



## Network Functions Virtualisation (NFV) Release 2; Protocols and Data Models; RESTful protocols specification for the Ve-Vnfm Reference Point

### *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.

---

**Reference**DGS/NFV-SOL002

---

---

**Keywords**API, NFV, protocol

---

**ETSI**

650 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 - NAF 742 C  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° 7803/88

---

**Important notice**

---

The present document can be downloaded from:

<http://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 only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

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/CommiteeSupportStaff.aspx>

---

**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 2017.

All rights reserved.

**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 protected for the benefit of its Members.

**GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

# Contents

Intellectual Property Rights .....	14
Foreword.....	14
Modal verbs terminology.....	14
1 Scope .....	15
2 References .....	15
2.1 Normative references .....	15
2.2 Informative references.....	16
3 Definitions and abbreviations.....	17
3.1 Definitions.....	17
3.2 Abbreviations .....	17
4 General aspects.....	18
4.1 Overview .....	18
4.2 URI structure and supported content formats.....	18
4.3 Common procedures.....	19
4.3.1 Introduction.....	19
4.3.2 Attribute-based filtering.....	19
4.3.2.1 Overview and example (informative).....	19
4.3.2.2 Specification.....	20
4.3.3 Attribute selectors.....	21
4.3.3.1 Overview and example (informative).....	21
4.3.3.2 Specification.....	21
4.3.3.2.1 GET request.....	21
4.3.3.2.2 GET response .....	22
4.3.4 Usage of HTTP header fields.....	22
4.3.4.1 Introduction.....	22
4.3.4.2 Request header fields.....	22
4.3.4.3 Response header fields.....	23
4.3.5 Error reporting .....	23
4.3.5.1 Introduction.....	23
4.3.5.2 General mechanism.....	23
4.3.5.3 Type: ProblemDetails.....	23
4.3.5.4 Common error situations.....	24
4.3.5.5 Overview of HTTP error status codes.....	25
4.4 Common data types.....	26
4.4.1 Structured data types.....	26
4.4.1.1 Introduction.....	26
4.4.1.2 Type: Object.....	26
4.4.1.3 Type: Link.....	26
4.4.1.4 Type: KeyValuePairs .....	26
4.4.1.5 Type: VnfInstanceSubscriptionFilter .....	26
4.4.2 Simple data types and enumerations.....	27
4.4.2.1 Introduction.....	27
4.4.2.2 Simple data types .....	27
4.4.2.3 Enumerations .....	28
4.5 Authorization of API requests and notifications .....	28
4.5.1 Introduction.....	28
4.5.2 Flows (informative) .....	28
4.5.2.1 Authorization of API requests.....	28
4.5.2.2 Authorization of notifications using the HTTP Basic authentication scheme.....	30
4.5.2.3 Authorization of notifications using OAuth 2.0.....	31
4.5.3 Specification .....	33
4.5.3.1 Introduction.....	33
4.5.3.2 General mechanism.....	33
4.5.3.3 Authorizing API requests.....	33

