

CLUDCO-APPN-003

Network Enhanced Residential Gateway (NERG) Service Initialization with Overlay Logical Subscriber Link (LSL) Connectivity

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1 Summary/Objective

Editor(s): Jie Hu;

Contributor(s): Jinwei Xia, Junfeng Ma;

Supporting Company/ies: China Telecom, Huawei, CAICT;

This application note describes the establishment of NERG (TR-317) service for a subscriber within a Cloud-CO domain instance. The NERG service in this application note supports Overlay Logical Subscriber Link (LSL) connectivity model.

2 Assumptions and Preconditions

1. The Cloud CO Domain instance is already fully bootstrapped.
2. Enduser(tenant) access is authorized by a AAA VNF using EAP. The AAA VNF can use a local database or use Radius. 802.1x will be used to send EAP requests and responses to the Premise PNF (BRG).
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 802.1x based authentication and DHCP for IP address assignment.
5. The user plane traffic from the Premise PNFs (BRGs) is aggregated at a vG_MUX VNF inside the Cloud CO Domain. The vG_MUX VNF maps the traffic to the appropriate vG and ensures traffic isolation between endusers(tenants). This function is managed through the Edge SDN M&C.
6. The physical connectivity between Premise PNFs (BRGs) at the enduser (tenant) home premise, Access PNFs, Switch Fabric, and Network I/O has been established.
7. 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).

3 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 the AAA and IPAM VNFs.
- Edge SDN M&C to configure the AAA VNF with the enduser(tenant)'s authentication credentials and account, and 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 VNF with the traffic mapping between the WAN IP address of the Premise PNF (BRG) and its corresponding vG.
- VIM to configure a pre-activation trail (control and user plane) from the Access PNF to the vG_MUX VNF.
- 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_MUX VNF and vG VNF.
- Leveraging Edge, DC and Access SDN M&C Controllers, as well as the VIM to establish end to end user-plane connectivity.

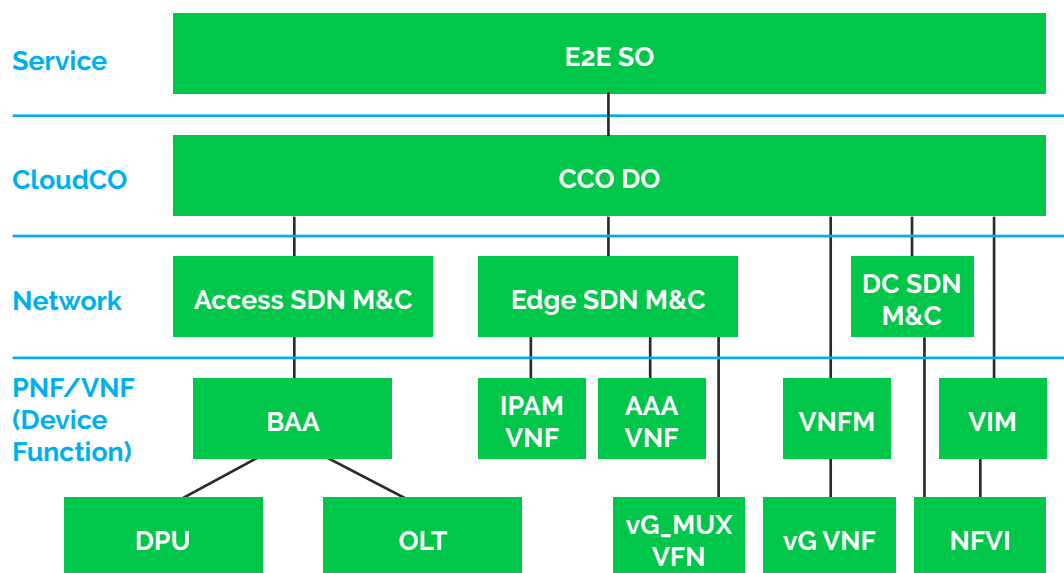


Figure 1 System description

4 Actors

Actor Name	Actor Description	Actions at CCO Domain
Cloud CO 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.

