Virtualised service assurance management in vGi-LAN

The following normative disclaimer shall be included on the front page of a PoC report:

> *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

Indicate the PoC Project Status. Can the PoC be considered completed? If this is a multi-stage PoC project, indicate the Reported Stage status and plans for future Project Stages.

- Overall PoC Project Completion Status:
  Completed

B.1.2 NFV PoC Project Participants

PoC Project Name: Virtualised service assurance management in vGi-LAN

- Network Operators/ Service Providers: Telenor — Contact: Pal.Gronsund@telenor.com
- Manufacturer A: Intel — Contact: brendan.ryan@intel.com
- Manufacturer B: Brocade — Contact: tepkes@brocade.com
- Manufacturer C: Creanord — Contact: antti.pappila@creanord.com

B.1.3 Confirmation of PoC Event Occurrence

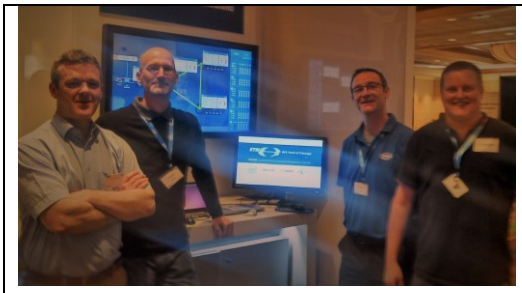
To be considered complete, the PoC should have been physically demonstrated with evidence provided that the demonstration has taken place.

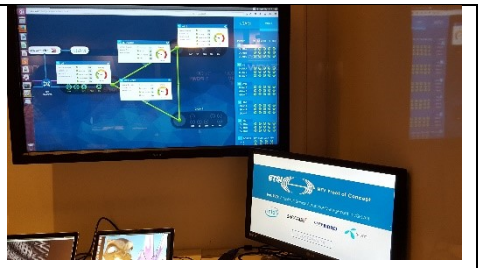
Provide details on venue and content of PoC demonstration event. Provide pictures and supporting literature where available. Please identify who was present at the demonstration event.

- PoC Demonstration Event Details: NFV World Congress, San Jose (20-22 April 2016)

  Attendees:
  Intel: Brendan Ryan, Rory Browne
  Brocade: Tim Epkes
  Creanord: Antti Pappila, Jari Augustin

See pictures below of the PoC demo station at the NFV World Congress event.





Below is a description of the PoC on the Brocade web-site, copies of which were provided to demo visitors.

http://community.brocade.com/t5/SDN-NFV/Service-Aware-Transport-for-Multi-site-NFV-Resiliency/ba-p/84943

Rory Browne of Intel also referenced the PoC as part of his keynote on Telco-grade service chaining - "Service Assurance Horizontal informs the Control Plane"

http://www.layer123.com/download&doc=Intel-0416-Browne-Telco_Grade_Service_Chaining

B.1.4 PoC Goals Status Report

Specify PoC Goals from NFV ISG PoC Proposal (clause A.1.2). Identify any changes from the original NFV ISG PoC Proposal with an explanation as to why the changes were made. Indicate the extent that each goal was met. Provide sufficient information for those not familiar with the PoC goals to understand what has been achieved and/or learned.

- *PoC Project Goal #1:* Demonstrate implementation of a TRAM (Test Results Analysis Module) as described in NFVREL004 where NFVI-PoP interconnect performance metrics are gathered from VTA's (vProbes) and provided to a service chaining application in correlation with NFVI performance metrics to enable intelligent decisions as regards placement of service chains on vGi-LAN resources across multiple sites.
    - *Goal Status:* Demonstrated and met.

B.1.5 PoC Feedback Received from Third Parties

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

The team received a lot of positive feedback on the demo at NFV World Congress where the PoC was demonstrated to several service providers as well as various software and equipment vendors. General feedback was that concept is innovative and will enhance service assurance for NFV deployments.

