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# Orchestrated Assurance enabled by NFV

## 1 NFV ISG PoC Proposal

### 1.1 PoC Team Members

- PoC Project Name: Orchestrated Assurance enabled by NFV
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### 1.2 PoC Project Goals

The primary goal of the PoC is to show the value and benefits of using integrated fulfilment and assurance components as part of the orchestration, using YANG as overall data-modeling language.

Classical OSS systems fail in that assurance and fulfilment are done using stovepipe architectures, where individual network components are handled separately without any shared knowledge of the overall network service. The same problem is true for using different models in assurance and fulfilment. This PoC will show that orchestrating a network service should include both aspects and using a tight service model coupling.

The PoC will show that service KPIs can be bound to the orchestrated service and monitored by virtual probes. So not only is the NFV orchestrator configuring the VNFs representing the service but is also performing sibling provisioning of virtual probes that monitor the service.

The PoC will also show that YANG can be used as data-model language both for the NFVO and for the OSS. The YANG models will cover both fulfilment and assurance, including OSS as well as the NFV-MANO descriptors.

The PoC will use streaming video over HTTP as an example. However, the demonstration and findings of the PoC will be generalized to cover a broader range of services. The PoC will illustrate the value of employing holistic orchestration that incorporates both fulfilment and assurance using YANG, irrespective of the underlying network functions and the involved network services.

The project is executed in two phases. The first phase will contain only simulated network elements, whereas the second phase will include physical network elements as well as a distributed NFV PoP (D-NFV PoP).

The first phase of this PoC has the following goals:

- PoC Project Goal #1: Define YANG models for the MANO descriptors and all other aspects of the service lifecycle. This covers descriptors for the network service, the VNF forwarding graphs, the KPIs to be monitored and assured, as well as descriptors of on-demand actions to be taken by the VNFO.

- PoC Project Goal #2: Using simulated network elements, demonstrate a use case of quality assured orchestration of a network service based on L3VPN which is used to implement a streaming video service. Orchestration of virtualized active probes (vProbes) is included for service turn-up testing and on-going service assurance. The PoC is built around caching of video content closer to the end-users and how vProbes can be used to verify that service turn up is successful and that performance improvements are gained.
- PoC Project Goal #3: Explore and suggest monitoring and assurance parameters to expose over the Os-Ma-nfvo interface.

The second phase of this PoC has the following goals:

- PoC Project Goal #4: Demonstrate how distributed NFV PoPs are leveraged to host test and monitoring VNFs close to end-user locations.
- PoC Project Goal #5: Automate reconfiguration of network policies (bandwidth, QoS and path) based on quality parameters that are fed back from the test controller to the orchestrator in order to optimize the end-user experience of the network service. In this PoC, HTTP streaming video will be used as the end-user service.

## 1.3 PoC Demonstration

- A first demo is planned to be shown during the Big Telecom Event, McCormick Place, Chicago, USA, June 9-10, 2015.
- A complete demo is planned to be shown at the SDN & OpenFlow World Congress, Swissôtel Düsseldorf, Germany, Oct 13-16, 2015.

## 1.4 Publication

Publication of PoC results will be through a webinar scheduled for October 2015, hosted by Intel. The results will also be made available on Netrounds' and other team members' blog pages.

## 1.5 PoC Project Timeline

- |   |                 |
|---|-----------------|
| • What is the PoC start date?           | March 30, 2015  |
| • (First) Demonstration target date     | June 9-10, 2015 |
| • Second demo date                      | Oct 13-16, 2015 |
| • PoC Report target date                | Nov 30, 2015    |
| • When is the PoC considered completed? | Nov 30, 2015    |

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# 2 NFV PoC Technical Details

## 2.1 PoC Overview

Until now, a lot of the focus for many activities around ETSI NFV ISG has been around automated fulfilment and provisioning of network services. As ETSI NFV ISG has entered Phase 2, there is a shift in focus from orchestration of network services towards considerations related to end-user service assurance and end-to-end network performance.

Today's hardware-based test and measurement equipment (T&M) are not very well suited for usage in automated delivery processes built for virtualized services. Firstly, it is difficult to attach hardware devices in a virtual world, and secondly, it is not particularly agile and also very expensive to physically distribute required hardware T&M at required geographic locations.

