ETSI NFV Management and Orchestration - An Overview

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Virtualization as a Paradigm

Virtual Network Functions (VNF)

Examples of VNFs:

- Switching: BNG, CG-NAT, routers.
- Mobile network nodes: HLR/HSS, MME, SGSN, GGSN/PDN-GW, RNC.
- Home routers and set top boxes.
- Tunnelling gateway elements.
- Traffic analysis: DPI.
- Signalling: SBCs, IMS.
- Network-wide functions: AAA servers, policy control.
- Application-level optimisation: CDNs, Load Balancers.
- Security functions: Firewalls, intrusion detection systems.

NF: Network Function
VNF: Virtual Network Function
NC: Network Controller
VN: Virtual Network
Network Function Virtualization Components

- **NFV Infrastructure (NFVI)**
  - **Virtual Resources**: Compute, Storage, Network
  - **Virtualization SW**: Virtualization Layer
  - **HW Resources**: Compute, Storage, Network

- **Logic Abstractions**
  - End Point
  - Network Service
  - VNF Forwarding Graph aka. Service Chain

- **SW Instances**
  - VNF: Virtualized Network Function

- **VNF Instances**
Example of an E2E Network Service with VNFs and nested VNF Forwarding Graphs

End-to-end network service

VNF-1

VNF-2A

VNF-2B

PNF-3

End Point

Virtualisation Layer

Legend
- NFVI-PoP
- Physical link
- Logical link
- Virtualisation

Source: ETSI NFV E2E Architectural Framework
MANO Functional Blocks

• NFV Orchestrator:
  – on-boarding of new Network Service (NS), VNF-FG and VNF Packages
  – NS lifecycle management (including instantiation, scale-out/in, performance measurements, event correlation, termination)
  – global resource management, validation and authorization of NFVI resource requests
  – policy management for NS instances

• VNF Manager:
  – lifecycle management of VNF instances
  – overall coordination and adaptation role for configuration and event reporting between NFVI and the E/NMS

• Virtualised Infrastructure Manager (VIM):
  – controlling and managing the NFVI compute, storage and network resources, within one operator’s infrastructure sub-domain
  – collection and forwarding of performance measurements and events
NFV Management and Orchestration Architecture

OSS/BSS

EMS

VNF

NFVI

NFV Orchestrator (NFVO)

VNF Manager (VNFM)

Virtualised Infrastructure Manager (VIM)

NFV Orchestrator (NFVO)

VNF Catalog

NS Catalog

NFV Instances

NFVI Resources

VeEn-Vnfm

VeNf-Vnfm

Nf-Vi

Or-Vnfm

Or-Vi

Vn-Nf

VeNf-Vnfm

Os-Nfvo

VeEn-Vnfm

NFV-MANO

Execution reference points

Other reference points

Main NFV reference points

Source: ETSI NFV MANO WI document (ongoing work)
NFV Entities to deploy and manage

- Network Service (NS):
  - described by its descriptor file, orchestrated by NFVO,
  - may cover 1 or more VNF Graphs, VNFs and PNFs.
- VNF Forwarding Graph (VNF-FG):
  - described by its descriptor file, orchestrated by NFVO,
  - may cover VNF-FGs, VNFs and NFs
- VNF:
  - described by its descriptor file, instantiated by the VNF Manager,
  - covers VNF components (VNFC) each mapped to a VM described with the Virtual Deployment Unit descriptor.
Overview of MANO Descriptor Files

VNF Forwarding Graph:
- E2E Service Description & KPIs
- Info about Component VNFD, PNFD, and associated links
- Inter NF KPIs with dependent VNFs/PNFs in service graph

Virtual VNF Link Descriptor:
- Link type (eg Point to Point, Multipoint), Inter VNF, & VNF to legacy network links, SAN
- KPIs (eg Bandwidth, QoS, Latency)
- Network type (Hypervisor vSwitch, NIC eSwitch, Cluster VEPA or FCoE/IB, WAN)

Virtual Network Function Descriptor:
- Compute requirements and SLAs
- For each Component sub functions, (eg Processing, memory, Storage access requirements & SLAs)
- Reliability SLAs/class
- Intra VNF component links

Physical Network Function Descriptor:
- Reliability SLAs/class
- Legacy network links...

Source: ETSI NFV MANO WI document (ongoing work)
Overview of MANO Descriptor Files (ongoing work)

- **Network Service descriptor:**
  - E2E service description including supported SLA parameter, references to covered VNF-FG and VNFs, list of supported service monitoring parameters.

- **VNF Forwarding Graph descriptor:**
  - VNFFG description, VNFs and VNFDs needed for orchestration, reference to link information, description of Physical/Logical interfaces

- **VNF Descriptor:**
  - Links to scripts for initiation and termination, description of internal and external connectivity, dependencies between VNFCs.

- **VDU Description:**
  - VM specification, required storage and computation resources, initiation and termination scripts, high availability redundancy model, scale_out/in limits.

- **PNF Descriptor:**
  - Reference to link information, exposed external interfaces, PNF addresses, PNF status, systems subscribed for notifications
Overview of MANO Descriptor Files (ongoing work) (ctd.)

• Network Service Instance Descriptor:
  – Network service category, network attachment points, scaling methodology and policy, list of SLA descriptors, and monitoring parameter.

