

NFV ISG PoC Proposal –Demonstration high availability vEPC and SDN controlled Service Chain

1. NFV ISG PoC Proposal

1.1 PoC Team Members

Include additional manufacturers, operators or labs should additional roles apply.

PoC Project Name: Demonstration high availability vEPC and SDN controlled Service Chain.

Network Operators/ Service Providers:

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1.2 PoC Project Goals

Goals

PoC Project Goal #1: This PoC will demonstrate vEPC based on NFV and Service Chaining based on SDN to verify compatibility of these two technologies. Also OVS and SR-IOV technology will be used by vEPC.

PoC Project Goal #2: This PoC will verify that legacy EPC elements can be implemented by Network Function Virtualization. vEPC has the equivalent functions of legacy EPC and possesses the advantages of NFV elements at the same time, such as fast deployment, scalability, high reliability.

PoC Project Goal #3: This PoC will verify that Dynamic Service Chaining will be possible by using vVAS and SDN. Flexible Service Chaining policy definition will be verified.

Elements of this PoC system are provided by several vendors, it is very convenient and flexible for Network Operator to build up its own virtualised network.

NOTE: vVAS is an entity which provides particular function in packet services, such as web optimisation, video optimisation, URL filtering or firewall, etc.

1.3 PoC Demonstration

- Venue for the demonstration of the PoC: The PoC is planned to be hosted in Network and Terminal Laboratory of China Telecom in GuangZhou China, and can be accessed remotely from any location with reliable internet service.
- We also propose to demonstrate the PoC at industry events in 2016, yet to be finalized.
- A webinar will be organized to present the PoC during the PoC lifetime.

1.4 Publication

Currently, publication is not planned.

1.5 PoC Project Timeline

- What is the PoC start date? September 15th , 2015
- (First) Demonstration target date October 7th ,2015
- PoC Report target date October 30th , 2015
- When is the PoC considered completed? October 30th , 2015

2 NFV PoC Technical Details

2.1 PoC Overview

In this PoC, we demonstrate high availability vEPC and SDN controlled Service Chaining based on multi-vendor environment.

Figure 1 shows the overall picture of the PoC which is based on NFV and SDN. Both OVS and SR-IOV are used in vEPC which is based on NFV, and SDN network is used in Service Chaining. All of these VNFs are integrated in the same CloudOS, and managed by the same NFV Orchestrator.

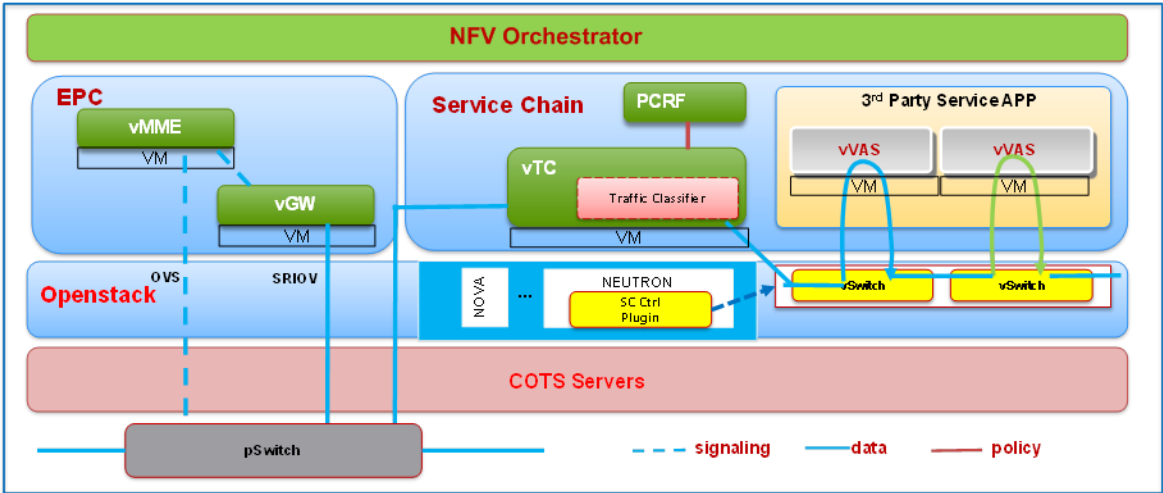


Figure 1 Overall picture of the PoC

Figure 2 shows elements from multiple vendors in this POC. As in Figure 2, COTS servers are provided by HP, and SR-IOV network adapters from Intel are integrated in COTS servers. vEPC, vTC, MANO are provided by Huawei. vVAS is provided by Trend.

