



GET A TASTE OF 1K+ NODES BY A HANDFUL OF SERVERS

Containerized Scalability Testing/Benchmarking

yaxuan.wang@intel.com

rui.zang@intel.com

Intel OpenSource Technology Center

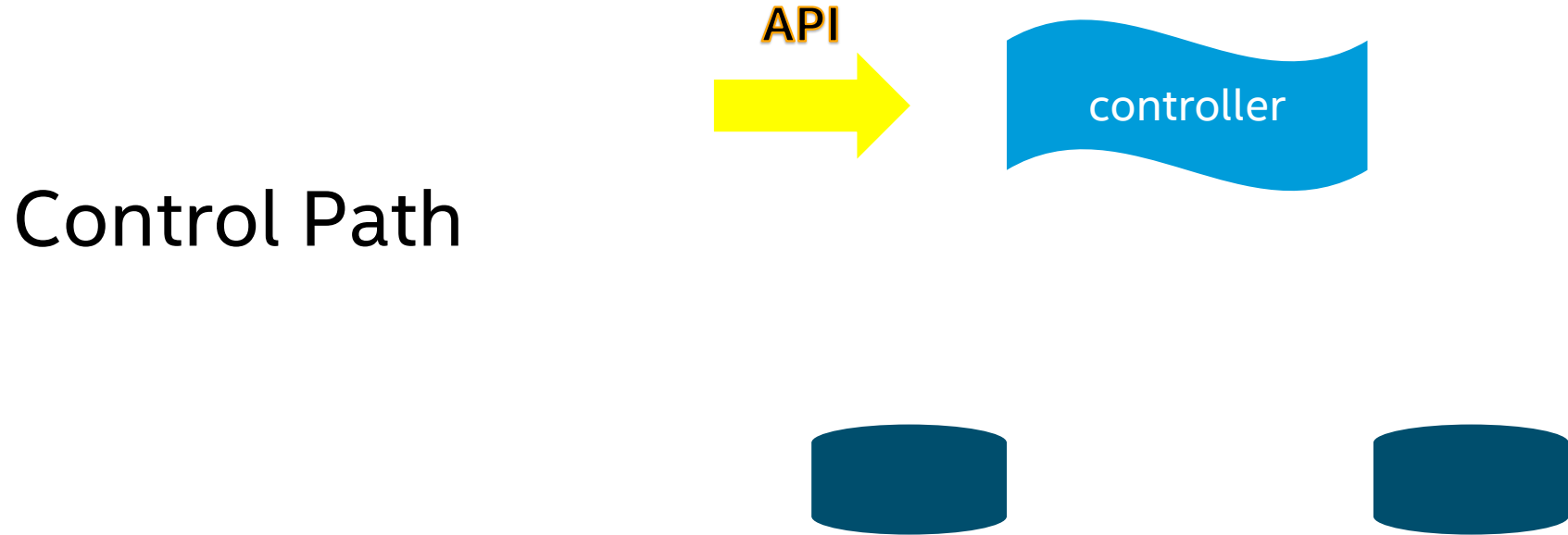
Intel Software & Service Group

DISTRIBUTED SOFTWARE TESTING SCOPES

Control Path

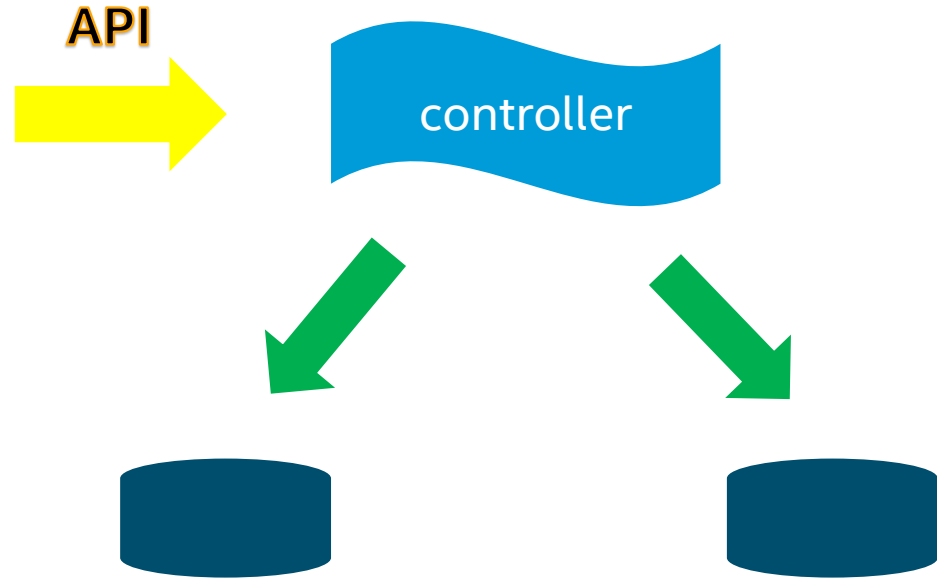


DISTRIBUTED SOFTWARE TESTING SCOPES



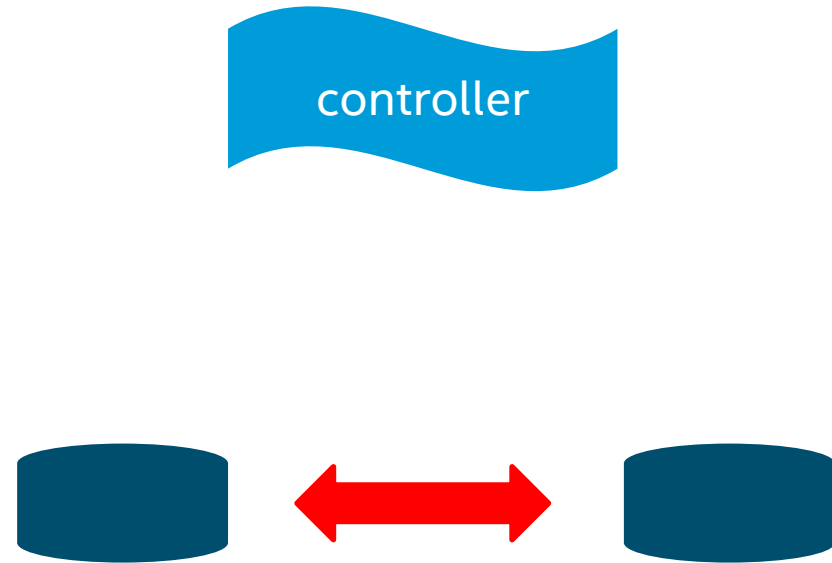
