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Requirements for Control Plane and User Plane Separated BNG Protocol draft-cuspdt-rtgwg-cusp-requirements-01

Abstract

This document introduces the Control Plane and User Plane separated BNG architecture and defines a set of associated terminology. What's more, this document focuses on defining a set of protocol requirements for the BNG-CP and BNG-UPs communication in the Control Plane and User Plane Separated BNG.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

BNG is an Ethernet-centric IP edge router, and the aggregation point for the user traffic. To provide centralized session management, flexible address allocation, high scalability for subscriber management capacity, and cost-efficient redundancy, the CU separated BNG is introduced [TR-384]. The CU separated Service Control Plane could be virtualized and centralized, which is responsible for user access authentication and setting forwarding entries to user planes. The routing control and forwarding plane, i.e. BNG user plane (local), could be distributed across the infrastructure.

This document introduces the Control Plane and User Plane separated BNG architecture and modeling. This document also defines the protocol requirements for Control Plane and User Plane Separated BNG (CUSP).

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

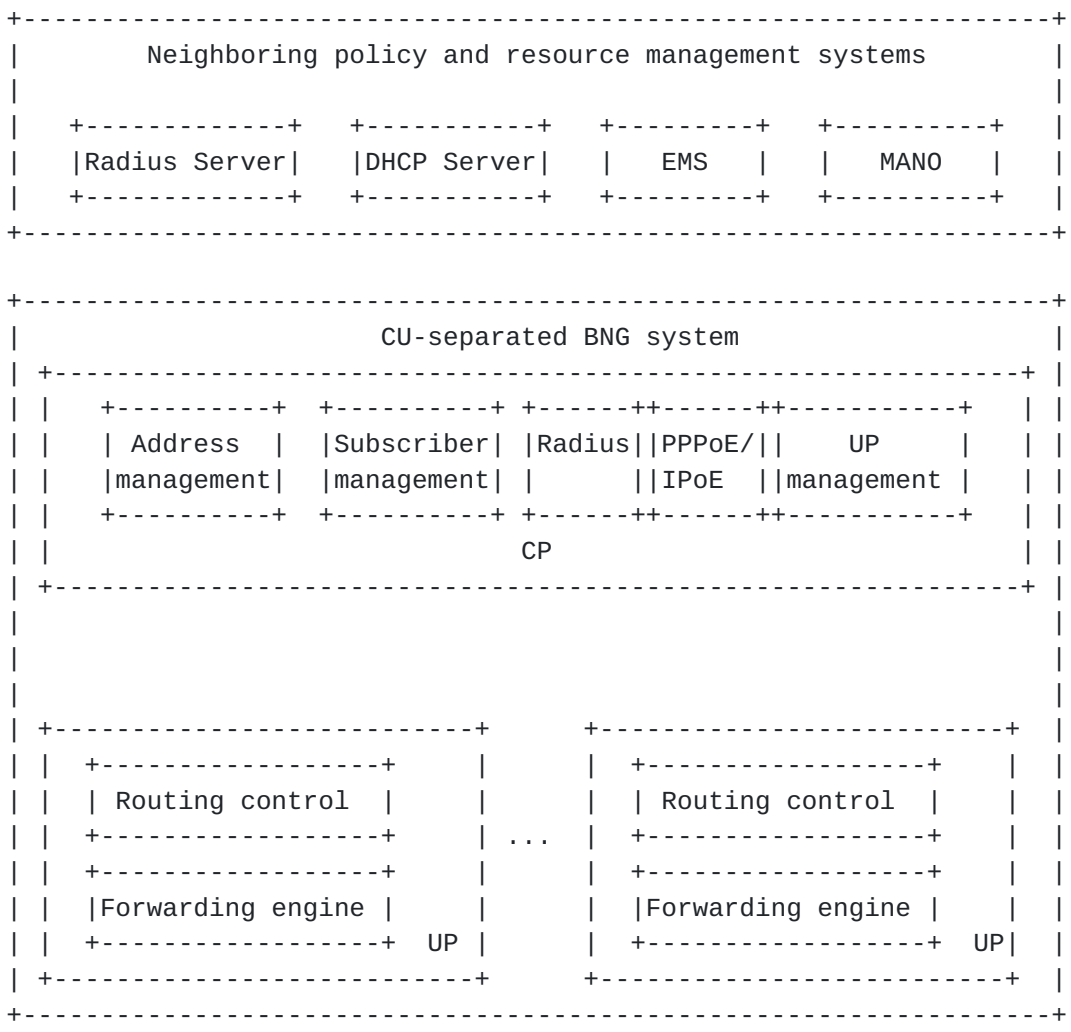
BNG: Broadband Network Gateway. A broadband remote access server (BRAS, B-RAS or BBRAS) routes traffic to and from broadband remote access devices such as digital subscriber line access multiplexers (DSLAM) on an Internet service provider's (ISP) network. BRAS can also be referred to as a Broadband Network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