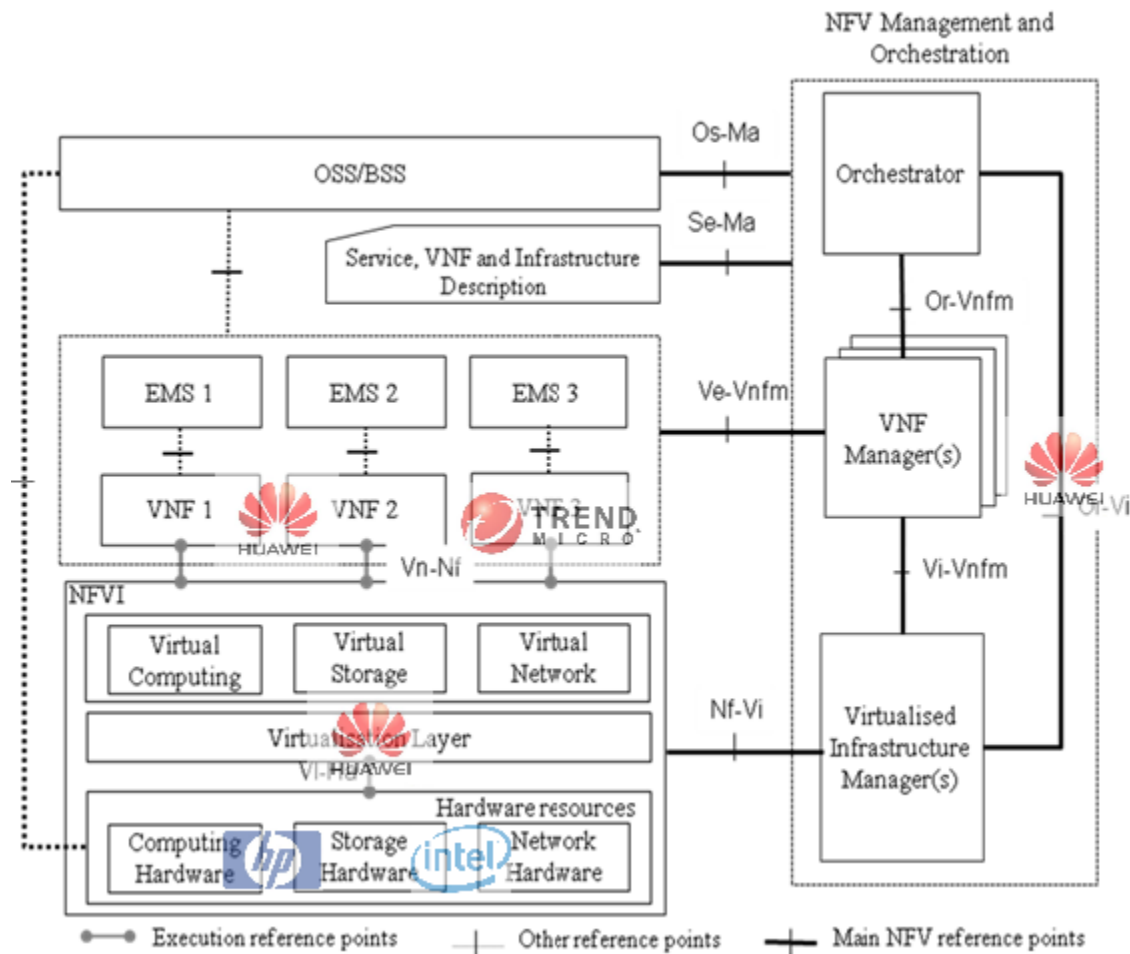


Figure 2 elements of multi-vendor

First of all, basic cloud features such as, instantiation and termination will be verified. We can see that, different vendors' VNFs can work well on top of COTS servers from HP and CloudOS from Huawei. Secondly, vVAS VM scaling, vEPC VM scaling with SR-IOV technology and high reliability of vEPC will be verified. At last, policy definition, flexible Service Chaining will be verified. Those features work well with vVAS from Trend, and the NFVI, MANO, and vTC from Huawei. MANO from Huawei can manage VNFs from both Huawei and Trend.

