Internet Engineering Task Force
Internet-Draft
Intended status: Informational
Expires: April 21, 2016

Q. Fu, Ed.
H. Deng
China Mobile

October 19, 2015

# Motivations, usecases and Models of VCPE
# draft-fu-dmm-vcpe-models-01

## Abstract

This document introduces the concept of Virtual Customer Premises Equipment (VCPE). Such concept was first proposed in Broadband Forum (BBF) as Network Enhanced Residential Gateway (NERG). The concept is further expanded as not only referring to virtual CPE of residential network, but all the virtual network and service functions shifted from the customer side to the operator side. Deployment of VCPE in some typical DMM (Distributed Mobility Management) scenarios brings specific requirements and even protocol extension in DMM. In this document, we will first explain the motivation and advantages of VCPE. A usecases of VCPE in the community Wi-Fi deployment is further discussed so as to explain the deployment of VCPE in a DMM scenario. Three models of field deployment of VCPE are discussed afterwards to indicate the possible CP/DP decomposition requirement and protocol extension.

## Status of This Memo

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

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on April 21, 2016.

## Copyright Notice

Table of Contents



## 1. Introduction

This document introduces the concept of VCPE. The concept of VCPE is to shift most of the networking and service functionalities from the customer side to the network side. In this way, the customer side's equipment, that is the pCPE (Physical Customer Premises Equiptment), can be simplified. The VCPE refers to one or a set of equipments at the network side to execute the networking and service functionalities used to be executed at the CPE. In such architecture, the CPE can be a simple L2 switch, which is only responsible for forwarding packets to a certain next hop. The concept of VCPE was first introduced in BBF as NERG (WT-317), which mainly focuses on shifting some of the functionalities of a residential gateway to the operator's network, for enabling network based features. The aim is to facilitate the deployment, maintenance and evolution of both existing and new capabilities without adding complexity to the RG and/or the home network.

Figure 1 shows the architecture of the pCPE and the VCPE.

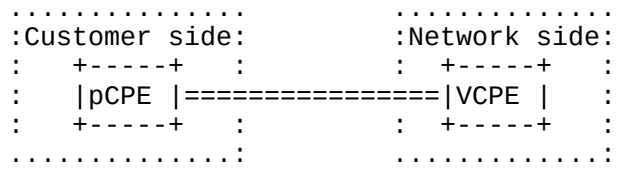


Figure 1: VCPE Architecture

In this document, we would like to further propose such concept in the following aspects:

(1) Motivation and advantages of VCPE.

(2) Usecases of VCPE.  A usecase of VCPE in the community Wi-Fi is explained in detail.

(3) Models of VCPE deployment.  We propose three models for the field deployment of VCPE.

## 2.  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].

## 3.  Motivation and Advantage of VCPE

The motivation and advantage of introduting VCPE can be concluded as follows:

(1) It will greatly speed up the service launching period.  Since most of the complicated functions are located at the VCPE in the network side, operators have more power over services.  Benefitting from the recent NFV (Network Function Virtualization) and cloud technologies, VCPE can be accomplished using SFC in the virtual network, where different services can act as different VNFs (Virtual Network Functions).  Operators only need to add new VNFs on the VCPE side to launch new services to the customers.  In this way, Operators can provide a variety of services through the network.

(2) It will reduce the cost of the pCPE.  By shifting most of the complicated functions from the customer’s side to the operator’s side, the cost of the pCPE can be reduced significantly.  Such reduction can be remarkable in the enterprise network, since network functions, such as Firewall and NAT(Network Address Translator) at the customer side can be expensive.  In the meantime, the cost of

upgrading tens of thousands of pCPE when launching new services can be saved, since only software upgrade at the VCPE side is required.

(3) It will simplify the maintainance of the pCPE. Since most of the complicated functionalities are shifted to the network side, the maintainance of the pCPE can be greatly simplified. On-line maintainance is possible in lots of cases since the pCPE is only a L2 devices and can be considered transparent to the operators.

