Cloud Native Indonesia Meetup
25 April 2020

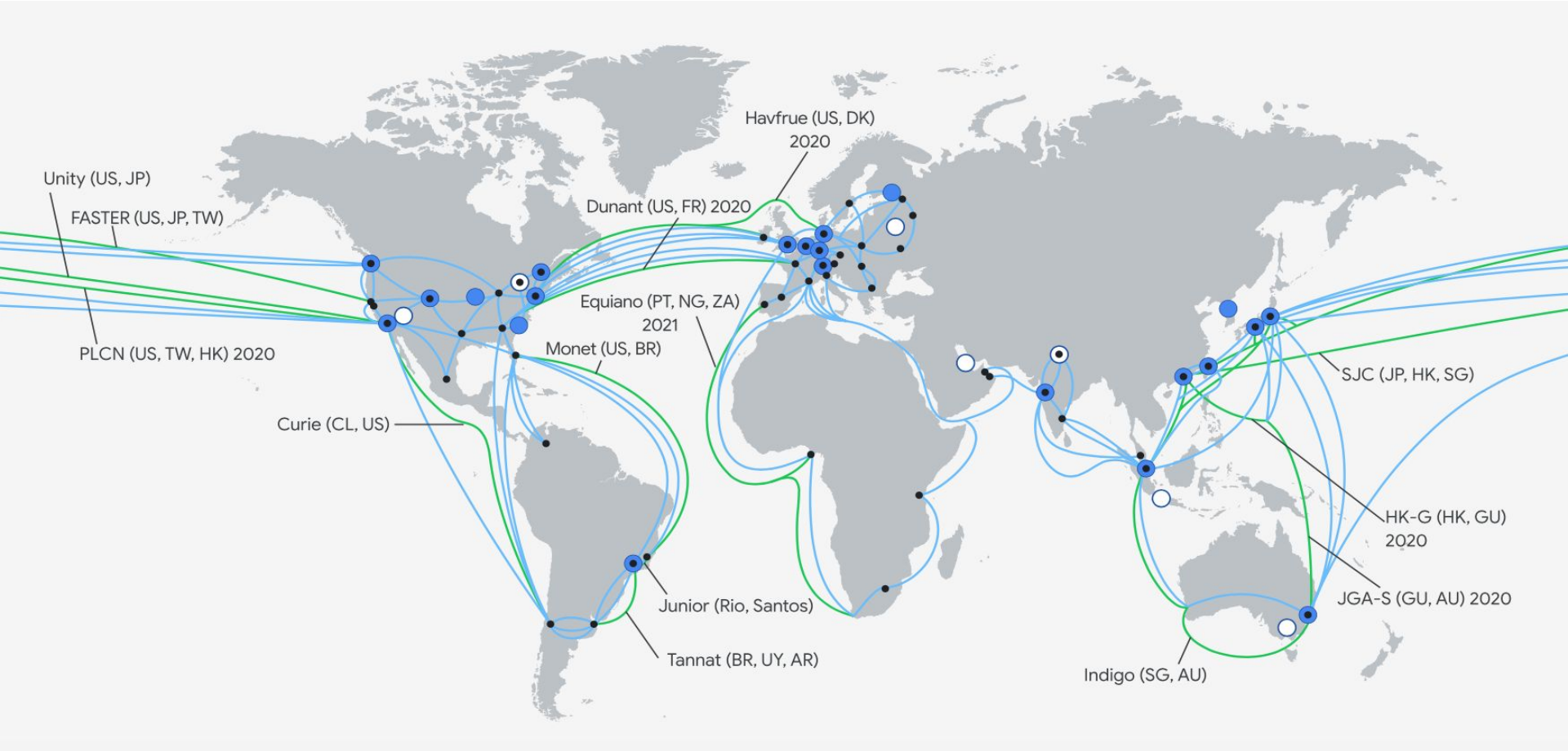
SONA-CNI for Kubernetes

Aris Cahyadi Risdianto
ONF (Open Networking Foundation) Ambassador

Introduction to Data Center Networking

https://maxkelsen.com/blog/building-serverless-architectures

Google Cloud Infrastructure



https://cloud.google.com/about/locations

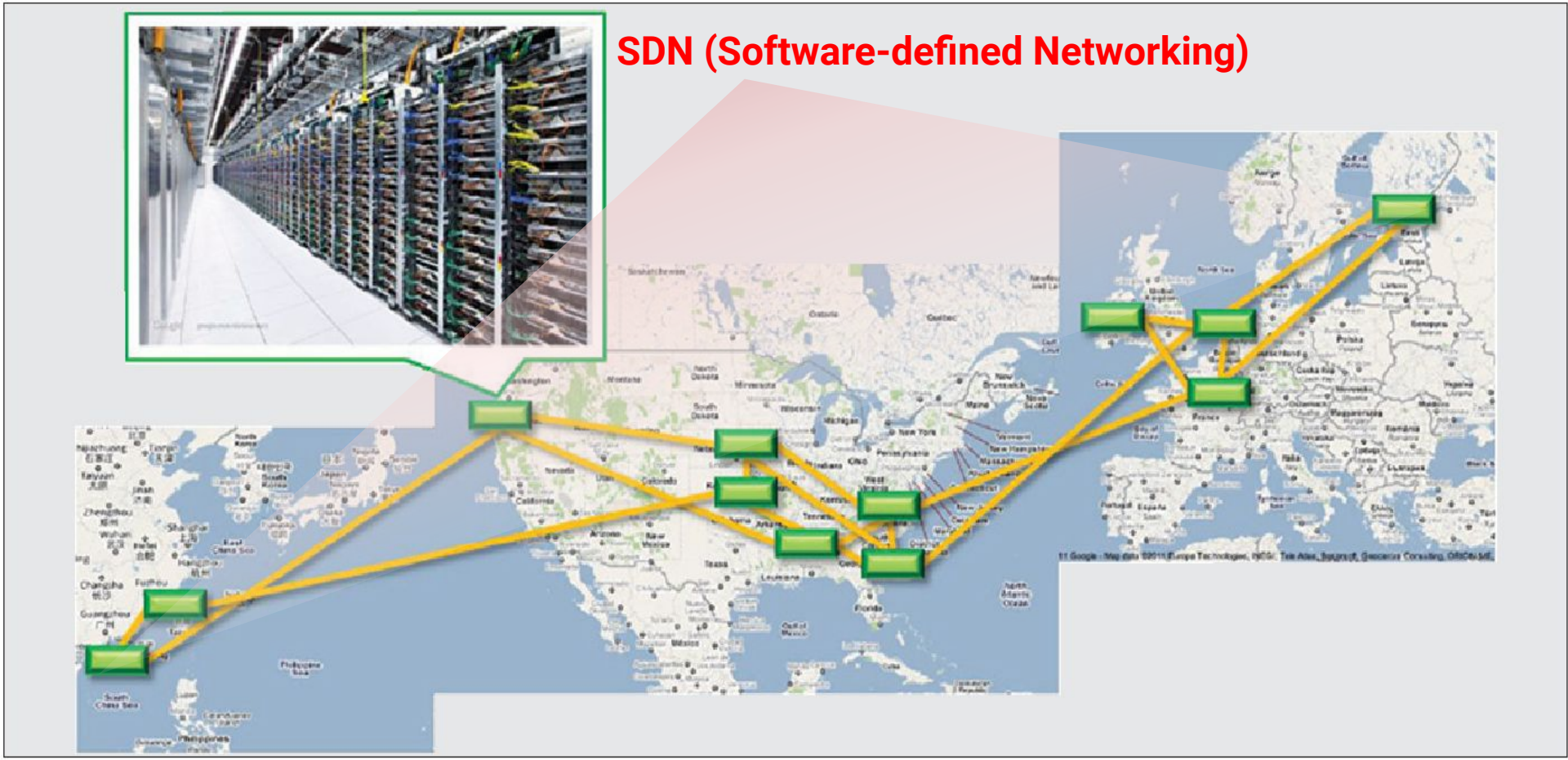
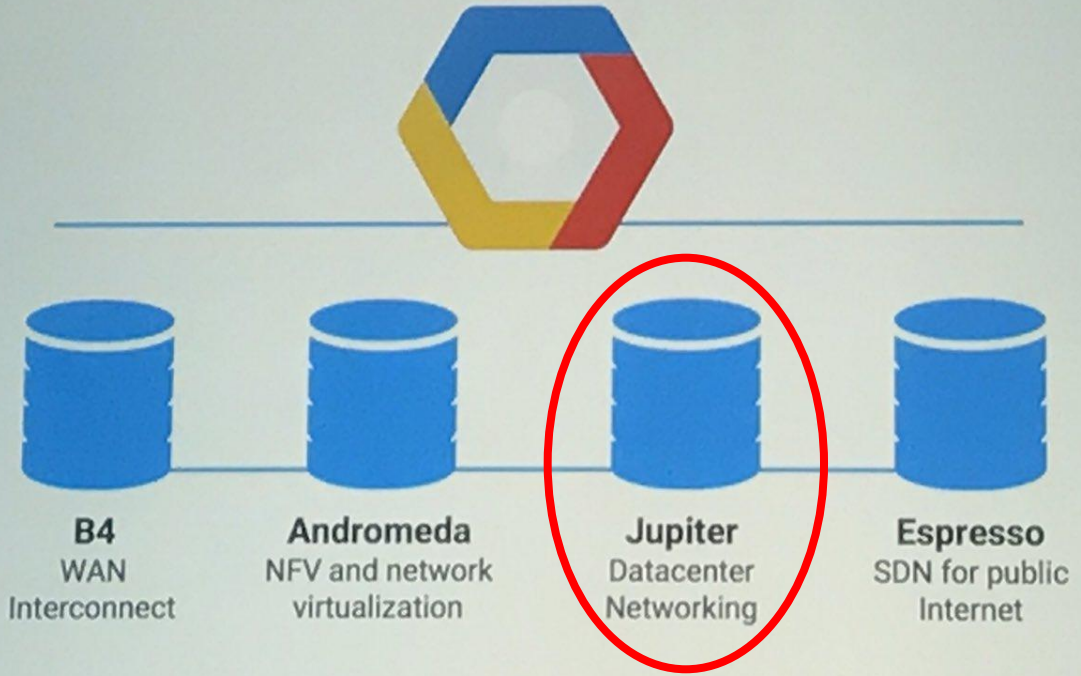


