Container4NFV

Release Latest

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CHAPTER 1

Container4NFV Gap Analysis

Project Container4NFV, https://wiki.opnfv.org/display/OpenRetriever/Container4NFV

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Abstract This document provides the users with top-down gap analysis regarding OpenRetriever feature requirements with OPNFV Installer, OpenStack Official Release and Kubernetes Official Release.

1.1 Container4NFV architecture options

Analyzis of the architecture options were moved to the Container4NFV wiki.

1.2 Container4NFV Gap Analysis with OPNFV Installer

This section provides users with Container4NFV gap analysis regarding feature requirement with OPNFV Installer in Danube Official Release. The following table lists the use cases / feature requirements of container integrated functionality, and its gap analysis with OPNFV Installer in Danube Official Release. OPNFV installer should support them.

Use Case / Requirement	Supported in Danube	Notes
Use Openstack Magnum to install container environment	No	Magnum is supported in Openstack Official Re
Use Openstack Ironic to supervise bare metal machine	No	Container could be installed in bare metal mach
Use Openstack Kuryr to provide network for container	No	Container has its own network solution. Contai

1.3 Container4NFV Gap Analysis with OpenStack

This section provides a gap analyzis between the targets of Container4NFV for release Euphrates (E) or later and the features provided by OpenStack in release Ocata. As the OPNFV and OpenStack releases tend to change over time this analyzis is planned to be countinously updated. During the analyzis all OpenStack projects considered.

(Editors note: Maybe we should define a scope of OpenStack projects which is considered. All OpenStack projects can mean anything.)

The following table lists the use cases / feature requirements of container integrated functionality, and its gap analysis with OpenStack.

Use Case / Requirement	Related OpenStack project	Notes
Manage container and virtual machine lifecycle with the same NB API	Zun or nova-docker driver	Magnum can deploy a Con
Container private registry to store container images	Swift, Cinder, Glance, Glare	Container images need a st
Kuryr needs to support MACVLAN and IPVLAN	Kuryr	Using MACVLAN or IPVI
Kuryr Kubernetes integration is needed	Kuryr	It is done in the frame of C
HA support for Kuryr	Kuryr	
HA support for Zun	Zun	

1.4 Container4NFV Gap Analysis with Kubernetes v1.5

This section provides users with Container4NFV gap analysis regarding feature requirement with Kubernetes Official Release. The following table lists the use cases / feature requirements of container integrated functionality, and its gap analysis with Kubernetes Official Release.

Use Case / Requirement	Supported in v1.5	Notes
Manage conainter and virtual ma-	No	There are some ways how Kuber-
chine in the same platform.		netes could manage VM-s:
		1. Kubevirt
		2. Kubernetes can start rkt and
		with rkt it is possible to start
		VM-s
		3. Virtlet
		4. Hypercontainer
Kubernetes support multiple net-	No	As VNF needs at least three inter-
works.		faces. Management, control plane,
		data plane. CNI already supports
		multiple interfaces in the API defi-
		nition.
		1. Multus
		2. CNI-Genie
		3. A solution built into Kuber-
		netes
Kubernetes support NAT-less con-	No	SIP/SDP and SCTP are not working
nections to a container		with NAT-ed networks
Kubernetes scheduling support CPU	No	The kubernetes schedular don't sup-
bindingNUMA features		port these features

Continued on next page

Use Case / Requirement	Supported in v1.5	Notes
DPDK need to support CNI	No	DPDK is the technology to acceler-
		ate the data plane. Container need
		support it, the same with virtual ma-
		chine.
SR-IOV can support CNI (Optional)	No	SR-IOV could let container get high
		performance

CHAPTER 2

Container4NFV Release Notes

2.1 Container4NFV E release Notes

- 1. Gap analysis for openstack,kubernetes,opnfv installer
- 2. Container architecture options
- 3. Joid could support Kubernetes
- 4. Using vagrant tool to setup an env with DPDK enabled.