DISTRIBUTED SOFTWARE TESTING SCOPES

Control Path



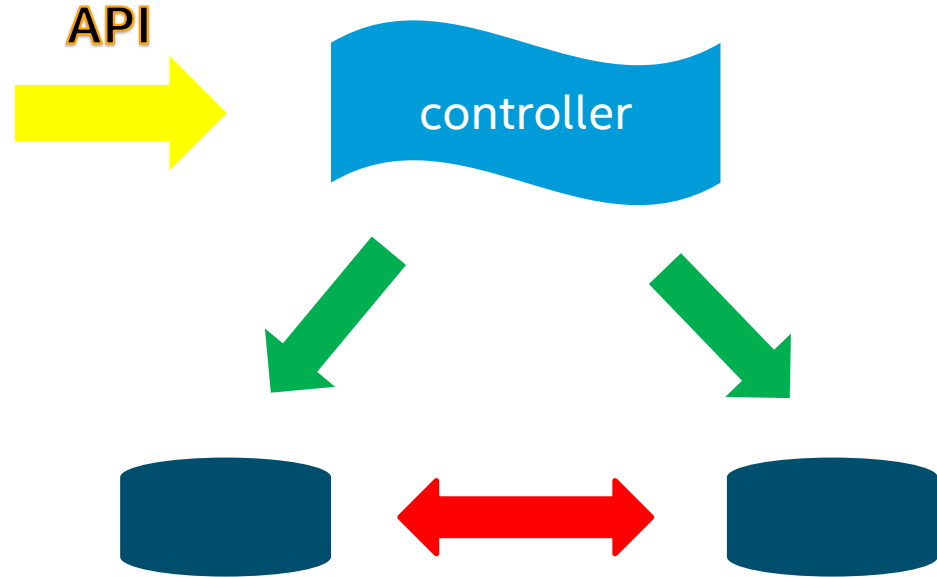
DISTRIBUTED SOFTWARE TESTING SCOPES

Data Plane



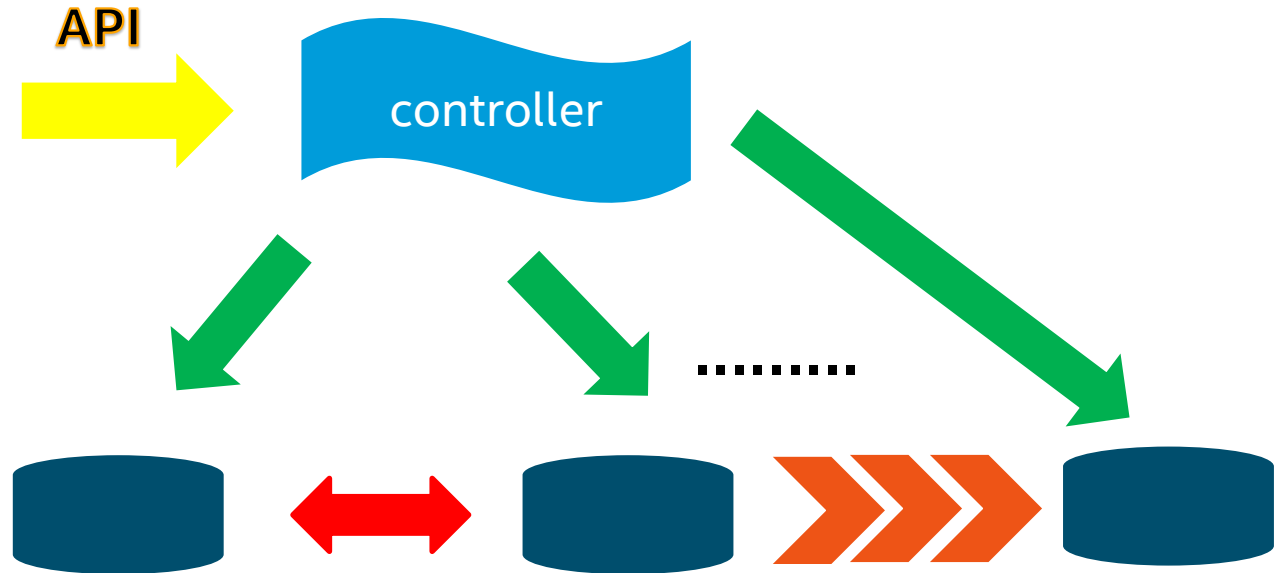
DISTRIBUTED SOFTWARE TESTING SCOPES

Scalability



DISTRIBUTED SOFTWARE TESTING SCOPES

Scalability



CONTAINERIZED SCALABILITY TESTING



- Light weighted
- Agile provision
- Highly condensed
- Complementary to bare metal based testing



