



## Network Functions Virtualisation (NFV); Infrastructure; Network Domain

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## Reference

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## Foreword

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

Infrastructure Architecture Document		Document #
Overview		GS NFV INF 001
Illustrative Use Cases for the NFV Infrastructure		GS NFV INF 002
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

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# 1 Scope

The present document presents an architectural description of the Infrastructure Network domain of the infrastructure which supports virtualised network functions. 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 infrastructure network 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).

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## 2 References

### 2.1 Normative references

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

- [1] ETSI GS NFV 003 (V1.1.1): "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".
- [2] ETSI GS NFV 002 (V1.1.1): "Network Functions Virtualisation (NFV); Architectural Framework".
- [3] ETSI GS NFV 001 (V1.1.1): "Network Functions Virtualisation (NFV); Use Cases".
- [4] ETSI GS NFV-MAN 001 (V1.1.1): "Network Functions Virtualisation (NFV); Management and Orchestration".

### 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.

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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] ETSI GS NFV-INF 001 (V1.1.1): "Network Functions Virtualisation (NFV); Infrastructure Overview".
- [i.2] ETSI GS NFV-INF 003 (V1.1.1): "Network Functions Virtualisation (NFV); Infrastructure; Compute Domain".
- [i.3] ETSI GS NFV-INF 004 (V1.1.1): "Network Functions Virtualisation (NFV); Infrastructure; Hypervisor Domain".

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- [i.5] MEF 6.1 (2008-04): "MEF Technical Specification; MEF 6.1; Ethernet Services Definitions - Phase 2".
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- [i.20] IEEE Std 802.1AX<sup>TM</sup> (2014): "IEEE Standard for Local and metropolitan area networks -- Link Aggregation".
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- [i.34] MEF 17 (2007-04): "MEF Technical Specification; MEF 17; Service OAM Requirements & Framework - Phase 1".
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- [i.43] draft-ietf-l3vpn-end-system-02 (work in progress): "End-system support for BGP-signaled IP/VPNs".
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- [i.45] IETF RFC 4665 (2006-09): "Service Requirements for Layer 2 Provider-Provisioned Virtual Private Networks".
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- [i.47] draft-ietf-opsawg-oam-overview-16 (work in progress): "An Overview of Operations, Administration, and Maintenance (OAM) Tools".
- [i.48] ETSI GS NFV-SWA 001 (V1.1.1): "Network Functions Virtualisation (NFV); Virtual Network Function Architecture".
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- [i.55] IETF RFC 5880 (2010-06): "Bidirectional Forwarding Detection (BFD)".
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## 3 Definitions and abbreviations

### 3.1 Definitions

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

**policy group:** grouping of nodes (VNFCIs), external entities, infrastructure components, etc.) in an NFV environment that share a common policy

NOTE: That policy is usually, but not limited to, a security or traffic isolation model. Other possible uses of a policy group could include common traffic forwarding class, policy based routing, etc.

**security group:** security group is a subset of Policy Groups that are only concerned with traffic isolation

NOTE: An example of a traffic isolation policy group might be that all the VNFCIs deployed to provide a load-balancing function as part of some service function can receive TCP traffic from any external source addressed to port 80 or port 443, and can communicate with other VNFCIs deployed as part of the same service using TCP addressed to port 80 or port 443, and ICMP PING protocols.

**virtual network:** See ETSI GS NFV-INF 001 [i.1].

### 3.2 Abbreviations

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

AMI	Advanced Metering Infrastructure
API	Application Programming Interface
ARP/ND	Address Resolution Protocol/ Neighbor Discovery
BEB	Backbone Edge Bridge
BFD	Bidirectional Forwarding Detection
BGP	Border Gateway Protocol
BSS	Business Support System
CD	Compute Domain
CFM	Connectivity Fault Management
CIR	Committed Information Rate
CPU	Central Processing Unit
C-VID	Customer VLAN Identifier
DHCP	Dynamic Host Configuration Protocol
D-LAG	Distributed Link Aggregation
E-BGP	External Border Gateway Protocol
ECMP	Equal-Cost Multi-Path
EIR	Excess Information Rate

