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Abstract: This document is the initial output of draft Recommendation Q.Scvh-iopt "Interoperability testing between SDN and hypervisor based computing virtualization". This document includes the results of discussion at the Q14/11 meeting which was held on 6-15 July 2022.

The following table shows discussion results for input documents:

DOC No.	Source	Title	Result and action
[35]	China Telecommunication Corporation	Proposal for a new work item on interoperability testing between SDN and computing virtualization	Accepted with modification.

Major issues of the draft Recommendation are summarized as follows:

- Framework for interoperability between SDN and hypervisor based computing virtualization, listing different target areas and scenarios.

It is recommended that future contributions cover following topics:

- Interoperability testing requirements between SDN and computing virtualization
- Data model framework for interoperability testing between SDN and hypervisor based computing virtualization

- Test cases of interoperability testing between SDN and computing virtualization
- But not limited to.

Draft Recommendation ITU-T Q.Scvh-iopt

Interoperability testing between SDN and hypervisor based computing virtualization

Summary

This proposed Recommendation aims to specify the interoperability testing requirements between SDN and hypervisor based computing virtualization. Firstly, this Recommendation introduces the framework for interoperability between SDN and hypervisor based computing virtualization, which includes but not limited to the target areas, components and interoperability in different scenarios. The corresponding requirements of the interoperability testing requirements between SDN and hypervisor based computing virtualization will be presented in the next. Based on these analysis, the data model framework will be introduced. And test cases of interoperability testing between SDN and hypervisor based computing virtualization will be provided as annex, which will describe the involved test procedures.

Keywords

SDN, hypervisor based computing virtualization, interoperability testing, IOPT requirements

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1. Scope

The scope of this new work item consists of:

- framework for interoperability between SDN and hypervisor based computing virtualization.
- interoperability testing requirements between SDN and hypervisor based computing virtualization.
- data model framework for interoperability testing between SDN and hypervisor based computing virtualization.
- test cases of interoperability testing between SDN and hypervisor based computing virtualization.

2. Reference

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.3300] Recommendation ITU-T Y.3300 (2014), *Framework of software-defined networking.*

[ITU-T Y.101] Recommendation ITU-T Y.101 (2000), *Global Information Infrastructure terminology: Terms and definitions.*

[ITU-T Y.3510] Recommendation ITU-T Y.3510 (2016), *Cloud computing infrastructure requirements.*

[ITU-T Y.4043] Recommendation ITU-T Y.4043 (2019), *Interoperability testing requirements of a virtual switch.*

[ITU-T Y.4040] Recommendation ITU-T Y.4040 (2016), *The framework and overview of cloud computing interoperability testing.*

[ITU-T Y.3502] Recommendation ITU-T Y.3502 (2014), *Information technology – Cloud computing – Reference architecture.*

[TBD]

3. Definition

3.1. Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 interoperability [ITU-T Y.101]: The ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged.

3.1.2 hypervisor [ITU-T Y.3510]: A type of system software that allows multiple operating systems to share a single hardware host.

3.1.3 Network Virtualization Edge [IETF RFC7365]: An Network Virtualization Edge (NVE) is the network entity that sits at the edge of an underlay network and implements L2 and/or L3 network virtualization functions.

3.1.4 virtual switch [ITU-T Q.4043]: Resource abstraction and control function abstracting physical network resources to offer virtual network capabilities.

[TBD]

3.2. Terms defined in this Recommendation

This Recommendation defines the following terms:

[TBD]

4. Abbreviations and acronyms

This Recommendation uses the following abbreviations:

CME	Compute management entity
HM	Hypervisor manager
IaaS	Infrastructure as a Service
IOPT	Interoperability Testing
L2	Layer 2
L3	Layer 3
NFV	Network Function Virtualization
NIC	Network Interface Card
NME	Network management entity
NVE	Network Virtualization Edge
SDN	Software Defined Network
SDNC	SDN Controller
ToR	Top of Rack
VIM	Virtualized Infrastructure Manager
VLAN	Virtual Local Area Network
VM	Virtual Machine
vNIC	Virtual Network Interface Card
vSwitch	Virtual switch
WAN	Wide Area Network

[TBD]

5. Conventions

In this Recommendation:

The keywords "is required" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

[TBD]

6. Framework for interoperability between SDN and hypervisor based computing virtualization

According to [ITU-T Y.3502], the resource abstraction and control function provides access to the physical computing resources through software abstraction. Resource abstraction needs to ensure efficient, secure and reliable usage of the underlying infrastructure. SDN and hypervisor based computing virtualization both belong to resource abstraction and control function.

