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Network Functions Virtualisation (NFV); Infrastructure; Compute Domain

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Contents

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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Network Functions Virtualisation (NFV).

The present document gives an overview to the series of documents covering the NFV Infrastructure.

Table 1: NFV infrastructure architecture documents

Infrastructure Architecture Document		Document #
Overview		GS NFV INF 001
Architecture of the Infrastructure Domains	Compute Domain	GS NFV INF 003
	Hypervisor Domain	GS NFV INF 004
	Infrastructure Network Domain	GS NFV INF 005
Architectural Methodology	Interfaces and Abstraction	GS NFV INF 007
Service Quality Metrics		GS NFV INF 010

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document presents an architectural description of the compute (& storage) domain of the infrastructure which supports virtualised network functions (VNFs). The compute domain includes the network & I/O interfaces required to interface to the infrastructure network and the storage network, if any.

It sets out the scope of the infrastructure domain acknowledging the potential for overlap between infrastructure domains, and between the infrastructure and the virtualised network functions. It also sets out the nature of interfaces needed between infrastructure domains and within the compute domain.

The present document does not provide any detailed specification but makes reference to specifications developed by other bodies and to potential specifications, which, in the opinion of the NFV ISG could be usefully developed by an appropriate Standards Developing Organisation (SDO).

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI GS NFV 001 (V1.1.1): "Network Functions Virtualisation (NFV); Use Cases".

[2] ETSI GS NFV 002 (V1.1.1): "Network Functions Virtualisation (NFV); Architectural Framework".

[3] ETSI GS NFV 003 (V1.1.1): "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".

[4] ETSI GS NFV 004 (V1.1.1): "Network Functions Virtualisation (NFV); Virtualisation Requirements".

[5] ETSI GS NFV-INF 001 (V1.1.1): "Network Function Virtualisation (NFV); Infrastructure Overview".

[6] DMTF DSP 0217: "SMASH Implementation Requirements".

[7] ETSI GS NFV-PER 001 (V1.1.1): "Network Function Virtualisation (NFV); NFV Performance & Portability Best Practices".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Master Usage Model: "Compute Infrastructure as a Service, Rev 1", (2012) Open Data Cneter Alliance.

NOTE: Available at http://www.opendatacenteralliance.org/docs/ODCA_Compute_IaaS_MasterUM_v1.0_Nov2012.pdf.

[i.2] IEEE 802.3™: "Ethernet Working Group".

[i.3] ETSI GS NFV-REL 001: "Network Functions Virtualisation (NFV); Resiliency Requirements".

[i.4] IEEE 1588™: "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

composite-NFVI: NFVI hardware resources are composed of field replaceable units that are COTS elements

field replaceable unit: unit of hardware resources designed for easy replacement during the operational life of a network element

gateway node: See ETSI GS NFV-INF 001 [5].

network node: See ETSI GS NFV-INF 001 [5].

NFVI components: NFVI hardware resources that are not field replaceable, but are distinguishable as COTS components at manufacturing time

NFVI-Plugin: NFVI hardware resources are deployable as a COTS field replaceable unit for another network element

NFVI-Pod: NFVI hardware resources are deployable as a single COTS entity with no field replaceable units

portability: See ETSI GS NFV-INF 001 [5].

storage node: See ETSI GS NFV-INF 001 [5].

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACL	Access Control List
ACPI	Advanced Configuration and Power Interface
AES	Advanced Encryption Standard
API	Application Programming Interface
ARM	Acorn RISC Machine
ARP	Address Resolution Protocol