The following is more specific feedback received from customers:

- the concept of vSAM (virtualized service assurance manager) monitoring is welcome as not much work has been done on how to monitor and trigger recovery of service chains.
- monitoring of service chains and their entities make it more viable to deploy VNF service chaining in a production environment
- several customers wished to know when the technology would be available to use in their NFV deployments

B.2 NFV PoC Technical Report

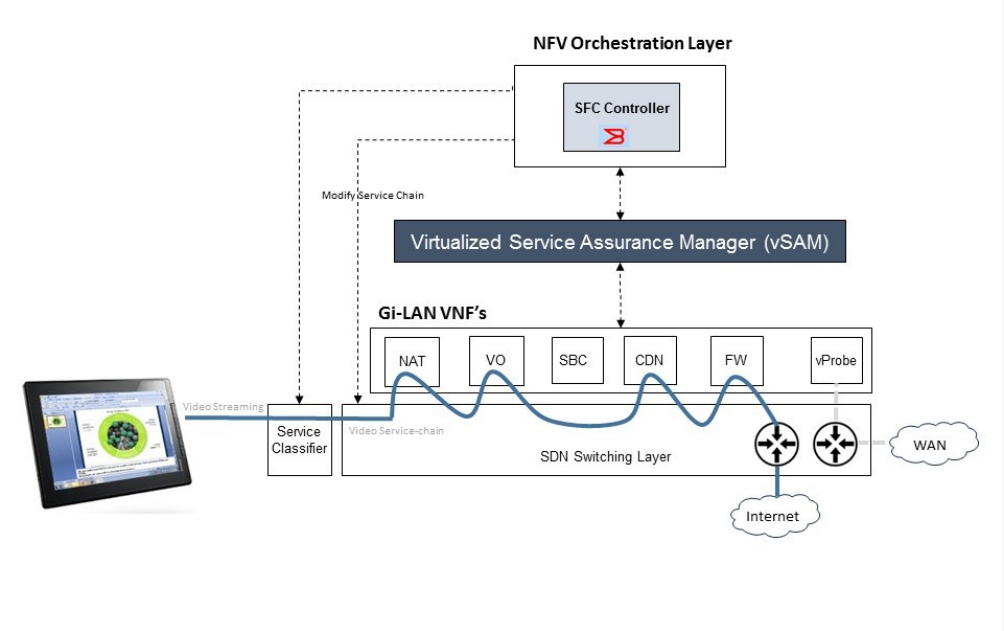
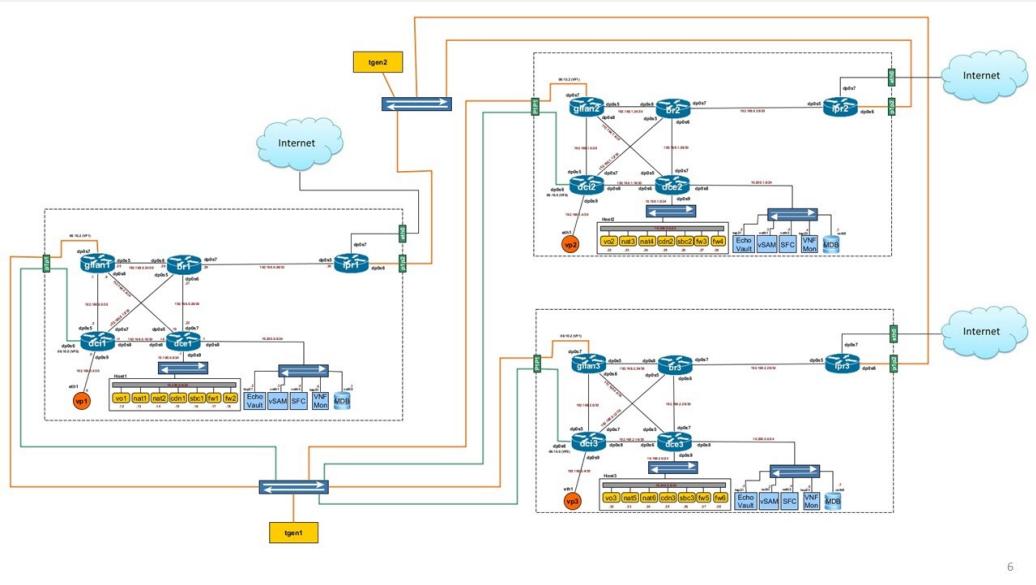
PoC Teams are encouraged to provide technical details on the results of their PoC using the PoC Scenario Report template below.