Figure 1. *Google's global inter-data-center network. Each box represents a mega data center. Inset: close-up of a Google data center.*

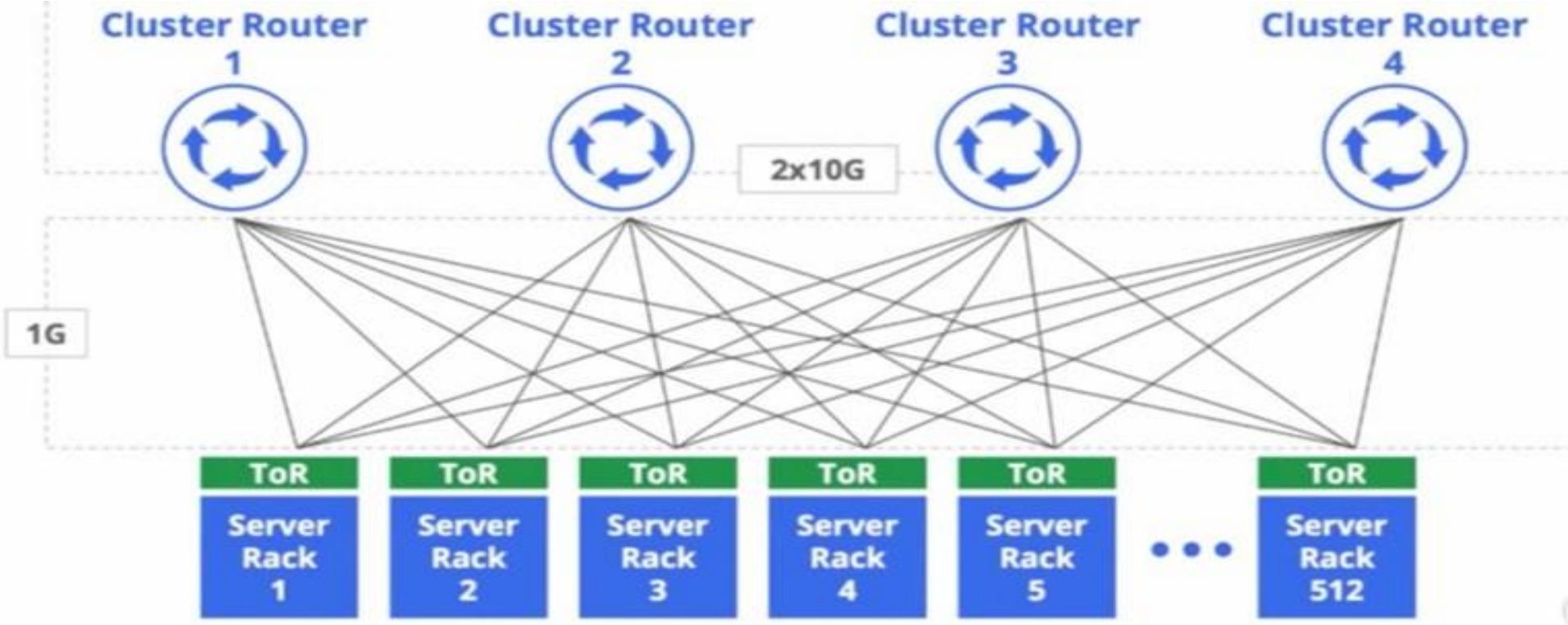
https://www.semanticscholar.org/paper/The-prospect-of-inter-data-center-optical-networks-Zhao-Vusirikala/190abe965d98de2e9dcd26e501fce2516acd8bab

The Pillars of SDN @ Google



https://twitter.com/ONF_SDN/status/849301475415257089?s=20

Jupiter Rising: A Decade of Clos Topologies and Centralized Control in Google's Datacenter Network



https://www.nextplatform.com/2015/06/19/inside-a-decade-of-google-homegrown-datacenter-networks/

Google

Jupiter Data Center Network Controller

The three key principles behind the design of Google's data center networks:

1. **A Clos topology** - a collection of small (commodity) switches with properties of a larger logical switch.
2. **A centralized software control stack** to manage thousands of switches within the data center as one large fabric.
3. **Build own software and hardware** - silicon from vendors, less rely on standard protocols tailored to the data center.

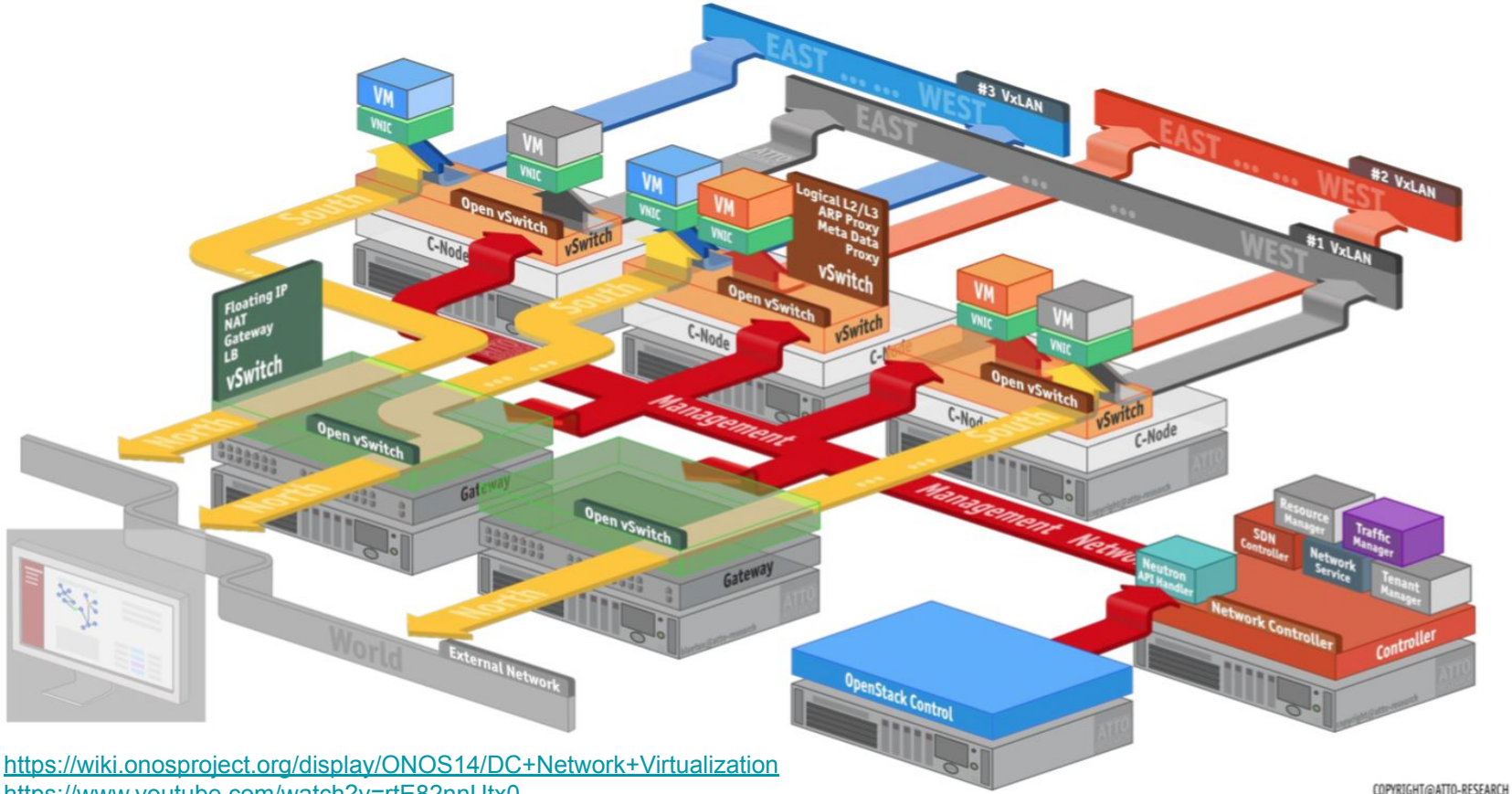
Not yet an Open Source Project :(

https://techcrunch.com/2015/06/17/google-pulls-back-curtain-on-its-data-center-networking-setup/

