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Oracle Communications Policy Management for Cable

Virtual Network Function Overview and Direction (R12.2)

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Glossary

This section lists terms and acronyms specific to this document.

Acronym/Term	Definition
AF	Application Function
CMP	Configuration Management Platform
CMTS	Cable Modem Terminal Systems
EMS	Element Management System
Guest	The VM running on the Host server.
HA	High Availability
HDD	Hard Disk Drive
Host	The server on which the VM (Guest) is running.
KPI	Key Performance Indicator
MA	Management Agent
MGPI	Multiple Grants Per Interval
MPE	Multimedia Policy Engine
MPE-R	Multimedia Policy Engine - Router
MPE-S	Multimedia Policy Engine - Server
NFA	Network Function Agent
NFV	Network Function Virtualization
OAM	Operations, Administration, and Management
PCMM	Packet Cable Multi-Media
PCRF	Policy and Charging Rules Function
PDP	Packet Data Protocol
PFE	Policy Front End
RAM	Random Access Memory
UGS	Unsolicited Grant Service
vCPU	Virtual CPU
VM	Virtual Machine
VNF	Virtual Network Function
VNFC	Virtual Network Function Component (MPE-R, MPE-S, BoD-AM, CMP, MA, as VMs)

Introduction

Oracle Communications Policy Management is a highly scalable and robust policy system that supports SIP/IMS VoIP, IPTV, Bandwidth on Demand Applications and Fair usage use cases. Oracle Communication Policy Management is the leading independent policy vendor and interoperates with commonly deployed cable nodes.

When deployed on bare metal servers, policy components (CMPs, MPEs, MAs, BoD-AMs) are available on a well-defined set of servers. In addition, each component can be deployed as a Virtual Network Function Component (VNFC). This enables Oracle Communication Policy Management to run on a broad range of hardware configurations.

While adding flexibility, virtualized deployment increase complexity and associated costs. To minimize the impact, Oracle has introduced the Network Function Agent (NFA). The new function adds automation to simplify the process of deploying, modifying and terminating BoD-AMs, MAs, MPE-R and MPE clusters.

This paper outlines the virtualized deployment information including supported hypervisors, Network Function Virtualization (NFV) performance testing, and current deployment options when deployed in a cable system. It also provides an introduction to NFA and summarizes Oracle's direction.

Oracle Communication Policy Management as a Virtualized Network Function

An Oracle Communication Policy Management system consists of five components that can operate independently with different lifecycles (instantiate and deploy, scale, turn down).

- MPE-R routes subscriber flows towards the MPE-S.
- MPE-S device allows stateful subscriber services flows routed by the MPE-R to be processed.
- The Bandwidth on Demand (BoD) Application Manager (AM) provides a simplified and abstract interface for creating dynamic service requests, allowing the application developer to integrate dynamic QoS resources into nearly any application. This is achieved by providing HTTP and Simple Object Access Protocol (SOAP) based interfaces that can easily be integrated into most application development environments.
- The Configuration Management Platform (CMP) performs the role of an Element Management System (EMS).
- The Management Agent (MA) collects topology and network information for use with PCMM message routing and policy decisions. Each component can run directly on specified hardware or as a guest under the supported hypervisors.

Oracle Communication Policy Management operates in two modes: high availability or geo-redundant configuration. In high availability mode, each cluster consists of an active and standby server located at the same site. All servers

can operate in this mode. In geo-redundant systems, each MPE-R, MPE-S and BoD-AM cluster includes active and standby servers at a single site and a third server located at a different site. Oracle Communication Policy Management can run as a guest on the following hypervisors with the associated Virtual Infrastructure Managers, using the following minimum release levels:

- KVM (version 1.5.3) / Openstack Liberty release
- VMware ESXi version 5.5 / VMware vSphere

Oracle validates Oracle Communication Policy Management scaling on Oracle X5-2 and HP Gen9 servers using a NFV reference profile which specifies the Virtual CPU (vCPU), memory (RAM), Hard Disk Drive (HDD) sizing and virtual Network Interface Cards (NICs) which are available to the VM. The profile definition is independent of which hypervisor and VIM is used. The Oracle Communication Policy Management VNFC reference profile definition is listed in Table 1.