OPENSTACK IN CONTAINERS



KOLLA

an OpenStack Community Project



OPENSTACK IN CONTAINERS



KOLLA

an OpenStack Community Project



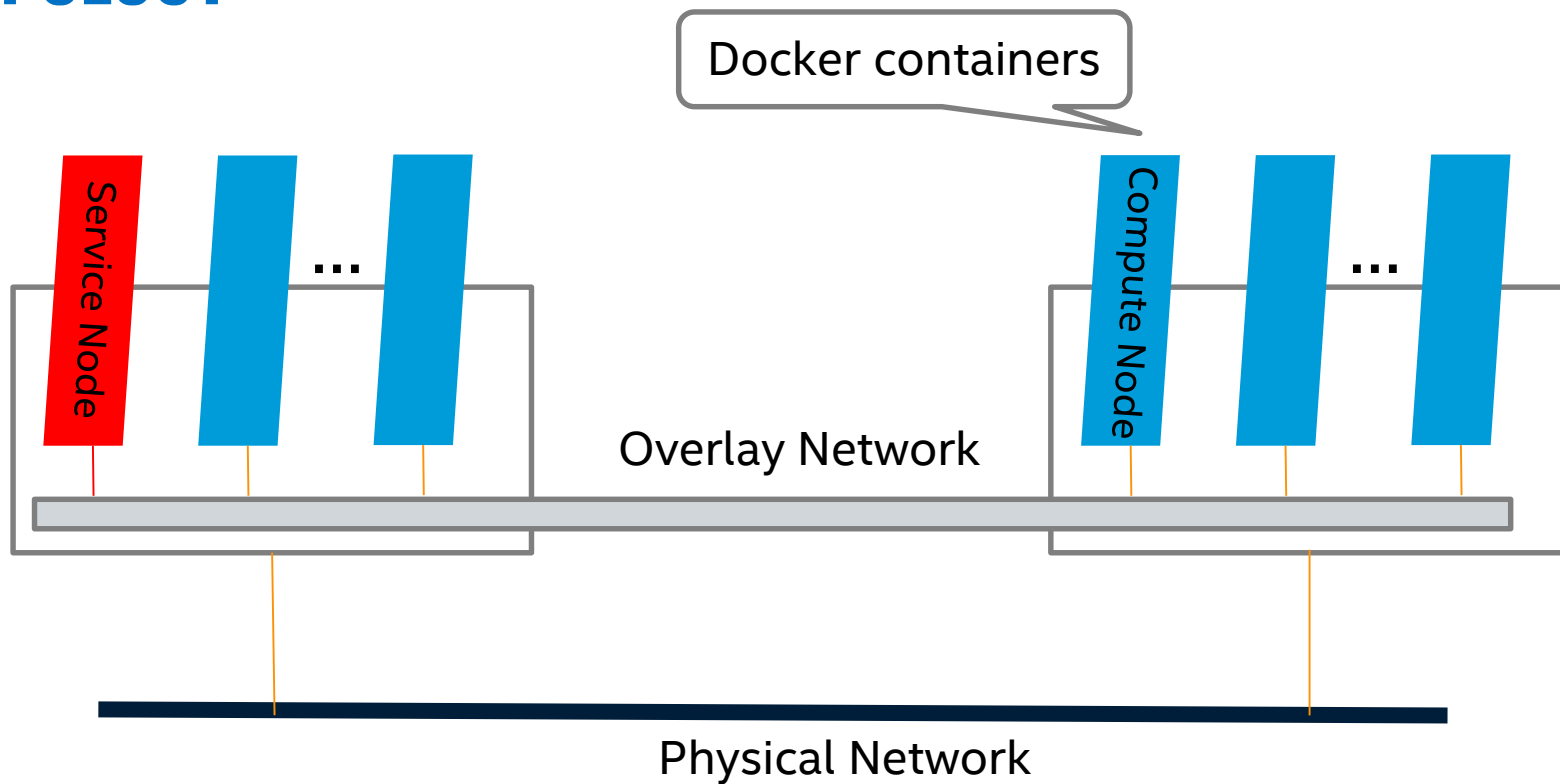
DEVSTACK IN CONTAINERS



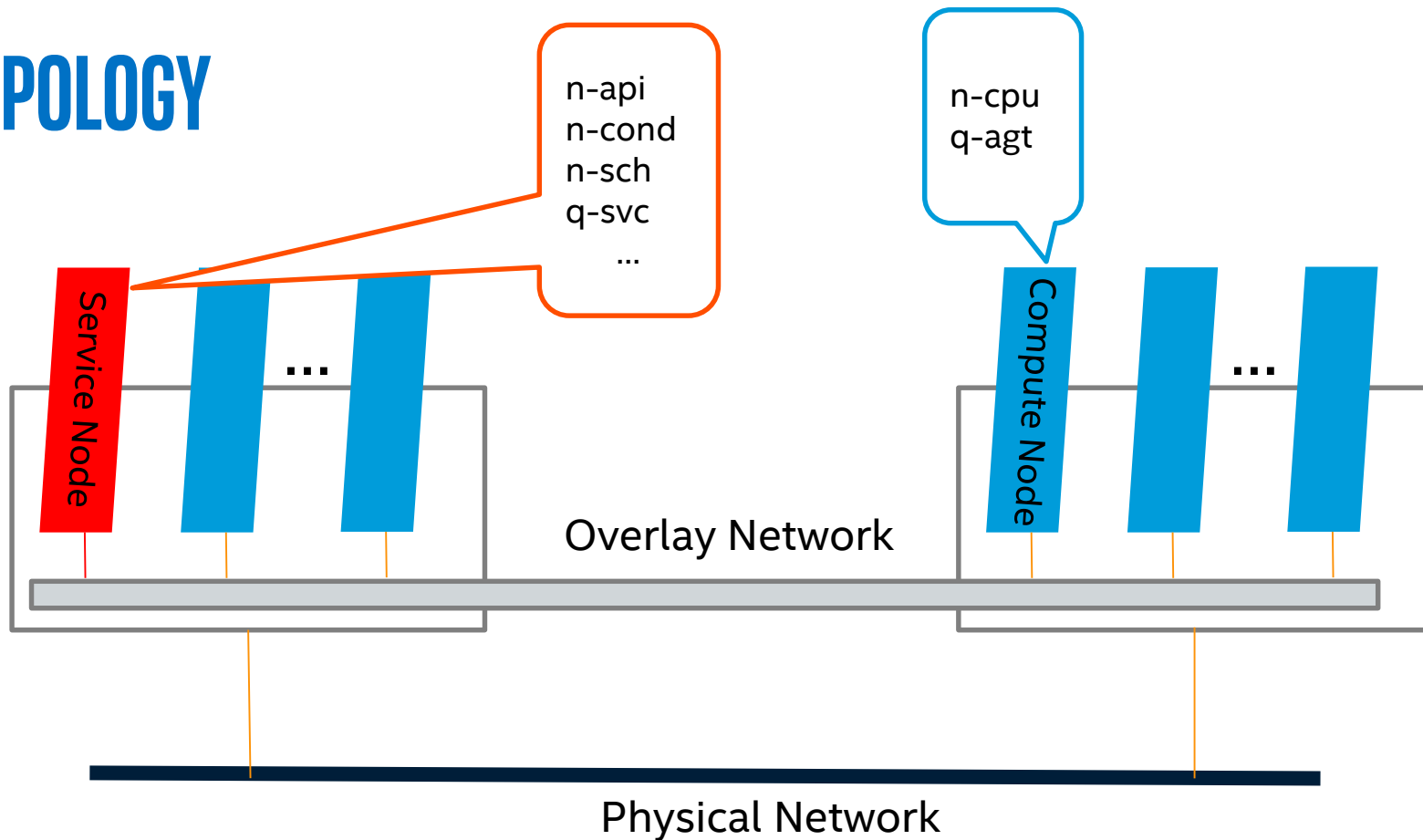
- Developers targeted
- Upstream focused
- Commit triggered (suitable for CI)
- Automated



