ONOS Northbound Interfaces

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Outline

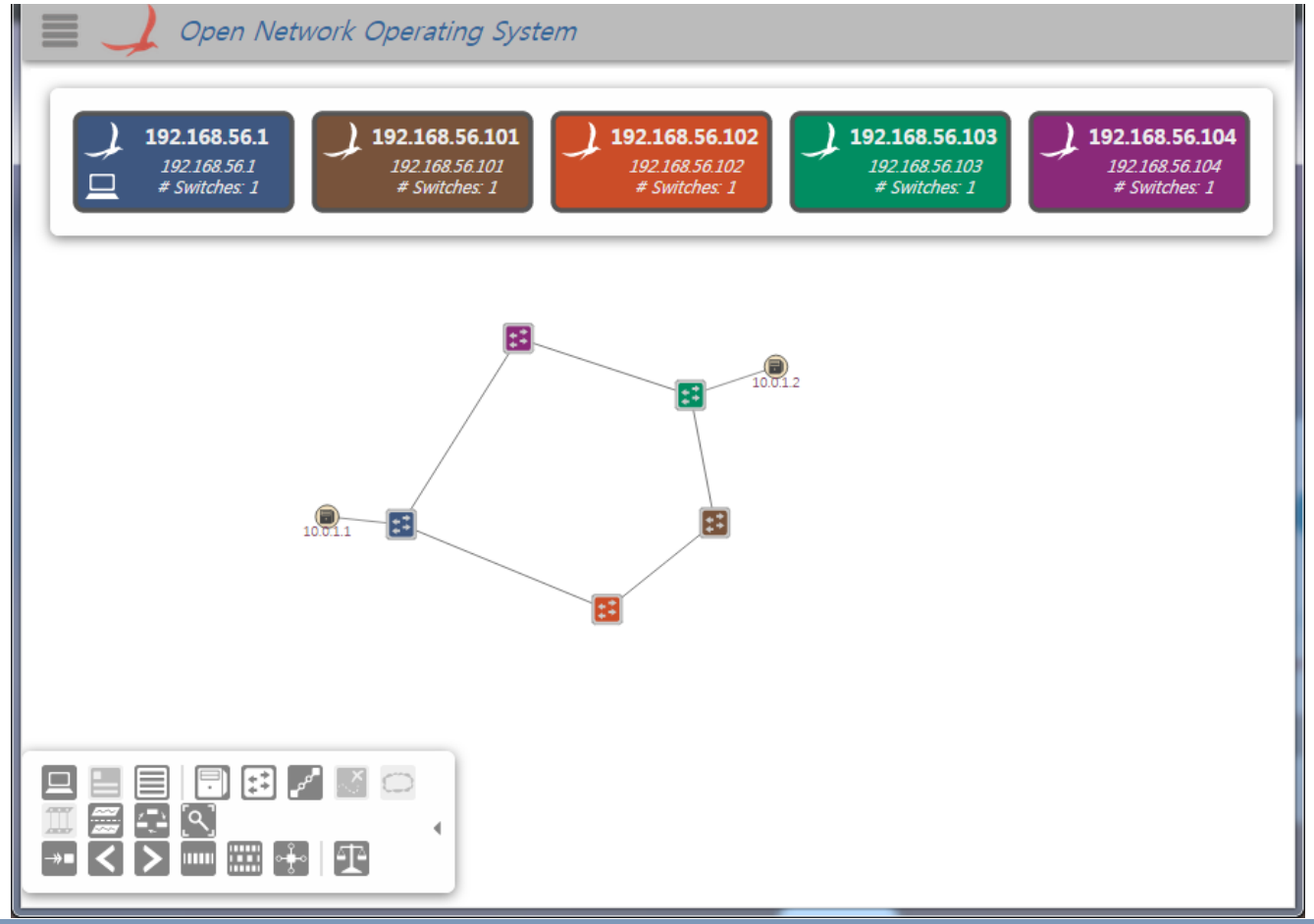
ONOS Interface

- Web GUI
- CLI
- REST API

ONOS Web GUI (1/17)

❖ ONOS (Web) GUI Overview

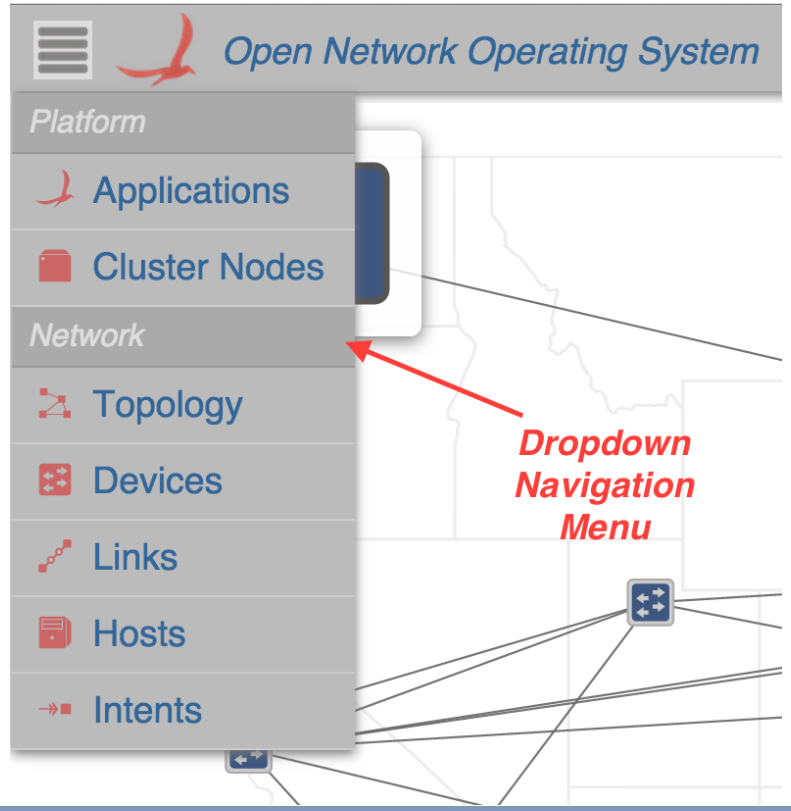
- A single-page web application
- Accessible through the URL http://onos_ip:8181/onos/ui



ONOS Web GUI (2/17)

❖ GUI Navigation

- Platform
  - Bundle installation, instance mgmt.
- Network
  - Network related resource mgmt.

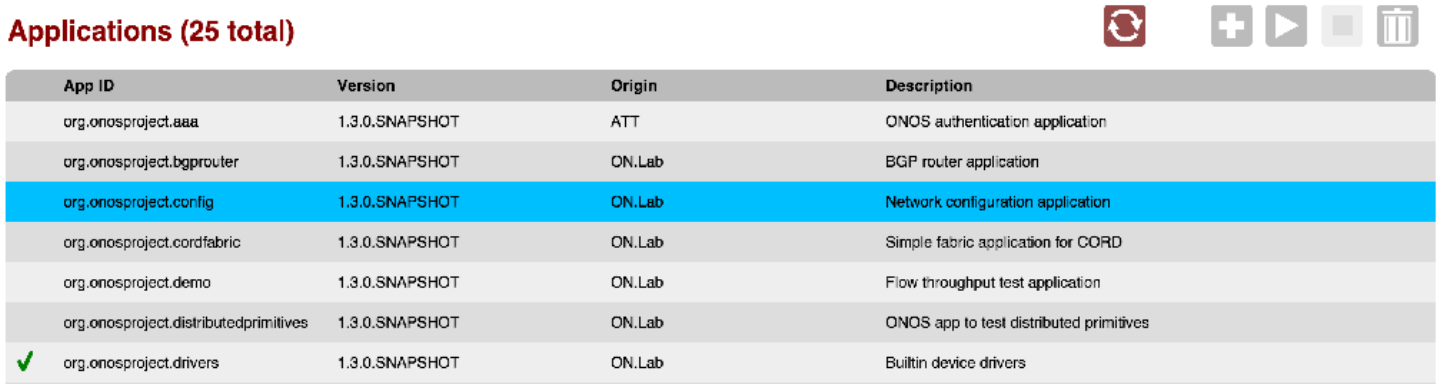


View	Description
Applications	A listing of applications installed
Cluster Nodes	A top level listing of all the cluster nodes, or instances in the network
Topology	An interactive visualization of the network topology (indication of which devices are mastered by each ONOS instance)
Devices	A top level listing of the devices
Links	A top level listing of all links
Hosts	A top level listing of all the hosts
Intents	A top level listing of all intents
Flows	A top level listing of all flows for a selected device
Ports	A top level listing of all ports for a selected device
Groups	A top level listing of all the groups for a selected device

