



Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; CCM-VIM Interoperability Interface and Information Model Specification

Disclaimer

The present document has been produced and approved by the Network Functions Virtualisation (NFV) ETSI Industry Specification Group (ISG) and represents the views of those members who participated in this ISG.
It does not necessarily represent the views of the entire ETSI membership.

ReferenceDGS/NFV-IFA052

KeywordsCCM, configuration, information model,
management, MANO, VIM

ETSI650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from:

<https://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

If you find a security vulnerability in the present document, please report it through our
Coordinated Vulnerability Disclosure Program:

<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2023.

All rights reserved.

Contents

Intellectual Property Rights	5
Foreword.....	5
Modal verbs terminology.....	5
1 Scope	6
2 References	6
2.1 Normative references	6
2.2 Informative references.....	6
3 Definition of terms, symbols and abbreviations.....	7
3.1 Terms.....	7
3.2 Symbols.....	7
3.3 Abbreviations	7
4 Overview	7
4.1 Introduction	7
4.2 Relation to other NFV Group Specifications.....	8
4.3 Conventions.....	8
5 Interoperability and Interface requirements	8
5.1 Introduction	8
5.2 General interoperability requirements	8
5.3 Interface requirements.....	9
5.3.1 Virtualised Resources Management interface requirements.....	9
5.3.2 Virtualised Resources Change Notification interface requirements	9
5.3.3 Virtualised Resources Information Management interface requirements	9
5.3.4 Virtualised Resources Performance Management interface requirements.....	9
5.3.5 Virtualised Resources Fault Management interface requirements.....	9
6 VIM exposed Interfaces	10
6.1 Introduction	10
6.2 Virtualised Compute Resources Management interface.....	10
6.3 Virtualised Network Resources Management interface	10
6.4 Virtualised Storage Resources Management interface	10
6.5 Virtualised Compute Resources Change Notification interface	10
6.6 Virtualised Network Resources Change Notification interface.....	10
6.7 Virtualised Storage Resources Change Notification interface.....	11
6.8 Virtualised Compute Resources Information Management interface.....	11
6.9 Virtualised Network Resources Information Management interface	11
6.10 Virtualised Storage Resources Information Management interface	11
6.11 Virtualised Storage Resources Information Management interface	11
6.12 Virtualised Resources Performance Management interface.....	12
6.13 Virtualised Resources Fault Management interface	12
7 Information elements exchanged.....	12
Annex A (informative): Operational flow examples.....	13
A.1 Introduction	13
A.2 Virtualised Resource Management	13
A.2.1 Virtualised Resource Allocation.....	13
A.2.2 Virtualised Resource Update.....	14
A.2.3 Virtualised Resource Termination.....	15
A.2.4 Virtualised Resource Scaling	16
A.2.5 Virtualised Resource Query	17
A.2.6 Virtualised Resources change notification	17
A.3 Virtualised Resource Information Management	18
A.3.1 Virtualised Resources information changes notification.....	18

A.3.2	Query information about consumable Virtualised Resource	19
A.4	Virtualised Resource Performance Management	19
A.4.1	Create PM job.....	19
A.4.2	Delete PM job.....	20
A.4.3	Query PM job.....	20
A.5	Virtualised Resource Fault Management	21
A.5.1	Virtualised Resources alarm notification	21
A.5.2	Get alarm list	22
Annex B (informative):	Change History	23
History		24

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

Foreword

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

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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document specifies the interfaces supported for interoperability between the Container Infrastructure Service (CIS) Cluster Management (CCM) and Virtualised Infrastructure Manager (VIM) in the NFV-MANO architecture framework, as well as information elements exchanged over these interfaces, to support the provisioning and management of resources for CIS clusters.

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.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

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 necessary for the application of the present document.

- [1] [ETSI GS NFV-IFA 005](#): "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Or-Vi reference point - Interface and Information Model Specification".
- [2] [ETSI GS NFV-IFA 006](#): "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Vi-Vnfm reference point - Interface and Information Model Specification".
- [3] [ETSI GS NFV-IFA 010](#): "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Functional requirements specification".

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 GR NFV 003: "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".
- [i.2] ETSI GS NFV-IFA 036: "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Requirements for service interfaces and object model for container cluster management and orchestration specification".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI GR NFV 003 [i.1] apply.

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

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GR NFV 003 [i.1] apply.

4 Overview

4.1 Introduction

NFV-MANO services produced by the VIM can be consumed by the CCM in context of CIS cluster management. The CCM utilizes these services to manage virtualised compute, storage and network resources for CIS clusters as specified in clause 4.2.5 of ETSI GS NFV-IFA 036 [i.2], and further support the CIS cluster lifecycle management and FCAPS management to its northbound consumers.

The following interfaces are used for exchanges between the CCM and the VIM:

- Virtualised Resources Information Management, composed of:
 - Virtualised Compute Resources Information Management.
 - Virtualised Network Resources Information Management.
 - Virtualised Storage Resources Information Management.
- Virtualised Resources Management, composed of:
 - Virtualised Compute Resources Management.
 - Virtualised Network Resources Management.
 - Virtualised Storage Resources Management.
- Virtualised Resources Change Notification, composed of:
 - Virtualised Compute Resources Change Notification.
 - Virtualised Network Resources Change Notification.
 - Virtualised Storage Resources Change Notification.
- Virtualised Resources Performance Management.
- Virtualised Resources Fault Management.

All the interfaces above are produced by the VIM and consumed by the CCM.