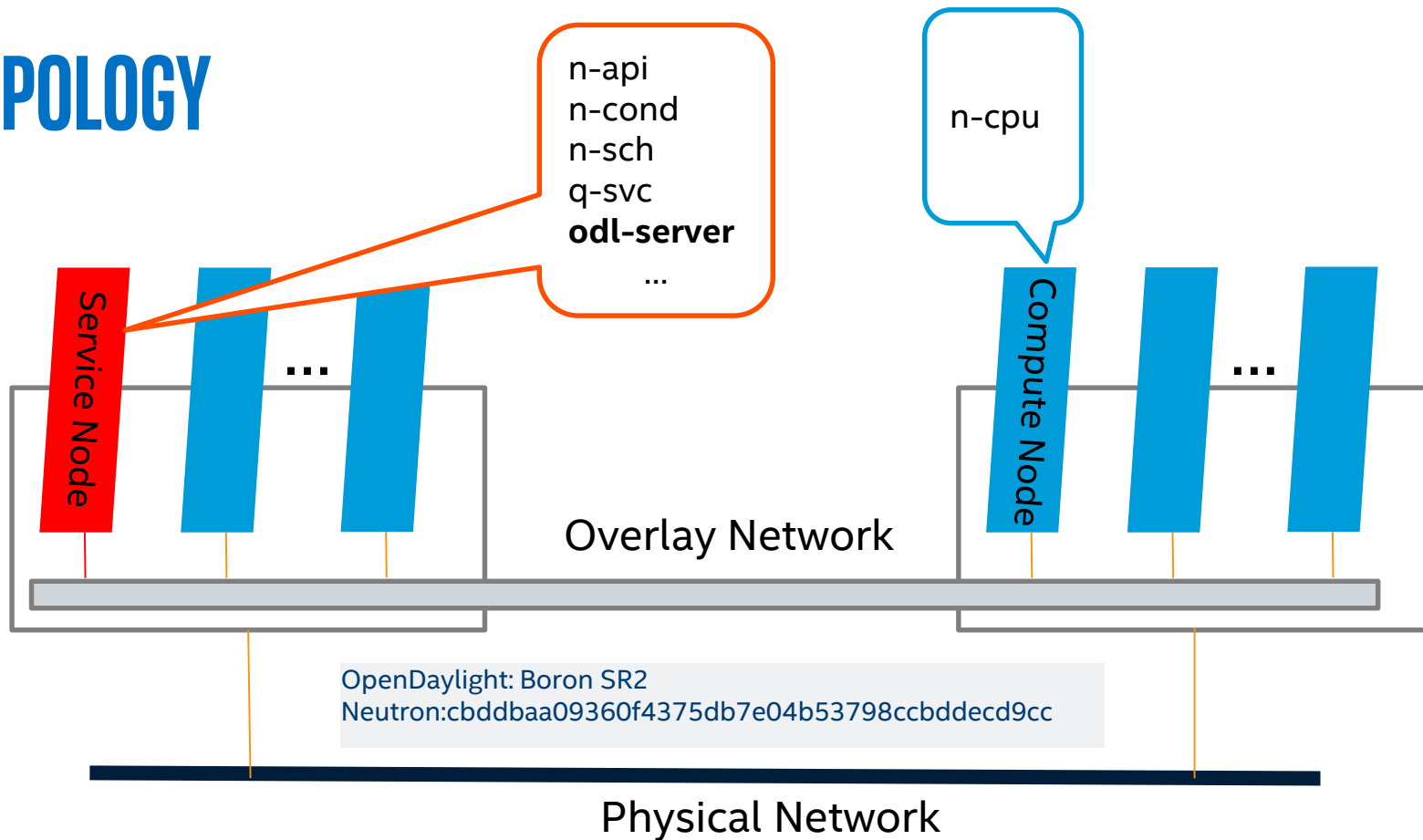
TOPOLOGY



TOPOLOGY



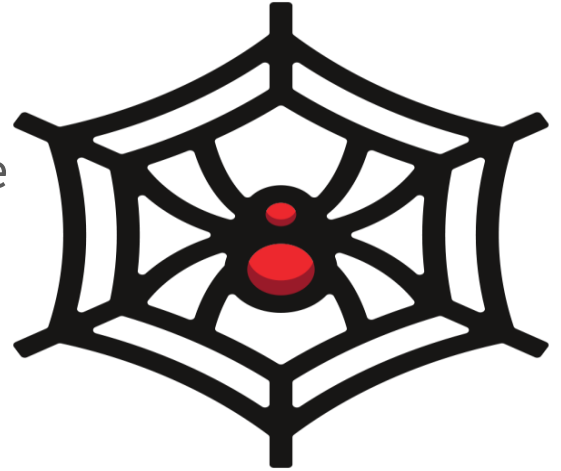
TOPOLOGY



DEPLOYMENT



- Privileged Docker containers
- Overlay networking with an external key-value store
- Non Docker Swarm mode
- 1 service node + many compute nodes
- OpenStack Neutron V.S. Neutron + OpenDaylight