Subscribers get policy from vTC or PCRF. Orchestrator define Service Chain based on service requirement. Both policy and Service Chain ID will be sent to Traffic Classifier which deployed in vTC. Traffic Classifier will marked traffic with Service Chain ID, and send it to Controller which deployed in CloudOS. Controller generates tag-based forwarding flow tables according to Service Chain ID and network topology, and distributes them to the network service switch (vSwitch). vSwitch forwards traffic to vVAS according to forwarding flow tables generated by Controller. Traffic will be sent to internet after processing by vVAS.

In this PoC, we will use some legacy elements, e.g. PCRF. So the compatibility of legacy elements and virtualized elements can also be verified.

Following scenario will be tested and verified:

- VNF Instantiation and Termination
- VNF Lifecycle Management based on MANO
- E2E service with Service Chaining
- vEPC VM auto scaling based on resource in SR-IOV network.
- Reliability (Host level and VM level)
- Flexible Service Chaining Policy Definition.

2.2 PoC Scenarios

Scenario 1 - VNF Instantiation and Termination

In this scenario, we show that how to perform instantiation and termination of VNF, as in Figure 3. All instantiation procedures are listed here:

- Import and register image in ClousOS, only registered image can be used.
- Import NS and VNFD template which consist of VM deployment flavor, network design, policy of scaling and some other basic configuration, etc.
- Perform on boarding operation on MANO. This step is a one-button operation after templates are available.
- After receiving request from API interface, CloudOS will check token first, then choose a proper host and create network.
- Create a VM which is requested by MANO. This VM cannot work immediately as it is empty. And CloudOS will feedback MANO when the VM is created.
- Download software from FTP server which contains the prepared software package.
- VM will do software installation after software is downloaded.

Instantiation is finished only after all VMs of the VNF are created and installed successfully. In this test case, vMME, vGW, vTC, vVAS and EMS will be instantiated by MANO. For termination, delete project operation is executed on MANO, then CloudOS will delete all VMs requested by MANO.

With Instantiation and Termination on COTS server, Network Operator can save investment on a large number of proprietary hardware, and shorten the lifecycle of new service deployment.

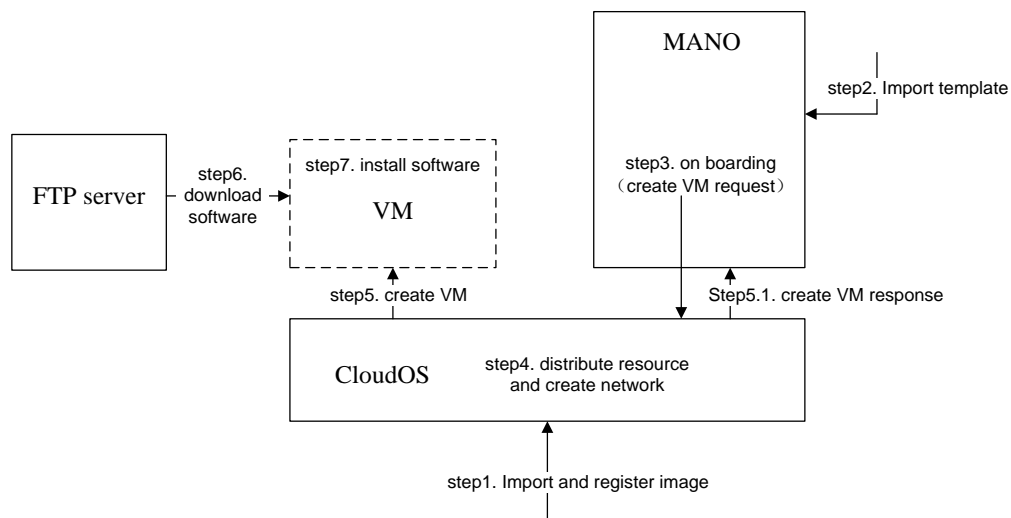


Figure 3 procedure of instantiation

Scenario 2 – VNF Lifecycle Management based on MANO

MANO is the manager of NFV architecture. MANO can manage resource, authorization, events and logs, and so on. Tenants are created for different vendors. For example, we can identify Huawei and Trend as two tenants. And these two tenants are separated from each other. Some basic function such as Template, Resource, Project, Policy and Alarms will be verified in this test case. We are going to show how MANO works with vVAS VM scaling automatically.