Open Source Data Center Network Controller

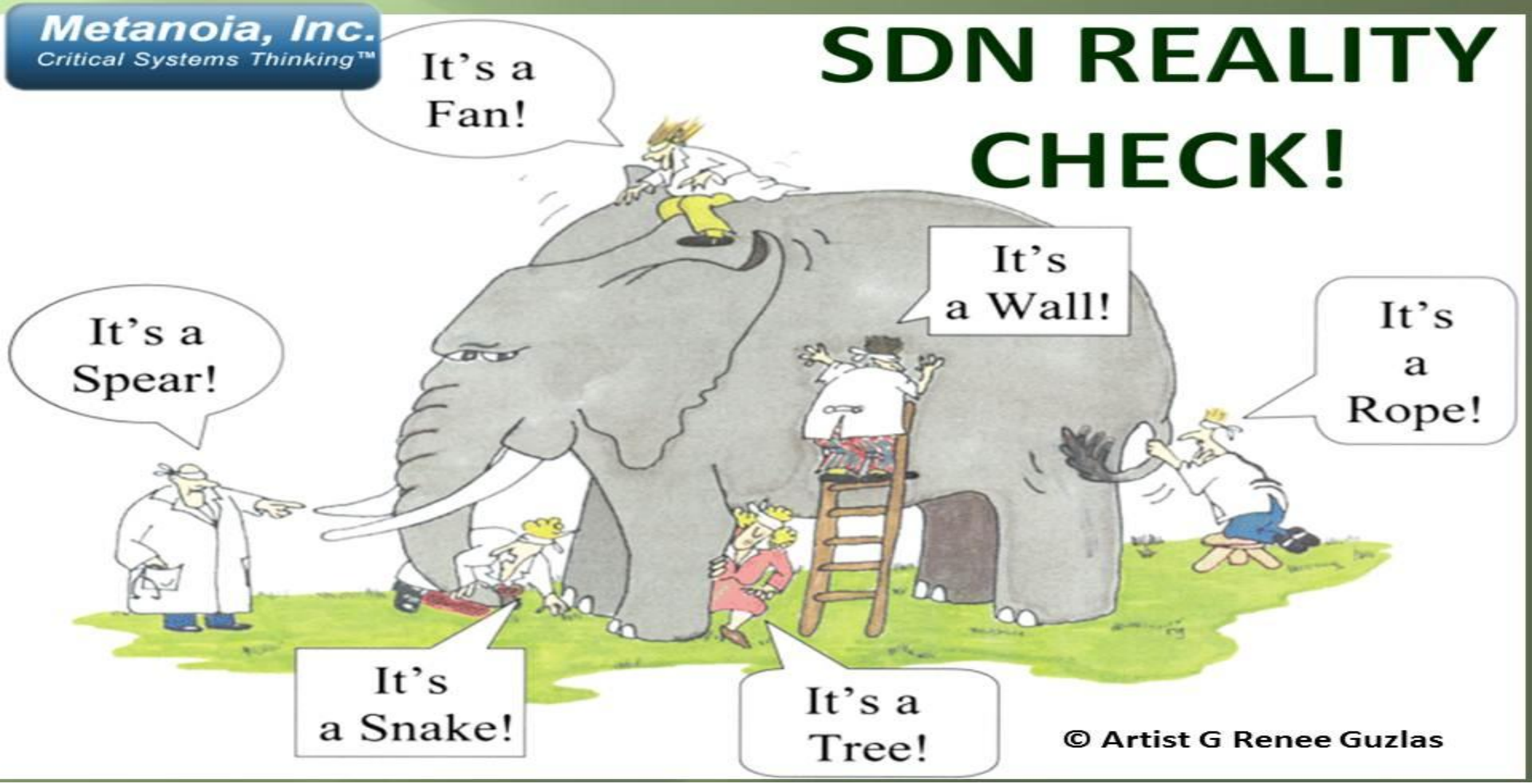
- ONOS Trellis - Open Networking Foundation (ONF)
- ONOS SONA - SK Telecom
- Open Contrail / Tungsten Fabric - Juniper / LF Networking
- OpenDaylight - LF Networking
- ....

SONA (Simplified Overlay Networking Architecture)



https://wiki.onosproject.org/display/ONOS14/DC+Network+Virtualization
https://www.youtube.com/watch?v=rtE82nnUtx0

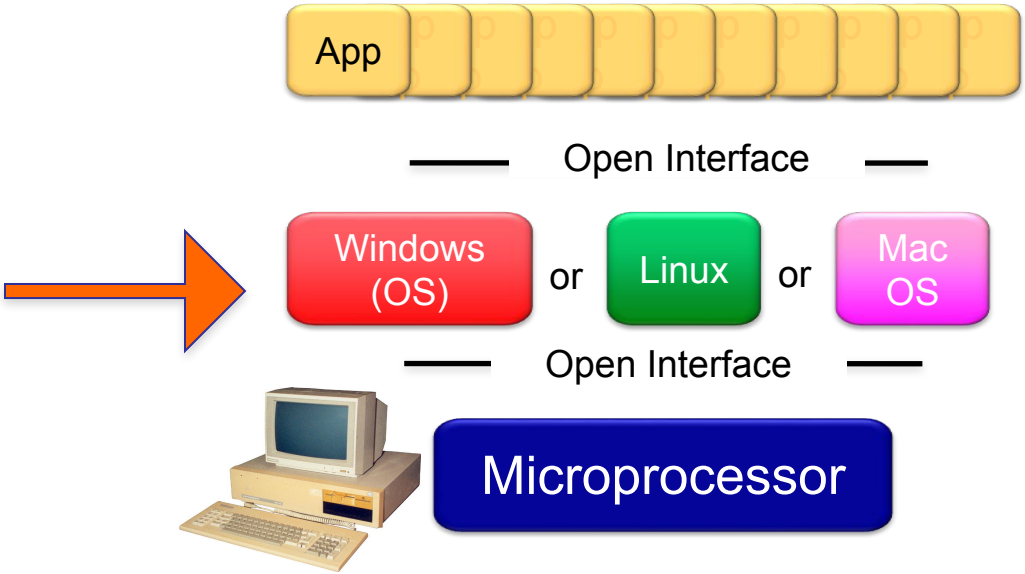
SDN and ONOS



https://metanoia-inc.com/blog/2013/02/10/sdn-reality-check-a-story-of-six-blind-men-and-the-elephant/

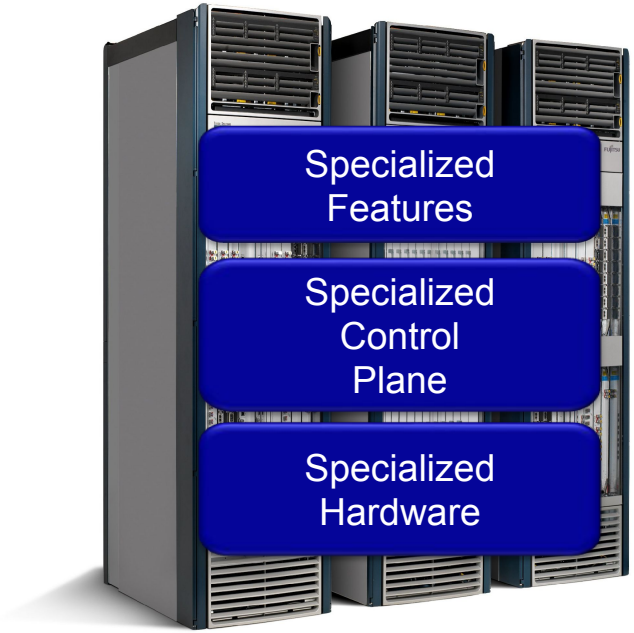
Transformation of Computing Industry

Vertically integrated
Closed, proprietary
Slow innovation
Small industry

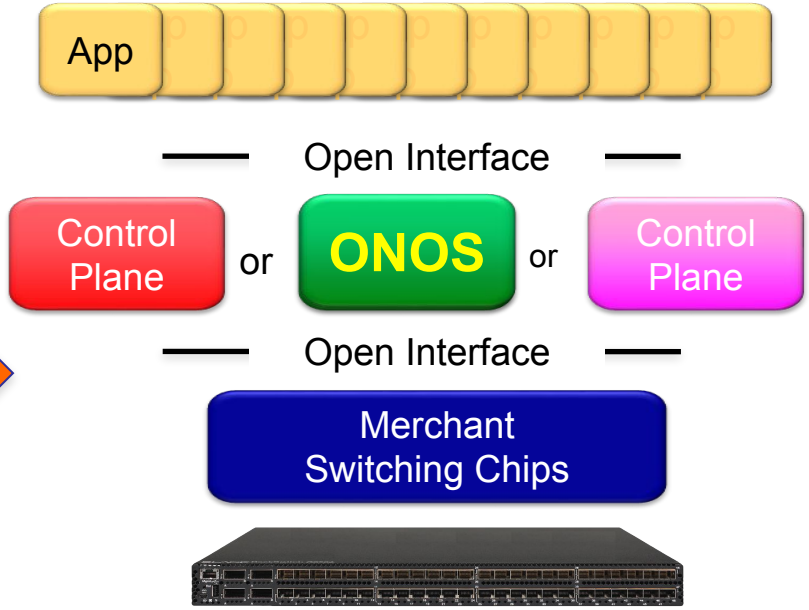


Horizontal
Open interfaces
Rapid innovation
Huge industry

Transformation of Networking Industry (with SDN) ?



