MARKETING REPORT

MD-459.4
Multi-service Disaggregated BNG New Features

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Issue History

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Executive Summary

The TR-459 series of Technical Reports defines the Multi-Service Disaggregated Broadband Network Gateway with Control User Plane separation. By separating the Control Plane (CP) and User Plane (UP) of the BNG, the disaggregated BNG (DBNG) offers new possibilities for both Service Providers and vendors. Opportunities and benefits of disaggregation are discussed in MR-459, MR-459.2, MR-459.3 and this document.

This Marketing Report accompanies the release of Issue 2 of TR-459 which details enhancements and improvements to the MS-DBNG. Issue 2 of TR-459 provides important new functionality to improve interoperability, and new features such as subscriber resiliency that enables capex/opex savings and availability improvements thanks to a type of geographical user plane redundancy that enables improvements in network efficiency. In addition, TR-459 Issue 2 defines a DHCP relay function, which also forms a building block of disaggregation for wireless-wireline convergence functions being defined within BBF.

The momentum has not slowed in the BBF; Service Providers and vendors continue to explore innovative new MS-DBNG use cases creating a list of topics to be addressed in future issues of TR-459.

1 TR-459 series

The Broadband Forum continues to develop and enhance the Multi-Service Disaggregated BNG with CUPS (MS-DBNG) that was originally introduced in MR-459 in 2019.

The first issue of TR-459 laid the foundations for and defined the functions for the Multi-Service DBNG Control Plane (DBNG-CP) and the DBNG User Plane (DBNG-UP).

TR-459.2 enhanced the capability of the DBNG solution by adding support for Carrier Grade Network Address Translation (CGNAT) functionality.

TR-459.3 further enhanced the capabilities of the DBNG solution by adding support for IPTV Multicast functionality.

The three TRs listed above provide a comprehensive DBNG CUPS architecture that supports multi-service wireline broadband use cases.

TR-459 Issue 2 further improves the capability of the MS-DBNG with new features and capabilities, now going much further than what is achievable with a legacy integrated BNG. More details on TR-459 Issue 2 are in Section 2.

2 TR-459 Issue 2

BBF is releasing the newest document for the TR-459 series: TR-459 Issue 2.

TR-459 Issue 2 has added many new features to the DBNG CUPS architecture. Key features in TR-459 Issue 2 include:

1.	Subscriber Group	An enabler for dynamic prefix assignment with routing policy control and DBNG-UP resiliency
2.	Subscriber Group Resiliency	Subscriber Group Resiliency enables Geographical Redundancy for DBNG-UP and minimizes network outage during a network fault or network maintenance at DBNG-UP
3.	DHCP relay	The ability to use an external DHCP server to assign addresses to subscribers
4.	ACL solution	A subscriber session can have an ACL or chain of ACLs applied for filtering, forwarding, and other specific traffic operations: the ACL can be programmed by the DBNG-CP onto the DBNG-UP
5.	BBF PFCP node reports and error notifications	The ability to report various types of faults from the DBNG-UP to DBNG-CP. This allows the DBNG-CP to intelligently determine for example if a switchover to a new DBNG-UP is necessary
6.	Additional Call Flows	Use cases related to delayed session programming, session modification, session statistics reporting, session termination and subscriber resiliency

2.1 Subscriber Groups

The concept of a Subscriber Group (SGRP) is introduced in TR-459 Issue 2. A SGRP is used to designate a group of subscribers that share the same properties, for example, subscribers sharing the same set of prefixes or subscribers sharing the same resiliency fate. The SGRP provides an additional layer of flexibility to treat multiple subscribers in the same manner, thereby simplifying operations and streamlining provisioning and maintenance processes.

In TR-459 Issue 2, SGRP is used to combine subscribers together that share:

- IP address prefixes
- same forwarding state on a given DBNG-UP
- User Plane assignment for resiliency (active DBNG-UP and backup DBNG-UP).

IP address allocation and management of subscriber unicast addresses is supported with the SGRP framework. The SGRP can be used to dynamically assign one or more prefixes depending on the number of subscribers that are part of the SGRP or withdraw prefixes quickly while not in use.