4.2 Relation to other NFV Group Specifications

The present document is referencing information from the following NFV Group Specifications:

- Management and Orchestration - Or-Vi reference point - Interface and Information Model Specification ETSI GS NFV-IFA 005 [1].
- Management and Orchestration - Vi-Vnfm reference point - Interface and Information Model Specification ETSI GS NFV-IFA 006 [2]:
 - ETSI GS NFV-IFA 005 [1], ETSI GS NFV-IFA 006 [2] and the present document are all specifying interfaces provided by the VIM. All these specifications are therefore related.
- Management and Orchestration - Functional requirements specification ETSI GS NFV-IFA 010 [3].

The key functional requirements from ETSI GS NFV-IFA 010 [3] provide the guidance and need to be fulfilled by the interfaces between the CCM and the VIM.

4.3 Conventions

The conventions stated in clause 4.3 of ETSI GS NFV-IFA 005 [1] apply for information elements of interfaces specified in the present document.

5 Interoperability and Interface requirements

5.1 Introduction

This clause defines or references requirements applicable to interfaces in the specific context of the interoperability between the CCM and VIM.

5.2 General interoperability requirements

Table 5.2-1 specifies general requirements applicable to the interoperability between the CCM and VIM.

Table 5.2-1: General interoperability requirements

Number	Functional requirement description
Ccm-Vim.001	The reference point between the CCM and VIM shall support the Virtualised Compute Resources Management interface provided by the VIM.
Ccm-Vim.002	The reference point between the CCM and VIM shall support the Virtualised Network Resources Management interface provided by the VIM.
Ccm-Vim.003	The reference point between the CCM and VIM shall support the Virtualised Storage Resources Management interface provided by the VIM.
Ccm-Vim.004	The reference point between the CCM and VIM shall support the Virtualised Resources Fault Management interface provided by the VIM.
Ccm-Vim.005	The reference point between the CCM and VIM shall support the Virtualised Resources Performance Management interface provided by the VIM.
Ccm-Vim.006	The reference point between the CCM and VIM shall support the Virtualised Compute Resources Information Management interface provided by the VIM.
Ccm-Vim.007	The reference point between the CCM and VIM shall support the Virtualised Network Resources Information Management interface provided by the VIM.
Ccm-Vim.008	The reference point between the CCM and VIM shall support the Virtualised Storage Resources Information Management interface provided by the VIM.
Ccm-Vim.009	The reference point between the CCM and VIM shall support the Virtualised Compute Resources Change Notification interface provided by the VIM.
Ccm-Vim.010	The reference point between the CCM and VIM shall support the Virtualised Network Resources Change Notification interface provided by the VIM.
Ccm-Vim.011	The reference point between the CCM and VIM shall support the Virtualised Storage Resources Change Notification interface provided by the VIM.
Ccm-Vim.012	All operations on interfaces supported for the reference point between the CCM and VIM require authentication and authorization of the consumer.

5.3 Interface requirements

5.3.1 Virtualised Resources Management interface requirements

The reference point between the CCM and VIM shall support Virtualised Resource Management interface requirements defined in ETSI GS NFV-IFA 005 [1], clause 5.3.5.

5.3.2 Virtualised Resources Change Notification interface requirements

The reference point between the CCM and VIM shall support Virtualised Resources Change Notification interface requirements defined in ETSI GS NFV-IFA 005 [1], clause 5.3.7.

5.3.3 Virtualised Resources Information Management interface requirements

The reference point between the CCM and VIM shall support Virtualised Resources Information Management interface requirements defined in ETSI GS NFV-IFA 005 [1], clause 5.3.2.

5.3.4 Virtualised Resources Performance Management interface requirements

The reference point between the CCM and VIM shall support Virtualised Resources Performance Management interface requirements defined in ETSI GS NFV-IFA 005 [1], clause 5.3.9.

5.3.5 Virtualised Resources Fault Management interface requirements

The reference point between the CCM and VIM shall support Virtualised Resources Fault Management interface requirements defined in ETSI GS NFV-IFA 005 [1], clause 5.3.10.

6 VIM exposed Interfaces

6.1 Introduction

Clause 6 of the present document defines the interfaces exposed by VIM towards CCM over the reference point between the CCM and VIM. Interface operations can be reused from corresponding definitions in ETSI GS NFV-IFA 005 [1] on per case by case basis.

6.2 Virtualised Compute Resources Management interface

This interface enables the CCM to invoke virtualised compute resources management operations towards the VIM.

The virtualised compute resources management operations in clause 7.3.1 of ETSI GS NFV-IFA 005 [1] apply for virtualised compute resources management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.3 Virtualised Network Resources Management interface

This interface enables the CCM to invoke virtualised network resources management operations towards the VIM.

The virtualised network resources management operations in clause 7.4.1 of ETSI GS NFV-IFA 005 [1] apply for virtualised network resources management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.4 Virtualised Storage Resources Management interface

This interface enables the CCM to invoke virtualised storage resources management operations towards the VIM.

The virtualised storage resources management operations in clause 7.5.1 of ETSI GS NFV-IFA 005 [1] apply for virtualised storage resources management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.5 Virtualised Compute Resources Change Notification interface

This interface enables the CCM to invoke virtualised compute resources change notification operations towards the VIM.

The virtualised compute resources change notification operations in clause 7.3.2 of ETSI GS NFV-IFA 005 [1] apply for virtualised compute resources change notification interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.6 Virtualised Network Resources Change Notification interface

This interface enables the CCM to invoke virtualised network resources change notification operations towards the VIM.

The virtualised network resources change notification operations in clause 7.4.2 of ETSI GS NFV-IFA 005 [1] apply for virtualised network resources change notification interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.7 Virtualised Storage Resources Change Notification interface

This interface enables the CCM to invoke virtualised storage resources change notification operations towards the VIM.