2.2 Container4NFV F release Notes

- 1. Enable Multus in Kubernetes
- 2. Enable SR-IOV in Kubernetes
- 3. Support ARM platform

CHAPTER 3

Container4NFV User Guide

3.1 Installation

This quickstart shows you how to easily install a Kubernetes cluster on VMs running with Vagrant. You can find the four projects inside *container4nfv/src/vagrant* and their documentation: - kubeadm_basic: weave.rst - kubeadm_multus: multus.rst - kubeadm_ovsdpdk: ovs-dpdk.rst - kubeadm_virtlet: virtlet.rst

Vagrant is installed in Ubuntu 16.04 64bit. vagrant is to create kubernetes cluster using kubeadm. kubernetes installation by kubeadm can be refered to https://kubernetes.io/docs/getting-started-guides/kubeadm.

3.2 e release

3.2.1 Vagrant Setup

sudo apt-get install -y virtualbox wget –no-check-certificate https://releases.hashicorp.com/vagrant/1.8.7/vagrant_1.8.7_x86_64.deb sudo dpkg -i vagrant_1.8.7_x86_64.deb

3.2.2 K8s Setup

git clone http://gerrit.opnfv.org/gerrit/container4nfv -b stable/euphrates cd container4nfv/src/vagrant/k8s_kubeadm/ vagrant up

3.2.3 Run K8s Example

vagrant ssh master -c "kubectl apply -f /vagrant/examples/virtio-user.yaml"

3.2.4 K8s Cleanup

vagrant destroy -f

3.3 f release

3.3.1 Vagrant Setup

1. setup_vagrant.sh may install all for you. The project uses vagrant with libvirt as default because of performance.

` container4nfv/src/vagrant# ./setup_vagrant.sh `

Consequently, we need to reboot to make libvirtd group effective.

2. Deploy:

To test all the projects inside *vagrant/* just run the next script:

```
` container4nfv/ci# ./deploy.sh `
```

3.4 Senario:

3.4.1 k8-nosdn-nofeature-noha

Using Joid to deploy Kubernetes in bare metal machine https://build.opnfv.org/ci/job/ joid-k8-nosdn-nofeature-noha-baremetal-daily-euphrates/lastBuild/

3.4.2 k8-nosdn-lb-noha

Using Joid to deploy Kubernetes in bare metal machine with load balance enabled https://build.opnfv.org/ci/job/ joid-k8-nosdn-lb-noha-baremetal-daily-euphrates/

3.5 YardStick test Cases

3.5.1 opnfv_yardstick_tc080

measure network latency between containers in k8s using ping https://git.opnfv.org/yardstick/tree/tests/opnfv/test_cases/opnfv_yardstick_tc080.yaml

3.5.2 opnfv_yardstick_tc081

measure network latency between container and VM using ping https://git.opnfv.org/yardstick/tree/tests/opnfv/test_cases/opnfv_yardstick_tc081.yaml

3.6 Multus implementation for OPNFV

This quickstart shows you how to easily install a Kubernetes cluster on VMs running with Vagrant. The installation uses a tool called kubeadm which is part of Kubernetes.

kubeadm assumes you have a set of machines (virtual or bare metal) that are up and running. In this way we can get a cluster with one master node and 2 workers (default). If you want to increase the number of workers nodes, please check the Vagrantfile inside the project.

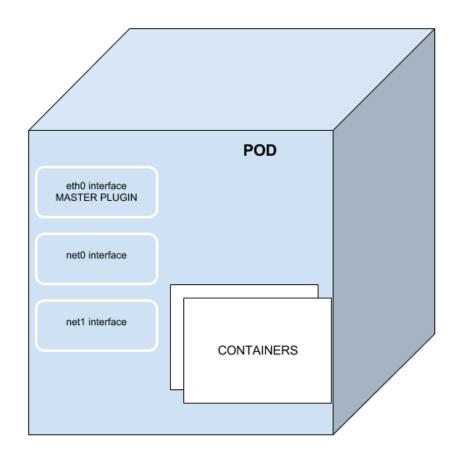
3.6.1 About Multus

[Multus](https://github.com/Intel-Corp/multus-cni) is a CNI proxy and arbiter of other CNI plugins.

With the help of Multus CNI plugin, multiple interfaces can be added at the same time when deploying a pod. Notably, Virtual Network Functions (VNFs) are typically requiring connectivity to multiple network interfaces.

