Submission of this NFV ISG PoC Report as a contribution to the NFV ISG does not imply any endorsement by the NFV ISG of the contents of this report, or of any aspect of the PoC activity to which it refers.

B.1 NFV ISG PoC Report

B.1.1 PoC Project Completion Status

- Overall PoC Project Completion Status: Completed

B.1.2 NFV PoC Project Participants

- PoC Project Name: Demonstration high availability vEPC and SDN controlled Service Chain
- Network Operator/Service Provider:
  China Telecom — Contact: Peirong Xie, xiepr@gsta.com; Jie Chen, chenjie@gsta.com; Biao Long, longb@gsta.com
- Manufacturer A: Huawei — Contact: Liu qi, leon.liuqi@huawei.com; Li jin, jason.lijin@huawei.com
- Manufacturer B: Hewlett Packard — Contact: Jianshu Luo,Jian-shu.luo@hp.com; Jianbo He, Jianbo.he@hp.com
- Manufacturer C: Trend — Contact: Yangyang, Young_Yang@trendmicro.com.cn
- Manufacturer D: Intel — Contact: Kuo Liao, kuo.liao@intel.com

B.1.3 Confirmation of PoC Event Occurrence

- PoC Demonstration Event Details:

  The PoC demonstration took place on November 20th 2015 in Network and Terminal Laboratory of China Telecom in GuangZhou China. Image of venue for our demo is shown in Figure 1.

Figure 1. Venue for demo

- The demo was presented by our PoC team members in a webinar. About 14 people from ALU, HP, NEC and other companies attend the webinar. Image of our PoC demo is shown in Figure 2. The demo slice can be found at the NFV PoC wiki page, http://nfvwiki.etsi.org/index.php?title=Demonstration_high_availability_vEPC_and_SDN_controlled_Service_Chain.

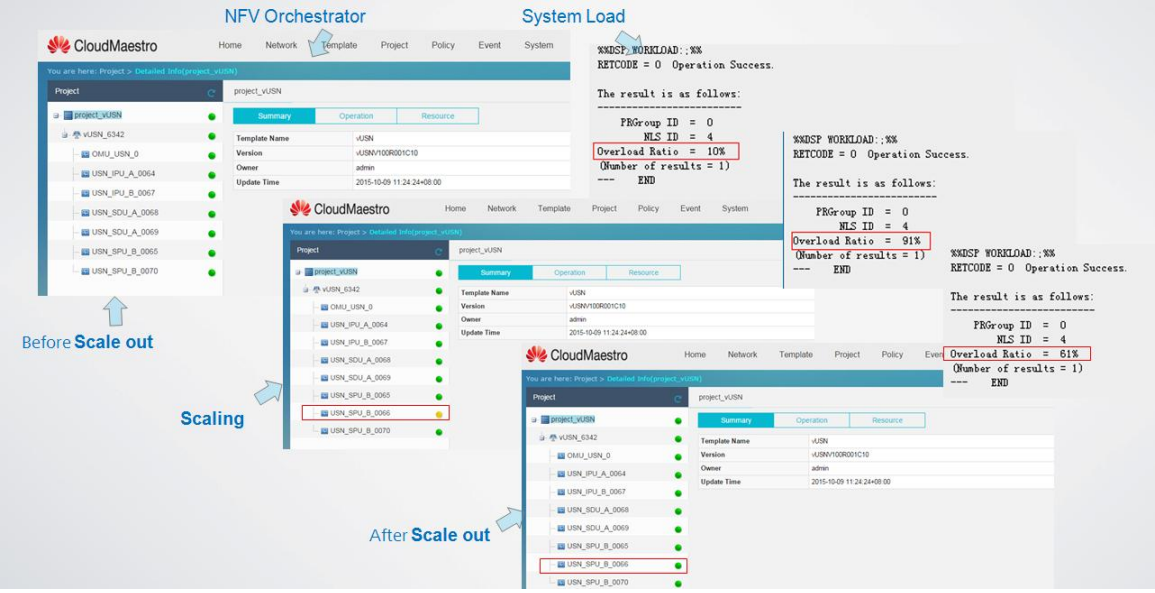


Figure 2. Our PoC demo exhibition

B.1.4 PoC Goals Status Report

- 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.

