



## **Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; VNF Snapshot Package specification**

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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).

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## Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**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 specifies the structure and format of a VNF Snapshot Package file and of the artifacts it contains, fulfilling the requirements specified in ETSI GS NFV IFA 011 [1] for a VNF Snapshot Package, to be used within a NFV-MANO administrative domain or where all artifacts are managed by the same security domain within the network. The present document does not support using a VNF Snapshot Package across different NFV-MANO administrative domains or where artifacts are managed by different security domains within the network.

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## 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.

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

- [1] ETSI GS NFV-IFA 011: "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; VNF Descriptor and Packaging Specification".
- [2] IETF RFC 3339 (July 2002): "Date and Time on the Internet: Timestamps".
- [3] ETSI GS NFV-SOL 005: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point".
- [4] ISO/IEC 21320-1 (2015): "Information Technology -- Document Container File -- Part 1: Core".
- [5] ETSI GS NFV-SOL 004: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; VNF Package and PNFD Archive specification".
- [6] Recommendation ITU-T X.509: "Information technology - Open Systems Interconnection - The Directory: Public-key and attribute certificate frameworks".
- [7] IETF RFC 5652 (September 2009): "Cryptographic Message Syntax (CMS)".
- [8] IETF RFC 2315 (March 1998): "PKCS #7: Cryptographic Message Syntax Version 1.5".
- [9] ETSI GS NFV-SOL 003: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; RESTful protocols specification for the Or-Vnfm Reference Point".

## 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] ETSI GS NFV 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".
- [i.2] ETSI GS NFV-SOL 001: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; NFV descriptors based on TOSCA specification".
- [i.3] ETSI GS NFV-SOL 006: "Network Functions Virtualisation (NFV) Release 3; Protocols and Data Models; NFV descriptors based on YANG specification".

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## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

For the purposes of the present document, the terms given in ETSI GS NFV 003 [i.1] and the following apply:

NOTE: A term defined in the present document takes precedence over the definition of the same term, if any, in ETSI GS NFV 003 [i.1].

**VNF Snapshot Package provider:** creator of the VNF Snapshot Package

NOTE: The NFVO is a VNF Snapshot Package provider as producer of the VNF Snapshot Package management interface specified in ETSI GS NFV-SOL 005 [3].

**VNF Snapshot Record:** file that contains runtime information representing a VNF instance at the time when the snapshot is taken

### 3.2 Symbols

Void.

### 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GS NFV 003 [i.1] and the following apply:

TOSCA	Topology and Orchestration Specification for Cloud Applications
VNFSR	VNF Snapshot Record
YAML	YAML Ain't Markup Language

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## 4 VNF Snapshot Package

### 4.1 VNF Snapshot Package format

The VNF Snapshot Package shall be a ZIP archive file whose format shall conform to ISO/IEC 21320-1 [4]. In the rest of the present document, this file is referred to as the "VNF Snapshot Package file".

## 4.2 VNF Snapshot Package file contents and structure

### 4.2.1 General

A VNF Snapshot Package shall contain:

- a VNF Snapshot Record (VNFSR) file;
- and additional files.

A VNF Snapshot Package may contain:

- The VNFD corresponding to the snapshotted VNF.

If a VNFD is present in the VNF Snapshot Package, the VNFD file shall be a ZIP archive file as specified in clause 10.4.4 of ETSI GS NFV-SOL 003 [9]. It shall be an exact copy of the VNFD in the VNF Package from which the snapshotted VNF was instantiated and be located at the root of the VNF Snapshot Package file. That copy can be used for troubleshooting by entities external to NFV-MANO. The VNFD in the VNF Snapshot Package is not intended to be used by NFV-MANO entities, e.g. for VNF snapshot reversal.

NOTE 1: ETSI GS NFV-SOL 001 [i.2] specifies the structure and format of the VNFD based on TOSCA specifications.

