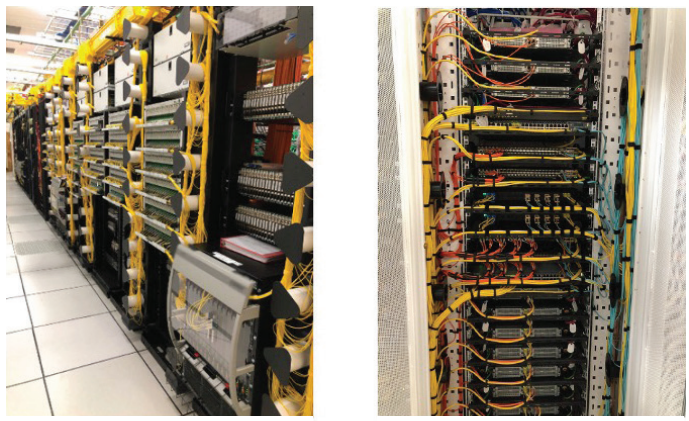
Deploying this network function on standards-based commercial off-the-shelf (COTS) servers instead of specialized hardware provides dramatic CapEx savings, with inherent scalability advantages. The ability for vCMTS and other services to share hardware resources and headroom compounds that savings. Intel architecture also consumes significantly less energy and requires less space than legacy CMTS.

Table 1 compares CapEx and facilities costs between legacy hardware-based CMTS versus a vCMTS implementation using Red Hat OpenShift and 3rd Generation Intel Xeon® Scalable processors. In the legacy setup, there are 400 subscribers per service group for a total of 3,750 service groups and approximately 19 service groups per rack. Facility costs such as real estate, power, cooling and network infrastructure combine with the cost of nodes, CMTS software and DOCSIS licensing for expansion. Taken as a composite whole, the CapEx and facilities TCO of the vCMTS solution with R-PHY is more than 60% less than the corresponding legacy CMTS solution.[3]

With the vCMTS solution deployed with R-PHY in DAA, the MSO is able to reduce the number of equipment racks from 198 racks in the legacy setup to just 12. Additional savings are achieved with the R-PHY solution and include the hub collapse, as well as savings on annual facility and maintenance costs. The vCMTS solution reduces overall energy requirements, allowing MSOs to sustainably expand capacity and scale, without worrying about real estate concerns each time an upgrade is needed. The facilities savings assumes three years of operation. In addition, the cloud-native network function topology (CNF) makes it easy to apply the performance gains and cost savings from successive generations of Intel Xeon Scalable processors.

The MSO reduced the 198 racks required for the legacy configuration to just 12 with vCMTS.

In another MSO example (see Figure 1), the legacy network setup had five racks of equipment for 96 service groups. With the vCMTS solution, the MSO was able to support 192 service groups in a single rack of equipment. In addition to the space, power, cooling and cost savings, the MSO was able to significantly reduce the time it takes to identify network problems and carry out upgrades.



Legacy:
Pod = 96 service groups
5 racks

Next Gen:
Pod = 192 service groups
1 rack

Figure 1. Rack space comparison of legacy CMTS and vCMTS solutions.

Implementing a vCMTS helps MSOs realize the cost savings of DAA, as well as making it easier to upgrade their broadband service tiers to compete against 5G and PON/FTTH service offerings. In addition, vCMTS offers long-term scalability advantages, location flexibility for the various CMTS components and demand-based scaling for each individual component. A legacy CMTS can be as large as a 13RU-high chassis. An entirely new chassis may even be needed just to add one single component, such as additional RF ports. With vCMTS, disaggregation allows MSOs to add only required resources, such as RF ports or additional data plane elements. Using COTS servers allows operators to reconfigure virtualized nodes during off-peak times for other workloads, such as usage analytics.

Table 1. CapEx and facilities TCO for legacy CMTS vs vCMTS on Red Hat OpenShift.

OpEx over Three Years	Legacy	DIY Kubernetes	Red Hat OpenShift
Initial (CapEx and Facilities) TCO[4]	$74,318,422[4]	$29,208,977[4]	$29,208,977[4]
Incremental Ongoing OpEx	$17,123,916	$13,172,243	$8,168,401
Total Initial and Ongoing TCO	**$91,442,338**	**$42,381,219**	**$37,377,377**
Savings Compared to Legacy	—	**$49,061,119**	**$54,064,961**
Savings Compared to DIY	—	—	**$5,003,842**

The vCMTS solution provides 192 service groups with a single rack of equipment.

This analysis shows that the vCMTS solution can save a significant amount of capital expense compared to legacy CMTS solutions, especially for facilities, optics, nodes and CMTS and DOCSIS licenses.

Part 2: OpEx Comparison

Red Hat OpenShift improves the efficiency and security of MSO cloud-native infrastructures. For Red Hat OpenShift and its other products, Red Hat uses an open source development model, contributing to and helping to foster community-based innovation. It provides a consistent foundation for containerized network functions built to operate across distributed hybrid and multi-cloud environments. Red Hat OpenShift provides advanced automation that supports operational efficiency at scale for cloud-native workloads. Hardened by proven Red Hat engineering processes, OpenShift provides a truly enterprise-ready Kubernetes platform that is less expensive to run.