EVPN	Ethernet Virtual Private Network
FIB	Forwarding Information Base
ForCES	Forwarding and Control Element Separation
GRE	Generic Routing Encapsulation
HD	Hypervisor Domain
HTTP	Hypertext Transfer Protocol
HW	Hardware
I-BGP	Internal Border Gateway Protocol
ICMP	Internet Control Message Protocol
ID	Identifier
IETF	Internet Engineering Task Force ( <a href="http://www.ietf.org/">http://www.ietf.org/</a> )
IG	Interworking Gateway
IND	Infrastructure Network Domain
IP	Internet Protocol
IPFIX	Internet Protocol Flow Information Export
IS-IS	Intermediate System to Intermediate System
LAG	Link Aggregation Group
LAN	Local Area Network
LDP	Label Distribution Protocol
LLDP	Link Layer Discovery Protocol
MAC	Media Access Control
MANO	Management and Orchestration
MEF	Metro Ethernet Forum ( <a href="http://metroethernetforum.org/">http://metroethernetforum.org/</a> )
MEP	Maintenance association End Point
MIB	Management Information Base
MIP	Maintenance domain Intermediate Point
MP-BGP	Multiprotocol Border Gateway Protocol
MPLS	Multi-Protocol Label Switching
MSTP	Multiple Spanning Tree Protocol [i.4]
NAT	Network Address Translation
NF	Network Function [1]
NFCI	Network Function Component Instance
NFV	Network Functions Virtualisation
NFVI	Network Functions Virtualisation Infrastructure [1]
NFVI-PoP	Network Functions Virtualisation Infrastructure Point of Presence [i.1]
NFVO	Network Functions Virtualisation Orchestrator
NI	Network Intensive
NIC	Network Interface Card
N-PoP	Network Point of Presence [1]
NVE	Network Virtualisation Edge
NVGRE	Network Virtualisation using Generic Routing Encapsulation
OA&M	Operations, Administration and Maintenance
OAM	Operations, Administration and Maintenance
ONF	Open Networking Foundation ( <a href="https://www.opennetworking.org/">https://www.opennetworking.org/</a> )
OS	Operating System
OSPF	Open Shortest Path First
OSS	Operations Support System
OTN	Optical Transport Network
PBB	Provider Backbone Bridge
PBB-TE	Provider Backbone Bridge Traffic Engineering
PCE	Path Computation Element
PE	Provider Edge
PNF	Physical Network Function [1]
PPP	Point-to-Point Protocol
PPTP	Point-to-Point Tunneling Protocol
QoS	Quality of Service
RFC	Request for Comments
ROCE	Remote Direct Memory Access (RDMA) over Converged Ethernet
RSTP	Rapid Spanning Tree Protocol
RSVP	Resource Reservation Protocol
SDH	Synchronous Digital Hierarchy
SDL	Software Development Lifecycle

SDN	Software-Defined Networking
SDO	Standards Development Organization
SID	Service Instance Identifier
SLA	Service Level Agreement [1]
SNMP	Simple Network Management Protocol
SPB	Shortest Path Bridging
SPBM	SPB-MAC
SPBV	SPB-VID
STP	Spanning Tree Protocol
STT	Stateless Transport Tunneling
S-VID	Service VLAN Identifier
TCP	Transmission Control Protocol
TE	Traffic Engineering
TEP	Tunnel End Point
TOR	Top Of Rack
TORS	Top-Of-Rack Switch
TRILL	Transparent Interconnection of Lots of Links ( <a href="http://datatracker.ietf.org/wg/trill/">http://datatracker.ietf.org/wg/trill/</a> )
UDP	Stateless Transport Tunneling
UNI	User Network Interface
VDP	Virtual Station Interface (VSI) Discovery and Configuration Protocol
VEB	Virtual Ethernet Bridging
VEPA	Virtual Ethernet Port Aggregator
VID	VLAN Identifier
VIM	Virtualisation Infrastructure Manager
VLAN	Virtual LAN
VM	Virtual Machine [1]
VN	Virtual Network
VNF	Virtualised Network Function [1]
VNFC	Virtual Network Function Component [i.1]
VNFCI	Virtual Network Function Component Instance
VNI	VxLAN Network Identifier
VNIC	Virtual Network Interface Card
VNID	Virtual Network Interface Device
VNP	Virtual Network Protocol
VPLS	Virtual Private LAN Service
VPN	Virtual Private Network
VPRN	Virtual Private Routed Network
VRF	Virtual Routing and Forwarding
VSID	Virtual Subnet Identifier
VTN	Virtual Tenant Network
VXLAN	Virtual eXtensible LAN
WAN	Wide Area Network
WIM	WAN Infrastructure Manager
XML	Extensible Markup Language