4.5.3.4	Authorizing the sending of notifications .....	34
4.5.3.5	Client roles .....	35
5	VNF Lifecycle Management interface .....	35
5.1	Description .....	35
5.2	Resource structure and methods .....	36
5.3	Sequence diagrams (informative) .....	39
5.3.1	Flow of the creation of a VNF instance resource .....	39
5.3.2	Flow of the deletion of a VNF instance resource .....	40
5.3.3	Flow of VNF lifecycle management operations triggered by task resources .....	40
5.3.4	Flow of automatic invocation of VNF scaling and VNF healing .....	43
5.3.5	Flow of the Query VNF operation .....	45
5.3.6	Flow of the Modify VNF Information operation .....	46
5.3.7	Flow of the Get Operation Status operation .....	47
5.3.8	Flow of managing subscriptions .....	48
5.3.9	Flow of sending notifications .....	49
5.3.10	Flow of retrying a VNF lifecycle management operation .....	50
5.3.11	Flow of rolling back a VNF lifecycle management operation .....	51
5.3.12	Flow of failing a VNF lifecycle management operation .....	53
5.3.13	Flow of cancelling a VNF lifecycle management operation .....	54
5.4	Resources .....	55
5.4.1	Introduction .....	55
5.4.2	Resource: VNF instances .....	55
5.4.2.1	Description .....	55
5.4.2.2	Resource definition .....	56
5.4.2.3	Resource methods .....	56
5.4.2.3.1	POST .....	56
5.4.2.3.2	GET .....	56
5.4.2.3.3	PUT .....	57
5.4.2.3.4	PATCH .....	57
5.4.2.3.5	DELETE .....	58
5.4.3	Resource: Individual VNF instance .....	58
5.4.3.1	Description .....	58
5.4.3.2	Resource definition .....	58
5.4.3.3	Resource methods .....	58
5.4.3.3.1	POST .....	58
5.4.3.3.2	GET .....	58
5.4.3.3.3	PUT .....	59
5.4.3.3.4	PATCH .....	59
5.4.3.3.5	DELETE .....	60
5.4.4	Resource: Instantiate VNF task .....	61
5.4.4.1	Description .....	61
5.4.4.2	Resource definition .....	61
5.4.4.3	Resource methods .....	61
5.4.4.3.1	POST .....	61
5.4.4.3.2	GET .....	62
5.4.4.3.3	PUT .....	62
5.4.4.3.4	PATCH .....	62
5.4.4.3.5	DELETE .....	62
5.4.5	Resource: Scale VNF task .....	62
5.4.5.1	Description .....	62
5.4.5.2	Resource definition .....	63
5.4.5.3	Resource methods .....	63
5.4.5.3.1	POST .....	63
5.4.5.3.2	GET .....	64
5.4.5.3.3	PUT .....	64
5.4.5.3.4	PATCH .....	64
5.4.5.3.5	DELETE .....	64
5.4.6	Resource: Scale VNF to Level task .....	65
5.4.6.1	Description .....	65
5.4.6.2	Resource definition .....	65
5.4.6.3	Resource methods .....	65

5.4.6.3.1	POST .....	65
5.4.6.3.2	GET .....	66
5.4.6.3.3	PUT .....	66
5.4.6.3.4	PATCH.....	66
5.4.6.3.5	DELETE.....	66
5.4.7	Resource: Change VNF Flavour task .....	67
5.4.7.1	Description .....	67
5.4.7.2	Resource definition .....	67
5.4.7.3	Resource methods .....	67
5.4.7.3.1	POST .....	67
5.4.7.3.2	GET .....	68
5.4.7.3.3	PUT .....	68
5.4.7.3.4	PATCH.....	68
5.4.7.3.5	DELETE.....	68
5.4.8	Resource: Terminate VNF task.....	69
5.4.8.1	Description .....	69
5.4.8.2	Resource definition .....	69
5.4.8.3	Resource methods .....	69
5.4.8.3.1	POST .....	69
5.4.8.3.2	GET .....	70
5.4.8.3.3	PUT .....	70
5.4.8.3.4	PATCH.....	70
5.4.8.3.5	DELETE.....	70
5.4.9	Resource: Heal VNF task .....	70
5.4.9.1	Description .....	70
5.4.9.2	Resource definition .....	70
5.4.9.3	Resource methods .....	71
5.4.9.3.1	POST .....	71
5.4.9.3.2	GET .....	72
5.4.9.3.3	PUT .....	72
5.4.9.3.4	PATCH.....	72
5.4.9.3.5	DELETE.....	72
5.4.10	Resource: Operate VNF task .....	73
5.4.10.1	Description .....	73
5.4.10.2	Resource definition .....	73
5.4.10.3	Resource methods .....	73
5.4.10.3.1	POST .....	73
5.4.10.3.2	GET .....	74
5.4.10.3.3	PUT .....	74
5.4.10.3.4	PATCH.....	74
5.4.10.3.5	DELETE.....	74
5.4.11	Resource: Change external VNF connectivity task .....	75
5.4.11.1	Description .....	75
5.4.11.2	Resource definition .....	75
5.4.11.3	Resource methods .....	75
5.4.11.3.1	POST .....	75
5.4.11.3.2	GET .....	76
5.4.11.3.3	PUT .....	76
5.4.11.3.4	PATCH.....	76
5.4.11.3.5	DELETE.....	76
5.4.12	Resource: VNF LCM operation occurrences .....	76
5.4.12.1	Description .....	76
5.4.12.2	Resource definition .....	76
5.4.12.3	Resource methods .....	77
5.4.12.3.1	POST .....	77
5.4.12.3.2	GET .....	77
5.4.12.3.3	PUT .....	78
5.4.12.3.4	PATCH.....	78
5.4.12.3.5	DELETE.....	78
5.4.13	Resource: Individual VNF LCM operation occurrence .....	78
5.4.13.1	Description .....	78
5.4.13.2	Resource definition .....	78

