



GROUP SPECIFICATION

Network Functions Virtualisation (NFV); Acceleration Technologies; Acceleration Resource Management Interface Specification; Release 3

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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).

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1 Scope

The present document specifies the interfaces used for acceleration resource management on the Nf-Vi reference point of the NFV MANO framework, as well as the information elements exchanged over those interfaces.

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] ISO/IEC 9646-7: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 7: Implementation Conformance Statements".

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-IFA 004: "Network Functions Virtualisation (NFV); Acceleration Technologies; Management Aspects Specification".

3 Definitions and abbreviations

3.1 Definitions

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

acceleration image: executable firmware image which can be run on the programmable hardware accelerator for one or more specific VNF implementation(s)

acceleration image repository: one repository which holds information of all available acceleration images

NOTE: The image information includes the image identifier, image provider, image version, accelerator provider, accelerator type, accelerator's requirements, accelerator model, image capability and corresponding image capacity, etc.

acceleration platform: hardware/software platform which accelerator's images/libraries can run on

NOTE: It usually contains various resources such as internal memories, input/output interfaces, DSP blocks, cores, etc. for accelerators to use.

acceleration resource repository: one repository which holds information of all available acceleration resources

NOTE: The acceleration resource information includes accelerator identifier, accelerator vendor, accelerator type, accelerator model, accelerator feature (e.g. re-programmability supporting, etc.), accelerator status (e.g. idle, occupied, partial occupied), accelerator capability, corresponding accelerator capacity as well as the identifier of host to which the accelerator attaches.

3.2 Abbreviations

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

4 Overview of interfaces and information elements associated with the Nf-Vi reference point regarding acceleration resource management

4.1 Introduction

This clause provides an overview of interfaces and information models associated to the Nf-Vi reference point regarding acceleration resource management.

The Nf-Vi reference point is used for exchanges between NFV Infrastructure and VIM, and supports the following interfaces regarding acceleration resource management:

- Acceleration Resource Discovery
- Acceleration Resource Lifecycle Management
- Acceleration Resource Fault Management
- Acceleration Image Management

The information elements exchanged by the interfaces above are also part of the present document.

4.2 Conventions

The following notations, defined in ISO/IEC 9646-7 [1], are used for the qualifier column of interface information elements:

- M mandatory - the capability is required to be supported;
- O optional - the capability may be supported or not;
- N/A not applicable - in the given context, it is impossible to use the capability;
- CM conditional mandatory - the capability is required to be supported and is conditional on the support of some condition. This condition shall be specified in the Description column;
- CO conditional optional - the capability may be supported or not and is conditional on the support of some condition. This condition shall be specified in the Description column.

5 Reference point and interface requirements

5.1 Introduction

This clause defines requirements applicable to interfaces in the specific context of the Nf-Vi reference point regarding acceleration resource management.

5.2 Nf-Vi reference point requirements

Table 5.2-1

Number	Functional requirement description
Nf-Vi-Acc.001	The Nf-Vi reference point shall support the Acceleration Resource Discovery interface provided by the NFVI.
Nf-Vi-Acc.002	The Nf-Vi reference point shall support the Acceleration Resource Lifecycle Management interface provided by the NFVI.
Nf-Vi-Acc.003	The Nf-Vi reference point shall support the Acceleration Image Management interface provided by the NFVI.
Nf-Vi-Acc.004	The Nf-Vi reference point shall support the Acceleration Resource Fault Management interface provided by the NFVI.

5.3 Interface requirements

5.3.1 Acceleration Resource Discovery

Table 5.3.1-1 specifies requirements applicable to the Acceleration Resource Discovery interface produced by the NFVI on the Nf-Vi reference point.

Table 5.3.1-1: Acceleration Resource Discovery interface requirements

Numbering	Requirement
Nf-Vi-Acc.Disc.001	The Acceleration Resource Discovery interface produced by the NFVI on the Nf-Vi reference point shall support obtaining information of the accelerators within the NFVI (see note).
NOTE: The information of the accelerators can include type, version, capabilities, QoS, etc.	

5.3.2 Acceleration Resource Lifecycle Management

Table 5.3.2-1 specifies requirements applicable to the Acceleration Resource Lifecycle Management interface produced by the NFVI on the Nf-Vi reference point.

Table 5.3.2-1: Acceleration Resource Lifecycle Management interface requirements

Numbering	Requirement
Nf-Vi-Acc.Rlcm.001	The Acceleration Resource Lifecycle Management interface produced by the NFVI on the Nf-Vi reference point shall support requesting allocation of acceleration resources.
Nf-Vi-Acc.Rlcm.002	The Acceleration Resource Lifecycle Management interface produced by the NFVI on the Nf-Vi reference point shall support requesting release of acceleration resources.
Nf-Vi-Acc.Rlcm.003	The Acceleration Resource Lifecycle Management interface produced by the NFVI on the Nf-Vi reference point shall support querying information of acceleration resources.
Nf-Vi-Acc.Rlcm.004	The Acceleration Resource Lifecycle Management interface produced by the NFVI on the Nf-Vi reference point shall support getting statistics of the acceleration resources.
Nf-Vi-Acc.Rlcm.005	The Acceleration Resource Lifecycle Management interface produced by the NFVI on the Nf-Vi reference point shall support resetting statistics of the acceleration resources.