Vertically integrated
Closed, proprietary
Slow innovation

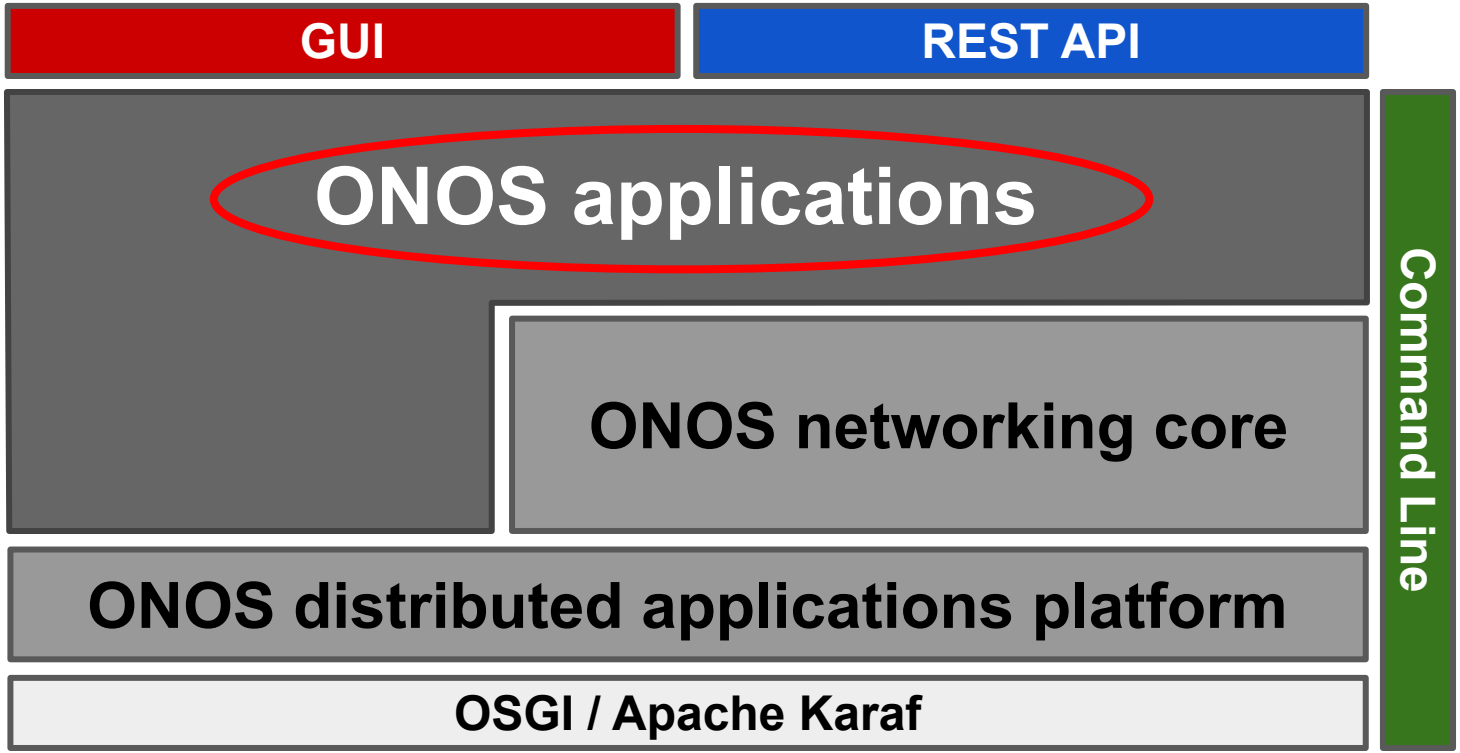


Horizontal
Open interfaces
Rapid innovation

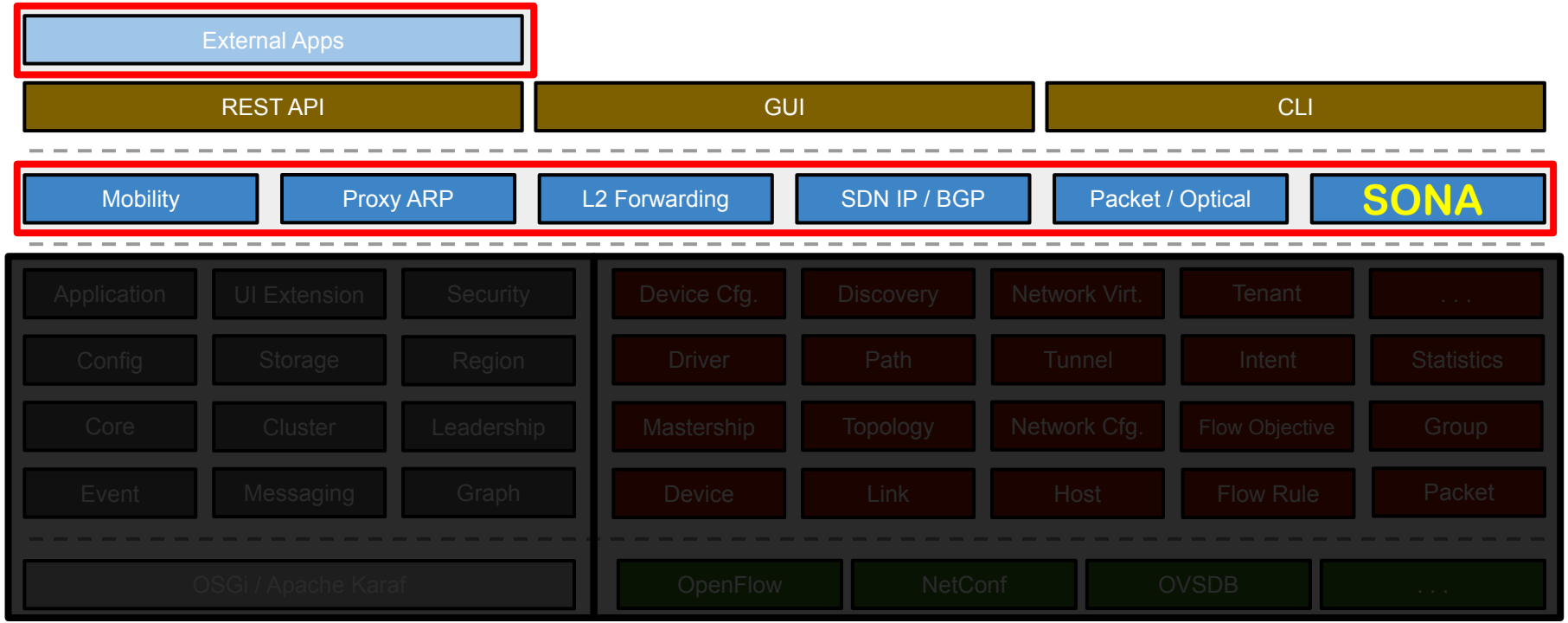
What is ONOS?

Open Network Operating System (ONOS) is an open source SDN network operating system. Our mission is to enable Service Providers to build real SDN/NFV Solutions.