ONOS Web GUI (3/17)

❖ Application View

- Active vs. Installed
  - Active: applications are installed and running
  - Installed: applications are installed but not running

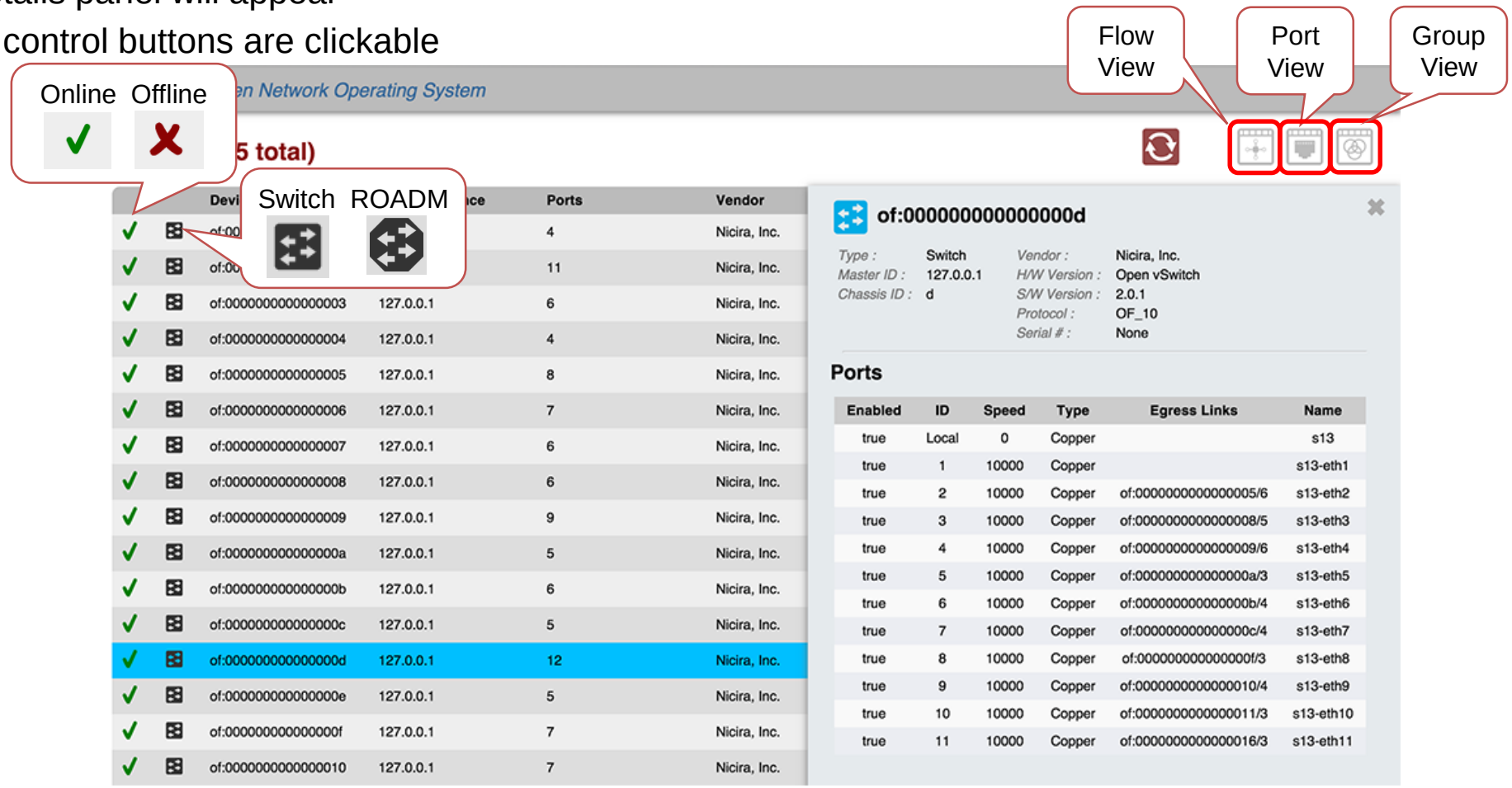


Icon	Action	Description
	Install	Bring up a file explorer so that you can upload an .oar file with your ONOS application directly
	Activate	Change the state of the current application from INSTALLED to ACTIVE
	Deactivate	Change the state of the current application from ACTIVE to INSTALLED
	Uninstall	Uninstall the current application

ONOS Web GUI (4/17)

❖ Device View

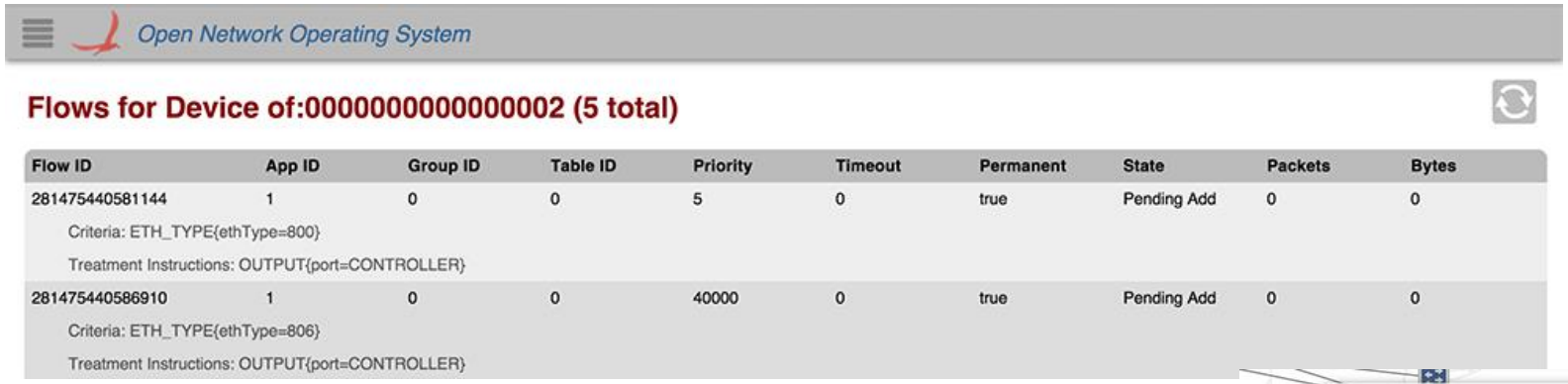
- When a row is selected
  - A details panel will appear
  - The control buttons are clickable



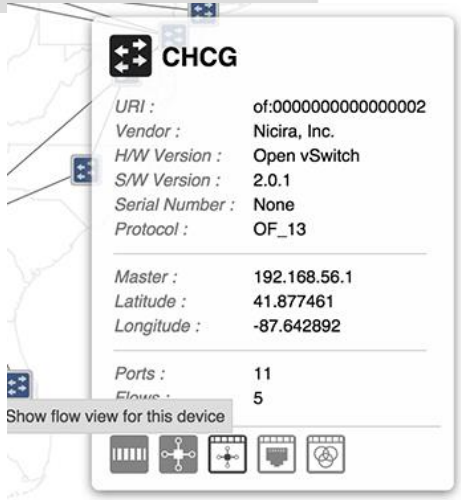
ONOS Web GUI (5/17)

