Recommendation
ITU-T Q.4070 (02/2023)

SERIES Q: Switching and signalling, and associated measurements and tests

Testing specifications – Testing specifications for IMT-2020 and IoT

Test suite for interoperability testing of virtualized broadband network gateways

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Recommendation ITU-T Q.4070

Test suite for interoperability testing of virtualized broadband network gateways

Summary

Recommendation ITU-T Q.4070 specifies the interoperability testing of virtualized broadband network gateway (vBNG), including an overview of the test suite and test cases for interoperability testing of vBNG.

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FOREWORD

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The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T Q.4070

Test suite for interoperability testing of virtualized broadband network gateways

1 Scope

This Recommendation gives:

- An overview of the test suite for interoperability testing (IOPT) of virtualized broadband network gateway (vBNG).
- Test cases for IOPT of vBNG between vBNG and customer premises equipment (CPE)/ virtual customer premises equipment (vCPE).
- Test cases for IOPT of vBNG between vBNG and BNG/vBNG/PE.
- Test cases for IOPT of vBNG between vBNG and management system.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Q.3315]   Recommendation ITU-T Q.3315 (2015), *Signalling requirements for flexible network service combination on broadband network gateway*.

[ITU-T Q.4064]   Recommendation ITU-T Q.4064 (2020), *Interoperability testing requirements for a virtualized broadband network gateway*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 broadband network gateway (BNG) [ITU-T Q.3315]: The access point to the provider's IP network for wireline broadband services.

3.1.2 virtualized broadband network gateway (vBNG) [ITU-T Q.4064]: A virtualized solution of a broadband network gateway, attained by using virtualization technologies, which is responsible for user access and traffic forwarding to realize broadband services.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAA   Authentication, Authorization and Accounting

ACL   Access Control List

ARP	Address Resolution Protocol
BGP	Border Gateway Protocol
BGP-FS	BGP-Flow Specification
CE	Customer Edge
CHAP	Challenge Handshake Authentication Protocol
CPE	Customer Premises Equipment
CPU	Central Processing Unit
CVLAN	Customer Virtual Local Area Network
DDoS	Distributed Denial of Service
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DoS	Denial of Service
EBGP	External Border Gateway Protocol
FW	Fire Wall
GRE	Generic Routing Encapsulation
HQoS	Hierarchical Quality of Service
ID	Identify
IGMP	Internet Group Management Protocol
IGP	Interior Gateway Protocol
IOPT	Interoperability Testing
IP	Internet Protocol
IPoE	IP over Ethernet
IPP	IP Precedence
IPvn	Internet Protocol version n
IS-IS	Intermediate System-Intermediate System
L2TP	Layer 2 Tunnelling Protocol
L3VPN	Layer 3 Virtual Private Network
LAC	L2TP Access Concentrator
LDP	Label Distribution Protocol
LNS	L2TP Network Server
MIB	Management Information Base
MLD	Multicast Listener Discovery
MPLS	Multi-Protocol Label Switching
MSDP	Multicast Source Discovery Protocol
MTU	Maximum Transmission Unit
NAT	Network Address Translation
OSPF	Open Shortest Path First

PAP	Password Authentication Protocol
PBR	Policy Based Routing
PC	Personal Computer
PE	Provider Edge
PIM-DM	Protocol Independent Multicast-Dense Mode
PIM-SM	Protocol Independent Multicast-Sparse Mode
PPP	Point-to-Point Protocol
PPPoE	Point-to-Point Protocol over Ethernet
QinQ	802.1Q-in-802.1Q
QoS	Quality of Service
RADIUS	Remote Authentication Dial-In User Service
RR	Round Robin
SID	Segment Identifier
SNMP	Simple Network Management Protocol
SP	Strict Priority
SR	Segment Routing
SR-TE	Segment Routing-Traffic Engineering
SRv6	IPv6-based SR
SVLAN	Service Virtual Local Area Network
SYN	Synchronous
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
URPF	Unicast Reverse Path Forwarding
VAS	Value-Added Service
vBIT	vBNG Interoperability Tester
vBNG	virtualized Broadband Network Gateway
vCPE	virtual Customer Premise(s) Equipment
vFW	virtual Fire Wall
VLAN	Virtual Local Area Network
VLL	Virtual Leased Line
VM	Virtual Machine
VNF	Virtualized Network Function
VPLS	Virtual Private Local area network Service
VPN	Virtual Private Network
WRR	Weighted Round Robin

5   Conventions

In this Recommendation:

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

6   Overview of test suite for IOPT of vBNG

As virtualized broadband network gateway (vBNG), is the access point to the provider's IP network for wireline broadband services [ITU-T Q.3315], it is the access gateway to the Internet for subscribers. Consequently, vBNG must provide both Layer 2 and Layer 3 functions.

Interoperability of vBNG is the ability to interact with other entities. vBNG interoperability testing (IOPT) is used to verify whether the interactions are as expected and as described in [ITU-T Q.4064].

As described in [ITU-T Q.4064], there are six typical use cases of vBNG: point-to-point protocol over Ethernet (PPPoE) access, IP over Ethernet (IPoE) access, virtual private network (VPN) service, multicast service, segment routing and network management. The IOPT of vBNG should cover its service and management capability based on these six typical use cases.

Test suite for vBNG IOPT is a combination of vBNG IOPT test cases. The IOPT architecture of vBNG refers to clause 7 of [ITU-T Q.4064]. It is recommended to consider the following three testing areas:

•   vBNG-CPE/vCPE: This refers to the IOPT between vBNG and CPE/vCPE.

•   vBNG-BNG/vBNG/PE: This refers to the IOPT between vBNG and BNG/vBNG/PE.

•   vBNG-management system: This refers to the IOPT between vBNG and the management system.

Test cases that should be provided in the suite for vBNG IOPT are listed in Table 6-1.

Table 6-1 – Test cases to be provided for the IOPT of vBNG

Testing area	Specific test cases
vBNG – CPE/vCPE	Point-to-point protocol over Ethernet (PPPoE)
	IP over Ethernet (IPoE)
	Multicast group management protocol
	Network address translation (NAT)
	Quality of service (QoS)
	Virtual local area network (VLAN)
	802.1Q-in-802.1Q (QinQ)
	Value-added service (VAS)
	Access control list (ACL)
	Address resolution protocol (ARP) proxy
	Domain name system (DNS)
	Access redirection
	Maximum transmission unit (MTU)

Table 6-1 – Test cases to be provided for the IOPT of vBNG

Testing area	Specific test cases
	Port aggregation
	Jumbo frame
	Anti-DOS/ distributed denial of service (DDOS)
	Unicast reverse path forwarding (URPF)
vBNG-BNG/vBNG/PE	Interior gateway protocol (IGP) routing protocols
	Border gateway protocol (BGP) routing protocol
	Multicast routing protocols
	Static route
	Multi-protocol label switching (MPLS) protocol
	Tunnelling protocols
	Segment routing (SR) protocols
	Policy-based routing
	Maximum transmission unit (MTU)
	QoS
	Port aggregation
	Jumbo frame
	Anti-DOS/DDOS
	Unicast reverse path forwarding (URPF)
vBNG-management system	Authentication, authorization and accounting (AAA)
	Dynamic host configuration protocol (DHCP) relay
	Simple network management protocol (SNMP)
	Flow sampling
	Port mirror
	Alarm
	Telemetry
	Virtualized resource management
	Basic device configuration
	Service configuration

7 Test cases for IOPT of vBNG between vBNG and CPE/vCPE

IOPT between vBNG and CPE/vCPE evaluates the interaction for user access control, network security and network QoS functions, etc. including the following abilities: PPPoE, IPoE, multicast group management protocol, NAT, QoS, VLAN, QinQ, VAS, ACL, ARP, DNS, Access

redirection, MTU, port aggregation, jumbo frame, anti-DOS/DDOS, and URPF. For a description of related functional requirements refer to [ITU-T Q.4064].

7.1 Test case: PPPoE

Table 7-1 shows the test case for the PPPoE access function.

Table 7-1 – Test case: PPPoE

PPPoE test description				
Test purpose		To verify that vBNG provides PPPoE access function, which includes providing point-to-point protocol (PPP) connection with CPE/vCPE and allocating an IP address for user to access the Internet.		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure user access domain name "pppoe" in vBNG. Create a PPPoE user account "test1@pppoe".	
	3	**Stimulus**	Configure the authentication mode as local, and configure the address allocation method as local assignment.	
	4	**Stimulus**	vBNG interoperability tester (vBIT) simulate as PPPoE user "test1" dialling in through CPE/vCPE. NOTE – vBIT refers to the test tool which can simulate as user or network equipment to help complete IOPT of vBNG.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	User "test1" can obtain IP address and access the Internet.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

7.2 Test case: IPoE

Table 7-2 shows the test case for IPoE access function.

Table 7-2 – Test case: IPoE

IPoE test description				
Test purpose		To verify that vBNG supports IPoE service, including providing related access and control functions.		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure user access domain name "ipoe" in vBNG. Create a IPOE user account "test2@ipoe".	
	3	**Stimulus**	Configure the authentication mode as local, and configure the address allocation method as local assignment.	
	4	**Stimulus**	vBIT simulate as IPoE user "test2" dialling in through CPE/vCPE.	

Table 7-2 – Test case: IPoE

IPoE test description				
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	User "test2" can obtain IP address and access the Internet.	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

7.3 Test case: Multicast group management protocol

Table 7-3 shows the test case for multicast group management protocol.