  Goal Status (Demonstrated/Met?) : Demonstrated

- 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.

  Goal Status (Demonstrated/Met?) : Demonstrated

- 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.

  Goal Status (Demonstrated/Met?) : Demonstrated

B.1.5 PoC Feedback Received from Third Parties (Optional)

- Where applicable, provide in a free text, feedback received from potential customers, Ecosystem partners, event audience and/or general public.

B.2 NFV PoC Technical Report (Optional)

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.

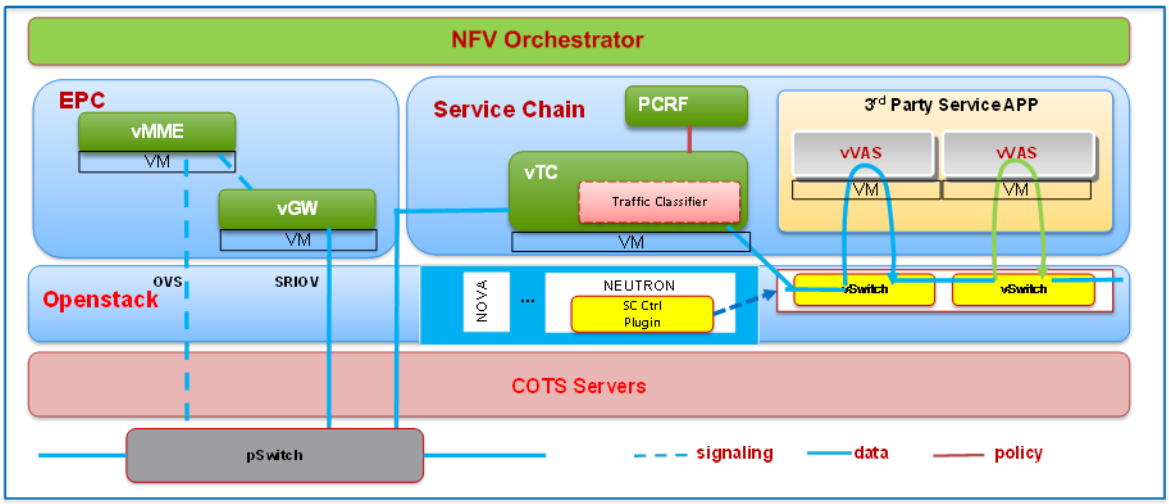


Figure 1 Overall picture of the PoC

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.