❖ Flow View

- List up the flows which are scrollable inside the table body
  - Criteria: matching fields
  - Treatment instruction: actions to take for matched packets



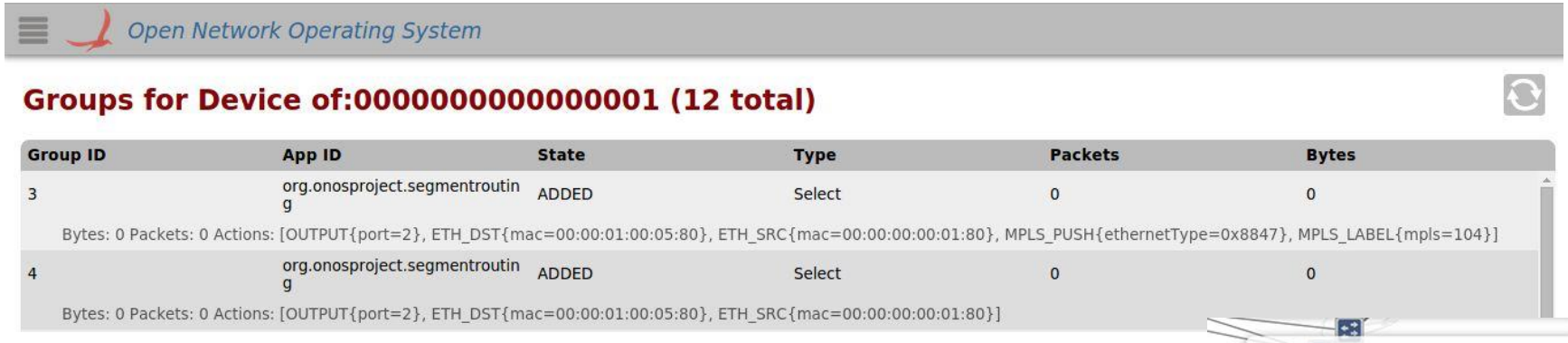
- Two ways of navigating to the Flow View
  - Topology view → select a device → click flow view icon
  - Device view → select a device → click flow view icon
- Query string via URL
  - List up the flows which are belonging to a device
    - E.g., http://localhost:8181/onos/ui/index.html#/flow?devId=of:0000000000000002



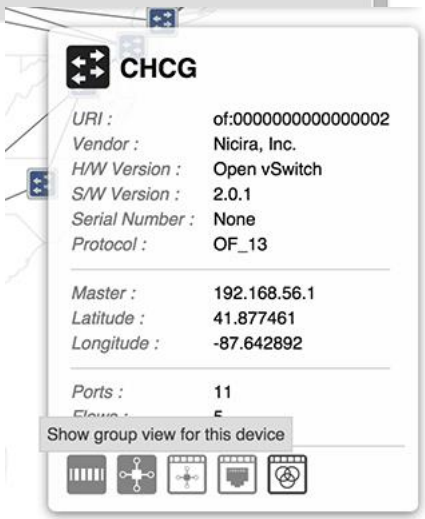
ONOS Web GUI (6/17)

❖ Group View

- List up all groups of a selected device
  - Group: consists of a set of flow rules
  - Similar to the group entries that stored in group table in OpenFlow protocol



- Two ways of navigating to the Group View
  - Topology view → select a device → click group view icon
  - Device view → select a device → click group view icon
- Query string via URL
  - List up the flows which are belonging to a device
    - E.g., http://localhost:8181/onos/ui/index.html#/group?devId=of:0000000000000002



ONOS Web GUI (7/17)

❖ Host View

	Host ID	MAC Address	VLAN ID	IP Addresses	Location
	00:00:00:00:00:01/-1	00:00:00:00:00:01	-1	10.0.0.1	of:0000000000000001/1
	00:00:00:00:00:02/-1	00:00:00:00:00:02	-1	10.0.0.2	of:0000000000000002/1
	00:00:00:00:00:03/-1	00:00:00:00:00:03	-1	10.0.0.3	of:0000000000000003/1
	00:00:00:00:00:04/-1	00:00:00:00:00:04	-1	10.0.0.4	of:0000000000000004/1
	00:00:00:00:00:05/-1	00:00:00:00:00:05	-1	10.0.0.5	of:0000000000000005/1

❖ Intent View

	Port 1	Port 2	Type	Direction	Durable
✓	of:0000000000000001/2	of:0000000000000019/2	Direct	A <--> B	false
✓	of:0000000000000001/3	of:0000000000000006/3	Direct	A <--> B	false
✓	of:0000000000000002/4	of:0000000000000006/4	Direct	A <--> B	false
✓	of:0000000000000002/6	of:000000000000000f/2	Direct	A <--> B	false
✓	of:0000000000000003/2	of:0000000000000002/3	Direct	A <--> B	false

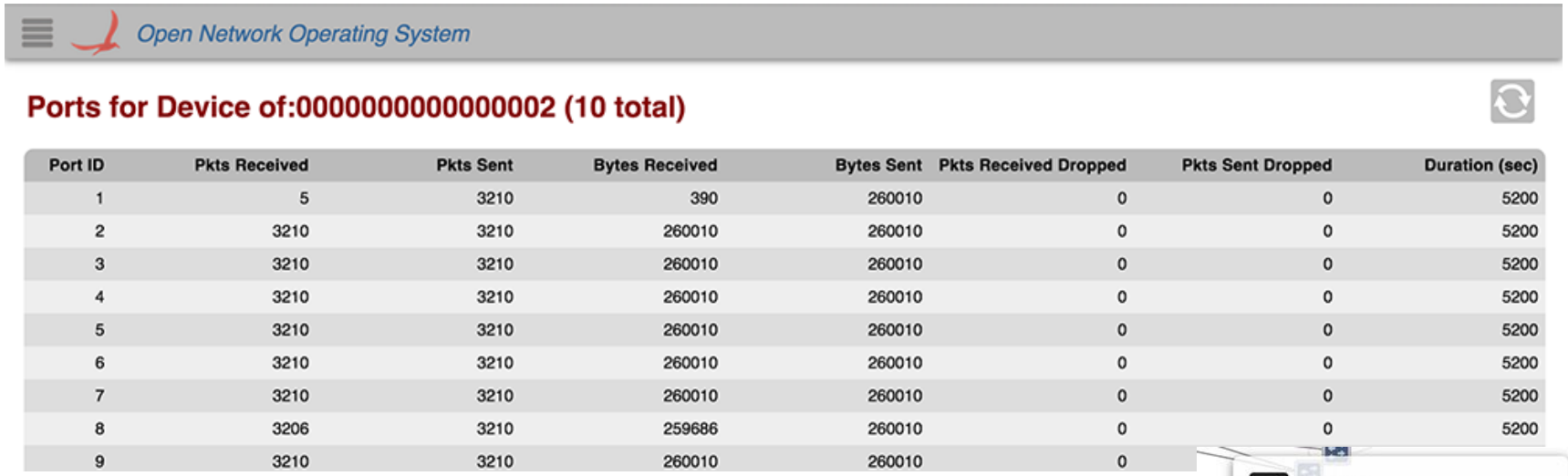
❖ Link View

Application ID	Key	Type	Priority
29 : org.onosproject.cli-random	0x57	HostToHostIntent	100
Resources: 00:00:00:00:00:04/-1, 00:00:00:00:00:17/-1			
Details: Host 1: 00:00:00:00:00:04/-1, Host 2: 00:00:00:00:00:17/-1			
29 : org.onosproject.cli-random	0x20	HostToHostIntent	100
Resources: 00:00:00:00:00:02/-1, 00:00:00:00:00:0B/-1			
Details: Host 1: 00:00:00:00:00:02/-1, Host 2: 00:00:00:00:00:0B/-1			