- vVAS will reports its CPU usage and throughput information to MANO, these KPIs will be showed in Project menu.
- MANO compares CPU usage and throughput with a threshold that is pre-defined in policy. If CPU usage or throughput is higher than the threshold, MANO will ask for a new VM.
- A new VM will be created only after resource is available. So MANO will check if resource is available first with Resource Management function.
- If resource is available, MANO will ask for a new VM with pre-defined template. Templates can be imported, created, modified or deleted in Template Management.
- If any faults of VM happens, alarms will be generated on MANO.

MANO can manage VNFs from different vendors. Tenant can help to avoid wrong operation, resource management and network isolation.

Figure 4 shows MANO's basic function.

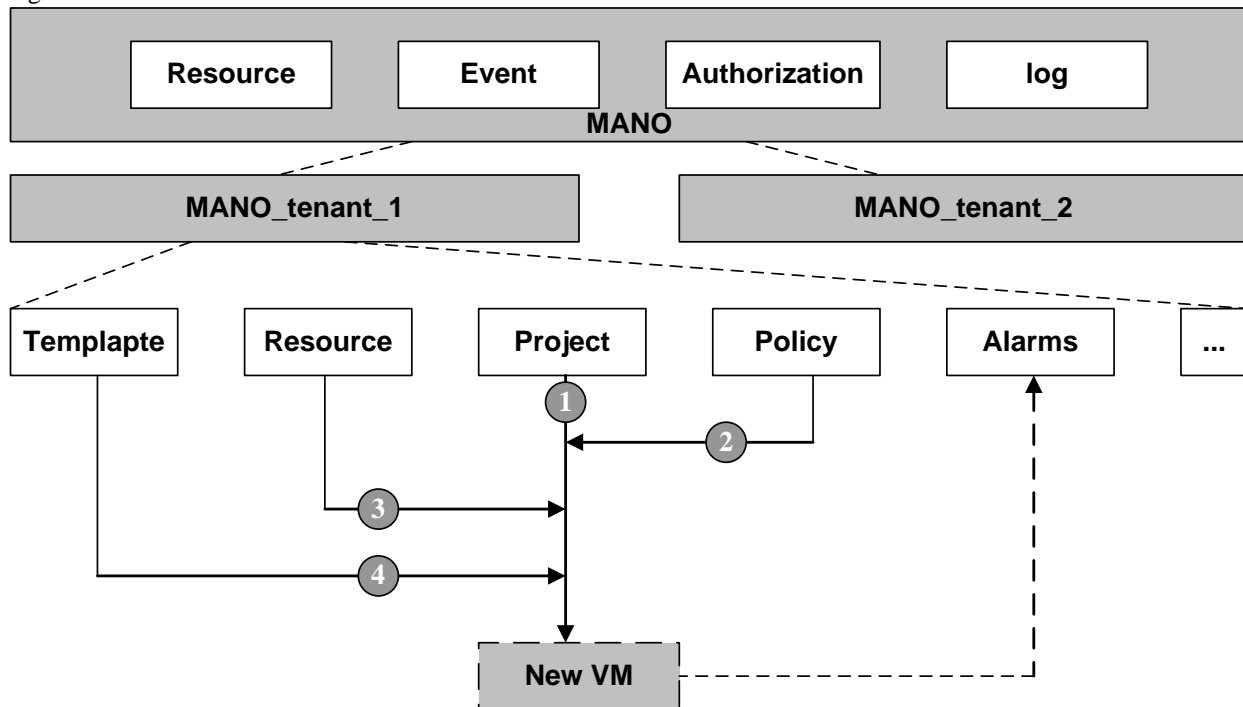


Figure 4 Basic function of MANO

Scenario 3 – E2E service with Service Chaining

E2E service with Service Chaining will be verified in this test case. UE will access to internet with bearer provided by vEPC and Service Chaining network. All elements in vEPC and Service Chaining network are virtualized. In this scenario, O&M of vMME and vGW can be done by EMS, Service Chain definition can be done by Orchestrator. We choose a URL filter vVAS here which will only allow subscribers to access in some particular websites. Traffic

Classifier will distinguish traffic flow according to policy from PCRF and Service Chain definition from Orchestrator.

Figure 5 shows E2E service with Service Chaining.