Also, as virtualized network services might be reconfigured or logically reallocated and migrated in run-time in order to handle changing workloads, T&M capabilities also have to be capable of being migrated and reallocated in the same way. This is not possible with physical T&M.

Using virtualized probes (vProbes) instead of the hardware counterparts has the following advantages:

- Service assurance at the speed of software. The NFV Orchestrator instantiates vProbes with the same level of agility and programmability as any other resource in the NFV architecture required to implementing the service chain.
- Immediate feedback to the NFV Orchestrator. Using vProbe(s) attached to the user data plane provides insight from an end-user perspective on whether the service is performing according to agreed service levels. If not, this feedback can be used by the Orchestrator to take actions on re-configuring the network service to conform to expectations.
- Great cost reduction since COTS hardware can be used (and shared with others) instead of custom-built hardware solutions. This also allows for great coverage throughout the entire network infrastructure.
- A well-designed vProbe can be used for both service turn-up testing, as well as for periodic or on-going service monitoring, as opposed to traditional hardware solutions that are commonly aimed for either testing or monitoring.

In the NFV MANO framework documentation (ETSI GS NFV-MAN 001 V1.1.1 (2014-12) chapter 7.1.4) the interface for Network Service Management is defined, referred to as Os-Ma-nfvo. This PoC will suggest suitable service quality parameters to expose over this interface. Since this PoC is built around L3VPN and video services as a use case, specific parameters related to network performance and video quality will be suggested.

This is illustrated in Figure 1 below:

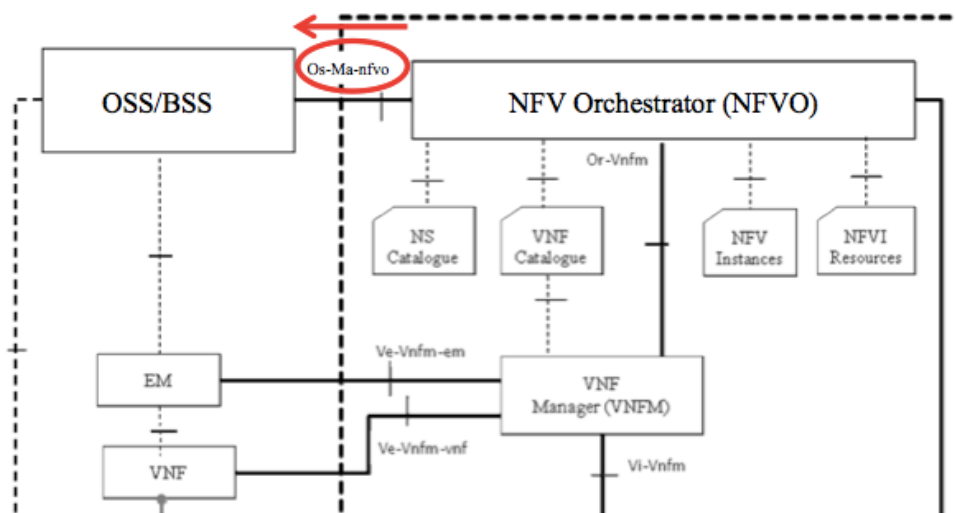


Figure 1. Interface for Network Service Performance Management, Os-Ma-nfvo

Methods for active monitoring of VNFs, NFVI and network services are currently being identified and developed in the NFVREL Work Group. In work item NFVREL004 “Active Monitoring and Failure Detection in NFV Environments”, three new components are currently suggested for the purpose of active monitoring; Test Controller (TC), Test Results Analysis Module (TRAM) and Virtual Test Agent (VTA), see Figure 2. In this PoC, the terms vProbe and VTA are used interchangeably.