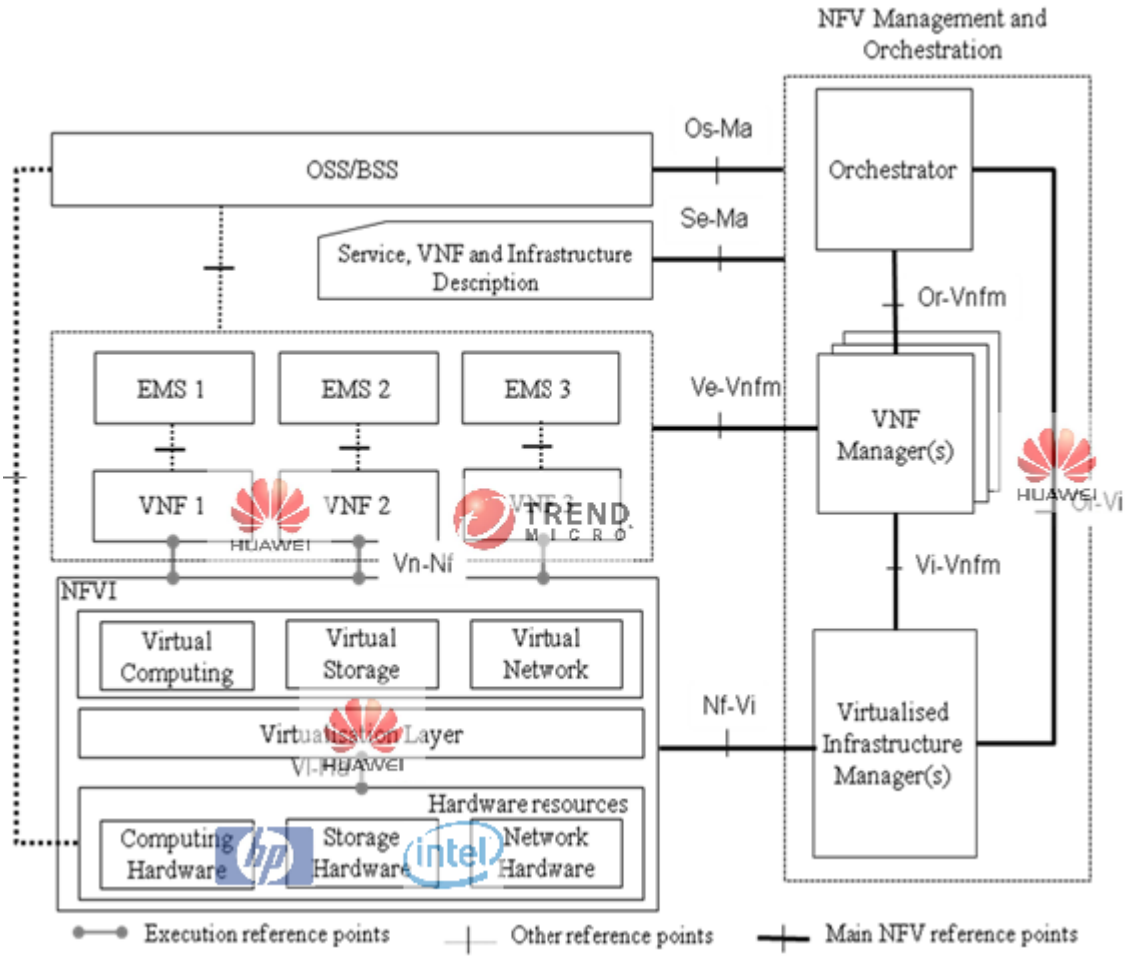


Figure 2 elements of multi-vendor

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.

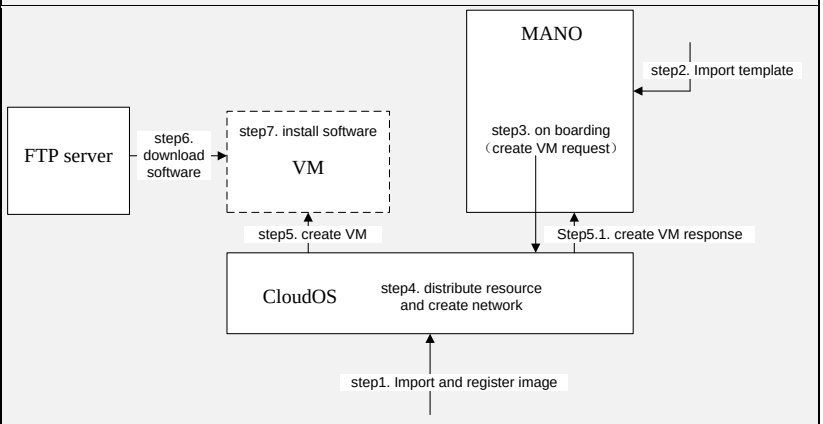
Subscribers get policy from vTC or PCRF. Orchestrator defines Service Chain based on service requirement. Both policy and Service Chain ID will be sent to Traffic Classifier which deployed in vTC. Traffic Classifier will marked traffic with Service Chain ID, and send it to Controller which deployed in 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.

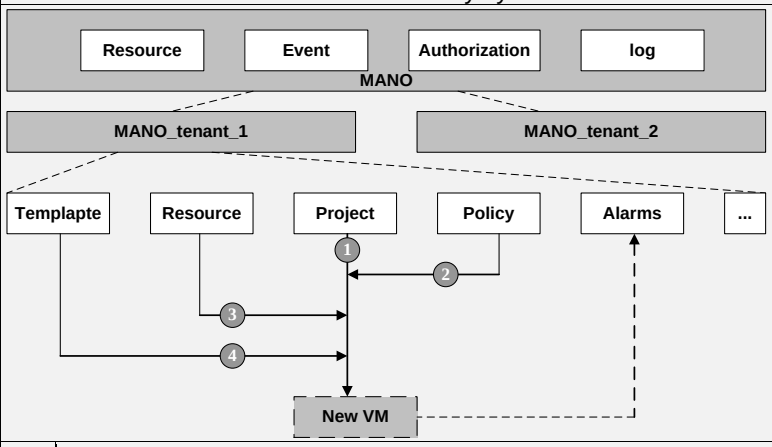
Following scenario will be tested and verified:

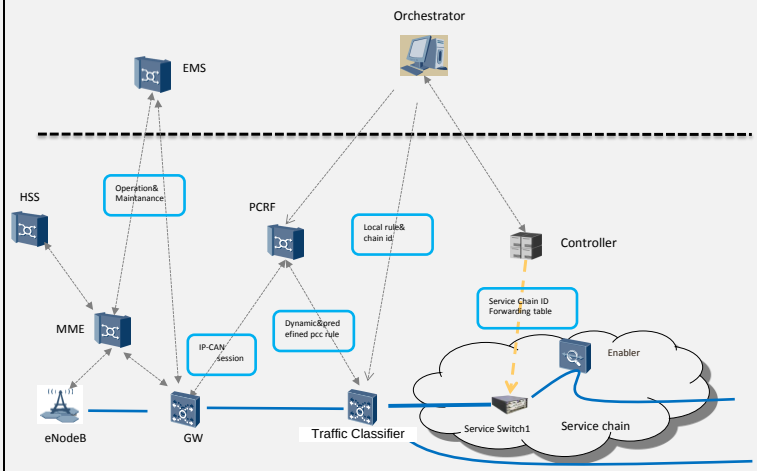
- VNF Instantiation and Termination
- VNF Lifecycle Management based on MANO
- E2E service with Service Chaining
- vEPC VM auto scaling based on resource in SR-IOV network.
- Reliability (Host level and VM level)
- Flexible Service Chaining Policy Definition.

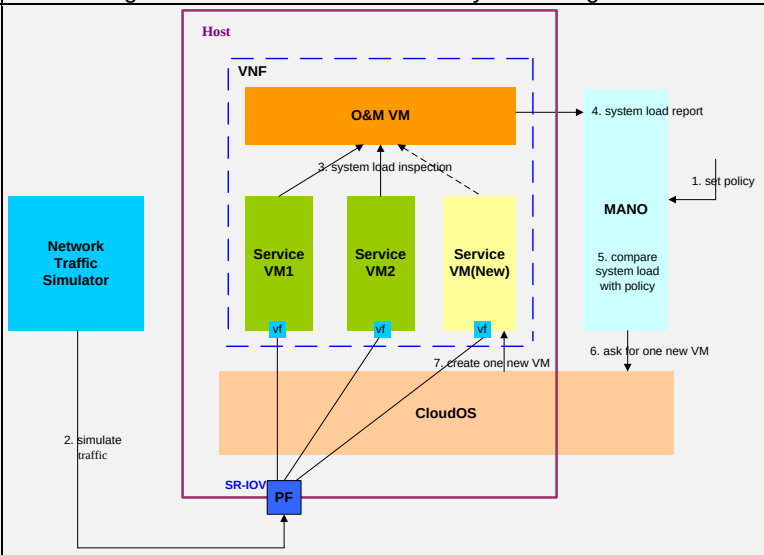
B.2.1 PoC Scenario Report

<table>
<tr><td>Objective Id:</td><td colspan="2">UC1,2,5/SCE1/2</td></tr>
<tr><td>Description:</td><td colspan="2">VNF Instantiation and Termination</td></tr>
<tr><td>Pre-conditions</td><td colspan="2">COTs Server and Cloud OS are ready.</td></tr>
<tr><td>Procedure:</td><td colspan="2"> 
</td></tr>
<tr><td></td><td>1</td><td>Import and register image in ClousOS, only registered image can be used.</td></tr>
<tr><td></td><td>2</td><td>Import NS and VNFD template which consist of VM deployment flavor, network design, policy of scaling and some other basic configuration, etc.</td></tr>
<tr><td></td><td>3</td><td>Perform on boarding operation on MANO. This step is a one-button operation after templates are available.</td></tr>
<tr><td></td><td>4</td><td>After receiving request from API interface, CloudOS will check token first, then choose a proper host and create network.</td></tr>
<tr><td></td><td>5</td><td>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.</td></tr>
<tr><td></td><td>6</td><td>Download software from FTP server which contains the prepared software package.</td></tr>
<tr><td></td><td>7</td><td>VM will do software installation after software is downloaded.</td></tr>
</table>

Results Details:	The objective has been demonstrated.
Lessons Learnt & Recommendations	In this scenario, it was confirmed that 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.