ASIC	Application Specific Integrated Circuit
AT&T	American Telephone & Telegraph
ATA	Advanced Technology Attachment
BBU	Base Band Unit
BIOS	Basic Input Output System
BRAS	Broadband Remote Access Server
BT	British Telecom
BW	Bandwidth
CBDMA	Common buffer DMA
CHD	Compute Host Descriptor
CIFS	Common Internet File System
CIM	Common Information Model
COTS	Commercial Off The Shelf
COW	Copy-On-Write
CPE	Customer Premise Equipment
CPU	Central Processing Unit
CRAN	Cloud Radio Access Network
CRC	Cyclic Redundancy Check
DAS	Direct Attached Storage
DCB	Data Center Bridging
DCMI	Data Center Management Interface
DMA	Direct Memory Access
DPDK	Data Plane Development Kit
DPI	Deep Packet Inspection
DSLAM	Digital Subscriber Loop Access Multiplexer
DSP	Digital Signal Processing
ECC	Error Correction Code
EMS	Element Management System
FC	Fibre-Channel
FCP	Fibre-Channel Protocol
FPGA	Field Programmable Gate Array
GPU	Graphic Processing Unit
GUI	Graphical User Interface
HAL	Hardware Abstraction Layer
HDD	Hard Disk Drive
HSM	Hardware Security Module
HW	Hardware
HWA	Hardware Acceleration
IB	InfiniBand
IO	Input Output
IOMMU	Input Output Memory Management Unit
IOPS	Input Output Operations Per second
IP	Internet Protocol
IPC	Inter Process Communication
IPMI	Intelligent Platform Management Interface
ISA	Instruction Set Architecture
IT	Information Technology
KQI	Key Quality Indicator
KVM	Kernel Virtual Machine
LAN	Local Area Network
LLC	Limited Liability Corporation (?)
LTFS	Linear Tape File System
LUKS	Linux Unified Key Setup
LVM	Logical Volume Manager
MAC	Media Access Control
MIB	Management Information Base
MMU	Memory Management Unit
NAPT	Network Address and Port Translation
NAS	Network Attached Storage
NAT	Network Address Translation
NFS	Network File System
NFVI	Network Functions Virtualisation Infrastructure

NGFW	Next Generation Fire Wall
NIC	Network Interface Card
NPU	Network Processor Unit
OCP	Open Compute Project
ODP	Open Data Plane
OS	Operating System
OSPF	Open Shortest Path First
PCI	Peripheral Computer Interface
PCI-E	Peripheral Computer Interface - Enhanced
PGP	Pretty Good Privacy
RAID	Redundant Array of Independent Disks
RAN	Radio Access Network
RAS	Remote Access Server
RDMA	Remote Direct Memory Access
RIP	Routing Information Protocol
RoCE	RDMA over Converged Ethernet
SaaS	Software as a Service
SAN	Storage Area Network
SAS	SAN Attached Storage
SATA	Serial Advanced Technology Attachment
SCSI	Small Computer Systems Interface
SDD	Solid State Disk
SDO	Standards Development Organization
SES	SCSI Enclosure Services
SLA	Service Level Agreement
SMASH	System Management Architecture for Server Hardware
SNMP	Simple Network Management Protocol
SR-IOV	Single Root Input Output Virtualisation
SSD	Solid State Disks
SSH	Secure Shell
SSL	Secure Socket Layer
SW	Software
TLB	Table Look-aside Buffer
TOR	Top of Rack
TPM	Trusted Platform Module
TX/RX	Transmit/Receive
UPS	Uninterruptable Power Supply
USB	Universal Serial Bus
VF	Virtual Function
VIA	Virtual Interface Architecture
VIM	Virtual Infrastructure Manager
VLAN	Virtual Local Area Network
VM	Virtual Machine
VMD	VM descriptor
VNF	Virtual Network Function
VNFC	Virtual Network Function Component
VNFCI	Virtual Network Function Component Instance
VNFD	Virtual Network Function Descriptor
VNFM	Virtual Network Function Manager
VPN	Virtual Private Network
WAN	Wide Area Network

4 Domain Overview

Cloud computing in data centers have been able to abstract the hardware from the software through virtualisation reaping benefits from hosting multiple applications, accelerating time to market and offering over the top services. 64-bit multi-core processors with hardware support for virtual machines, form the core of the industry-standard server within the data center. These, coupled with offload and acceleration technologies, form the required server architecture. These are sometimes accelerated to meet workload performance. Data Center servers may use processors with 10 or more cores and have multiple sockets per server (e.g. a 4-way server with 10 cores has 40 physical cores).