5.3.3 Acceleration Resource Fault Management

Table 5.3.3-1 specifies requirements applicable to the Acceleration Resource Fault Management interface produced by the NFVI on the Nf-Vi reference point.

Table 5.3.3-1: Acceleration Resource Fault Management interface requirements

Numbering	Requirement
Nf-Vi-Acc.Fm.001	The Acceleration Resource Fault Management interface produced by the NFVI on the Nf-Vi reference point shall enable the VIM to collect acceleration resource fault information.
Nf-Vi-Acc.Fm.002	The Acceleration Resource Fault Management interface produced by the NFVI on the Nf-Vi reference point shall support providing alarm notifications related to faults on acceleration resources to the VIM.

5.3.4 Acceleration Image Management

The programmable hardware accelerator receives the appropriate kind and version of acceleration image from the acceleration image repository maintained by the VIM via the Acceleration Image Management interface. More illustrative text about how the acceleration image management works is depicted in Annex A.

NOTE: The interface exposure assumes (but does not mandate that) acceleration images are stored in repositories managed by the VIM(s) in order to minimize delays incurred on transferring such acceleration images.

Table 5.3.4-1 specifies requirements applicable to the Acceleration Image Management interface produced by the NFVI on the Nf-Vi reference point.

Table 5.3.4-1: Acceleration Image Management interface requirements

Numbering	Requirement
Nf-Vi-Acc. Im.001	The Acceleration Image Management interface produced by the NFVI on the Nf-Vi reference point shall support onloading the acceleration image from the acceleration image repository managed by the VIM to the programmable hardware accelerator(s).

6 VIM exposed interface

There are no interfaces exposed by the VIM associated to the Nf-Vi reference point.

7 NFVI exposed interfaces

7.1 Introduction

This clause defines the interfaces exposed by the NFVI towards the VIM over the Nf-Vi reference point and the operations related to the interfaces.

7.2 Acceleration Resource Lifecycle Management interface

7.2.1 Description

This interface allows the VIM to invoke acceleration resource lifecycle management operations towards the NFVI.

The following operations are defined:

- Allocate acceleration resource
- Release acceleration resource
- Query acceleration resource
- Get statistics
- Reset statistics

7.2.2 Allocate Acceleration Resource operation

7.2.2.1 Description

This operation attaches a hardware or software accelerator to a VNFC instance.

NOTE: There are some types of acceleration resources that could be implicitly allocated to VNFC instances (e.g. an accelerator for IPsec offloading which is embedded on the NIC can be attached to a VNFC instance when creating the virtual NIC). This operation is not needed for these acceleration resources.

Table 7.2.2.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.2.2.1-1: Allocate Acceleration Resource operation

Message	Requirement	Direction
AllocateAccResourceRequest	Mandatory	VIM → NFVI
AllocateAccResourceResponse	Mandatory	NFVI → VIM

7.2.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.2.2-1.

Table 7.2.2.2-1: Allocate Acceleration Resource operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
attachTargetInfo	M	1		Information on the resource the accelerator is to be attached to. The resource can be a virtual machine, an OS container, a virtual network interface of a virtual machine, etc.
accResourceInfo	CM	1	AccResourceInfo	Information of the accelerator.

7.2.2.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.2.3-1.

Table 7.2.2.3-1: Allocate Acceleration Resource operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
accResourceId	M	1	Identifier	It indicates the acceleration resource that is successfully allocated.

7.2.2.4 Operation results

In case of success, a hardware or software accelerator is attached to a VNFC instance. In case of failure, appropriate error information is returned.

7.2.3 Release Acceleration Resource operation

7.2.3.1 Description

This operation detaches a hardware or software accelerator from a VNFC instance.

Table 7.2.3.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.2.3.1-1: Allocate Acceleration Resource operation

Message	Requirement	Direction
ReleaseAccResourceRequest	Mandatory	VIM → NFVI
ReleaseAccResourceResponse	Mandatory	NFVI → VIM

7.2.3.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.3.2-1.

Table 7.2.3.2-1: Release Acceleration Resource operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
accResourceId	M	1	Identifier	The identifier of the acceleration resource to be released.

7.2.3.3 Output parameters

No output parameters.

7.2.3.4 Operation results

In case of success, a hardware or software accelerator is detached from a VNFC instance. In case of failure, appropriate error information is returned.

7.2.4 Query Acceleration Resource operation

7.2.4.1 Description

This operation is used to get the information of the accelerators in a specific host.

Table 7.2.4.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.2.4.1-1: Query Acceleration Resource operation

Message	Requirement	Direction
QueryAccResourceRequest	Mandatory	VIM → NFVI
QueryAccResourceResponse	Mandatory	NFVI → VIM

7.2.4.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.4.2-1.