The Multus CNI has the following features: - It is a contact between the container runtime and other plugins, and it doesn't have any of its own net configuration, it calls other plugins like flannel/calico to do the real net conf. job. - Multus reuses the concept of invoking the delegates in flannel, it groups the multi plugins into delegates and invoke each other in sequential order, according to the JSON scheme in the cni configuration. - No. of plugins supported is dependent upon the number of delegates in the conf file. - Master plugin invokes "eth0" interface in the pod, rest of plugins(Mininon plugins eg: sriov,ipam) invoke interfaces as "net0", "net1"... "netn". - The "masterplugin" is the only net conf option of Multus cni, it identifies the primary network. The default route will point to the primary network.

3.6.2 Multus example



3.7 Nginx implementation for OPNFV

This quickstart shows you how to easily install a Kubernetes cluster on VMs running with Vagrant. The installation uses a tool called kubeadm which is part of Kubernetes.

kubeadm assumes you have a set of machines (virtual or bare metal) that are up and running. In this way we can get a cluster with one master node and 2 workers (default). If you want to increase the number of workers nodes, please check the Vagrantfile inside the *kubeadm_basic/*.

3.7.1 About Nginx

Nginx is a web server which can also be used as a reverse proxy, load balancer and HTTP cache.

3.8 Ovsdpdk implementation for OPNFV

This quickstart shows you how to easily install a Kubernetes cluster on VMs running with Vagrant. The installation uses a tool called kubeadm which is part of Kubernetes.

kubeadm assumes you have a set of machines (virtual or bare metal) that are up and running. In this way we can get a cluster with one master node and 2 workers (default). If you want to increase the number of workers nodes, please check the Vagrantfile inside the project.

3.8.1 About OvS-dpdk

Open vSwitch* with the Data Plane Development Kit [OvS-DPDK](http://openvswitch.org/) is a high performance, open source virtual switch.

Using DPDK with OVS gives us tremendous performance benefits. Similar to other DPDK-based applications, we see a huge increase in network packet throughput and much lower latencies.

3.9 Clearwater implementation for OPNFV

CONTAINER4NFV setup a Kubernetes cluster on VMs running with Vagrant and kubeadm.

kubeadm assumes you have a set of machines (virtual or bare metal) that are up and running. In this way we can get a cluster with one master node and 2 workers (default). If you want to increase the number of workers nodes, please check the Vagrantfile inside the project.

Is Clearwater suitable for Network Functions Virtualization?

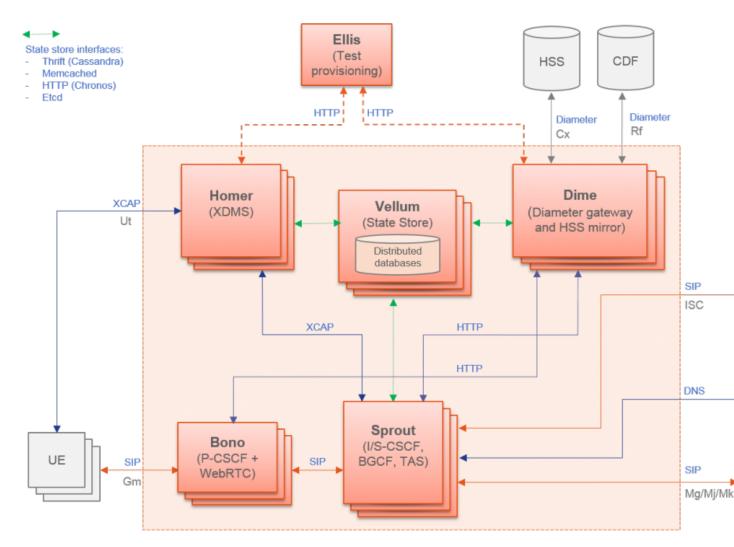
Network Functions Virtualization or NFV is, without any doubt, the hottest topic in the telco network space right now. It's an approach to building telco networks that moves away from proprietary boxes wherever possible to use software components running on industry-standard virtualized IT infrastructures. Over time, many telcos expect to run all their network functions operating at Layer 2 and above in an NFV environment, including IMS. Since Clearwater was designed from the ground up to run in virtualized environments and take full advantage of the flexibility of the Cloud, it is extremely well suited for NFV. Almost all of the ongoing trials of Clearwater with major network operators are closely associated with NFV-related initiatives.