ONOS Web GUI (8/17)

❖ Port View

- List up all ports of a selected device



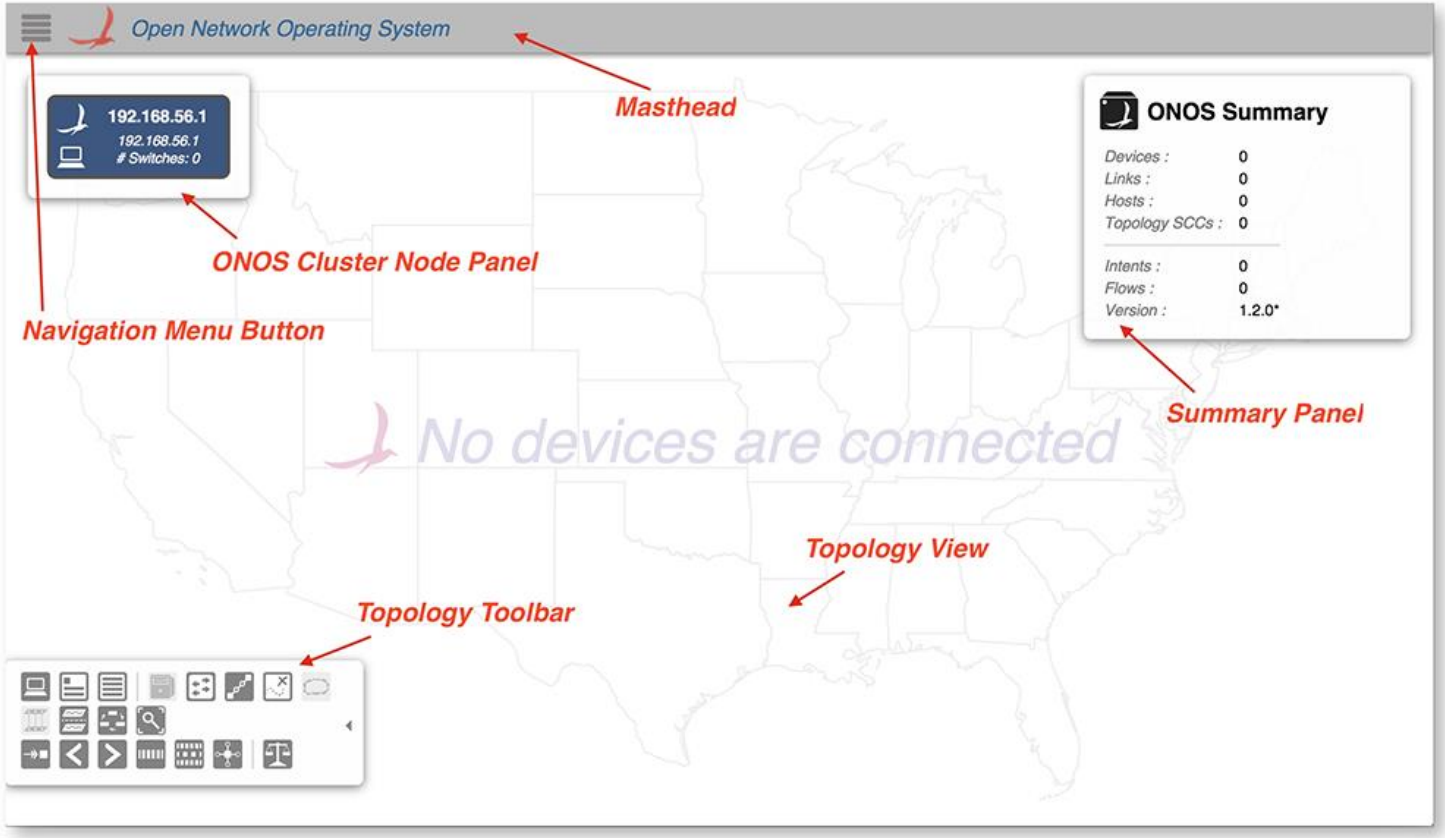
Port ID	Pkts Received	Pkts Sent	Bytes Received	Bytes Sent	Pkts Received Dropped	Pkts Sent Dropped	Duration (sec)
1	5	3210	390	260010	0	0	5200
2	3210	3210	260010	260010	0	0	5200
3	3210	3210	260010	260010	0	0	5200
4	3210	3210	260010	260010	0	0	5200
5	3210	3210	260010	260010	0	0	5200
6	3210	3210	260010	260010	0	0	5200
7	3210	3210	260010	260010	0	0	5200
8	3206	3210	259686	260010	0	0	5200
9	3210	3210	260010	260010	0		

- Two ways of navigating to the Port View
  - Topology view → select a device → click port view icon
  - Device view → select a device → click port view icon
- Query string via URL
  - List up the flows which are belonging to a device
    - E.g., http://localhost:8181/onos/ui/index.html#/port?devId=of:0000000000000002

ONOS Web GUI (9/17)

❖ Topology View

- A visual overview of the network topology
- Establish a web socket connection with ONOS instance
  - Exchange the event message to determine the topology state



ONOS Web GUI (10/17)

❖ Topology View

- Toolbar

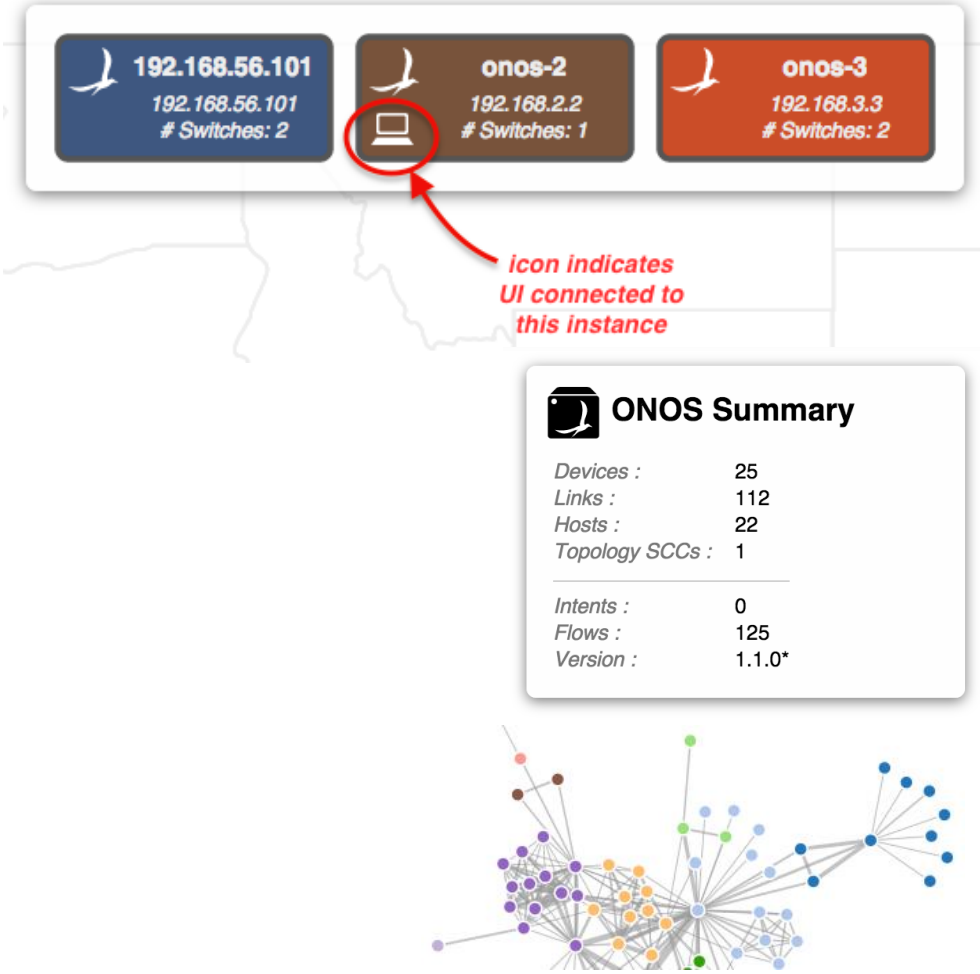
Icon	Key	Description
	I	Toggle ONOS instances panel
	O	Toggle ONOS summary panel
	D	Disable / enable details panel
	H	Toggle host visibility
	M	Toggle offline visibility
	P	Toggle port highlighting
	B	Toggle background map
	S	Toggle sprite layer

