

APP NOTE

CLUDCO-APPN-447: NERG Overlay LSL with vG_MUX PNF

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1 Executive Summary

This application note deals with how to instantiate a [TR-317](#) compliant Network Enhanced Residential Gateway Service (NERG) inside the CloudCO Domain, and to create and activate the associated Service Users. The [TR-317](#) Virtual Gateway components are instantiated as VNFs, while the Virtual Gateway MUX component is instantiated as a Physical Network Function inside the CloudCO Domain Instance. Inside this application note the physical device at the customer premise and the [TR-317](#) Virtual Gateway are not assumed to be Layer 2 adjacent.

2 Summary/Objective

This application note describes the establishment of NERG (TR-317) service for a subscriber within a CloudCO domain instance. The NERG service in this application note supports Overlay Logical Subscriber Link (LSL) connectivity model. The major difference with APPN-003 is that the vG_MUX function is executed as a PNF on a L3 switch rather than a VNF in COTS. In addition, the authentication is not using AAA VNF method, instead, the Serial Number of the BRG is delivered to Access SDN M&C via Access PNF. Access SDN M&C runs an authentication application instance and assigns the SN to the subscriber database through the CloudCO NB API.

Interactions for the creation and activation of the service are provided.

3 Assumptions and Preconditions

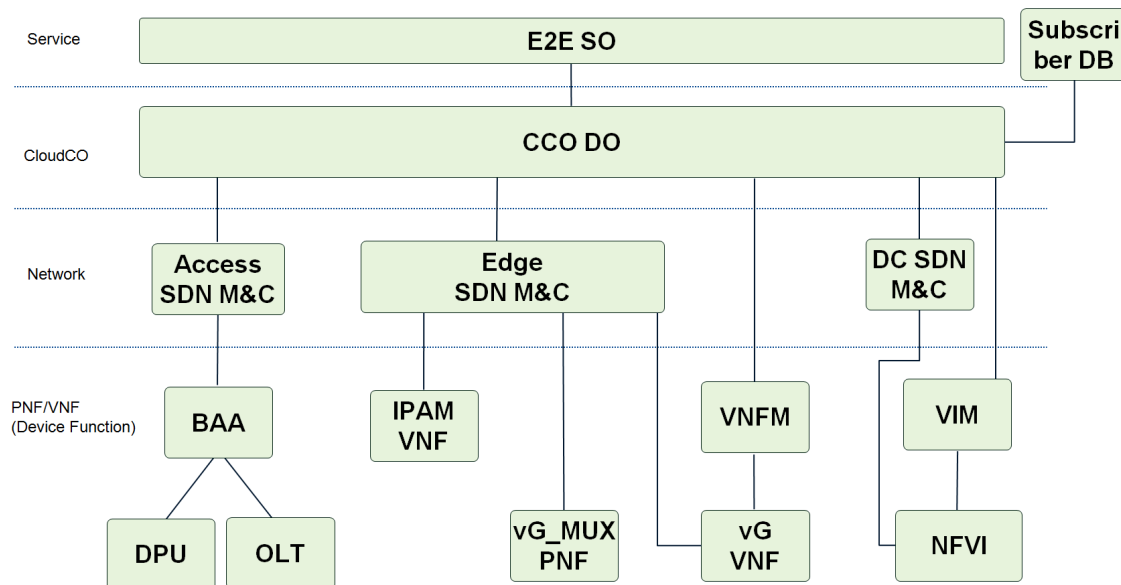
1. The Cloud CO Domain instance is already fully bootstrapped.
2. Enduser(tenant) access is authorized by a subscriber database using Serial Number of BRG encapsulated in TR-069/JSON format.
3. The address and QoS information for the trail is assigned by an IPAM (IP Address Management) VNF. DHCP will be used to request and deliver IPAM requests to the Premise PNF (BRG).
4. The Premise PNF (BRG) can be managed by the Edge SDN M&C which integrates the ACS module, or managed by the CCO DO or E2E SO integrating the ACS module. The Premise PNF (BRG) is using an untagged UNI, and needs to support Serial Number based authentication and DHCP for IP address assignment.
5. The subscriber database is accessible via the CCO NB API for authenticating the enduser of the retail ISP.
6. The user plane traffic from the Premise PNFs (BRGs) is aggregated at a vG_MUX PNF inside the Cloud CO Domain. vG_MUX PNF is supported on the L3 access switch, it is pre-configured with reachable IP address. This function is managed through the Edge SDN M&C.
7. The physical connectivity between Premise PNFs (BRGs) at the enduser (tenant) home premise, Access PNFs, Switch Fabric, and Network I/O has been established.
8. All Controllers are applications running inside the NFVI, Controllers can talk to the elements they manage. This was all deployed in the previous bootstrapping stage (See [CLOUDCO-APPN-000](#)).