FOOTPRINTS



```
top - 23:58:16 up 3 days, 4:05, 4 users, load average: 5.25, 5.83, 7.30
Tasks: 2151 total, 3 running, 2148 sleeping, 0 stopped, 0 zombie
%Cpu(s): 9.1 us, 2.3 sy, 0.0 ni, 88.4 id, 0.0 wa, 0.0 hi, 0.3 si, 0.0 st
KiB Mem : 26403435+total, 85322360 free, 68269680 used, 11044230+buff/cache
KiB Swap: 26833715+total, 26833715+free, 0 used. 19182454+avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
122401	z1r04h10	20	0	40.642g	3.082g	36672	S	471.7	1.2	1042:58	java
76343	z1r04h10	20	0	266364	117056	11692	S	22.1	0.0	54:01.57	neutron-server
28900	113	20	0	5965216	677960	5052	S	19.9	0.3	600:49.29	beam.smp
139379	z1r04h10	20	0	1998288	167036	22996	S	17.6	0.1	21:37.16	nova-compute
136515	z1r04h10	20	0	2000284	167404	23036	S	16.3	0.1	23:44.65	nova-compute
55537	114	20	0	35.649g	2.093g	19748	S	10.7	0.8	136:19.12	mysqld
76499	z1r04h10	20	0	305380	149900	5380	S	8.5	0.1	6:08.67	neutron-server
37203	root	20	0	1788192	41504	22428	S	7.2	0.0	6:28.08	libvirtd
130145	root	20	0	1788192	35220	22212	S	7.2	0.0	7:11.40	libvirtd
56170	z1r04h10	20	0	35416	10880	5040	S	4.9	0.0	233:27.03	dstat
13224	root	10	-10	5408048	617004	7780	S	3.3	0.2	118:42.22	ovs-vswitchd
26193	root	10	-10	5408052	617004	7780	S	3.3	0.2	122:56.82	ovs-vswitchd
46544	root	10	-10	5408036	616992	7780	S	3.3	0.2	121:01.26	ovs-vswitchd
53413	root	10	-10	5483564	627244	7780	S	3.3	0.2	132:45.95	ovs-vswitchd
80661	z1r04h10	20	0	261980	106960	6144	S	3.3	0.0	48:07.66	nova-conductor
80662	z1r04h10	20	0	262168	107416	6144	S	3.3	0.0	48:27.88	nova-conductor
96074	root	10	-10	5408040	616992	7780	S	3.3	0.2	123:25.83	ovs-vswitchd
38466	root	10	-10	5408044	616996	7780	S	2.9	0.2	122:07.65	ovs-vswitchd
55668	root	10	-10	5408044	616996	7780	S	2.9	0.2	130:28.31	ovs-vswitchd
64499	root	10	-10	5408044	616996	7780	S	2.9	0.2	122:58.78	ovs-vswitchd
68520	root	10	-10	5408040	616996	7780	S	2.9	0.2	124:20.21	ovs-vswitchd
80013	root	10	-10	5408048	617004	7780	S	2.9	0.2	122:17.72	ovs-vswitchd
80655	z1r04h10	20	0	261508	106732	6144	S	2.9	0.0	48:09.56	nova-conductor
80660	z1r04h10	20	0	261892	107128	6132	S	2.9	0.0	48:15.28	nova-conductor
90822	root	10	-10	5408036	616996	7780	S	2.9	0.2	121:45.16	ovs-vswitchd
98174	root	10	-10	5408044	616996	7780	S	2.9	0.2	122:27.37	ovs-vswitchd
100534	root	10	-10	5408040	616996	7780	S	2.9	0.2	121:38.43	ovs-vswitchd
105738	root	10	-10	5408036	616992	7780	S	2.9	0.2	121:17.98	ovs-vswitchd
132085	root	10	-10	5408036	616992	7780	S	2.9	0.2	121:28.79	ovs-vswitchd
141660	root	10	-10	5408052	617004	7780	S	2.9	0.2	125:45.23	ovs-vswitchd
147353	root	10	-10	5408048	617000	7780	S	2.9	0.2	128:45.69	ovs-vswitchd
147803	root	10	-10	5408040	616996	7780	S	2.9	0.2	129:17.96	ovs-vswitchd
172637	root	10	-10	5408044	617000	7780	S	2.9	0.2	121:27.54	ovs-vswitchd
181365	root	10	-10	5408052	617004	7780	S	2.9	0.2	127:31.05	ovs-vswitchd
2258	root	10	-10	5408036	616988	7780	S	2.6	0.2	130:07.36	ovs-vswitchd
4254	root	10	-10	5408044	617000	7780	S	2.6	0.2	130:22.20	ovs-vswitchd
15947	root	10	-10	5408052	617004	7780	S	2.6	0.2	121:37.86	ovs-vswitchd
18441	root	10	-10	5408052	617004	7780	S	2.6	0.2	119:02.22	ovs-vswitchd

FOOTPRINTS



root@jzfz1r04h10:~/yaxuan/output# free -g						
	total	used	free	shared	buff/cache	available
Mem:	251	65	81	0	105	182
Swap:	255	0	255			
root@jzfz1r04h10:~/yaxuan/output# docker stats --no-stream						
CONTAINER	CPU %	MEM USAGE / LIMIT	MEM %	NET I/O	BLOCK I/O	PIDS
c80108f6b28c	3.67%	1.025GiB / 251.8GiB	0.41%	70.1MB / 138MB	5.64MB / 125MB	190
936161937fe2	3.66%	1.673GiB / 251.8GiB	0.66%	108MB / 172MB	8.19kB / 135MB	184
75df1728de68	1.87%	1.653GiB / 251.8GiB	0.66%	108MB / 173MB	172kB / 76.2MB	184
23719607f6af	3.36%	1.669GiB / 251.8GiB	0.66%	110MB / 176MB	0B / 84.9MB	184