(4) It will provide user-define-network experience. By introducing SFC concept into the VCPE, users can define his own service order and sequence. Therefore, customers can enjoy the self-defined services over the public network.

## 4. Use case of VCPE

The concept of VCPE can be used in multiple scenarios. In this section, we will propose a usecase of VCPE when deploying community Wi-Fi.

The community Wi-Fi is a new service that operators provide to leverage unused capacity on existing residential Wi-Fi infrastructure to offer Wi-Fi network access to visitors and passers by near the neighbourhood. An operator can also use this excess capacity to offer services to retail and roaming-parter operators' subscribers. The residential subscribers accessing the network from inside their homes have prioritized access to the Wi-Fi resources. The residential Wi-Fi infrastructure is configured in a manner that allows for a secure and independent access channel to retain service quality, safety, and privacy for both residential and visitor customers. Roaming users are only allowed to use the Wi-Fi network capacity that is not currently used by the subscriber at home.

Basically, the wireless Access Point (AP) in the home will provide two networks: a private one for the home owner/subscriber, and a community network for on-the-go subscribers passing through the neighborhood. Home users can have all of their Wi-Fi devices (smartphone, tablet, etc.) automatically connect to the private network. In the meantime users travel outside can connect to the community network, and can roaming through different APs supporting community Wi-Fi as he/she is moving. The community Wi-Fi service is a typical usecase of DMM.

Deploying community Wi-Fi on the pCPE means upgrading tens of thousands of existing pCPE devices at the customer side, which is not cost-effective and may bring extra complexity for maintainance. Therefore VCPE becomes an optimized solution for such deployment. In such deployment, the private users access to the pCPE (which is the

AP at home) as usual. The public users are roaming through different pCPEs. The traffic all goes though the tunnel from the pCPE to the VCPE. The deployment of VCPE in the community Wi-Fi sencario brings specific requirement and protocol extensions to DMM. The deployment model of VCPE and its possible influence to DMM is further discussed in the following section.

## 5. Models of VCPE Deployment

There are multiple models when deploying VCPE in use cases as are discussed in the previous section. In this document, we conclude the deployment of VCPE into three models. In the first model, a logical instance of VCPE is deployed in the cloud for each pCPE instance. That is, the pCPE and VCPE is deployed in an 1:1 manner. All traffic from pCPE goes through the vCPE.

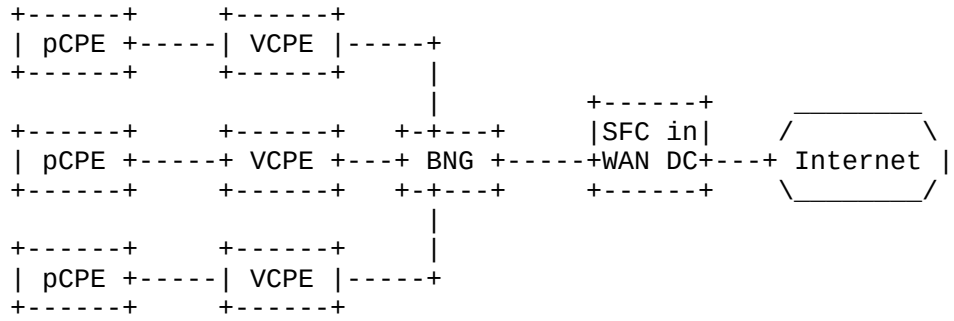


Figure 2: VCPE deployment model NO.1: Logical Instance of VCPE

In the second model, vCPE is modeled service function chains in Gi-LAN. BNG knows how to classify the traffic from a given CPE with the help of the control plane, and run it through the service chain. In such model, the CP/DP interface should be used between the control plane (which might be the controller) and the pCPE.