5 Components

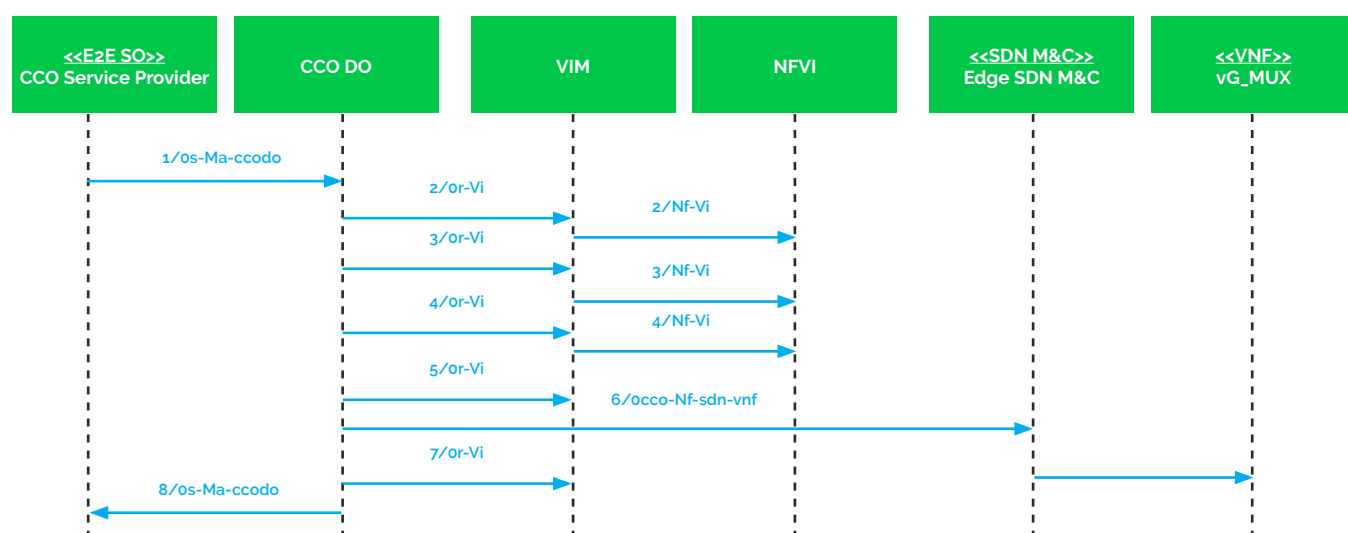
Component Framework Name	Component Description
CCO DO	Cloud CO Domain Orchestrator
Edge SDN M&C	Edge SDN Management and Control: TR-384, WT-411, WT-413 - Provides SDN Management and Control of the Routing and CCO awareness BRG, as well as control plane functions that have been virtualized such as AAA, IPAM and vG_MUX VNFs.
Access SDN M&C	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 PNF (BRG)	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 VNF	The vG_MUX VNF: TR-317, pre-created in the CCO Domain.
DPU	Access PNF
OLT	OLT PNF
VNFM	VNF Manager: ETSI NFV: Manages the lifecycle of the vG VNFs.

6 Interactions

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.

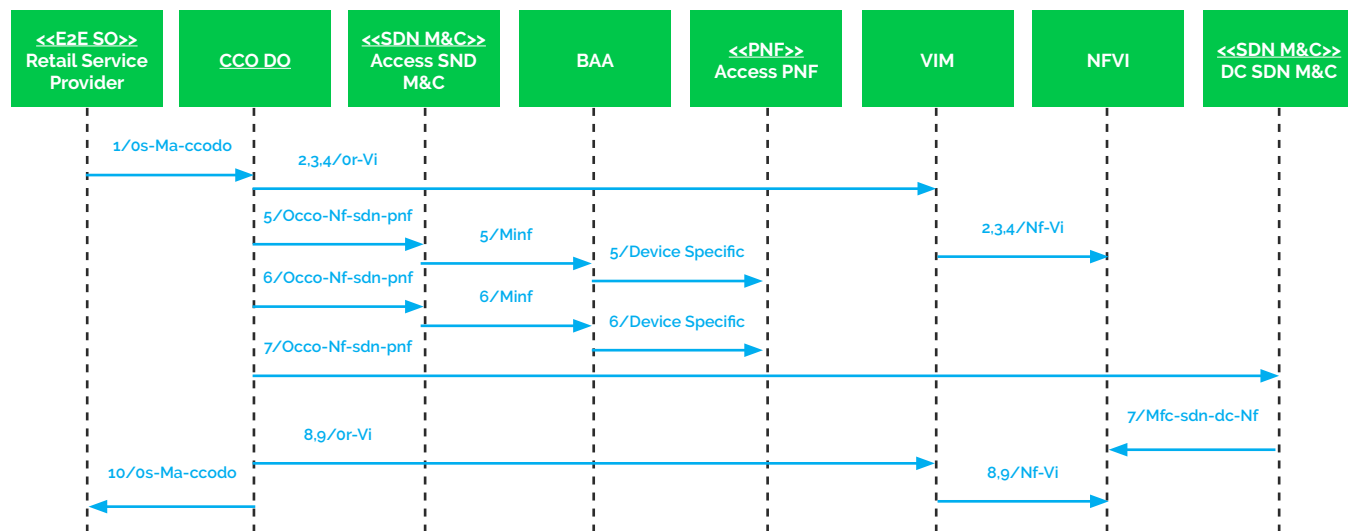
3. CCO DO requests VIM to create an overlay network to connect the uplink of Distributed Router,
4. CCO DO requests VIM to create a bridge to connect the overlay network to a pre-created S-VLAN configured on one of the network facing interfaces of the CloudCO Domain.
5. CCO DO requests VIM to deploy a vG_MUX instance and create another overlay network between the vG_MUX 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'.