NOTE 2: ETSI GS NFV-SOL 006 [i.3] specifies the structure and format of the VNFD based on YANG specifications.

Examples of a VNF Snapshot Package file are described in annex A.

### 4.2.2 VNF Snapshot Package manifest file

A VNF Snapshot Package shall contain a manifest file located at the root of the VNF Snapshot Package file. The name and extension of the manifest file shall be "manifest.mf". The name and extension are case-insensitive.

The manifest file shall start with the VNF Snapshot Package metadata in the form of name-value pairs. Each pair shall appear on a different line. The "name" and the "value" shall be separated by a colon and, optionally, one or more blanks. The order of the name-value pairs is not significant.

The name shall be one of those specified in table 4.2.2-1 and the values shall comply with the provisions specified in table 4.2.2-1. All of these pairs in table 4.2.2-1 shall be in the manifest file.

**Table 4.2.2-1: List of valid names and values for VNF Snapshot Package metadata**

Name	Value
vnfd_id	A sequence of UTF-8 characters. See note 1.
vnf_snapshot_pkg_name	A sequence of UTF-8 characters. See note 2.
vnf_snapshot_pkg_id	A sequence of UTF-8 characters. See note 3.
vnf_snapshot_id	A sequence of UTF-8 characters. See note 4.
vnf_snapshot_scope	A sequence of UTF-8 characters. See note 5.
vnf_snapshot_pkg_create_date_time	String formatted according to IETF RFC 3339 [2]. See note 6.
<p>NOTE 1: The value shall be identical to the value specified in the VNFD.</p> <p>NOTE 2: The value shall be identical to the "name" attribute of the "VnfSnapshotPkgInfo" structure specified in ETSI GS NFV-SOL 005 [3], which is signalled to the NFVO (as VNF Snapshot Package provider) during the VNF Snapshot Package creation request.</p> <p>NOTE 3: The value shall be identical to the "vnfSnapshotPkgUniqueld" attribute of the "VnfSnapshotPkgInfo" structure specified in ETSI GS NFV-SOL 005 [3], which is assigned by the NFVO (as VNF Snapshot Package provider) during the VNF Snapshot Package building.</p> <p>NOTE 4: The value shall be identical to the value specified in the VNFSR file.</p> <p>NOTE 5: Indicates whether it is a partial or full VNF Snapshot Package. The value is set from the value of the isFullSnapshot attribute specified in in ETSI GS NFV-SOL 005 [3]. Permitted values: PARTIAL, FULL.</p> <p>NOTE 6: The value shall be identical to the "createdAt" attribute of the "VnfSnapshotPkgInfo" structure specified in ETSI GS NFV-SOL 005 [3], which is assigned by the NFVO during the VNF Snapshot Package building.</p>	

An example of valid manifest file metadata entries follows.

**EXAMPLE 1:**

```

metadata:
vnfd_id: 2116fd24-83f2-416b-bf3c-ca1964793aca
vnf_snapshot_pkg_id: 3225d37-64f4-518b-af3d-da2064793adb
vnf_snapshot_pkg_name: Sunshine
vnf_snapshot_scope: PARTIAL
vnf_snapshot_id: 43253d7-84f5-619d-bf4e-cf2054783aef
vnf_snapshot_pkg_create_date_time: 2020-04-01T10:00+08:00

```

**END OF EXAMPLE 1.**

The manifest file shall include a list of all files contained in or referenced from the VNF Snapshot Package with their location, expressed using a Source: location/name key-value pair. The manifest file itself shall not be included in the list.

The manifest file shall also contain a list of entries corresponding to the snapshot images that are part of the VNF Snapshot Package. For each of the comprising snapshot images, a reference to the snapshot image information contained in the VNFSR shall be provided after the corresponding "Source" entry as follow:

- For an image artifact corresponding to a compute snapshot resource, the tag "ComputeImageId" shall be used whose value is the same as the "id" attribute of the specific "VnfcSnapshotInfo" in the VNFSR of the compiled VNFC snapshot.
- For an image artifact corresponding to a storage snapshot resource, the tag "StorageImageId" shall be used whose value is the same as the "storageResourceId" attribute of the specific "VnfcSnapshotInfo" in the VNFSR of the compiled VNFC snapshot.