Table 2 compares total project costs over a three-year period, including CapEx and facilities costs as well as OpEx. The long-term cost profile shows that the Red Hat OpenShift maintains cost savings relative to legacy hardware of more than 60% over the three-year period.[1]

Red Hat OpenShift provides a robust foundation for cloud-connected management services that deliver ongoing business and technical benefits to MSOs. Automation of routine tasks streamlines operations and enhances monitoring capabilities across workloads. IT Ops, DevOps and DevSecOps teams have enhanced visibility into the network, helping them reduce response times and become more proactive, often resolving issues before they impact the network. In addition, Red Hat OpenShift helps MSOs deliver superior broadband experiences with improved network performance, while also reducing support calls and churn.

MSOs that deploy vCMTS using Red Hat OpenShift can significantly reduce their time to deployment using Red Hat Advanced Cluster Management for Kubernetes to automate full-lifecycle management for OpenShift clusters. It allows operations teams to schedule rolling upgrades for new services, simplifying staged deployments and increasing efficiency.

Red Hat Advanced Cluster Management controls placement of workloads based on capacity and policy, as well as providing a single control plane to manage multiple clusters wherever they reside, on-premises or in public clouds. Red Hat thoroughly vets OpenShift images and releases for vulnerabilities, helping reduce workloads for security teams.

Table 2. Ongoing TCO savings over three years for legacy hardware CMTS vs vCMTS on Red Hat OpenShift.[4]

	Legacy CMTS	vCMTS on Red Hat OpenShift
CapEx and Facilities Cost	$74,318,422	$29,208,977
OpEx Cost	$8,608,795	$3,708,121
TCO	**$82,927,217**	**$32,917,098**
Savings	—	**$50,010,119**

Red Hat OpenShift Systems, Powered by Intel® Xeon® Scalable processors

Red Hat OpenShift is optimized as part of the unparalleled software ecosystem for servers based on Intel Xeon Scalable processors. This foundation for powerful data center and network edge platforms is easily scalable. The innovative processor platform converges capabilities across compute, storage, memory, network and security.

The Intel Xeon Scalable platform is designed to modernize MSO networks and yield operational efficiencies that reduce costs. Systems running on Intel Xeon Scalable processors deliver agile services with enhanced performance and capabilities.

Part 3: Economies of Scale in Converged Networks

Looking ahead, multi-system operators are expecting to reduce costs by transitioning proprietary solution stacks for PON, DOCSIS and wireless to the Red Hat OpenShift environment. Creating a converged, cloud-native access network sets the stage for an emerging generation of change in MSO infrastructures that overcome interoperability challenges among proprietary technology stacks. In fact, Red Hat OpenShift goes beyond interoperability to create operational homogeneity, eliminating islands of infrastructure that behave differently than others. This ability releases MSOs from vendor-limited solutions and enables them to buy best-of-breed CNFs for each workload, harmonized by OpenShift.

For example, an MSO might buy a vCMTS solution from Vendor A that uses a proprietary software stack and orchestration layer for the container management function. That same MSO might buy a virtual PON solution from Vendor B that uses its own proprietary stack. Finally, the MSO might add wireless services that use yet another proprietary stack. This scenario leaves the MSO with three separate stacks to maintain, and to provide vendor diversity for each solution would double that number to six. The complexity of managing all this proprietary technology would incur significant expense due to demands on engineering and operations teams.

By contrast, cloud-native open architecture based on Red Hat OpenShift enables a large proportion of infrastructure to be shared among the DOCSIS, PON and wireless solution. The resulting environment is simpler and less expensive to manage and maintain, with the agility to accommodate new solutions and services in the future.

Essential Takeaway: Red Hat OpenShift Delivers Cloud-Native TCO Advantages

As illustrated in the Part 1 scenario of this study, deploying vCMTS in cloud-native networks enables more than 60% CapEx and facilities cost savings while expanding capacity by eliminating expensive legacy single-purpose hardware-based solutions. Part 2 discussion reveals OpEx savings over the three-year modeling period from automation and other platform benefits of more than 60% over legacy deployments.

Looking ahead, performance and feature advances in successive generations of Intel Xeon processors are expected to drive further improvements in metrics such as throughput, throughput per service group, and TCO. That alignment with the Intel processor roadmap provides a compelling ongoing advantage for MSOs.

The Part 3 scenario reveals that Red Hat OpenShift provides a common, cloud-native application platform to collapse multiple solutions stacks for PON, DOCSIS and wireless functions onto it and to reduce TCO even further. The business momentum toward these fundamental architecture shifts continues to build, enabling MSOs to deliver superior quality of experience from expanded service offerings and increased performance with improved TCO, for the smarter, greener and more agile broadband network of the future.

More Information

Intel and Red Hat vCMTS Solution Blueprint:
https://networkbuilders.intel.com/solutionslibrary

01.org vCMTS homepage:
https://01.org/access-network-dataplanes

Intel Select Solutions for NFVI Forwarding Platform:
networkbuilders.intel.com/solutionslibrary/intel-select-solutions-for-nfvi-forwarding-platform-v2

Intel Xeon Scalable processors: intel.com/xeonscalable

[1] See Table 2 for calculations of ongoing TCO savings.

[2] Comcast, March 3, 2022. "Comcast 2021 Network Report: Traffic Increased Over Historic 2020 Levels, Even as Usage Shifted Toward Pre-Pandemic Patterns." https://corporate.comcast.com/press/releases/comcast-2021-network-report.

[3] Data provided by Harmonic, September 2020. See Table 1 for calculations of initial TCO savings.

[4] Refer to vCMTS TCO Analysis authored by Harmonic, Inc. https://networkbuilders.intel.com/solutionslibrary/harmonic-vcmts-enables-greener-gigabit-broadband-lowers-tco.

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