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Control Plane and User Plane Separated BNG Deployment Model
draft-cuspdt-rtgwg-cu-separation-bng-deployment-02

Abstract

This document describes the deployment model for a Broadband Network Gateway (BNG) device with Control Plane (CP) and User Plane(UP) separation. It is intended to give guidance for the deployment of CP and UP separated BNG devices in an operators' network.

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1. Introduction and Overview

A Broadband Network Gateway (BNG) is an Ethernet-centric IP edge router and acts as the aggregation point for the user traffic with some additional functions such as address management and cooperating with AAA (Radius/Diameter) systems and subscriber management. Because of the rapid development of new services, such as 4K, IoT, etc. and the increasing numbers of distributed home broadband service users, high resource utilization, high-efficiency management, and fast service provisioning are required. This calls for a new BNG architecture with CP and UP separation, which is also called Cloud BNG, as proposed in [BBF-CloudCO] [TR-384].

The CP and UP separation architecture of the BNG is composed of a Control Plane and a User Plane, with the concentrated CP responsible for control and management of the UP's resources and subscribers' information, and with the distributed UP taking charge of policy implementation and traffic forwarding. The obvious advantages of this new architecture are listed below.

Resource Utilization Improvement: A centralized Control Plane provides unified management capability for network resources and users information. The CP has an overview of all the resources and can distribute resources as specific users require, thus resources can be totally controlled and balanced.

Management with High Efficiency: A centralized CP provides a unified management interface to the outside systems such as EMS, DHCP Server, AAA Server, etc. In this situation, management can be easier for the centralized CP as it's the only device interfacing with the outside systems.

Dynamic and Flexible: The CP can be virtualized as a VNF with MANO management in an NFVI, while the UP can be a virtual machine or physical device as needed. A software-oriented CP can be designed with flexibility. The CP can handle all the situations dynamically over a wide range from few users accessing to large numbers of users accessing.

Fast TTM: The CP and UP can be deployed separately with the CP deployed centrally and the UP deployed in distribution closer to users. Thus, according to different situations such as session overload or extremely high throughput, the CP and UP can be extended separately. This can help shorten the time to market (TTM).

As noted, the new BNG architecture has CP and UP separation. The CP and UP are deployed with separation due to practical requirements. This document gives the CU separation BNG deployment model for actual

deployments.

2. Concept and Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

2.1 Terminology

BNG: Broadband Network Gateway. A broadband remote access server (BRAS, B-RAS or BBRAS) routes traffic to and from broadband remote access devices such as digital subscriber line access multiplexers (DSLAM) on an Internet service provider's (ISP) network. BRAS can also be referred to as a Broadband Network Gateway (BNG).

CP: Control Plane. The CP is a user control management component which manages UP's resources such as the user entry and user's QoS policy

CUPS: Control/User Plane Separation

UP: User Plane. The UP is a network edge and user policy implementation component. The traditional router's Control Plane and forwarding plane are both preserved on BNG devices in the form of a user plane.

TTM: Time to Market. It is the length of time it takes from a product or a service being conceived until it is available for sale.

MANO: Management and Orchestration. Functions are collectively provided by NFVO, VNFM and VIM.

VNF: Virtual Network Function. Implementation of a Network Function that can be deployed on a Network Function Virtualization Infrastructure (NFVI).