Icon	Key	Description
	N	Cycle node layers
	L	Cycle device labels
	R	Reset pan / zoom
	V	Show all related intents
	W	Monitor traffic of selected intent
	A	Monitor all traffic
	F	Show device link flows
	E	Equalize mastership roles

ONOS Web GUI (11/17)

❖ Topology View

- Instance panel
  - Show the instance ID, IP, # of switches
  - Color coding shows controller mastership
- Summary panel
  - Show a brief summary of network properties
    - Devices, links, hosts, intents, flows, versions, etc.
- Nodes and links
  - Undirected graph of nodes and links
    - Nodes → devices (switches) and hosts
    - Links → network links
  - Initial layout of the nodes and links
    - Provided by the use of **D3 Force Layout** algorithm
  - Layout customization
    - **onos-topo-cfg** command can be used to upload topology meta-data to the server
    - Include longitude/latitude information for each of the nodes

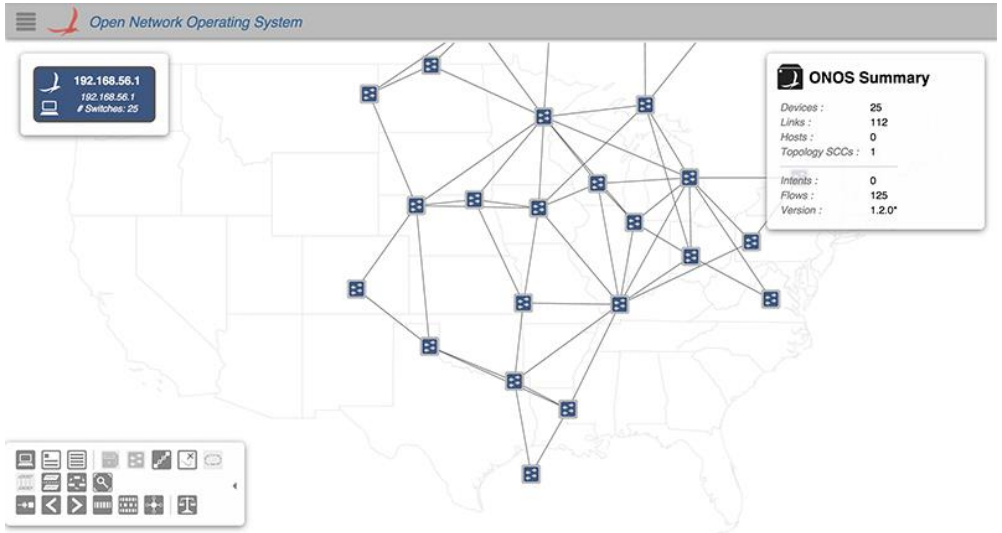


ONOS Web GUI (12/17)

❖ Topology View

- Layout rearrangement
  - Topology generation
    - ONOS uses free-floating topology by default

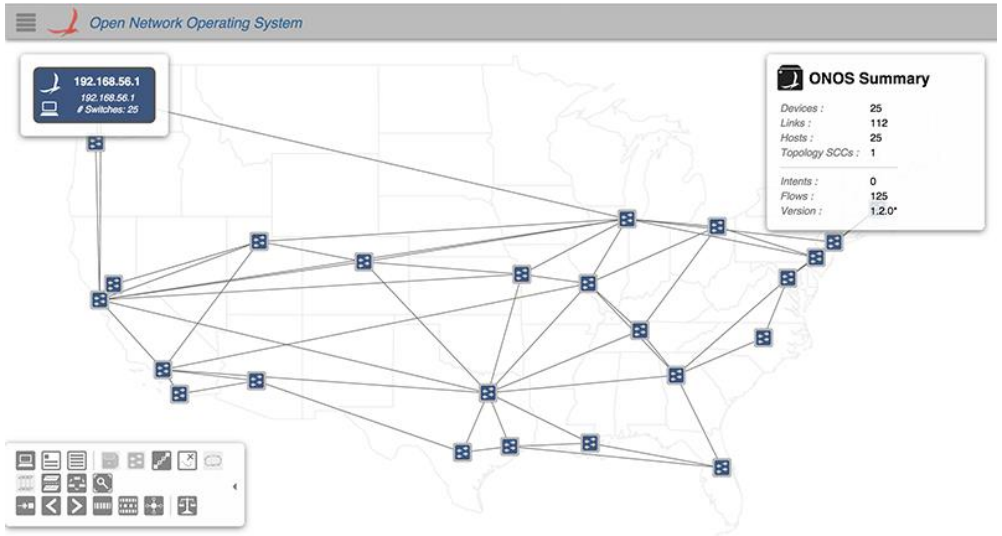
```
$ cd ~/onos/tools/test/topos
$ sudo python ./att-onos.py $OC1
```



  - Topology rearrangement
    - On receipt of the data, the server sends node updates to the GUI
    - Longitude/latitude data is used to calibrate node positions

```
$ cd ~/onos/tools/test/topos
$ onos-topo-cfg 127.0.0.1 attmpls.json
```

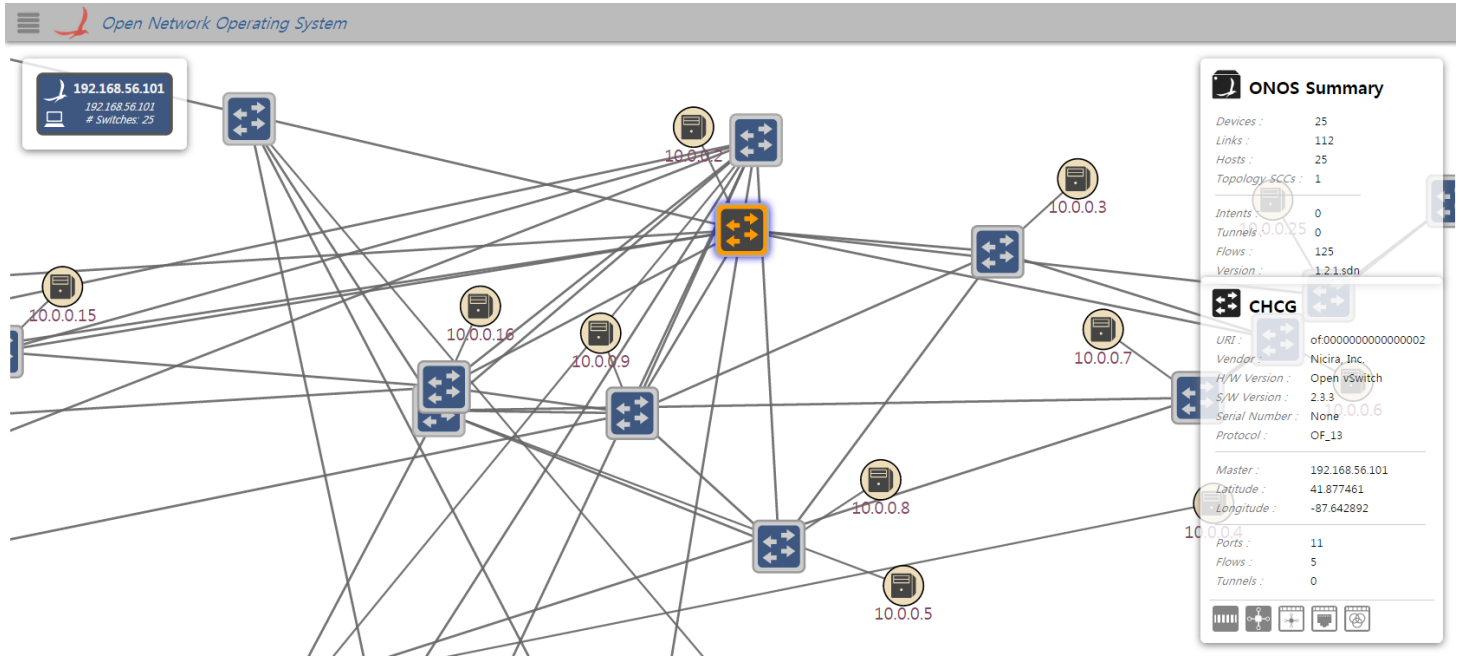
```
{ "alias":  "s1", "uri": "of:0000000000
00001", "mac": "000000000001", "annotations":
{ "name": "CMBR", "latitude": 42.373730,
"longitude": -71.109734  }, "type": "SWITCH" }
```