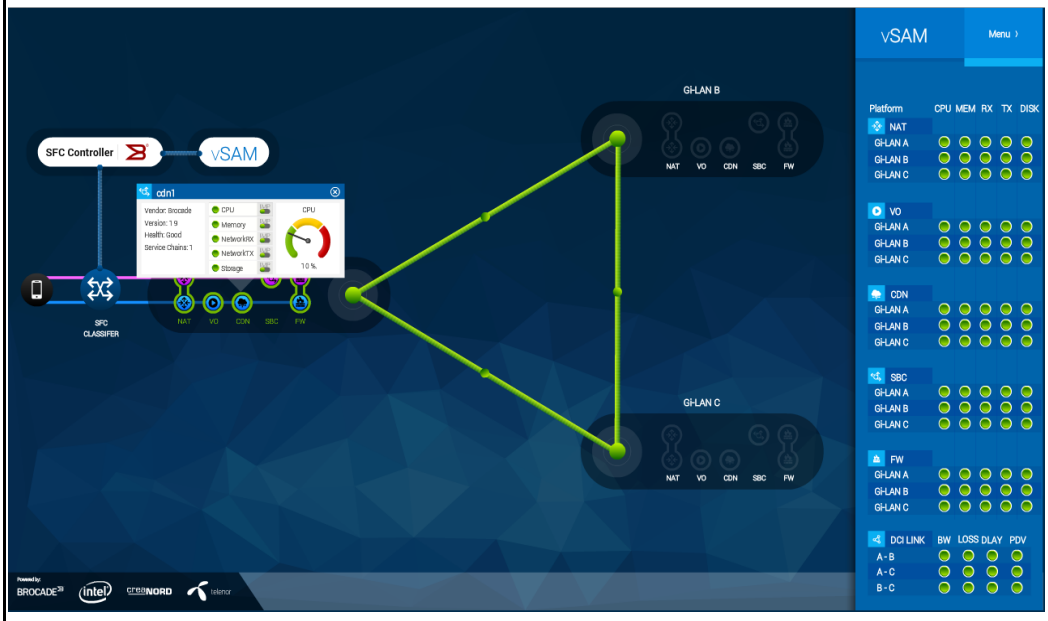
B.2.1 PoC Scenario Report

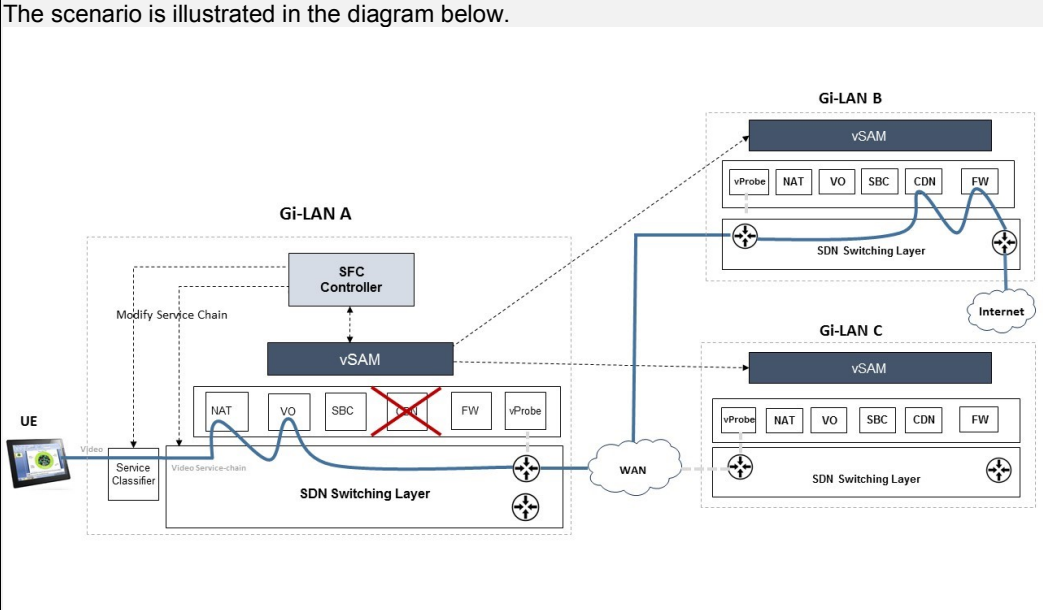
Use the table structure below and refer back to the Scenarios in the NFV ISG PoC Proposal (clause A.2.2) and provide information for each of them. Feel free to include additional Scenarios developed during the implementation of the PoC. Do not eliminate Scenarios that were not performed, instead provide a brief status for each with a reason why the scenario was not performed. Do not hesitate to fill multiple instances of the table if several objectives have been demonstrated for each scenario.