4 Description of the System

The E2E SO issues a Internet Access Service creation request to the CCO DO via the CCO NBI.

CCO DO orchestrates the establishment of appropriate network service by requesting the:

- Access and Edge SDN M&C and VIM to configure a pre-activation trail (control and user plane) from the home premise to the Access PNF, and from the Access PNF to IPAM VNF.
- Edge SDN M&C to configure the IPAM VNF with the policy, address information and tunnel information for the enduser(tenant).
- Edge SDN M&C to configure the vG_MUX PNF with the traffic mapping between the WAN IP address of the Premise PNF (BRG) and its corresponding vG.
- DC SDN M&C to configure a pre-activation trail (control and user plane) from the Access PNF to the vG_MUX PNF.
- VNFM to configure vG VNF with the composing functions (e.g., LAN private address pools, home DHCP server, NAT rules etc) for the enduser(tenant).
- VNFM to execute the lifecycle management of VNF instances, such as vG VNF.
- Leveraging Edge, DC and Access SDN M&C Controllers, as well as the VIM to establish end to end user-plane connectivity.



5 Components

Component Framework Name	Component Description
CCO DO	Cloud CO Domain Orchestrator
Edge SDN M&C	Edge SDN Management and Control: TR-384, WT-411, WT-413 - Provides SDN Management and Control of the Routing and CCO awareness BRG, as well as control plane functions that have been virtualized such as IPAM and vG_MUX PNFs.
Access M&C	SDN Access SDN Management and Control: TR-384, WT-411, WT-413 - Provides SDN Management and Control of the DPU and OLT via the BAA
DC SDN M&C	Data Center SDN Management and Control: WT-411 - Provides SDN Management and Control of the NFVI , in this case the physical network fabric.
VIM	Virtualized Infrastructure Manager: WT-411, ETSI NFV - Controls the NFVI, deploys VNFs and interconnects them.
BAA	Broadband Access Abstraction layer: TR-384, WT-411, WT-413: Aggregates and virtualizes access to DPUs and vOLT PNFs.
Premises (BRG)	PNF The bridged residential gateway: TR-317-located at the residential customer premise.
vG	The virtual gateway VNF: TR-317, TR-384-hosted in CCO Domain.
vG_MUX PNF	The vG_MUX PNF: TR-317, pre-configured on L3 access switch in the CCO Domain.
DPU	Access PNF
OLT	OLT PNF
VNFM	VNF Manager: ETSI NFV: Manages the lifecycle of the vG VNFs.

