LAB GUIDE

NAE – IP SLA

Important! **This guide assumes that the AOS-CX ova has been installed and works in GNS3 or EVE-NG. Please refer to GNS3/EVE-NG initial setup labs if required.**
https://www.eve-ng.net/index.php/documentation/howtos/howto-add-aruba-cx-switch/

At this time, EVE-NG does not support exporting/importing AOS-CX startup-config. The lab user should copy/paste the AOS-CX node configuration from the lab guide as described in the lab guide if required.

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Lab Objective

This lab will enable the reader to gain hands-on experience with NAE (Network Analytics Engine) technology on AOS-CX. It will also provide an example of NAE use-case and associated interest for in production network.

Lab Overview

This lab guide explains how to demonstrate the benefits of NAE (Network Analytics Engine) by showing automatic actions taken when IP-SLA reports average RTT higher than a pre-defined threshold. The use-case is kept as simple as possible so it can be easily reproduced.

In this demonstration, when the direct link between CX1 and CX3 is down, traffic is re-routed through a backup path that has higher latency. IP-SLA detects the latency increase and automatically performs a “show ip route”, so that the network admin can see and troubleshoot what happened during this event, the said event that could have been transient and during off-hour support time.

This lab guide explains how to configure NAE IP SLA agent on AOS-CX switch.

Please refer to the AOS-CX 10.6 Network Analytics Engine Guide (https://support.hpe.com/hpesc/public/docDisplay?docId=a00108354en_us)

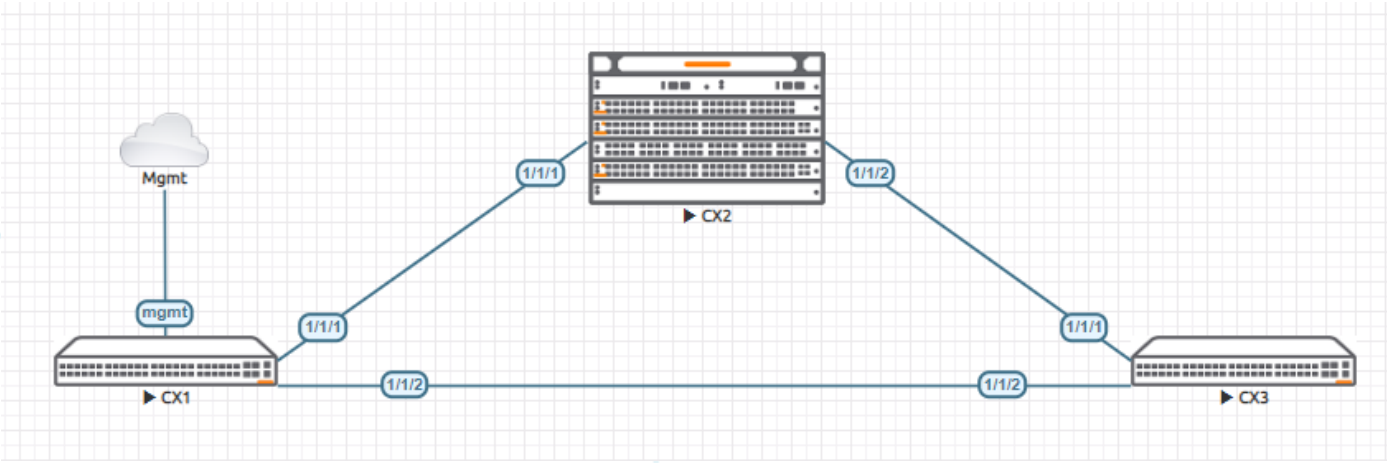
or AOS-CX 10.6 NAE page ((https://support.hpe.com/hpesc/public/docDisplay?docId=a00108354en_us)).

The minimum required AOS-CX Switch Simulator version for this lab is 10.5.

This lab uses EVE-NG but GNS3 might be used as well.

Lab Network Layout

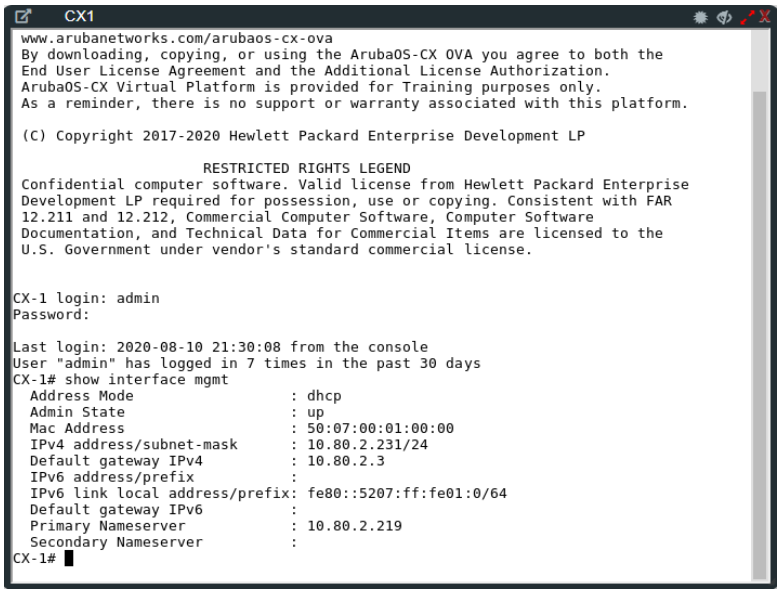
Here is the proposed and simple topology.