5.4.13.3	Resource methods .....	79
5.4.13.3.1	POST .....	79
5.4.13.3.2	GET .....	79
5.4.13.3.3	PUT .....	79
5.4.13.3.4	PATCH .....	79
5.4.13.3.5	DELETE .....	80
5.4.14	Resource: Retry operation task .....	80
5.4.14.1	Description .....	80
5.4.14.2	Resource definition .....	80
5.4.14.3	Resource methods .....	80
5.4.14.3.1	POST .....	80
5.4.14.3.2	GET .....	81
5.4.14.3.3	PUT .....	81
5.4.14.3.4	PATCH .....	81
5.4.14.3.5	DELETE .....	81
5.4.15	Resource: Rollback operation task .....	82
5.4.15.1	Description .....	82
5.4.15.2	Resource definition .....	82
5.4.15.3	Resource methods .....	82
5.4.15.3.1	POST .....	82
5.4.15.3.2	GET .....	83
5.4.15.3.3	PUT .....	83
5.4.15.3.4	PATCH .....	83
5.4.15.3.5	DELETE .....	83
5.4.16	Resource: Fail operation task .....	84
5.4.16.1	Description .....	84
5.4.16.2	Resource definition .....	84
5.4.16.3	Resource methods .....	84
5.4.16.3.1	POST .....	84
5.4.16.3.2	GET .....	85
5.4.16.3.3	PUT .....	85
5.4.16.3.4	PATCH .....	85
5.4.16.3.5	DELETE .....	85
5.4.17	Resource: Cancel operation task .....	86
5.4.17.1	Description .....	86
5.4.17.2	Resource definition .....	86
5.4.17.3	Resource methods .....	86
5.4.17.3.1	POST .....	86
5.4.17.3.2	GET .....	87
5.4.17.3.3	PUT .....	87
5.4.17.3.4	PATCH .....	87
5.4.17.3.5	DELETE .....	87
5.4.18	Resource: Subscriptions .....	88
5.4.18.1	Description .....	88
5.4.18.2	Resource definition .....	88
5.4.18.3	Resource methods .....	88
5.4.18.3.1	POST .....	88
5.4.18.3.2	GET .....	89
5.4.18.3.3	PUT .....	89
5.4.18.3.4	PATCH .....	89
5.4.18.3.5	DELETE .....	89
5.4.19	Resource: Individual subscription .....	89
5.4.19.1	Description .....	89
5.4.19.2	Resource definition .....	90
5.4.19.3	Resource methods .....	90
5.4.19.3.1	POST .....	90
5.4.19.3.2	GET .....	90
5.4.19.3.3	PUT .....	90
5.4.19.3.4	PATCH .....	91
5.4.19.3.5	DELETE .....	91
5.4.20	Resource: Notification endpoint .....	91
5.4.20.1	Description .....	91