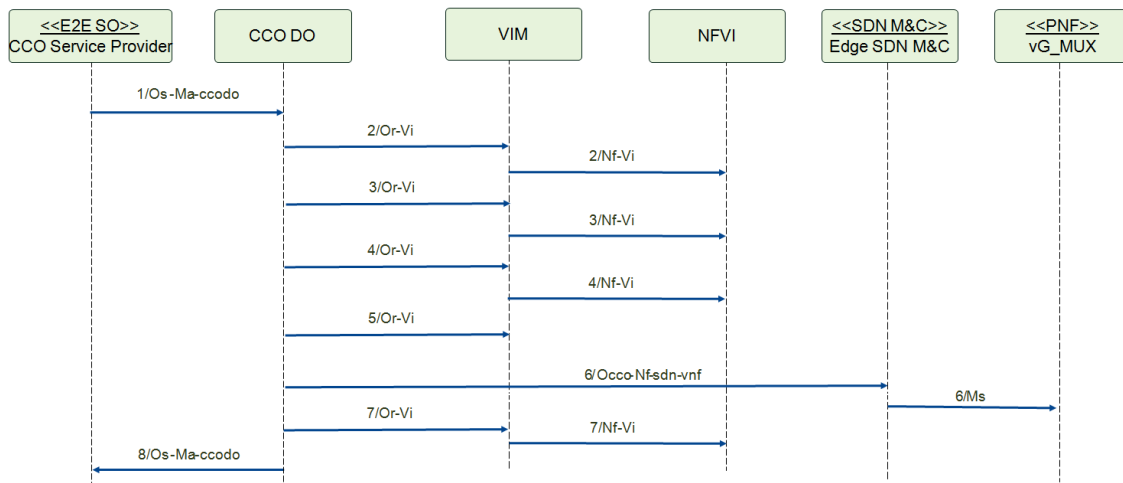
6 Actors

Actor Name	Actor Description	Actions at CCO Perimeter (CCO DO NBI, User action)
Cloud Service Provider	The wholesale service provider offers the CCO infrastructure to retail Internet service provider.	1. Create Internet Access Service for the retail Internet SP.
Retail Internet Service Provider	The service provider rents the CCO resources from Cloud CO Operator and offers NERG service to the service user.	1. Create NERG Service for the Service User. 2. Creates service user for a enduser(tenant).
Service User	Subscriber of the NERG service	1. User connects the Premises PNF to the network and enters the retail Internet service provider supplied user credentials into the Premises PNF.

7 Interactions

7.1 Interaction 1: Create Internet Access Service

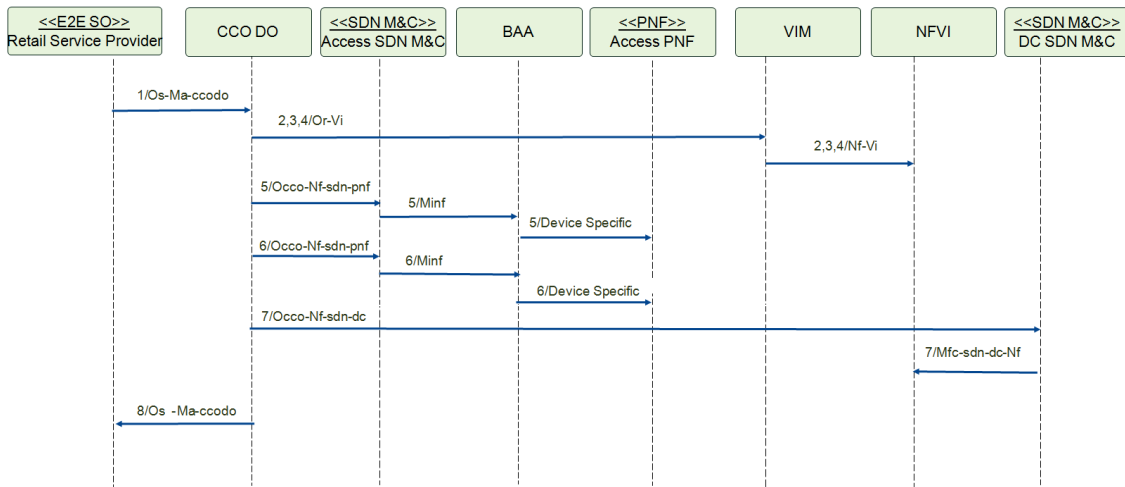
1. CCO DO receives an Internet Access Service creation request. The CCO Service Provider assigns the Internet Access Service instance to the retail Internet Service Provider:
2. CCO DO requests VIM to create a Distributed Router across the NFVI through the VIM, associated with a pool of public IP addresses.
3. CCO DO requests VIM to create an overlay network to connect the uplink of Distributed Router,
4. CCO DO requests VIM to create a bridge to connect the overlay network to a pre-created S-VLAN configured on one of the network facing interfaces of the CloudCO Domain.
5. CCO DO requests VIM to create an overlay network between the vG_MUX PNF and the Edge SDN M&C.
6. CCO DO requests the Edge SDN M&C to configure the vG_MUX with the reachable IP address.
7. CCO DO requests VIM to establish the connectivity between the vG_MUX and the Distributed Router to enable vG_MUX to be IP reachable.
8. CCO DO reports 'Service Ready'.