Hypervisor based computing virtualization abstracts physical compute resources to enable a cloud service provider to offer virtualized compute resources, including hypervisor, hypervisor manager, vSwitch and so on. And SDN abstracts physical network resources to enable a cloud service provider to offer virtual network connectivity for VM or container with capabilities of rapid elasticity, resource pooling and on-demand self-service, which is composed of SDN Controller, SDN NVE, etc.

Interoperability between SDN and hypervisor based computing virtualization focuses on dealing with interaction between NVE and hypervisor, meanwhile, virtualized infrastructure manager (VIM) including Compute management entity(CME) and Network management entity(NME) also play indispensable role in the IOPT between SDN and hypervisor based computing virtualization.

NOTE- The SDN mentioned in this article refers to the SDN in the cloud computing data center, excluding the WAN, the Access Network and other scenarios.

6.1. Target areas for interoperability testing between SDN and hypervisor based computing virtualization

Interoperability testing between SDN and hypervisor based computing virtualization is to verify that SDN can interact with hypervisor based computing virtualization as expected. According to the way SDN and hypervisor based computing virtualization works, there are 10 different target areas that need to be considered in IOPT between SDN and hypervisor based computing virtualization as follows:

- Target area 1: "**CME-NME**", dealing with interaction between compute management entity and network management entity;
- Target area 2:" **SDNC-NME**", dealing with interaction between SDN Controller and network management entity;
- Target area 3: "**CME-HM**", dealing with interaction between compute management entity and hypervisor manager;
- Target area 4: "**SDNC-VM**", dealing with interaction between SDN Controller and VM;
- Target area 5: "**NVE-vSwitch**", dealing with interaction between virtual switch and SDN NVE;
- Target area 6: "**NVE – VM**", dealing with interaction between SDN NVE and VM;
- Target area 7: "**SDNC-vSwitch**", dealing with interaction between SDN Controller and virtual switch;
- Target area 8: "**SDNC-NIC**", dealing with interaction between SDN Controller and intelligent NIC;
- Target area 9: "**NVE-Hypervisor**", dealing with interaction between SDN NVE and hypervisor;
- Target area 10: "**SDNC-ToR**", dealing with interaction between SDN Controller and ToR;

Since SDN and hypervisor based computing virtualization both belong to resource abstraction and control function, they are capabilities of the IaaS. Interoperability testing between SDN and hypervisor based computing virtualization should be concerned as an infrastructure capability type IOPT. Meanwhile, different implementation scenarios of SDN NVE will lead to different target

areas that need to be considered in IOPT between SDN and hypervisor based computing virtualization. Referring to the form of NVE, four scenarios can be respectively named as virtual machine (VM) NVE, vSwitch NVE, intelligent Network Interface Card (NIC) NVE and ToR NVE.

- Scenario 1: "**virtual machine NVE**", deploying the NVE as a VM on hypervisor based computing virtualization.
- Scenario 2: "**vSwitch NVE**", deploying the NVE in the form of vSwitch on the hypervisor based computing virtualization, which merge the original functions of vSwitch.
- Scenario 3: "**intelligent NIC NVE**", realizing overlay encapsulation/decapsulation packet forwarding services of NVE by the physical network card of the host where the hypervisor based computing virtualization is located.
- Scenario 4: "**ToR NVE**", realizing the function of NVE on ToR corresponding to the host where the hypervisor based computing virtualization is located.

Chapters 6.2 to 6.5 describe the four scenariosrespectively and their corresponding IOPT target areas.

6.2. Scenario 1: "virtual machine NVE"

As shown in the figure 6-1, NVE is deployed in hypervisor based computing virtualization in the form ofVM, and vSwitch directs the traffic of VMs to NVE to realize overlay encapsulation/decapsulation packet forwarding services. The user initiates requests related to the VM life cycle, including VM creation, startup, shutdown, deletion, migration, adding network card or deleting network card. The interaction between SDN and hypervisor based computing virtualization are as follow parts:

- **Compute management entity:** deploy event processing module and virtualization event interface. The computing management entity responds to the VM life cycle related requests and sends the VM life cycle related requests to the hypervisor manager
- **hypervisor manager**, which calls the hypervisor to perform the VM life cycle related operations on the specific physical host. After the operation, the hypervisor manager calls the virtualization event interface of the compute management entity to report the VM life cycle related operation information;
- **SDN controller:** subscribes VM life cycle related operation information from the computing management entity and updates the network configuration of the SDN NVE according to the operation information.

