**3GPP TSG-SA5 Meeting #157 *S5-245676rev1***

Hyderabad, India, 14 - 18 October 2024

**Source: NTT DOCOMO**

**Title: pCR 28.869 Addressing Annexes ENs**

**Document for: Approval**

**Agenda Item: 6.19.6**

# 1 Decision/action requested

***In this box give a very clear / short /concise statement of what is wanted.***

# 2 References

1. 3GPP TR 28.869 v1.0.1 Study on cloud aspects of management and orchestration.

# 3 Rationale

The contribution proposes to add conclusions and recommendations.

# 4 Detailed proposal

It proposes to make the following changes to TR 28.869 [1].

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| **1st Change** |

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| **2nd Change** |

Annex <G>: Support for containerized VNF deployments in ETSI NFV

ETSI NFV has developed since Release 4 a set of specifications that enable support for containerized deployments in bare metal and VMs using the NFV-MANO framework. The various dimensions considered include aspects such as containerized VNF lifecycle management, descriptors’ management, containerized VNF onboarding and containerized cluster management.

NOTE: In ETSI NFV specifications, the term VNF also covers the case of a cloud native NF, as the VNF modelling is also able to cater for the specific design cloud-native and containerization properties. Furthermore, the terms virtualization and cloudification are used interchangeably, while the terms containerized NF, container based VNF and containerized VNF refer to the same concept and are also used interchangeably.

The NFV-MANO architectural framework introduced in Release 4 supports containerized VNF deployments and is compatible with the de facto Kubernetes® open-source solutions. Additionally, it remains compatible with previous ETSI NFV Releases that offer services for VM-based deployments. The NFV-MANO architectural framework with support for containers is specified in ETSI GS NFV 006 [18].

Table G-1 summarizes the key ETSI NFV specifications for supporting containerized VNF deployments.

**TableG-1: Summary of NFV-MANO specifications enabling support for containers.**

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| **Stage**  | **Specification**  | **Topic** |
| Stage 0 (info)  | ETSI GR NFV-IFA 029 [25] | Use cases, concepts, and recommendations. |
| Stage 1 & 2 | ETSI GS NFV-IFA 040 [28] (new in Rel4)ETSI GS NFV-IFA 036 [26] (new in Rel4) | Containerized workloads management and orchestration, container cluster management and orchestration (requirements, functionality, object modeling, etc.) |
| ETSI GS NFV-IFA 010 [21] | Enhanced NFV-MANO functional requirements including functional requirements for existing NFV-MANO functional blocks and new NFV-MANO functions responsible for the management and orchestration of containerized workloads and container clusters.  |
| ETSI GS NFV-IFA 007 [19]ETSI GS NFV-IFA 008 [20]ETSI GS NFV-IFA 013 [23] | Enhanced interfaces, and information models for functionality produced by existing NFV-MANO functional blocks, such as NFVO and VNFM. |
| ETSI GS NFV-IFA 011 [22]ETSI GS NFV-IFA 014 [24] | Information modeling of enhanced descriptors/templates. |
| Stage 3 | ETSI GS NFV-SOL 018 [36] (new in Rel4) | Mapping of the NFV object model for OS container management to Kubernetes® managed objects. Protocol and data models profiling Kubernetes® APIs fulfilling the requirements specified in respective stage 2 documents (ETSI GS NFV-IFA 040 [28] and ETSI GS NFV-IFA 036 [26]). |
| ETSI GS NFV-SOL 020 [37] (new in Rel4) | Protocol and data models profiling Cluster API (CAPI) fulfilling the requirements specified in respective stage 2 document (ETSI GS NFV-IFA 036 [26]) regarding cluster management. |
| ETSI GS NFV-SOL 001 [30]ETSI GS NFV-SOL 004 [33] | Data model (stage 3) of enhanced descriptors and packaging supporting containerized workloads. |
| ETSI GS NFV-SOL 002 [31]ETSI GS NFV-SOL 003 [32]ETSI GS NFV-SOL 005 [34] | Protocol and data models (stage 3) of enhanced NFV-MANO APIs. |

Additional aspects, such as networking for container-based deployments and creation of secondary cluster networks are investigated in ETSI GR NFV-IFA 038 [27] and ETSI GR NFV-IFA 043 [29]. Performance measurements of containerized deployments are specified in ETSI GS NFV-IFA 027 [38]. Study of power efficiency topics are addressed in ETSI GR NFV-EVE 021 [39]. Topics related to physical infrastructure management for both VM and containerized deployments (in bare metal or VMs) are covered in ETSI GS NFV-IFA 053 [40].