ONOS Architecture



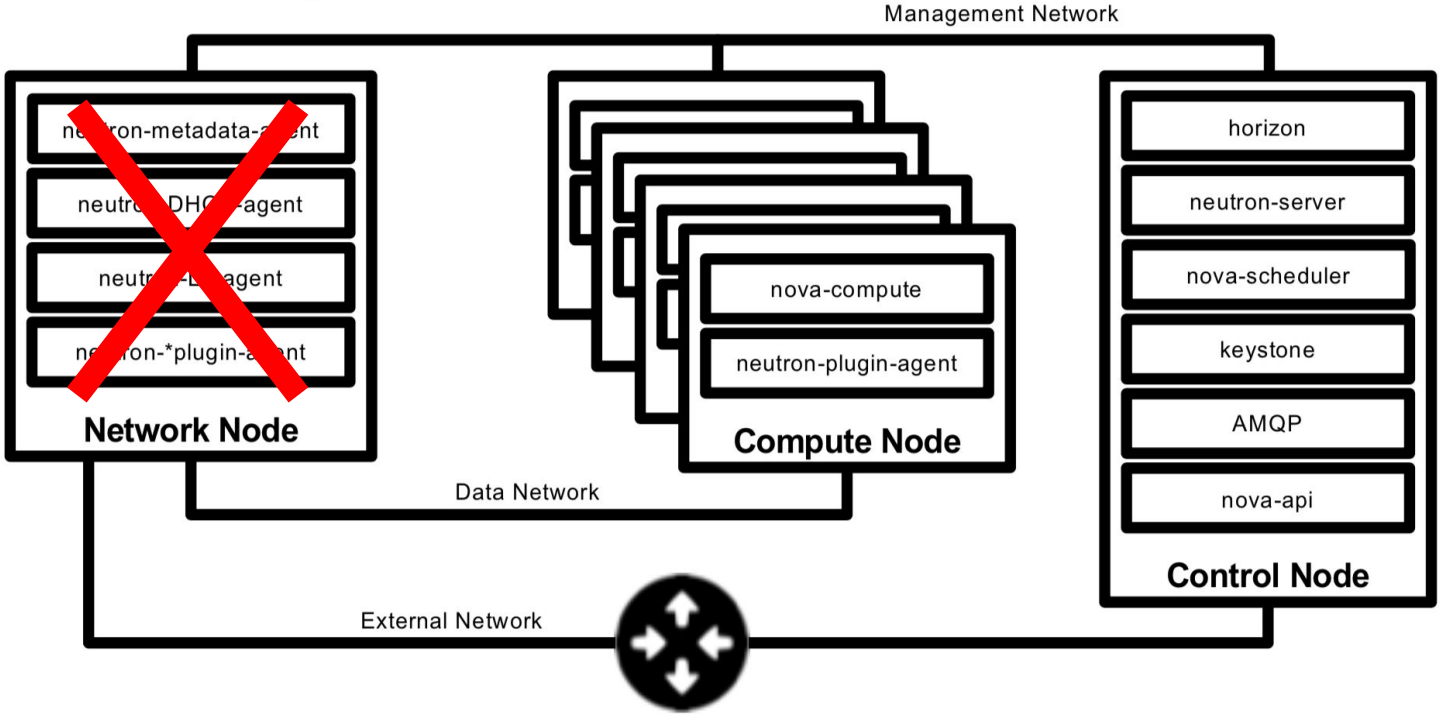
ONOS Applications (Internal and External)



ONOS SONA

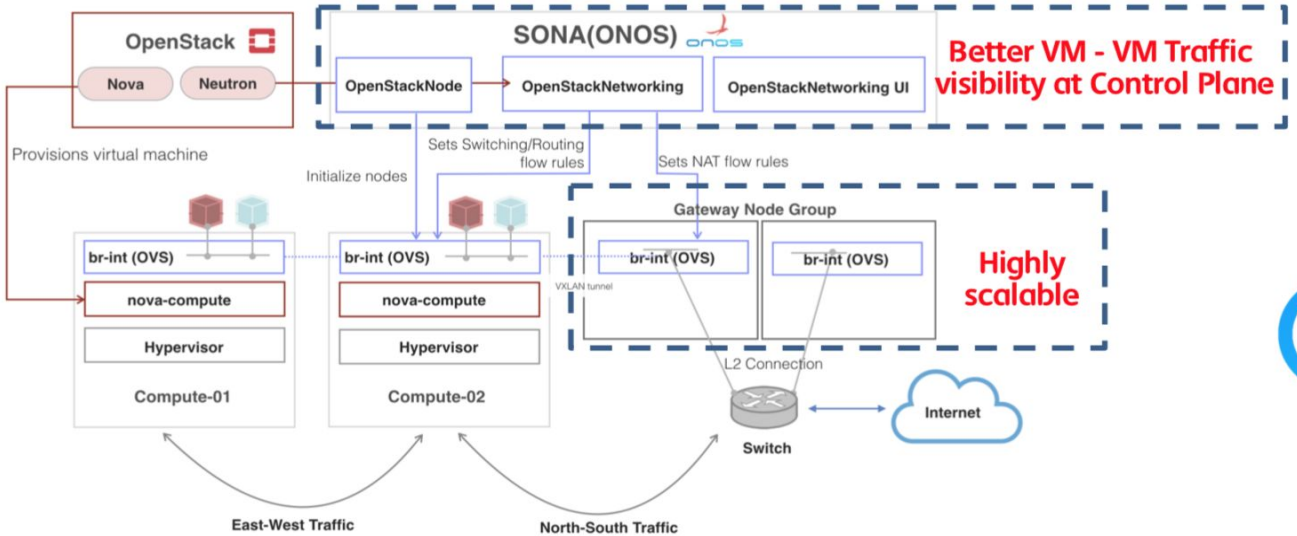
Why SONA?

- **Limitation of Neutron network**
  - Limited visibility of VM traffic
  - Limited scalability of network node



SONA (Simplified Overlay Networking Architecture)

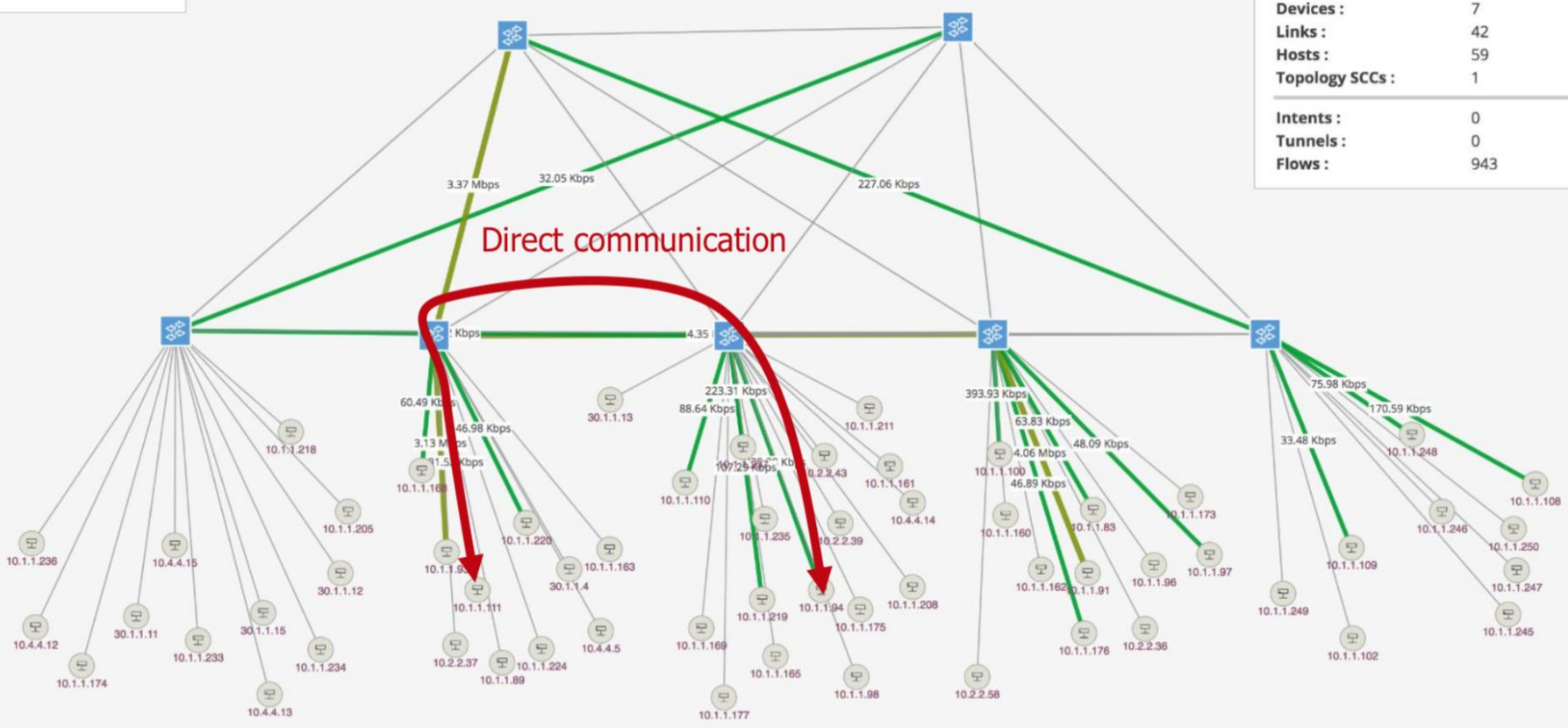
- **SONA: Overlay Network Management Solution for SDDC**
  - ONOS based Virtual Network Management solution
  - Support various **network types** and **DPA models**
    - Virtual network types: **VxLAN, VLAN, FLAT, GENEVE, GRE**
    - DPA models: **OVS-DPDK, SR-IOV, PCI-PT, SmartNIC (OVS embedded)**
  - **Scalable gateway,** fully compatible with **OpenStack** (mitaka ~ stein)