Table 7-3 – Test case: Multicast group management protocol

Multicast group management protocol test description				
Test purpose	To verify that vBNG supports access and control functions of multicast users based on the Internet group management protocol (IGMP) [b-IETF RFC 3376] or multicast listener discovery (MLD) protocol [b-IETF RFC 3810].			
Reference	[ITU-T Q.4064] clause 8.1			
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure user access domain name "multicast" in vBNG. Create two PPPoE user accounts "test3@pppoe", "test4@pppoe", and two IPoE user accounts "test5@ipoe", "test6@ipoe".	
	3	**Stimulus**	Configure the authentication mode as local, and configure the address allocation method as local assignment.	
	4	**Stimulus**	vBIT1 simulate user "test3", "test4", "test5" and "test6" dialling in through CPE/vCPE, The expected result is 1.	
	5	**Stimulus**	Configure two multicast group "group1" and "group2".	
	6	**Stimulus**	Add user "test3" and "test5" to the multicast group "group1", add user "test4" and "test6" to the multicast group "group2".	
	7	**Stimulus**	vBIT2 simulate multicast source and send traffic to the two multicast group, The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	User "test3", "test4", "test5" and "test6" access Internet successfully, and obtain IP address.	
	2	**Check**	User "test3" and "test5" receive multicast packets from the multicast group "group1", User "test4" and "test6" receive multicast packets from the multicast group "group2".	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

7.4 Test case: NAT

Table 7-4 shows the test case for network address translation (NAT).

Table 7-4 – Test case: NAT

NAT test description				
Test purpose		To verify that vBNG supports network address translation (NAT) by converting the internal network address (possibly a private address) to an external network address in order to complete the communication between the internal network and the external network, and ensure the independence and privacy of the internal network.		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	**step**	**Type**	**Description**	
	1	Stimulus	Login to the configuration interface of vBNG.	
	2	Stimulus	Configure user access domain name "private" in vBNG. Create a PPPoE user account "test7@private".	
	3	Stimulus	Configure the authentication mode as local. Configure the address allocation method as local assignment, and allocate user IP address from private address pool. Configure the public address pool corresponding to user domain.	
	4	Stimulus	vBIT1 simulate PPPoE user "test7" dialling in vBNG through CPE/vCPE. The expected result is 1.	
	5	Stimulus	vBIT2 is configured with IP address "IP2", vBIT2 and vBNG learn route from each other.	
	6	Stimulus	vBIT2 send packets to vBIT1. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	Check	User "test7" obtain a private IP address, and create a NAT forwarding item in vBNG.	
	2	Check	User "test7" receives packets.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

7.5 QoS

Verification of QoS including verification of following abilities: traffic classification, bandwidth guarantee, queue scheduling, congestion control and HQoS.

7.5.1 Test case: Traffic classification

Table 7-5 shows the test case for traffic classification.

Table 7-5 – Test case: Traffic classification

Traffic classification test description				
Test purpose		To verify that vBNG supports traffic classification by different rules and remark functions.		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	step	Type	Description	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure six traffic classification rules: traffic classification according to access interface, source and destination IP address, TCP/UDP port ID, protocol ID, VLAN and user ID.	
	3	**Stimulus**	Configure vBNG by labelling the IP Precedence(IPP) of the 6 streams as 6, 5, 4, 3, 2, 1 respectively.	
	4	**Stimulus**	vBIT1 is configured to create test streams matching six stream classification rules.	
	5	**Stimulus**	vBIT1 send traffic to vBIT2.	
	6	**Stimulus**	vBIT2 receive the packet and observe the stream classification and labelling results. The expected result is 1.	
Expected results	step	Type	Description	Result
	1	**Check**	Traffic is labelled correctly.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

7.5.2   Test case: Bandwidth guarantee

Table 7-6 shows the test case for bandwidth guarantee.

Table 7-6 – Test case: Bandwidth guarantee

Bandwidth guarantee test description			
Test purpose		To verify that vBNG supports bandwidth guarantee and rate limitation functions.	
Reference		[ITU-T Q.4064] clause 8.1	
Test procedures	step	Type	Description
	1	**Stimulus**	Login to the configuration interface of vBNG.
	2	**Stimulus**	Configure two VLAN "vlan1" and "vlan2" for user access in one port.
	3	**Stimulus**	Configure "vlan1" maximum bandwidth as 1 Gbit/s, and "vlan2" bandwidth maximum as 500 Mbit/s in vBNG.
	4	**Stimulus**	vBIT1 create two streams for "vlan1" and "vlan2" respectively.
	5	**Stimulus**	vBIT1 send traffic to vBIT2 as 2 Gbit/s for "vlan1" and "vlan2" respectively. The expected result is 1.
	6	**Stimulus**	vBIT1 send traffic to vBIT2 as 1 Gbit/s for "vlan1" and "vlan2" respectively. The expected result is 2.

Table 7-6 – Test case: Bandwidth guarantee

<table>
<tr><td colspan="5">Bandwidth guarantee test description</td></tr>
<tr><td rowspan="3">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>Traffic rate received by vBIT2 is 1 Gbit/s for "vlan1" and 500 Mbit/s for "vlan2".</td><td></td></tr>
<tr><td>2</td><td>Check</td><td>Traffic rate received by vBIT2 is 1 Gbit/s for "vlan1" and 500 Mbit/s for "vlan2".</td><td></td></tr>
<tr><td>Notes</td><td colspan="4"></td></tr>
<tr><td>Test verdict</td><td colspan="4">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

7.5.3   Test case: Queue scheduling and congestion control

Table 7-7 shows the test case for queue scheduling and congestion control.

Table 7-7 – Test case: Queue scheduling and congestion control

<table>
<tr><td colspan="5">Queue scheduling and congestion control test description</td></tr>
<tr><td>Test purpose</td><td colspan="4">To verify that vBNG supports queue scheduling and congestion control functions.</td></tr>
<tr><td>Reference</td><td colspan="4">[ITU-T Q.4064] clause 8.1</td></tr>
<tr><td rowspan="6">Test procedures</td><td>step</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td>1</td><td>Stimulus</td><td colspan="2">Login to the configuration interface of vBNG.</td></tr>
<tr><td>2</td><td>Stimulus</td><td colspan="2">Configure stream classification rule on vBNG: create seven priority data streams, and the IP precedence was set as 7/6/5/4/3/2/1 respectively. The queue 7 is configured with bandwidth limitation of 1 Gbit/s. Queue 6/5/4 are configured with bandwidth insurance of 2 Gbit/s respectively. Queue 3/2/1 are configured as normal level.
NOTE – In the case of congestion, the bandwidth exceeding the queue level will be discarded, and the low level will be discarded first. The bandwidth of the level 7 can guarantee priority forwarding in the case of congestion.</td></tr>
<tr><td>3</td><td>Stimulus</td><td colspan="2">vBNG applies the rules in output interface. The interface bandwidth is 10 Gbit/s.</td></tr>
<tr><td>4</td><td>Stimulus</td><td colspan="2">vBIT1 simulate seven streams corresponding to the seven queues, and send traffic to vBIT2. In the case of no congestion, the traffic rates are 1.1/2.1/2.1//2.1/0.8/0.8/0.8 Gbit/s. The expected result is 1.</td></tr>
<tr><td>5</td><td>Stimulus</td><td colspan="2">vBIT1 simulate seven streams corresponding to the seven queues, and sends the traffic to vBIT2. in case of congestion, the traffic rates are 1/2.2/2.2//2.2/1/1/1 Gbit/s. The expected result is 2.</td></tr>
<tr><td rowspan="3">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>Traffic of queue 7 have packet loss, others are received correctly.</td><td></td></tr>
<tr><td>2</td><td>Check</td><td>Traffic of queue 3/2/1 have packet loss, others are received correctly.</td><td></td></tr>
</table>

Table 7-7 – Test case: Queue scheduling and congestion control

Queue scheduling and congestion control test description	
Notes	
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.

7.5.4   Test case: HQoS

Table 7-8 shows the test case for hierarchical quality of service (HQoS).

Table 7-8 – Test case: HQoS

HQoS test description			
Test purpose		To verify that vBNG supports HQoS function.	
Reference		[ITU-T Q.4064] clause 8.1	
Test procedures	step	Type	Description
	1	Stimulus	Login to the configuration interface of vBNG.
	2	Stimulus	Configure HQoS rules: 1. Home-level service scheduling: Each home has 8 kinds of service, and the IP precedence (IPP) are set to 7/6/5/4/3/2/1/0 respectively. The traffic scheduling is based on IPP. 2. Customer virtual local area network (CVLAN) scheduling: Each home is configured with a same CVLAN, different homes share the bandwidth. The traffic scheduling is based on CVLAN. 3. Service virtual local area network (SVLAN) scheduling: for different kinds of service, IPP 7/6/5/4/3/2/1/0 are configured as SVLAN 1/2/3/4/5/6/7/8. Different SVLAN share the bandwidth. 4. SVLAN group scheduling: divided the 8 SVLAN into 4 SVLAN groups, and the traffic scheduling is based on different SVLAN groups. 5. Interface queue scheduling: the traffic scheduling is based on different interface output queues.
	3	Stimulus	vBIT1 simulate 8 sessions to dial in for one user (home), and set 8 session's traffic IPP with 7/6/5/4/3/2/1/0 respectively. Configure IPP 7/6 traffic scheduling rule as strict priority (SP), and granted bandwidth as 5 Mbit/s and 1 Mbit/s respectively. Configure IPP 5/4/3/2/1/0 traffic scheduling rule as weighted round robin (WRR) with weight 6:5:4:3:2:1. vBIT1 sends traffic to vBIT2. The expected result is 1.
	4	Stimulus	vBIT1 simulate 10 users to dial in with different CVLAN (cvlan1-cvlan10). Configure traffic scheduling rule as RR. vBIT1 send traffic to vBIT2. The expected result is 2.
	5	Stimulus	vBIT1 simulate 80 users to dial in, configure every 10 users with different CLAN as one SVLAN. Configure traffic scheduling rule as WRR with weight 2:1:2:1:2:1:2:1. vBIT1 send traffic to vBIT2. The expected result is 3.