3. CU Separated BNG Model

The following figure describes the architecture of CU separated BNG



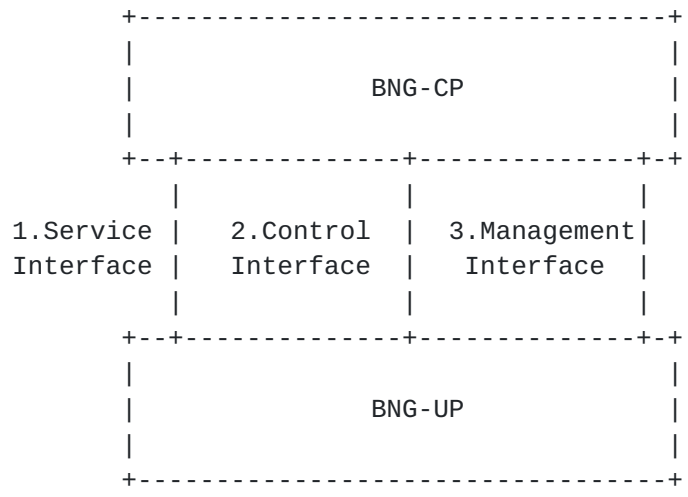
Architecture of CU Separated BNG

Briefly, a CU separated BNG is made up of a Control Plane (CP) and a set of User Planes (UPs) [TR-384], [I-D.cuspdt-rtgwg-cu-separation-bng-deployment]. The Control Plane is a user control management component which supports to manage UP's resources such as the user entry and user's QoS policy, for example, the access bandwidth and priority management. This Control Plane could be virtualized and centralized. The functional modules 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, update, and maintenance of channels between control planes and user planes [TR-384], [I-D.cuspdt-rtgwg-cu-separation-bng-deployment]. And the User Plane (UP) is a network edge and user policy implementation component. It can support the forwarding plane functions on traditional BNG devices, such as traffic forwarding, QoS, and traffic statistics

collection, and it can also support the control plane functions on traditional BNG devices, such as routing, multicast, etc [TR-384], [I-D.cuspdt-rtgwg-cu-separation-bng-deployment].