Component	Profile
CMP, MPE-R, MPE-S, BoD-AM and MA	12 vCPUs, 60GB RAM, 108GB HDD, and 6 vNICs

Table 1: Oracle Communication Policy Management VM Reference Profile

Oracle validates the performance and capacity on each server. For a VM with the reference profile shown in Table 1, the following capacities are supported:

- MPE-S: 400,000 simultaneous sessions and 280 CMTSs (Policy Enforcement Function)
- MPE-R: 300 IP subnets per CMTS (not including IPV6 prefix delegation)
- CMP: 8400 CMTSs, 15 MA clusters, 5 MPE-R clusters, 45 MPE-S clusters and 2.4 million IP subnets

Performance is measured in Transactions per Second (TPS) for MPE-R, MPE-S and BoD-AM. The performance can vary based on both the selected hypervisor and the underlying hardware. These results utilize a representative call model derived from customer experience using the reference profile. The call model that was used in virtualized benchmarking for MPE-R and MPE-S includes a distribution of transactions using either PCMM or Rx. MPE-R and MPE-S performance is affected by whether Multiple Grants per Interval (MGPI) is enabled. MGPI provides the ability to map multiple gates (application flows) into a single DOCSIS service flow. MPE-R communicates with AF (e.g., Session Border Controller) using the Rx interface as depicted in Figure 1, wherein Rx messages are routed towards the MPE-S, which processes the Rx messages and translates into PCMM subsequently forwarding towards the CMTS. MPE-R can as well communicate with an application manager using the PCMM interface and routing the requests towards MPE-S. Performance testing results are summarized in Table 2.

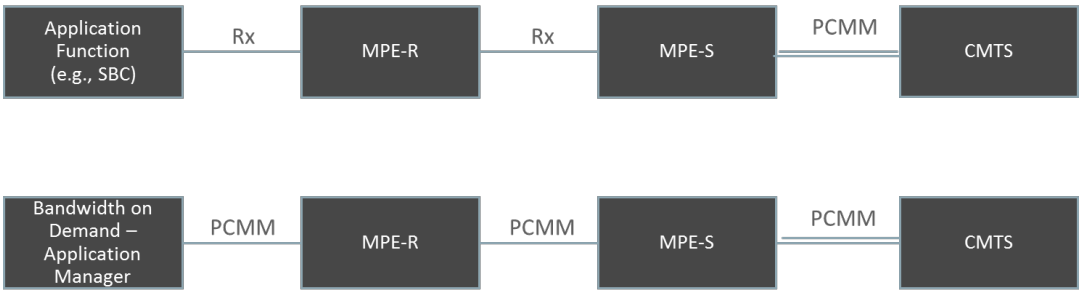

Figure 1: Rx and PCMM Message Flow Sequence

	Transactions Per Second		
	Oracle X5-2 with KVM/ OpenStack	HP G9 with KVM/ OpenStack	HP G8 with VMware/ vSphere
MPE-S (Rx) - MGPI Disabled	3000	3000	2100
MPE-S (Rx) - MGPI Enabled	1800	1800	1500
MPE-S (PCMM) - MGPI Enabled	7200	7200	6000
MPE-S (Rx and PCMM)- MGPI Disabled	Rx-2700 PCMM-2700	Rx-2700 PCMM-2700	Rx-2100 PCMM-2100
MPE-R (Rx and PCMM) - MGPI Enabled, Supporting 30 MPE-S	Rx-8100 PCMM-8100	Rx-8100 PCMM-8100	Rx-7200 PCMM-7200

Table 2 : Maximum TPS per MPE

The call model that was used in virtualized benchmarking for BoD-AM includes interface (HTTP or SOAP) information for creating and deleting session. Performance results are summarized in Table 3.