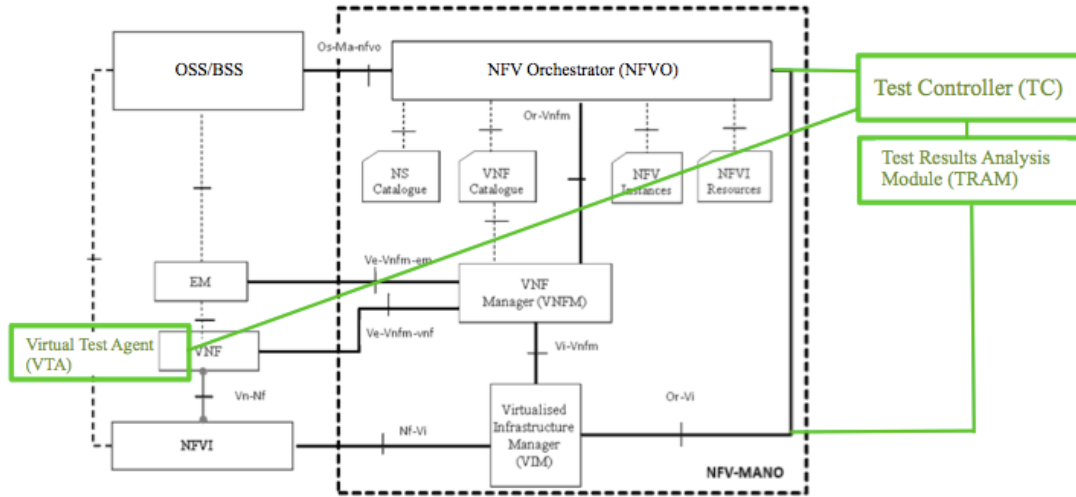


Figure 2. Three new components as suggested in NFV REL WG (TC, TRAM, VTA)

This PoC will have the NFVO orchestrating a complete network service chain for an HTTP video streaming service, including orchestration of virtual test agents, VTAs, as well as virtualized functions for content caching and firewalling.

## 2.2 PoC Scenarios

Figure 3 shows the generic view of the suggested PoC scenario. The main use case is to leverage content caching closer to the end-users to improve end-user experience of an HTTP video service, and at the same time provide active service monitoring. This applies to end-users connected over either mobile or fixed networks.

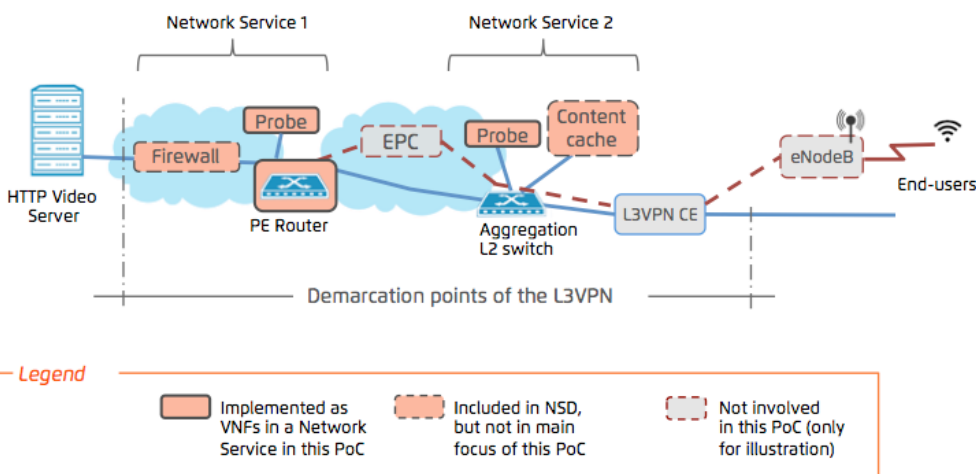


Figure 3. Generic view of the suggested PoC scenario.

In this PoC, the NFVO will instantiate the two network services shown in Figure 3, and the OSS will setup the overall interconnecting end-to-end L3VPN. Both the OSS and NFVO will be provided by Cisco in this PoC.

The following VNFs are in primary focus in this PoC:

1. **Two or more virtual Probes (vProbes)**, with support for active measurements of network performance, as well as HTTP video quality. In this PoC, Netrounds will provide the vProbes.
2. **A virtualized Provider Edge (vPE) router** that acts as the hub for the L3VPN that interconnects central HTTP servers producing video content with remote aggregation Customer Edge (CE) routers. The vPE will be provided by Cisco in this PoC.