5.4.20.2	Resource definition .....	91
5.4.20.3	Resource methods .....	92
5.4.20.3.1	POST .....	92
5.4.20.3.2	GET .....	92
5.4.20.3.3	PUT .....	93
5.4.20.3.4	PATCH .....	93
5.4.20.3.5	DELETE .....	93
5.5	Data model .....	93
5.5.1	Introduction .....	93
5.5.2	Resource and notification data types .....	93
5.5.2.1	Introduction .....	93
5.5.2.2	Type: VnfInstance .....	93
5.5.2.3	Type: CreateVnfRequest .....	96
5.5.2.4	Type: InstantiateVnfRequest .....	96
5.5.2.5	Type: ScaleVnfRequest .....	97
5.5.2.6	Type: ScaleVnfToLevelRequest .....	97
5.5.2.7	Type: ChangeVnfFlavourRequest .....	97
5.5.2.8	Type: TerminateVnfRequest .....	98
5.5.2.9	Type: HealVnfRequest .....	98
5.5.2.10	Type: OperateVnfRequest .....	99
5.5.2.11	Type: ChangeExtVnfConnectivityRequest .....	99
5.5.2.12	Type: VnfInfoModifications .....	99
5.5.2.13	Type: VnfLcmOpOcc .....	101
5.5.2.14	Type: CancelMode .....	102
5.5.2.15	Type: LccnSubscriptionRequest .....	102
5.5.2.16	Type: LccnSubscription .....	103
5.5.2.17	Type: VnfLcmOperationOccurrenceNotification .....	103
5.5.2.18	Type: VnfIdentifierCreationNotification .....	105
5.5.2.19	Type: VnfIdentifierDeletionNotification .....	105
5.5.3	Referenced structured data types .....	105
5.5.3.1	Introduction .....	105
5.5.3.2	Type: ExtVirtualLinkData .....	106
5.5.3.3	Type: ExtVirtualLinkInfo .....	106
5.5.3.4	Type: ExtManagedVirtualLinkData .....	106
5.5.3.5	Type: ExtManagedVirtualLinkInfo .....	107
5.5.3.6	Type: VnfExtCpData .....	107
5.5.3.7	Type: ScaleInfo .....	107
5.5.3.8	Type: VnfcResourceInfo .....	108
5.5.3.9	Type: VnfVirtualLinkResourceInfo .....	108
5.5.3.10	Type: VirtualStorageResourceInfo .....	108
5.5.3.11	Type: VnfLinkPort .....	109
5.5.3.12	Type: ExtLinkPort .....	109
5.5.3.13	Type: ResourceHandle .....	109
5.5.3.14	Type: FixedNetworkAddressData .....	110
5.5.3.15	Type: DynamicNetworkAddressData .....	110
5.5.3.16	Type: NetworkAddressInfo .....	111
5.5.3.17	Type: MonitoringParameter .....	111
5.5.3.18	Type: LifecycleChangeNotificationsFilter .....	112
5.5.3.19	Type: AffectedVnfc .....	112
5.5.3.20	Type: AffectedVirtualLink .....	113
5.5.3.21	Type: AffectedVirtualStorage .....	114
5.5.3.22	Type: LccnLinks .....	114
5.5.3.23	Type: VnfcInfo .....	114
5.5.3.24	Type: VnfcInfoModifications .....	115
5.5.4	Referenced simple data types and enumerations .....	115
5.5.4.1	Introduction .....	115
5.5.4.2	Simple data types .....	115
5.5.4.3	Enumeration: VnfOperationalStateType .....	115
5.5.4.4	Enumeration: StopType .....	116
5.5.4.5	Enumeration: LcmOperationType .....	116
5.5.4.6	Enumeration: LcmOperationStateType .....	116
5.5.4.7	Enumeration: CancelModeType .....	116