70c87c693fd8	3.87%	1.661GiB / 251.8GiB	0.66%	108MB / 172MB	451kB / 86.7MB	184
ca18a76df4cf	3.19%	1.665GiB / 251.8GiB	0.66%	109MB / 174MB	451kB / 58.7MB	184
09bd535afc72	3.67%	1.677GiB / 251.8GiB	0.67%	108MB / 174MB	393kB / 130MB	184
fe1c3452609c	1.39%	1.652GiB / 251.8GiB	0.66%	108MB / 172MB	205kB / 128MB	184
46af23fe0116	2.99%	1.676GiB / 251.8GiB	0.67%	109MB / 174MB	1.85MB / 139MB	184
7a634e16370f	79.86%	1.68GiB / 251.8GiB	0.67%	108MB / 173MB	918kB / 125MB	184
53a44b298911	3.20%	1.682GiB / 251.8GiB	0.67%	109MB / 175MB	287kB / 132MB	184
07435bf3123e	4.46%	1.669GiB / 251.8GiB	0.66%	110MB / 177MB	287kB / 134MB	184
7a028fc8cab3	4.02%	1.659GiB / 251.8GiB	0.66%	108MB / 173MB	836kB / 78.8MB	184
8e5cdfef1ef64	1.33%	1.671GiB / 251.8GiB	0.66%	108MB / 172MB	1.83MB / 107MB	184
1b37987ccc44	3.59%	1.669GiB / 251.8GiB	0.66%	108MB / 173MB	8.19kB / 61.4MB	184
2275a2922372	3.38%	1.671GiB / 251.8GiB	0.66%	109MB / 176MB	16.4kB / 63.3MB	184
db7dd25ec14b	2.73%	1.673GiB / 251.8GiB	0.66%	109MB / 176MB	1.16MB / 116MB	186
2749687eefa1	1.61%	1.679GiB / 251.8GiB	0.67%	109MB / 176MB	238kB / 71.9MB	184
d61d9beb05e6	4.75%	1.679GiB / 251.8GiB	0.67%	110MB / 180MB	0B / 64.8MB	184
b348cbec584c	4.08%	1.672GiB / 251.8GiB	0.66%	109MB / 175MB	811kB / 94.7MB	184
7b1e3dbab754	1.78%	1.674GiB / 251.8GiB	0.66%	109MB / 175MB	16.4kB / 76.2MB	184
5b310c239717	4.12%	1.672GiB / 251.8GiB	0.66%	116MB / 239MB	0B / 78.7MB	184
bce32f648752	1.62%	1.677GiB / 251.8GiB	0.67%	110MB / 177MB	786kB / 151MB	184
a6141a21c3c6	4.59%	1.672GiB / 251.8GiB	0.66%	109MB / 175MB	16.4kB / 112MB	184
fc54f72c21b5	1.94%	1.671GiB / 251.8GiB	0.66%	109MB / 175MB	0B / 119MB	184
004e6917a38f	4.04%	1.67GiB / 251.8GiB	0.66%	109MB / 177MB	229kB / 97.1MB	184
bfad8b46d1de	2.64%	1.657GiB / 251.8GiB	0.66%	109MB / 177MB	385kB / 84.3MB	184
d172c04a5d21	5.37%	1.675GiB / 251.8GiB	0.67%	109MB / 176MB	131kB / 111MB	184
52bd737c91ac	4.12%	1.675GiB / 251.8GiB	0.67%	116MB / 238MB	2.09MB / 129MB	184
a42ed7bbbe6f	4.12%	1.671GiB / 251.8GiB	0.66%	109MB / 177MB	188kB / 126MB	184
70da733d4235	3.86%	1.681GiB / 251.8GiB	0.67%	111MB / 181MB	565kB / 108MB	184
29a77fb1f8bc	2.70%	1.677GiB / 251.8GiB	0.67%	108MB / 175MB	836kB / 75.9MB	184

FOOTPRINTS



6c7e22f0a401	1.36%	1.754GiB / 251.8GiB	0.70%	120MB / 224MB	958kB / 92.1MB	184
d67ea240a382	2.56%	1.748GiB / 251.8GiB	0.69%	119MB / 222MB	262kB / 105MB	184
8d4d295dcee5	3.03%	1.75GiB / 251.8GiB	0.70%	118MB / 219MB	303kB / 107MB	184
0b47fb32f7b3	3.24%	1.752GiB / 251.8GiB	0.70%	118MB / 219MB	205kB / 130MB	184
6a9238d8238d	1.52%	1.751GiB / 251.8GiB	0.70%	118MB / 219MB	0B / 129MB	184
f9dbe74d4a46	2.86%	1.751GiB / 251.8GiB	0.70%	118MB / 219MB	24.6kB / 123MB	184
622c2d94a152	3.38%	1.753GiB / 251.8GiB	0.70%	118MB / 220MB	156kB / 87.2MB	184
f8ec9e626249	3.45%	1.759GiB / 251.8GiB	0.70%	119MB / 222MB	32.8kB / 108MB	184
4741f216cf07	2.02%	1.749GiB / 251.8GiB	0.69%	119MB / 222MB	8.19kB / 108MB	184
176c273a51ca	1.83%	1.752GiB / 251.8GiB	0.70%	120MB / 224MB	205kB / 112MB	184
7fee46e03105	3.29%	1.756GiB / 251.8GiB	0.70%	120MB / 225MB	983kB / 107MB	184
fd21e25414b5	1.71%	1.742GiB / 251.8GiB	0.69%	120MB / 224MB	4.24MB / 76.2MB	184
f4fce5310a5b	4.07%	1.756GiB / 251.8GiB	0.70%	119MB / 222MB	8.03MB / 80.8MB	184
55501d76e96f	4.08%	2.113GiB / 251.8GiB	0.84%	120MB / 225MB	777MB / 110MB	184
86624b77be5e	3.65%	1.735GiB / 251.8GiB	0.69%	155MB / 258MB	11MB / 55.9MB	184
c95a7f9b2cbd	1.66%	1.753GiB / 251.8GiB	0.70%	119MB / 222MB	9.61MB / 76.1MB	184
6c75ec022b36	2.11%	1.751GiB / 251.8GiB	0.70%	155MB / 259MB	45.9MB / 91.9MB	186
17d90fd37115	386.74%	27.59GiB / 251.8GiB	10.96%	24.1GB / 8.62GB	1.44GB / 100GB	1512
86cf9855a63b	0.11%	32MiB / 251.8GiB	0.01%	62.7MB / 237MB	30.9MB / 1.73GB	9

Compute node

Key Value Store

Service node

CONTAINER DENSITY