Below is an example of valid manifest file entries for image artifacts contained in or referenced from the VNF Snapshot Package.



**EXAMPLE 2:**

```
Source: images/image1
ComputeImageId: 1234d1-5678-910a-bf01-cf1234567abc
Source: images/image2
StorageImageId: 5678e1-1234-109b-bf02-cf7654321def
```

END OF EXAMPLE 2.

In addition, the manifest file shall contain an entry with the tag "Vnfsr" to identify the VNFSR file and, if the VNFD file is contained in the VNF Snapshot Package, another entry with the tag "Vnfd" to identify the VNFD file.

The "Vnfsr" and "Vnfd" tags and the generic "Source" tag are case-insensitive.

The "Vnfsr" entry and, if present, the "Vnfd" entry, shall be listed before the "Source" entries.

Below is an example of valid manifest file entries for files contained in or referenced from the VNF Snapshot Package.

**EXAMPLE 3:**

```
Vnfsr: MyVnfSnapshot.json
Vnfd: MyVnfd.zip
Source: MyVnfSnapshot.json
Source: MyVnfd.zip
Source: images/image1
```

END OF EXAMPLE 3.

### 4.2.3 VNF Snapshot Record in the VNF Snapshot Package

The VNF Snapshot Package shall contain a VNFSR of the snapshotted VNF instance. The specification of the contents and format of a VNFSR file is outside the scope of the present document.

The VNFSR file shall be located at the root of the VNF Snapshot Package file. In addition, the VNFSR file shall have an extension .json and the same name as the VNF Snapshot Package file.

---

## 5 Adding security to VNF Snapshot Package

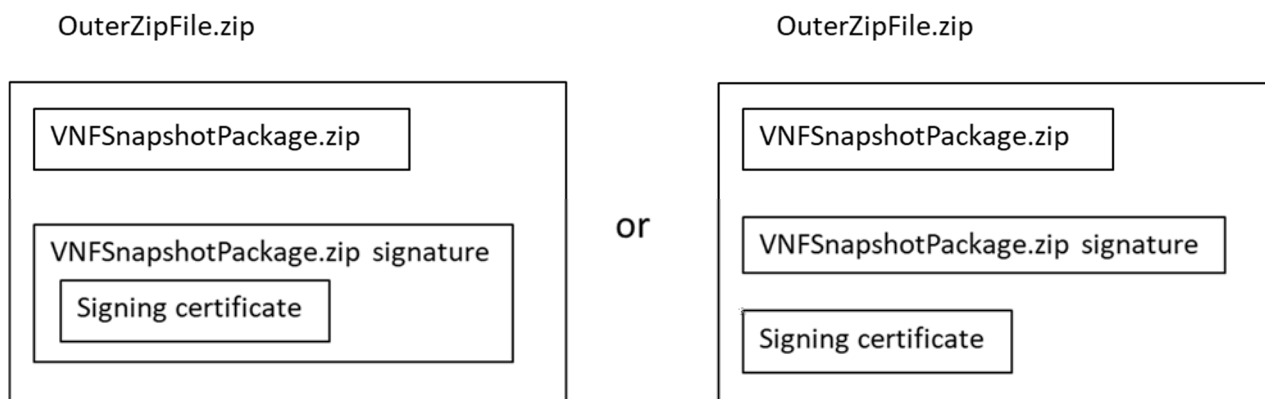
### 5.1 VNF Snapshot Package authenticity and integrity

A VNF Snapshot Package shall support a method for authenticity and integrity assurance.