Interaction 2: Create NERG with Overlay LSL Service

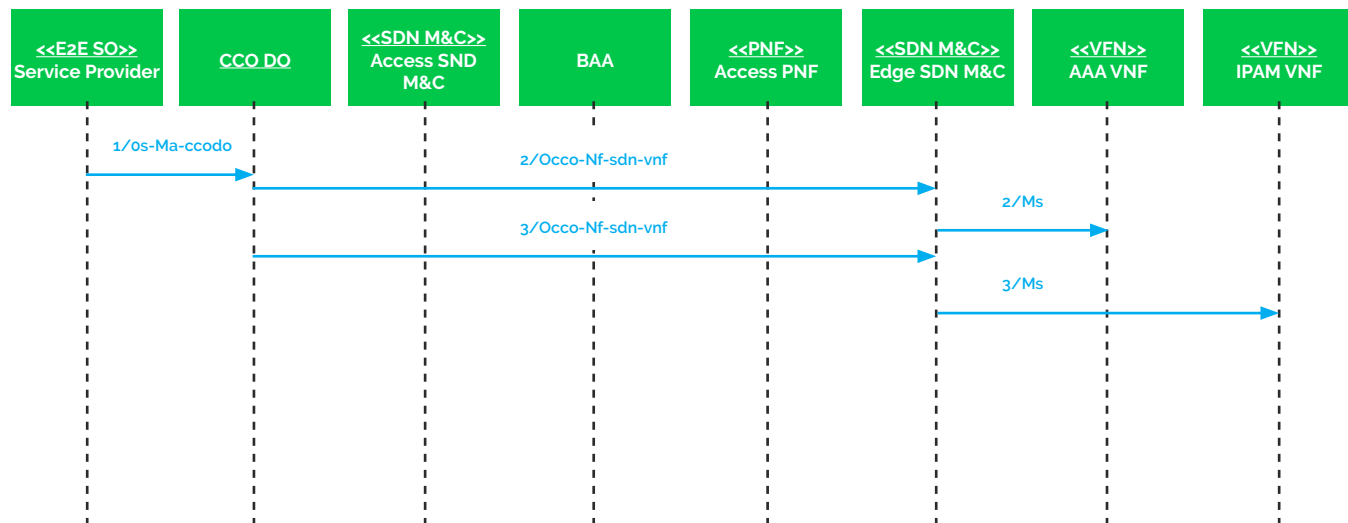
1. CCO DO receives a NERG service creation request from a retail Internet Service Provider.
2. CCO DO requests VIM to create an NERG VNF instance inside the CloudCO Domain.
3. CCO DO requests VIM to deploy an AAA VNF and an IPAM VNF inside the CloudCO Domain for the retail Internet Service Provider.
4. CCO DO requests VIM to establish the connectivity between the Access SDN M&C and the AAA VNF 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 801.1x 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 requests VIM to create a new overlay network inside the NFVI and create a bridge between the S-VLAN and the new overlay network.
9. CCO DO requests VIM to connect this overlay network to the downlink of the Distributed Router.
10. CCO DO reports 'Service Ready'.