PNF: Physical Network Function

DHCP: Dynamic Host Configuration Protocol

PPPoE: Point-to-Point Protocol over Ethernet

IPoE: Internet Protocol over Ethernet

3. BNG with CP and UP Separation Deployment Model

3.1 CP and UP of BNG Deployment Within One District

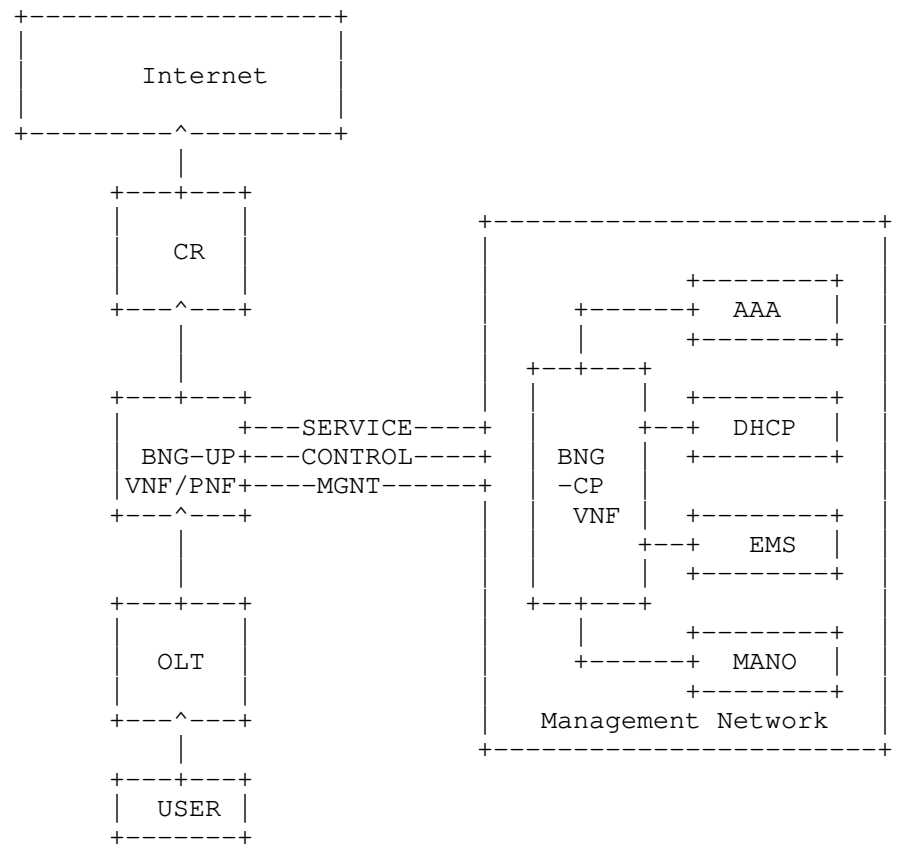

Figure 1: Cloud BNG Deployed in One District

Take a one district example as in Figure 1. Here BNG-CP and BNG-UP are separated as deployed. Since the CP is computationally intensive, a virtualized CP acting as a VNF can meet the requirements of flexibility and fast calculation. The UP is traffic intensive, which can be virtualized or stay physical depending on traffic. The virtualized UP with low expense and high flexibility can be suitable for light traffic. In high traffic, special hardware is needed with high traffic forwarding performance.

In order to fulfill the function of a BNG, the BNG-CP needs to communicate with outside systems such as a AAA (Radius/Diameter) server and many others in the management network. In addition, the

BNG-CP has three interfaces with the BNG-UP separated by their traffic categories: Service Interface, Control Interface, and Management Interface.

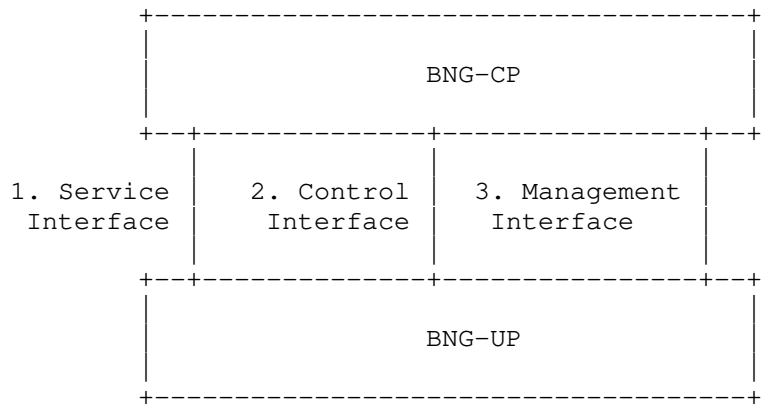

Figure 2. Internal Interfaces Between the BNG CP and UP

The functions of the three interfaces are as follows:

Service Interface: The CP and UP use this interface to establish VXLAN tunnels with each other and transmit PPPoE and IPoE packets over the VXLAN tunnels for authentication.