The virtualised storage resources change notification operations in clause 7.5.2 of ETSI GS NFV-IFA 005 [1] apply for virtualised storage resources change notification interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.8 Virtualised Compute Resources Information Management interface

This interface enables the CCM to invoke virtualised compute resources information management operations towards the VIM.

The virtualised compute resources information management operations in clause 7.3.3 of ETSI GS NFV-IFA 005 [1] apply for virtualised compute resources information management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.9 Virtualised Network Resources Information Management interface

This interface enables the CCM to invoke virtualised network resources information management operations towards the VIM.

The virtualised network resources information management operations in clause 7.4.3 of ETSI GS NFV-IFA 005 [1] apply for virtualised network resources information management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.10 Virtualised Storage Resources Information Management interface

This interface enables the CCM to invoke virtualised storage resources information management operations towards the VIM.

The virtualised storage resources information management operations in clause 7.5.3 of ETSI GS NFV-IFA 005 [1] apply for virtualised storage resources information management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.11 Virtualised Storage Resources Information Management interface

This interface enables the CCM to invoke virtualised storage resources information management operations towards the VIM.

The virtualised storage resources information management operations in clause 7.5.3 of ETSI GS NFV-IFA 005 [1] apply for virtualised storage resources information management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.12 Virtualised Resources Performance Management interface

This interface enables the CCM to invoke virtualised resources performance management operations towards the VIM.

The virtualised resources performance management operations in clause 7.7 of ETSI GS NFV-IFA 005 [1] apply for virtualised resources performance management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

6.13 Virtualised Resources Fault Management interface

This interface enables the CCM to invoke virtualised resources fault management operations towards the VIM.

The virtualised resources fault management operations in clause 7.6 of ETSI GS NFV-IFA 005 [1] apply for virtualised resources fault management interface in the present document, except that the producer is the VIM and the consumer is the CCM.

7 Information elements exchanged

The information elements defined in clause 8 of ETSI GS NFV-IFA 005 [1] are referred by information elements of interfaces specified in the present document.

Annex A (informative): Operational flow examples

A.1 Introduction

The present clause describes operational flow examples of the CCM and VIM interaction, by utilizing the interface operations specified in clause 6.

A.2 Virtualised Resource Management

A.2.1 Virtualised Resource Allocation

Figure A.2.1-1 illustrates an operational flow for the CCM to request the VIM to allocate virtualised resources, to support the CIS cluster creation or modification.

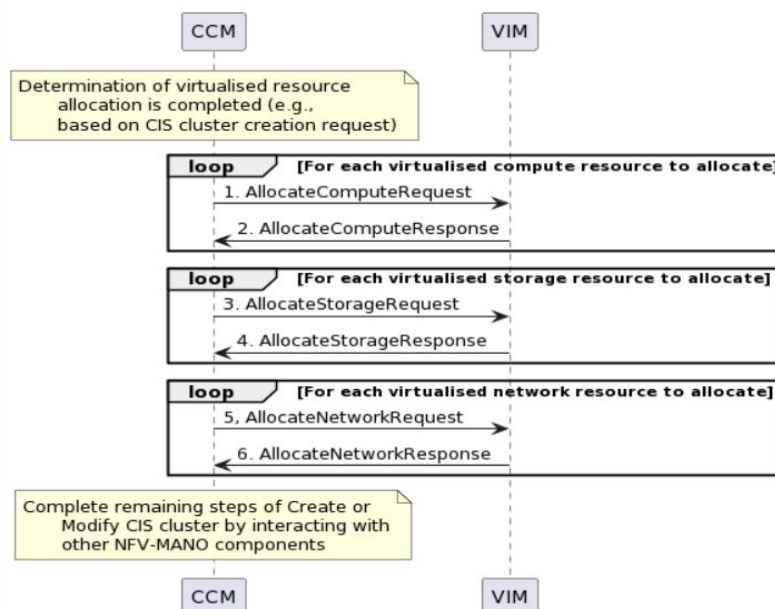


Figure A.2.1-1: Virtualised resource allocation

When the CCM receives a request to create or modify the CIS cluster, it processes and determines the necessary virtualised resources to be allocated from the input request and CIS cluster descriptors. Based on this determination, it further triggers the following steps (which can be loops or collective operations) of virtualised resource allocation by interacting with the VIM:

- 1) For each of the virtualised compute resources to allocate, the CCM requests the VIM to allocate Virtual Machine (VM) resources used as the CIS cluster nodes, by invoking the Allocate Virtualised Compute Resource operation.
- 2) The VIM responds to the CCM with the information of VM resources allocated for the CIS cluster.
- 3) For each of the virtualised storage resources to allocate, the CCM requests the VIM to allocate virtual storage resources for the CIS cluster nodes, by invoking the Allocate Virtualised Storage Resource operation.
- 4) The VIM responds to the CCM with the information of virtual storage resources allocated for the CIS cluster.

- 5) For each of the virtualised network resources to allocate, the CCM requests the VIM to allocate virtual network resources for the CIS cluster nodes networking, by invoking the Allocate Virtualised Network Resource operation.
- 6) The VIM responds to the CCM with the information of virtual network resources allocated for the CIS cluster.

NOTE: The order of Steps 1-2, Steps 3-4 and Steps 5-6 can vary or even be executed in parallel.

After the virtualised resources associated to the CIS cluster creation or modification are allocated, the CCM interacts with other NFV-MANO functional components to complete the remaining steps of CIS cluster management operation.