In order to provide the public key based authenticity and integrity for the whole VNF Snapshot Package, the complete VNF Snapshot Package file shall be digitally signed with the private key of the VNF Snapshot Package provider. The NFVO, as VNF snapshot package provider, shall sign the file when the VNF Snapshot Package is created with the "Build VNF snapshot package" operation specified in ETSI GS NFV-SOL 005 [3]. The VNF Snapshot Package provider shall deliver one ZIP archive file consisting of the VNF Snapshot Package file, a signature file and a certificate file that includes the public key of the VNF Snapshot Package provider. The signature file shall have an extension '.cms' and the same name as the VNF Snapshot Package file. The certificate may also be included in the signature container, if the signature format allows that.

The format of the ZIP archive file embedding the VNF Snapshot Package file shall conform to ISO/IEC 21320-1 [4].

The ZIP archive file embedding the VNF Snapshot Package file delivered by the VNF Snapshot Package provider is therefore structured according to one of the options described in figure 5.1-1.



**Figure 5.1-1: Composition of the VNF Snapshot Package zip file**

Signing the complete VNF Snapshot Package file is only valid if all artifacts are included in the VNF Snapshot Package, i.e. no external artifacts are referenced from the files contained in the VNF Snapshot Package.

NOTE 1: The present document version does not specify the support VNF Snapshot Package referring to external files. However, VNF snapshot package management API specified in ETSI GS NFV-SOL 005 [3] specifies such support.

This solution, relies on the existence at the VNF Snapshot Package consumer side of a root certificate of a trusted CA that shall have been delivered via a trusted channel that preserves its integrity (separate from the VNF Snapshot Package) to the VNF Snapshot Package consumer side and be preinstalled in the consumer side before processing of the VNF Snapshot Package.

NOTE 2: The present document makes no assumption on who this trusted CA is. Furthermore, it does not exclude that the root certificate be issued by the VNF Snapshot Package provider.

## 5.2 Certificate files in the VNF Snapshot Package

As described in clause 5.1, authenticity and integrity of the VNF Snapshot Package is ensured by signing the VNF Snapshot Package file with the private key of VNF Snapshot Package provider. The digital signature is stored in a separate file. The VNF Snapshot Package provider shall also include an X.509 certificate [6]). The certificate may be included in the signature itself if the signature format allows it or in a signature file. The certificate file shall have an extension .cert and the same name as the VNF Snapshot Package file. A consumer of the VNF Snapshot Package can verify the signature of the complete VNF Snapshot Package file with the public key of VNF Snapshot Package provider.

Table 5.2-1 summarizes the characteristics for integrity assurance.

**Table 5.2-1: Integrity assurance: summary of characteristics**

Digest per artifact	Signature per artifact	Support external artifacts	Signature as part of the manifest file	External Signature file for the whole ZIP	Certificate may be part of the signature	Certificate may be in a separate file
No	Optional	No	Yes (if manifest is signed)	Yes	Yes	Yes

The X.509 certificate may contain one single signing certificate or a complete certificate chain. The root certificate that may be present in this X.509 certificate file shall not be used for validation purposes. Only a trusted root certificate pre-installed in the consumer side shall be used for validation (see clause 5.1).

## 5.3 Conventions in the manifest file

If the manifest file is signed, the signature in the manifest file shall conform to conventions specified in clause 5.3 of ETSI GS NFV-SOL 004 [5].

## 5.4 Signature of individual artifacts

The VNF Snapshot Package provider may digitally sign some or all artifacts individually. If the artifact is included in the VNF Snapshot Package file, a signature file in CMS (see IETF RFC 5652 [7]) or PKCS#7 (see IETF RFC 2315 [8]) format shall accompany the signed artifact. Except for the manifest file, the signature file shall be a sibling of the signed artifact, i.e. placed in the same folder in the VNF Snapshot Package file, which can also be the root of the file. The naming scheme for the signature file shall maintain the original file name and extension and append a '.sig' extension followed by a file type specific extension (e.g. '.cms', '.p7b', '.p7c').

