CASE STUDY

Communication Service Provider
Virtual Content Delivery Network

Orange* Builds and Tests Virtual Content Delivery Network

To accommodate growth in IP-based video traffic, Orange works with leading vendors on CDN service with a virtualized PoP architecture. In a successful trial, across the operator's production network, a virtualized CDN solution from Akamai is orchestrated by Ciena's Blue Planet* on top of Red Hat* OpenStack* infrastructure and networked via Juniper Contrail's* SDN running on Intel-powered servers.

Introduction

The market for content delivery networks (CDNs) has flourished as video transport has moved from specialized cable, satellite, or terrestrial networks to the internet. Thanks to successful CDN deployments, carriers have been able to continue to deliver a great customer video experience without the need to massively increase bandwidth in core networks to transport these vast amounts of video traffic. But anticipated video traffic growth means CDN cache deployments need to evolve to push even further out to the edge of the network and to be instantly scalable in order to cost-effectively meet peak bandwidth needs.

Communications service providers (CommSPs) are adopting network functions virtualization (NFV) to orchestrate new services using virtual network functions (VNFs) operating on industry standard servers. This lets CommSPs develop a more agile network where services can be automatically turned up or turned down to match customer needs. This virtualization is happening at both the core and edge of the network.

Among the services being virtualized are CDNs because virtual CDN (vCDN) services offer the agility needed to meet future video demands with the same performance in caching and serving video content. For example, vCDN video caches can be increased at a specific time of day, such as after work when demand for video on demand (VoD) services increases. Then later in the night and into the next day, those caches can be torn down and the compute capability utilized for different VNFs.

France-based CommSP Orange* is a pioneer in vCDN development, having worked with leading vendors Akamai,* Ciena,* Red Hat,* Juniper,* and Intel to create a vCDN service from scratch in its lab and testing it in a field experiment on a production network.

The Challenge

Orange operates networks in 29 countries with 263 million customers.[1] The company has a long history of utilizing CDN appliances on dedicated physical machines at its various affiliates, including Orange France, Orange Spain, and Orange Poland. The evolution to a vCDN provides important scalability for the CDN solution from smaller "nano data centers" all the way to a CDN that can scale geographically.

Figure 1. Map of Orange France CDN deployments in Europe, Caribbean, Americas, and Africa.[2]

Orange is also a leading force in the NFV movement, having co-authored the original European Telecommunications Standards Institute (ETSI) NFV White Paper in 2012 and launching its "On Demand Network Program" in 2016 to examine where virtualization could be deployed in its networks.

Orange targeted CDNs as a candidate for virtualization as part of this program due to the critical role they play in the company's network. vCDNs allow Orange to provide consistently high-quality video delivery services in order to keep current customers and attract new customers. The potential for new services revenue—such as cloud DVR service—is also an important reason for making the change to a vCDN. Understanding that moving to vCDN services would entail technology development and process changes, Orange worked with industry leaders to develop a lab trial that could then be moved into a limited field trial using live data.

Key Objectives of Orange On Demand Networks

1. Build a new portfolio of service offerings leveraging on-demand capabilities. These services improve the customer experience by offering time-saving features like self-service mode with one-click provisioning; or offer innovative and flexible pay-per-use pricing models.
2. Automate more processes in order to improve operational models and enhance business responsiveness. To accomplish this, Orange will transform the skills of its build-and-run team to embrace an agile, DevOps-based software culture.
3. Define the Orange transformation strategy and make it happen at scale, resulting in an efficient company business model and a sustainable value chain. Orange will share what it learns from the On Demand Networks with its affiliates to help them efficiently deploy these network services.