The following VNFs are not the main focus, and should be seen as supporting building blocks to provide the complete network service chains:

3. **A virtualized and distributed content cache (vCache)** for video streams. Control and life cycle management of the vCache is out of scope for this PoC.
4. **A virtualized and central firewall (vFirewall)** to filter traffic going in and out of the L3VPN. Control and life cycle management of the vFirewall is out of scope for this PoC.

All the above VNFs will be setup by the NFV Orchestrator as two separate network services as shown below.

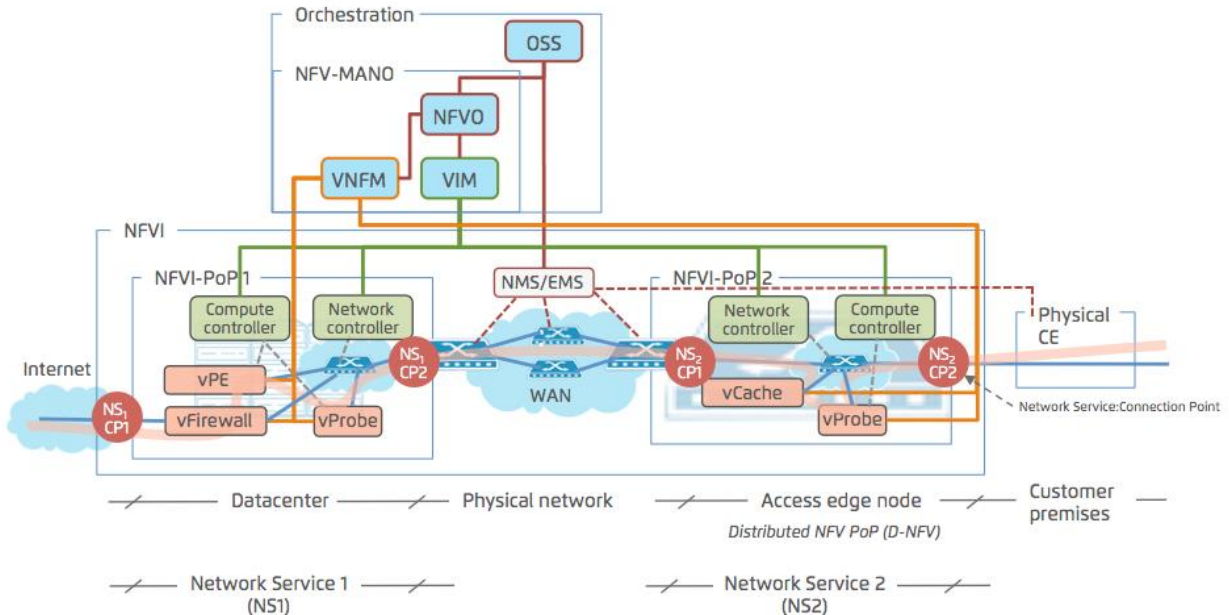
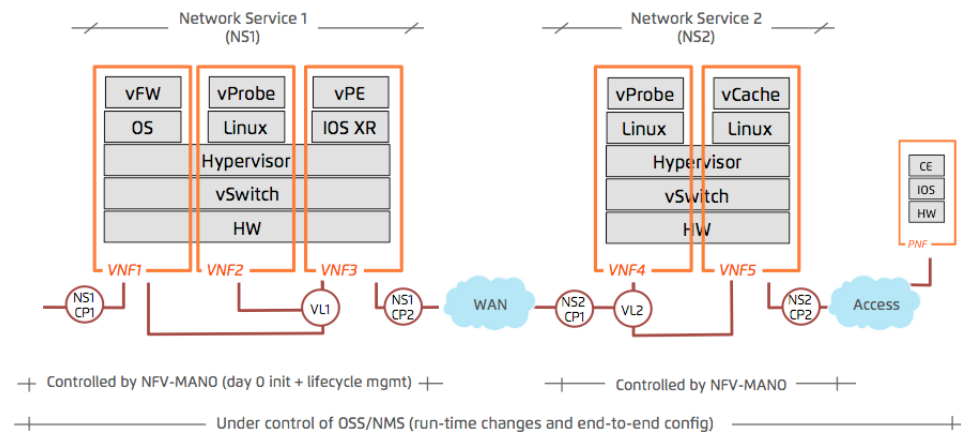