NFV is an effort by the operators to leverage cloud computing benefits and enhance the abstraction of the software from the hardware for the network.

The present document will define the compute domain for NFV and document what is necessary for the compute domain to meet the NFV requirements.

4.1 Domain Scope

The Compute Domain is one of three domains constituting the NFV infrastructure, or NFVI. The other two domains are the Hypervisor, and the Infrastructure Network.

The compute domain includes storage & network, I/O interface - it comprises the generic servers and storage. It should be noted that the compute domain is closely associated with the orchestration and management domain. The latter runs on the NFVI as a set of modular, interconnected virtual machines.

4.2 High Level NFV Framework

The ISG NFV Architectural Framework document discusses three domains: VNFs; NFVI; and NFV Management & Orchestration. This is shown in the figure below depicting NFVI, which supports the execution of the VNFs including the diversity of physical resources and their virtualised counterpart. The Compute Domain is one of three domains constituting the NFVI. The other two domains are the Hypervisor, and the Infrastructure Network.

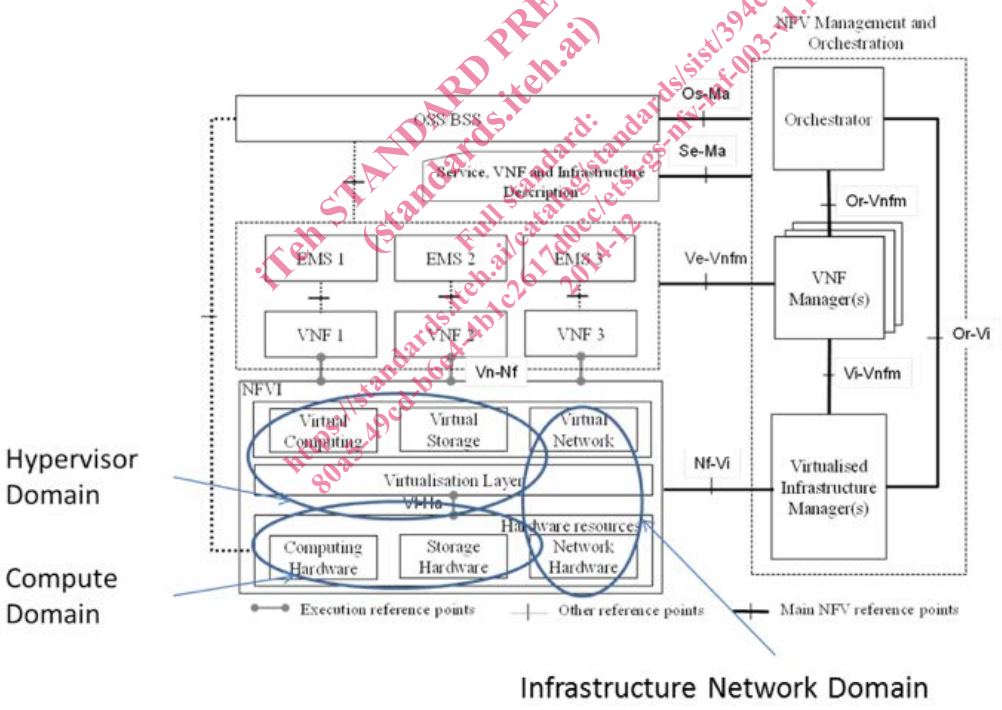

Figure 1: NFVI consists of three domains: compute (includes storage), hypervisor, and infrastructure network

4.3 Compute Domain and Inter-Domain Interfaces

Common to all three NFVI domains is figure 2 [5]. It depicts the general domain architecture, and associated interfaces. Of particular interest to the compute domain is interface #11, interfacing the compute domain to the orchestration and management, and interface #14, interconnecting to the infrastructure network.

