VNFD Information Model Specification

V0.1

1. Scope

The scope of the present document is to describe the VNFD Information Model Specification.

2. Terms, Definitions and Abbreviations

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

Abbreviation	Definition
CM	Conditional Mandatory
CO	Conditional Optional
CP	Connection Point
CPD	Connection Point Descriptor
DF	Deployment Flavour
DSL	Domain Specific Language
GS	Group Specification
MANO	Management and Orchestration
MPLS	Multi-Protocol Label Switching
NCT	Network Connectivity Topology
NFP	Network Forwarding Path
NFPD	Network Forwarding Path Descriptor
NSD	Network Service Descriptor
ODU2	Optical channel Data Unit - type 2
PM	Performance Management
PNFD	Physical Network Function Descriptor
UML	Unified Modeling Language
VL	Virtual Link
VLD	Virtual Link Descriptor
VNFFG	VNF Forwarding Graph
VNFFGD	VNF Forwarding Graph Descriptor
XOR	eXclusive OR

Table 2-1 Abbreviations

3. VNF Information Mode

The present document develops specifications for packaging of VNFs to be delivered to service providers, focusing on the holistic end-to-end view of the VNF Package lifecycle, from design to runtime, capturing development as well as operational views. The present document provides an analysis of end-to-end VNF Package lifecycle management operations based on use-cases and NFV Architectural Framework functional blocks.

A VNF Package contains all of the required files and meta-data descriptors required to validate and instantiate a VNF.

Standardized meta-data descriptors are required to:

□ describe the NFV infrastructure resource requirements for a VNF in a service provider environment;

□ describe design constraints and other dependencies in order for the VNF to successfully install, instantiate and
terminate; and

□ describe VNF operational behaviour including VNF lifecycle events (e.g. scaling, upgrading).

Standardized packaging and validation of VNFs is required to:

□ provide a consistent, documented method for VNF providers to package VNFs;

□ harmonize the service provider on-boarding process for VNFs coming from different VNF providers;

□ ensure integrity, trust and auditability of a VNF Package;

□ allow for a flexible and extensible VNF packaging structure that accommodates a wide variety of NFV infrastructure scenarios; and

□ allow the packaged VNF-related meta-data to be interpreted and the packaged VNF to be instantiated in a wide variety of orchestration systems irrespective of technology choice or infrastructure environment.

A VNFD is a deployment template which describes a VNF in terms of deployment and operational behavior requirements. It also contains connectivity, interface and virtualized resource requirements.

4. Functional Requirements

4.1 VNF Package

Table 4-1 specifies requirements to the structure for a VNF package.

Numbering	Requirements Description
VNF_PACK.STRUCT.001	The VNF Package shall be assembled in one file.
VNF_PACK.STRUCT.002	The VNF Package shall be digitally signed by the VNF Provider.

Numbering	Requirements Description
VNF_PACK.STRUCT.003	The VNF Package should contain files for one VNF and its corresponding metadata.
VNF_PACK.STRUCT.004	The VNF Package shall enable including VNF specific files organized according to the design of the VNF, or referencing these files if they are external to the package. See note.
VNF_PACK.STRUCT.005	The VNF Package shall provide means to address individually the files which it contains and/or which it references.
VNF_PACK.STRUCT.006	If an external reference (e.g. URL) is used, file integrity information (such as checksum/signature) shall be specified to guarantee the integrity of the referenced file, so it cannot be substituted with a different file by the same name.
NOTE: This can include e.g. software images and additional specific files to run and manage the VNF, supplied by the VNF provider.	

Table 4-1 requirements of VNF package structure

4.2 VNF Package Content

Table 4-2 specifies requirements to the content of a VNF package.

Numbering	Requirements Description
VNF_PACK.DESC.001	The VNF Package shall contain the license terms information under which the packaged VNF is released.
VNF_PACK.DESC.002	The VNF Package should contain other license terms information corresponding with all the components included in the package if different than the one of the VNF.
VNF_PACK.DESC.003	The VNF Package should contain a Change Log. Change log captures the changes from one version to another including but not limited to features added/removed, issues fixed as well as known issues not resolved.
VNF_PACK.DESC.004	VNF Package shall contain or reference one or more software images.
VNF_PACK.DESC.005	The VNF Package may contain at most one software image per VNFC.

Numbering	Requirements Description
VNF_PACK.DESC.006	The VNF Package shall provide a mechanism to describe the package and its contents including, not limited to, version of the package, provider of the package and identification of the included metadata/artifacts.
VNF_PACK.DESC.007	The VNF Package shall contain VNFD metadata.
VNF_PACK.DESC.008	VNFD metadata shall not be modified once the package is assembled.
VNF_PACK.DESC.009	VNFD metadata shall be placed in a well-known location within the VNF Package in order for the compliant parsers to find and extract.