Table 7.2.4.2-1: Query Acceleration Resource operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
hostId	M	1	Identifier	Identifier of the specified host.
Filter	M	0..1	Filter	Filter defining the accelerators on which the query applies.

7.2.4.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.4.3-1.

Table 7.2.4.3-1: Query Acceleration Resource operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
accQueryResult	M	0..N	AccResourceInfo	Details of the accelerators matching the input filter located in the selected host.

7.2.4.4 Operation results

In case of success, the VIM gets the information of the accelerators matching the filter in a specific host. In case of failure, appropriate error information is returned.

7.2.5 Get Statistics operation

7.2.5.1 Description

This operation is used to get the statistics of the accelerators in a specific host.

Table 7.2.5.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.2.5.1-1: Get statistics operation

Message	Requirement	Direction
GetAccStatisticsRequest	Mandatory	VIM → NFVI
GetAccStatisticsResponse	Mandatory	NFVI → VIM

7.2.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.5.2-1.

Table 7.2.5.2-1: Get statistics operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
hostId	M	1	Identifier	Identifier of the specified host.
Filter	M	0..1	Filter	Filter defining the accelerators on which the query applies.

7.2.5.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.2.5.3-1.

Table 7.2.5.3-1: Get statistics operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
accStatistics	M	0..N	AccStatistics	Statistics data of the accelerators matching the input filter located in the selected host.

7.2.5.4 Operation results

In case of success, the VIM gets the statistics of the accelerators matching the filter in a specific host. In case of failure, appropriate error information is returned.

7.2.6 Reset statistics operation

7.2.6.1 Description

This operation is used to reset the statistics of the accelerators in a specific host.

Table 7.2.6.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.2.6.1-1: Reset statistics operation

Message	Requirement	Direction
ResetAccStatisticsRequest	Mandatory	VIM → NFVI
ResetAccStatisticsResponse	Mandatory	NFVI → VIM

7.2.6.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.2.6.2-1.

Table 7.2.6.2-1: Reset statistics operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
hostId	M	1	Identifier	Identifier of the specified host.
Filter	M	0..1	Filter	Filter defining the accelerators on which the request applies.

7.2.6.3 Output parameters

No output parameter.

7.2.6.4 Operation results

In case of success, the VIM resets the statistics of the accelerators matching the filter in a specific host. In case of failure, appropriate error information is returned.

7.3 Acceleration Resource Fault Management interface

7.3.1 Description

This interface allows the VIM to receive alarm notifications and collect fault information from the NFVI.

The following operations are defined:

- Subscribe
- Terminate Subscription
- Notify
- Get alarm information

7.3.2 Subscribe operation

7.3.2.1 Description

This operation enables the VIM to subscribe for notifications related to alarms and the state changes of the alarms resulting from the acceleration resources faults within the NFVI.

Table 7.3.2.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.3.2.1-1: Subscribe operation

Message	Requirement	Direction
SubscribeRequest	Mandatory	VIM → NFVI
SubscribeResponse	Mandatory	NFVI → VIM

7.3.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.2.2-1.

Table 7.3.2.2-1: Subscribe operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
hostId	M	1	Identifier	Identifier of the specified host.
filter	M	1	Filter	Filter selecting the accelerators and related alarms. The filter could include accelerator information, severity of the alarm, etc.

NOTE: Specification of filtering mechanism is left for the protocol design stage.

7.3.2.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.2.3-1.

Table 7.3.2.3-1: Subscribe operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
subscriptionId	M	1	Identifier	Identifier of the successfully created subscription.

7.3.2.4 Operation results

In case of success, the VIM subscribes for notifications related to fault alarms of acceleration resources in a specific host. In case of failure, appropriate error information is returned.

7.3.3 Terminate subscription operation

7.3.3.1 Description

This operation enables the VIM to terminate the subscription for notifications related to alarms and the state changes of the alarms resulting from the acceleration resources faults within the NFVI.

Table 7.3.3.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.3.3.1-1: Terminate Subscription operation

Message	Requirement	Direction
UnsubscribeRequest	Mandatory	VIM → NFVI
UnsubscribeResponse	Mandatory	NFVI → VIM

7.3.3.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.3.2-1.

Table 7.3.3.2-1: Terminate Subscription operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
hostId	M	1	Identifier	Identifier of the specified host.
subscriptionId	M	1	Identifier	Identifier of the subscription to be unsubscribed.

7.3.3.3 Output parameters

None.

7.3.3.4 Operation results

After successful termination of a subscription, the identified subscription does not exist anymore, and the VIM will not receive notifications related to that subscription any longer. The result of the operation shall indicate if the subscription termination has been successful or not with a standard success/error result.

7.3.4 Notify operation

This operation distributes notifications to subscribers. It's a one-way operation issued by the NFVI that cannot be invoked by VIM.

Table 7.3.4.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.3.4.1-1: Notify operation

Message	Requirement	Direction
Notify	Mandatory	NFVI → VIM

The following notifications can be notified by this operation:

- AlarmNotification. See clause 8.3.2.
- AlarmClearedNotification. See clause 8.3.3.