In scenario 1, the interoperability testing between SDN and hypervisor based computing virtualization involve target area 1, 2, 3, 4 and 5.

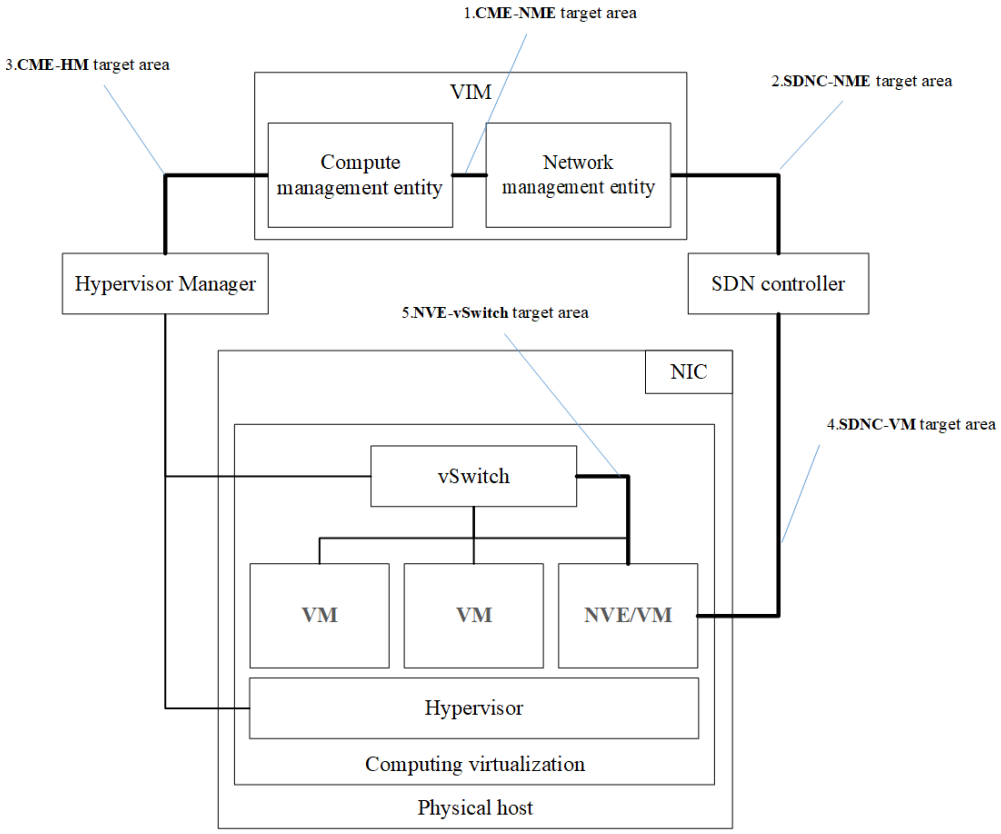

Figure 6-1 –Scenario **1: "virtual machine NVE"**

6.3. Scenario 2: "vSwitch NVE"

In this scenario, NVE is embedded into vSwitch to achieve services of overlay encapsulation/decapsulation packet forwarding. Target area 1, 2, 3, 6 and 7 will be considered in this solution.

The hypervisor needs an open kernel environment to allow SDN to deploy NVE adaptation programs, and embedded NVE need secondary development to interact with hypervisor with certain version of qemu and Linux kernel.

Similarly, in this case, VIM is also required to standardize the interoperability between SDN and hypervisor based computing virtualization in different VM life cycle services.