3.9.1 About Clearwater

Clearwater follows IMS architectural principles and supports all of the key standardized interfaces expected of an IMS core network. But unlike traditional implementations of IMS, Clearwater was designed from the ground up for the Cloud. By incorporating design patterns and open source software components that have been proven in many global Web applications, Clearwater achieves an unprecedented combination of massive scalability and exceptional cost-effectiveness.

Clearwater provides SIP-based call control for voice and video communications and for SIP-based messaging applications. You can use Clearwater as a standalone solution for mass-market VoIP services, relying on its built-in set of basic calling features and standalone subscriber database, or you can deploy Clearwater as an IMS core in conjunction with other elements such as Telephony Application Servers and a Home Subscriber Server. Clearwater was designed from the ground up to be optimized for deployment in virtualized and cloud environments. It leans heavily on established design patterns for building and deploying massively scalable web applications, adapting these design patterns to fit the constraints of SIP and IMS. The Clearwater architecture therefore has some similarities to the traditional IMS architecture but is not identical.

- All components are horizontally scalable using simple, stateless load-balancing.
- All long lived state is stored on dedicated "Vellum" nodes which make use of cloud-optimized storage technologies such as Cassandra. No long lived state is stored on other production nodes, making it quick and easy to dynamically scale the clusters and minimizing the impact if a node is lost.
- Interfaces between the front-end SIP components and the back-end services use RESTful web services interfaces.
- Interfaces between the various components use connection pooling with statistical recycling of connections to ensure load is spread evenly as nodes are added and removed from each layer.



3.9.2 Clearwater Architecture

3.10 Quickstart

This repository contains instructions and resources for deploying Metaswitch's Clearwater project with Kubernetes.

If you need more information about Clearwater project please checkout our [documentation](https://github.com/opnfv/ container4nfv/blob/master/docs/release/userguide/clearwater-project.rst) or the official repository.

3.10.1 Exposed Services

The deployment exposes:

- the Ellis web UI on port 30080 for self-provisioning.
- STUN/TURN on port 3478 for media relay.
- SIP on port 5060 for service.
- SIP/WebSocket on port 5062 for service.

SIP devices can register with bono.:5060 and the Ellis provisioning interface can be accessed at port 30080.

3.10.2 Prerequirement

Install Docker and Vagrant

CONTAINER4NFV uses setup_vagrant.sh to install all resource used by this repository.

```
container4nfv/src/vagrant# ./setup_vagrant.sh -b libvirt
```

3.10.3 Instalation

Deploy Clearwater with kubeadm

Check clearwater/clearwater_setup.sh for details about k8s deployment.

container4nfv/src/vagrant/kubeadm_clearwater# ./deploy.sh

3.10.4 Destroy

container4nfv/src/vagrant# ./cleanup.sh

3.10.5 Making calls through Clearwater

Connect to Ellis service

It's important to connect to Ellis to generate the SIP username, password and domain we will use with the SIP client. Use your <master ip addres> + port 30080 (k8s default port). If you are not which Ellis's url is, please check inside your master node.

```
kubeadm_clearwater# vagrant ssh master
master@vagrant# ifconfig eth0 | grep "inet addr" | cut -d ':' -f 2 | cut -d ' ' -f 1
192.168.121.3
```

In your browser connect to <master_ip>:30080 (ex. 192.168.121.3:30080).

After that, signup and generate two users. The signup key is **secret**. Ellis will automatically allocate you a new number and display its password to you. Remember this password as it will only be displayed once. From now on, we will use <username> to refer to the SIP username (e.g. 6505551234) and password> to refer to the password.