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## 4 Domain Overview

Figure 1 illustrates the four domains described in [i.1], their relationship with each other and their relationship to other domains outside the infrastructure. The figure also sets out the primary interfaces.

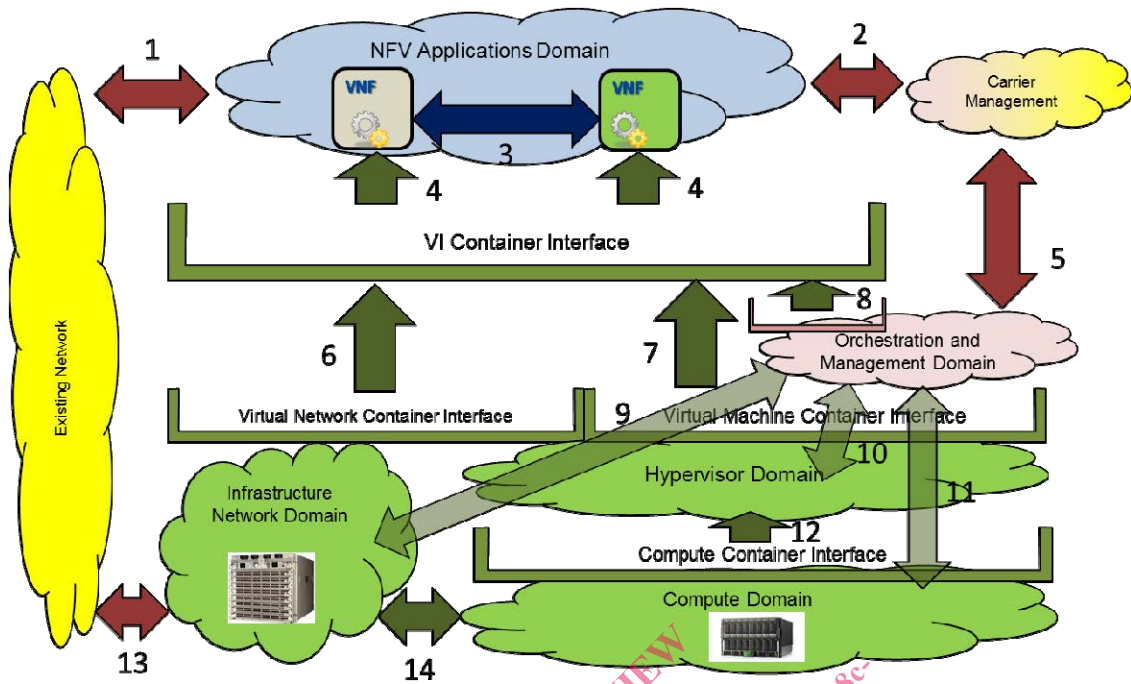


Figure 1: General Domain Architecture and Associated Interfaces

Figure 2 [i.1] gives a high level overview of the three domains within the NFVI and shows how the domains realise the primary interfaces of the NFV overall architectural framework.