	Transactions Per Second		
	HP G9 with KVM/OpenStack	Oracle X5-2 with KVM/OpenStack	HP G8 with VMware/vSphere
HTTP interface, create/deleteSession, 2 Gates per Session	4200	4200	4200
SOAP interface, create/deleteSession 2 Gates per Session	3000	3000	3000

Table 3: Oracle Communication Policy Management BoD-AM Performance Reference

Operators can also run Oracle Communication Policy Management on different hardware servers, or can use different profiles. In this case the operator can validate the performance and capacity independently or can use Oracle Consulting Services to perform this validation.

Oracle Communication Policy Management Automation using Network Function Agent

While virtualization reduces hardware costs by allowing multiple applications to reside on the same physical server, introducing virtualization increases complexity and the associated operational costs. *Automation* reduces the number of manual steps required to deploy new instances of Oracle Communication Policy Management components, allowing new clusters to be brought up more quickly and with less chance of error.

Oracle Communication Policy Management automation is provided by the *Network Function Agent (NFA)*. This Oracle Communication Policy Management component operates in conjunction with CMP to reduce the complexity of deploying new (or removing) MPE-R or MPE-S clusters running as VM guests. Oracle Communication Policy Management NFA conforms to ETSI's Management and Network Orchestration (MANO) framework, which is the evolving standard for NFV automation and orchestration depicted in Figure 1. NFA performs the role of the *VNF Manager* defined by this architecture, while CMP is enhanced to automate the Element Management (EM) functions required to deploy new virtual clusters.