ONOS Web GUI (13/17)

❖ Topology View

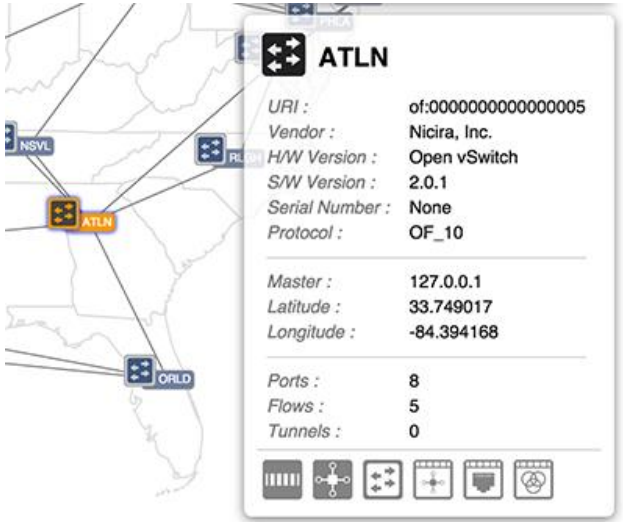
- Mouse gestures
  - Node reposition
    - Click & drag to a new location
  - Multiple selection
    - Hold shift key + click on node
  - Release selection
    - Escape key
- Panning
  - cmd-drag (MAC)
  - alt-drag (Win)
- Zooming
  - cmd-scroll (MAC)
  - alt-scroll (Win)
- Reset panning & zooming
  - ‘R’ key



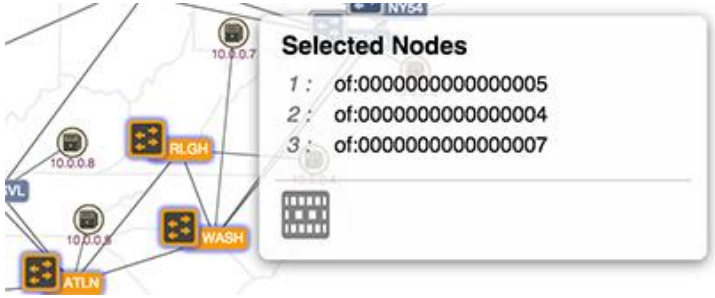
ONOS Web GUI (14/17)

❖ Topology View

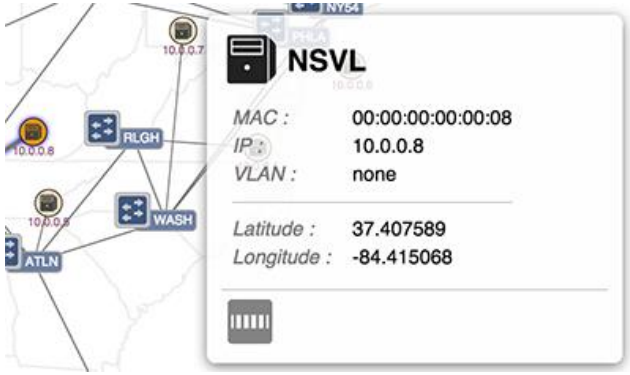
- Details panel (4 cases)
  - A single device is selected



