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Architecture for Control Plane and User Plane Separated BNG
draft-cuspdt-rtgwg-cu-separation-bng-architecture-00

Abstract

This document defines the new architecture of BNG devices with control plane (CP) and user plane (UP) separation. BNG-CP is a user control management component while BNG-UP takes responsibility as the network edge and user policy implementation component. Both BNG-CP and BNG-UP are core components for fixed broadband services and deployed separately at different network layer in actual network.

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1. Introduction

BNG device is defined as an Ethernet-centric IP edge router, and the aggregation point for the user traffic. It performs Ethernet aggregation and packets forwarding via IP/MPLS, and supports user management, access protocols termination, QoS and policy management, etc.

This document introduce an architecture of BNG devices with control plane (CP) and user plane (UP) separation. BNG-CP is a user control management component while BNG-UP takes responsibility as the network edge and user policy implementation components. Both BNG-CP and BNG-UP are core components for fixed broadband services and deployed separately at different network layer in actual network.

1.1. Motivation

The rapid development of new services, such as 4K, IoT, etc, and increasing numbers of home broadband service users present some new challenges for BNGs such as:

Low resource utilization: The traditional BNG acts as both a gateway for user access authentication and accounting and an IP network's Layer 3 edge. The mutually affecting nature of the tightly coupled control plane and forwarding plane makes it difficult to achieve the maximum performance of either plane.

Complex management and maintenance: Due to the large numbers of traditional BNGs, a network must have each device configured one at a time when deploying global service policies. As the network expands and new services are introduced, this deployment mode will cease to be feasible as it is unable to manage services effectively and rectify faults rapidly.

Slow service provisioning: The coupling of control plane and forwarding plane, in addition to a distributed network control mechanism, means that any new technology has to rely heavily on the existing network devices.

To address these challenges, cloud-based BNG with CU separation conception is raised [TR-384]. The main idea of Control-Plane and User-Plane separation method is to extract and centralize the user management functions of multiple BNG devices, forming an unified and centralized control plane (CP). And the traditional router's Control Plane and Forwarding Plane are both preserved on BNG devices in the form of a user plane (UP). Note that the CU separation conception also be introduced by 3GPP 5G architecture [3GPP.23.501].

2. Concept and Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

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 supports to manage UP's resources such as the user entry and user's QoS policy

UP: User Plane. 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.

AAA: Authentication Authorization Accounting.

DHCP: Dynamic Host Configuration Protocol.

MANO: Management and Orchestration.