If the artifact and signature are included in the VNF Snapshot Package an X.509 certificate shall also be included in the VNF Snapshot Package file as per one of the two following alternatives:

- 1) One certificate per signed artifact, according to one of the following options:
  - 1a) A certificate file is included as a sibling of the signed artifact file, i.e. placed in the same folder as the signed artifact. The naming scheme for the certificate file shall maintain the original file name and extension and append the '.cert' extension.
  - 1b) The certificate is included in the signature file, provided that the signature format allows for it.
- 2) One single certificate for all signed artifacts in which case the certificate file shall follow the rules specified in clause 5.2. If some, but not all, artifacts have an individual signing certificate, the certificate described in this alternative shall only be used for those artifacts that do not have an individual signing certificate.

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## Annex A (informative): VNF Snapshot Package Examples

### A.1 Basic VNF Snapshot Package example

The example illustrates a VNF Snapshot Package file which contains a VNFSR (CompanySnapshotPackage.json), a manifest file and images. In this example, the VNFSR, images, and the manifest file are located at the root level.

EXAMPLE:

```
!---- CompanySnapshotPackage.json
!---- manifest.mf
!---- image(s)
  END OF EXAMPLE.
```

---

### A.2 VNF Snapshot Package example including VNFD

The example illustrates another VNF Snapshot Package file which contains a VNFSR (CompanySnapshotPackage.json), a manifest file, VNFD (CompanyVNFD.zip) and images. In this example, the VNFSR, VNFD, images, and the manifest file are located at the root level.

EXAMPLE:

```
!---- CompanySnapshotPackage.json
!---- manifest.mf
!---- CompanyVNFD.zip
!---- image(s)
  END OF EXAMPLE.
```

## Annex B (informative): Change History

Date	Version	Information about changes
October 2018	0.0.1	Initial version based on contributions that were agreed at the NFVSOL#81 meeting. <ul style="list-style-type: none"> <li>- NFVSOL(18)000599_SOL010_ToC_Skeleton</li> <li>- NFVSOL(18)000600_SOL010_Scope</li> <li>- NFVSOL(18)000601_SOL010_Normative_Reference</li> </ul>
November 2018	0.0.2	Version 0.0.2 based on contributions that were agreed during Email Approval (EA) following the NFVSOL#83 meeting. <ul style="list-style-type: none"> <li>- NFVSOL(18)000646_SOL010_Adding_4_1_TOSCA_YAML_CSAR</li> <li>- NFVSOL(18)000648_SOL010_Adding_References_and_Abbreviations</li> </ul>
January 2019	0.0.3	Version 0.0.3 based on contributions that were agreed at the NFVSOL#85 meeting. <ul style="list-style-type: none"> <li>- NFVSOL(18)000647r3_SOL010_Normative_text_for_CSAR_Structure_options</li> </ul>
March 2019	0.0.4	Version 0.0.4 based on a contribution that was agreed at the NFVSOL#92 meeting. <ul style="list-style-type: none"> <li>- NFVSOL(19)000122r1_SOL010_-_Definitions_of_VNF_Snapshot_Record_and_Abbreviation</li> </ul>
April 2019	0.0.5	Version 0.0.5 based on contributions that were agreed at the NFVSOL#97 and NFVSOL#98 meetings. <ul style="list-style-type: none"> <li>- NFVSOL(19)000238r1_SOL010_the_skeleton_of_Clause_4_3</li> <li>- NFVSOL(19)000244r2_SOL010_VNF_Snapshot_Record_in_the_VNF_Snapshot_Package</li> </ul>
February 2020	0.0.6	Version 0.0.6 based on a contribution that were agreed during Email Approval (EA) following the NFVSOL#125 meeting. <ul style="list-style-type: none"> <li>- NFVSOL(19)000056r4_SOL010__VNF_Snapshot_Package_file_contents_General</li> </ul> <p>Rapporteur action: deleted the authors annex.</p>
April 2020	0.0.7	Version 0.0.7 based on contributions that were agreed at the NFVSOL#131 and NFVSOL#133 meetings and during Email Approval (EA) following the NFVSOL#132 meeting. <ul style="list-style-type: none"> <li>- NFVSOL(20)000196r1_SOL010_ZIP_structure_for_the_VNF_Snapshot_package</li> <li>- NFVSOL(20)000250_SOL010_editorial_changes</li> <li>- NFVSOL(20)000248r3_SOL010_VNF_Snapshot_Package_manifest_file</li> <li>- NFVSOL(20)000272r2_SOL010_vnf_snapshot_package_content</li> </ul>
July 2020	0.0.8	Version 0.0.8 based on contributions that were agreed at the NFVSOL#142 and NFVSOL#143 meetings and during Email Approval(EA) following the NFVSOL#143 meeting. <ul style="list-style-type: none"> <li>- NFVSOL(20)000575r5_SOL010_VNF_Snapshot_Package_authenticity_and_integrity</li> <li>- NFVSOL(20)000611r1_SOL010_zip_file_compression_method</li> <li>- NFVSOL(20)000610r1_SOL010_Conventions_in_the_manifest_file</li> <li>- NFVSOL(20)000625r1_SOL010_Certificate_file</li> <li>- NFVSOL(20)000109r5_SOL010_Annex_A_ZIP_example</li> </ul>
August 2020	0.1.0	Version 0.1.0 based on contributions that were agreed at the NFVSOL#145 and NFVSOL#148 meetings. <ul style="list-style-type: none"> <li>- NFVSOL(20)000645r1_SOL010_Clause_5_2_Manifest_and_certificate_files_in_the_VNF</li> <li>- NFVSOL(20)000646r3_SOL010_Clause_5_4_Signature_of_individual_artifacts</li> <li>- NFVSOL(20)000647r1_SOL010_Annex_A_2_VNF_Snapshot_example_including_VNFD</li> </ul>