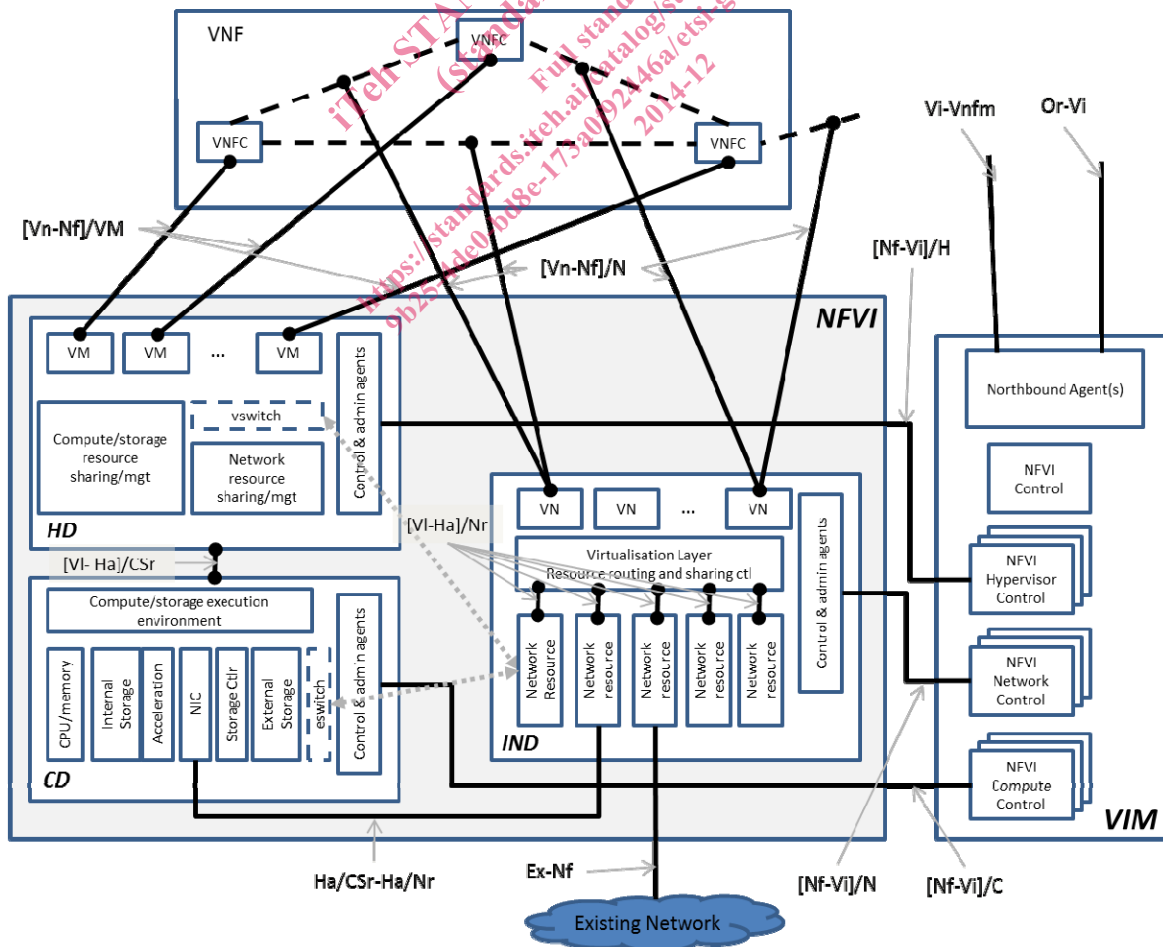


Figure 2: High Level Overview of the NFVI Domains and Interfaces

The general domain architecture of figure 2 is reduced to a reference point architecture (figure 3) showing only the Network Domain and aligning these reference points with the NFV E2E Architecture (ETSI GS NFV 002 [2]). The Network Domain reference architecture has five reference points catalogued in table 1.