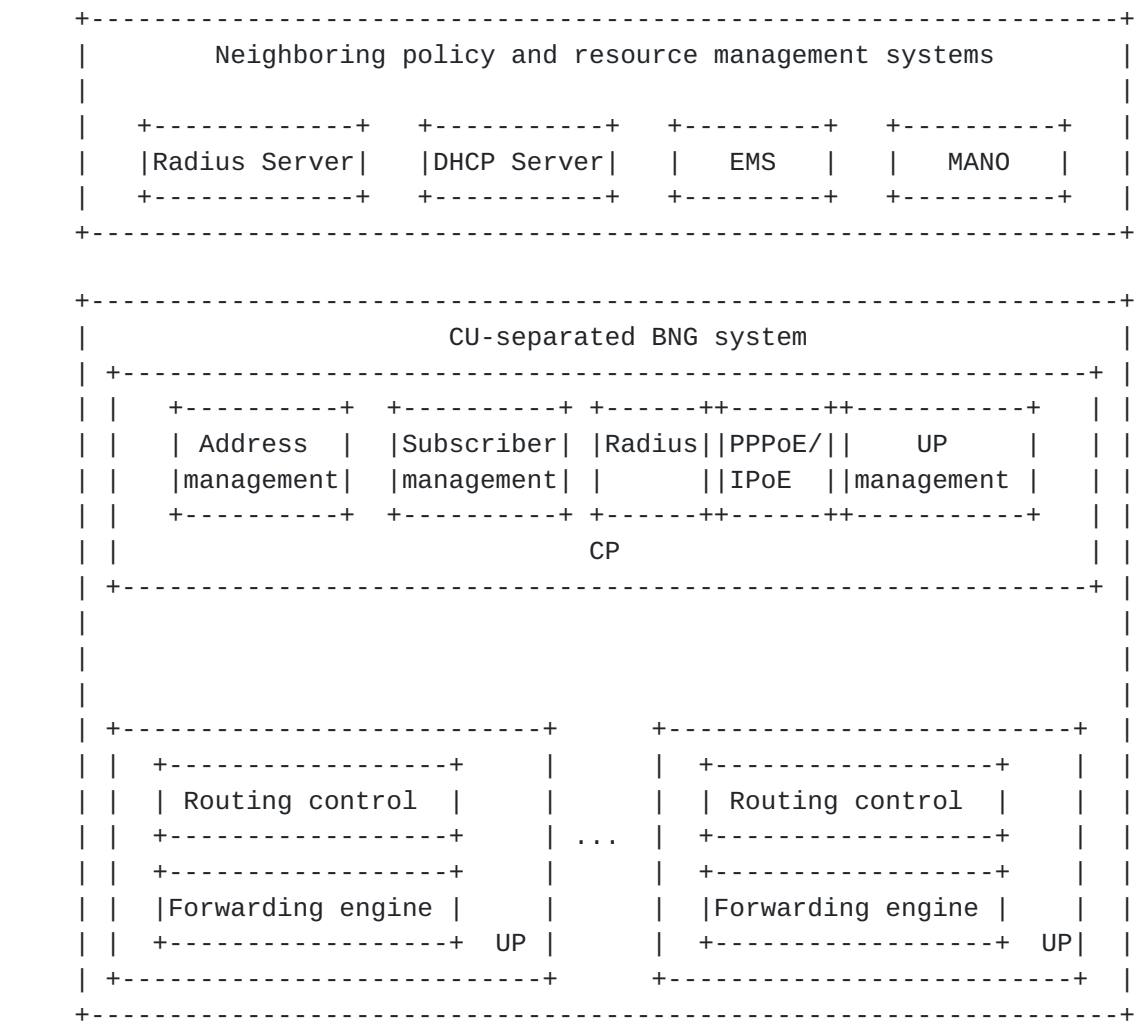
NFV: Network Function Virtualization.

PPPoE: Point to Point Protocol over Ethernet.

3. CU separated BNG architecture

There are two parts of functions in traditional BNG: one is user access management function, the other is router function. While in cloud-based BNG, we find out that tearing these two functions apart can make a difference. Actually the user management function can be centralized deployed as a concentrated module or device which can be called BNG-CP (Control Plane). The reserved functions such as router function and forwarding engine can be deployed in the form of BNG User Plane. Thus the Cloud-based BNG architecture is made up of control plane and user plane.

The following figure describes the architecture of CU separated BNG:



Architecture of CU Separated BNG

AS above figure, the BNG Control Plane could be virtualized and centralized, which provides significant benefits such as centralized session management, flexible address allocation, high scalability for subscriber management capacity, and cost-efficient redundancy, etc. The functional components inside the BNG Service Control Plane can be implemented as VNFs and hosted in a NFVI.

The User Plane Management module in the BNG control plane centrally manages the distributed BNG User Planes (e.g. load balancing), as well as the setup, deletion, maintenance of channels between Control Planes and User Planes. Other modules in the BNG control plane, such as address management, AAA, and etc., are responsible for the connection with outside subsystems in order to fulfill the service. Note that the User Plane SHOULD support both physical and virtual network function. For example, BNG user plane L3 forwarding related network functions can be disaggregated and distributed across the

physical infrastructure. And the other control plane and management plane functions in the CU Separation BNG can be moved into the NFVI for virtualization [TR-384].

The details of CU separated BNG's function components are described as following:

The Control Plane should supports:

(1)Address management: unified address pool management.