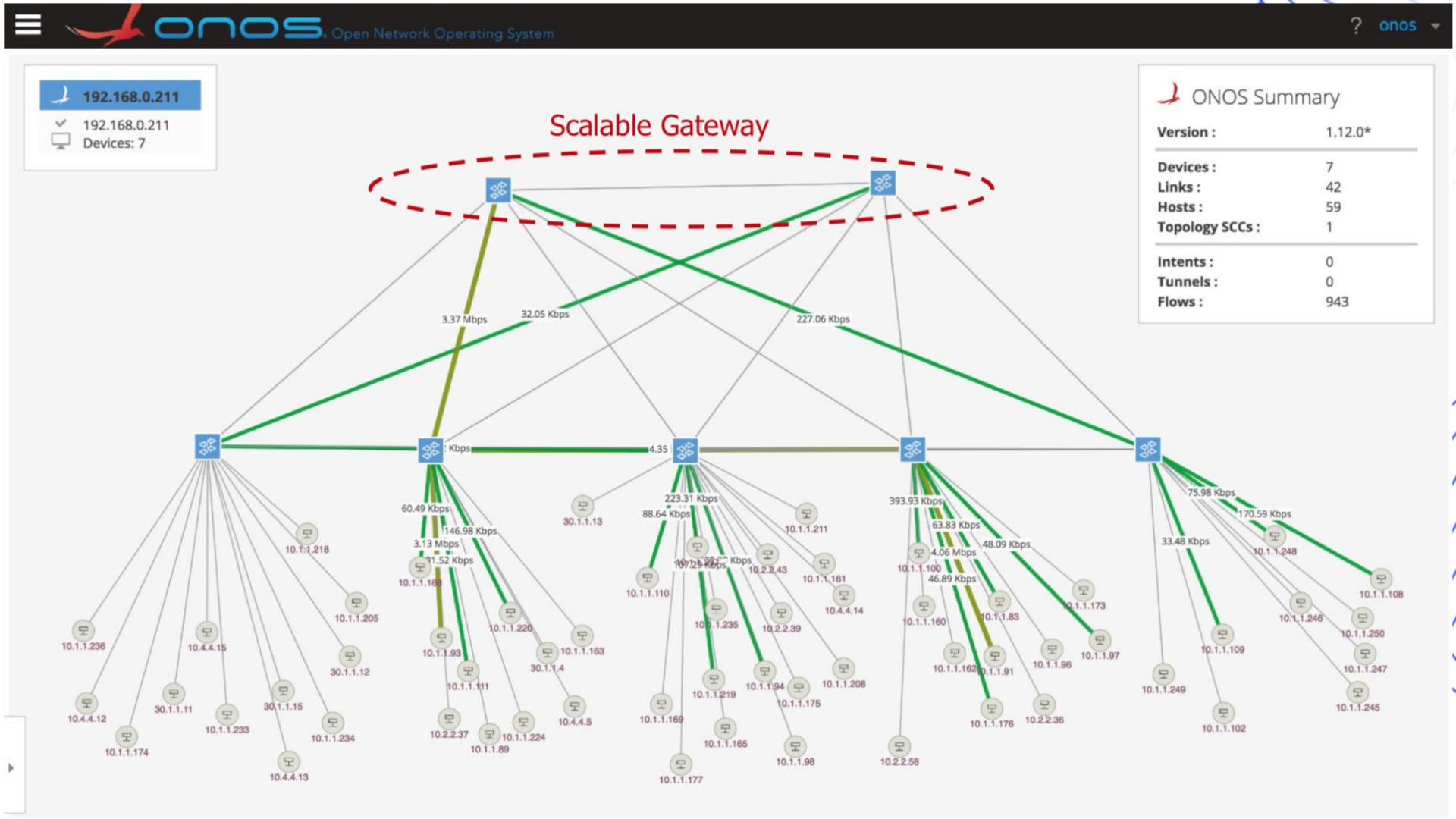


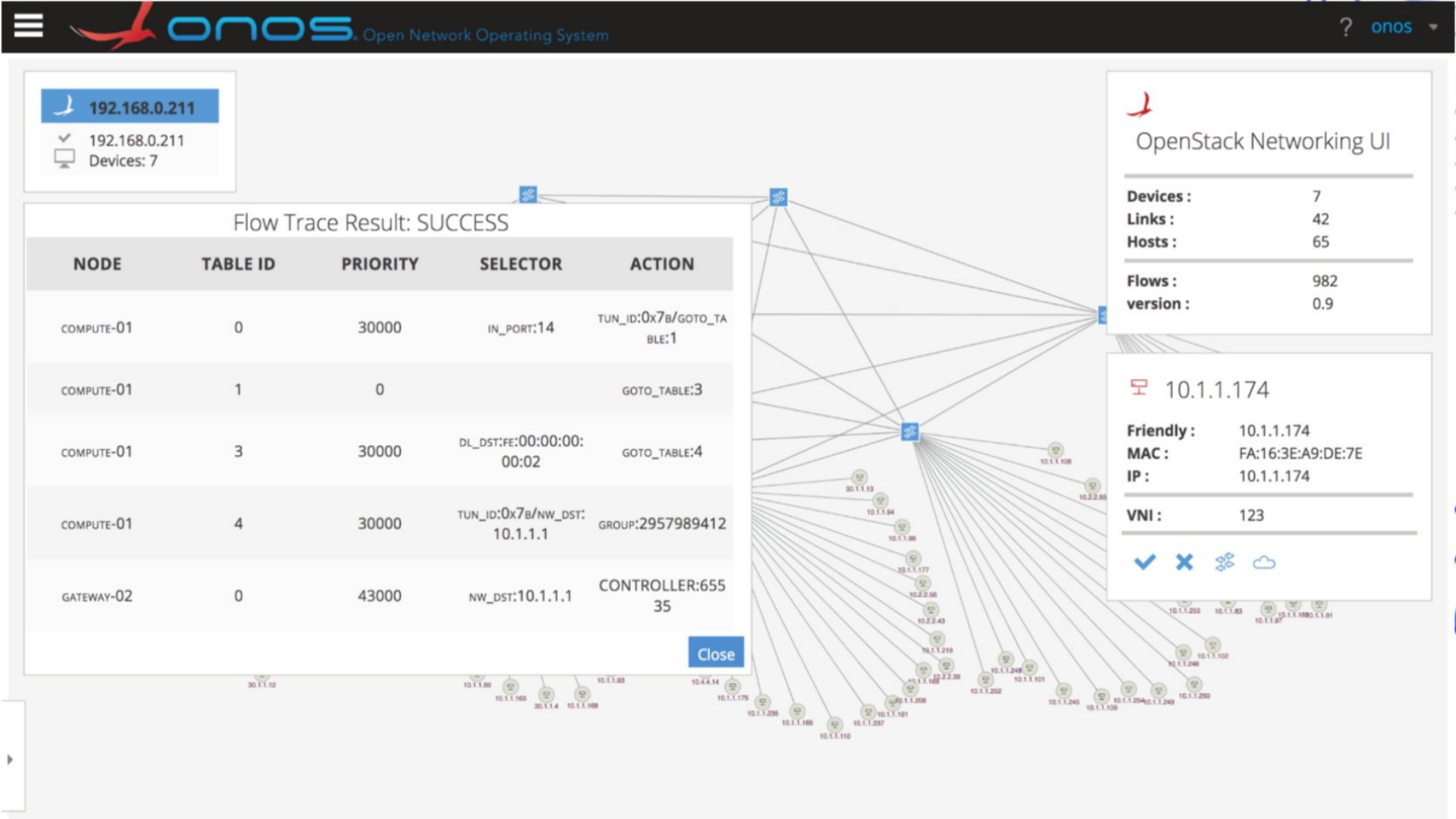
192.168.0.211
192.168.0.211
Devices: 7

ONOS Summary

Version :	1.12.0*
Devices :	7
Links :	42
Hosts :	59
Topology SCCs :	1
Intents :	0
Tunnels :	0
Flows :	943



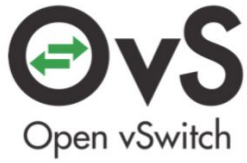

ONOS Open Network Operating System
onos
192.168.0.211
192.168.0.211
Devices: 7
Scalable Gateway
ONOS Summary
Version : 1.12.0*
Devices : 7
Links : 42
Hosts : 59
Topology SCCs : 1
Intents : 0
Tunnels : 0
Flows : 943
3.37 Mbps
32.05 Kbps
227.06 Kbps
60.49 Kbps
146.98 Kbps
3.13 Mbps
11.52 Kbps
88.64 Kbps
223.31 Kbps
393.93 Kbps
63.83 Kbps
4.06 Mbps
48.09 Kbps
46.89 Kbps
75.98 Kbps
170.59 Kbps
33.48 Kbps
10.1.1.218
10.1.1.205
10.1.1.236
10.4.4.15
30.1.1.12
10.4.4.12
30.1.1.11
30.1.1.15
10.1.1.233
10.1.1.234
10.1.1.174
10.4.4.13
10.1.1.168
10.1.1.220
10.1.1.93
10.1.1.163
30.1.1.4
10.1.1.111
10.2.2.37
10.1.1.89
10.1.1.224
10.4.4.5
30.1.1.13
10.1.1.211
10.1.1.110
10.2.2.43
10.1.1.161
10.4.4.14
10.1.1.235
10.2.2.39
10.1.1.208
10.1.1.219
10.1.1.94
10.1.1.175
10.1.1.169
10.1.1.165
10.1.1.98
10.1.1.177
10.1.1.100
10.1.1.160
10.1.1.173
10.1.1.83
10.1.1.97
10.1.1.162
10.1.1.91
10.1.1.96
10.1.1.176
10.2.2.36
10.2.2.58
10.1.1.108
10.1.1.248
10.1.1.246
10.1.1.250
10.1.1.247
10.1.1.249
10.1.1.109
10.1.1.245
10.1.1.102


onos
Open Network Operating System
onos
192.168.0.211
192.168.0.211
Devices: 7
Flow Trace Result: SUCCESS
NODE
TABLE ID
PRIORITY
SELECTOR
ACTION
COMPUTE-01
0
30000
IN_PORT:14
TUN_ID:0x7B/GOTO_TABLE:1
COMPUTE-01
1
0
GOTO_TABLE:3
COMPUTE-01
3
30000
DL_DST:FE:00:00:00:00:02
GOTO_TABLE:4
COMPUTE-01
4
30000
TUN_ID:0x7B/NW_DST:10.1.1.1
GROUP:2957989412
GATEWAY-02
0
43000
NW_DST:10.1.1.1
CONTROLLER:65535
Close
OpenStack Networking UI
Devices : 7
Links : 42
Hosts : 65
Flows : 982
version : 0.9
10.1.1.174
Friendly : 10.1.1.174
MAC : FA:16:3E:A9:DE:7E
IP : 10.1.1.174
VNI : 123