Table 7-8 – Test case: HQoS

			HQoS test description	
	6	**Stimulus**	vBIT1 simulate 80 users to dial in, configure every 10 users with different CLAN as one SVLAN, and set svlan1-2, svlan3-4, svlan5-6, svlan7-8 as a group respectively. Configure traffic scheduling rule as WRR with weight 2:2:1:1. vBIT1 send traffic to vBIT2. The expected result is 4.	
	7	**Stimulus**	vBIT1 simulate 80 users to dial in, for each user, mapping the session IPP 7/6/5/4/3/2/1/0 to interface queue 7/6/5/4/3/2/1/0 respectively. Configure IPP 7/6 traffic scheduling rule as SP. Configure IPP 5/4/3/2/1/0 traffic scheduling rule as WRR. vBIT1 sends traffic to vBIT2. The expected result is 5.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	Traffic is scheduled correctly.	
	2	**Check**	Traffic is scheduled correctly.	
	3	**Check**	Traffic is scheduled correctly.	
	4	**Check**	Traffic is scheduled correctly.	
	5	**Check**	Traffic is scheduled correctly.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

7.6 Test case: VLAN

Table 7-9 shows the test case for virtual local area network (VLAN).

Table 7-9 – Test case: VLAN

			VLAN test description
Test purpose			To verify that vBNG provides the VLAN function and can recognize traffic based on VLAN for access network.
Reference			[ITU-T Q.4064] clause 8.1
Test procedures	**step**	**Type**	**Description**
	1	**Stimulus**	Login to the configuration interface of vBNG.
	2	**Stimulus**	Configure VLAN1 and VLAN2 on one interface of vBNG to mapping access users.
	3	**Stimulus**	Configure vBNG with traffic IPP from VLAN1 remarked to 5, and traffic IPP from VLAN2 remarked to 3.
	4	**Stimulus**	vBIT1 simulate 2 PPPoE users with VLAN1 and VLAN2 respectively.
	5	**Stimulus**	vBIT1 send traffic of these 2 users to vBIT2. The expected result is 1.
	6	**Stimulus**	vBIT2 send traffic of these 2 users to vBIT1 through CPE/vCPE. Capture packets in CPE/vCPE. The expected result is 2.

Table 7-9 – Test case: VLAN

VLAN test description				
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	vBIT2 receive packets from the 2 users, IPP of VLAN1 is 5, and IPP of VLAN2 is 3.	
	2	**Check**	The captured packet has VLAN tag as VLAN1 and VLAN2 respectively.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

7.7 Test case: QinQ

Table 7-10 shows the test case for 802.1Q-in-802.1Q (QinQ).

Table 7-10 – Test case: QinQ

QinQ test description				
Test purpose		To verify that vBNG comprises supports to encapsulate the private network VLAN tag in the public network VLAN so that the packet can be forwarded with two VLAN tags [b-IEEE 802.1Q].		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure VLAN1 as SVLAN and VLAN2 as CVLAN on one interface of vBNG for access users.	
	3	**Stimulus**	vBIT1 simulate as PPPoE user with QinQ tags: VLAN1 and VLAN2.	
	4	**Stimulus**	vBIT2 send traffic of the user to vBIT1 through CPE/vCPE. Capture packets in CPE/vCPE. The expected result is 1.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The captured packet has 2 VLAN tags. The inner tag VLAN2 is encapsulated in the outer tag VLAN1.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

7.8 Test case: VAS

Table 7-11 shows the test case for value-added service (VAS).

Table 7-11 – Test case: VAS

<table>
<tr><td colspan="5" align="center">VAS test description</td></tr>
<tr><td>Test purpose</td><td colspan="4">To verify that vBNG supports value-added service, such as FW.</td></tr>
<tr><td>Reference</td><td colspan="4">[ITU-T Q.4064] clause 8.1</td></tr>
<tr><td rowspan="6">Test procedures</td><td>step</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td>1</td><td>Stimulus</td><td colspan="2">Login to the configuration interface of vBNG.</td></tr>
<tr><td>2</td><td>Stimulus</td><td colspan="2">Configure traffic filter rule as discard traffic with vlan2.</td></tr>
<tr><td>3</td><td>Stimulus</td><td colspan="2">Create 2 PPPoE users account, and configure with VLAN 1 and VLAN 2 respectively for the 2 users.</td></tr>
<tr><td>4</td><td>Stimulus</td><td colspan="2">vBIT simulate user 1 and user 2 access to vBNG through CPE/vCPE.</td></tr>
<tr><td>5</td><td>Stimulus</td><td colspan="2">vBIT send traffic of user 1 and user 2 to vBNG. The expected result is 1.</td></tr>
<tr><td rowspan="2">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>Traffic of user 1 is received successfully, and traffic of user 2 is discarded by vBNG.</td><td></td></tr>
<tr><td>Notes</td><td colspan="4"></td></tr>
<tr><td>Test verdict</td><td colspan="4">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

7.9 Test case: ACL

Table 7-12 shows the test case for access control list (ACL).

Table 7-12 – Test case: ACL

<table>
<tr><td colspan="5" align="center">ACL test description</td></tr>
<tr><td>Test purpose</td><td colspan="4">To verify that vBNG supports ACL based on quintuple information (source/destination IP address, source/destination port, protocol type).</td></tr>
<tr><td>Reference</td><td colspan="4">[ITU-T Q.4064] clause 8.1</td></tr>
<tr><td rowspan="6">Test procedures</td><td>step</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td>1</td><td>Stimulus</td><td colspan="2">Login to the configuration interface of vBNG.</td></tr>
<tr><td>2</td><td>Stimulus</td><td colspan="2">Create VLAN1 on sub-interface of vBNG.</td></tr>
<tr><td>3</td><td>Stimulus</td><td colspan="2">Create two users user 1 and user 2 access to vBNG. Configure user 1 with IP1 and user 2 with IP2.</td></tr>
<tr><td>4</td><td>Stimulus</td><td colspan="2">Configure ACL rule 1 which enables packet from IP1. Create ACL rule 2 which disables packet from IP2.</td></tr>
<tr><td>5</td><td>Stimulus</td><td colspan="2">vBIT send packets of user 1 and user 2 through CPE/vCPE. The expected result is 1.</td></tr>
<tr><td rowspan="2">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>Traffic of user 1 received successfully, and traffic of user 2 is discarded by vBNG.</td><td></td></tr>
</table>

Table 7-12 – Test case: ACL

ACL test description	
Notes	
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.

7.10 Test case: ARP proxy

Table 7-13 shows the test case for address resolution protocol (ARP) proxy.

Table 7-13 – Test case: ARP proxy

ARP proxy test description				
Test purpose	To verify that vBNG provides ARP response to CPE/vCPE.			
Reference	[ITU-T Q.4064] clause 8.1			
Test procedures	step	Type	Description	
	1	Stimulus	Login to the configuration interface of vBNG.	
	2	Stimulus	Create two users user 1 and user 2 access to vBNG through two different CPE/vCPE . Configure user 1 with IP1 and user 2 with IP2.	
	3	Stimulus	Keep capturing packet from CPE/vCPE1 and CPE/vCPE2. From user 1 ping IP2.	
	4	Stimulus	Check CPE/vCPE1 and CPE/vCPE2, The expected result is 1.	
Expected results	step	Type	Description	Result
	1	Check	CPE/vCPE1 can receive ARP REQUEST packet, CPE/vCPE2 do not receive any ARP REQUEST packet.	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

7.11 Test case: DNS

Table 7-14 shows the test case for domain name system (DNS).

Table 7-14 – Test case: DNS

DNS test description				
Test purpose	To verify that vBNG can obtain DNS address, and access users can then surf the Internet.			
Reference	[ITU-T Q.4064] clause 8.1			
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Create PPPoE user account "user1" in vBNG, and connect vBNG to Internet.	
	3	**Stimulus**	Connect PC1 to CPE/vCPE, and PC1 simulate as user 1 to access to vBNG through CPE/vCPE.	
	4	**Stimulus**	PC1 surf the website: https://www.baidu.com/. The expected result is 1.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	PC1 can access to Baidu website successfully.	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

7.12 Test case: Access redirection

Table 7-15 shows the test case for access redirection.

Table 7-15 – Test case: Access redirection

Access redirection test description				
Test purpose	To verify that vBNG supports user access redirection function.			
Reference	[ITU-T Q.4064] clause 8.1			
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Create two PPPoE users account "user1" and "user2" to access to vBNG with VLAN1 and VLAN2 respectively.	
	3	**Stimulus**	Configure user access redirection rule: if user 1 access successfully, redirect the website page to http://10.17.49.250/.	
	4	**Stimulus**	PC1 simulate as user 1 access to Internet. The expected result is 1.	
	5	**Stimulus**	PC2 simulate as user 2 access to Internet. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	PC1 access successfully, and the website page is redirected to http://10.17.49.250/.	
	2	**Check**	PC1 access successfully without website page redirected.	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

7.13 Test case: MTU

Table 7-16 shows the test case for maximum transmission unit (MTU).

Table 7-16 – Test case: MTU

MTU test description				
Test purpose	To verify that vBNG supports the limitation of the maximum frame size allowed through the port.			
Reference	[ITU-T Q.4064] clause 8.1			
Test procedures	step	Type	Description	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure MTU on one user access interface and one layer 3 forwarding interface of vBNG.	
	3	**Stimulus**	vBIT1 simulate as a PPPoE user to access through the access interface of vBNG.	
	4	**Stimulus**	vBIT1 send traffic with packet length lager than MTU of the user to vBIT2 through CPE/vCPE. Capture packets in the layer 3 forwarding interface of vBNG. The expected result is 1.	
	5	**Stimulus**	vBIT2 send traffic with packet length lager than MTU of the user to vBIT1 through CPE/vCPE. Capture packets in the user access interface of vBNG. The expected result is 2.	
Expected results	step	Type	Description	Result
	1	**Check**	The captured packets are sliced into several shorter packets whose length are not greater than the configured MTU.	
	2	**Check**	The captured packets are sliced into several shorter packets whose length are not greater than the configured MTU.	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

7.14 Test case: Port aggregation

Table 7-17 shows the test case for port aggregation.