(2)AAA and RADIUS: cooperation with the RADIUS server and others to implement AAA for access users.

(3)Subscriber management: user entry management and forwarding policy management.

(4)PPPoE/IPoE: process user dialup packets of PPPoE/IPoE.

(5)UP management: management of UP interface status, and the setup, deletion, maintenance of channels between CP and UP.

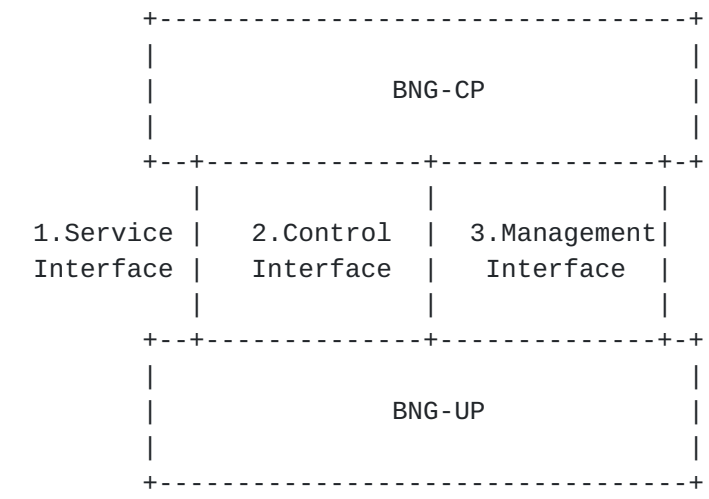
The User Plane should supports:

(1)Control plane functions including routing, multicast and MPLS.

(2)Forwarding plane functions including traffic forwarding, QoS and traffic statistics collection.

3.1. Internal interfaces between the CP and UP

To support the communication between the Control Plane and User Plane, several interfaces are involved. Figure 2 illustrates the internal interfaces of CU Separated BNG.



Internal interfaces between the CP and UP of the BNG device

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 which be present in [draft-huang-nov3-vxlan-gpe-extension-for-vbng].

Control interface: The CP uses this interface to deliver service entries, and the UP uses this interface to report service events to the CP. The requirements of this interface are introduced in [draft-cuspdt-rtgwg-cusp-requirements], and the carrying protocol are presented in [draft-cuspdt-rtgwg-cu-separation-bng-protocol], the information model of this interface are presented in [draft-cuspdt-rtgwg-cu-separation-infor-model].

Management interface: The CP uses this interface to deliver configurations to the UP. This interface runs NETCONF [draft-hu-rtgwg-cu-separation-yang-model].

4. The usage of CU separation BNG

In the CU seprated BNG scenario, there are several processes when a home user accesses the Internet:

(1)User dialup packets of PPPoE or IPoE from BNG-UP which will send to BNG-CP from BNG-UP's Service Interface.

(2)BNG-CP processes the dialup packet. Confirming with the outside neighboring systems in the management network, BNG-CP makes the decision to permit or deny of the dial through certification.