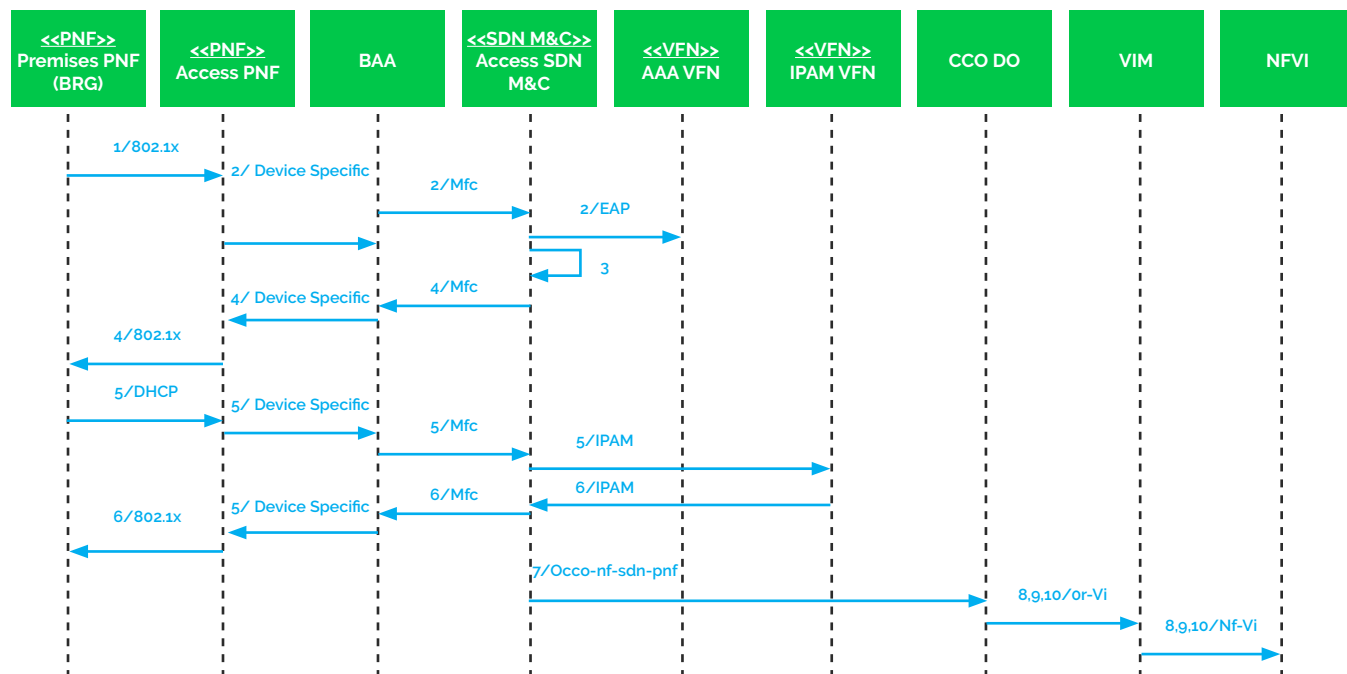
Interaction 3: Create NERG Service User

1. CCO DO receives a NERG Service User creation request with enduser(tenant) credentials from the retail ISP.
2. CCO DO requests the Edge SDN M&C to configure the AAA VNF with the enduser(tenant) credentials.
3. 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).



Interaction 4: Activate NERG Service (Successful authentication)

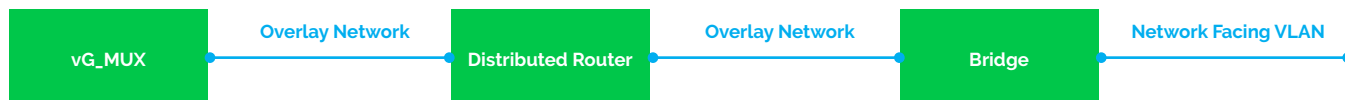
1. The Premises PNF (BRG) attaches to the Access Network, and provides 802.1x credentials for authentication.
2. Access PNF sends, via the BAA and Access SDN M&C, The EAP information from the 802.1x packet toward the AAA VNF. The AAA VNF authenticates the enduser(tenant) and returns the response.
3. 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.



7 Success Criteria

7.1 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.



7.2 Interaction 2:

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

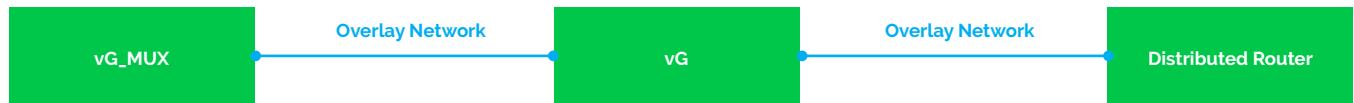


7.3 Interaction 3:

1. NERG Service User is created.
9. AAA and IPAM VNFs are configured with the tenant information.

7.4 Interaction 4:

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



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