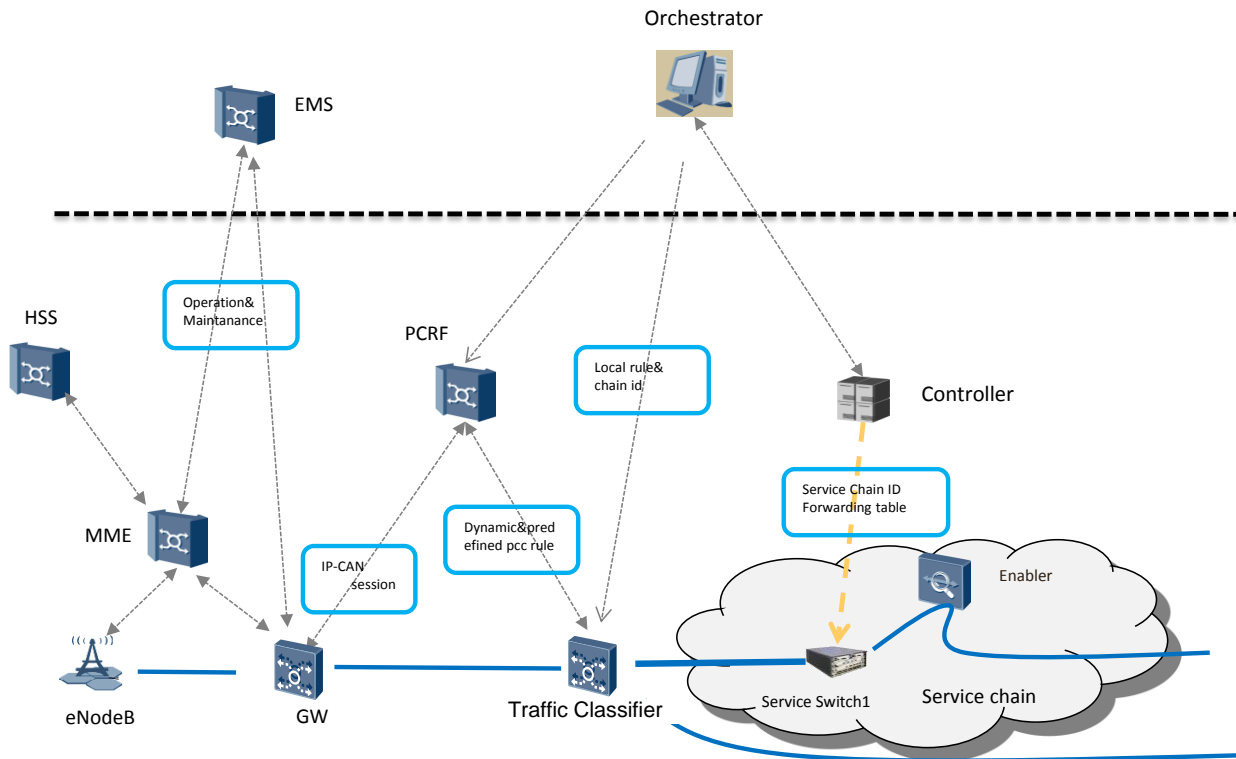


Figure 5 E2E service with Service Chaining

Scenario 4 – vEPC VM auto scaling based on resource in SR-IOV network

The threshold of automatic scaling is determined by system load. System load is reported by VNF to MANO, and MANO initiates scaling operation according to pre-defined policy.

A Simulator will be used to generate and remove sessions by simulating eNB and UEs. First of all, the policy for scale in/out should be defined on MANO. Then, the simulator is used to generate service traffic. MANO will query the system load periodically. MANO will ask for one new VM when it detects that the system load exceeds the threshold defined in the policy. At last, CloudOS will create one new VM requested by MANO.

Compared with traditional embedded hardware, COTS server does not have proprietary hardware acceleration facilities, such as, chips for DPI or user plane forwarding. So SR-IOV is the key technology to improve performance (latency, throughput) in NFV environment. We use SR-IOV technology in vEPC, traffic will be sent from virtual NIC to physical NIC without passing through OVS in CloudOS. When equipped with SR-IOV technology, vEPC exhibits good performance. However, SR-IOV may also cause inconvenience to flexible deployment.

Figure 6 shows the procedure of auto scale-out.