Control Interface: The CP uses this interface to deliver service entries to the UP, and the UP uses this interface to report service events to the CP.

Management Interface: The CP uses this interface to deliver basic configurations to the UP. This interface uses NETCONF.

Several related drafts exist describing these interfaces in detail. The VXLAN-GPE extension draft for C/U separated BNG is related to the Service Interface [huang-nov3-vxlan-gpe-extension-for-vbng]. The draft YANG data model for CU separated BNG focuses on Management Interface, seeing in [cuspdt-rtgwg-cu-separation-yang-model]. Another two drafts [cuspdt-rtgwg-cusp-requirements] and [cuspdt-rtgwg-cu-separation-infor-model] are related to the control interface giving an information model abstraction and suitable protocol.

3.2. CP and UP of BNG Deployment in Multiple Districts

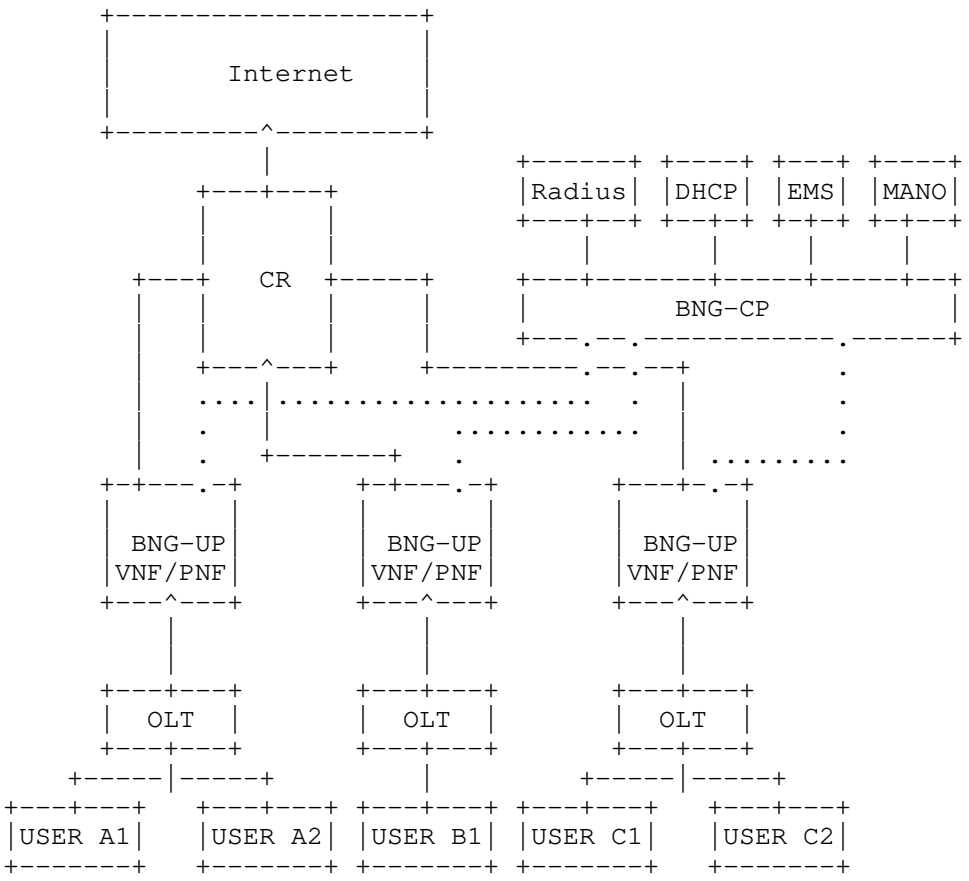

Figure 3: Cloud BNG Deployed in Several Districts

If subscribers are distributed in several districts, the CP can be deployed centrally with the UP deployed in different districts close to subscribers as shown in Figure 3. Thus the deployment model can be a bit complex.