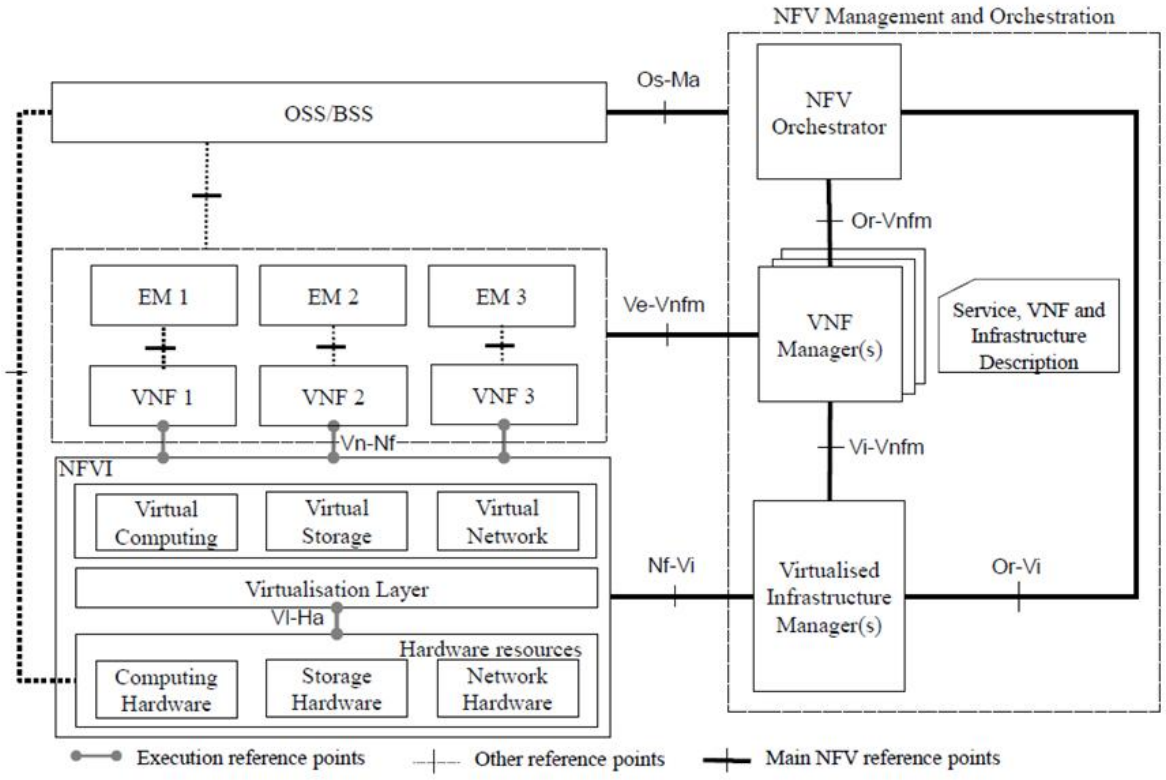

Figure 2: MANO Framework

As shown in Figure 2, NFA works with CMP and the VIM to speed up deployment of new MPE-R or MPE-S clusters. Under operator control, OpenStack allocates resources for new MPE-R or MPE-S instances, places them onto appropriate hosts, configures these components based on Openstack catalog information and adds them into the Oracle Communication Policy Management system topology. Using NFA, you can streamline the steps required to perform tasks such as:

- Create an individual server instance, high-availability cluster or geo-redundant cluster
- Add an additional server to migrate from a high-availability to a geo-redundant deployment
- Terminate a server or cluster
- Upgrade to a new release by sequentially deleting each server instance in a cluster and creating a new instance which runs the upgraded software

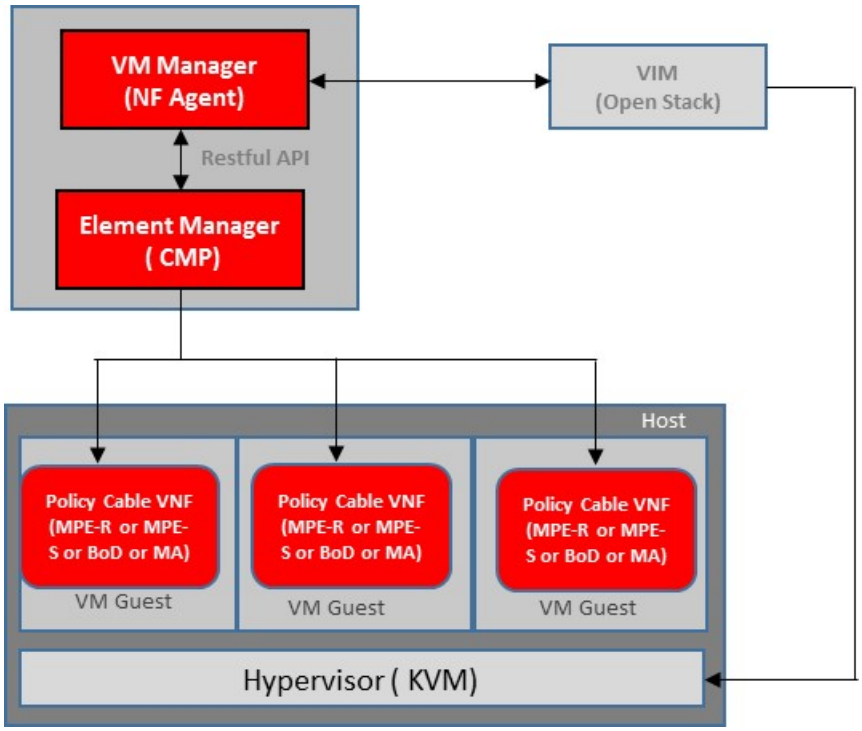

Figure 3: NFV Automation Overview Using NFA

NFA works in conjunction with CMP and the VIM to create new MPE-R, MPE-S, BoD and MA guests as follows:

- Oracle Communication Policy Management systems profiles and images are populated in the OpenStack catalog using the following steps:
    - The MPE-R, MPE-S, BoD and MA *software images* are loaded into the VIM
    - The VNF *profiles* are defined to within the VIM.
    - The Openstack resources which can be used by Oracle Communication Policy Management are grouped into Availability Zones and Security Groups