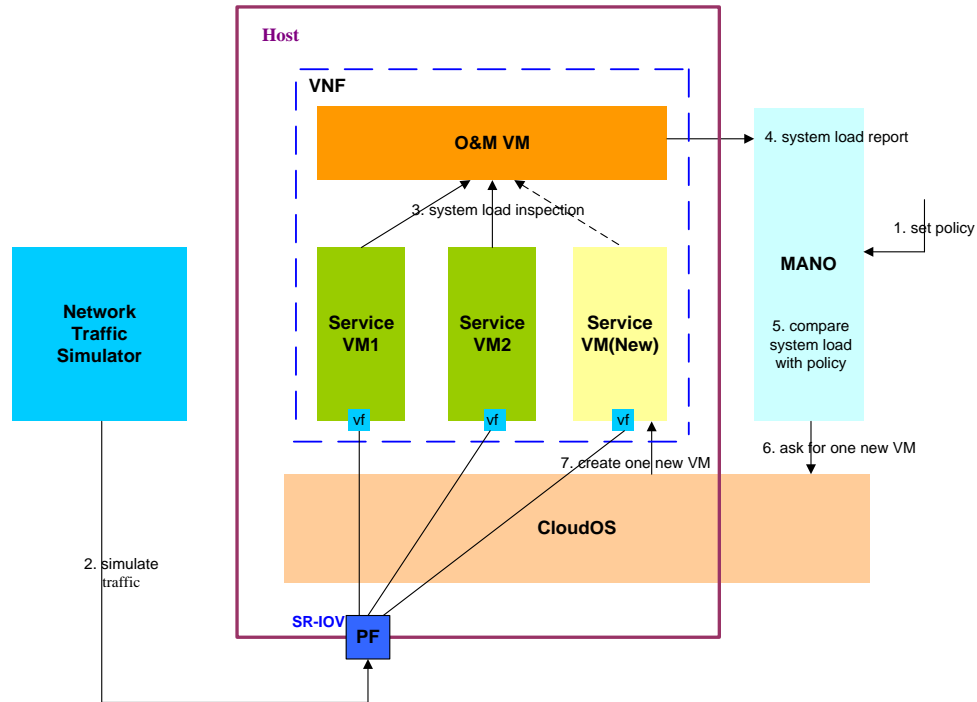


Figure 6 procedure of auto scale-out

Manual scaling is based on manual operation, we can scale in/out VMs at any time or any condition on MANO.

Scenario 5 - Reliability (VM level and Host level)

Reliability is one particular KPI applied for telecom equipment. When fault happens, such as VM failure, power off, or equipment is broken, the whole system which the service is running on should not be impacted, or tiny impacted. We will show two ordinary failure cases: VM failure and Host power off.

For VM failure test, procedures are listed here:

- Attach one real UE (datacard or cellphone) to the system, and access to the internet, such as watch a video on www.youku.com.
- Simulate some subscribers by the simulator.
- Discover the VM which serves the real UE.
- Reboot the VM.
- Video is playing without any interruption. And no subscriber will be lost.
- When the VM completes reboot, video is still in playing.

For Host power off test, procedures are listed here:

- Attach one real UE (datacard or cellphone) to the system, and access to the internet, such as watch a video on www.youku.com.
- Simulate some subscribers by the simulator.
- Discover the Host which serves the real UE.

- Power off the Host.
- Video is in playing without any interruption. And no subscriber will be lost.

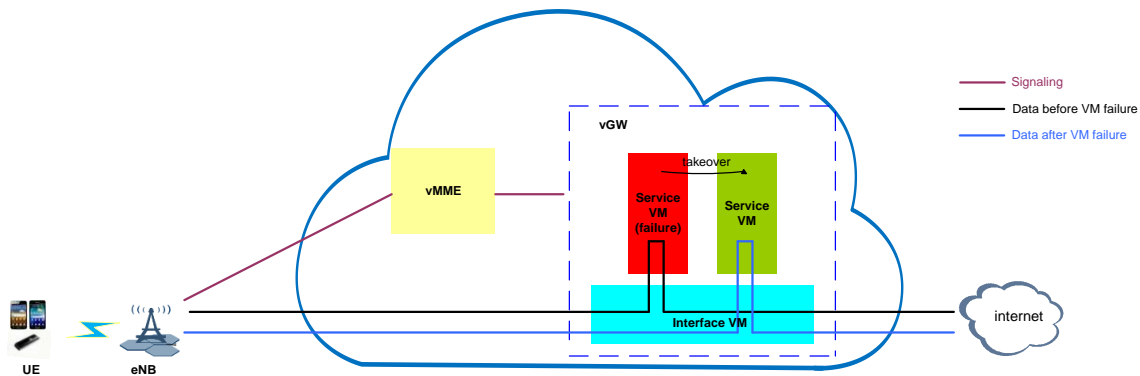


Figure 7 processing of system when VM is failure

We show that the processing of system when one service VM is failure. When one service VM is down, vGW will detect the failure and re-calculate the distribution of subscribers, and make a report to service VM and Interface VM. The active service VM will take over sessions from the failed one, and Interface VM will forward traffic flow to the VM which has taken over sessions at the same time. Some data will be lost when takeover happens. But this period only last a few seconds. Host power off failure case has the similar procedure as VM failure.