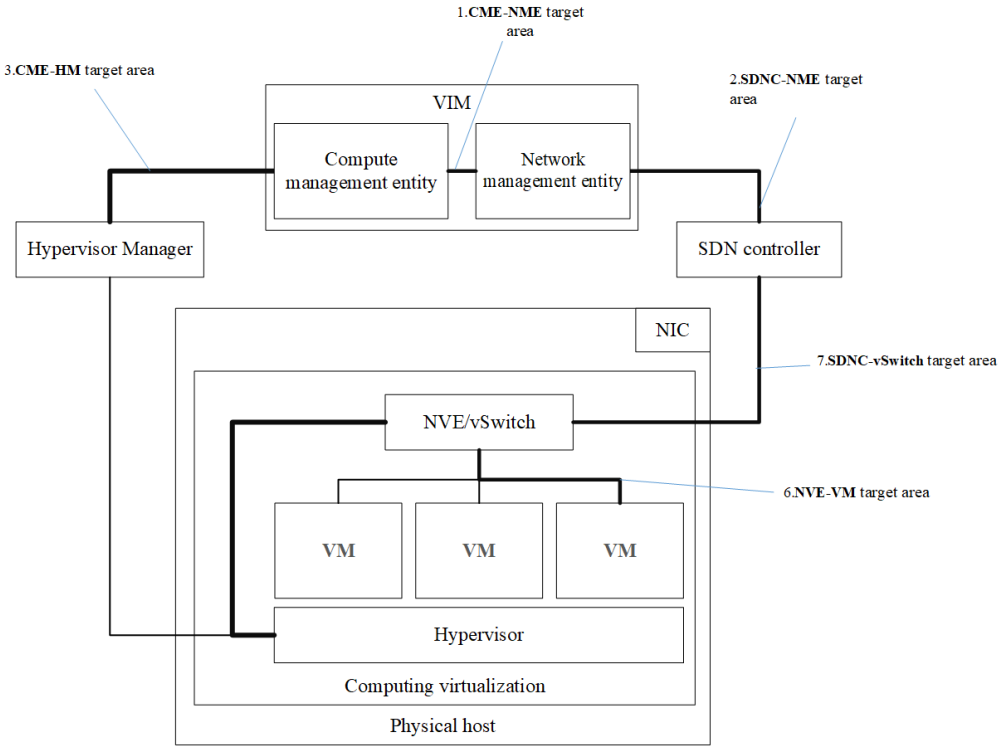

Figure 6-2 –Scenario **2: "vSwitch NVE"**

6.4. Scenario 3: "intelligent NIC NVE"

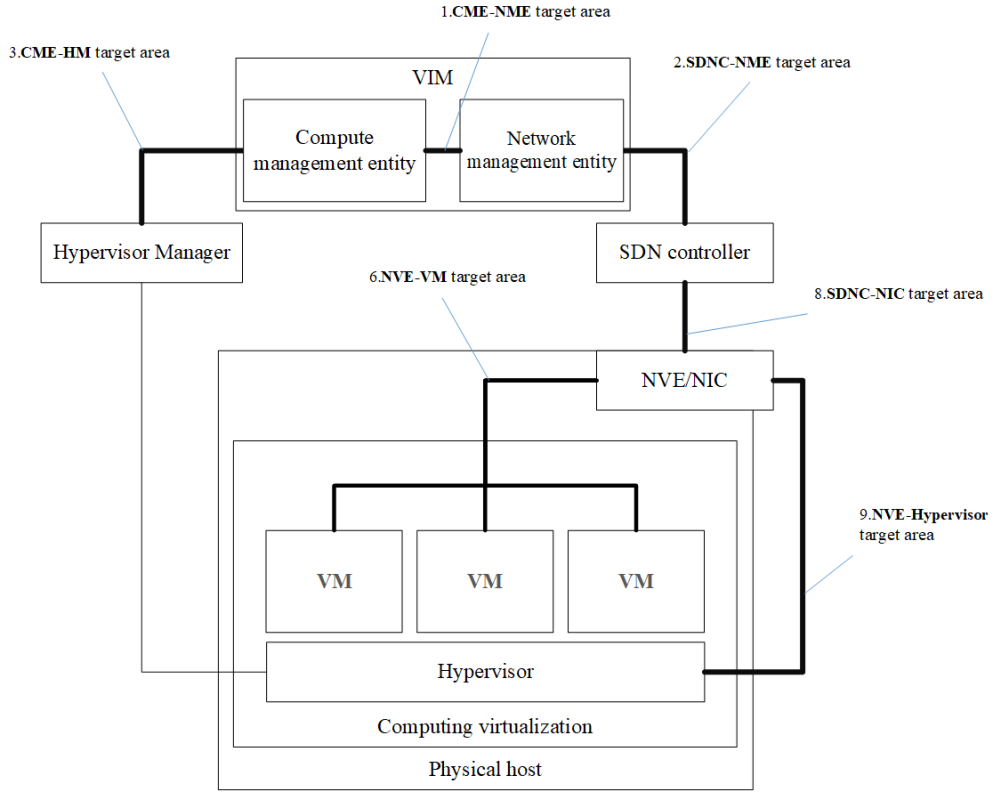

Figure 6-3 – Scenario 3: "intelligent NIC NVE"

In scenario 3，SDN NVE is realized in the intelligent NIC, the interaction between SDN and hypervisor based computing virtualization on the host are as follow parts:

- **Intelligent NIC,** deploying SDN NVE and its corresponding kernel dependencies, runnable software library and interface plug-ins, provides standard interfaces of SDN NVE to hypervisor. The standard interface of SDN NVE defines the operation process and parameters between the vNIC of VM and virtual port of NVE. The interface plug-ins of NVE inherits from the standard interfaces of SDN NVE, and realizes the conversion between them and different versions of NVE interfaces.
- **Hypervisor**, include its corresponding kernel dependencies and runnable software library.