Figure 4. Illustration of the proposed scenario, with relation to OSS/NMS/EMS and NFV-MANO

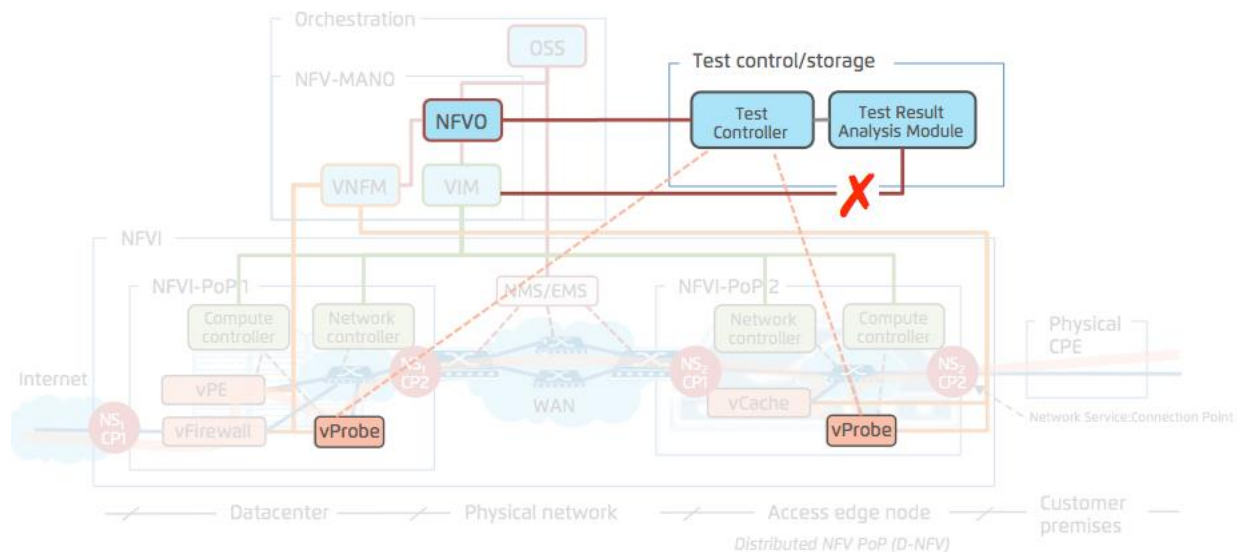
To better understand the suggested network services, Figure 5 shows how the various VNFs are interconnected to form the two resulting network services, NS1 and NS2. Note that NFV-MANO is responsible to instantiate VNF1 to VNF5 and to establish the Virtual Links between the Connection Points, CP1 and CP2, in the respective network service. VL1 and VL2 will be implemented completely inside the virtualized infrastructure by means of Openstack Neutron.

The PoC team recognizes that run-time changes, like adding a new physical CE spoke to the L3PVN, or reconfiguring a firewall rule, are within the responsibility of OSS/NMS, whereas NFV-MANO is responsible for making the initial setup, instantiation and lifecycle management of the VNFs and VLs.



**Figure 5. Illustration of the Network Connectivity Topology (NCT).**

In order to relate to on-going work in NFV REL WG, the vProbes will be remotely controlled from a centralized Test Controller (TC) that also acts Test Result Analysis Module (TRAM). This is illustrated in Figure 6.



**Figure 6. Relation between proposed PoC and on-going work in NFVREL WG**

There are a few deviations between the present PoC scenario and the concept proposed in NFVREL004:

- In this PoC, the TRAM does not extract infrastructure performance metrics from the VIM. The TRAM focuses on retrieving performance metrics from the VTAs (vProbes) only.

- The proposed steps for measurement execution might deviate, that is, the interaction between OSS-NFVO-TC-VTA might not be strictly the same as proposed. If so, this will be documented and explained.
- The Test Controller and the Virtual Test Agents will not comply with all suggested requirements at this stage. However, the focus for this PoC is on data-modeling of the network service, KPIs and on-demand actions, rather than the specific details of the TC and VTAs.