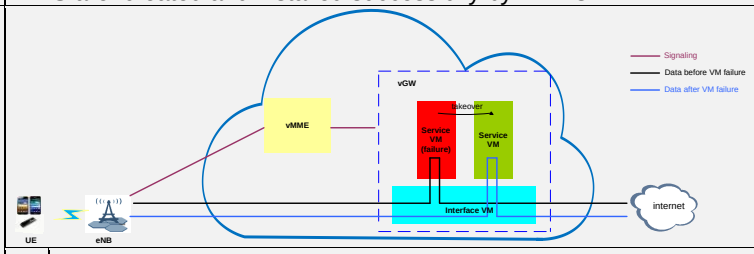
Objective Id:	UC2,5/SCE2/2	
Description:	VNF Lifecycle Management based on MANO	
Pre-conditions	We constructed the network shown in Figure 1, vMME, vGW, vTC, vVAS are created and installed successfully by MANO.	
Procedure:		
	1	vVAS will reports its CPU usage and throughput information to MANO, these KPIs will be showed in Project menu.
	2	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.
	3	A new VM will be created only after resource is available. So MANO will check if resource is available first with Resource Management function.
	4	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.
	5	If any faults of VM happens, alarms will be generated on MANO.
Results Details:	The objective has been demonstrated.	
Lessons Learnt & Recommendations	In this scenario, it was confirmed that MANO can manage VNFs from different vendors	

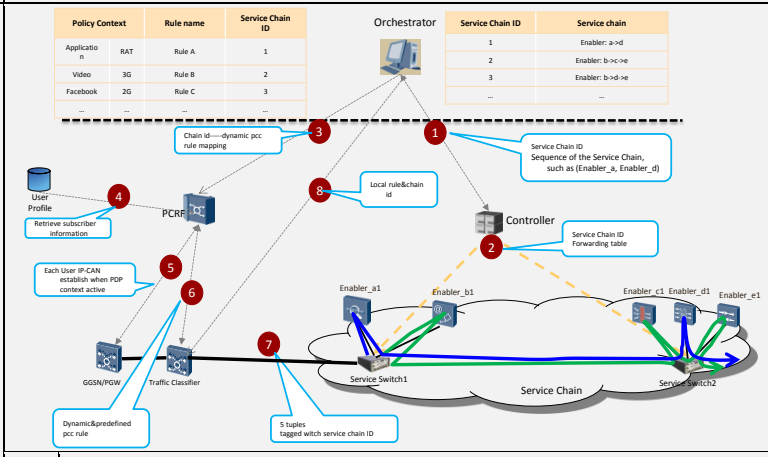
Objective Id:	UC2,5/SCE3/3	
Description:	E2E service with Service Chaining	
Pre-conditions	We constructed the network shown in Figure 1, vMME, vGW, vTC, vVAS are created and installed successfully by MANO.UE has already been subscribed at HSS and PCRF successfully. Policy is configured at URL filter vVAS which will only allow subscribers to access in some particular websites.	
Procedure:		
	1	UE accesses to internet with bearer provided by vEPC and Service Chaining network successfully.
	2	Traffic Classifier will distinguish traffic flow according to policy from PCRF and Service Chain definition from Orchestrator.
	3	UE fail to access to website 1, for website 1 is forbidden by URL filter vVAS.
	4	UE access to website 2 successfully, for website 2 is allowed by URL filter vVAS.
Results Details:	The objective has been demonstrated.	
Lessons Learnt & Recommendations		

Objective Id:	UC4/SCE4/2
Description:	vEPC VM auto scaling based on resource in SR-IOV network
Pre-conditions	We constructed the network shown in Figure 1, vMME, vGW, vTC, vVAS are created and installed successfully by MANO.A Simulator will be used to generate and remove sessions by simulating eNB and UEs.
Procedure:	

1	The policy for scale in/out is defined on MANO.
2	The simulator is used to generate service traffic
3	MANO queries the system load periodically.
4	MANO asks for one new VM when it detects that the system load exceeds the threshold defined in the policy.
5	CloudOS creates one new VM requested by MANO.