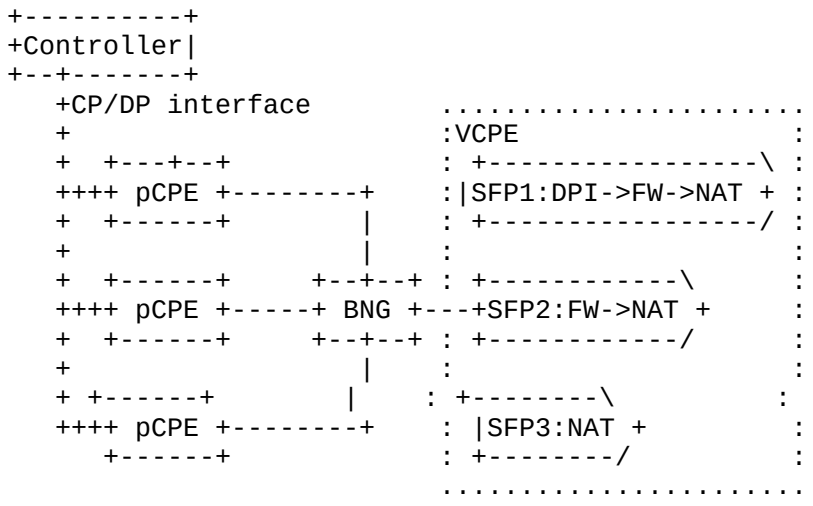


Figure 3: VCPE deployment model NO.2: VCPE as SFC

The third model is almost the same with the second one, except that the BNG is also CP/DP decomposed. In this model, The control plane is composed of the controller of the pCPE and the control plane of the BNG. The CP/DP interface is used between the controller and the pCPE, and between the control plane and the data plane of the BNG. Both of model No.2 and No.3 may have specific requirement and protoco extensions for the CP/DP interface due to the usecase of VCPE.

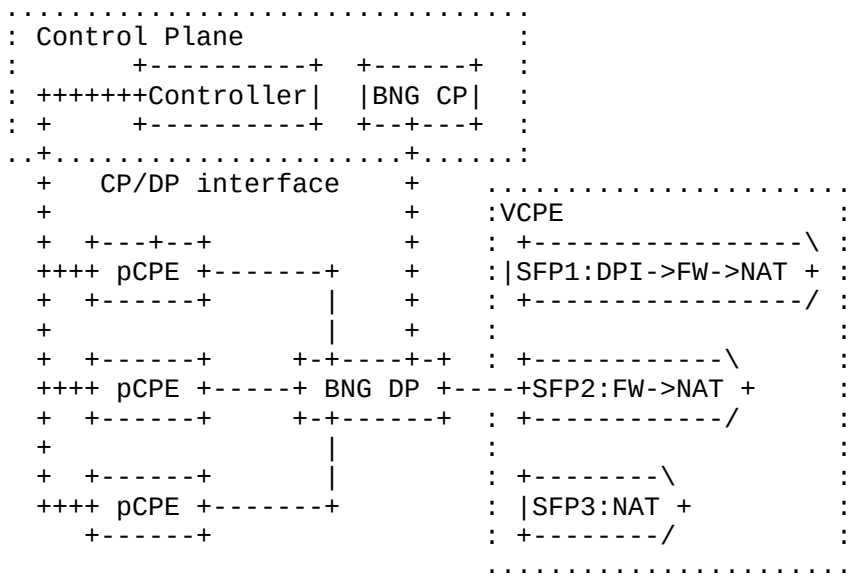


Figure 4: VCPE deployment model NO.3: VCPE as SFC, with CP/DP decomposition of BNG

SDN (Software Define Network) controllers can also be introduced in the third model. In which case, all of the pCPEs and the BNG data plane (BNG DP) can be controlled by the SDN-controller. When the customer selects a set of services, the SDN-controller will inform the pCPE and the BNG DP to direct the traffic flow to a certain SFC.