Table G-2 summarizes the key ETSI NFV terms used when considering operations in containerized deployments and the corresponding terms used in Kubernetes®.

**Table G-2: Terminology alignment for containerized VNFs**

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| **ETSI NFV term**  | **Kubernetes ecosystem term** |
| Container Infrastructure Service (CIS) | Kubernetes® services exposing CRI, CNI, CSI |
| Container Infrastructure Service (CIS) instance | Kubernetes® node  |
| Container Infrastructure Service Management (CISM) | Kubernetes® control plane & Helm 3 client |
| CIS cluster | Kubernetes® cluster |
| Managed Container Infrastructure Object (MCIO) | Kubernetes® managed objects (e.g., Deployments, StatefulSet, Persistent Volume Claim, Service, etc.) |
| Managed Container Infrastructure Object Package (MCIOP) | Helm charts |
| Managed CIS Cluster Object (MCCO) | Kubernetes® Custom Resource Definition (CRD), etc. |
| Container Image Repository (CIR) | Docker Registry |
| CIS Cluster Management (CCM) | Cluster API (CAPI) |

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| **3rd Change** |

Annex <H>: Support for CNF deployments in ETSI NFV

H.1 Create CNF example using NFV-MANO

In TS 23.531 [7] the flow and procedures of creating network function instances are described, through instantiation of the VNF(s) that realize the virtualized part of subject 3GPP NF, using NFV-MANO.

In clause 5.2.3 of the present document, use case #3 is about the creation of an NF Deployment instance running in the cloud.

In this Annex details are provided regarding the operations performed in NFV-MANO upon an instantiation request for the case of NF Deployments in containers using NFV-MANO . The process of creation of cloud native VNFs using NFV-MANO procedures is described in ETSI GS NFV-SOL 016 [35] and is summarized as follows.

Assuming there is no MCIOP available in the NFV-MANO system, the 3GPP management system interacts with NFVO over the Os-Ma-nfvo reference point using the VNF Package Management interface described in ETSI GS NFV-SOL 005 [34] to provide the VNF Package. The VNF Package is described in ETSI GS NFV-SOL 004 [33] and contains the VNFD and additional files (like a manifest file, files used for testing, non-MANO artifacts like scripts etc.). The VNFD of a cloud native VNF has references to one or multiple MCIOPs, which are included as file artifacts in the VNF Package (see ETSI GS NFV-SOL 001 [30]).

NOTE: In ETSI NFV MCIO stands for Managed Container Infrastructure Object and MCIOP stands for Managed Container Infrastructure Object Package. See section 4.x for more details on support for CNF deployments in ETSI NFV.

As an example, in case the cloud native VNF to be deployed refers to a Kubernetes Deployment (or a Kubernetes Pod etc.), then the corresponding entity in NFV-MANO is a Compute MCIO that needs to be instantiated. The MCIO declarative descriptor (i.e., the Kubernetes® manifest file) needed is in the MCIOP. The availability of the MCIOP in the local MCIOP repository does not mean instantiation of the MCIO.

NOTE: The process of uploading the VNF Package described above can be also triggered when uploading a corresponding NSD archive file.

To trigger the instantiation of the cloud native VNF as part of an NS, the 3GPP management system needs to request the instantiation of a corresponding NS by calling the Instantiate NS operation exposed by NFVO over Os-Ma-nfvo. For the instantiation of the cloud native NF, VNFM fetches from the NFVO a VNFD (by passing the vnfPkgId) (the VNFD is available in the system according to the process described before). Then by analysing the VNFD and performing the VNF LCM granting procedure between the VNFM and the NFVO, the VNFM requests to CISM through the OS container workload management service interface, to instantiate and configure the containerised workload part of the VNF as described in clause 7.3.1 of ETSI GS NFV-SOL 018 [36]. The CISM creates the MCIO (i.e., the Kubernetes® Deployment) by interpreting the MCIOP available to the local MCIOP repository and allocating the requested infrastructure resources on CIS instances. Other aspects like configuration of a secondary container cluster network are achieved through interaction of CISM and CCM with the NFVO.

It is also possible that the 3GPP management system requests the instantiation directly to the VNFM by interacting on the VNFM exposed interfaces over the Ve-Vnfm-em reference point, considering that the NFV-MANO framework also enables NS-level procedures to be decoupled from VNF-level ones. For instance, an NS managed object can be prepared in advanced by interacting with the NFVO but leaving such an NS "empty"; afterwards, VNF instantiation can be triggered directly to the VNFM, and later add the VNF instance into the NS by interacting with the NFVO.

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| **End of Changes** |