5.6	Handling of errors during VNF lifecycle management operations.....	117
5.6.1	Basic concepts (informative) .....	117
5.6.1.1	Motivation.....	117
5.6.1.2	Failure resolution strategies: Retry and Rollback .....	117
5.6.1.3	Error handling at VNFM and EM .....	118
5.6.2	States and state transitions of a VNF lifecycle management operation occurrence.....	119
5.6.2.1	General .....	119
5.6.2.2	States of a VNF lifecycle management operation occurrence.....	119
5.6.2.3	Error handling operations that change the state of a VNF lifecycle management operation occurrence .....	122
5.6.3	Detailed flows .....	123
5.6.3.1	Immediate failure .....	123
5.6.3.2	Failure in "STARTING" state .....	123
5.6.3.3	Failure during actual LCM operation execution .....	124
5.6.3.4	LCM operation cancellation.....	126
6	VNF Performance Management interface.....	126
6.1	Description .....	126
6.2	Resource structure and methods.....	126
6.3	Sequence diagrams (informative).....	127
6.3.1	Flow of creating a PM job .....	127
6.3.2	Flow of querying/reading PM jobs .....	128
6.3.3	Flow of deleting a PM job .....	129
6.3.4	Flow of obtaining performance reports.....	129
6.3.5	Flow of creating a threshold .....	130
6.3.6	Flow of querying/reading thresholds .....	131
6.3.7	Flow of deleting thresholds.....	132
6.3.8	Flow of managing subscriptions .....	132
6.3.9	Flow of sending notifications.....	134
6.4	Resources .....	135
6.4.1	Introduction.....	135
6.4.2	Resource: PM jobs .....	135
6.4.2.1	Description .....	135
6.4.2.2	Resource definition .....	135
6.4.2.3	Resource methods .....	135
6.4.2.3.1	POST .....	135
6.4.2.3.2	GET .....	136
6.4.2.3.3	PUT .....	136
6.4.2.3.4	PATCH.....	137
6.4.2.3.5	DELETE .....	137
6.4.3	Resource: Individual PM job .....	137
6.4.3.1	Description .....	137
6.4.3.2	Resource definition .....	137
6.4.3.3	Resource methods .....	137
6.4.3.3.1	POST .....	137
6.4.3.3.2	GET .....	137
6.4.3.3.3	PUT .....	138
6.4.3.3.4	PATCH.....	138
6.4.3.3.5	DELETE .....	138
6.4.4	Resource: Individual performance report .....	139
6.4.4.1	Description .....	139
6.4.4.2	Resource definition .....	139
6.4.4.3	Resource methods .....	139
6.4.4.3.1	POST .....	139
6.4.4.3.2	GET .....	139
6.4.4.3.3	PUT .....	140
6.4.4.3.4	PATCH.....	140
6.4.4.3.5	DELETE .....	140
6.4.5	Resource: Thresholds.....	140
6.4.5.1	Description .....	140
6.4.5.2	Resource definition .....	140
6.4.5.3	Resource methods .....	140



6.4.5.3.1	POST .....	140
6.4.5.3.2	GET .....	141
6.4.5.3.3	PUT .....	142
6.4.5.3.4	PATCH.....	142
6.4.5.3.5	DELETE.....	142
6.4.6	Resource: Individual threshold .....	142
6.4.6.1	Description .....	142
6.4.6.2	Resource definition .....	142
6.4.6.3	Resource methods .....	143
6.4.6.3.1	POST .....	143
6.4.6.3.2	GET .....	143
6.4.6.3.3	PUT .....	143
6.4.6.3.4	PATCH.....	143
6.4.6.3.5	DELETE.....	143
6.4.7	Resource: Subscriptions.....	144
6.4.7.1	Description .....	144
6.4.7.2	Resource definition .....	144
6.4.7.3	Resource methods .....	144
6.4.7.3.1	POST .....	144
6.4.7.3.2	GET .....	145
6.4.7.3.3	PUT .....	146
6.4.7.3.4	PATCH.....	146
6.4.7.3.5	DELETE.....	146
6.4.8	Resource: Individual subscription.....	146
6.4.8.1	Description .....	146
6.4.8.2	Resource definition .....	146
6.4.8.3	Resource methods .....	146
6.4.8.3.1	POST .....	146
6.4.8.3.2	GET .....	146
6.4.8.3.3	PUT .....	147
6.4.8.3.4	PATCH.....	147
6.4.8.3.5	DELETE.....	147
6.4.9	Resource: Notification endpoint .....	148
6.4.9.1	Description .....	148
6.4.9.2	Resource definition .....	148
6.4.9.3	Resource methods .....	148
6.4.9.3.1	POST .....	148
6.4.9.3.2	GET .....	149
6.4.9.3.3	PUT .....	149
6.4.9.3.4	PATCH.....	149
6.4.9.3.5	DELETE.....	149
6.5	Data Model.....	149
6.5.1	Introduction.....	149
6.5.2	Resource and notification data types .....	149
6.5.2.1	Introduction .....	149
6.5.2.2	Type: PmSubscriptionRequest .....	150
6.5.2.3	Type: PmSubscription.....	150
6.5.2.4	Type: ThresholdCrossedNotification .....	150
6.5.2.5	Type: PerformanceInformationAvailableNotification .....	151
6.5.2.6	Type: CreatePmJobRequest .....	152
6.5.2.7	Type: PmJob .....	152
6.5.2.8	Type: CreateThresholdRequest .....	153
6.5.2.9	Type: Threshold .....	153
6.5.2.10	Type: PerformanceReport .....	153
6.5.3	Referenced structured data types .....	154
6.5.3.1	Introduction .....	154
6.5.3.2	Type: PmNotificationsFilter.....	154
6.5.3.3	Type: PmJobCriteria .....	155
6.5.3.4	Type: ThresholdCriteria .....	155
6.5.4	Referenced simple data types and enumerations .....	156
6.5.4.1	Introduction.....	156
6.5.4.2	Simple data types .....	156