Results Details:	The objective has been demonstrated.
Lessons Learnt & Recommendations	

Objective Id:	UC2/SCE5/2	
Description:	Reliability (VM level and Host level)	
Pre-conditions	We constructed the network shown in Figure 1, vMME, vGW, vTC, vVAS are created and installed successfully by MANO.	
Procedure:		
	1	Attach one real UE (datacard or cellphone) to the system, and access to the internet, such as watch a video on www.youku.com.
	2	Simulate some subscribers by the simulator.
	3	Discover the VM which serves the real UE.
	4	Reboot the VM.
	5	Video is playing without any interruption. And no subscriber will be lost.
	6	When the VM completes reboot, video is still in playing.
	7	Attach one real UE (datacard or cellphone) to the system, and access to the internet, such as watch a video on www.youku.com.
	8	Simulate some subscribers by the simulator.
	9	Discover the Host which serves the real UE.
	10	Power off the Host.
	11	Video is in playing without any interruption. And no subscriber will be lost.
Results Details:	The objective has been demonstrated.	
Lessons Learnt & Recommendations	In this scenario, it was confirmed that when one service VM is down, 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.	

Objective Id:	UC2/SCE6/1
Description:	Flexible Service Chaining Policy Definition
Pre-conditions	We constructed the network shown in Figure 1, vMME, vGW, vTC, vVAS are created and installed successfully by MANO. 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. Pre-define policy is configured by PCRF, and the policy itself is configured on vTC. Dynamic policy is configured by PCRF, and rules in policy are associated with Service Chain ID.
Procedure:	
	1 Service Chain ID and sequence of Service Chain are sent to Controller by Orchestrator.
	2 Controller generates Forwarding table according to information from Orchestrator.
	3 Service Chain ID will be sent to PCRF also.
	4 PCRF retrieve subscriber information by registering manually.
	5 IP-CAN session will be established when subscriber is active.
	6 If traffic matches policy, PCRF will send dynamic policy to PCEF.
	7 PCEF forward traffic tagged with Service Chain ID to Service vSwitch.
	8 Traffic will be sent to internet after processing by vVAS.
Results Details:	The objective has been demonstrated.
Lessons Learnt & Recommendations	In this scenario, it was confirmed that it is easy to add, modify or remove a Service Chain on MANO. It is convenient and zero-impact for network operator to deploy a new service with flexible Service Chaining.

B.2.2 PoC Contribution to NFV ISG

Use the table below to list any contributions to the NFV ISG resulting from this PoC Project.

Contribution	WG/EG	Work Item (WI)	Comments
A use case of deploying elastic EPC with SR-IOV technology	IFA	DGS/NFV-IFA001	IFA001 is already stable, so adding new content is not allowed. This contribution is cancelled.
Forwarding graph and forwarding path related information elements on Os-Ma-nfvo interface	IFA	DGS/NFV-IFA013 and maybe DGS/NFV-IFA012	Contribution "NFVIFA(15)0001559 IFA013 NFP management through NS update operation" issubmitted to address this topic. There is also a related contribution describing the interface requirements named “NFVIFA(15)0001198r1 IFA013 section 5.3 NFP related Network Service lifecycle management interface requirements”.
A use case of Service Chaining using SDN and potential requirements to SDN controller / MANO	EVE	DGS/EVE005	EVE005 is already stable, so adding new content is not allowed. This contribution is cancelled.
A test description example using TST002’s terminology and templates	TST	DGS/NFV-TST002	A contribution is being prepared aiming at adding test description examples to TST002’s annex.

B.2.3 Gaps identified in NFV standardization

Nothing in particular.

Gap Identified	Forum (NFV ISG, Other)	Affected WG/EG	WI/Document Ref	Gap details and Status

B.2.4 PoC Suggested Action Items

- Nothing in particular.

B.2.5 Any Additional messages the PoC Team wishes to convey to the NFV ISG as a whole?

- Nothing in particular.

B.2.6 Any Additional messages the PoC Team wishes to convey to Network Operators and Service Providers?

- Nothing in particular.