7.3.5 Get alarm information operation

7.3.5.1 Description

This operation enables the VIM to query the alarms from the NFVI.

Table 7.3.5.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.3.5.1-1: Get alarm information operation

Message	Requirement	Direction
GetAlarmInfoRequest	Mandatory	VIM → NFVI
GetAlarmInfoResponse	Mandatory	NFVI → VIM

7.3.5.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.3.5.2-1.

Table 7.3.5.2-1: Get alarm information operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
hostId	M	1	Identifier	Identifier of the specified host.
filter	M	1	Filter	Filter selecting the accelerators and related alarms. The filter could include accelerator information, severity of the alarm, etc.

NOTE: Specification of filtering mechanism is left for the protocol design stage.

7.3.5.3 Output parameters

The output parameters returned by the operation shall follow the indications provided in table 7.3.5.3-1.

Table 7.3.5.3-1: Get alarm information operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
alarm	M	0..N	Alarm	Information about the alarms. The cardinality can be "0", if no alarm matches the filter.

7.3.5.4 Operation results

In case of success, the VIM retrieves the information of the alarms related to acceleration resource faults in a specific host. In case of failure, appropriate error information is returned.

7.4 Acceleration Image Management interface

7.4.1 Description

This interface allows the VIM to invoke acceleration image management operations towards the NFVI.

The following operations are defined:

- Onload acceleration image.

7.4.2 Onload Acceleration Image operation

7.4.2.1 Description

This operation allows VIM to onload the acceleration image to programmable hardware accelerator for the acceleration requesting VNF instance.

Table 7.4.2.1-1 lists the information flow exchanged between the NFVI and the VIM.

Table 7.4.2.1-1: Onload Acceleration Image operation

Message	Requirement	Direction
OnloadAcclImageRequest	Mandatory	VIM → NFVI
OnloadAcclImageResponse	Mandatory	NFVI → VIM

7.4.2.2 Input parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.4.2.2-1.

Table 7.4.2.2-1: Onload Acceleration Image operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
accResourceId	M	1	Identifier	Identifier of the chosen accelerator in the NFVI. See note.
acclmageInfo	M	1	AcclmageInfo	Information about the acceleration image. See clause 8.4.2.
acclmage	M	0...1		The binary file of acceleration image. This attribute present only if the acceleration image is stored in repository managed by the VIM.

NOTE: This operation can only be applied to programmable hardware accelerator(s).

7.4.2.3 Output parameters

No output parameters.

7.4.2.4 Operation results

In case of success, the acceleration image is loaded into the hardware accelerator for the acceleration requesting VNF instance. In case of failure, appropriate error information is returned.

7.5 Acceleration Resource Discovery Interface

7.5.1 Description

This interface allows the VIM to discover available acceleration resources within the NFVI.

The following operations are defined:

- Acceleration resource discovery

Support for this interface is optional, because there might be other mechanisms (including manual ones) which the VIM can use in order to discover acceleration resources within NFVI.

The mechanism of how the NFVI collects the information about the available acceleration resources is out of the scope of the present document.

7.5.2 Acceleration Resource Discovery operation

7.5.2.1 Description

This operation enables the VIM to discover acceleration resources available within a particular NFVI.

Table 7.5.2.1-1 lists the information flow exchanged between the NFVI and the VIM during that operation.

Table 7.5.2.1-1: AccResourcesDiscovery operation

Message	Requirement	Direction
AccResourcesDiscoveryRequest	Mandatory	VIM → NFVI
AccResourcesDiscoveryResponse	Mandatory	NFVI → VIM

7.5.2.2 Input Parameters

The input parameters sent when invoking the operation shall follow the indications provided in table 7.5.2.2-1.

Table 7.5.2.2-1: Acceleration Resource Discovery operation input parameters

Parameter	Qualifier	Cardinality	Content	Description
hostId	M	1	Identifier	Identifier of the specified host.

7.5.2.3 Output Parameters

The output parameters sent when invoking the operation shall follow the indications provided in table 7.5.2.3-1.

Table 7.5.2.3-1: Acceleration Resource Discovery operation output parameters

Parameter	Qualifier	Cardinality	Content	Description
discoveredAccResourceInfo	M	0 ... N	AccResourceInfo	Information on the discovered acceleration resources within the NFVI.

7.5.2.4 Operation Results

The number of returned AccResourceInfo will determine the number of resources available within the NFVI.

8 Information elements associated with Nf-Vi interface

8.1 Introduction

This clause defines, or references, definitions of information elements used in the interfaces defined in the present document.

The specification of the following information elements is left for the protocol design stage:

- String
- Integer
- Identifier
- Filter
- DateTime

- Value
- Version
- KeyValuePair

8.2 Information elements related to Acceleration Resource Lifecycle Management

8.2.1 Introduction

This clause defines information elements related to Acceleration Resource Lifecycle Management.

8.2.2 AccResourceInfo information element

8.2.2.1 Description

This information element provides the details of an accelerator.