6.5.4.3	Enumeration: CrossingDirectionType.....	156
7	VNF Fault Management interface.....	156
7.1	Description.....	156
7.2	Resource structure and methods.....	156
7.3	Sequence diagrams (informative).....	157
7.3.1	Flow of the Get Alarm List operation.....	157
7.3.2	Escalate perceived severity task flow.....	158
7.3.3	Flow of acknowledging alarm.....	159
7.3.4	Flow of managing subscriptions.....	159
7.3.5	Flow of sending notifications.....	161
7.4	Resources.....	162
7.4.1	Introduction.....	162
7.4.2	Resource: Alarms.....	162
7.4.2.1	Description.....	162
7.4.2.2	Resource definition.....	162
7.4.2.3	Resource methods.....	162
7.4.2.3.1	POST.....	162
7.4.2.3.2	GET.....	162
7.4.2.3.3	PUT.....	163
7.4.2.3.4	PATCH.....	163
7.4.2.3.5	DELETE.....	163
7.4.3	Resource: Individual alarm.....	163
7.4.3.1	Description.....	163
7.4.3.2	Resource definition.....	163
7.4.3.3	Resource methods.....	164
7.4.3.3.1	POST.....	164
7.4.3.3.2	GET.....	164
7.4.3.3.3	PUT.....	164
7.4.3.3.4	PATCH.....	164
7.4.3.3.5	DELETE.....	165
7.4.4	Resource: Escalate Perceived Severity task.....	165
7.4.4.1	Description.....	165
7.4.4.2	Resource definition.....	165
7.4.4.3	Resource Methods.....	166
7.4.4.3.1	POST.....	166
7.4.4.3.2	GET.....	166
7.4.4.3.3	PUT.....	166
7.4.4.3.4	PATCH.....	166
7.4.4.3.5	DELETE.....	166
7.4.5	Resource: Subscriptions.....	167
7.4.5.1	Description.....	167
7.4.5.2	Resource definition.....	167
7.4.5.3	Resource methods.....	167
7.4.5.3.1	POST.....	167
7.4.5.3.2	GET.....	168
7.4.5.3.3	PUT.....	168
7.4.5.3.4	PATCH.....	168
7.4.5.3.5	DELETE.....	168
7.4.6	Resource: Individual subscription.....	168
7.4.6.1	Description.....	168
7.4.6.2	Resource definition.....	169
7.4.6.3	Resource methods.....	169
7.4.6.3.1	POST.....	169
7.4.6.3.2	GET.....	169
7.4.6.3.3	PUT.....	169
7.4.6.3.4	PATCH.....	170
7.4.6.3.5	DELETE.....	170
7.4.7	Resource: Notification endpoint.....	170
7.4.7.1	Description.....	170
7.4.7.2	Resource definition.....	170
7.4.7.3	Resource methods.....	170