Table 7-17 – Test case: Port aggregation

Port aggregation test description			
Test purpose	To verify that vBNG supports a port aggregation function by logically using multiple independent links as a single link.		
Reference	[ITU-T Q.4064] clause 8.1		
Test procedures	step	Type	Description
	1	**Stimulus**	Login to the configuration interface of vBNG.
	2	**Stimulus**	Configure Ethernet trunk 1 of vBNG, add port1 and port2 of vBNG in Ethernet trunk 1.

Table 7-17 – Test case: Port aggregation

Port aggregation test description				
	3	**Stimulus**	Configure Ethernet trunk 1 of CPE/vCPE, add port1 and port2 of CPE/vCPE in Ethernet trunk 1 which is connected to the Ethernet trunk 1 of vBNG.	
	4	**Stimulus**	vBIT simulate as a PPPoE user to access through the Ethernet trunk 1 interface of the CPE/vCPE.	
	5	**Stimulus**	vBIT send traffic of the user to vBNG. The expected result is 1.	
	6	**Stimulus**	Shutdown port1 of vBNG in the Ethernet trunk 1.	
	7	**Stimulus**	vBIT send traffic of the user to vBNG. The expected result is 2.	
Expected results	step	**Type**	**Description**	**Result**
	1	**Check**	The traffic of user is received successfully through port1 and port2 of vBNG.	
	2	**Check**	The traffic of user is received successfully through port2 of vBNG.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

7.15 Test case: Jumbo frame

Table 7-18 shows the test case for jumbo frame.

Table 7-18 – Test case: Jumbo frame

Jumbo frame test description				
Test purpose		To verify that vBNG supports jumbo frame.		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	step	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Enable jumbo frame function in vBNG. Configure VLAN1 in the access interface port1 of vBNG.	
	3	**Stimulus**	vBIT simulate a PPPoE user to access by the access interface port1 of the vBNG through CPE/vCPE.	
	4	**Stimulus**	vBIT send traffic with jumbo frame to vBIT2. Capture packet in the input interface of vBNG, The expected result is 1.	
	5	**Stimulus**	Capture packet in the output interface of vBNG, The expected result is 2.	
Expected results	step	**Type**	**Description**	**Result**
	1	**Check**	The captured packet in the input interface of vBNG is jumbo frame.	
	2	**Check**	The captured packet in the output interface of vBNG is jumbo frame.	

Table 7-18 – Test case: Jumbo frame

Jumbo frame test description	
Notes	
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.

7.16 Test case: Anti-DOS/DDOS

Table 7-19 shows the test case for anti-DOS/DDOS.

Table 7-19 – Test case: Anti-DOS/DDOS

Anti-DOS/DDOS test description				
Test purpose		To verify that vBNG supports anti-DOS/DDOS function.		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	step	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Enable anti-DOS and anti-DDOS function of vBNG. Configure IP address of interface port1 of vBNG.	
	3	**Stimulus**	vBIT simulate network application with IP address IP2 to send synchronous (SYN) flood, user datagram protocol (UDP) flood, Ping flood, ARP attack to vBNG. The expected result is 1.	
	4	**Stimulus**	vBIT simulate network application with several IP addresses to send SYN flood, UDP flood, Ping flood, ARP attack to vBNG. The expected result is 2.	
Expected results	step	**Type**	**Description**	**Result**
	1	**Check**	vBNG is not affected by these attacks.	
	2	**Check**	vBNG is not affected by these attacks.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

7.17 Test case: URPF

Table 7-20 shows the test case for unicast reverse path forwarding (URPF).

Table 7-20 – Test case: URPF

URPF test description				
Test purpose		To verify that vBNG supports URPF function.		
Reference		[ITU-T Q.4064] clause 8.1		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure URPF function of interface port1 and port2 of vBNG.	
	3	**Stimulus**	vBIT simulate a PPPoE user "user1" to access vBNG by the interface port1 through CPE/vCPE.	
	4	**Stimulus**	vBIT simulate a PPPoE user "user2" to access vBNG by the interface port2 through CPE/vCPE.	
	5	**Stimulus**	vBIT send traffic of user 1 and user 2 to vBNG through port1 and port2 respectively. The expected result is 1.	
	6	**Stimulus**	vBIT send traffic of user 1 and user 2 to vBNG both through port1. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	Traffic of user 1 and user 2 are received successfully.	
	2	**Check**	Traffic of user 1 is received successfully, traffic of user 2 is discarded by vBNG.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8 Test cases for IOPT of vBNG between vBNG and BNG/vBNG/PE

IOPT between vBNG and BNG/vBNG/PE evaluates the interaction for routing control, tunnelling protocols, network security and network QoS functions, etc. Including the following abilities: interior gateway protocol (IGP), border gateway protocol (BGP), multicast routing protocol, static route, multi-protocol label switching (MPLS) protocol, tunnelling protocols, SR protocol, policy-based routing, maximum transmission unit (MTU), port aggregation, jumbo frame, anti-DOS/DDOS, and unicast reverse path forwarding (URPF). For a description of related functional requirements refer to [ITU-T Q.4064].

8.1 IGP routing protocols

Verification of interior gateway protocol (IGP) routing protocols including verification intermediate system-intermediate system (IS-IS) and open shortest path first (OSPF) protocols.

8.1.1 Test case: IS-IS

Table 8-1 shows the test case for IS-IS.

Table 8-1 – Test case: IS-IS

IS-IS test description				
Test purpose		To verify that vBNG supports IS-IS protocol.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interface of vBNG.	
	3	**Stimulus**	Configure vBIT with IS-IS.	
	4	**Stimulus**	Configure vBNG with IS-IS and configure IS-IS neighbour between vBNG and vBIT. The expected result is 1.	
	5	**Stimulus**	From vBNG ping IP address of vBIT. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	vBIT learned route to vBNG by IS-IS.	
	2	**Check**	vBNG receives reply packet from vBIT.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.1.2   Test case: OSPF

Table 8-2 shows the test case for OSPF.

Table 8-2 – Test case: OSPF

OSPF test description				
Test purpose		To verify that vBNG supports OSPF protocol.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interface of vBNG.	
	3	**Stimulus**	Configure vBIT with OSPF.	
	4	**Stimulus**	Configure vBNG with OSPF and configure OSPF neighbour between vBNG and vBIT. The expected result is 1.	
	5	**Stimulus**	From vBNG ping IP address of vBIT. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	vBIT learned route to vBNG by OSPF.	
	2	**Check**	vBNG receives reply packet from vBIT.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.2 BGP routing protocol

Table 8-3 shows the test case for BGP.

Table 8-3 – Test case: BGP routing protocol

BGP routing protocol test description				
Test purpose		To verify that vBNG supports BGP protocol.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interface of vBNG.	
	3	**Stimulus**	Configure vBIT with BGP.	
	4	**Stimulus**	Configure vBNG with BGP and configure BGP neighbour between vBNG and vBIT. The expected result is 1.	
	5	**Stimulus**	From vBNG ping IP address of vBIT. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	vBIT learned route to vBNG by BGP.	
	2	**Check**	vBNG receives reply packet from vBIT.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.3 Multicast routing protocols

Verification of multicast routing protocols including verification of protocol independent multicast-dense mode (PIM-DM), protocol independent multicast-sparse mode (PIM-SM) and multicast source discovery protocol (MSDP) protocols.

8.3.1 Test case: PIM

Table 8-4 shows the test case for PIM.

Table 8-4 – Test case: PIM protocol

PIM protocol test description			
Test purpose		To verify that vBNG supports PIM-DM and PIM-SM protocol.	
Reference		[ITU-T Q.4064] clause 8.2	
Test procedures	**step**	**Type**	**Description**
	1	**Stimulus**	Login to the configuration interface of vBNG1 and vBNG2.
	2	**Stimulus**	Configure user access domain name "multicast" in vBNG1. Create two PPPoE user accounts "test3@pppoe", "test4@pppoe", and two IPoE user accounts "test5@ipoe", "test6@ipoe".
	3	**Stimulus**	Configure multicast user access to vBNG1 as described in clause 7.3.
	4	**Stimulus**	Configure two multicast group "group1" and "group2". Add user "test3" and "test5" to the multicast group "group1", and user "test4" and "test6" to the multicast group "group2".

Table 8-4 – Test case: PIM protocol

			PIM protocol test description	
	5	**Stimulus**	vBIT1 simulate multicast users, vBIT2 simulate multicast source. vBNG1 connect with vBIT1 and vBNG2, vBNG2 connect with vBIT2.	
	6	**Stimulus**	Configure PIM-DM protocol between vBNG1 and vBNG2. Check the multicast routing table in vBNG1 and vBNG2. The expected result is 1.	
	7	**Stimulus**	vBIT2 send traffic to the two multicast group. The expected result is 2.	
	8	**Stimulus**	PIM-DM protocol replaced by PIM-SM, and perform step 6 and 7 again. The expected result is 3.	
Expected results	step	**Type**	**Description**	**Result**
	1	**Check**	vBNG1 and vBNG2 can display the multicast routing table corresponding to the multicast group and users.	
	2	**Check**	User "test3" and "test5" receive multicast packet from multicast group "group1", user "test4" and "test6" receive multicast packet from multicast group "group2".	
	3	**Check**	The results are the same with PIM-DM.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

8.3.2   Test case: MSDP

Table 8-5 shows the test case for MSDP.

Table 8.5 – Test case: MSDP protocol

			MSDP protocol test description	
Test purpose			To verify that vBNG supports MSDP protocol.	
Reference			[ITU-T Q.4064] clause 8.2	
Test procedures	step	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG1 and vBNG2. Configure vBNG1 with AS 1 while vBNG2 with AS 2.	
	2	**Stimulus**	Configure user access domain name "multicast" in vBNG. Create two PPPoE user accounts "test3@pppoe", "test4@pppoe", and two IPoE user accounts "test5@ipoe", "test6@ipoe".	
	3	**Stimulus**	vBIT1 simulate user "test3" and "test5" dialling in vBNG1, vBIT2 simulate user "test4" and "test6" dialling in vBNG2.	
	4	**Stimulus**	Configure two multicast group "group1" and "group2". Add all users to the multicast group "group1" and "group2".	
	5	**Stimulus**	vBIT3 and vBIT4 simulate as multicast source. Connect vBNG1 with vBIT3 and connect vBNG2 with vBIT4.	