7.2 Interaction 2: Create NERG with Overlay LSL Service

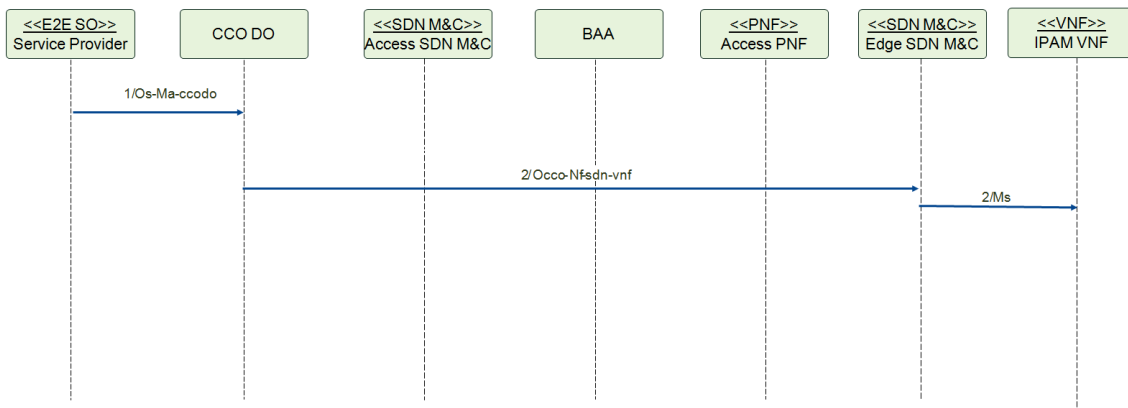
1. CCO DO receives a NERG service creation request from a retail Internet Service Provider.
2. CCO DO requests VIM to create an NERG VNFM instance inside the CloudCO Domain.
3. CCO DO requests VIM to deploy an IPAM VNF inside the CloudCO Domain for the retail Internet Service Provider.
4. CCO DO requests VIM to establish the connectivity between the Access SDN M&C and the IPAM VNF.

5. CCO DO request the Access SDN M&C to create an S-VLAN on the Access PNF (through the BAA), as well as assigning Access UNIs to that S-VLAN, as well as enabling split-horizon forwarding on that S-VLAN.
6. CCO DO request the Access SDN M&C provisions the Access PNF via the BAA to redirect Serial Number encapsulated in TR-069/JSON and DHCP packets within the context of that S-VLAN to it, while blocking all the rest.
7. CCO DO requests the DC SDN M&C to configure that S-VLAN on the switch attached to the Access PNF on all of its ports.
8. CCO DO reports 'Service Ready'.



