

## Cost-efficient uCPE: NETCONF-based management without OpenStack

Networking and edge use cases at the customer premise are very sensitive to hardware costs because of the volume of deployed devices. OpenStack, a high consumer of customer premise hardware resources, is therefore a poor fit for uCPE. NETCONF provides an excellent alternative for a low footprint management solution. For this reason, Enea Edge uses NETCONF and YANG to create a highly cost-effective edge platform, optimized for uCPEs.

Together with ensuring streamlined operations, minimizing unit cost at the customer premises edge is crucial to ensuring good margins for service providers, due to the sheer scale of deployment. With virtualization replacing fixed-function appliances and bare-metal servers at the customer premises edge, the software virtualization platform is key to keep down hardware costs and streamline integration and management.

This makes OpenStack a poor fit for the customer premise. OpenStack was designed and built for data center deployment on data center hardware solutions. Where OpenStack is big, feature-rich, and complex, a typical uCPE needs a software platform designed for its purpose, meaning less resource overhead in combination with a feature set for extensive automation and management of large-scale deployments. Reducing RAM footprint and CPU overhead can make it possible to use more cost-effective hardware.

Native Linux virtualization using KVM or Docker provide a slimmed down runtime for applications, but needs a standardized interface to management and automation. Enea Edge uses the NETCONF protocol to provide this interface, significantly reducing resource overhead on the uCPE compared to OpenStack and minimizing costs at the customer premise.

NETCONF is a modern network management protocol bringing a standardized, unified way to configure and manage uCPEs and applications. It provides mechanisms for installing, manipulating, and deleting configurations for network functions and the virtual infrastructure using transaction management, and enables key attributes for efficient uCPE management like zero-touch provisioning (ZTP) and extensive automation capabilities. All communication is secured using Secure Shell (SSH).

Since Enea Edge is not based on OpenStack and uses NETCONF, it can provide a complete feature set for uCPE management including full FCAPS, but with a significantly reduced footprint in terms of RAM consumption and CPU utilization.

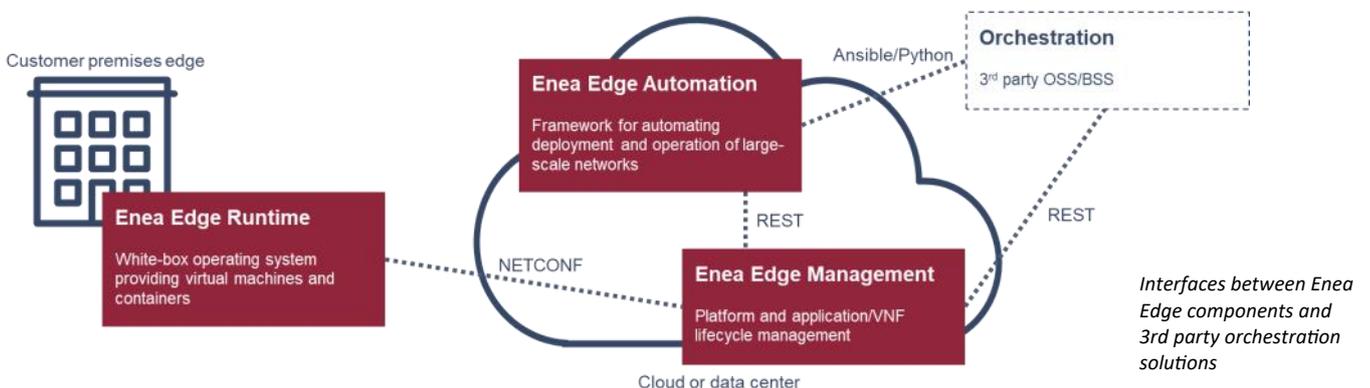
Characteristics	Enea Edge	Alternatives
Platform RAM Footprint	< 1 GB	4-12 GB
Platform Disk Footprint	< 1 GB	4-12 GB
Platform CPU Footprint	1 core	2-4 cores
Platform Boot Speed (excl. BIOS)	< 3 s	10-30 s
Network Throughput over vSwitch	10 Gb IMIX Line Rate	1 Gb IMIX Line Rate
Network Latency over vSwitch	10-15 $\mu$ s Average	25-75 $\mu$ s Average

### Enea Edge

Enea Edge is a managed virtualization platform for universal Customer Premise Equipment (uCPE). It has been developed from the bottom up with the goal of providing a software infrastructure platform that is truly independent of hardware, applications, and orchestration, with optimal characteristics for the customer premise.

Enea Edge consists of:

- Enea Edge Runtime: white-box operating system providing virtual machines and containers
- Enea Edge Management: Platform and application/VNF lifecycle management
- Enea Edge Automation: Framework for automating deployment and operation of large-scale networks



# Virtualization Platform Comparison

Enea Edge main characteristics and features are based on specific architectural and design choices. The table below compares these choices with those of leading uCPE solutions on the market.

Design Choice	Enea Edge	Typical uCPE Software Platforms	Comment
Platform Foundation	Bottom up approach with optimizations and footprint reduction in every layer of the platform based on open-source software.	Top down, adapting either <ul style="list-style-type: none"> <li>Common Linux Distributions such as Centos and Ubuntu</li> <li>Preexisting CPE or Data Center platforms</li> </ul>	Enea Edge is optimized for small CPU, RAM and Disk footprint and fast boot speed to drastically reduce the hardware BOM.
Feature Set	Extensible feature set implemented specifically for white-box uCPE.	Large feature set through the presence of OpenStack services.	Start with a small feature set and extend it according to needs to ensure minimal platform footprint and optimal uCPE characteristics.
Infrastructure Management Architecture	Delocalized infrastructure management using NETCONF for management protocols.	Localized infrastructure management using OpenStack with OpenStack internal management protocols.	Delocalized infrastructure management reduces uCPE CPU utilization, RAM and Disk footprint.
Data Plane	Optimized DPDK and OVS-DPDK and SR-IOV networking for physical and virtualized network functions.	DPDK, optimized OVS and SR-IOV for virtualized network functions.	Enea Edge outperforms competition with data plane optimizations in combination with small RAM footprint.
Virtualization	Optimized KVM/QEMU and Docker Containers.	Optimized KVM/QEMU	Docker Containers for minimized footprint.
Platform Feature Extensibility	Platform SDK enabling : <ul style="list-style-type: none"> <li>Development of custom kernel modules in host and VMs</li> <li>Development of custom kernel configuration in host and VMs</li> <li>Native platform extensions</li> <li>VM and container platform extensions.</li> </ul>	Professional Services for custom configurations and extensions and VM -based extensions.	Extend the platform to adapt to specific customer use cases.
Management Extensibility	SDK for NETCONF and YANG modelling support, for FCAPS and for customized Platform Management.	NETCONF protocol support for FCAPS.	Use NETCONF for standardized and extendable platform management beyond FCAPS.
VIM Feature Extensibility	Enea Edge Management is a customizable and model-based infrastructure manager with REST northbound and NETCONF southbound APIs.	Not Available.	Customizing OpenStack is hard, complex and costly. Enea uCPE Manager is designed to be extensible.

Find out more on the Enea website!



Enea develops the software foundation for the connected society with a special emphasis on reducing cost and complexity at the network edge. We supply open-source based NFVI software platforms, embedded DPI software, Linux and Real-Time Operating Systems, and professional services. Solution vendors, Systems Integrators, and Service Providers use Enea to create new networking products and services faster, better and at a lower cost. More than 3 billion people around the globe already rely on Enea technologies in their daily lives. For more information: [www.enea.com](http://www.enea.com)