- Using standard OpenStack Compute API or HEAT Template interfaces, you create a new (or modify an existing) cluster by:
    - Choosing the desired cluster type (high availability, geo-redundant or individual server)
    - Selecting the software image, resource profile and affinity/security zones from the OpenStack catalog options
    - Providing initial required server configuration such as the instance name, DNS server and NTP server.
- After the VIM creates the instances, NFA instructs CMP to add the new servers into its Topology database. The operator then uses CMP to provide additional information such as associating a newly created MPE-S with an existing MPE-R, and assigning virtual IP addresses such as signaling (SIG-A).

The NFA user interface is integrated into CMP. This approach provides a single GUI interface for all management, while enabling other authorized tools such as network service orchestrators (NSOs) to interface with the NFA using open RESTful APIs in the future.

NFA has been verified with Oracle distribution of OpenStack Liberty release.

Direction

Introducing the NFA to simplify instantiating new OCPM components in a KVM/OpenStack environment is an important step towards integrating OCPM into orchestrated NFV deployments. Oracle is looking to enhance NFA automation capabilities by:

- Adding support for other virtual environments (hypervisors and VIMs).
- Further automating the process of deploying new instances by automatically mapping the service attributes, such as by dynamically assigning a Configuration Templates.
- Deploying and terminating new MPE-R and MPE-S instances based on capacity (sessions and bindings) or performance (TPS) requirements,
- Deploying new Oracle Communication Policy Management systems (CMP, MPE-Rs and MPE-Ss) to support new customers and opportunities.
- Enabling external orchestrators to instantiate, modify or terminate MPE-R and MPE-S instances by exposing an open RESTful API.

Summary

Oracle Communication Policy Management can be deployed in virtualized environments using KVM, VMware, and OVM hypervisors as well as on specific bare metal servers. Oracle tests and validates the performance of the defined Oracle Communication Policy Management VNFC profiles on combinations of hypervisors running on selected hardware. In addition to this, operators can run Oracle Communication Policy Management on other hardware platforms or using profiles using the specified hypervisors. In this case the service provider should validate the performance of the virtualized system in their labs and production environments or can optionally use the Oracle Consulting Services team.

For KVM/OpenStack environments, Oracle Communication Policy Management's Network Function Agent (NFA) simplifies the process of adding, modifying and removing virtual servers and clusters. NFA can communicate with multiple KVM/OpenStack VIMs and integrates with CMP, allowing customers to easily take advantage of this important capability.

Appendix A: Hardware Validation

Oracle Communication Policy Management operates on bare metal or as a VM guest. VNF performance shown in this paper reflects testing performed using the VNF reference profile on the following servers:

- Oracle Server X5-2 rack-mounted server
    - CPU: 72x Intel® Xeon® CPU E5-2699 v3 @ 2.30GHz
    - Number of hyperthreaded vCPU: 72
    - RAM: 256 GB
    - HDD: 2x HGST (1.2 TB each)
    - NICs: 10GbE SFP+ NIC with minimum of 2 ports, or 10GbE RJ45 NIC with minimum of 2 ports
- HP DL380 Gen 9 rack-mounted server
    - CPU: Two 12-core E5-2600v3-series Intel® Xeon® Processors
    - Number of hyperthreaded vCPUs: 48
    - RAM: 256 GB
    - HDD: 2x900GB
    - NICs: Four 1000BASE-T ports (on motherboard), four additional 1000BASE-T ports
- HP DL380 Gen 8 rack-mounted server
    - CPU Model: two 8-core Intel(R) Xeon(R) CPU E5-2670 0 @ 2.60GHz
    - Number of hyperthreaded vCPUs: 32
    - RAM: 64 GB
    - HDD: Two disks of 300GB
    - NICs: Four 1000BASE-T ports (on Motherboard), four additional 1000BASE-T ports

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