A.2.2 Virtualised Resource Update

Figure A.2.2-1 illustrates an operational flow for the CCM to request the VIM to update virtualised resources, to support the CIS cluster modification or configuration.

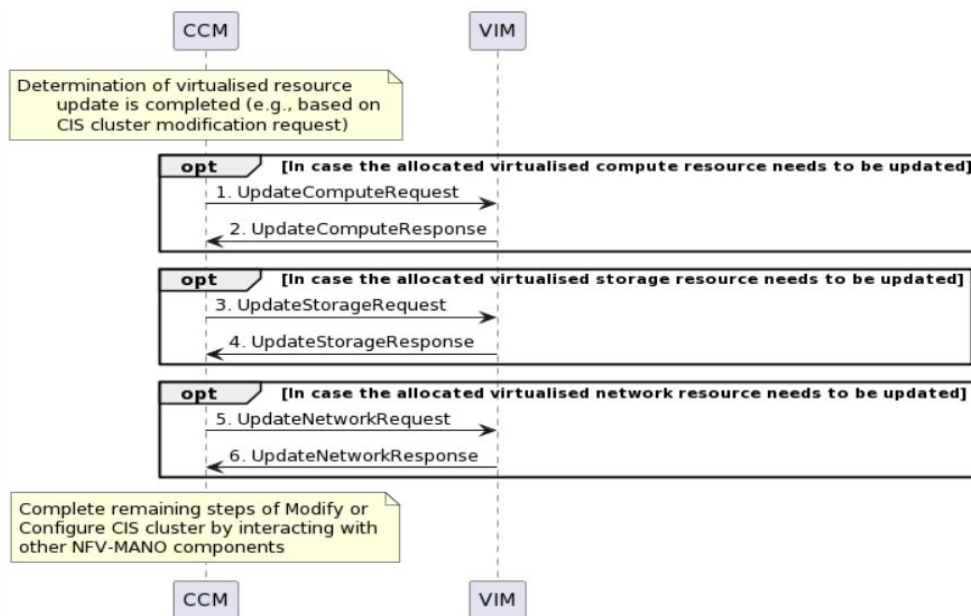


Figure A.2.2-1: Virtualised resource update

When the CCM receives a request to modify (e.g. modifying the network related configuration of the CIS cluster) or configure the CIS cluster (e.g. configuring the CIS cluster nodes of a CIS cluster), it processes and determines which allocated virtualised resources need to be updated based on the input request and CIS cluster descriptors and runtime information. Based on this determination, it further triggers the following steps of virtualised resource updates by interacting with the VIM:

- 1) In case the allocated virtualised compute resource needs to be updated, the CCM requests the VIM to update the configuration of Virtual Machine (VM) resource instances associated to the CIS cluster (CIS cluster nodes), by invoking the Update Virtualised Compute Resource operation.
- 2) The VIM responds to the CCM with the updated information of VM resource instances.
- 3) In case the allocated virtualised storage resource needs to be updated, the CCM requests the VIM to update the configuration of virtual storage resource instances associated to the CIS cluster (CIS cluster storage), by invoking the Update Virtualised Storage Resource operation.
- 4) The VIM responds to the CCM with the updated information of virtual storage resource instances.
- 5) In case the allocated virtualised network resource needs to be updated, the CCM requests the VIM to update the configuration of virtual network resource instances associated to the CIS cluster (CIS cluster nodes network), by invoking the Update Virtualised Network Resource operation.

6) The VIM responds to the CCM with the updated information of virtual network resource instances.

NOTE: Which updates are feasible for each type of virtualised resource is defined by the referenced interface operation in the flow.

After the configuration of virtualised resource instances associated to the CIS cluster modification or configuration is updated, the CCM interacts with other NFV-MANO functional components to complete the remaining steps of CIS cluster management operation.

A.2.3 Virtualised Resource Termination

Figure A.2.3-1 illustrates an operational flow for the CCM to request the VIM to terminate virtualised resources, to support the CIS cluster deletion or modification.