7.4.7.3.1	POST .....	170
7.4.7.3.2	GET .....	171
7.4.7.3.3	PUT .....	172
7.4.7.3.4	PATCH .....	172
7.4.7.3.5	DELETE .....	172
7.5	Data Model .....	172
7.5.1	Introduction .....	172
7.5.2	Resource and notification data types .....	172
7.5.2.1	Introduction .....	172
7.5.2.2	Type: FmSubscriptionRequest .....	172
7.5.2.3	Type: FmSubscription .....	173
7.5.2.4	Type: Alarm .....	173
7.5.2.5	Type: AlarmNotification .....	174
7.5.2.6	Type: AlarmClearedNotification .....	174
7.5.2.7	Type: PerceivedSeverityRequest .....	174
7.5.2.8	Type: AlarmListRebuiltNotification .....	175
7.5.2.9	Type: AlarmModifications .....	175
7.5.3	Referenced structured data types .....	175
7.5.3.1	Introduction .....	175
7.5.3.2	Type: FmNotificationsFilter .....	175
7.5.3.3	Type: FaultyResourceInfo .....	176
7.5.4	Referenced simple data types and enumerations .....	176
7.5.4.1	Introduction .....	176
7.5.4.2	Simple data types .....	176
7.5.4.3	Enumeration: PerceivedSeverityType .....	176
7.5.4.4	Enumeration: EventType .....	177
7.5.4.5	Enumeration: FaultyResourceType .....	177
8	VNF Indicator interface .....	178
8.1	Description .....	178
8.2	Resource structure and methods .....	178
8.3	Sequence diagrams (informative) .....	179
8.3.1	Flow of querying VNF indicators .....	179
8.3.2	Flow of reading a VNF indicator .....	180
8.3.3	Flow of managing subscriptions .....	180
8.3.4	Flow of sending notifications .....	182
8.4	Resources .....	183
8.4.1	Introduction .....	183
8.4.2	Resource: VNF indicators .....	183
8.4.2.1	Description .....	183
8.4.2.2	Resource definition .....	183
8.4.2.3	Resource methods .....	183
8.4.2.3.1	POST .....	183
8.4.2.3.2	GET .....	183
8.4.2.3.3	PUT .....	184
8.4.2.3.4	PATCH .....	184
8.4.2.3.5	DELETE .....	184
8.4.3	Resource: VNF indicators related to a VNF instance .....	184
8.4.3.1	Description .....	184
8.4.3.2	Resource definition .....	184
8.4.3.3	Resource methods .....	185
8.4.3.3.1	POST .....	185
8.4.3.3.2	GET .....	185
8.4.3.3.3	PUT .....	185
8.4.3.3.4	PATCH .....	185
8.4.3.3.5	DELETE .....	185
8.4.4	Resource: Individual VNF indicator .....	186
8.4.4.1	Description .....	186
8.4.4.2	Resource definition .....	186
8.4.4.3	Resource methods .....	186
8.4.4.3.1	POST .....	186
8.4.4.3.2	GET .....	186