Table 4-2 requirements of VNF Package content

4.3 VNFD

Table 4-3 specifies requirements to the templates for VNFD instances.

Numbering	Requirements Description
VNF_VNFD001	A VNFD shall provide the information about an internal VL.

Table 4-3 specifies requirements to the templates for VNFD instances

4.4 VLD

Table 4-4 specifies requirements to the templates for VLD instances.

Numbering	Requirements Description
VNF_VLD001	A VLD shall provide the information about an internal VL.

Table 4-4 requirements of VLD instance

5. Information Model Definition

5.1 VNFD

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifies this vnfd information element within a NSD.
vendor	M	1	String	Identifies the vendor of VNFD.
version	M	1	String	Identifies the version of the VNFD
vnfmInfo	M	1…N	String	Identifies VNFM(s) compatible with the VNF described in this version of the VNFD.
vdu	M	1…N	VDU	Virtualisation Deployment Unit.
virtualComputeDesc	M	0…N	VirtualComputeDesc	Defines descriptors of virtual compute resources to be used by the VNF.
virtualStorageDesc	M	0…N	VirtualStorageDesc	Defines descriptors of virtual storage resources to be used by the VNF.
intVirtualLinkDesc	M	0…N	VnfVirtualLinkDesc	Represents the type of network connectivity mandated by the VNF provider between two or more CPs which includes at least one internal CP.
vnfExtCpd	M	1…N	VnfExtCpd	Describes network connectivity between VNF instances.

Table 5-1 Attributes of VNFD information element

5.2 VnfVirtualLinkDesc

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifies this CPD information element within a NSD.
description	M	0…1	String	Specifies human-readable information on the purpose of the connection point (e.g. connection point for control plane traffic).

Attribute	Qualifier	Cardinality	Content	Description
virtualLinkDescFlavour	M	1..N	VirtualLinkDescFlavour	Describes a specific flavour of the VL with specific bitrate requirements.
connectivityType	M	0…1	ConnectivityType	Describes the connectivity type of this VL.
testAccess	M	0..N	String	Specifies test access facilities expected on the VL (e.g. none, passive monitoring, or active (intrusive) loopbacks at endpoints.

Table 5-2 Attributes of VnfVirtualLinkDesc information element

5.3 ConnectivityType

Attribute	Qualifier	Cardinality	Content	Description
layerProtocol	M	1	String	Identifies the protocol that the VL supports (Ethernet, MPLS, ODU2, IPV4, IPV6, Pseudo-Wire, etc.).
flowPattern	M	0..1	String	Identifies the flow pattern of the connectivity (Line, Tree, Mesh, etc.).

Table 5-3 Attributes of ConnectivityType information element

5.4 VDU

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifies the id of this vdu in VNFD.
name	M	1	String	Human readable name of the Vdu.
description	M	1	String	Human readable description of the Vdu.
intCpd	M	1…N	VduCpd	Describes network connectivity between a VNFC instance (based

Attribute	Qualifier	Cardinality	Content	Description
				on this Vdu) and an internal Virtual Link (VL).
virtualComputeDesc	M	1	Identifier (reference to VirtualComputeDesc)	Describes CPU, Memory and acceleration requirements of the Virtualisation Container realizing this Vdu.
virtualStorageDesc	M	0…N	Identifier (reference to VirtualStorageDesc)	Describes storage requirements for a VirtualStorage instance attached to the virtualisation container created from virtualComputeDesc defined for this Vdu.
bootOrder	M	0…N	KeyValuePair	The key indicates the boot index (lowest index defines highest boot priority). The Value references a descriptor from which a valid boot device is created e.g. VirtualStorageDesc from which a VirtualStorage instance is created. See note 1.
swImageDesc	M	0…1	Identifier (reference to SwImageDesc)	Describes the software image which is directly loaded on the virtualization container realizing this Vdu.
nfviConstraint	M	0…N	String	Describes constraints on the NFVI for the VNFC instance(s) created from this Vdu. For example, aspects of a secure hosting environment for the VNFC instance that involve additional entities or processes. See note 3.
monitoringParameter	M	0…N	MonitoringParameter	Describes monitoring parameters of this VDU.
configurableProperties	M	0…N	VnfcConfigurableProperties	Describes the configurable properties of all VNFC instances based on this VDU.
NOTE 1: If no boot order is defined the default boot order defined in the VIM or NFVI shall be used. NOTE 2: More software images can be attached to the virtualization container using VirtualStorage				

Attribute	Qualifier	Cardinality	Content	Description
resources. NOTE 3: These are constraints other than stipulating that a VNFC instance has access to a certain resource, as a prerequisite to instantiation. The attributes virtualComputeDesc and virtualStorageDesc define the resources required for instantiation of the VNFC instance.				