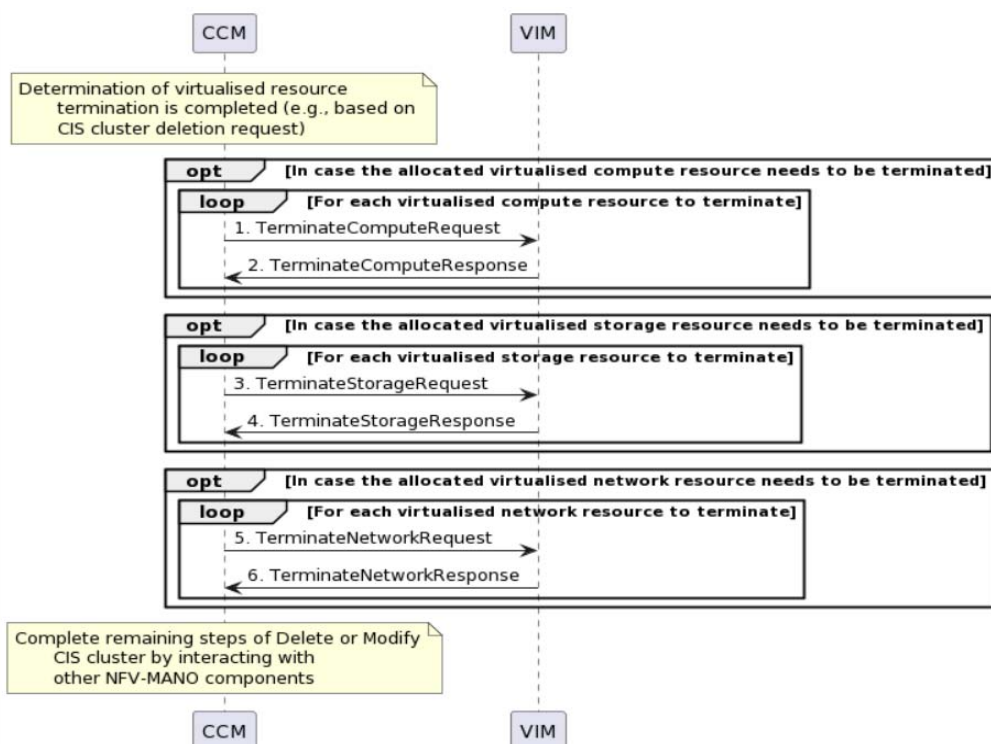


Figure A.2.3-1: Virtualised resource termination

When the CCM receives a request to delete or modify the CIS cluster, it processes and determines which allocated virtualised resources need to be terminated based on the input request, CIS cluster descriptors and runtime information. Based on this determination, it further triggers the following steps of virtualised resource termination (which can be loops or collective operations) by interacting with the VIM:

- 1) In case the allocated virtualised compute resource needs to be terminated, for each of the virtualised compute resources to terminate, the CCM requests the VIM to terminate the Virtual Machine (VM) resource instances associated to the CIS cluster (CIS cluster nodes), by invoking the Terminate Virtualised Compute Resource operation.
- 2) The VIM responds to the CCM with the identifier of VM resource instances successfully terminated.
- 3) In case the allocated virtualised storage resource needs to be terminated, for each of the virtualised storage resources to terminate, the CCM requests the VIM to terminate the virtual storage resource instances associated to the CIS cluster (CIS cluster storage), by invoking the Terminate Virtualised Storage Resource operation.
- 4) The VIM responds to the CCM with the identifier of virtual storage resource instances successfully terminated.

- 5) In case the allocated virtualised network resource needs to be terminated, for each of the virtualised network resources to terminate, the CCM requests the VIM to terminate the virtual network resource instances associated to the CIS cluster (CIS cluster nodes network), by invoking the Terminate Virtualised Network Resource operation.
- 6) The VIM responds to the CCM with the identifier of virtual storage resource instances successfully terminated.

NOTE: The order of Steps 1-2, Steps 3-4 and Steps 5-6 can vary or even be executed in parallel.

After the virtualised resource instances associated to the CIS cluster deletion or modification are terminated, the CCM interacts with other NFV-MANO functional components to complete the remaining steps of CIS cluster management operation.

A.2.4 Virtualised Resource Scaling

Figure A.2.4-1 illustrates an operational flow for the CCM to request the VIM to scale virtualised resources, to support the CIS cluster modification or configuration.

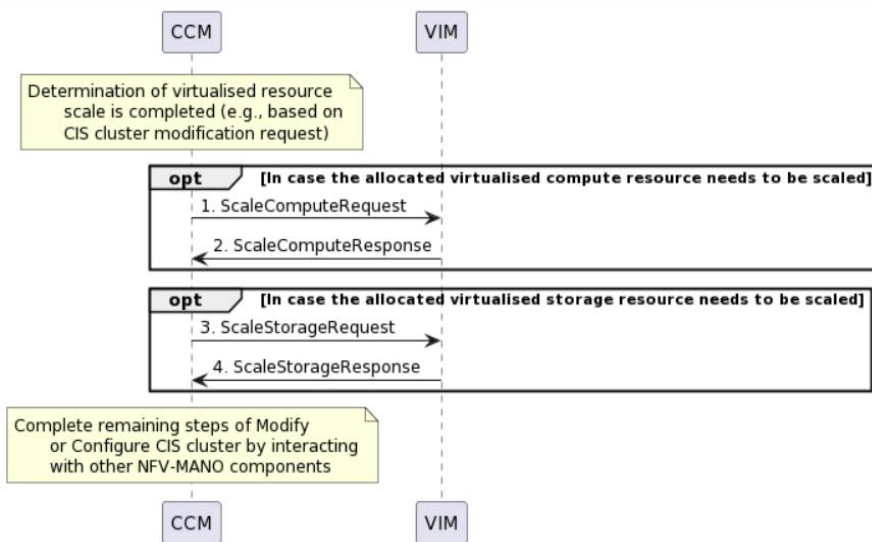


Figure A.2.4-1: Virtualised resource scaling

When the CCM receives a request to modify or configure the CIS cluster (e.g. modifying the storage-related configuration of the CIS cluster, or changing the compute flavour of the CIS cluster node), it processes and determines which allocated virtualised resources need to be scaled based on the input request, CIS cluster descriptors and runtime information. Based on this determination, it further triggers the following steps of virtualised resource scaling by interacting with the VIM:

- 1) In case the allocated virtualised compute resource needs to be scaled, the CCM requests the VIM to scale Virtual Machine (VM) resource instances associated to the CIS cluster (CIS cluster nodes), by invoking the Scale Virtualised Compute Resource operation.
- 2) The VIM responds to the CCM with the information of the scaled VM resource instances.
- 3) In case the allocated virtualised storage resource needs to be scaled, the CCM requests the VIM to scale virtual storage resource instances associated to the CIS cluster (CIS cluster storage), by invoking the Scale Virtualised Storage Resource operation.
- 4) The VIM responds to the CCM with the information of scaled storage resource instances.

After virtualised resource instances associated to the CIS cluster modification are scaled, the CCM interacts with other NFV-MANO functional components to complete the remaining steps of CIS cluster management operation.