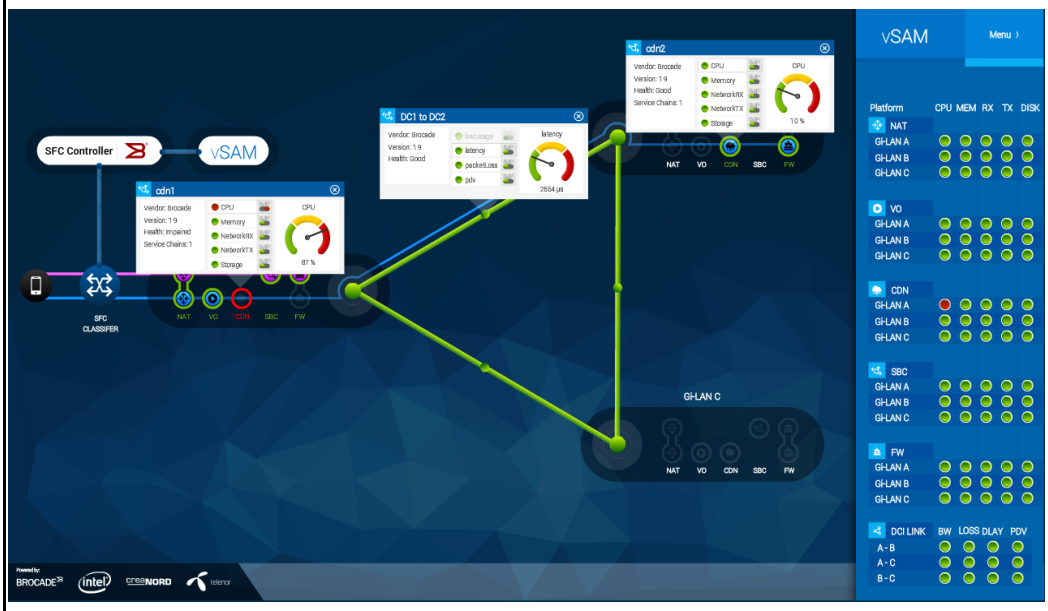
The following scenarios were demonstrated:

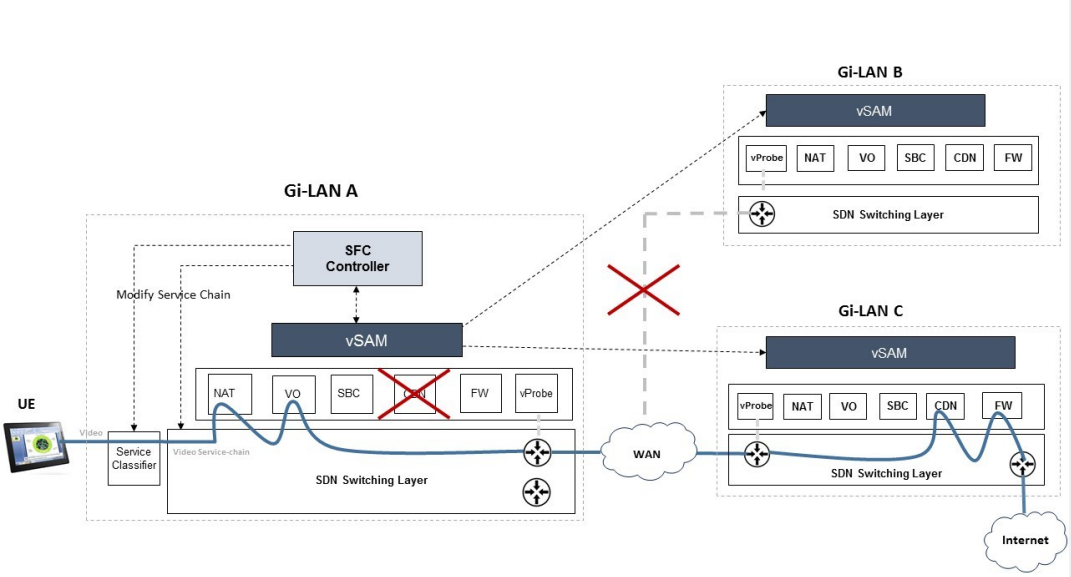
- SCE1: End-to-end video service provided through Gi-LAN VNF service chaining
- SCE2: Automatic adaptation of service chains on detection of VNF KPI violation
- SCE3: Automatic adaptation of service chains on detection of inter-site WAN link KPI violation