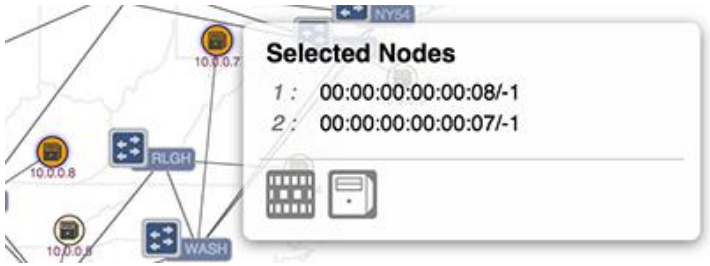
  - Multiple devices are selected



  - A single host is selected



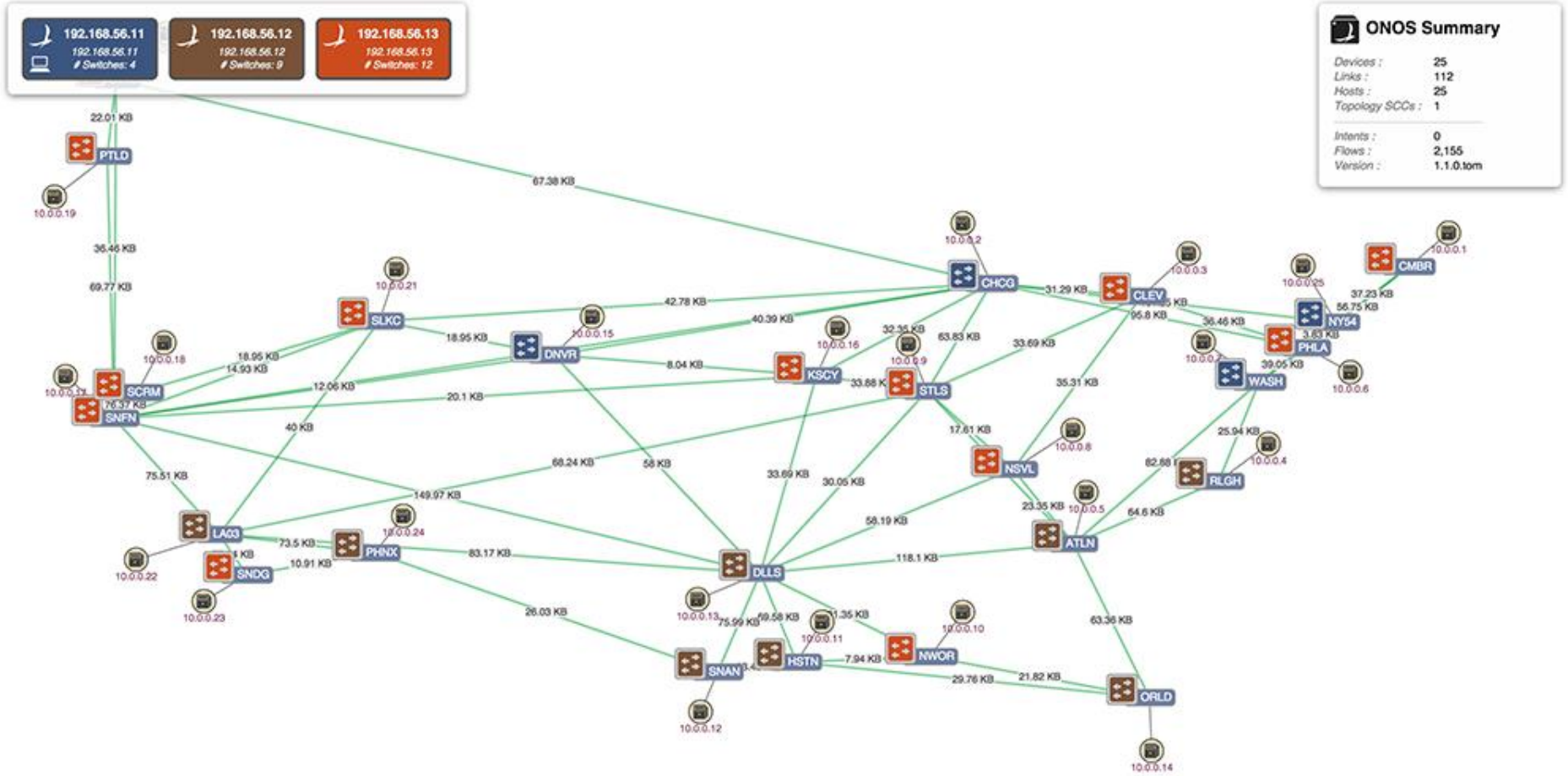
  - Exactly two hosts are selected



ONOS Web GUI (15/17)

❖ Topology View

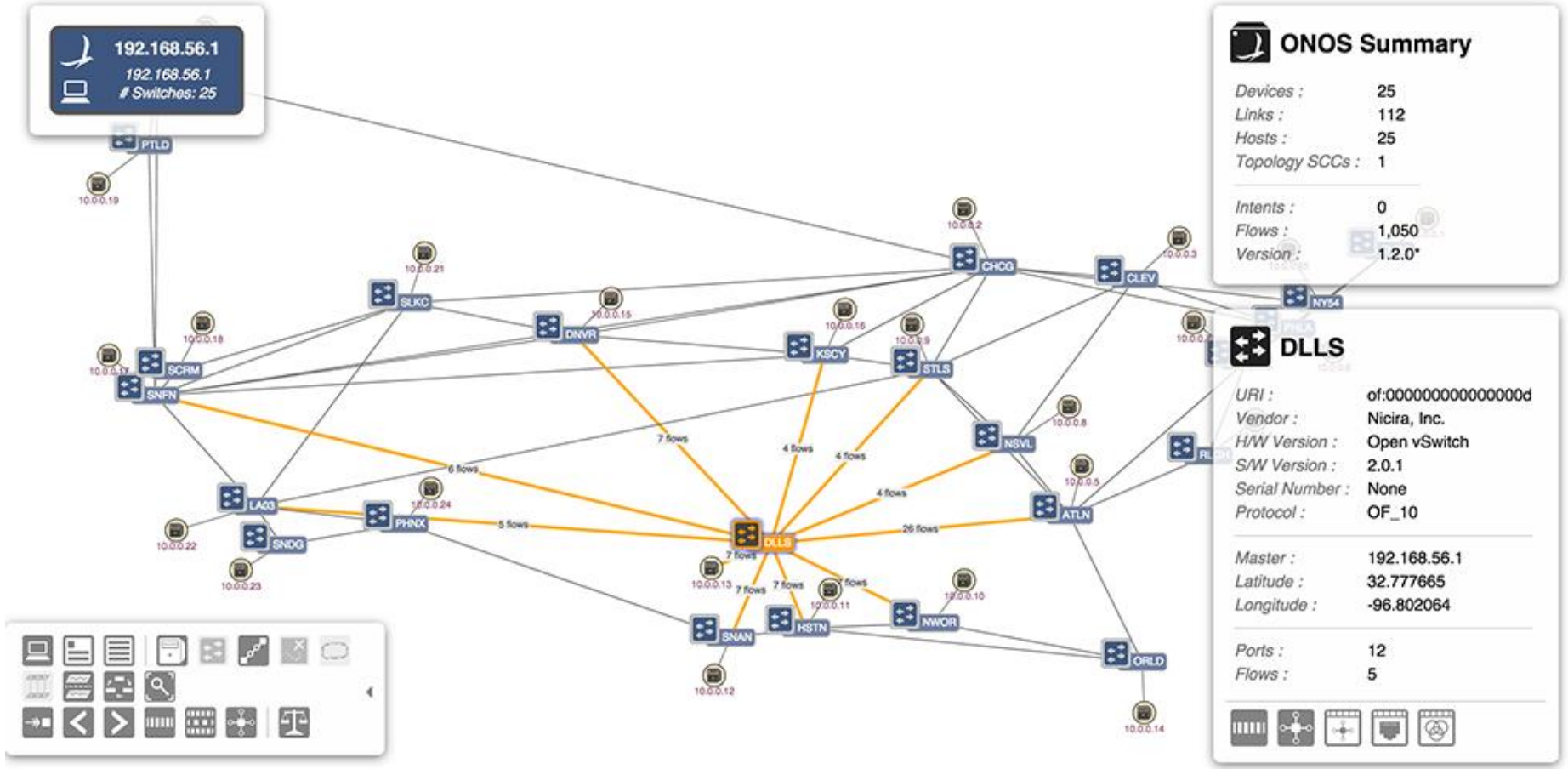
- Visualizing traffic
  - Press the ‘A’ key will display the traffic in green color



ONOS Web GUI (16/17)

❖ Topology View

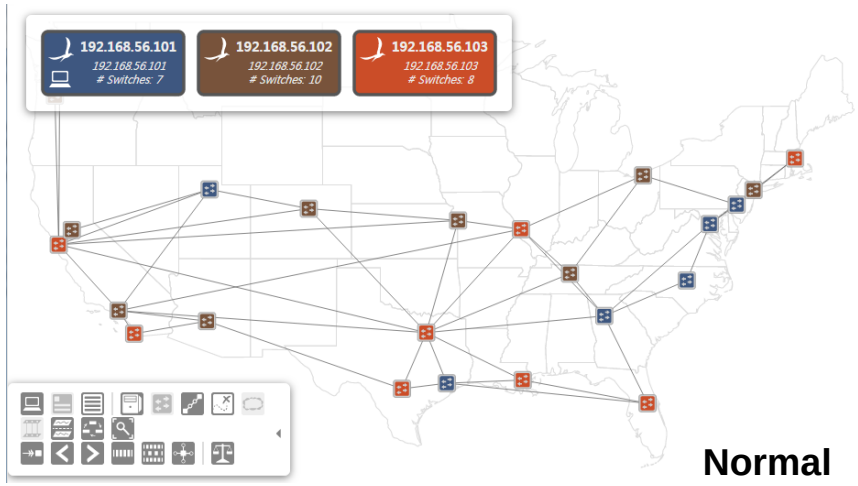
- Visualizing device link flows
  - Select a device, and press the ‘F’ key will display the # of flows egressing from it



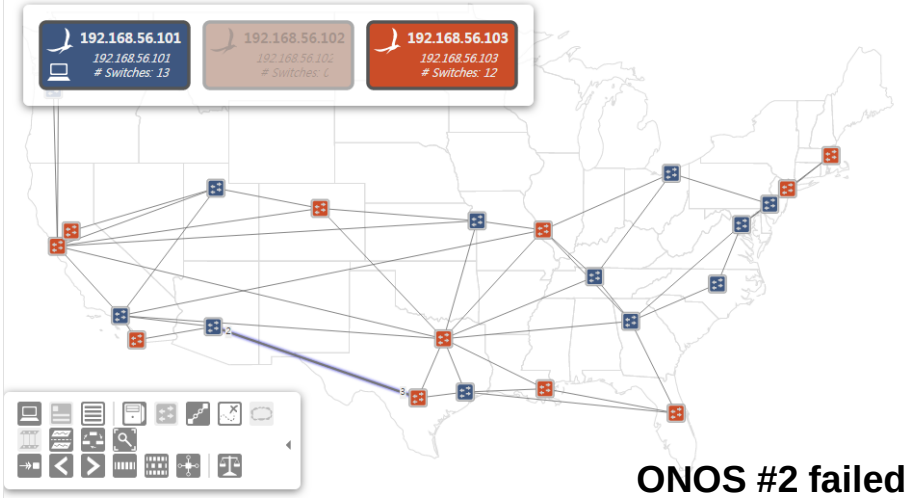
ONOS Web GUI (17/17)