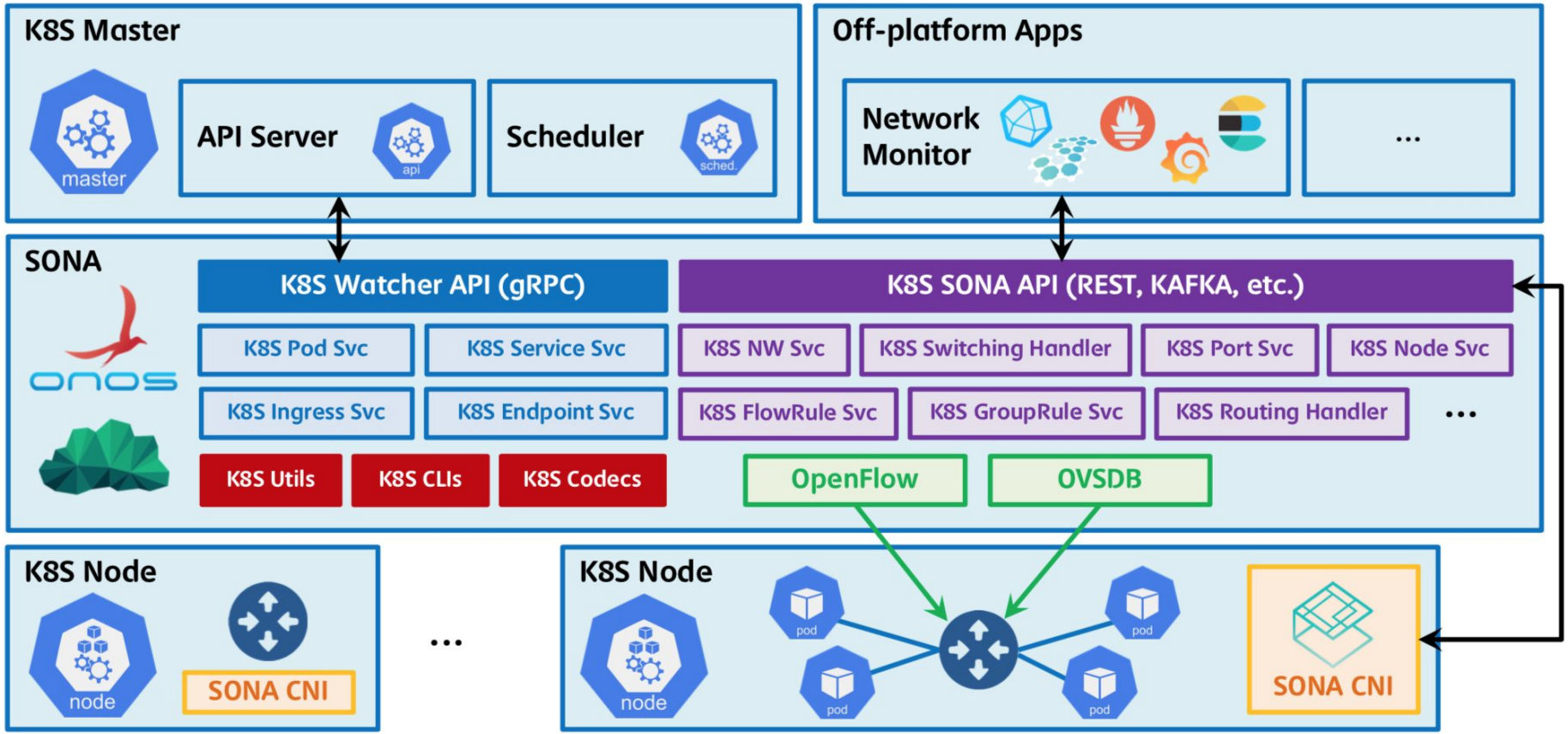
SONA-CNI for Kubernetes

SONA-CNI

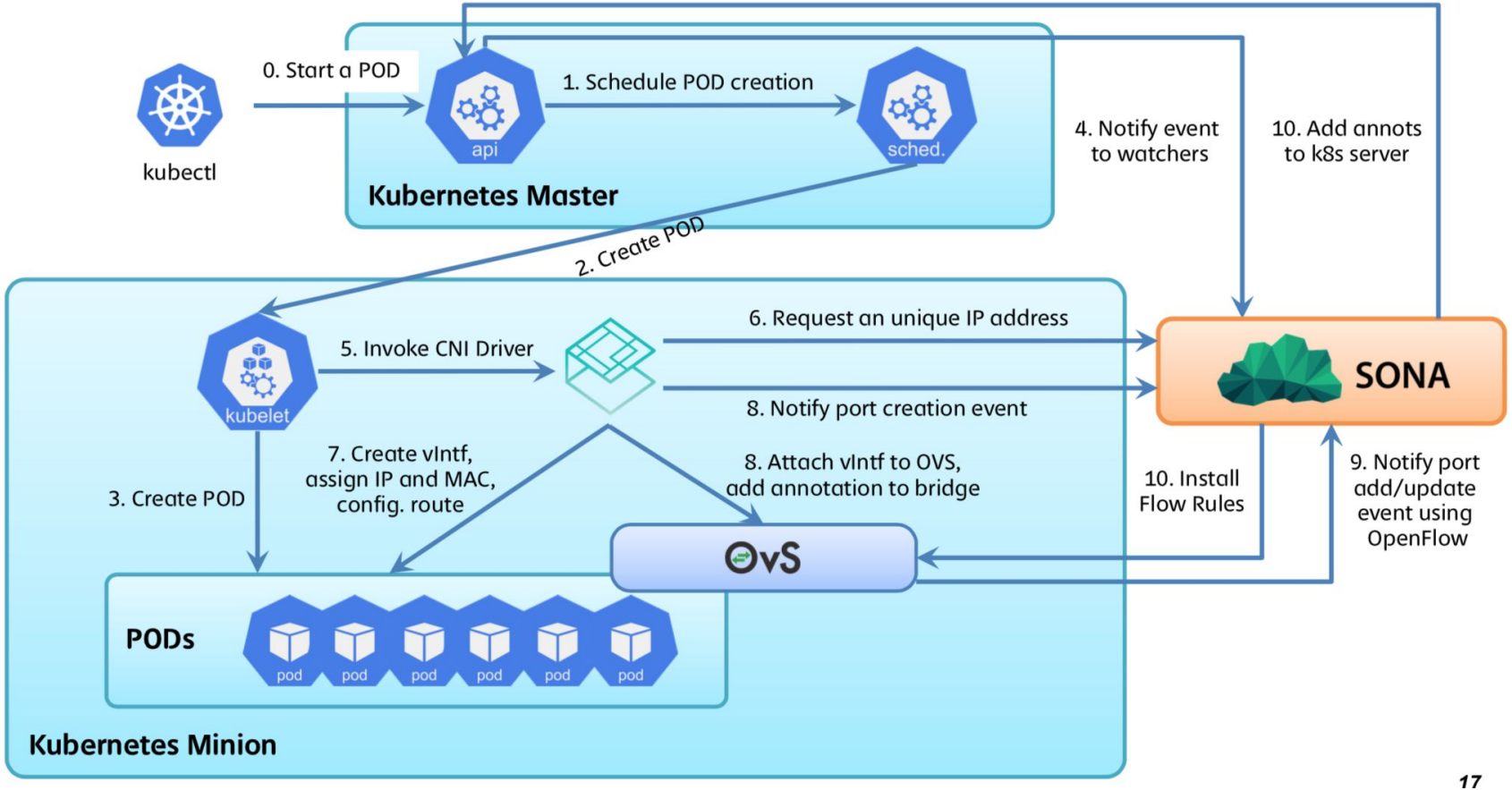
- **What is SONA-CNI**
  - An extension work of SONA
    - SONA: Simplified Overlay Networking Architecture
    - Originally aims to support **OpenStack** network
  - A pure **SDN (ONOS, OpenvSwitch)** based overlay solution
  - **100% open source**
  - Supports all **kubernetes** networking models
  - **Fully compatible** with kubernetes CNI, no change to kubernetes
  - Supports **multiple** tunneling protocols
    - VXLAN, GRE, GENEVE, etc.
  - **Line-rate** performance
    - Leverages data-plane acceleration technologies (DPDK, SmartNIC, etc.)
  - Provides container to container **traffic visibility**
    - Telemetry, vTap, etc