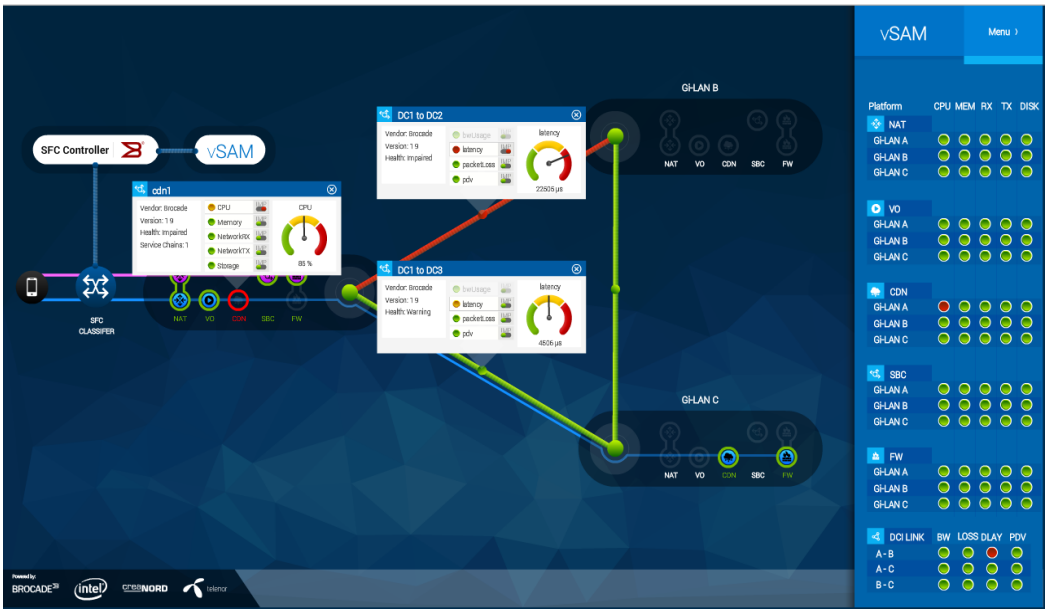
Objective Id:	**SCE1**
Description:	**End-to-end video service provided through Gi-LAN VNF service chaining** This scenario demonstrates how an end-to-end video service may be provided by service chaining of VNF's in a typical vGi-LAN deployment. The scenario is illustrated in the diagram below. 
Pre-conditions	A multi-site vGi-LAN simulation is running on three Intel Xeon servers with voice and video service chains controlled by the Brocade service chaining controller and classifier and KPI monitoring by the virtualized service assurance manager (vSAM). A HTTP Live video stream is being generated by an Nginx server for each vGi-LAN site. The video streams are in synch with an overlay caption to indicate the location of the CDN which is providing the video stream. A Wireless Access Point has been set up to allow a tablet device to access the live video stream from the Gi-LAN simulation environment. A GUI front end displays the status of VNF health, Gi-LAN site interconnect link health and service chain paths. A diagram of the vGi-LAN simulation environment is shown below 

Procedure:	**1**	VLC player is started on the tablet device and a request is initiated to connect to the live video stream
	2	The request is routed to Gi-LAN vRouter on Gi-LAN A which does an initial classification of the flow, identifies that the flow should be routed via a service chain, and routes to the DCE (data centre edge) vRouter
	3	The DCE vRouter classifies the traffic as video. Based on vSAM the local NAT VNF is healthy so the DCE vRouter has been instructed by SFC controller to route all video traffic to the local NAT as the head-end VNF for the video service chain
	4	The NAT VNF receives video stream packets and forwards to the next-hop VNF on the video service chain. Based on vSAM the local Video-Optimizer VNF is healthy so the SDN Switching layer has been instructed by SFC controller to route video traffic form the NAT to the local Video-Optimizer VNF.
	5	As all local VNF's are healthy the video stream flow is similarly routed hop-by-hop through local CDN and FW VNF's to the tail-end of the video chain and routed out through the Internet Peering Router to an Nginx server which is the source of a live video stream for Gi-LAN A.
	6	A connection is established to the Nginx server and the live video stream is routed back in reverse direction through the vRouters and service chain to the user equipment
Results Details:	The video stream plays on the VLC player on the tablet device with caption Gi-LAN A, and the GUI indicates that there is traffic passing through the virtual network interfaces of the video service chain VNF's in Gi-LAN A. A screen shot of the GUI is shown below which indicates that all VNF's are health and thus the default service chain path for video traffic is applied by the SFC controller. 	
Lessons Learnt & Recommendations	A video streaming service may be effectively provided through SDN service chaining in a vGi-LAN NFV environment and furthermore such control plane separation may enable granular control of a service chain through integration of a virtualized service assurance manager.	