Defining Project Objectives

The vCDN service project began in the engineering lab at Orange, where it was defined and tested. Orange would eventually conduct the field trial through its French subsidiary where it has more than 25 points of presence (PoPs) serving 6 million users who consume 60 million content views per month and 300 Gbps of live IP television.[3]

Before it began the field trial, Orange set four project objectives:

1. **Cloud Ready vCDN:** The ability for a vCDN service to be deployed on an open-standards based and common VNF infrastructure that can support multiple functions and workloads.
2. **Orchestration:** Test how well service orchestration can provide operational automation of service deployment, vCDN node life cycle management, and the relevant management of computational, storage, and network resources.
3. **Analytics-guided insights:** Answer the question: "How can analytics be used to replace extensive up-front network planning and over provisioning with a right-sized solution with orchestration workflows for traffic engineering, failure mitigation, and dynamic elastic scaling?"
4. **Operational skills development:** Understand what new skill sets are needed to operate and direct virtualization and orchestration solutions, and what was needed to adapt operational processes and organizational teams to these new technologies.

Zero Touch Automation

Orange and its team realized that the key technical innovation that underpinned many of its goals for the vCDN project was zero touch automation. Thus, the deployment team identified the following four workflows that would deliver zero touch automation:

1. **Zero Touch Cache Cluster Set Up:** This is the real advantage to the vCDN because it replaces a technician visit and the procurement of a CDN appliance. This workflow is automated by service orchestration technology resulting in the dynamic service that delivers reduced deployment costs.
2. **Scheduled Horizontal Scaling:** Historically, provisioning CDNs has meant provisioning the hardware and software to meet peak load, which leaves the CDN underutilized for most of the time. With the ability to schedule scaling, CDNs can be right-sized for each part of a day or for known special events.
3. **Recovery Procedures:** It was important to test the load sharing capability of vCDNs for recovery from scheduled or unscheduled downtime. In these workflows, unused capacity on other servers was utilized for the out-of-service vCDNs.
4. **Elastic Dynamic Scaling:** Leveraging Akamai's analytics capabilities in the centralized PoP, this workflow scales the vCDN caches to meet service demands in response to changes in the dataflow. The Orange trial proved that this feature can work and set the stage for future integration of more extensive analytics to make it more responsive.

Building the vCDN Infrastructure

Orange worked closely with vendors and supporters of the open source technology, commercial technology, and Intel-based hardware that made up the vCDN solution.

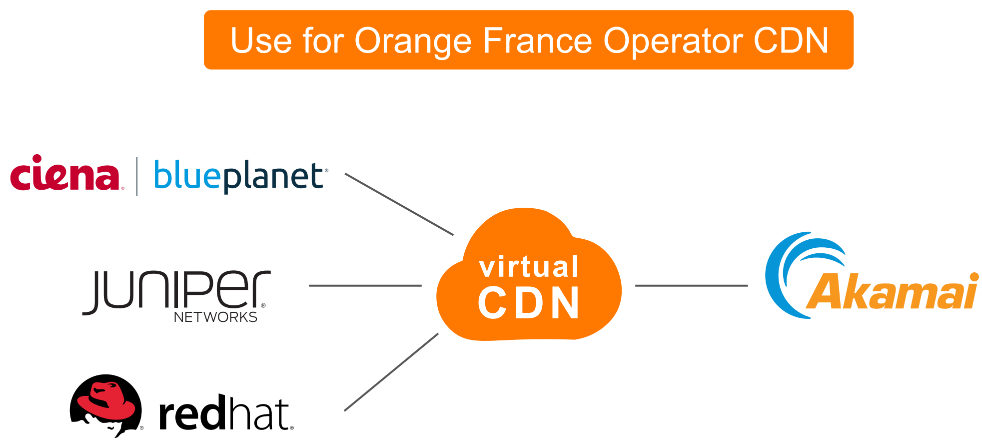

Figure 2. Orange vCDN software platform.*

Some of the key software components include:

- Akamai Aura Licensed CDN* (LCDN): A dedicated on-net CDN solution designed primarily for use by network operators, Akamai's Aura LCDN is a suite of licensed software that provides all of the CDN functionality (content mapping, caching, management and analytics, etc.) needed to deliver high-quality live and on-demand IP video and other HTTP content to subscribers, reliably and at scale. Since 2012, Aura LCDN has been available in a virtualized (vCDN) form factor, and in addition to its role as the vCDN for the Orange trial, it has been featured as the reference vCDN in a number of industry demonstrations of virtualized and edge infrastructure.
- Ciena Blue Planet*: A multidomain orchestrator, Blue Planet is based on a container-based microservices software architecture that incorporates advanced modeling, templating, and orchestration methodologies to provide a scalable, vendor-agnostic, highly programmable software platform. This modular and extensible approach enables network operators to automate the life cycle of differentiated new services that can be deployed across multivendor and multidomain environments and scaled on demand.
- Red Hat OpenStack* Platform and Red Hat Ceph* Storage: This software provides a standardized virtual infrastructure management (VIM) layer that provides the flexibility to onboard a variety of VNFs from third-party vendors. The software works together to provide a common multi-VNF infrastructure that can shift resources between CDN workloads and other VNFs to optimize resource utilization and lower costs.
- Juniper Contrail*: The vCDN implementation utilizes Juniper Contrail for its software defined network (SDN) control. Contrail offers SDN-enabled management and control software for simplified service delivery. In the context of vCDN, Juniper Contrail provides full automation of networking services such as dynamically and seamlessly attaching physical network (MPLS L3VPN) with virtualized network resources. Juniper Contrail also provides advanced networking features such as fine-grained routing control to allow flexibility and agility, all from a single automation touch point.

Hardware Platform

Orange worked closely with Intel to ensure that the software platform could be run in volume servers based on the Intel® Xeon® processors E5-2640 v3, a processor used in similar software defined storage platforms. Manufactured on Intel's 22 nm process technology, the processor delivers versatility across diverse workloads in the cloud environment. The servers also include network adapters based on Intel® Converged Ethernet Adapter X520 10 Gigabit Ethernet controller.

Community Contributions

Orange, Akamai, and Ciena have made the resources available to other ecosystem partners in order to share some of the orchestration-related technology that was developed for this project. Specifically, Orange made available a set of resource adapters (RAs) that integrate Akamai's Aura Client Tools with the Blue Planet software. As such, members of Ciena's Blue Orbit DevOps Exchange Community can obtain, further modify, and reuse these components free of charge.

vCDN Deployment Architecture

As shown in Figure 3, the software platform created by Orange utilizes an innovative point-of-presence (PoP) architecture that allows for a distributed architecture with a smaller software footprint for PoPs that are closer to the network edge.