The vProbes will actively test and monitor the following aspects in the different phases of activation and assurance:

	Fulfilment / Activation	Assurance
L3VPN (Network performance)	<ul style="list-style-type: none"> <li>• TCP performance tests (RFC6349)</li> <li>• Service activation tests (Y.1564)</li> <li>• Max achievable TCP rate</li> <li>• Max achievable UDP rate</li> <li>• Verify expected QoS profile, shaping, policing and marking</li> <li>• Verify DSCP policy mapping</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring of low-rate UDP streams in multiple classes (loss, jitter, delay)</li> </ul>
Video service (Video performance)	<ul style="list-style-type: none"> <li>• DNS lookup</li> <li>• HTTP caching performance</li> <li>• Current video playback rate</li> <li>• HTTP segment download rate</li> <li>• Buffer underrun events</li> <li>• Bit-rate selection events</li> </ul>	<ul style="list-style-type: none"> <li>• Current video playback rate</li> <li>• HTTP segment download rate</li> <li>• Buffer underrun events</li> <li>• Bit-rate selection events</li> </ul>

During the first stage of this PoC, Cisco and Netronds will carry out most of the actual activity within the PoC team. Cisco will focus on the OSS and NFV-MANO Orchestration, whereas Netronds will handle the vProbes and the TC/TRAM part. As shown in Figure 7, during the first phase, the OSS configures a complete end-to-end service including a physical CE and Probe. There is no vCache or vFirewall in the first phase.

The idea is to use YANG as a modelling language to describe the network service (VNFs, VNFFG, VLs), as well as KPIs and on-demand actions. Heat Orchestration Templates (HOT) will be used for launching the vProbe and vPE in an Openstack lab environment.

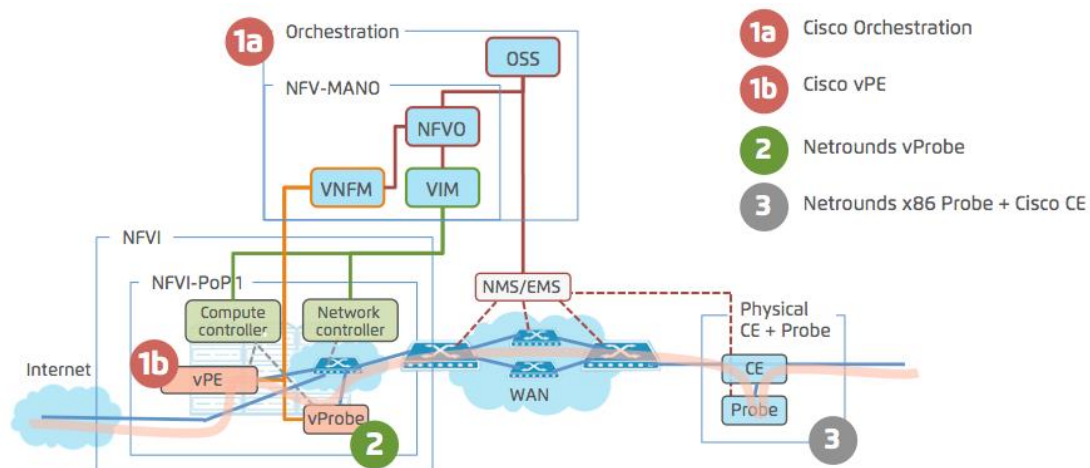


Figure 7. First stage – vPE and vProbe in Openstack (no D-NFV, vCache or vFirewall)

Once the goals have been achieved in the first phase, the PoC will expand its scope and include the following as illustrated in Figure 8:

- Cisco provides the vPE as well as the overall orchestration of the network service and all required VNFs.
- Netronds provides vProbes for service quality measurements and assurance.

- Telco Systems provide a Cloud Metro node to provide a distributed NFVI-PoP that will host both a vProbe as well as a vCache.
- Orange provides the central NFVI-PoP (similar to a real-world data center location).
- A vFirewall is included at the NFVI-PoP1.
- Intel provides support, knowledge and recommendations for hardware used in either of the NFVI-PoPs.