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

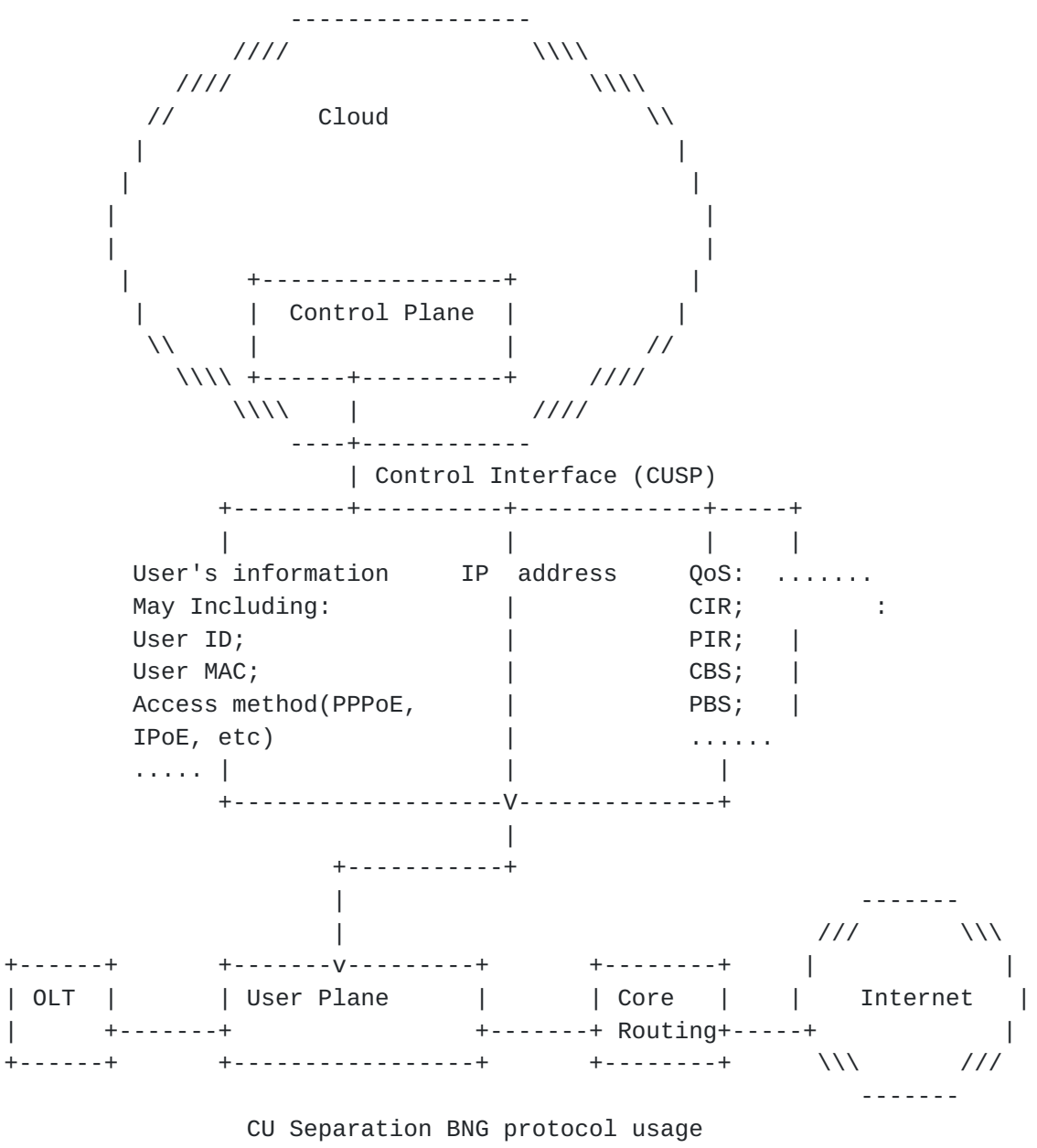
Service interface: The CP and UP use this interface to establish VXLAN tunnels with each other and transmit PPPoE and IPoE packets over the VXLAN tunnels.

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

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

The CUSP (Control plane and User plane Separated BNG protocol) defines the control interface, and specifies the communication between the centralized control plane and user planes. This protocol should be designed to support establishing and maintaining a conversation between CP and UPs, and transporting the tables which specified in [draft-cuspdt-rtgwg-cu-separation-infor-model].

4. The usage of CU separation BNG protocol



CU Separation BNG protocol usage

As shown in above figure, when users access to the BNG network, the control plane solicits these users' information (such as user's ID, user's MAC, user's access methods, for example via PPPoE/IPoE), associates them with available bandwidth which are reported by User planes, and based on the service's requirement to generate a set of tables, which may include user's information, UP's IP segment, and QoS, etc. Then the control plane can transmit these tables to the

User planes. User planes receive these tables, parse them, match these rules, and then perform corresponding actions.

5. Control Plane and User Plane Separation Protocol Requirements

This section specifies some of the requirements that the CU separation protocol SHOULD support.

5.1. Transmit information tables

The Control Plane and User Plane Separation Protocol MUST allow the CP to send tables to each User Plane device.

a) The current BNG service requires that the UP should support at least 2000 users being accessed every second. And every user requires at least 2000 bytes. To achieve high performance, the CU Separation protocol SHOULD be lightweight.

b) CU separation protocol should support XML/binary data which serves as the encoding format. It allows user information data to be read, saved, and manipulated with tools specific to XML/binary.

c) In order to provide centralized session management, high scalability for subscriber management capacity, and cost-efficient redundancy, batching ability should be involved. The CU Separation protocol should be able to group an ordered set of commands to a UP device. Each such group of commands SHOULD be sent to the UP in as few messages as possible. Furthermore, the protocol MUST support the ability to specify if a command group MUST have all-or-nothing semantics.

5.2. Scalability

The CU Separation protocol SHOULD be able to support at least hundreds of UP devices and tens of thousands of ports. For example, the protocol field sizes corresponding to UP or port numbers SHALL be large enough to support the minimum required numbers. This requirement does not relate to the performance of the system as the number of UPs or ports in the system grows.