8.2.2.2 Attributes

The AccResourceInfo information element shall follow the indications provided in table 8.2.2.2-1.

Table 8.2.2.2-1: Attributes of the AccResourceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
accResourceId	M	1	Identifier	Identifier of the accelerator. (hardware or software).
accCapability	M	0..1	AccelerationCapability	Description of the abstracted capabilities of the accelerator.
devicePlatInfo	M	0..1	DevicePlatInfo	Information of the device/platform which the accelerator can run on.
isRemote	O	0..1	Boolean	Whether the accelerator is located in the same server with the VNFC instance. If not provided, the accelerator is considered as not remote, i.e. the accelerator locates in the same server with the VNFC instance).
isSoftware	M	0..1	Boolean	This identifies if the resource is a software or hardware one.
accPlatRources	M	0 .. N	AccPlatResources	Information about the platform resources that are available/required for/by the accelerator.
additionalParams	M	0..N	KeyValuePair	Additional parameters passed by the VIM.

8.2.3 AccelerationCapability information element

8.2.3.1 Description

This information element provides information of the abstracted capabilities of the accelerator.

8.2.3.2 Attributes

The AccelerationCapaibility information element shall follow the indications provided in table 8.2.3.2-1.

Table 8.2.3.2-1: Attributes of the AccelerationCapability information element

Attribute	Qualifier	Cardinality	Content	Description
subSysCapabilities	M	1..N	SubSysCapabilities	Details of the capabilities per sub-system.
accCapabilities	M	0..N	KeyValuePair	Non sub-system capabilities.

8.2.4 DevicePlatInfo information element

8.2.4.1 Description

This information element provides detailed information of the accelerator device.

8.2.4.2 Attributes

The DevicePlatInfo information element shall follow the indications provided in table 8.2.4.2-1.

Table 8.2.4.2-1: Attributes of the DeviceInfo information element

Attribute	Qualifier	Cardinality	Content	Description
devicePlatId	M	1	Identifier	An identifier for the device/platform which the accelerator can run on.
devicePlatType	M	1	Enum	Type of the accelerator, for example, a fixed device such as a SmartNIC or a platform such as GPU, FPGA.
devicePlatVendor	M	1	Identifier	An identifier of the vendor of the acceleration device/platform.
devicePlatModel	M	1	identifier	An identifier of the model of the acceleration device/platform.
devicePlatAddress	M	0..N	KeyValuePair	The address(es) of the accelerator devices or platforms, for example, MAC address, PCI address, etc. This is required for hardware acceleration only and not for software acceleration.
devicePlatDefinedData	M	0..N	KeyValuePair	Additional parameters that provides more details about the device/platform requested or discovered.

8.2.5 AccStatistics information element

8.2.5.1 Description

This information element provides the statistics data of an accelerator.

8.2.5.2 Attributes

The AccStatistics information element shall follow the indications provided in table 8.2.5.2-1.

Table 8.2.5.2-1: Attributes of the AccStatistics information element

Attribute	Qualifier	Cardinality	Content	Description
accResourceId	M	1	Identifier	Identifier of the accelerator.
subSysStatistics	M	1..N	SubSysStatistics	Collected statistics per sub-system.
accStatistics	M	0..N	KeyValuePair	Non sub-system statistics.

8.2.6 SubSysStatistics information element

8.2.6.1 Description

This information element provides the statistics data of the sub-system of an accelerator.

8.2.6.2 Attributes

The SubSysStatistics information element shall follow the indications provided in table 8.2.6.2-1.

Table 8.2.6.2-1: Attributes of the SubSysStatistics information element

Attribute	Qualifier	Cardinality	Content	Description
subSysName	M	1	String	Name of the sub-system.
userDefinedData	M	1..N	KeyValuePair	Statistics information of the sub-system of the accelerator.

8.2.7 SubSysCapabilities information element

8.2.7.1 Description

This information element provides the details of the accelerator sub system capabilities of an existing accelerator.

8.2.7.2 Attributes

The SubSysCapabilities information element shall follow the indications provided in table 8.2.7.2-1.

Table 8.2.7.2-1: Attributes of the SubSysCapabilities information element

Attribute	Qualifier	Cardinality	Content	Description
subSysName	M	1	String	Name of sub system.
userDefinedData	M	0... N	KeyValuePair	Capabilities of the sub-system.

8.3 Information elements related to Acceleration Resource Fault Management

8.3.1 Introduction

This clause defines information elements related to Acceleration Resource Fault Management.

8.3.2 AlarmNotification information element

8.3.2.1 Description

This notification informs the subscriber about a fault occurred or changed within the acceleration resources in the NFVI.

8.3.2.2 Trigger conditions

- An alarm has been created.
- An alarm has been updated, e.g. the severity of the alarm has changed.

8.3.2.3 Attributes

The AlarmNotification information element shall follow the indications provided in table 8.3.2.3-1.

Table 8.3.2.3-1: Attributes of the AlarmNotification information element

Attribute	Qualifier	Cardinality	Content	Description
alarm	M	1	Alarm	Information about the alarm.