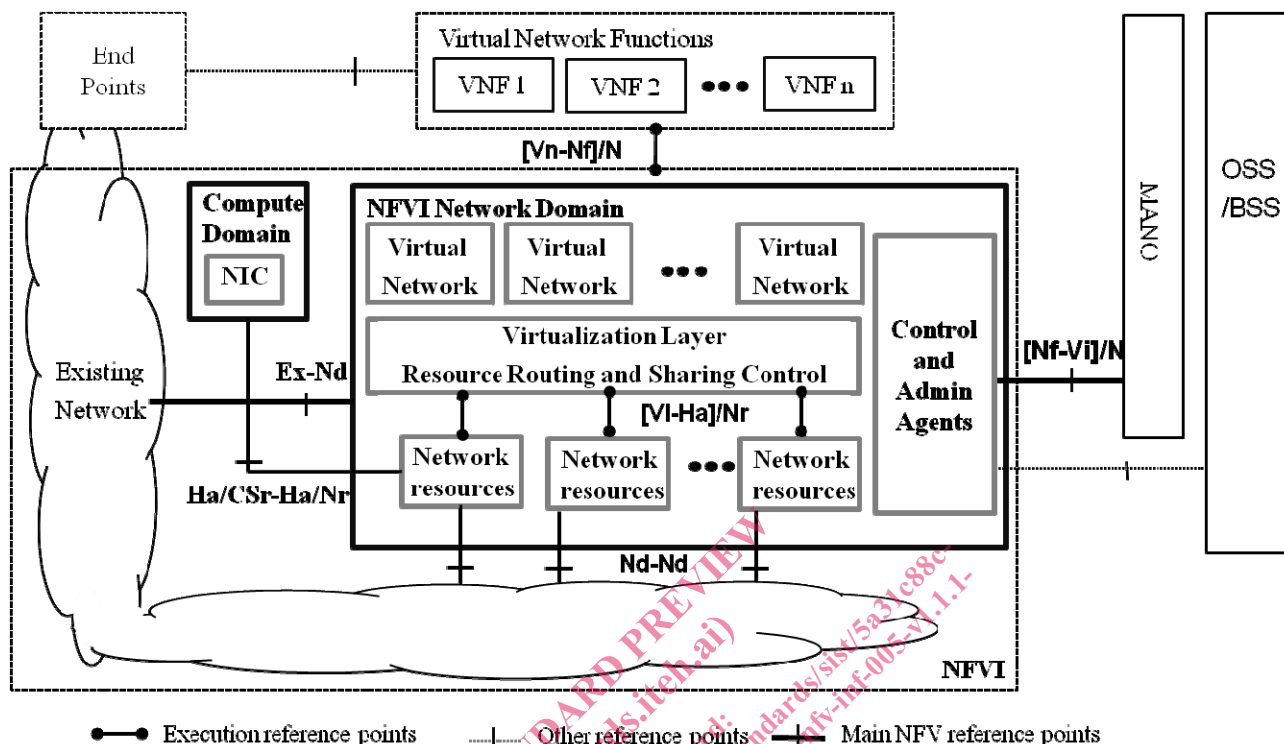


Figure 3: Network Domain Reference Point Architecture

The inter-domain and intra-domain interfaces are summarized in table 1. The inter-domain interfaces are described in more detail in clause 5. The functional blocks consist of the virtual networks, the virtualisation layer resource routing and sharing control, the network resources and the control & admin agents. They are described in clause 6. The interfaces internal to the domain are described in more detail in clause 7.

Table 1: Catalogue of Inter-domain Interfaces related to the Infrastructure Network Domain

Reference Point	Description
[Vn-Nf]/N	This reference point is the virtual network (VN) container interface carrying communication between VNFC instances. Note that a single VN can support communication between more than a single pairing of VNFC instances (eg an E-LAN VN). It is the reference point over which the services of the network domain are delivered. These services may be either IP forwarding services or Ethernet private line/LAN/TREE services provided by the infrastructure. The reference point is providing services at two layers: IP forwarding services across the [Vn-Nf]/N/L3 reference point and Ethernet services, e.g. E-LINE, E-LAN, E-TREE, across the [Vn-Nf]/N/L2 reference point.
[Nf-Vi]/N	This is the reference point between the management and orchestration agents in the infrastructure network domain and the management and orchestration functions in the virtual infrastructure management (VIM). It is the part of the Nf-Vi interface relevant to the infrastructure network domain.
[VI-Ha]/Nr	The reference point between the virtualisation layer and the network resources.
Ex-Nd	The reference point between the infrastructure network domain and external networks.
Nd-Nd	The reference point between NFVI-PoPs used to extend the virtualisation layer of a single Network Operator's NFVI over multiple geographically separated sites.
Ha/Csr-Ha/Nr	This is the reference point between the infrastructure network domain and the servers/storage of the compute domain.