Table 8.5 – Test case: MSDP protocol

<table>
<tr><td colspan="6" align="center">MSDP protocol test description</td></tr>
<tr><td></td><td>6</td><td>Stimulus</td><td colspan="3">Configure MSDP protocol between vBNG1 and vBNG2. Check the multicast routing table in vBNG1 and vBNG2. There is an expected result 1.</td></tr>
<tr><td></td><td>7</td><td>Stimulus</td><td colspan="3">vBIT3 send traffic to multicast group "group1", and vBIT4 send traffic to multicast group "group2", The expected result is 2.</td></tr>
<tr><td rowspan="3">Expected results</td><td>step</td><td>Type</td><td colspan="2">Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td colspan="2">vBNG1 and vBNG2 both can display the multicast routing table with multicast groups "group1" and "group2". vBNG1 and vBNG2 can connect to the multicast source across AS domains.</td><td></td></tr>
<tr><td>2</td><td>Check</td><td colspan="2">All users receive multicast packet from multicast groups "group1" and "group2".</td><td></td></tr>
<tr><td>Notes</td><td colspan="5"></td></tr>
<tr><td>Test verdict</td><td colspan="5">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

8.4 Static route

Table 8-6 shows the test case for static route.

Table 8-6 – Test case: Static route

<table>
<tr><td colspan="5" align="center">Static route test description</td></tr>
<tr><td>Test purpose</td><td colspan="4">To verify that vBNG supports the configuration of static routes to specific destinations defined by network prefix.</td></tr>
<tr><td>Reference</td><td colspan="4">[ITU-T Q.4064] clause 8.2</td></tr>
<tr><td rowspan="7">Test procedures</td><td>step</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td>1</td><td>Stimulus</td><td colspan="2">Login to the configuration interface of vBNG.</td></tr>
<tr><td>2</td><td>Stimulus</td><td colspan="2">Configure IP address for the interfaces of vBNG. Configure IP address of vBIT2.
NOTE – For example, the IP address of vBIT2 is 1.1.1.1 32.</td></tr>
<tr><td>3</td><td>Stimulus</td><td colspan="2">Configure a static route to vBIT2 in vBNG with a nexthop IP address which is an output interface IP address of vBNG.
NOTE – Ip route-static 1.1.1.1 32 10.11.0.1, which means the destination is 1.1.1.1, prefix length is 32, and nexthop is 10.11.0.1.</td></tr>
<tr><td>4</td><td>Stimulus</td><td colspan="2">Check the routing table in vBNG. The expected result is 1.</td></tr>
<tr><td>5</td><td>Stimulus</td><td colspan="2">Configure vBNG to advertise this static route to vBIT1.</td></tr>
<tr><td>6</td><td>Stimulus</td><td colspan="2">vBIT1 send traffic to vBIT2 with the destination IP address. The expected result is 2.</td></tr>
<tr><td rowspan="2">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>The configured static route is displayed in the routing table of vBNG.</td><td></td></tr>
</table>

Table 8-6 – Test case: Static route

			Static route test description	
	2	**Check**	vBIT2 received the traffic through vBNG without packet loss.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

8.5 MPLS protocol

Table 8-7 shows the test case for MPLS protocol.

Table 8-7 – Test case: MPLS protocol

			MPLS protocol test description	
Test purpose			To verify that vBNG supports MPLS protocol.	
Reference			[ITU-T Q.4064] clause 8.2	
Test procedures	step	Type	Description	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interfaces of vBNG. Configure IS-IS neighbour between vBIT1 and vBNG, and IS-IS neighbour between vBNG and vBIT2.	
	3	**Stimulus**	Configure LDP protocol to distribute MPLS labels between vBNG, vBIT1 and vBIT2.	
	4	**Stimulus**	Check the routing table and label information table in vBNG. The expected result is 1.	
	5	**Stimulus**	vBIT1 send traffic to vBIT2. The expected result is 2. Capture packets in the output interface of vBNG. The expected result is 3.	
Expected results	step	Type	Description	Result
	1	**Check**	The route and label information to vBIT1 and vBIT2 can be displayed in vBNG.	
	2	**Check**	vBIT2 received the traffic through vBNG without packet loss.	
	3	**Check**	The packets are encapsulated with MPLS label.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

8.6 Tunnelling protocols

Verification of tunnelling protocols including verification of generic routing encapsulation (GRE), layer 2 tunnelling protocol (L2TP), virtual private local area network service (VPLS), virtual leased line (VLL) and layer 3 virtual private network (L3VPN).

8.6.1 Test case: GRE

Table 8-8 shows the test case for GRE.

Table 8-8 – Test case: GRE

GRE test description				
Test purpose		To verify that vBNG supports GRE function.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interfaces of vBNG. Configure IS-IS neighbour between vBNG and vBIT2.	
	3	**Stimulus**	Configure GRE tunnel between vBNG and vBIT2, and specify the source and destination IP address of the tunnel.	
	4	**Stimulus**	Check the GRE tunnel state in vBNG. The expected result is 1.	
	5	**Stimulus**	vBIT1 simulate as a PC, which is connected with vBNG.	
	6	**Stimulus**	vBIT1 send traffic to vBIT2. The expected result is 2. Capture packets in the output interface of vBNG. The expected result is 3.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The GRE tunnel is up.	
	2	**Check**	vBIT2 received the traffic through vBNG without packet loss.	
	3	**Check**	The packets are encapsulated with GRE header.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.6.2 Test case: L2TP

Table 8-9 shows the test case for L2TP.

Table 8-9 – Test case: L2TP

L2TP test description			
Test purpose		To verify that vBNG supports L2TP function.	
Reference		[ITU-T Q.4064] clause 8.2	
Test procedures	**step**	**Type**	**Description**
	1	**Stimulus**	Login to the configuration interface of vBNG1 and vBNG2. vBNG1 simulates as LAC and vBNG2 simulates as LNS.
	2	**Stimulus**	Configure IP address for the interfaces of vBNG. Configure L2TP tunnel authentication information between vBNG1 and vBNG2.
	3	**Stimulus**	Create a PPPoE user account "test1@l2tp" in vBNG2.
	4	**Stimulus**	vBIT1 simulate as the PPPoE user "test1@l2tp" access to vBNG1. The expected result is 1.
	5	**Stimulus**	vBIT2 is connected with vBNG2, and configure IS-IS neighbour between vBNG2 and vBIT2.

Table 8-9 – Test case: L2TP

L2TP test description				
	6	**Stimulus**	vBIT1 send traffic to vBIT2. The expected result is 2. Capture packets in the output interface of vBNG1. The expected result is 3.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The L2TP tunnel is established, and the user accesses to vBNG2 successfully.	
	2	**Check**	The traffic is received by vBIT2 without packet loss.	
	3	**Check**	The packets are encapsulated with L2TP header.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.6.3 Test case: VPLS

Table 8-10 shows the test case for VPLS.

Table 8-10 – Test case: VPLS

VPLS test description				
Test purpose		To verify that vBNG supports VPLS function.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interfaces of vBNG. Configure IS-IS neighbour between vBNG and vBIT2.	
	3	**Stimulus**	vBIT1 simulate as CE connected to vBNG. vBIT2 simulate as PE, and configure VPLS tunnel between vBNG and vBIT2.	
	4	**Stimulus**	Check the VPLS state and forwarding table in vBNG. The expected result is 1.	
	5	**Stimulus**	vBIT1 send traffic to vBIT2. The expected result is 2.	
	6	**Stimulus**	Capture packets in the output interface of vBNG1. The expected result is 3.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The VPLS tunnel is established, and the VPLS forwarding table can be displayed in vBNG.	
	2	**Check**	The traffic is received by vBIT2 without packet loss.	
	3	**Check**	The packets are encapsulated with MPLS label which identifies the private network services.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.6.4 Test case: VLL

Table 8-11 shows the test case for VLL.

Table 8-11 – Test case: VLL

VLL test description				
Test purpose		To verify that vBNG supports VLL function.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interfaces of vBNG. Configure IS-IS neighbour between vBNG and vBIT2.	
	3	**Stimulus**	vBIT1 simulate as CE connected to vBNG. vBIT2 simulate as PE, and configure VLL tunnel between vBNG and vBIT2.	
	4	**Stimulus**	Check the VLL state and forwarding table in vBNG. The expected result is 1.	
	5	**Stimulus**	vBIT1 send traffic to vBIT2. The expected result is 2.	
	6	**Stimulus**	Capture packets in the output interface of vBNG1. The expected result is 3.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The VLL tunnel is established, and the VLL forwarding table can be displayed in vBNG.	
	2	**Check**	The traffic is received by vBIT2 without packet loss.	
	3	**Check**	The packets are encapsulated with MPLS label which identifies the private network services.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.6.5 Test case: L3VPN

Table 8-12 shows the test case for L3VPN.

Table 8-12 – Test case: L3VPN

L3VPN test description			
Test purpose		To verify that vBNG supports L3VPN function.	
Reference		[ITU-T Q.4064] clause 8.2	
Test procedures	**step**	**Type**	**Description**
	1	**Stimulus**	Login to the configuration interface of vBNG.
	2	**Stimulus**	Configure IP address for the interfaces of vBNG. Configure BGP neighbour between vBNG and vBIT2.
	3	**Stimulus**	vBIT1 simulate as CE connected to vBNG. vBIT2 simulate as PE, and configure L3VPN tunnel between vBNG and vBIT2.
	4	**Stimulus**	Check the L3VPN state and forwarding table in vBNG. The expected result is 1.