• VNF Instance Descriptor:
  – VNF category, information on external connectivity, scaling methodology and policy, list of SLAs, and the list of monitoring parameter.
## VNF DESCRIPTOR MODEL (ongoing work)

<table>
<thead>
<tr>
<th>Name</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VNFD_elements</td>
<td>1</td>
<td>This describes a set of elements related with the entire template (VNFD).</td>
</tr>
<tr>
<td>VNF_elements</td>
<td>1</td>
<td>This describes a set of elements related with a particular VNF instance.</td>
</tr>
<tr>
<td>VDU_elements</td>
<td>1..N</td>
<td>This describes a set of elements related to a particular VDU. Each VDU will have a set of its own elements.</td>
</tr>
</tbody>
</table>

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Vendor</td>
<td>1</td>
<td>Specify the vendor generating this VNFD.</td>
</tr>
<tr>
<td>VNF_id</td>
<td>1</td>
<td>Specify the identifier (e.g. name)</td>
</tr>
</tbody>
</table>

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</thead>
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<tr>
<td>VDU_no</td>
<td>1</td>
<td>Specify the number of VDUs present in this VNF. This can be used to validate VNFD.</td>
</tr>
<tr>
<td>Initiation</td>
<td>1</td>
<td>Defines the VNF initiation workflow including the functional script.</td>
</tr>
<tr>
<td>Termination</td>
<td>1</td>
<td>Defines the VNF termination workflow including the functional script.</td>
</tr>
<tr>
<td>Graceful_Shutdown</td>
<td>0..1</td>
<td>Defines the VNF graceful shutdown workflow (VNF is pre-warmed and can take actions before the shutdown), including the functional script.</td>
</tr>
<tr>
<td>Internal_conn</td>
<td>1..N</td>
<td>This element describes the internal connectivity/interfaces between this VDU and other VDUs of this VNF, including Key Quality Indicators (KQIs) for performance and reliability/availability.</td>
</tr>
<tr>
<td>External_conn</td>
<td>1..N</td>
<td>This element describes the external interfaces exposed by this VDU enabling connection with other VNFs.</td>
</tr>
<tr>
<td>Other lifecycle events</td>
<td>0..N</td>
<td>Defines VNF functional scripts for specific lifecycle events (e.g. scaling out/in)</td>
</tr>
<tr>
<td>Dependencies</td>
<td>0..1</td>
<td>Describe dependencies between VNFCs. Defined in terms of source and target VNFC, i.e., target VNFC &quot;depends on&quot; source VNFC. In other words sources VNFC must exists before target VNFC can be initiated/deployed.</td>
</tr>
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<tr>
<td>VDU_id</td>
<td>1</td>
<td>A unique identifier of the said VDU, including version functional description and other identification information. This will be used to refer to VDU when defining relationships between them.</td>
</tr>
<tr>
<td>VM_specification</td>
<td>1</td>
<td>This provides a VM image or a reference.</td>
</tr>
<tr>
<td>Storage_req</td>
<td>0..1</td>
<td>Describes the required storage characteristics (e.g. size), including Key Quality Indicators (KQIs) for performance and reliability/availability.</td>
</tr>
<tr>
<td>Computation_req</td>
<td>0..1</td>
<td>Describe the required computation resources characteristics (e.g. processing power), including Key Quality Indicators (KQIs) for performance and reliability/availability.</td>
</tr>
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<tr>
<td>Other constraints</td>
<td>0..1</td>
<td>Placeholder for other constraints.</td>
</tr>
<tr>
<td>High_availability</td>
<td>0..1</td>
<td>Defines redundancy model to ensure high availability examples include:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>ActiveActive</strong>: Implies that two instance of the same VDU will co-exists with continuous data synchronization.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>ActivePassive</strong>: Implies that two instance of the same VDU will co-exists without any data synchronization.</td>
</tr>
<tr>
<td>Scale_out/in</td>
<td>0..1</td>
<td>Defines minimum and maximum number of instances which can be created to support scale out/in.</td>
</tr>
</tbody>
</table>
Current Development in NFV MANO WG

• NFV MANO WG recently developed:
  – Network Service and VNF lifecycle management message flows:
    • including onboarding, instantiation, scaling and termination,
    • yet to do: VNF Forwarding Graph lifecycle management
  – Information elements for the entities VNF, VNFFG, NS and their instances,
• Current focus is on NFV operational management:
  – Fault and event management
  – planned: capacity planning, migration, etc.
• Provide gap analysis and recommendations to SDOs as well as open source organizations,
  – Collaboration for further development in selected organizations planned based on a cooperation on working group level.

GS: Group Specification
Timeline for ETSI NFV Work Programme
References

• Published E2E Arch, REQ, Use Case, Terminology documents in ETSI NFV Open Area:
  – http://docbox.etsi.org/ISG/NFV/Open/Published/

• Published ETSI NFV white paper:

• ETSI member area:
  – Current NFV MANO WG WI document: DGS/NFV-MAN001 (ongoing work)
    • http://docbox.etsi.org/ISG/NFV/MAN/70-DRAFT/MAN1/NFV-MAN001v0011.zip
  – ETSI NFV ISG portal:
    • http://portal.etsi.org/portal/server.pt/community/NFV/367?tbId=789
  – NFV MANO WG on ETSI portal:
    • http://portal.etsi.org/portal/server.pt/community/NFV/367?tbId=796