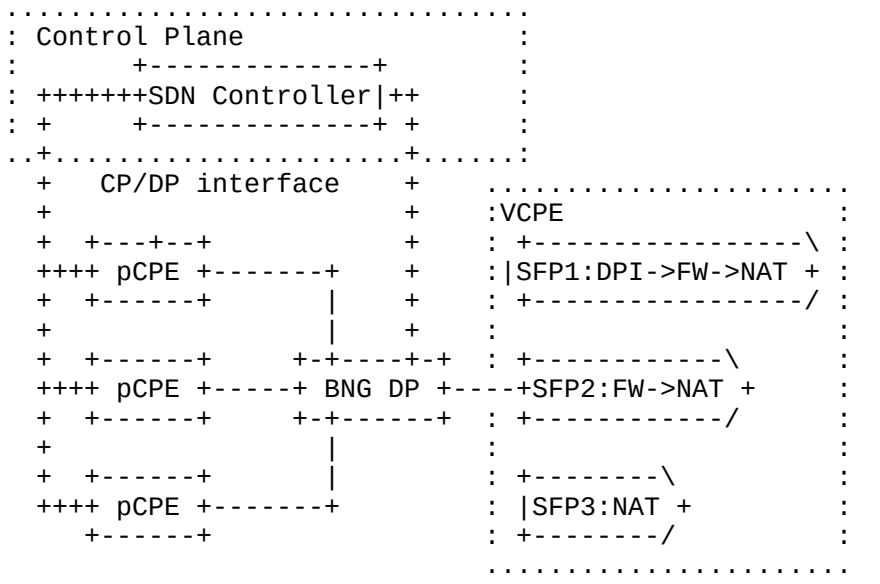


Figure 5: VCPE deployment model NO.3: SFC realization of VCPE, with SDN controller as control plane

## 6. VCPE Deployment for Community Wi-Fi

In this section, we will discuss about the VCPE deployment for Community Wi-Fi in detail. In the following deployment, we assume the VCPE is deployed following the third model we discussed in section 5. That is, the VCPE is a bounch of SFCs at the operator side behind the BNG. The pCPEs and BNG-DP are all controlled by a mutual control plane. The FPC protocol is used between the control plane and the pCPEs, and that and the BNG-DP.

As we discussed in section 4, Community Wi-Fi can be deployed with the help of deploying VCPE. In order to provide the Community Wi-Fi service, the pCPE should provide two SSIDs, one for the pubic Wi-Fi users, and the other for the private Wi-Fi users. Packets from different SSID are marked with different VLAN ID. The VCPE should know of the corresponding relation between the SSID and the VLAN ID, so as to provide distinguished services to the publice users and the private users. For instance, the private users should experience a better QoS than the publice ones. In the meantime, the private users and the public users may choose different SFC in the VCPE. All of these different services are classified based on the VLAN ID.

Such deployment requirs the FPC client to support the following task:

1) The FPC client should be able to set specific VLAN to each SSID.

2) The FPC client should be able to set the QoS for specific VLAN ID.

3) The FPC client should be able to inform the agent the specific SFC for each VLAN ID.

4) The FPC client should be capable of instruct the agent to handle the MN hand-over of the public Wi-Fi users.

In the meantime, such deployment requirs the FPC agent to support the following task:

1) The FPC agent should be able to set specific VLAN to each SSID following the command from the client.

2) The FPC agent should be able to set the QoS for specific VLAN ID following the command from the client.

3) The FPC agent should be able to direct the traffic for specific VLAN ID to a certain SFC following the command of the client.

4) The FPC agent should be able to handle the MN hand-over of the public Wi-Fi users.

## 7. Conclusion

In this document, the concept of VCPE is illustrated in detail. The basic concept of VCPE is to shift the complicated functions from the pCPE at the customer side to the VCPE at the service provider side. The motivation of such shifting can be concluded as providing quick launched customer defined services, reducing the Capex and Opex of the pCPE, and simlify the maintainance of both pCPE and VCPE. A use cases of community Wi-Fi is proposed for VCPE, which is a typical scenario for DMM. Three models are then discussed for the field deployment of VCPE. And CP/DP interface is suggested to be utilized in the deployment models.

## 8. Informative References

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

Authors' Addresses

Qiao Fu (editor)
China Mobile
Xuanwumenxi Ave. No.32
Beijing
China

Email: fuqiao1@outlook.com

Hui Deng
China Mobile
Xuanwumenxi Ave. No.32
Beijing
China

Email: denghui@chinamobile.com