As shown above, Hypervisor binds vNIC of VM and virtual port of NVE by the standard interfaces of SDN NVE, and target area 1, 2, 3, 6, 8 and 9 will be considered in this scenario.

6.5. Scenario 4: "ToR NVE"

In addition, ToR can also carry the overlay encapsulation/decapsulation packet forwarding services which is the function of NVE, and target area 1, 2, 3 and 10 will be considered in this scenario.

VIM can take advantage of Port Binding schemes to achieve the interoperability between SDN and hypervisor based computing virtualization.

Same as the above scenarios, SDN will require the port attribute values of API during VM lifecycle management by VIM.

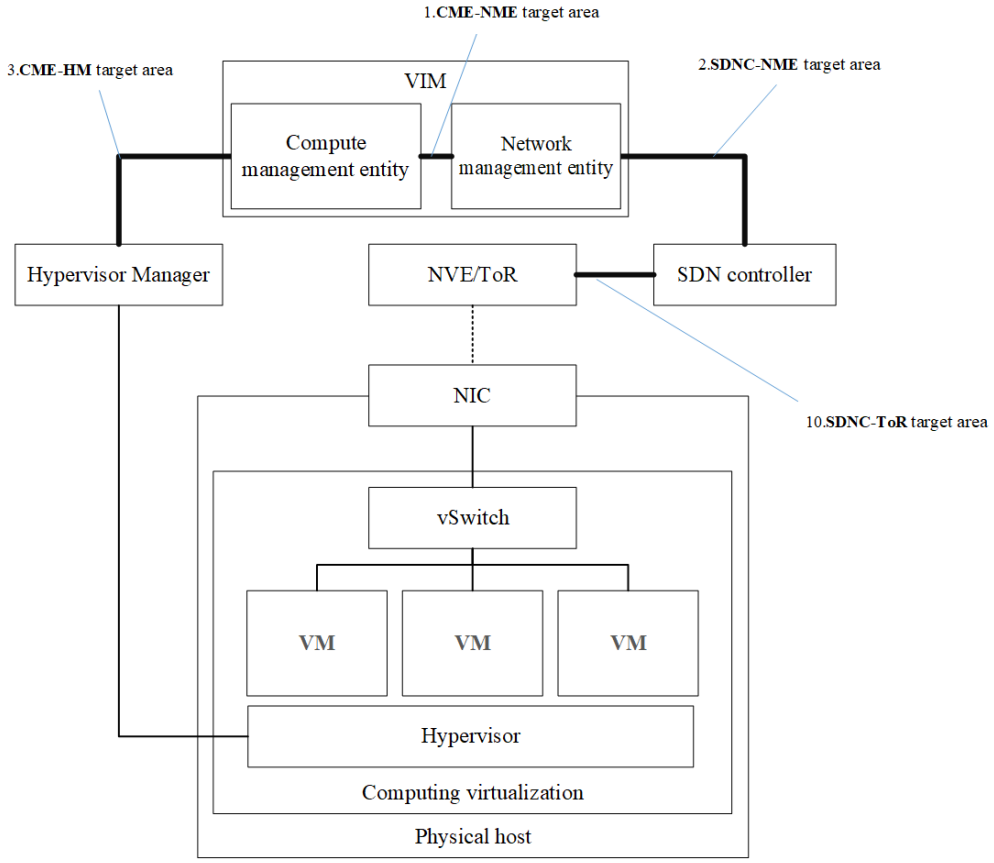

Figure 6-4 –Scenario **4: "ToR NVE"**

7. IOPT requirements between SDN and hypervisor based computing virtualization

Clauses 7.1 and 7.2 provide the concrete IOPT requirements between SDN and hypervisor based computing virtualization in different target areas.

7.1. Interoperability testing between SDN NVE and hypervisor based computing virtualization

[TBD]

7.2. Interoperability testing between SDN and VIM

[TBD]

8. Data model framework for interoperability testing between SDN and hypervisor based computing virtualization

[TBD]

[Editor's Note on July 2022] The data model concerning the interfaces will be specified in this chapter.

8.1. Resource data models

[TBD]

8.2. Operations of the resource data models

[TBD]

Annex I. Test cases of interoperability testing between SDN and hypervisor based computing virtualization

This annex identifies test cases for interoperability testing between SDN and hypervisor based computing virtualization.

[TBD]

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