Table 5-4 Attributes of VDU information element

5.5 VirtualComputeDesc

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifies the id of this VLD in VNFD.
requestAdditionalCapabilities	M	0…N	RequestedAdditionalCapabilityData	Specifies requirements for additional capabilities. These may be for a range of purposes. One example is acceleration related capabilities.
virtualMemory	M	1	VirtualMemoryData	The virtual memory of the virtualized compute.
virtualCpu	M	1	VirtualCpuData	The virtual CPU(s) of the virtualised compute..

Table 5-5 Attributes of VirtualComputeDesc information element

5.6 VirtualStorageDesc

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifies the id of this VLD in VNFD.
typeOfStorage	M	1	String	Type of virtualised storage resource (e.g. volume, object).
sizeOfStorage	M	1	Number	Size of virtualised storage resource (e.g. size of volume, in GB).
rdmaEnabled	M	0…1	String	Indicate if the storage support RDMA.

Attribute	Qualifier	Cardinality	Content	Description
SwImageDesc	M	0…N	Identifier (Reference to a SwImageDesc)	Software image to be loaded on the VirtualStorage Resource created based on this VirtualStorageDesc.

Table 5-6 Attributes of VirtualStorageDesc information element

5.7 SwImageDesc

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifies the id of this software image.
name	M	1	String	Name of this software image.
version	M	1	String	The version of this software image.
checksum	M	1	String	The checksum of this software image.
containerFormat	M	1	String	The container format describes the container file format in which software image is provided..
diskFormat	M	1	String	The disk format of a software image is the format of the underlying disk image.
minDisk	M	1	Number	The minimal disk size requirement for this software image. The value of the "size of storage" attribute of the VirtualStorageDesc referencing this SwImageDesc shall not be smaller than the value of minDisk.
minRam	M	0..1	Number	The minimal RAM requirement for this software image. The value of the "size" attribute of VirtualMemoryData of the Vdu referencing this SwImageDesc shall not be smaller than the value of minRam.

Attribute	Qualifier	Cardinality	Content	Description
size	M	1	Number	The size of this software image.
swImage	M	1	String	This is a reference to the actual software image. The reference can be relative to the root of the VNF Package or can be a URL.
operatingSystem	M	0…1	String	Identifies the operating system used in the software image. This attribute may also identify if a 32 bit or 64 bit software image is used.
supportedVirtualisationEnvironment	M	0…N	String	Identifies the virtualisation environments (e.g. hypervisor) compatible with this software image.

Table 5-7 Attributes of SwImageDesc information element

5.8 VnfdElementGroup

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifies the id of this group in VNFD.
description	M	1	String	Human readable description of the group.
vdu	M	0…N	ConnectivityType	References to Vdus that are part of this group.
virtualLinkDesc	M	0…N	String	Provides human-readable information on the purpose of the VL (e.g. control plane traffic).

Table 5-8 Attributes of VnfdelementGroup information element

5.9 VnfcConfigurableProperties

Attribute	Qualifier	Cardinality	Content	Description

Attribute	Qualifier	Cardinality	Content	Description
additionalVnfcConfigurableProperty	M	0…N	KeyValuePair	It provides VNFC configurable properties.

Table 5-9 Attributes of VnfcConfigurableProperties information element

5.10 VduCpd

Attribute	Qualifier	Cardinality	Content	Description
id	M	1	Identifier	Identifier of this VduCpd information element.
layer_protocol	M	1	String	Identifies which protocol the CP uses for connectivity purposes (Ethernet, MPLS, ODU2, IPV4, IPV6, Pseudo-Wire, etc.). See note.
cpRole	M	0…1	String	Identifies the role of the port in the context of the traffic flow patterns in the VNF or parent NS. For example a VNF with a tree flow pattern within the VNF will have legal cpRoles of ROOT and LEAF.
description	M	0…1	String	Human readable description of the VduCpd.
addressData	M	1	AddressData	Provides information on the addresses to be assigned to the CP(s) instantiated from this VduCpd.
vduId	M	0…1	Identifier (Reference to Vdu)	Reference to the internal VDU which is used to instantiate internal CPs. These internal CPs are, in turn, exposed as external CPs defined by this vdu.
virtualLinkDesc	M	0…1	Identifier (Reference to VnfVirtualLinkDesc)	Provides human-readable information on the purpose of the VL (e.g. control plane traffic).

Attribute	Qualifier	Cardinality	Content	Description
virtualNetworkInterfaceRequirements	M	0…N	VirtualNetworkInterfaceRequirements	Specifies requirements on a virtual network interface realising the CPs instantiated from this VduCpd.
bitrateRequirement	M	0…1	Number	Bitrate requirement on this VduCpd P.
NOTE: This information determines, amongst other things, which type of address to assign to the access point at instantiation time.				