Objective Id:	**SCE2**	
Description:	**Automatic adaptation of service chains on detection of VNF KPI violation** This scenario demonstrates automatic adaptation of Gi-LAN VNF Service Chaining to address a VNF KPI violation. The video service chain path initially uses VNF's on the local site. A UE accesses a video steaming service provided by a vGi-LAN service chain which shows the Gi-LAN A caption (as the Gi-LAN A CDN is being used). vSAM detects CPU overload in the local CDN VNF and alerts the SFC controller, which re-routes the service chain path to use the CDN VNF on Gi-LAN B. The scenario is illustrated in the diagram below.  	
Pre-conditions	A multi-site vGi-LAN simulation is running on three Intel Xeon servers with voice and video service chains controlled by the Brocade service chaining controller and classifier and KPI monitoring by the virtualized service assurance manager (vSAM). A HTTP Live video stream is being generated by an Nginx server for each vGi-LAN site. The video streams are in synch with an overlay caption to indicate the location of the CDN which is providing the video stream. A Wireless Access Point has been set up to allow a tablet device to access the live video stream from Gi-LAN simulation environment. A GUI front end displays the status of VNF health, Gi-LAN site interconnect WAN link health and service chain paths. All VNF's and Gi-LAN site interconnect links are initially in a healthy condition, so the Gi-LAN An overlay caption is being displayed on the VLC player running on the UE (tablet device). The CDN VNF is configured with a maximum CPU usage threshold of 85%.	
Procedure:	1	VLC player on the tablet device is connected to Gi-LAN A and receiving the live video stream with Gi-LAN A overlay caption as the CDN VNF on Gi-LAN A is initially being used to route the video stream.
	2	The CDN VNF on Gi-LAN is impaired by forcing its CPU usage to greater than 85% using the Linux "stress" utility program.
	3	vSAM detects that Gi-LAN A CDN has exceeded its maximum CPU usage threshold and notifies the SFC controller that an alternate service chain path is required. Based on KPI values in the vSAM repository for the Gi-LAN B CDN VNF and the link between Gi-LAN A and B, the SFC controller determines that the video service chain path should be routed from the Video Optimizer on Gi-LAN A to the CDN on Gi-LAN B.
	4	The SFC controller changes the next-hop route in the uplink direction for Gi-LAN A VO to Gi-LAN B CDN. The SFC also changes the next-hop route in the downlink direction for the CDN on Gi-LAN B to the VO on Gi-LAN A.

Results Details:	The service chain path change is reflected in the GUI (as shown below). The video stream continues to play on the VLC player on the tablet device, but now shows the caption Gi-LAN B, which indicates that the video traffic is now traffic passing through the CDN on Gi-LAN B. 
Lessons Learnt & Recommendations	Service continuity and resilience to Gi-LAN VNF failures may be enhanced through use of a virtualized service assurance manager which has the capability to monitor VNF's and site interconnect link KPI's in real time across a number of Gi-LAN sites and to inform an SFC controller to perform remedial actions to adapt service chain paths to alleviate an overloaded VNF by using an alternate VNF on another Gi-LAN site.