The subscriber state indicates whether the SGRP and hence the subscribers who are members of that SGRP are actively forwarding data packets on a specific DBNG-UP.

The SGRP also enables subscriber redundancy where an Active DBNG-UP can be protected from different types of failures through a designated Backup DBNG-UP which can be co-located or geographically separated from the Active DBNG-UP.

TR-459 provides two types of switchover options:

- DBNG-CP control: Faults are reported to the DBNG-CP and the DBNG-CP determines the action that needs to be taken to handle the sessions on another DBNG-UP.
- DBNG-UP tracking: This is to allow the DBNG-UP to switchover SGRP(s) without consulting the DBNG-CP. The intent of this mode is to allow the fastest resiliency without any signaling from the DBNG-CP to DBNG-UP.

2.1.1 Dynamic Prefix Assignment

This is a critical capability with the exhaustion of IPv4 address space.

The DBNG-CP can dynamically and efficiently allocate prefixes to the DBNG-UP as needed. It is also possible for the DBNG-CP to reclaim prefixes when they are unused on the DBNG-UP, thereby maximizing the usage of available IP addresses. The SGRP prefixes along with the SGRP state are also applicable in the case of a non-redundant SGRP.

2.1.2 Resiliency with Backup Oversubscription

The partial programming of a DBNG-UP for the sessions in an SGRP operating in backup state is a unique extension to resiliency. The DBNG-CP can optionally give liberty to the backup DBNG-UP as to whether to program all the required resources for backup state before a failure event. For example, the DBNG-UP may install the forwarding rules and store the QoS and/or usage reporting rules. It may take this approach for all the sessions or for some sessions only. This advanced capability allows the resources of the User Plane to be efficiently used for backup subscribers and makes spare capacity available for backing up additional subscribers thereby achieving N:1 oversubscription. The complete subscriber state is always fully installed by the DBNG-UP (from the locally stored information) when a SGRP becomes active on the DBNG-UP.

2.2 DHCP Relay

DHCP relay, relay-proxy, and DHCPv6 relay are used for deployments where external DHCP/DHCPv6 server is used to satisfy the address and configuration attributes requested by the subscribers.

An external DHCP/DHCPv6 server may be used within the provider's network in conjunction with AAA or in support of L3 wholesale in which the DHCP/DHCPv6 server is part of the retailer's network. For the former case, the external DHCP/DHCPv6 server is connected to the DBNG-CP, whereas, for the latter, it is connected to the DBNG-UP via the A10 interface.

The DHCP Relay access model may be deployed by an operator to migrate their BNG deployment use case to DBNG, and it also facilitates wireless-wireline convergence. For example, the IP and IPv6 address for a wireline subscriber can be obtained from a DHCP server in the 5G Core network and thereafter the subscriber can forward traffic through the 5G data network. For more details on BBF's work on wireless-wireline convergence, refer TR-470.

2.3 PFCP Node Reports & Notifications

The TR-459 SCi protocol has been augmented to facilitate DBNG-UP to send asynchronous notifications not specific to a session to DBNG-CP using the 3GPP PFCP Node Request/ Response messages.

The DBNG CUPS leverages these PFCP node reports to further advance broadband resiliency. To enable the DBNG-CP make an informed decision on resiliency switchover, the DBNG-UP sends reports to the DBNG-CP detailing the faults and the bandwidth left due to the faults. This enables us to minimize the disruption for the end subscriber, and to switchover to a new DBNG-UP only when absolutely necessary.

3 Additional TR-459 work

The BBF continues its industry leading innovative work on MS-DBNG. The below areas are being considered:

- Wireline extensions to 3GPP QoS for subscribers
- CGNAT public prefix using SGRP
- Remain aligned with BBF work on subscriber session steering
- Resiliency for L2TP subscribers
- Route Advertisement improvements
- Recovering and reprogramming DBNG-UP for various fault scenarios.

4 DBNG CUPS demo

BBF members have already showcased the important and innovative capabilities now enabled by TR-459 Issue 2 as part of the BBF Cloud CO Demonstration at Network X 2022. BBF Cloud CO demo covered two use-cases showing TR-459 Issue 2 and Subscriber Session Steering “in action”.