A.2.5 Virtualised Resource Query

Figure A.2.5-1 illustrates an operational flow for the CCM to request the VIM to query information about virtualised resources associated to the CIS cluster.

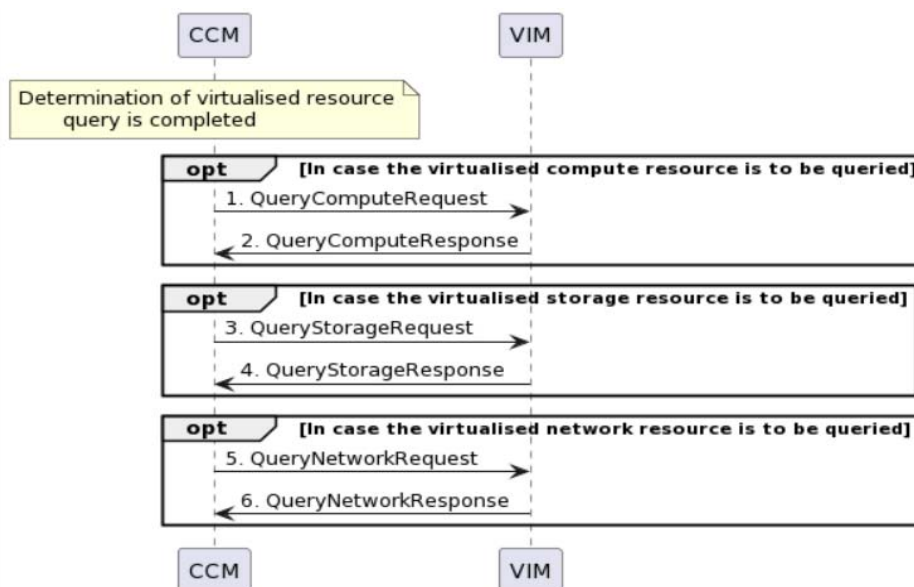


Figure A.2.5-1: Virtualised resource query

When the CCM determines which virtualised resources to query, it further triggers the following steps of virtualised resource query by interacting with the VIM:

- 1) In case the virtualised compute resource is to be queried, the CCM requests the VIM to query information about Virtual Machine (VM) resource instances associated to the CIS cluster (CIS cluster nodes), by invoking the Query Virtualised Compute Resource operation with certain query filters.
- 2) The VIM responds to the CCM with the information of VM resource instances as the query result.
- 3) In case the virtualised storage resource is to be queried, the CCM requests the VIM to query information about virtual storage resource instances associated to the CIS cluster (CIS cluster storage), by invoking the Query Virtualised Storage Resource operation with certain query filters.
- 4) The VIM responds to the CCM with the information of virtualised storage resource instances as the query result.
- 5) In case the virtualised network resource is to be queried, the CCM requests the VIM to query information about virtual network resource instances associated to the CIS cluster (CIS cluster nodes network), by invoking the Query Virtualised Network Resource operation with certain query filters.
- 6) The VIM responds to the CCM with the information of virtualised network resource instances as the query result.

A.2.6 Virtualised Resources change notification

Figure A.2.6-1 illustrates an operational flow for the CCM to request subscription to virtualised resources change notifications and the VIM provides such notifications to the CCM.

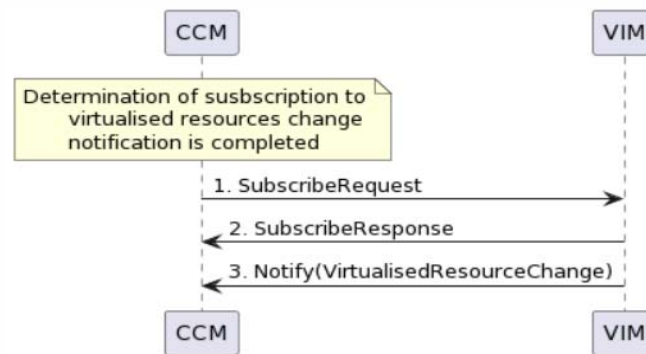


Figure A.2.6-1: Virtualised resources change notification

The CCM determines the need to receive the notifications about virtualised resource changes. It further triggers the following steps of subscription/notification by interacting with the VIM:

- 1) The CCM subscribes to notifications on virtualised resources (either compute, storage or network) change from the VIM, by invoking the Subscribe operation with necessary input filter.
- 2) The VIM responds to the CCM with the identifier of the subscription realized.
- 3) When the event of virtualised resources change occurs, the VIM sends the notification on virtualised resources change to the CCM by invoking Notify operation.

A.3 Virtualised Resource Information Management

A.3.1 Virtualised Resources information changes notification

Figure A.3.1-1 illustrates an operational flow for the CCM to request subscription to notifications related to information changes about consumable virtualised resources and the VIM provides such notifications to the CCM.

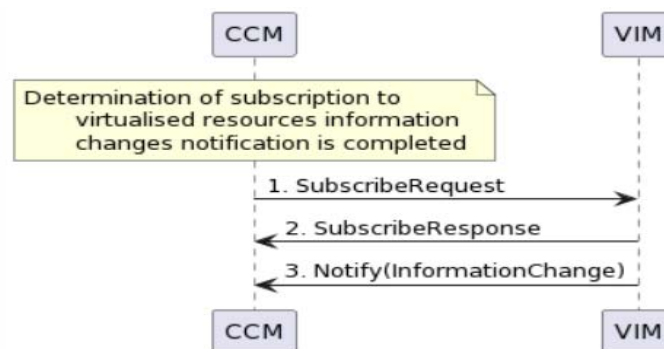


Figure A.3.1-1: Virtualised resources information changes notification

The CCM determines the need to receive notifications related to information changes about consumable virtualised resources. It further triggers the following steps of subscription/notification by interacting with the VIM:

- 1) The CCM subscribes to notifications on information changes about consumable virtualised resources from the VIM, by invoking the Subscribe operation with necessary input filter.
- 2) The VIM responds to the CCM with the identifier of the subscription realized.
- 3) When the event of virtualised resources information changes occurs, the VIM sends the notification on information change to the CCM by invoking Notify operation.