Table 5-10 Attributes of VduCpd information element

5.11 AddressData

Attribute	Qualifier	Cardinality	Content	Description
addressType	M	0…N	Enum	Describes the type of the address to be assigned to the CP instantiated from the parent CPD. Value: • MAC address. • IP address. • … The content type shall be aligned with the address type supported by the layerProtocol attribute of the parent CPD.
l3AddressData	M	0…1	L3AddressData	Provides the information on the IP addresses to be assigned to the CP instantiated from the parent CPD. Shall be present when the addressType is IP address.

Table 5-11 Attributes of AddressData information element

5.12 L3AddressData

Attribute	Qualifier	Cardinality	Content	Description
iPAddressAssignment	M	1	Boolean	Specify if the address assignment is the responsibility of management

Attribute	Qualifier	Cardinality	Content	Description
				and orchestration function or not. If it is set to True, it is the management and orchestration function responsibility.
iPAddressType	M	0…1	Enum	Define address type. Value: • IPv4 address. • IPv6 address. See note.
floatingIpActivated	M	1	Boolean	Specify if the floating IP scheme is activated on the CP or not.
numberOfIpAddress	M	0…1	Integer	Minimum number of IP addresses to be assigned based on this L3AddressData information element.
NOTE: The address type should be aligned with the address type supported by the layerProtocol attribute of the parent VnfExtCpd.				

Table 5-12 Attributes of L3AddressData information element

5.13 RequestedAdditionalCapabilityData

Attribute	Qualifier	Cardinality	Content	Description
requestedAdditionalCapabilityName	M	1	String	Identifies a requested additional capability for the VDU. ETSI GS NFV-IFA 002 [i.1] describes acceleration capabilities.
supportMandatory	M	1	Boolean	Indicates whether the requested additional capability is mandatory for successful operation.
numaEnabled	M	0…1	String	Identifies the minimum version of the requested additional capability.
preferredRequestedAdditionalCapabilityVersion	M	0…1	String	Identifies the preferred version of the requested additional capability.
targetPerformanceParameters	M	1…N	KeyValuePair	dentifies specific attributes, dependent on the requested additional capability type.

Table 5-13 Attributes of RequestedAdditionalCapabilityData information element

5.14 VirtualMemoryData

Attribute	Qualifier	Cardinality	Content	Description
virtualMemSize	M	1	Number	Amount of virtual Memory (e.g. in MB).
virtualMemOversubscriptionPolicy	M	1	Integer	The memory core oversubscription policy in terms of virtual memory to physical memory on the platform. The cardinality can be 0 during the allocation request, if no particular value is requested.
numaEnabled	M	0…1	Boolean	It specifies the memory allocation to be cognisant of the relevant process/core allocation. The cardinality can be 0 during the allocation request, if no particular value is requested.

Table 5-14 Attributes of VirtualMemoryData information element

5.15 VirtualCpuData

Attribute	Qualifier	Cardinality	Content	Description
cpuArchitecture	M	0…1	Enum	Describes the type of the address to be assigned to the CP instantiated from the parent CPD. Value: • MAC address. • IP address. • … The content type shall be aligned with the address type supported by the layerProtocol attribute of the parent CPD.
numVirtualCpu	M	1	Integer	Provides the information on the IP addresses to be assigned to the CP instantiated from the parent CPD.

Attribute	Qualifier	Cardinality	Content	Description
				Shall be present when the addressType is IP address.
virtualCpuClock	M	0…1	Number	Minimum virtual CPU clock rate (e.g. in MHz). The cardinality can be 0 during the allocation request, if no particular value is requested.
virtualCpuOversubscriptionPolicy	M	0…1	String	The CPU core oversubscription policy e.g. the relation of virtual CPU cores to physical CPU cores/threads. The cardinality can be 0 during the allocation request, if no particular value is requested.
virtualCpuPinning	M	0…1	VirtualCpuPinningData	The virtual CPU pinning configuration for the virtualised compute resource.

Table 5-15 Attributes of VirtualCpuData information element

5.16 VirtualCpuPinningData

Attribute	Qualifier	Cardinality	Content	Description
cpuPinningPolicy	M	1	Enum	Specify if the address assignment is the responsibility of management and orchestration function or not. If it is set to True, it is the management and orchestration function responsibility.
cpuPinningMap	M	0…1	KeyValuePair	If cpuPinningPolicy is defined as "static", the cpuPinningMap provides the map of pinning virtual CPU cores to physical CPU cores/threads. Cardinality is 0 if cpuPinningPolicy has a different value than "static".

Table 5-16 Attributes of VirtualCpuPinningData information element