Table 8-12 – Test case: L3VPN

<table>
<tr><td colspan="5" align="center">L3VPN test description</td></tr>
<tr><td rowspan="2"></td><td>5</td><td>Stimulus</td><td colspan="2">vBIT1 send traffic to vBIT2. The expected result is 2.</td></tr>
<tr><td>6</td><td>Stimulus</td><td colspan="2">Capture packets in the output interface of vBNG1. The expected result is 3.</td></tr>
<tr><td rowspan="4">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>The L3VPN tunnel is established, and the L3VPN forwarding table can be displayed in vBNG.</td><td></td></tr>
<tr><td>2</td><td>Check</td><td>The traffic is received by vBIT2 without packet loss.</td><td></td></tr>
<tr><td>3</td><td>Check</td><td>The packets are encapsulated with MPLS label which identifies the private network services.</td><td></td></tr>
<tr><td colspan="2">Notes</td><td colspan="3"></td></tr>
<tr><td colspan="2">Test verdict</td><td colspan="3">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

8.7 SR protocols

8.7.1 Test case: MPLS-based SR

Table 8-13 shows the test case for MPLS-based segment routing (SR).

Table 8-13 – Test case: MPLS-based SR

<table>
<tr><td colspan="5" align="center">MPLS-based SR test description</td></tr>
<tr><td colspan="2">Test purpose</td><td colspan="3">To verify that vBNG supports MPLS-based SR technology.</td></tr>
<tr><td colspan="2">Reference</td><td colspan="3">[ITU-T Q.4064] clause 8.2</td></tr>
<tr><td rowspan="7">Test procedures</td><td>step</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td>1</td><td>Stimulus</td><td colspan="2">Login to the configuration interface of vBNG1 and vBNG2.</td></tr>
<tr><td>2</td><td>Stimulus</td><td colspan="2">Configure IP address for the interfaces of vBNG1 and vBNG2. Configure IS-IS neighbour between vBNG1 and vBNG2.</td></tr>
<tr><td>3</td><td>Stimulus</td><td colspan="2">vBIT1 simulate as CE1 connected to vBNG1. vBIT2 simulate as CE2 connected to vBNG2. Configure EBGP neighbour between vBNG1 and vBIT1, and neighbour between vBNG2 and vBIT2.</td></tr>
<tr><td>4</td><td>Stimulus</td><td colspan="2">Configure MPLS-based SR tunnel and IBGP neighbour between vBNG1 and vBNG2. Check the forwarding table in vBNG1 and vBNG2.The expected result is 1.</td></tr>
<tr><td>5</td><td>Stimulus</td><td colspan="2">vBIT1 and vBIT2 send traffic to each other. The expected result is 2.</td></tr>
<tr><td>6</td><td>Stimulus</td><td colspan="2">Capture packets in the output interface of vBNG1 which is connected to vBNG2.The expected result is 3.</td></tr>
<tr><td rowspan="2">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>vBNG1 and vBNG2 learn the private network routing from each other. The private network routing is iterated to the MPLS-based SR tunnel.</td><td></td></tr>
</table>

Table 8-13 – Test case: MPLS-based SR

			MPLS-based SR test description	
	2	**Check**	The traffic is received by vBIT1 and vBIT2 without packet loss respectively.	
	3	**Check**	The packets are encapsulated with segment label stack that describes the path using MPLS label. The segment label can be the node segment identifier (SID), prefix SID and adjacent SID, etc.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

8.7.2 Test case: IPv6-based SR

Table 8-14 shows the test case for IPv6-based SR (SRv6).

Table 8-14 – Test case: IPv6-based SR

			IPv6-based SR test description	
Test purpose			To verify that vBNG supports IPv6-based SR technology.	
Reference			[ITU-T Q.4064] clause 8.2	
Test procedures	step	Type	Description	
	1	**Stimulus**	Login to the configuration interface of vBNG1 and vBNG2.	
	2	**Stimulus**	Configure IPv6 address for the interfaces of vBNG1 and vBNG2. Configure IS-IS neighbour between vBNG1 and vBNG2.	
	3	**Stimulus**	vBIT1 simulate as CE1 connected to vBNG1. vBIT2 simulate as CE2 connected to vBNG2. Configure EBGP neighbour between vBNG1 and vBIT1 and between vBNG2 and vBIT2.	
	4	**Stimulus**	Configure IPv6-based SR tunnel and IBGP neighbour between vBNG1 and vBNG2. Check the forwarding table in vBNG1 and vBNG2. The expected result is 1.	
	5	**Stimulus**	vBIT1 and vBIT2 send traffic to each other. The expected result is 2.	
	6	**Stimulus**	Capture packets in the output interface of vBNG1 which is connected to vBNG2. There is an expected result 3.	
Expected results	step	Type	Description	Result
	1	**Check**	vBNG1 and vBNG2 learn the private network routing from each other. The private network routing is iterated to the IPv6-based SR tunnel.	
	2	**Check**	The traffic is received by vBIT1 and vBIT2 without packet loss respectively.	
	3	**Check**	The packets are encapsulated with SRH(Segment routing Header) which is used to encapsulate segment list to specify the forwarding path. The segment list consists of multiple IPv6-based SID, which can include End SID, End.X SID and other service SIDs, for	

Table 8-14 – Test case: IPv6-based SR

		IPv6-based SR test description	
		example, End.DT4 SID, etc. [b-IETF RFC 8986]. NOTE 1 – End SID refers to the "Endpoint" behaviour which is the most basic behaviour. It is the instantiation of a Prefix-SID. NOTE 2 – End.X SID refers to the "Endpoint with L3 cross-connect" behaviour which is a variant of the End behaviour. NOTE 3 – End.DT4 SID refers to the "Endpoint with decapsulation and specific IPv4 table lookup" behaviour.	
Notes			
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

8.8 Policy-based routing

8.8.1 Test case: ACL-based PBR

Table 8-15 shows the test case for ACL-based policy-based routing (PBR).

Table 8-15 – Test case: ACL-based PBR

ACL-based PBR test description				
Test purpose		To verify that vBNG supports ACL-based PBR technology.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	step	Type	Description	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interfaces of vBNG.	
	3	**Stimulus**	vBIT1, vBIT2 and vBIT3 simulate as PE1, PE2 and PE3 respectively, which are all connected to vBNG.	
	4	**Stimulus**	Configure the ACL-based PBR to change the priority of traffic which match the rule of ACL in vBNG. For example, Configure the ACL to match the traffic with priority 5, after the traffic is matched, the action is to change the traffic priority to 2. vBIT1 send traffic to vBIT2 with priority 5. The expected result is 1.	
	5	**Stimulus**	Configure the ACL-based PBR to redirect the traffic in vBNG. For example, configure the ACL to match the traffic whose nexthop is vBIT2, after the traffic is matched, the action is to change the nexthop to vBIT3. vBIT1 send traffic to vBIT2. The expected result is 2.	
Expected results	step	Type	Description	Result
	1	**Check**	The priority of the traffic is changed by vBNG according to the PBR successfully.	

Table 8-15 – Test case: ACL-based PBR

ACL-based PBR test description				
	2	**Check**	The traffic is redirected to vBIT3 by vBNG according to the PBR successfully.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.8.2 Test case: BGP-FS

Table 8-16 shows the test case for border gateway protocol-flow specification (BGP-FS).

Table 8-16 – Test case: BGP-FS

BGP-FS test description				
Test purpose		To verify that vBNG supports BGP-FS technology.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Configure IP address for the interfaces of vBNG.	
	3	**Stimulus**	vBIT1 and vBIT2 simulate as PE1 and PE2 respectively, which are both connected to vBNG. vBIT3 simulate as controller connected to vBNG. Configure BGP neighbour between vBNG and vBIT3.	
	4	**Stimulus**	vBIT3 deliver the BGP flow spec route to the vBNG to change the priority of traffic. For example, deliver the BGP flow specification (flowspec) route to match the traffic whose source is vBIT1, after matching the traffic, vBNG change the traffic priority to 2. vBIT1 send traffic to vBIT2. The expected result is 1.	
	5	**Stimulus**	Add vBIT4 simulate as PE3 connected to vBNG. vBIT3 deliver the BGP flowspec route to the vBNG to redirect the traffic. For example, deliver the BGP flowspec route to match the traffic whose nexthop is vBIT2, after matching the traffic, vBNG redirect the nexthop to vBIT4. vBIT1 send traffic to vBIT2. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The priority of the traffic is changed by vBNG according to the BGP flowspec route successfully.	
	2	**Check**	The traffic is redirected to vBIT4 by vBNG according to the BGP flowspec route successfully.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.9 Test case: MTU

Table 8-17 shows the test case for MTU.

Table 8-17 – Test case: MTU

<table>
<tr><td colspan="5" align="center">MTU test description</td></tr>
<tr><td>Test purpose</td><td colspan="4">To verify that vBNG supports the limitation of the maximum frame size allowed through the port.</td></tr>
<tr><td>Reference</td><td colspan="4">[ITU-T Q.4064] clause 8.2</td></tr>
<tr><td rowspan="5">Test procedures</td><td>step</td><td colspan="3">Type   Description</td></tr>
<tr><td>1</td><td colspan="3">Stimulus   Login to the configuration interface of vBNG.</td></tr>
<tr><td>2</td><td colspan="3">Stimulus   vBIT1 and vBIT2 simulate as PE1 and PE2 respectively, which are both connected to vBNG.</td></tr>
<tr><td>3</td><td colspan="3">Stimulus   Configure MTU on one layer 3 forwarding interface of vBNG which is connected to the vBIT2.</td></tr>
<tr><td>4</td><td colspan="3">Stimulus   vBIT1 send traffic with packet length longer than MTU to vBIT2. Capture packets in the output interface of vBNG which is connected with vBIT2. There is an expected result 1.</td></tr>
<tr><td rowspan="2">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>The captured packets are sliced to several shorter packets whose lengths are not longer than the configured MTU.</td><td></td></tr>
<tr><td>Notes</td><td colspan="4"></td></tr>
<tr><td>Test verdict</td><td colspan="4">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

8.10 Test case: QoS

Verification of QoS including verification of following abilities: traffic classification, bandwidth guarantee, queue scheduling, congestion control and hierarchical quality of service (HQoS). The test cases for these functions can refer to those described in clause 7.5.