Take three districts A, B. and C for example. Here three UPs are placed with one shared CP. The CP is usually deployed in a Core Data Center such as in a provincial datacenter with UPs in edge Date Centers such as city datacenters. In this Data Centers design, we have core data centers and edge data centers according to their location and responsibility. Core data centers are often planned in provinces for control and management, while edge data centers are in cities or towns for easy service access.

In this scenario, a centralized CP interfaces to the subsystems outside and communicate with all these UPs for control and management.

Under the CP's control, the corresponding traffic is forwarded by UP to the Internet.

4. The Process of BNG with CUPS in Home Service

Take a user Bob accessing to the Internet using Home Broadband Service as an example. The process includes the service traffic from user to the internet and signaling traffic between BNG-UP and BNG-CP. Below is the whole process.

(1) User Bob dials up with packets of PPPoE or IPoE from BNG-UP which will be sent to the BNG-CP with the user's information. This is signaling traffic.

(2) The BNG-CP processes the dialup packets. Confirming with the outside neighboring systems in the management network, the BNG-CP makes the decision to permit or deny of the dial access through certification. In this step, the BNG-CP manages resources and generates tables with information such as User Info, IP Info, QoS Info, etc. This is signaling traffic.

(3) The BNG-CP sends tables to the corresponding UP or to one UP it chooses from the corresponding UPs. This is signaling traffic.

(4) The BNG-UP receives the tables, matches rules and performs corresponding actions.

(5) If Bob is certificated and permitted, the UP forwards their traffic into the Internet with related policies such as limited bandwidth, etc. Otherwise, Bob is denied to access the Internet. This is service traffic.

From Step 2 to Step 4, the information model defined in [cuspdt-rtgwg-cu-separation-infor-model] can be used.

5. High Availability Considerations

As the BNG-CP takes responsibility for control and management, such as communicating with outside systems, generating flow tables, and managing the UP's resources, high availability of this key component should be considered. Some redundancy should be adopted for reliability, such as N+N or N+K active standby BNG-CPs. N+N standby means 1:1 backup for each BNG-CP, which enables easy rapid switch of any number of BNG-CP to their backup but is expensive because it requires a large number of backup CPs. N+K means a smaller number of backup CPs, for example N2:1 backup where N2<N which is less expensive but does not handle more than 1 failure in the N2 subset of N BNG-CPs.

6. Security Considerations

TBD.

7. IANA Considerations

This document requires no IANA actions.

Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174> .in -10

Informative References

[hu-nov3-vxlan-gpe-extension-for-vbng] Huang, L., "VXLAN GPE Extension for Packets Exchange Between Control and User Plane of vBNG", draft-hu-nvo3-vxlan-gpe-extension-for-vbrg, work in progress, 2017.

[cuspdt-rtgwg-cu-separation-yang-model] Hu, F., "YANG Data Model for Configuration Interface of Control-Plane and User-Plane separation BNG", draft-cuspdt-rtgwg-cu-separation-yang-model, work in progress, 2018.

[cuspdt-rtgwg-cusp-requirements] Hu, S., "Requirements for Control Plane and User Plane Separated BNG Protocol", draft-cuspdt-rtgwg-cusp-requirements, work in progress, 2018.

[cuspdt-rtgwg-cu-separation-infor-model] Wang, Z., "Information Model of Control-Plane and User- Plane separation BNG", draft-cuspdt-rtgwg-cu-separation-infor-model, work in progress, 2018.

[TR-384] BroadBand Forum, "Cloud Central Office Reference Architectural Framework", January 2018.

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