Config and install two SIP clients

We'll use both Twinkle and Blink SIP client., since we are going to try this out inside a LAN network. This is, of course, only a local test inside a LAN network. Configure the clients may be a little bit trickie, so we add some screenshots:

Blink setup

1. Add <username> and <password>.

Private Identity:	Associated Public Identities:
6505550111@default.svc.cluster.local	sip:6505550111@default.svc.cluster.local Configure Delete
Password: n4qn37FD7	Reset
only shown once	New Public Identity
😣 🖨 🗊 Blink Preferences	
Private Ide	
65055502	hat Screen Sharing Logging Advanced
Bonjour	Account Information Media Server Settings Network Advanced
6505550111@default.svd	Vise account
Private Ide O 6505550270@default.sv	
65055503	Display Name: 6505550111
Password: I	Password: ••••••
only shown one	
Private Ide	
65055505	
Password: I	
only shown on	
Private Ide	
65055509	
Password: I	
only shown on	
Private Ide	
65055509	
Password: I	Registration Succee

2. Configure a proxy to k8s.

Clearwater	Dashboard Addressbook		
Private Ident	itv:	As	sociated Public Identities:
only shown once Private Ide 65055502 Password: 1 only shown once Bonjour Image: State of Stat		sin	:6505550111@default.svc.cluster.local Configure Delete
Password: n4	qn37FD7	Reset	
only shown once			lew Public Identity
Drivete Ide	Blink Preferences		
	n 🚑 🗩		1. 🛱
	counts Audio Video Chat Sc	reen Sharing Logo	ing Advanced
anti-strengen and		Account Informa	
			How Media Server Securitys Retwork Advanced
		SIP Proxy	
	, 0505550270@derddid.sve.edd		🧭 Always use my proxy for outgoing sessions
		Outbound F	Proxy: 192.168.121.145 Port: 5060 🗘 Transport: TCP
only shown one		Auth Userr	name: 6505550111@default.svc.
		, addred ber	
Private Ide		MSRP Relay	
			Always use my relay for outgoing sessions
Password: I		MCDD	
only shown one		MSRP	Relay: Relay address taken from [Port: 2855 📫 Transport: TLS
		Extra Server S	ettings
Private Ide		Voicema	l URI: Discovered by subscribing to 6505550111@default.svc.cluster.ld
65055509		XCAP Root	URL: Taken from the DNS TXT record for xcap.default.svc.cluster.loca
Password: I			
only shown one		Server Tools	; URL:
		Conference S	erver: conference.sip2sip.info
Private Ide			
65055509			

3. Configure the network to use TCP only.

Clearwater Dashboard Addressbook	
Private Identity:	Associated Public Identities:
6505550111@default.svc.cluster.local	sip:6505550111@default.svc.cluster.local
Password: n4qn37FD7	Reset
only shown once	New Public Identity
😣 🖱 🗉 🛛 Blink Preferences	
Private Ide	🖬 🛓 🙃
65055502	
	Screen Sharing Logging Advanced
Bonjour	Account Information Media Server Settings Network Adva
6505550111@default.svc.clu.	Network Settings
Private Ide O 6505550270@default.svc.clu.	🗹 Use ICE to improve NAT traversal for m
65055503 Password: I	MSRP Transport: TCP ‡
Password: 1 only shown one	
ony one on	
Drivete Ide	
Private Ide 65055505	
Password: I	
only shown one	
Private Ide	
65055509	
Password: I	
only shown one	
Private Ide	
65055509	
Password: I	

😕 🗖 🗊 Blink Preferences	
AccountsImage: Second Seco	
SIP and RTP	
Transports: 🗌 Enable UDP UDP port: Auto 🗦 Set SIP ports to 0 for automatic allocation	
🗹 Enable TCP	
Enable TLS TLS port: Auto	
RTP Ports: 500 🗘 starting at: 50000 🗘	
Files and directories	
Save received files to: ~/Downloads	
Save screenshots to: ~/Downloads	
TLS settings	
Certificate Authority: /usr/share/blink/tls/ca.crt	

Twinkle setup

1. Configure a proxy to k8s.

Clearwater Dashboard	Addressbook
Private Identity:	Associated Public Identities:
6505550111@default.svc.c	uster.local sip:6505550111@default.svc.cluster.local Configure
Password: n4qn37FD7 only shown once	Reset New Public Identity
Private Identity:	Associated Public Identities:
6505550270@default.svc.d	uster.local sip:6505550270@default.svc.cluster.local Configure
Password: zba6H6yKG only shown once	Reset New Public Identity
Privat 65055 Passw only sho RTP audio	Registrar Registrar: Expiry: 3600 2 seconds Image: Register at startup Add q-value to registration
Privat SIP protocol	Outbound Proxy
6505: 67 Transport/NAT Passw	✓ Use outbound proxy
only sho	Course of the second se
Timers	 Don't send a request to proxy
Privat Ring tones	
65055 Scripts	
only sho	
Add F	
Create OK Can	