8.11 Test case: Port aggregation

Table 8-18 shows the test case for port aggregation.

Table 8-18 – Test case: Port aggregation

<table>
<tr><td colspan="4" align="center">Port aggregation test description</td></tr>
<tr><td>Test purpose</td><td colspan="3">To verify that vBNG supports port aggregation function by logically using multiple independent links as a single link.</td></tr>
<tr><td>Reference</td><td colspan="3">[ITU-T Q.4064] clause 8.2</td></tr>
<tr><td rowspan="4">Test procedures</td><td>step</td><td>Type</td><td>Description</td></tr>
<tr><td>1</td><td>Stimulus</td><td>Login to the configuration interface of vBNG.</td></tr>
<tr><td>2</td><td>Stimulus</td><td>vBIT1 and vBIT2 simulate as PE1 and PE2 respectively, which are both connected to vBNG.</td></tr>
<tr><td>3</td><td>Stimulus</td><td>Configure Ethernet trunk 1 of vBNG, add port1 and port2 of vBNG in Ethernet trunk 1.</td></tr>
</table>

Table 8-18 – Test case: Port aggregation

			Port aggregation test description	
	4	**Stimulus**	Configure Ethernet trunk 1 of vBIT2, add port1 and port2 of vBIT2 in Ethernet trunk 1. Port1 and port2 of vBIT2 are connected to port1 and port2 of vBNG respectively.	
	5	**Stimulus**	vBIT1 send traffic to vBIT2 through the aggregated ports. The expected result is 1.	
	6	**Stimulus**	Shutdown port1 of vBIT2 in the Ethernet trunk 1. The expected result is 2.	
Expected results	step	**Type**	**Description**	**Result**
	1	**Check**	The traffic is received successfully by vBIT2 though port1 and port2 of vBNG.	
	2	**Check**	The traffic is received successfully by vBIT2 though port2 of vBNG.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

8.12 Test case: Jumbo frame

Table 8-19 shows the test case for jumbo frame.

Table 8-19 – Test case: Jumbo frame

			Jumbo frame test description	
Test purpose			To verify that vBNG supports jumbo frame.	
Reference			[ITU-T Q.4064] clause 8.2	
Test procedures	step	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	vBIT1 and vBIT2 simulate as PE1 and PE2 respectively, which are connected to vBNG.	
	3	**Stimulus**	Enable jumbo frame function in vBNG.	
	4	**Stimulus**	vBIT1 send traffic with jumbo frame to vBIT2. Capture packet in the input interface of vBNG, The expected result is 1.	
	5	**Stimulus**	Capture packet in the output interface of vBNG, The expected result is 2.	
Expected results	step	**Type**	**Description**	**Result**
	1	**Check**	The captured packet in the input interface of vBNG is jumbo frame.	
	2	**Check**	The captured packet in the output interface of vBNG is jumbo frame without fragment.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

8.13 Test case: Anti-DOS/DDOS

Table 8-20 shows the test case for anti-DOS/DDOS.

Table 8-20 – Test case: Anti-DOS/DDOS

Anti-DOS/DDOS test description				
Test purpose		To verify that vBNG supports anti-DOS/DDOS function.		
Reference		[ITU-T Q.4064] clause 8.2		
Test procedures	step	Type	Description	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Enable anti-DOS and anti-DDOS function of vBNG. Configure IP address of interface port1 of vBNG.	
	3	**Stimulus**	vBIT simulate network application with IP address IP2 to send SYN flood, UDP flood, Ping flood, ARP attack to vBNG through the layer 3 interface. The expected result is 1.	
	4	**Stimulus**	vBIT simulate network application with several IP addresses to send SYN flood, UDP flood, Ping flood, ARP attack to vBNG through the layer 3 interface. The expected result is 2.	
Expected results	step	Type	Description	Result
	1	**Check**	vBNG is not affected by these attacks.	
	2	**Check**	vBNG is not affected by these attacks.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

8.14 Test case: URPF

Table 8-21 shows the test case for URPF.

Table 8-21 – Test case: URPF

URPF test description			
Test purpose		To verify that vBNG supports URPF function.	
Reference		[ITU-T Q.4064] clause 8.2	
Test procedures	step	Type	Description
	1	**Stimulus**	Login to the configuration interface of vBNG.
	2	**Stimulus**	vBIT1 and vBIT2 simulate as PE1 and PE2 respectively, which are connected to vBNG.
	3	**Stimulus**	Configure URPF function of interface port1 and port2 of vBNG which both are connected to vBIT1.
	4	**Stimulus**	Configure IP1 on vBIT1 port1 which is connected to port 1 of vBNG. Configure IP2 on vBIT1 port2 which is connected to port 2 of vBNG.
	5	**Stimulus**	vBIT1 send traffic whose source IP address is IP1 and IP2 to vBIT2 through port1 and port2 respectively. The expected result is 1.

Table 8-21 – Test case: URPF

URPF test description				
	6	**Stimulus**	vBIT1 send traffic whose source IP address is IP1 and IP2 to vBIT2 both through port1. The expected result is 2.	
Expected results	step	**Type**	**Description**	**Result**
	1	**Check**	Traffic with source IP addresses IP1 and IP2 are both received by vBIT2 successfully.	
	2	**Check**	Traffic with source IP addresses IP1 are received by vBIT2 successfully. Traffic with source IP addresses IP2 is discarded in vBNG.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

9   Test cases for IOPT of vBNG between vBNG and management system

IOPT between vBNG and management system evaluates the interaction for control and management functions including the following abilities: dynamic host configuration protocol (DHCP) relay, simple network management protocol (SNMP), flow sampling, port mirror, alarm, telemetry, virtualized resource management, basic device configuration, and service configuration. For a description of related functional requirements refer to [ITU-T Q.4064].

9.1   Test case: AAA

Table 9-1 shows the test case for authentication, authorization and accounting (AAA).

Table 9-1 – Test case: AAA

AAA test description			
Test purpose		To verify that vBNG supports AAA function.	
Reference		[ITU-T Q.4064] clause 8.3	
Test procedures	step	**Type**	**Description**
	1	**Stimulus**	Login to the configuration interface of vBNG.
	2	**Stimulus**	Configure user access domain name "pppoe" in vBNG. Create a PPPoE user account "test1@pppoe". Configure the authentication mode as RADIUS, and configure the address allocation method as local assignment.
	3	**Stimulus**	Configure PPPoE user account "test1@pppoe" on RADIUS server.
	4	**Stimulus**	vBIT1 simulate as a PPPoE user "test1", vBIT2 simulate as PE/vBNG.
	5	**Stimulus**	Configure the authentication mode of PPPoE user "test1" to CHAP.
	6	**Stimulus**	vBIT1 dialling in through CPE/vCPE. vBIT1 send traffic to vBIT2. The expected result is 1.
	7	**Stimulus**	Change the authentication mode of PPPoE user "test1" to PAP. Perform step 6. The expected result is 2.

Table 9-1 – Test case: AAA

AAA test description				
	8	**Stimulus**	Configure the time accounting rule in vBNG, such as limited the online time of user "test1" to 10 minutes. Perform step 6. The expected result is 3.	
	9	**Stimulus**	Configure the traffic accounting rule in vBNG, such as limiting the traffic of user "test1" to 100 Mbytes. Perform step 6, The expected result is 4.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	User "test1" can obtain IP address. vBIT2 received packets without loss.	
	2	**Check**	User "test1" can obtain IP address. vBIT2 received packets without loss.	
	3	**Check**	Within 10 minutes after the user "test1" online, vBIT2 received the traffic without packet loss. After 10 minutes, user "test1" will be offline.	
	4	**Check**	vBIT2 received the traffic without packet loss until the traffic reaches 100Mbytes.When the traffic reaches 100 Mbytes, user "test1" will be offline.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

9.2 Test case: DHCP relay

Table 9-2 shows the test case for DHCP relay.

Table 9-2 – Test case: DHCP relay

DHCP relay test description				
Test purpose		To verify that vBNG supports DHCP relay function.		
Reference		[ITU-T Q.4064] clause 8.3		
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	vBIT1 simulate as DHCP server. Configure vBNG as DHCP relay agent of vBIT1.	
	3	**Stimulus**	vBIT2 simulate as PC to obtain IP address from vBNG by DHCP.	
	4	**Stimulus**	vBIT2 initiate a DHCP dial-up request to vBNG. The expected result is 1.	
	5	**Stimulus**	Capture packet in the output interface of vBNG which is connected to vBIT1. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	vBIT2 can obtain IP address.	
	2	**Check**	The captured packet in the output interface of vBNG contained DHCP DISCOVER, DHCP OFFER, DHCP	

Table 9-2 – Test case: DHCP relay

DHCP relay test description				
			REQUEST and DHCP ACK.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

9.3 Test case: SNMP

Table 9-3 shows the test case for SNMP.

Table 9-3 – Test case: SNMP

SNMP test description				
Test purpose			To verify that vBNG supports SNMP function.	
Reference			[ITU-T Q.4064] clause 8.3	
Test procedures	**step**	**Type**	**Description**	
	1	Stimulus	Login to the configuration interface of vBNG.	
	2	Stimulus	Connect SNMP server to vBNG. Configure the SNMP service in vBNG, and add the MIB of vBNG on the SNMP server.	
	3	Stimulus	Use SNMP server to read device information by MIB browser. such as board status, interface status, interface configuration, CPU utilization, etc. The expected result is 1.	
	4	Stimulus	Use SNMP server to operate MIB browser to modify device parameter values, such as shutdown or no shutdown the interface. The expected result is 2.	
	5	Stimulus	Using SNMP server read the information on vBNG by SNMP periodically. The expected result is 3.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	Check	The device information of vBNG can be read by SNMP server.	
	2	Check	The device parameter values of vBNG can be modified by SNMP server.	
	3	Check	The device information of vBNG can be read periodically by SNMP server.	
Notes				
Test verdict			If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.	

9.4 Test case: Flow sampling

Table 9-4 shows the test case for flow sampling.