SONA-CNI Architecture



SONA-CNI with OpenvSwitch (OVS)



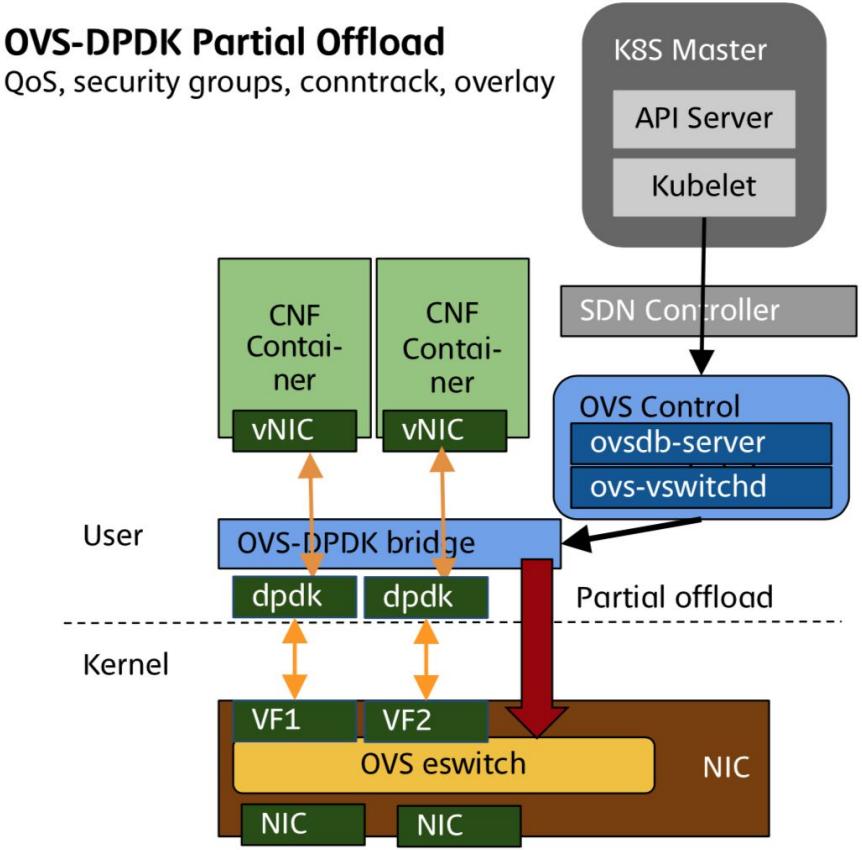
SONA-CNI

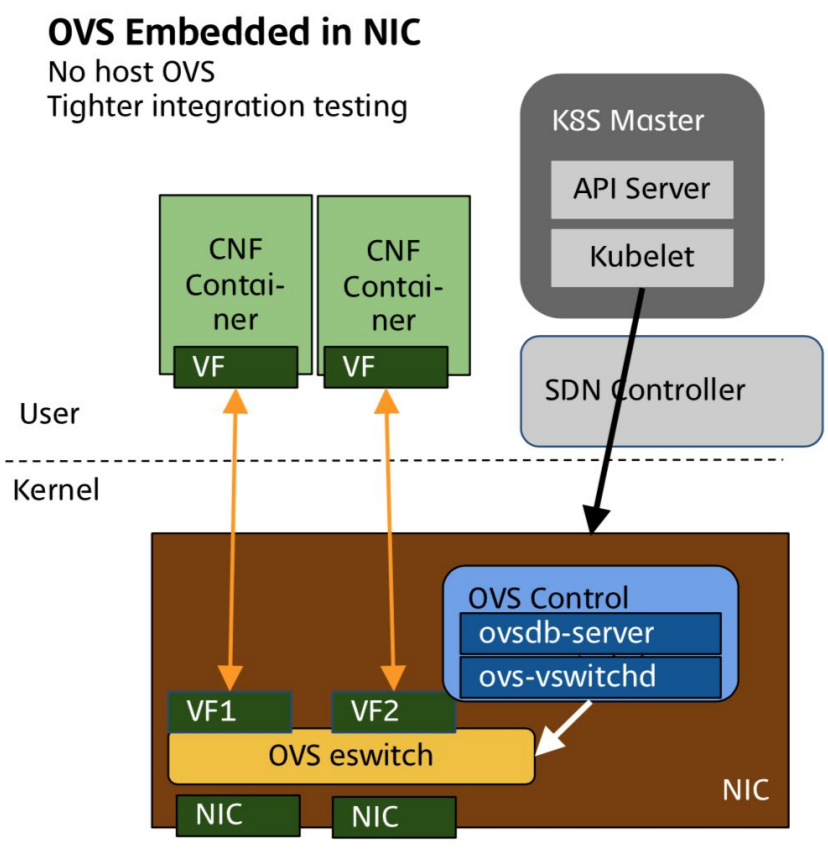
ONOS Controller and **Kubernetes** Master/Worker Integration

```
# kubectl get po -n kube-system
NAME                                                READY   STATUS    RESTARTS   AGE
coredns-5c98db65d4-98wkp                            1/1     Running   2          59m
coredns-5c98db65d4-b5h6b                            1/1     Running   2          59m
etcd-ubuntu-test-maste  Hint: double-click to select code  1/1  Running  0        59m
kube-apiserver-ubuntu-test-master                   1/1     Running   0          59m
kube-controller-manager-ubuntu-test-master          1/1     Running   0          59m
kube-scheduler-ubuntu-test-master                   1/1     Running   0          59m
sona-atomix-0                                       1/1     Running   0          59m
sona-dummy-cr6ch                                    1/1     Running   0          59m
sona-dummy-z72p8                                    1/1     Running   0          59m
sona-node-b4mp8                                     2/2     Running   0          59m
sona-node-n521x                                     2/2     Running   0          59m
sona-onos-0                                         1/1     Running   0          59m
sona-onos-config-0                                  1/1     Running   0          59m
tiller-deploy-54f7455d59-gtp4m                      1/1     Running   0          59m
```

```
onos> k8s-nodes -j
[ {
  "hostname" : "k8s-master",
  "type" : "MASTER",
  "state" : "COMPLETE",
  "managementIp" : "10.1.1.29",
  "integrationBridge" : "of:0000000000000001",
  "externalBridge" : "of:0000000000000002",
  "dataIp" : "10.1.1.29",
  "externalInterface" : "eth2",
  "externalBridgeIp" : "172.16.230.2",
  "externalGatewayIp" : "172.16.230.1"
}, {
  "hostname" : "k8s-worker1",
  "type" : "MINION",
  "state" : "COMPLETE",
  "managementIp" : "10.1.1.11",
  "integrationBridge" : "of:0000000000000003",
  "externalBridge" : "of:0000000000000004",
  "dataIp" : "10.1.1.11",
  "externalInterface" : "eth2",
  "externalBridgeIp" : "172.16.230.11",
  "externalGatewayIp" : "172.16.230.1"
}, {
  "hostname" : "k8s-worker2",
  "type" : "MINION",
  "state" : "COMPLETE",
  "managementIp" : "10.1.1.21",
  "integrationBridge" : "of:0000000000000005",
  "externalBridge" : "of:0000000000000006",
  "dataIp" : "10.1.1.21",
  "externalInterface" : "eth2",
  "externalBridgeIp" : "172.16.230.4",
  "externalGatewayIp" : "172.16.230.1"
} ]
```

OVS Offload - Virtio Option for Container





Kubernetes CNI Comparison

		Flannel	Calico	Openshift SDN	NSX-T	SONA
Datastore		etcd	etcd	etcd	NSX Manager	Atomix
Overlay		Def: VXLAN, None Exp: IP-in-IP	None, IP-in-IP	VXLAN	GENEVE	VXLAN, GENEVE, GRE
Network policy	Mechanism	-	iptables/istio	iptables/OVS	vDS	OVS
	App policy	-	HTTP method/path	No	No	No
Load balancer	N-S	-	-	-	NSX LB	In progress...
	E-W	iptables	iptables	OVS	vDS	OVS
VM N/W support		No	No	No	Yes	Yes
Visibility Tools		External (prometheus)	External (Prometheus)	External (Prometheus)	Built-in (vFlow, mirroring)	Hybrid (vFlow, mirroring)
HW acceleration		No	No	No	Yes	Yes
Open source		Yes	Yes	Yes	No	Yes

Open Source Community

- **Installation Guide** (Step-by-step & Ansible Script)

  https://wiki.onosproject.org/display/ONOS/SONA-CNI+Installation

  https://github.com/sonaproject/k8s-sona-ansible

- **Source Code** (SONA-CNI & K8S ONOS Apps)

  https://github.com/sonaproject/sona-cni

  https://github.com/opennetworkinglab/onos/tree/master/apps/k8s-node

  https://github.com/opennetworkinglab/onos/tree/master/apps/k8s-networking

- **Slack Channel**

  #sonaproject @ onosproject.slack.com

Special Thanks:

Jian Li

gunine@sk.com

Terima Kasih!

aris@onos-ambassadors.org