8.3.3 AlarmClearedNotification information element

8.3.3.1 Description

This notification informs the subscriber that a fault has been solved and the corresponding alarm is marked as "cleared".

8.3.3.2 Trigger conditions

- An alarm has been cleared.

8.3.3.3 Attributes

The AlarmClearedNotification information element shall follow the indications provided in table 8.3.3.3-1.

Table 8.3.3.3-1: Attributes of the AlarmClearedNotification information element

Attribute	Qualifier	Cardinality	Content	Description
alarmId	M	1	Identifier	Identifier of the alarm.
alarmClearedTime	M	1	DateTime	Timestamp indicating when the alarm was cleared.

8.3.4 Alarm information element

8.3.4.1 Description

This information element contains the information about an alarm corresponding to a fault related to the acceleration resources in the NFVI.

8.3.4.2 Attributes

The Alarm information element shall follow the indications provided in table 8.3.4.2-1.

Table 8.3.4.2-1: Attributes of the Alarm information element

Attribute	Qualifier	Cardinality	Content	Description
alarmId	M	1	Identifier	Identifier of the alarm.
hostId	M	1	Identifier	Identifier of the host where the accelerator locates.
accResourceId	M	1	Identifier	Identifier of the accelerator.
alarmRaisedTime	M	1	DateTime	Timestamp indicating when the alarm is first raised.
alarmChangedTime	M	0..1	DateTime	Timestamp indicating when the alarm was last changed.
alarmClearedTime	M	0..1	DateTime	Timestamp indicating when the alarm was cleared.
state	M	1	Enum	State of the alarm. For example, "fired", "updated", "cleared".
severity	M	1	Enum	Severity of the fault. For example, "critical", "major", "minor", "warning", "indeterminate", "cleared".
faultType	M	1	String	Type of the fault.
probableCause	M	1	String	Probable cause of the fault.
details	O	0..1		Vendor-provided additional information about the fault.
isRootCause	O	1	Boolean	Parameter indicating if this fault is the root for other correlated alarms. If TRUE, then the alarms listed in the parameter correlatedAlarmId are caused by this fault.
correlatedAlarmId	O	0..N	Identifier	List of other alarms correlated to this fault.

NOTE: The content of "details" is left for further study.

8.4 Information elements related to Acceleration Image Management

8.4.1 Introduction

This clause defines information elements related to acceleration image management.

8.4.2 AccImageInfo information element

8.4.2.1 Description

This information element presents the information of an acceleration image.

8.4.2.2 Attributes

The AccImageInfo information element shall follow the indications provided in table 8.4.2.2-1.

Table 8.4.2.2-1: Attributes of the AcclmageInfo information element

Attribute	Qualifier	Cardinality	Content	Description
acclmageId	M	1	Identifier	Identifier of the acceleration image.
acclmageName	M	1	String	Name of the acceleration image.
acclmageProvider	M	1	String	The provider of the acceleration image, usually it is same as the accelerator provider.
acclmageVersion	M	1	Version	The version of the acceleration image.
devPlatInfo	M	1	DevicePlatInfo	Information about the device/platform which the image is intended to run on.
acclmageCapability	M	1..N	AccelerationCapability	Description of the abstracted capabilities supported on the image. See note. AccelerationCapability is defined in clause 8.2.3.
acclmageAccess	M	0..1		Access information (such as a URL, a path to the accelerator image storage) that allows NFVI to access a copy of this acceleration image artifact. This attribute presents only if the acceleration image is not stored in the repository managed by the VIM.
reqAccPlatResources	M	0 .. 1	AccPlatResources	Platform resources such as internal RAM, DSP Blocks, number of cores, bandwidth which the acceleration image requires in a platform to run on.
userMetadata	O	0..N	KeyValuePair	User-defined metadata.

NOTE: The AccelerationCapability content at least includes the capabilities supported on the acceleration image and the corresponding capacities of the capabilities.

8.5 Information elements related to Acceleration Resources Discovery

8.5.1 AccPlatResources information element

8.5.1.1 Description

This information element provides the details of the resources available by the platform for a given acceleration resource.

8.5.1.2 Attributes

The AccPlatResources information element shall follow the indications provided in table 8.5.1.2-1.

Table 8.5.1.2-1: Attributes of the AccPlatResources information element

Attribute	Qualifier	Cardinality	Content	Description
platDefinedResources	M	1..N	KeyValuePair	Platform resources, such as internal memories, DSP blocks, cores, etc.

Annex A (informative): An implementation example for the acceleration image management

A.1 Introduction

This annex provides the illustrative text to support the acceleration image management part in the present document. It aims to facilitate a better understanding on why the acceleration image management interface and information models are needed.

NOTE: This annex is only an implementation example of the acceleration image management, not a recommendation nor a normative design.

A.2 Overview

Besides of managing the NFVI compute, storage and network resources, the VIM is also responsible for controlling and managing the NFVI acceleration resources, which includes the physical acceleration resources (e.g. accelerator type, capability, capacity, etc.) as well as the corresponding acceleration images.