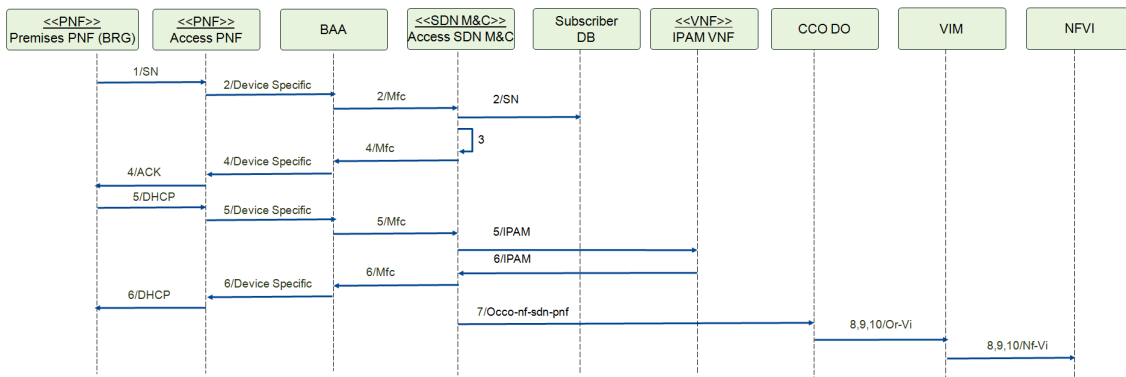
7.3 Interaction 3: Create NERG Service User

1. CCO DO receives a NERG Service User creation request from the retail ISP.
2. CCO DO requests the Edge SDN M&C to configure the IPAM VNF with the enduser(tenant) addresses and policies (rate/quality of service, type of protection).



7.4 Interaction 4: Activate NERG Service (Successful authentication)

1. The Premises PNF (BRG) attaches to the Access Network, and provides Serial Number encapsulated in TR-069/JSON for authentication.
2. Access PNF sends, via the BAA, Access SDN M&C and CCO DO, the SN information toward the subscriber database through CloudCO NB API. The subscriber database authenticates the enduser(tenant) and returns the response.
3. Upon successful authentication, the Access SDN M&C registers a port activation, i.e allowing now other type of packets on the Access UNI port.
4. The Access SDN M&C reports a port activation to the BAA which reports it to the Access PNF which establishes L2 connectivity between the enduser port and the Access PNF NNI via S-VLAN forwarding.
5. The Access PNF relays, via the BAA and Access SDN M&C, the DHCP request to the IPAM VNF.
6. IPAM VNF responds with the address information, the tunnel information (vG_MUX's address and tunnel protocol) and policies for the enduser (tenant).
7. The Access SDN M&C reports a enduser(tenant) activation to the CCO DO with the attachment point.
8. CCO DO requests VIM to deploy a vG instance and create a new overlay network inside the NFVI and connect this overlay network between the vG and the Edge SDN M&C. The vG is managed by the Edge SDN M&C via this overlay network.
9. CCO DO requests VIM to create one new overlay network inside the NFIV and connect this overlay network between the WAN facing interface of the vG_MUX and the LAN facing interface of the vG to establish the user-plane connectivity between them.
10. CCO DO Requests VIM to create another new overlay network inside the NFVI and connect this overlay network between the WAN facing interface of the vG and the Distributed Router (created in step 2 of Interaction 1) to establish the user-plane connectivity between them.



8 Success Criteria

8.1 Interaction 1:

1. CCO DO maintains the Internet Access Service request.
2. Routed User Plane Connectivity is created, from the Distributed Router to the Network I/O of CCO Domain.
3. Management and control plane is established between the vG_MUX PNF and Edge SDN M&C.

8.2 Interaction 2:

1. CCO DO onboards the NERG Service.
2. Management and control plane is established between the Premise PNF (BRG) and IPAM VNF.
3. Management and control plane is established between the Premises' physical termination and Access SDN M&C via the BAA.

8.3 Interaction 3:

1. NERG Service User is created.
2. IPAM VNFs are configured with the tenant information.

8.4 Interaction 4:

1. The vG instance is instantiated.
2. The Service User behind the Premises PNF (BRG) accesses the Internet service.