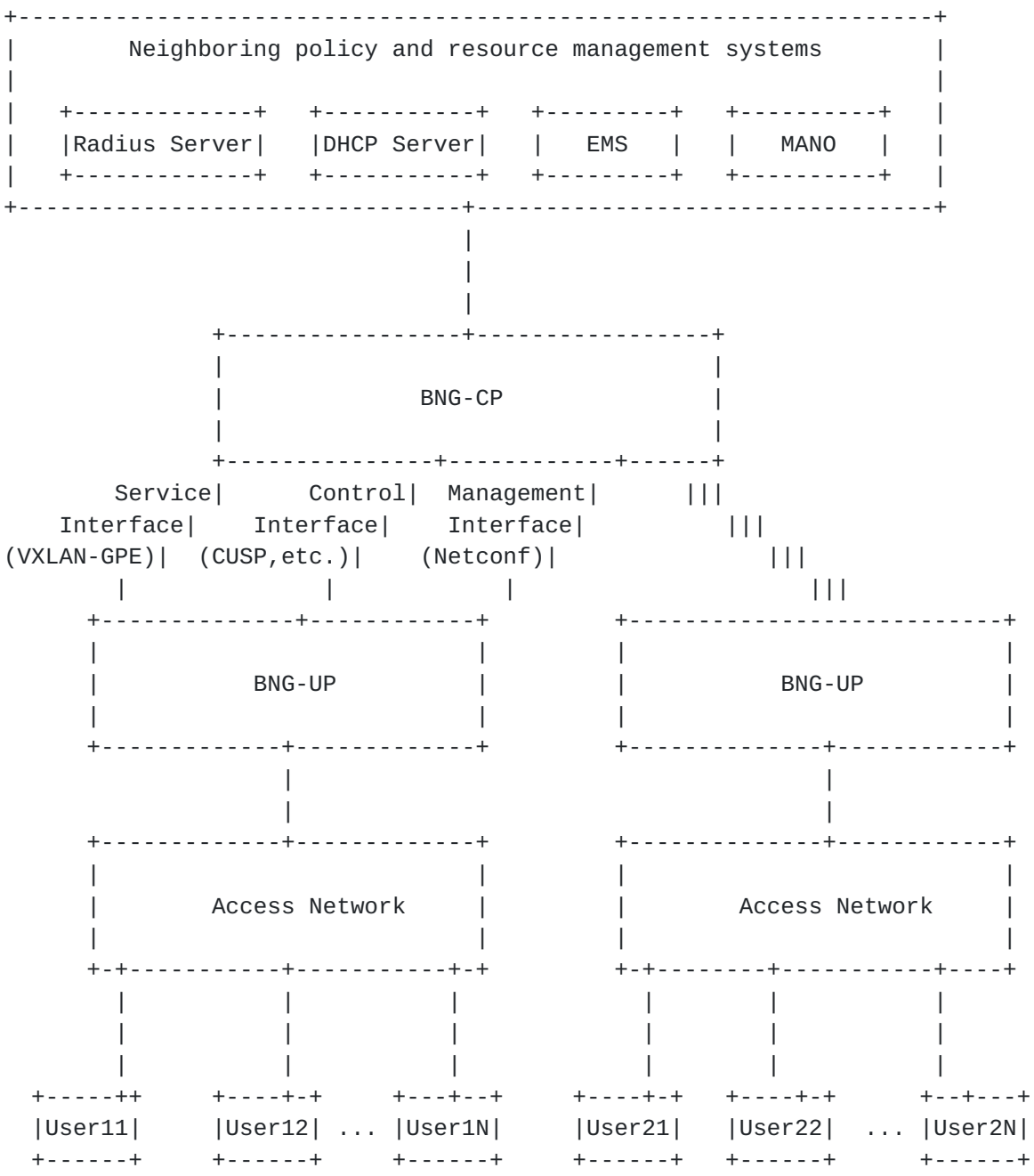
(3)After that, BNG-CP tells UP to do the responding forwarding actions with related policies.

(4)If the user is certificated and permitted, the UP forwards the traffic into the Internet with related policies such as limited bandwidth, etc. Otherwise, the user is denied to access the Internet.

In the actual deployment, a CU separated BNG device is composed of CP and UPs. CP is centralized deployed which takes responsibility of a user control management component managing UP's resources such as the user entry and forwarding policy. And UP is distributed in the bottom acting as a network edge and user policy implementation component.

In order to fulfill a service, Neighboring policy and resource management systems is deployed outside. In the neighboring system, different service systems such as RADIUS server, DHCP server and EMS are included. Besides if BNG-CP is virtualized as a NFV. The NFV infrastructure management system MANO is also included here. BNG-CP has connections with the outside neighboring systems to transmit management traffic.

The deployment scenarios are described as following figure:



5. Security Considerations

None.

6. IANA Considerations

None.

7. References

7.1. 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>.

7.2. Informative References

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