Scenario 6 - Flexible Service Chaining Policy Definition

There are three Service Chaining policies: local static policy, pre-define policy and dynamic policy.

- Local static policy is configured on vTC. Rules in the policy is bound to Service Chain ID. Traffic flows will be forwarded to vVAS when they match policy successfully.
- Pre-define policy is configured by PCRF, and the policy itself is configured on vTC. vTC will get pre-define policy name over Gx interface when service traffic matches the policy successfully.
- Dynamic policy is configured by PCRF, and rules in policy are associated with Service Chain ID. Policy and Service Chain ID will be sent to vTC when subscriber is online.

Value-added service can be done based on subscriber or type of service. Subscribers who subscribe to 3rd party value-added service can sign Service Chaining policy. When these Subscribers initial traffic, value-added service will be applied if traffic match policy. And value-added service can be also applied for some particular service types, once these service types are initialled, value-added service will be applied. Figure 8 shows procedures of Service Chaining.

Procedures are listed here:

- Service Chain ID and sequence of Service Chain are sent to Controller by Orchestrator.
- Controller generates Forwarding table according to information from Orchestrator.
- Service Chain ID will be sent to PCRF also.
- PCRF retrieve subscriber information by registering manually.
- IP-CAN session will be established when subscriber is active.
- If traffic matches policy, PCRF will send dynamic policy to PCEF.
- PCEF forward traffic tagged with Service Chain ID to Service vSwitch.
- Traffic will be sent to internet after processing by vVAS.