2. Add <username> and <password>.

Clearwate	r Dashboard Add	ressbook				
6505550 Password	Private Identity: 6505550111@default.svc.cluster. Password: n4qn37FD7 only shown once			Associated Public Identities: sip:6505550111@default.svc.cluster.local	Configure	Delete
	270@default.svc.cluste : zba6H6yKG	Rese	ət	Associated Public Identities: sip:6505550270@default.svc.cluster.local New Public Identity	Configure	Delete
Privat 65055 Passw only sho	Twinkle - User prof ser profile: sofi User User SIP server				*	Delete
Privat 65055 Passw only sho	Voice mail Instant message Presence RTP audio		6505550 default.:	1270 svc.cluster.local		Delete
Privat 65055 Passw only sho	SIP protocol Transport/NAT Address format Timers	SIP authentication Realm: Authentication	 <u>n</u> ame: [Delete
Privat 65055 Passw only sho	Ring tones Scripts Security	<u>P</u> assword: A <u>K</u> A OP: AKA AM <u>F</u> :				Delete
Add F Create						

3. Configure the network to use TCP only.

Password: n4qn37FD7 Reset only shown once New Public Identity Private Identity: Associated Public Identities:			
ady shown once New Public Identity Private Identity: 65055550270@default.svc.cluster.local Password: zba6H6yKG Password: zba6H6yKG row shown once Reset Private Identity: 6505550270@default.svc.cluster.local Cont Password: zba6H6yKG Reset Sip 6505550270@default.svc.cluster.local Cont Password: Zba6H6yKG Reset New Public Identity Image: Sip 6505550270@default.svc.cluster.local Cont Private Were Public Identity Image: Sip 6505550270@default.svc.cluster.local Cont Vereine Were Public Identity Image: Sip 6505550270@default.svc.cluster.local Cont Vereine Soff Sip 65055 Sip 65055 Sip 750550270@default.svc.cluster.local Cont Private Soff Soff Soff Nat traversal not needed Up threshold: 1300bytes : Password: Soff Matt raversal not needed Use statically configured public IP address inside SIP messages Public IP address: Struk server:			
6505550270@default.svc.cluster.local cont Password: zba6H6yKG Reset orly shown once New Public Identity ▼ Image: Stript Stri			
Password: zba6H6yKG Reset New Public Identity only shown once Image: Sofi Privat Sofi 6005 SiP server Privat SiP server Passw Presence Privat SiP protocol SiP transport/NAT NAT traversal not needed Privat Address format SiP rimers Timers Privat Ring tones Sofis Persistent TCP connection Struth server: Persistent TCP connection Privat Scripts Privat Scripts Privat Scripts			
enty show nonce Privat 65055 Passw 65055 Passw 65055 Privat 65			sip:6505550270@default.svc.cluster.local Config
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65058 Scripts Enable NAT keep alive	Privat	Fing tones	
Passw A Security		Scripts	Enable NAT keep alive
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Make the call

	Associated Public Identities:					
		() () () () () () () () () () () () () ()elete			
Call Answe	n Bye Reject Redirect Xfer Hold Con	0 - 1	SO Blink			
			⊙ 6505550111@default.svc.clu			
Buddy list		<u>U</u> ser: sofi ‡ ♥ ♥ ⊗ ₽ ≯ ★	Q Search Contacts or Ente			
🐼 sofi t		Call:	6505550111 hola			
		Display	Switch to Cal			
	😣 🗉 Incoming Session Request	200 04	▼ Bonjour Neighbours			
- It Ie	6505550270@default. 6505550270@default.svc.clu	4 6	 Test Call echo@conference.sig Test Conference test@conference.sip 			
le		Audio call sip: vc.cluster.l	All Contacts Test Call			
-	Reject Busy	Accept	 echo@conference.sig Test Conference test@conference.sig 			
It		Line 1: call rejected.				
le		Line status				
		Line 1: Ringing				
-		From:				
lt		То:				
le		Subject:				
		○ Line <u>2</u> : idle				
		From:	+ / = +			
		То:				
lt .		Subject:	Delete			
le						