8.4.4.3.3	PUT .....	187
8.4.4.3.4	PATCH.....	187
8.4.4.3.5	DELETE.....	187
8.4.5	Resource: Subscriptions.....	187
8.4.5.1	Description.....	187
8.4.5.2	Resource definition .....	187
8.4.5.3	Resource methods .....	187
8.4.5.3.1	POST .....	187
8.4.5.3.2	GET .....	188
8.4.5.3.3	PUT .....	189
8.4.5.3.4	PATCH.....	189
8.4.5.3.5	DELETE.....	189
8.4.6	Resource: Individual subscription.....	189
8.4.6.1	Description.....	189
8.4.6.2	Resource definition .....	189
8.4.6.3	Resource methods .....	190
8.4.6.3.1	POST .....	190
8.4.6.3.2	GET .....	190
8.4.6.3.3	PUT .....	190
8.4.6.3.4	PATCH.....	190
8.4.6.3.5	DELETE.....	190
8.4.7	Resource: Notification endpoint .....	191
8.4.7.1	Description .....	191
8.4.7.2	Resource definition .....	191
8.4.7.3	Resource methods .....	191
8.4.7.3.1	POST .....	191
8.4.7.3.2	GET .....	192
8.4.7.3.3	PUT .....	192
8.4.7.3.4	PATCH.....	192
8.4.7.3.5	DELETE.....	192
8.5	Data model .....	193
8.5.1	Introduction.....	193
8.5.2	Resource and notification data types .....	193
8.5.2.1	Introduction.....	193
8.5.2.2	Type: VnfIndicator.....	193
8.5.2.3	Type: VnfIndicatorSubscriptionRequest.....	193
8.5.2.4	Type: VnfIndicatorSubscription.....	193
8.5.2.5	Type: VnfIndicatorValueChangeNotification.....	194
8.5.3	Referenced structured data types .....	194
8.5.3.1	Introduction.....	194
8.5.3.2	Type: VnfIndicatorNotificationsFilter .....	194
8.5.4	Referenced simple data types and enumerations .....	195
9	VNF Configuration interface.....	195
9.1	Description .....	195
9.2	Resource structure and methods.....	195
9.3	Sequence diagrams (informative).....	196
9.3.1	Flow of setting the VNF configuration.....	196
9.4	Resources .....	196
9.4.1	Introduction.....	196
9.4.2	Resource: Configuration .....	196
9.4.2.1	Description.....	196
9.4.2.2	Resource definition .....	197
9.4.2.3	Resource methods .....	197
9.4.2.3.1	POST .....	197
9.4.2.3.2	GET .....	197
9.4.2.3.3	PUT .....	197
9.4.2.3.4	PATCH.....	198
9.4.2.3.5	DELETE.....	198
9.5	Data model .....	198
9.5.1	Introduction.....	198
9.5.2	Resource and notification data types .....	198

9.5.2.1	Introduction.....	198
9.5.2.2	Type: VnfConfigModifications.....	199
9.5.3	Referenced structured data types .....	199
9.5.3.1	Introduction.....	199
9.5.3.2	Type: VnfConfiguration.....	199
9.5.3.3	Type: VnfConfigurationData .....	200
9.5.3.4	Type: VnfcConfigurationData.....	200
9.5.3.5	Type: CpConfiguration .....	200
9.5.3.6	Type: CpAddress.....	201
9.5.4	Referenced simple data types and enumerations .....	201
<b>Annex A (informative): Mapping operations to protocol elements.....</b>		<b>202</b>
A.1	Overview .....	202
A.2	VNF Lifecycle Management interface.....	202
A.3	VNF Performance Management interface.....	203
A.4	VNF Fault Management interface.....	203
A.5	VNF Indicator interface.....	204
A.6	VNF Configuration interface.....	204
<b>Annex B (informative): Explanations.....</b>		<b>205</b>
B.1	Introduction .....	205
B.2	Scaling of a VNF instance.....	205
B.3	Examples of VNF connectivity patterns .....	207
B.3.1	Introduction.....	207
B.3.2	Example of a VNF with two different types of external connection points .....	207
B.3.3	Example of changing VNF connectivity.....	208
<b>Annex C (informative): Differences between SOL002 and SOL003.....</b>		<b>209</b>
C.1	Overview .....	209
C.2	Interfaces present in both SOL002 and SOL003.....	209
C.2.1	Basic principles .....	209
C.2.2	VNF Lifecycle Management interface.....	209
C.2.3	VNF Performance Management interface.....	210
C.2.4	VNF Fault Management interface.....	210
C.2.5	VNF Indicator interface.....	211
C.3	Interfaces present in one of SOL002 and SOL003.....	211
C.3.1	Interfaces only present in SOL002.....	211
C.3.2	Interfaces only present in SOL003.....	211
<b>Annex D (informative): Authors &amp; contributors.....</b>		<b>212</b>
<b>Annex E (informative): Change History .....</b>		<b>213</b>
History .....		216