```
root@jfz1r04h10:~/yaxuan/output# df -h
Filesystem                Size      Used Avail Use% Mounted on
udev                     126G         0  126G   0% /dev
tmpfs                     26G        15M   26G   1% /run
/dev/mapper/jfz1r04h10--vg-root 188G      182G   3.9G  98% /
tmpfs                     126G         0  126G   1% /dev/shm
tmpfs                     5.0M         0   5.0M   0% /run/lock
tmpfs                     126G         0  126G   0% /sys/fs/cgroup
/dev/sda1                  472M       57M   391M  13% /boot
tmpfs                     26G         0   26G   0% /run/user/0
none                      188G      182G   3.9G  98% /var/lib/docker/aufs/mnt/2acc74d5945ff2648a14b1e0d359dde1b2900d42690b491d6a5d05381895602e
shm                       64M         0   64M   0% /var/lib/docker/containers/62815b6938ed075a35314f6d2f954c1d82e0d74e354fa0232ce46c6b312c1c2f/shm
none                      188G      182G   3.9G  98% /var/lib/docker/aufs/mnt/72d24bd085849a996a8eeb27368cb029b0a411c891b8b24d5ccbc659eddb130c
shm                       64M         0   64M   0% /var/lib/docker/containers/1629baee6433551cde3f18d682bee60e9c55f62d1bc09d39be81ecd51d7db16c/shm
none                      188G      182G   3.9G  98% /var/lib/docker/aufs/mnt/bcc1e8a4124d1f3627559a0ff2bc1a3d04dfe5a45613742548463342b9cca66
shm                       64M         0   64M   0% /var/lib/docker/containers/045429aaaa5951030efbb3e3ce2b2f27b0489233d78ad81c278f5668ca1f0f3b/shm
none                      188G      182G   3.9G  98% /var/lib/docker/aufs/mnt/578011b6906bfaf2a6a18032a8b71b55dbaa9452cc8680301c2eecf4f7d11807
shm                       64M         0   64M   0% /var/lib/docker/containers/2c3cf7dde0001801c3dc53ebbd6702828924f66e6445e05d49f882e2b88136d/shm
```

- CPU cycles
- System memory
- Disk usage