A.3.2 Query information about consumable Virtualised Resource

Figure A.3.2-1 illustrates an operational flow for the CCM to query the information about consumable virtualised resources from the VIM.

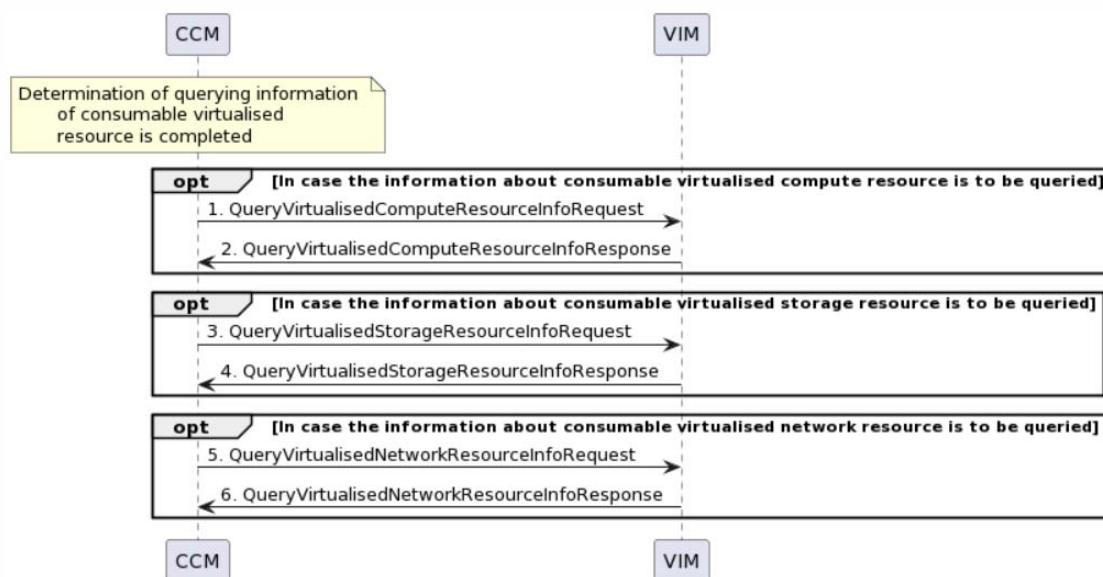


Figure A.3.2-1: Query information about consumable Virtualised Resource

The CCM determines to query the information about consumable virtualised resources. It further triggers the following steps of querying the information about different types of virtualised resources by interacting with the VIM:

- 1) In case the information about consumable virtualised compute resource is to be queried, the CCM queries the information about consumable virtualised compute resource from the VIM, by invoking the QueryVirtualisedComputeResourceInfo operation with certain query filters.
- 2) The VIM responds to the CCM with the information of consumable virtualised compute resources as the query result.
- 3) In case the information about consumable virtualised storage resource is to be queried, the CCM queries the information about consumable virtualised storage resource from the VIM, by invoking the QueryVirtualisedStorageResourceInfo operation with certain query filters.
- 4) The VIM responds to the CCM with the information of consumable virtualised storage resources as the query result.
- 5) In case the information about consumable virtualised network resource is to be queried, the CCM queries the information about consumable virtualised network resource from the VIM, by invoking the QueryVirtualisedNetworkResourceInfo operation with certain query filters.
- 6) The VIM responds to the CCM with the information of consumable virtualised network resources as the query result.

A.4 Virtualised Resource Performance Management

A.4.1 Create PM job

Figure A.4.1-1 illustrates an operational flow for the CCM to request the VIM to create a Performance Management (PM) job for monitoring virtualised resources associated to the CIS cluster, to support CCM layer PM activities such as creating PM job specifying the CIS cluster performance information to be collected.

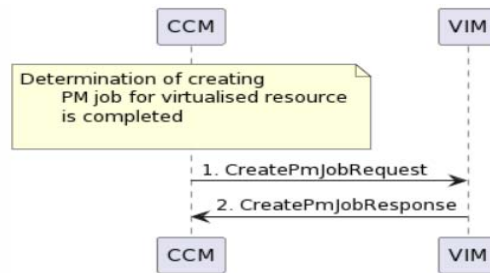


Figure A.4.1-1: Create PM job

The CCM determines to create a PM job for monitoring virtualised resources:

- 1) The CCM requests the VIM to create a PM job, enabling the CCM to specify a set of virtualised resources that the VIM is managing, for which the CCM wants to receive performance information, by invoking the Create PM Job operation.
- 2) The VIM responds to the CCM with identifier of the created PM job.

A.4.2 Delete PM job

Figure A.4.2-1 illustrates an operational flow for the CCM to request the VIM to deleting one or more Performance Management (PM) job monitoring virtualised resources associated to the CIS cluster, to support CCM layer PM activities such as deleting PM job specifying the CIS cluster performance information to be collected.