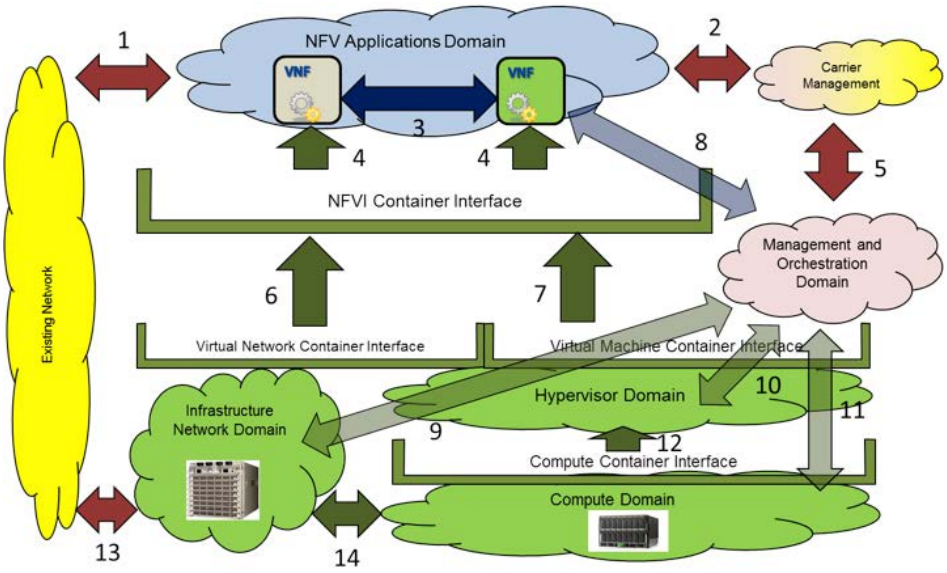

Figure 2: General domain architecture and associated interfaces

The basic functional blocks contained are shown in figure 2: processor/acceleration, network interface, and storage. All functional blocks are managed and orchestrated remotely through interface 11.

4.3.1 Relevant Interfaces

Table 2 depicts the relevant interfaces for compute domain.

Table 2: Relevant interfaces of compute domain

Relevant Interface Type	#	Description
NFVI Container Interfaces	4	This is the primary interface provided by the infrastructure to host VNFs. The applications may be distributed and the infrastructure provides virtual connectivity which interconnects the distributed components of an application.
Infrastructure Interconnect Interfaces	8	**Virtual MANO Container Interface:** the interfaces that allows the VNFs to request different resources of the infrastructure, for example, request new infrastructure connectivity services, allocate more compute resources, or activate/deactivate other virtual machine components of the application.
Orchestration & Management Interface	9	Orchestration and management interface with the infrastructure network domain.
	11	Orchestration and management interface with the compute domain.
	14	Network interconnect between the compute equipment's and the infrastructure network equipment.
Legacy Interconnect Interfaces	1	The interface between the VNF and the existing network. This is likely to be higher layers of protocol only as all protocols provided by the infrastructure are transparent to the VNFs.
	2	Management of VNFs by existing management systems.
	5	Management of NFV infrastructure by existing management systems.
	13	The interface between the infrastructure network and the existing network. This is likely to be lower layers of protocol only as all protocols provided by VNFs are transparent to the infrastructure.

4.4 Relation to NFV Architecture Framework

Figure 3 depicts the NFV reference architectural framework [5]. Of interest to the compute domain are:

- VNF-NFVI: this reference point presents the execution environment provided by NFVI to the VNF.
- VI-Ha: this is the reference point interfacing the virtualisation layer to the hardware resources, including compute and storage.

- Nf-Vi: this reference point is used to assign virtualised resources in response to resource allocation requests; forwarding and exchange state information.