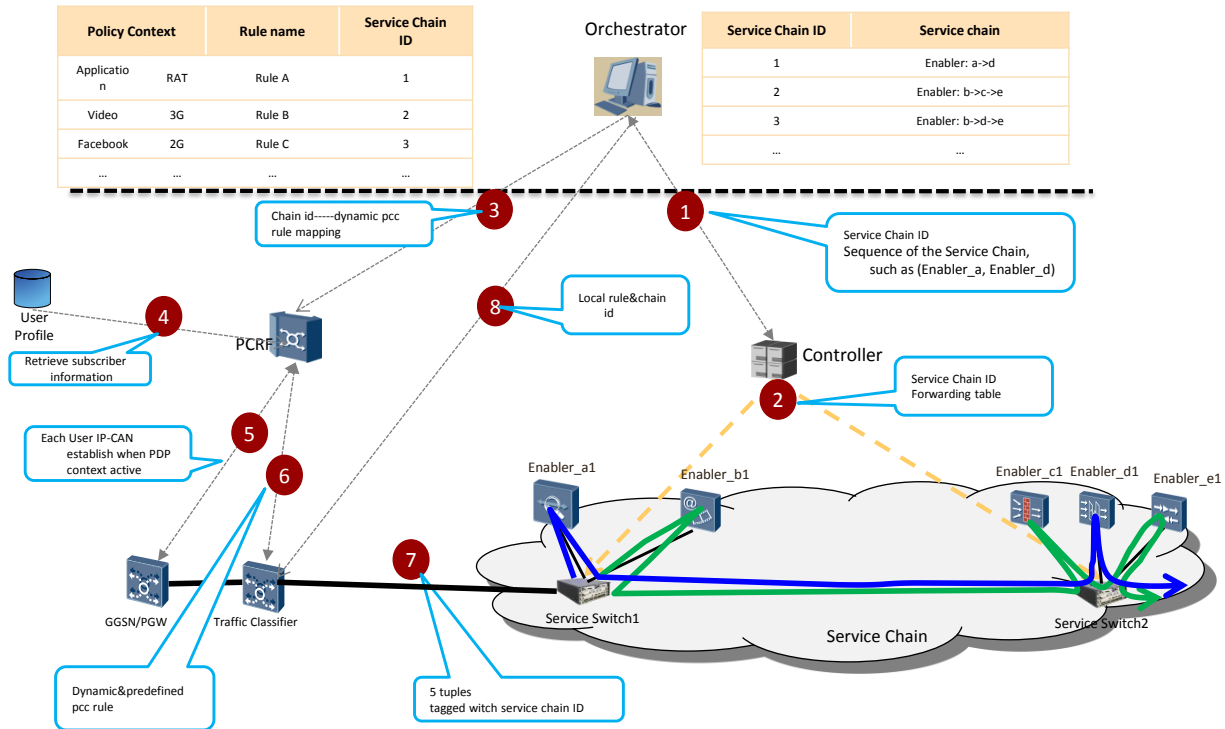


Figure 8 procedure of Service Chaining

It is easy to add, modify or remove a Service Chain on MANO. So, it is convenient and zero-impact for network operator to deploy a new service with flexible Service Chaining.

2.3 Mapping to NFV ISG Work

Describe how this PoC relates to the NFV ISG work:

- Specify the most relevant NFV ISG end-to-end concept from the NFV Use Cases , Requirements , and Architectural Framework functional blocks or reference points addressed by the different PoC scenarios:

Scenario	Use Case	Requirement	E2E Arch	Comments
Scenario 1	UC#1 UC#2 UC#5	Gen.1 Port.1, Port.2	VNFs, NFVI,VIM VNF Management and Orchestration	NFV environment setup based on multi-vendor elements.
Scenario 2	UC#2 UC#5	Gen.1 Port.1, Port.2,Port3 Elas.2	VNFs, NFVI,VIM VNF Management and Orchestration, Element Management System,	VNF Lifecycle management on MANO
Scenario 3	UC#2 UC#5	Gen.1 Port.1, Port.2	VNFs, NFVI,VIM VNF Management and Orchestration, Element	E2E Service with Service Chaining

		<i>Elas.2</i>	<i>Management System,</i>	
Scenario 4	<i>UC#4</i>	<i>Gen.1</i> <i>Port.1, Port.2</i> <i>Elas.2</i>	<i>Service, VNFs, NFVI,VIM</i> <i>VNF Management and</i> <i>Orchestration, Element</i> <i>Management System,</i>	<i>Scaling based on system load or</i> <i>resource with SR-IOV.</i>
Scenario 5	<i>UC#2</i>	<i>Gen.2, Gen.4</i> <i>Port.1, Port.2</i> <i>Elas.5</i> <i>Cont.2</i>	<i>Service, VNFs, NFVI,VIM</i> <i>VNF Management and</i> <i>Orchestration, Element</i> <i>Management System,</i>	<i>VM failure and Hardware failure.</i> <i>Verification impact on service.</i>
Scenario 6	<i>UC#2</i>	<i>Gen.2</i> <i>Port.1, Port.2</i> <i>Elas.2</i>	<i>VNFs, NFVI,VIM</i> <i>VNF Management and</i> <i>Orchestration</i>	<i>Implementation of Service Chaining</i> <i>method by VNF Forwarding Graph.</i> <i>Realize the switch of Forwarding</i> <i>Graph.</i>

2.4 PoC Success Criteria

In this PoC, the criteria for success are verifying scalable vEPC in SR-IOV network, the impact on service when VM failure or Hardware failure, and the VNF forwarding graph with Service Chaining by using policy based on subscribers and type of service on the multi-vendor environment. Other criteria for success are confirming the compatibility with legacy elements, and also the basic function of virtualized MME and GW. Integration of NFV and SDN on a same CloudOS.

2.5 Expected PoC Contribution

One of the intended goals of the NFV PoC activity is to support the various groups within the NFV ISG. The PoC Team is therefore expected to submit contributions relevant to the NFV ISG work items as a result of their PoC Project.

List of contributions towards specific NFV ISG WIs expected to result from the PoC Project:

- PoC Project Contribution #1: A use case of deploying elastic EPC with SR-IOV technology. Contribute to work item DGS/NFV-IFA001.
- PoC Project Contribution #2: Forwarding graph and forwarding path related information elements on Os-Manfvo interface. Contribute to work item DGS/NFV-IFA013 and maybe DGS/NFV-IFA012.
- PoC Project Contribution #3: A use case of Service Chaining using SDN and potential requirements to SDN controller / MANO. Contribute to work item DGS/EVE005.
- PoC Project Contribution #4: A test description example using TST002's terminology and templates. Contribute to work item DGS/NFV-TST002.