❖ Topology View

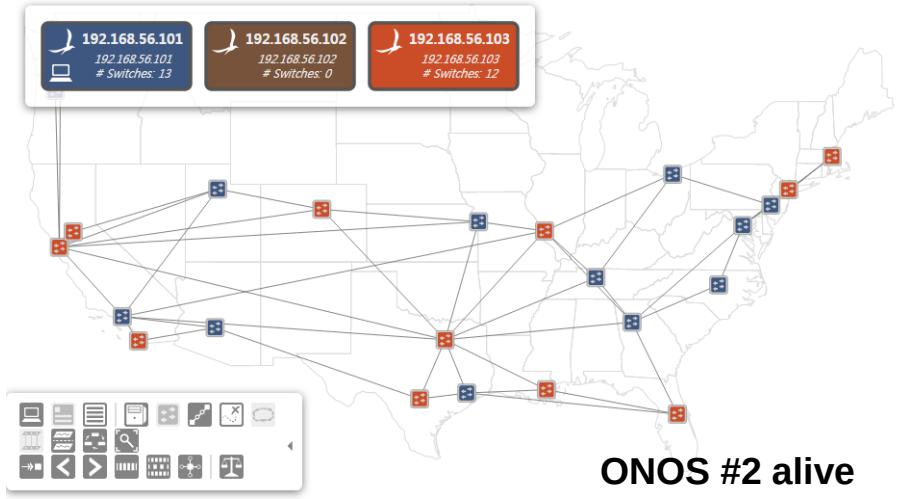
- Failover & mastership



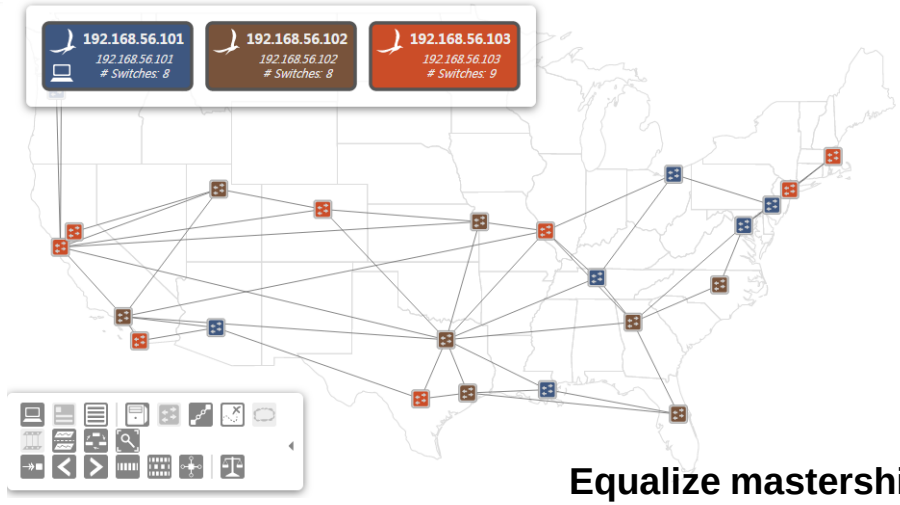
Normal



ONOS #2 failed



ONOS #2 alive



Equalize mastership

ONOS CLI

❖ ONOS CLI Overview

- An extension of Karaf's CLI
- Leverage features such programmatic extensibility
- Able to load and unload bundles and SSH access

❖ Access CLI

- Local installation
  - Access with the command ***karaf clean***
- Remote installation
  - Deploy with ***onos-package*** and ***onos-install*** command
  - Access with ***onos*** command

```
$ onos {$ip_address}
Logging in as karaf
Welcome to Open Network Operating System (ONOS)!
    ____  _  ______  ____
   / __ \/ |/ / __ \/ __/
  / /_/ /    / /_/ /\ \
  \____/_/|_/\____/___/

...
onos>
```

ONOS CLI

❖ ONOS Commands

- ONOS Supplies a set of its own commands
  - ***help onos*** lists the available commands

```
onos> help onos
COMMANDS
...
onos:add-host-intent            Installs host-to-host connectivity intent
onos:add-mpls-intent            Installs mpls connectivity intent
...
onos:app                        Manages application inventory
onos:app-ids                    Lists application ID information
onos:apps                       Lists application information
--More--
```

  - ***help onos:<command>*** shows the descriptions about the command

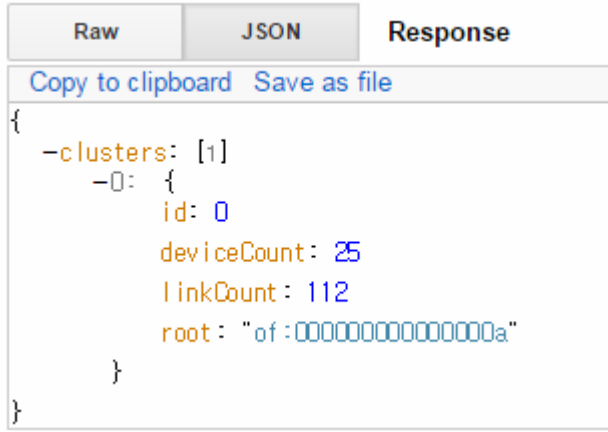
```
onos> help onos:apps
DESCRIPTION
        onos:apps
        Lists application information
SYNTAX
        onos:apps [options]

OPTIONS
        -a, --active            Show active only
        -j, --json              Output JSON
        --help                  Display this help message
        -s, --short             Show short output only
```

ONOS REST API (1/2)

❖ ONOS REST API Overview

- Provide REST API using Jersey
- All endpoints need to be prefixed with
  - http://onos_ip:8181/onos/v1
- Available REST APIs
  - Device, Link, Host, Topology, Path, Flow, Intent, Application, Component Configuration

- Later version will provide graphical interface for REST API
  - E.g., swagger



ONOS REST API (2/2)

❖ Example REST API

Type	API	Method	Description
Device	/devices	GET	Lists all infrastructure devices.
	/devices/{deviceId}	GET	Lists details of a specific infrastructure device.
	/devices/{deviceId}/ports	GET	Lists ports of a specific infrastructure device.
Link	/links	GET	Lists all infrastructure links.
	/links?{device=deviceId}{port=portNumber}{direction=[ALL,INGRESS,EGRESS]}	GET	Lists details of a link.
Host	/hosts	GET	Lists all end-stations hosts.
	/hosts/{hostId}	GET	Lists details of a specific end-station host specified by the host ID.
	/hosts/{mac}/{vlan}	GET	Lists details of a specific end-station host specified by the host MAC address and VLan Id.
Flow	/flows/{deviceId}	GET	Gets list of flow rules applied to the specified infrastructure device.
	/flows/{deviceId}{flowId}	GET	Gets details of a specified flow rule.
	/flows	GET	Gets details of all flow rules in the system.

References

1. ONOS: http://onosproject.org/
2. ONOS CLI: https://wiki.onosproject.org/display/ONOS/Appendix+A+%3A+CLI+commands
3. ONOS REST: https://wiki.onosproject.org/display/ONOS/Appendix+B%3A+REST+API
4. ONOS GUI: https://wiki.onosproject.org/display/ONOS/The+ONOS+Web+GUI