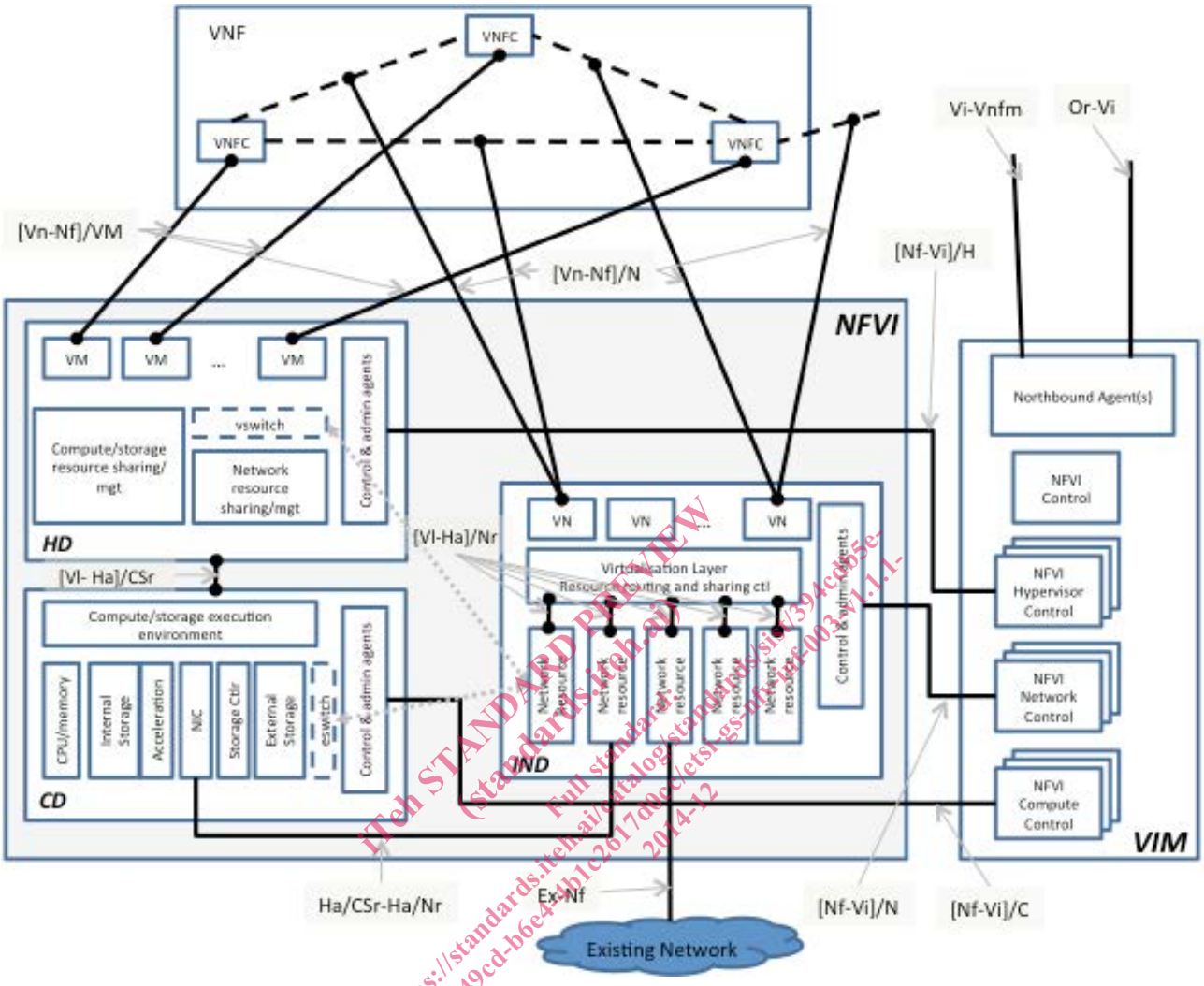

Figure 3: High-level overview of the NFVI domains and interfaces