The novelty of this BBF demo was two-fold:

1. Showcased Subscriber Group (SGRP) resiliency/ SGRP switchover with TR-459 Issue 2 subscribers in a 1:1 resiliency configuration.
2. Showed interoperability of multiple vendors performing Access node to DBNG-UP traffic steering/ Make-Before-Break (MBB) for an SGRP. The network monitored the subscriber traffic SLAs on active DBNG-UP and when the SLAs were not being met, switched the subscribers to the backup DBNG-UP in a hitless manner.

As part of the BBF Cloud CO Demo, the “Zero-touch HSIA service in a multi-vendor CloudCo environment” use case was shown, using the TR 459 Issue 2 Disaggregated BNG functions and subscriber steering on login.

Another use case shown was “Automated Intelligent Management (AIM), with Network congestion and traffic steering”, where network congestion was detected and through SGRP Make-Before-Break in Subscriber Steering, resilient SGRP switched traffic over the less congested path.

5 Terminology

5.1 References

The following references are of relevance to this Marketing Report. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Marketing Report are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below.

A list of currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

Document		Title	Source	Year
[1]	TR-459 Issue 2	*Multi-Service Disaggregated BNG with CUPS. Reference Architecture, Deployment Models, interface, and Protocol Specifications*	Broadband Forum	2023
[2]	MR-459	*Disaggregated BNG*	Broadband Forum	2019
[3]	MR-459.2	*Improving Service Resilience through BNG Disaggregation*	Broadband Forum	2020
[4]	MR-459.3	*Five Key Questions on the Disaggregated BNG*	Broadband Forum	2020
[5]	TR-145	*Multi-service Broadband Network Functional Modules and Architecture*	Broadband Forum	2012
[6]	TR-178	*Multi-service Broadband Network Architecture and Nodal Requirements*	Broadband Forum	2017
[7]	TR-459	*TR-459, Control and User Plane Separation for a Disaggregated BNG*	Broadband Forum	2020
[8]	TR-459.2	*Multi-Service Disaggregated BNG with CUPS: Integrated Carrier Grade NAT function. Reference Architecture, Deployment Models, Interface, and Protocol Specifications*	Broadband Forum	2021
[9]	TR-459.3	*Multi-Service Disaggregated BNG with CUPS: IPTV Multicast function - Reference Architecture, Deployment Models, Interface and Protocol Specifications*	Broadband Forum	2021
[10]	TR-470	*5G Wireless Wireline Convergence Architecture*	Broadband Forum	2022

5.2 Definitions

The following terminology is used throughout this Marketing Report.

Term	Definition
ACL	An ACL is an ordered set of rules used to filter traffic in a device. Each rule is used to find a match on a packet and define actions that will be performed on the packet.

AGF	A function which is added to a wireline access network and allows connectivity to the 5G core.
MS-BNG	TR-178 introduces the Multi-Service BNG (MS-BNG), which extends the capabilities of a traditional BNG to offer services to both residential and business customers as well as to allow mobile backhaul deployments. To achieve this, it performs Ethernet Aggregation and can either forward packets via MPLS or through IP Aggregation/routing. A MS-BNG is part of a TR-145 network architecture and can be deployed in a hierarchical BNG architecture.

5.3 Abbreviations

This Marketing Report uses the following abbreviations:

Term	Definition
3GPP	3rd Generation Partnership Project
5G	5th Generation
AAA	Authentication, Authorization & Accounting
ACL	Access Control List
AGF	Access Gateway Function
BBF	Broadband Forum
BNG	Broadband Network Gateway
CGNAT	Carrier Grade Network Address Translation
CUPS	Control and User Plane Separation
DBNG-CP	Disaggregated BNG Control Plane
DBNG-UP	Disaggregated BNG User Plane
DHCP	Dynamic Host Configuration Protocol
DHCPv6	Dynamic Host Configuration Protocol Version 6
IP	Internet Protocol
IPoE	IP over Ethernet
IPTV	IP Television
L2TP	Layer 2 Tunnel Protocol
MR	Marketing Report
MS-BNG	Multi-Service BNG
ONT	Optical Network Terminal
PFCP	Packet Forwarding Control Protocol
QoS	Quality of Service
SCi	State Control Interface
SGRP	Subscriber Group
TR	Technical Report

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