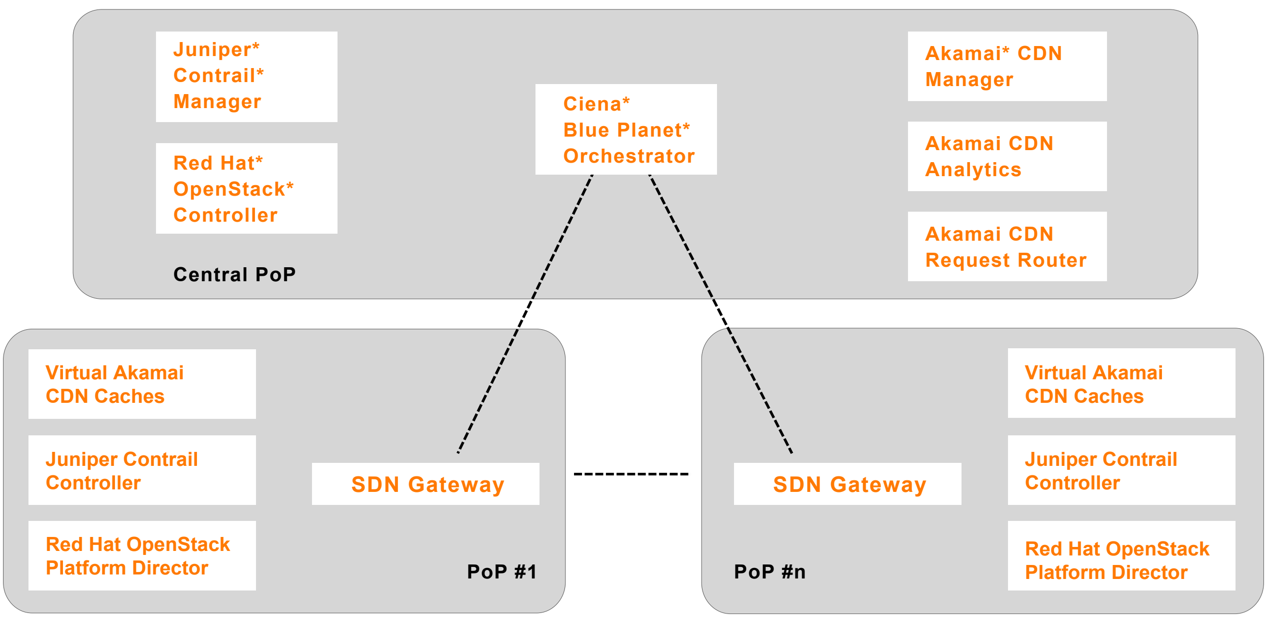

Figure 3. vCDN PoP architecture comprising a full-function centralized PoP, and distributed PoPs with a lighter software footprint.

The architecture requires a central PoP that hosts a complete NFVI/VIM platform based on the Red Hat OpenStack and Juniper Contrail SDN. The Blue Planet orchestration is also deployed in the central PoP and coordinating and automating the creation of vCDN services across multiple remote PoPs, as well as the on-demand scaling of the Akamai virtual caches.

In the distributed PoPs, Red Hat OpenStack provides the virtualization layer with a separate SDN controller from Juniper. Also deployed at these sites were Red Hat Ceph storage-based software defined storage nodes, a switch, and an SDN gateway router. Only the cache components of the Akamai LCDN needed to be virtualized and instantiated as VMs on the compute hosts.

Trial Results

Orange built out these PoPs in its engineering labs and then deployed them in its Orange France network. Orange organized the deployment stage in two steps. First, it launched the service in a production network with simulated traffic to be able to validate the four workflows. Then it cut over a small subset of actual customer traffic served by vCDN cache instances from these new virtualized PoPs.

Lessons Learned

Because of the potential to utilize the vCDN service—or any virtualized service—across all of its networks, the company documented best practices in both planning and execution phases of deployment.

Collaboration Is Key: There is a significant integration activity that goes into supporting the virtualized infrastructure hosting the vCDN services, which makes CommSP staff training and lab experimentation an essential activity. While vCDN and other virtualization projects bring agility to the network, they need significant coordination and collaboration amongst multiple CommSP departments and all vendors.

Go Beyond the Reference Design: Reference designs of virtualized infrastructure are an important starting point, but Orange found it essential to define, test, and validate reference designs before proceeding to production deployments to ensure the technology is optimized for its unique environment. For example, Orange found it was critical to utilize an apples-to-apples lab-to-production configuration ranging from the Intel hardware-based servers and NICs for its software defined infrastructure to be able to troubleshoot issues that come up when applying software updates. This was not called out on a reference design nor was it a condition that could have been anticipated.

Understand Software/DevOps: The rollout of vCDN services required more software expertise than was anticipated or needed for the rollout of appliance-based CDN services. Knowledge of agile processes and in-service software upgrade solutions became foundational skills. Ideally the overall approach follows so-called continuous practices from lab to production.

Conclusion

The development of a new vCDN service—or any virtualized service—is a significant software integration task. It takes planning, training, collaboration, and testing. The potential payoff is a significant increase in agility, lower costs, and more rapid service deployment. Orange was able to follow this process throughout its lab and production network trials to develop a new service that could be critical to the future of its business across all of the markets it operates in. The company is sharing its experience to prepare other service providers for what to expect when they undertake a vCDN service.

[1] **https://www.orange.com/en/Group/Our-vision**

[2] Figures courtesy of Orange.

[3] Source: Orange Presentation at Content Delivery World Summit 2017