```
none b2704f1e7cb2 yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute89 2.81GB (virtual 5.73GB)
none 4faf66e92bb5 yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute88 2.81GB (virtual 5.73GB)
none cdba543ad1df yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute87 2.82GB (virtual 5.73GB)
none f0b6f8f2ec7c yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute86 2.82GB (virtual 5.73GB)
none 36efde45d8e4 yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute85 2.81GB (virtual 5.73GB)
none a9c2341def3e yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute84 2.81GB (virtual 5.73GB)
none f72ecc3a4466 yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute83 2.82GB (virtual 5.74GB)
none 760db6c9f21b yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute82 2.82GB (virtual 5.73GB)
none 54f9b5aded88 yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute81 2.82GB (virtual 5.73GB)
none 2121af40a3cf yaxuan/compute-neutron_setup "/bin/sh -c '/conf...'
shm compute80 2.82GB (virtual 5.73GB)
```


RALLY BENCHMARKING



Rally task results

Task overview

Input file

► NeutronNetworks

► NeutronSecurityGroup

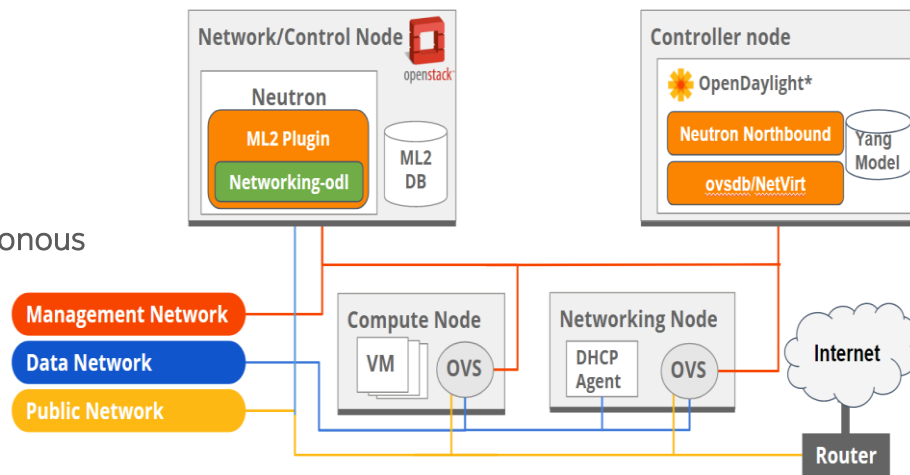
Task overview

Scenario ▾	Load duration (s)	Full duration (s)	Load duration (s)	Full duration (s)
NeutronNetworks.create_and_delete_floating_ips	6.067	11.431	8.222	15.158
NeutronNetworks.create_and_delete_networks	14.594	21.457	17.123	25.821
NeutronNetworks.create_and_delete_ports	187.982	224.827	206.352	246.657
NeutronNetworks.create_and_delete_routers	32.959	84.266	36.600	90.556
NeutronNetworks.create_and_delete_subnets	74.781	115.533	65.951	107.943
NeutronNetworks.create_and_list_floating_ips	5.533	13.764	5.514	15.603
NeutronNetworks.create_and_list_networks	12.350	31.266	11.778	32.905
NeutronNetworks.create_and_list_networks-2	7.244	25.827	8.426	30.762
NeutronNetworks.create_and_list_ports	133.064	253.892	143.356	272.566
NeutronNetworks.create_and_list_routers	65.369	186.435	70.801	208.263
NeutronNetworks.create_and_list_subnets	5.941	40.961	4.771	45.199
NeutronNetworks.create_and_update_networks	2.751	12.060	2.951	11.048
NeutronNetworks.create_and_update_ports	27.962	59.309	24.619	56.594
NeutronNetworks.create_and_update_routers	20.092	58.621	20.998	63.626
NeutronNetworks.create_and_update_subnets	7.921	43.606	7.376	44.065
NeutronSecurityGroup.create_and_delete_security_groups	6.000	12.864	8.223	16.778
NeutronSecurityGroup.create_and_list_security_groups	5.699	19.782	7.477	23.701
NeutronSecurityGroup.create_and_update_security_groups	4.147	18.487	7.795	23.762

OpenDaylight

- Tasks are DB intensive (create/update/delete)
- Neutron
 - Server: DB operation (create/update/delete)
 - Agent: RPC, asynchronous
- Neutron+ODL
 - Neutron Server: DB operation
 - ODL Neutron Northbound: Yang Model
 - ODL ovsdb/netvirt: act on data model change, asynchronous
- More meaningful scenarios
 - Create VMs and test connectivity

OpenStack and OpenDaylight Integration



CONSIDERATIONS TO EXTEND TO 1K SCALE

- Physical server capacity
- Container placement & density
- Network bandwidth
- ...



TO THE BEYOND

- Service dedicated containers
- Footprint tune-up
- Adopt to container orchestration
- More sophisticated and specific test scenarios
- Real CI deployment
- White paper
- ...