Table 9.4 – Test case: Flow sampling

Flow sampling test description				
Test purpose		To verify that vBNG supports flow sampling function.		
Reference		[ITU-T Q.4064] clause 8.3		
Test procedures	step	Type	Description	
	1	Stimulus	Login to the configuration interface of vBNG.	
	2	Stimulus	vBIT1 and vBIT2 simulate as PE1 and PE2 respectively, which are connected to vBNG. Connect traffic sampling server to vBNG.	
	3	Stimulus	Configure flow sampling on port1 of vBNG, set the sampling ratio to 1000:1, the sampled traffic is sent to the traffic sampling server.	
	4	Stimulus	vBIT1 send traffic whose bandwidth is 1 Gbit/s to vBIT2 through port1 of vBNG. The expected result is 1.	
Expected results	step	Type	Description	Result
	1	Check	The traffic sampling server received the sampled traffic with bandwidth of 1 Mbit/s.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

9.5 Test case: Port mirror

Table 9-5 shows the test case for port mirror.

Table 9-5 – Test case: Port mirror

Port mirror test description				
Test purpose		To verify that vBNG supports port mirror function.		
Reference		[ITU-T Q.4064] clause 8.3		
Test procedures	step	Type	Description	
	1	Stimulus	Login to the configuration interface of vBNG.	
	2	Stimulus	vBIT1, vBIT2 and vBIT3 simulate as PE1, PE2 and PE3 respectively, which are all connected to vBNG.	
	3	Stimulus	Configure traffic mirroring from port1 which is connected to vBIT1 to port3 which is connected to vBIT3 on the vBNG.	
	4	Stimulus	vBIT2 send traffic to vBIT1 through port1 of vBNG, The expected result is 1.	
Expected results	step	Type	Description	Result
	1	Check	vBIT1 and vBIT3 both received the traffic without packet loss, and thevBIT3 received the same number of packets as vBIT1.	
Notes				
Test verdict		If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.		

9.6   Test case: Alarm

Table 9-6 shows the test case for alarm.

Table 9-6 – Test case: Alarm

Alarm test description				
Test purpose	To verify that vBNG supports alarm function.			
Reference	[ITU-T Q.4064] clause 8.3			
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login to the configuration interface of vBNG.	
	2	**Stimulus**	Connect syslog server to vBNG, configure the vBNG to send alarms to the syslog server.	
	3	**Stimulus**	Traverse different levels of alarm operations on vBNG, such as removing the optical fiber/board/fan/power, deleting the BGP neighbour, keep new users dial-in until the IP address is exhausted. The expected result is 1.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The alarm information is generated on the vBNG. The syslog server can receive these alarms successfully.	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

9.7   Test case: Telemetry

Table 9-7 shows the test case for telemetry.

Table 9-7 – Test case: Telemetry

Telemetry test description			
Test purpose	To verify that vBNG supports telemetry function.		
Reference	[ITU-T Q.4064] clause 8.3		
Test procedures	**step**	**Type**	**Description**
	1	**Stimulus**	Login to the configuration interface of vBNG.
	2	**Stimulus**	Deploy a collection platform for collecting telemetry messages of vBNG.
	2	**Stimulus**	Configure telemetry function of vBNG to send the device and service information to collection platform, such as BGP neighbour status, QoS information, interface bandwidth utilization, CPU utilization and so on. The expected result is 1.
	3	**Stimulus**	Change the information collection method to actively query on the collection platform. The expected result is 2.

Table 9-7 – Test case: Telemetry

<table>
<tr><td colspan="5" align="center">Telemetry test description</td></tr>
<tr><td rowspan="3">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>The collection platform received the collected device and service information of vBNG successfully.</td><td></td></tr>
<tr><td>2</td><td>Check</td><td>The collection platform can actively query the device and service information of vBNG.</td><td></td></tr>
<tr><td>Notes</td><td colspan="4"></td></tr>
<tr><td>Test verdict</td><td colspan="4">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

9.8 Test case: Virtualized resource management

Table 9-8 shows the test case for virtualized resource management.

Table 9-8 – Test case: Virtualized resource management

<table>
<tr><td colspan="5" align="center">Virtualized resource management test description</td></tr>
<tr><td>Test purpose</td><td colspan="4">To verify that vBNG supports virtualized resource management function.</td></tr>
<tr><td>Reference</td><td colspan="4">[ITU-T Q.4064] clause 8.3</td></tr>
<tr><td rowspan="5">Test procedures</td><td>step</td><td>Type</td><td colspan="2">Description</td></tr>
<tr><td>1</td><td>Stimulus</td><td colspan="2">Login the virtualization resource management system of vBNG.</td></tr>
<tr><td>2</td><td>Stimulus</td><td colspan="2">vBNG is deployed in virtualization mode. View virtualized management system, The expected result is 1.</td></tr>
<tr><td>3</td><td>Stimulus</td><td colspan="2">Create or delete a VM on virtualization resource management system of vBNG, The expected result is 2.</td></tr>
<tr><td>4</td><td>Stimulus</td><td colspan="2">vBIT1 simulate PPPoE users dialling in through CPE/vCPE. Increasing the number of PPPoE users, until the number of PPPoE users carried by the vBNG exceeds the maximum value supported by the current user management VNF/VM of vBNG. The expected result is 3.</td></tr>
<tr><td rowspan="4">Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td>1</td><td>Check</td><td>The virtualized network function (VNF)/virtual machine (VM) and virtual interface can be displayed, and also can view the mapping relationship between virtualized resource and physical device of vBNG.</td><td></td></tr>
<tr><td>2</td><td>Check</td><td>The VM can be created/deleted successfully.</td><td></td></tr>
<tr><td>3</td><td>Check</td><td>The vBNG can expand the user management VNF/VM automatically to support new PPPoE users.</td><td></td></tr>
<tr><td>Notes</td><td colspan="4"></td></tr>
<tr><td>Test verdict</td><td colspan="4">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

9.9 Test case: Basic device configuration

Table 9-9 shows the test case for basic device configuration.

Table 9-9 – Test case: Basic device configuration

Basic device configuration test description				
Test purpose	To verify that vBNG supports basic device configuration function.			
Reference	[ITU-T Q.4064] clause 8.3			
Test procedures	**step**	**Type**	**Description**	
	1	**Stimulus**	Login the management system of vBNG.	
	2	**Stimulus**	Configure IP address on the interface of vBNG through the management system of vBNG. The expected result is 1.	
	3	**Stimulus**	Delete IP address on the interface of vBNG through the management system of vBNG. The expected result is 2.	
Expected results	**step**	**Type**	**Description**	**Result**
	1	**Check**	The IP address is successfully configured to the vBNG interface through the management system.	
	2	**Check**	The IP address is successfully deleted to the vBNG interface through the management system.	
Notes				
Test verdict	If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.			

9.10 Test case: Service configuration

Table 9-10 shows the test case for service configuration.

Table 9-10 – Test case: Service configuration

Service configuration test description			
Test purpose	To verify that vBNG supports service configuration function.		
Reference	[ITU-T Q.4064] clause 8.3		
Test procedures	**step**	**Type**	**Description**
	1	**Stimulus**	Login the management system of vBNG.
	2	**Stimulus**	vBIT1 simulate as CE connected to vBNG. vBIT2 simulate as PE connected to vBNG.
	3	**Stimulus**	Configure vBNG through the management system of vBNG.
	4	**Stimulus**	Configure VPLS tunnel between vBNG and vBIT2, Check the VPLS tunnel state and forwarding table in vBNG.vBIT1 send traffic to vBIT2. The expected result is 1.
	5	**Stimulus**	Configure VLL tunnel between vBNG and vBIT2, Check the VLL tunnel state in vBNG. vBIT1 send traffic to vBIT2. The expected result is 2.
	6	**Stimulus**	Configure L3VPN tunnel between vBNG and vBIT2, Check the L3VPN tunnel state and forwarding table in vBNG. vBIT1 send traffic to vBIT2. The expected result is 3.

Table 9-10 – Test case: Service configuration

<table>
<tr><td colspan="5" align="center">Service configuration test description</td></tr>
<tr><td></td><td>7</td><td>Stimulus</td><td colspan="2">Delete configurations of VPLS/VLL/L3VPN on vBNG through the management system of vBNG. The expected result is 4.</td></tr>
<tr><td>Expected results</td><td>step</td><td>Type</td><td>Description</td><td>Result</td></tr>
<tr><td></td><td>1</td><td>Check</td><td>The VPLS tunnel is established, and the VPLS forwarding table can be displayed.
vBIT2 received packets without loss.</td><td></td></tr>
<tr><td></td><td>2</td><td>Check</td><td>The VLL tunnel is established, and the VLL forwarding table can be displayed.
vBIT2 received packets without loss.</td><td></td></tr>
<tr><td></td><td>3</td><td>Check</td><td>The L3VPN tunnel is established, and the L3VPN forwarding table can be displayed.
vBIT2 received packets without loss.</td><td></td></tr>
<tr><td></td><td>4</td><td>Check</td><td>The configurations of VPLS/VLL/L3VPN are deleted successfully on the vBNG through the management system of vBNG.</td><td></td></tr>
<tr><td>Notes</td><td colspan="4"></td></tr>
<tr><td>Test verdict</td><td colspan="4">If all checks described in the test case are successful, it is deemed successfully terminated. If at least one check is successful but at least one check is failed, the test is deemed partially passed. If no checks are successful, the test is deemed failed.</td></tr>
</table>

Bibliography

[b-IEEE 802.1Q]   IEEE 802.1Q-2022, *IEEE Standard for Local and Metropolitan Area Networks-Bridges and Bridged Networks*.

[b-IETF RFC 3376]   IETF RFC 3376 (2002), *Internet group management protocol, version 3*.

[b-IETF RFC 3810]   IETF RFC 3810 (2016), *Multicast listener discovery version 2 (MLDv2) for IPv6*.

[b-IETF RFC 8986]   IETF RFC 8986 (2021), *Segment Routing over IPv6 (SRv6) Network Programming*.

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