Upon receiving a request for acceleration resource allocation, the VIM looks up the acceleration resource repository as well as the acceleration image repository to select the most appropriate accelerator and the corresponding acceleration image running on the chosen accelerator to meet the acceleration requirements (at least including acceleration capability and capacity requirements) from the acceleration requesting VNF. After that, the VIM notifies the NFVI the chosen accelerator and enables the NFVI to receive the corresponding acceleration image from the acceleration image repository.

NOTE: The acceleration images only fit the programmable hardware accelerators like NPU, FPGA, rather than the customized accelerator like ASIC. If the chosen accelerator belongs to the latter, the acceleration image procedure is skipped.

The document assumes the acceleration images are stored in the acceleration image repository managed by the VIM in order to minimize delays incurred on transferring such acceleration images. But if not, the access information (such as an URL, a path to the acceleration image storage) that allows the NFVI to access the acceleration images is necessary. What protocol is used by the NFVI to access the acceleration images is out of scope of the present document.

A.3 Architecture

This clause depicts how these relevant functional blocks work together to form a complete acceleration image management system.

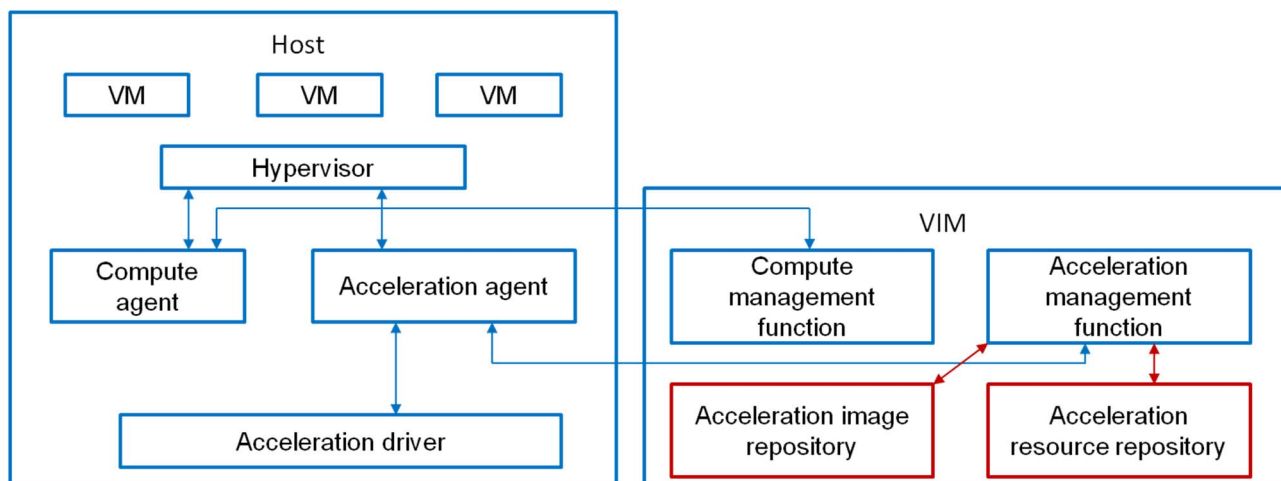


Figure A.3-1: Acceleration image management architecture example

In the acceleration image management, figure A.3-1 complements a couple of functional blocks (red rectangles) to figure B.2.1-1 (acceleration management architecture example) in ETSI GS NFV-IFA 004 [i.2].

The acceleration resource repository holds information of all available acceleration resources. The acceleration resource information includes accelerator identifier, accelerator vendor, accelerator type, accelerator model, accelerator feature (e.g. re-programmability supporting, etc.), accelerator status (e.g. idle, occupied, partial occupied), accelerator capability, corresponding accelerator capacity as well as the identifier of host to which the accelerator attaches. While the acceleration image repository holds information of all available acceleration images. The acceleration image information includes the image identifier, provider, version, capability, corresponding capacity as well as the vendor, type and model of accelerator on which the image runs.

The two repositories are managed and maintained by the acceleration management function which selects the most appropriate accelerator and the corresponding acceleration image to meet the acceleration requirements from the acceleration requesting VNF instance.

A.4 Information flows

Figure A.4-1 shows one example of the acceleration image management information flows. The example basically keeps consistent with the information flows of acceleration resource allocation in clause B.2.2.1 of ETSI GS NFV-IFA 004 [i.2].