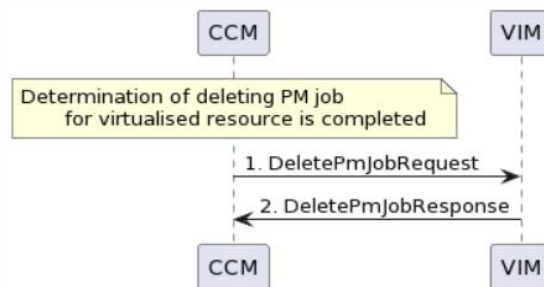


Figure A.4.2-1: Delete PM job

The CCM determines to delete a PM job monitoring virtualised resources:

- 1) The CCM requests the VIM to delete one or more PM jobs monitoring performance information of virtualised resources associated to the CIS cluster, by invoking the Delete PM Job operation.
- 2) The VIM responds to the CCM with identifiers of PM jobs successfully deleted.

A.4.3 Query PM job

Figure A.4.3-1 illustrates an operational flow for the CCM to query the VIM about information of one or more PM jobs monitoring virtualised resources associated to the CIS cluster.

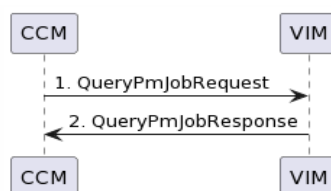


Figure A.4.3-1: Query PM job

- 1) The CCM queries the VIM about information of one or more PM jobs monitoring virtualised resources associated to the CIS cluster, by invoking the Query PM Job operation with certain query filters.
- 2) The VIM responds to the CCM with details of PM jobs matching query filters.

NOTE: Querying PM jobs monitoring virtualised resources associated to the CIS cluster is independent from querying PM jobs monitoring the associated CIS cluster.

A.5 Virtualised Resource Fault Management

A.5.1 Virtualised Resources alarm notification

Figure A.5.1-1 illustrates an operational flow for the CCM to request subscription to notifications related to alarms and their state changes resulting from the virtualised resources faults and the VIM provides such notifications to the CCM.

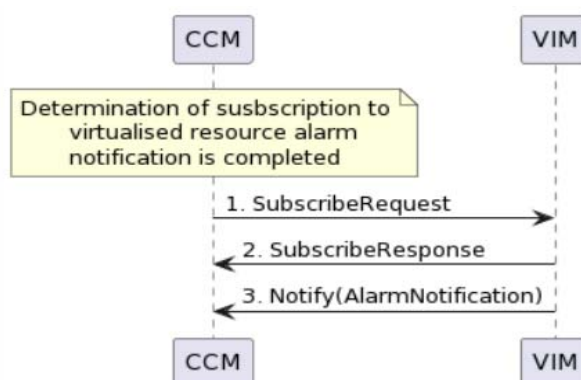


Figure A.5.1-1: Virtualised resources alarm notification

The CCM determines to receive the notifications on alarms and their state changes resulting from the virtualised resources faults. It further triggers the following steps of subscription/notification by interacting with the VIM:

- 1) The CCM subscribes to notifications on alarms and their state changes resulting from the virtualised resources faults from the VIM, by invoking the Subscribe operation with necessary input filter.
- 2) The VIM responds to the CCM with the identifier of the subscription realized.
- 3) When the alarms and their state changes occur, the VIM sends the notification on virtualised resource alarms to the CCM by invoking Notify operation.

A.5.2 Get alarm list

Figure A.5.2-1 illustrates an operational flow for the CCM to query for active alarms (associated to virtualised resources) from the VIM.

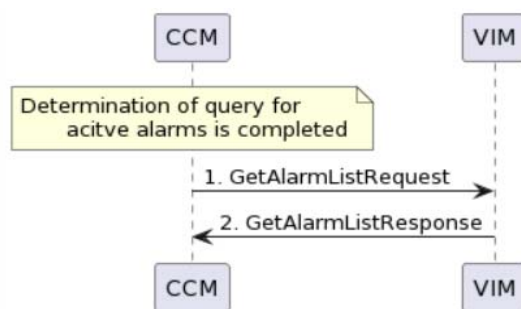


Figure A.5.2-1: Get alarm list

The CCM determines to query for active alarms associated to virtualised resources. It further triggers the following steps of getting alarm list by interacting with the VIM:

- 1) The CCM queries active alarms (associated to virtualised resources) from the VIM, by invoking the GetAlarmList operation with input filters to select alarms.
- 2) The VIM responds to the CCM with the information about one or more alarms.

Annex B (informative): Change History

Date	Version	Information about changes
January 2023	0.0.1	First draft, introducing the document skeleton and scope.
March 2023	0.0.2	Early draft including the following contributions until IFA#325 meeting: NFVIFA(23)000094r1, NFVIFA(23)000095, NFVIFA(23)000100r1, NFVIFA(23)000101r1, NFVIFA(23)000114, NFVIFA(23)000115r1.
June 2023	0.1.0	Stable draft including the following contributions until IFA#337 meeting: NFVIFA(23)000255, NFVIFA(23)000256r2, NFVIFA(23)000285r1, NFVIFA(23)000286r2, NFVIFA(23)000287r2, NFVIFA(23)000288r2, NFVIFA(23)000289r1, NFVIFA(23)000290r1, NFVIFA(23)000292r1, NFVIFA(23)000343r1, NFVIFA(23)000344r1, NFVIFA(23)000345r2.
July 2023	0.2.0	Stable draft including the following contributions until IFA#340 meeting: NFVIFA(23)000468, NFVIFA(23)000469r1, NFVIFA(23)000470r1, NFVIFA(23)000491.

History

Document history		
V4.5.1	August 2023	Publication