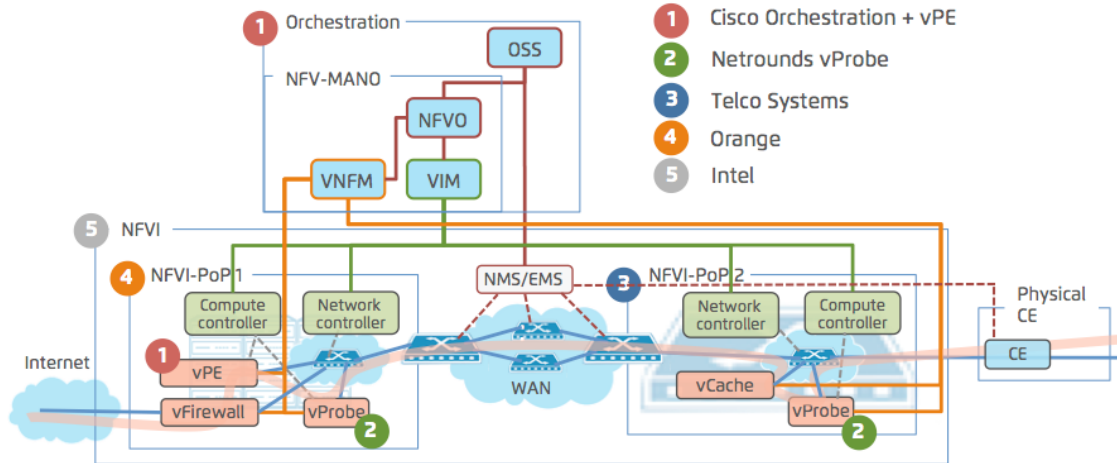


Figure 8. Second stage – expanded scope using real D-NFV equipment.

## 2.3 Mapping to NFV ISG Work

Describe how this PoC relates to the NFV ISG work:

	Use Case	Requirement	E2E Arch	Comments
<b>Scenario 1</b>	UC#2: Virtual Network Function as a Service (VNaaS)	GS NFV 004, Chapter 5.3, Performance Requirements [Per.1]  NFV REL004, Chapter 5, Impact of NFV on active monitoring	NFVO VNFM VIM	This scenario proves that virtualized service assurance can be offered as a VNaaS, where the performance of the deployed service is reliably assessed without using physical test equipment.
<b>Scenario 2</b>	UC#4: VNF Forwarding Graphs	GS NFV 004, Chapter 5.3, Performance Requirements [Per.1]  NFV REL004, Chapter 5, Impact of NFV on active monitoring	NFVO VNFM VIM	This scenario shows how virtual test agents (VTA) or virtual probes (vProbes) can be used as a fundamental component to be part of each VNFFG that is orchestrated.



## 2.4 PoC Success Criteria

Successfully demonstrate orchestration of an assured NFV network service for HTTP video streaming using vProbes. The network service will also contain a L3VPN to interconnect the video source with the end users. The vProbes will measure caching performance metrics and video quality as well as network performance, which will make it possible to determine whether the orchestration of the video service was successful from an end-user perspective. If measurement results are not within acceptable limits, the orchestrator will take actions to adjust and re-apply its configuration, thereby effectively closing the loop between fulfilment and assurance.

## 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 validated and proven YANG model for the Network Service Descriptor (NSD), including a VNF forwarding graph (VNFFG), KPIs and on-demand actions. Contributed to work item DGS/NFV-IFA014.
- PoC Project Contribution #2: Best practises on orchestrating network services along with active network monitoring probes. Contributed to work item DGS/NFV-REL004.
- PoC Project Contribution #3: Suitable monitoring and assurance parameters to expose over the Os-Ma-nfvo interface. Contributed to work item DGS/NFV-IFA013 and maybe IFA012.
- PoC Project Contribution #4: Active measurement results of video quality improvements using virtual probes and virtual caches close to end-user locations. Including a VNF Descriptor (VNFD) suitable as a “Test VNFD”, where considerations on HTTP streaming video are taken. Contributed to work item DGS/NFV-IFA011.