Objective Id:	**SCE3**	
Description:	**Automatic adaptation of service chains on detection of inter-site WAN link KPI violation** This scenario demonstrates automatic adaptation of Gi-LAN VNF Service Chaining to address a Gi-LAN site interconnect WAN link KPI violation. The video service chain path initially spans from Gi-LAN VO to Gi-LAN B CDN. A UE accesses a video steaming service provided by a vGi-LAN service chain which shows the Gi-LAN B caption (as Gi-LAN B CDN is being used). vSAM detects a KPI threshold violation on the WAN link between Gi-LAN A and Gi-LAN B and alerts the SFC controller, which re-routes the service chain path to use the CDN VNF on Gi-LAN C. The scenario is illustrated in the diagram below.  	
Pre-conditions	A multi-site vGi-LAN simulation is running on three Intel Xeon servers with voice and video service chains controlled by the Brocade service chaining controller and classifier and KPI monitoring by the virtualized service assurance manager (vSAM). A HTTP Live video stream is being generated by an Nginx server for each vGi-LAN site. The video streams are in synch with an overlay caption to indicate the location of the CDN which is providing the video stream. A Wireless Access Point has been set up to allow a tablet device to access the live video stream from Gi-LAN simulation environment. A GUI front end displays the status of VNF health, Gi-LAN site interconnect link health and service chain paths. The video service chain path initially is spanning from Gi-LAN VO to Gi-LAN B CDN, so the Gi-LAN B overlay caption is being displayed on the VLC player running on the UE (tablet device). The WAN link between Gi-LAN A and Gi-LAN B is configured with a maximum latency threshold of 5ms.	
Procedure:	1	VLC player on the tablet device is connected to Gi-LAN A and receiving the live video stream with Gi-LAN B overlay caption as the CDN VNF on Gi-LAN B is initially being used to route the video stream.
	2	The link between Gi-LAN site A and B is impaired by forcing its latency to greater than 5ms using Linux “traffic control netem” commands.
	3	vSAM detects that the link between Gi-LAN A and Gi-LAN B has exceeded its maximum latency threshold and notifies the SFC controller that an alternate service chain path is required. Based on KPI values in the vSAM repository for the Gi-LAN C CDN VNF and the link between Gi-LAN A and C, the SFC controller determines that the video service chain path should now be routed from the Video Optimizer on Gi-LAN A to the CDN on Gi-LAN C.

	4	The SFC controller changes the next-hop route in the uplink direction for Gi-LAN A VO to Gi-LAN C CDN. The SFC also communicates with the CDN on Gi-LAN C to change its next-hop route in the downlink direction to the VO on Gi-LAN A.
Results Details:	The service chain path change is reflected in the GUI (as shown below). The video stream continues to play on the VLC player on the tablet device, but now shows the caption Gi-LAN C, which indicates that the video traffic is now traffic passing through the CDN on Gi-LAN C. 	
Lessons Learnt & Recommendations	Service continuity and resilience to Gi-LAN VNF failures may be enhanced through use of a virtualized service assurance manager which has the capability to monitor VNF's and site interconnect link KPI's in real time across a number of Gi-LAN sites and to inform an SFC controller to perform remedial actions to adapt service chain paths to avoid use of a sub-optimal inter-site link by using an alternate link to another Gi-LAN site.	

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
NFVREL(16)000003	REL	ETSI GS NFV-REL004 V0.2.0 - Report on Active Monitoring and Failure Detection	The team contributed a section on "Active Monitoring of Service Chains" to this work item

B.2.3 Gaps identified in NFV standardization

Use the table below to indicate Gaps in standardization identified by this PoC Team including which forum(s) would be most relevant to work on closing the gap(s).Where applicable, outline any action(s) the NFV ISG should take.

No additional gaps were identified.

B.2.4 PoC Suggested Action Items

Provide suggested Action Items and/or further work required from the NFV ISG and/or external forums.

No additional suggestions.

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

Please indicate whether the team wishes any specific message to be published or publically quoted.

- As a PoC team we would like to thank you for the opportunity to run an ETSI PoC. We believe that the concept of "Virtualized Service Assurance Management" is a valuable one that can enhance availability and resilience of service chains for NFV deployments.

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

Are there any specific requests/messages that the team would like to convey to Network Operators and Service Providers?

- To run service chains in a production environment this minimal level of monitoring (and more) of service chain entities is required.
- Additional uses cases such as Maintenance procedures and VNF growth could use these concepts to ensure 5 x 9's reliability.

Glossary

CDN	Content Delivery Network
FW	Firewall
KPI	Key Performance Indicator
NAT	Network Address Translation
NFV	Network Function Virtualization
SBC	Session Border Controller
SFC	Service Function Controller
VNF	Virtual Network Function
VO	Video Optimizer
vSAM	Virtualized Service Assurance Manager
WAN	Wide Area Network