5.3. Message Priority

The CU Separation protocol MUST provide a means to express the protocol message priorities.

5.4. Reliability

Heartbeat is a periodic signal generated by hardware or software to indicate normal operation or to synchronize other parts of network system.

In CU separation BNG, the heartbeat is sent between CP and UPs at a regular interval in the order of seconds. If the CP/UP does not receive a heartbeat for a time--usually a few heartbeat intervals--the CP/UP that should have sent the heartbeat is assumed to have failed.

The CU separation protocol should support some kind of heartbeat monitor mechanism. And this mechanism should have ability to distinguish whether the interruption is an actual failure. For example, in some scenarios (i.e. CP/UP update, etc), the connection between the UP and CP need to be interrupted. In this case, the interruption should not be reported.

5.5. Support for Secure Communication

As mentioned above, CP may send some information tables to the UP which may be critical to the network function (e.g, User Information, IPv4/IPv6 information) and may reflect the business information (e.g, QoS, service level agreements, etc). Therefore, it MUST be supported to ensure the integrity of all CU Separation protocol messages and protect against man-in-the-middle attacks.

And the CP Separation protocol should support multiple security mechanisms to satisfy various scenarios. For example, when the special lines are implemented between the CP and UPs, the key chain SHOULD be supported. And if some VPNs are deployed between the CP and UPS, the TLS SHOULD be supported. In case of the CP and UPs cross several domains (i.e. cross third-party network), the IPsec SHOULD be supported.

5.6. Version negotiation

The CU separated BNG may consist of different vendors' devices. Since different vendors' device may implement different versions of protocol, therefore, the CU separation protocol should provide some mechanisms to perform the version negotiation.

The version negotiation is the process that the CU separated BNG's Control-Plane uses to evaluate the protocol versions supported by both the control-plane and the user-plane devices. Then a suitable protocol version is selected for communication in CUSP. The process is a "negotiation" because it requires identifying the most recent

protocol version that is supported by both the control-plane and the user-plane devices.

5.7. Capability Exchange

The UP Capability Report displays the devices profile, service capability, and other assigned capabilities within the CU separated BNG. The CU separation protocol should provide some mechanism to exchange the UP device's capability

5.8. CP primary/backup capability

A backup CP for disaster recovery is required for the CU separated BNG network. And the CUSP should provide some mechanism to implement the backup CP:

a) In some scenarios, there may be two CP devices both declaring the primary CP. Thus the CUSP should support or associate with some mechanisms to determine which CP is the primary device.

b) In the scenario of the primary CP down, the CUSP should support switching between primary and backup CP.

5.9. Event Notification

The CUSP protocol SHOULD be able to asynchronously notify the CP of events on the UP such as failures and changes in available resources and capabilities. Some scenarios which may initiate the event notification list as follows.

a) Sending response message: As mentioned above, the control plane solicits users' information, associates them with available bandwidth, and generates a set of tables based on the service's requirement. Then the control plane transmits these tables to the conresponding User plane. The UP should respond with an event notification to inform the CP that the tables are received.

b) User trace: The user trace mechanism can support the Control Plane to trace and monitor the network status for users (for example the real-time bandwidth, etc) , debug the user's application. Therefore, the UPs SHOULD be able to notify the CP with the User trace message.

c) Sending statistics parameters: In CU separation BNG, the User-plane will report the traffic statistics parameters to the Control-plane, such as the ingress packets, ingress bytes, egress packets, egress bytes, etc. These parameters can help to measure the BNG network performance. Available network resources can be

allocated basing on the statistics parameters by the BNG-CP. Therefore, the UPs SHOULD be able to notify the CP with statistics parameters.

d) Report the result of User Detect: "User Detect" message will be send periodically to detect user dial-up and disconnect. The UPs SHOULD be able to notify the CP with the result of User Detect.

5.10. Query Statistics

The CUSP protocol MUST provide a means for the CP to be able to query statistics (performance monitoring) from the UP.

6. Security Considerations

None.

7. IANA Considerations

None.

8. Normative References

[I-D.cuspdt-rtgwg-cu-separation-bng-deployment]
Gu, R., Hu, S., and Z. Wang, "Deployment Model of Control Plane and User Plane Separation BNG", draft-cuspdt-rtgwg-cu-separation-bng-deployment-00 (work in progress), October 2017.

[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>.

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