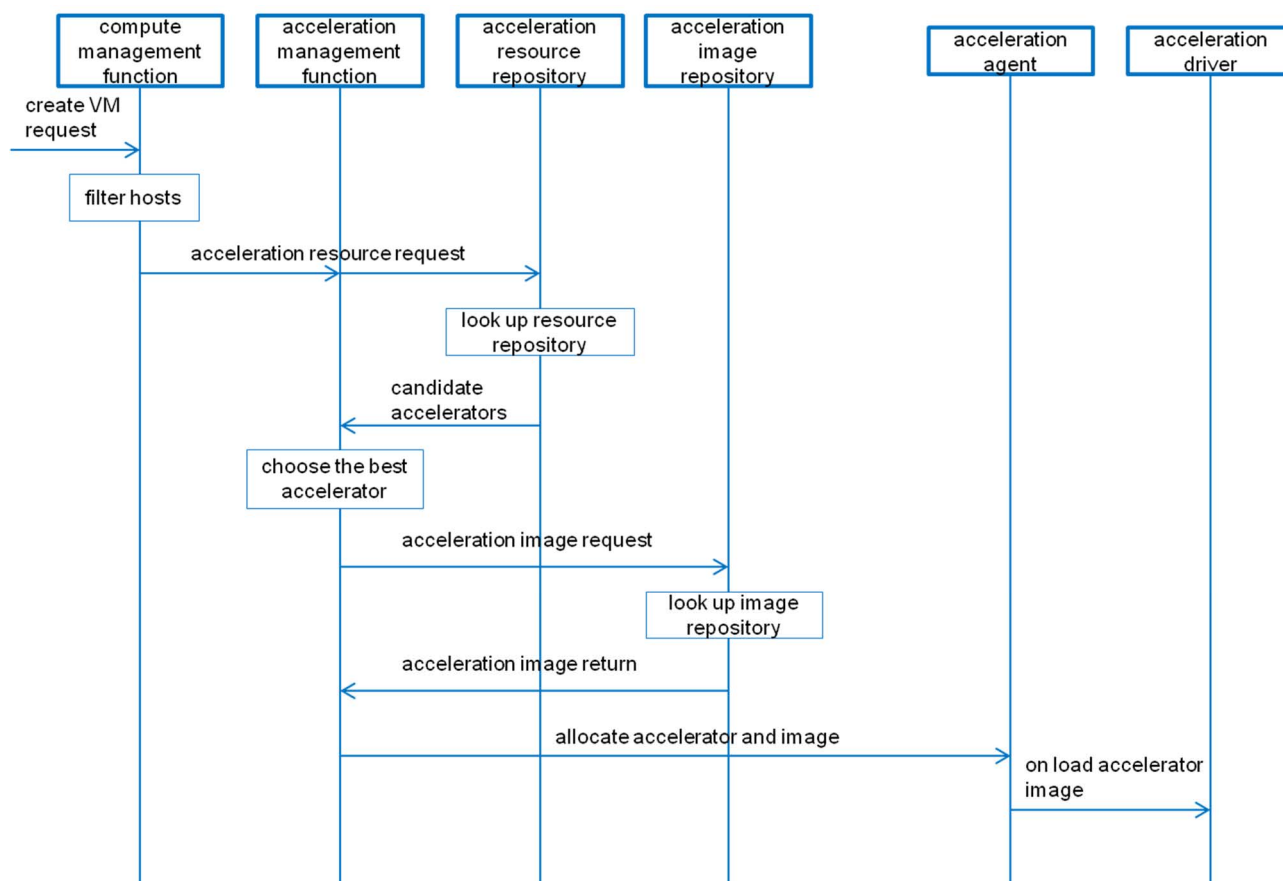


Figure A.4-1: Acceleration image management information flows example

The main steps for the acceleration image procedure are:

- 1) The compute management function receives create VM request.
- 2) The compute management function filters appropriate hosts by factors like available compute resources, storage resources, network resources.
- 3) The compute management function calls the acceleration management function to further filter the hosts by the acceleration resource constraints.
- 4) The acceleration management function relays the call to the acceleration resource repository to look up the list of accelerators among the hosts chosen by the compute management function in the 2nd step. The acceleration resource repository gets the candidate accelerator(s) which meet the acceleration requirement, e.g. having enough resource to meet throughput, latency and even forwarding table size requirements for L3 forwarding acceleration.
- 5) The acceleration resource repository returns the information of the candidate accelerator(s), such as the host attached by the candidate accelerator, accelerator vendor, accelerator type, accelerator model, accelerator feature, accelerator status, etc. to the acceleration management function.
- 6) The acceleration management function further estimates the candidate accelerator(s) and their hosts based on some kinds of policies, e.g. considering the workload on the host, the geographic position of the host, the workload on the accelerators on the host, and so on. Finally, the acceleration management function chooses the most appropriate host and its accelerator.
- 7) The acceleration management function requires the image of the chosen accelerator in the 6th step from the acceleration image repository.
- 8) The acceleration image repository looks up the list of images and gets the appropriate image of the chosen accelerator.

- 9) The acceleration image repository returns the appropriate image of the chosen accelerator to the acceleration management function.
- 10) The acceleration management function sends the chosen accelerator and image information to the acceleration agent via the onload acceleration image operation in clause 7.4.2.
- 11) The acceleration agent loads the image to the accelerator driver.

Annex B (informative): Authors & contributors

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Annex C (informative): Change History

Date	Version	Information about changes
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May 2016	0.0.2	NFVIFA(16)000693
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February 2017	0.5.0	NFVIFA(17)000014r1 NFVIFA(17)000015r3 NFVIFA(17)000031r1
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History

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