Date	Version	Information about changes
October 2020	0.2.0	<p>Version 0.2.0 based on contributions that were agreed at the NFVSOL#151, NFSOL#152 and NFVSOL#153 meetings and during Email Approval(EA) following the NFVSOL#151 meeting.</p> <ul style="list-style-type: none"> <li>- NFVSOL(20)000675_SOL010_two_editor_s_notes_cleanup</li> <li>- NFVSOL(20)000678r1_SOL010_clause_4_2_2_Clarify_the_presence_of_pairs</li> <li>- NFVSOL(20)000680r1_SOL010_Clause_4_2_2_Resolving_EN_about_vnf_snapshot_name</li> <li>- NFVSOL(20)000691r1_SOL010_-_Miscellaneous_Improvements</li> <li>- NFVSOL(20)000693r2_SOL010_File_identification_in_the_manifest_file</li> <li>- NFVSOL(20)000692r2_SOL010_Removal_of_left-overs_from_integrity_assurance_option</li> <li>- NFVSOL(20)000685r2_SOL010_Clause_4_2_2_Adding_information_about_VNFC_snapshots</li> <li>- NFVSOL(20)000690_SOL010_Clause_5_2_Resolving_EN_about_signature_per_artifact</li> <li>- NFVSOL(20)000720_SOL010_Annex_A_examples_correction</li> <li>- NFVSOL(20)000712r3_SOL010_Resolving_the_comments_from_NFVSEC</li> <li>- NFVSOL(20)000722r1_SOL010_Clause_5_1_Resolving_EN_about_VNF_Snapshot_Package_pr</li> <li>- NFVSOL(20)000717_SOL010_Clause_4_2_2_Clarification_vnf_snapshot_pkg_create_da</li> </ul>

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## History

<b>Document history</b>		
V3.3.1	December 2020	Publication