Lab Tasks

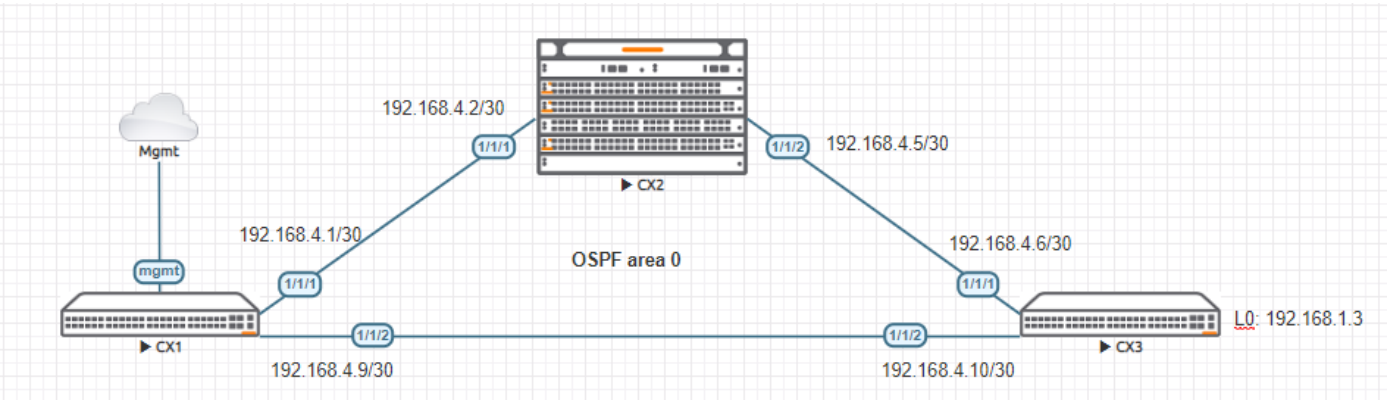
Task 1 - Lab setup

- In EVE-NG, i**mport the .zip lab file containing the "unl" file.**
  All the connections between nodes are already set-up. Appropriate numbers of CPUs (1), RAM (2048 MB) and interfaces are already allocated. (Or Interconnect switches as proposed).
- Check the connectivity as proposed above
- Start the 3 switches.
- Open each switch console and log in with user "admin".
  The switches will ask to enter a new password. This new password can be an empty password for simplicity in this lab.
- Change the switch hostnames to CX-1, CX-2, CX-3 as shown in the topology.
- Use external connection (refer to Lab Guide 2 if needed) in order to access the WEB-UI of the switch named CX1 that will run the NAE agent.
- Check that CX-1 received a DHCP IP address on the "mgmt" interface or set a static IP address as appropriated.



Use show interface mgmt to identify IP address being assign if DHCP is used.

- Here is an example of IPs and interfaces that will be configured in this guide



- Set the IP address on each interfaces and enable interfaces (no shut).
- Configure OSPF on the 3 switches and include Loppback0 in OSPF area 0 on CX3. This loopback0 of CX3 will be the target for the IP-SLA configured on CX1.

Baseline Configuration proposal (for initial copy/paste):

CX1

```
hostname CX-1
led locator on
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    ip address 192.168.4.1/30
    ip ospf 1 area 0.0.0.0
interface 1/1/2
    no shutdown
    ip address 192.168.4.9/30
    ip ospf 1 area 0.0.0.0
!
router ospf 1
    area 0.0.0.0
https-server vrf mgmt
```

CX2

```
hostname CX-2
led locator on
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    ip address 192.168.4.2/30
    ip ospf 1 area 0.0.0.0
interface 1/1/2
    no shutdown
    ip address 192.168.4.5/30
    ip ospf 1 area 0.0.0.0
!
router ospf 1
    area 0.0.0.0
https-server vrf mgmt
```

CX3

```
hostname CX-3
led locator on
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    ip address 192.168.4.6/30
    ip ospf 1 area 0.0.0.0
interface 1/1/2
    no shutdown
    ip address 192.168.4.10/30
    ip ospf 1 area 0.0.0.0
interface loopback 0
    ip address 192.168.1.3/32
    ip ospf 1 area 0.0.0.0
!
router ospf 1
    area 0.0.0.0
https-server vrf mgmt
```

- Verify the connectivity and routing as follows on each switch:

CX1

```
CX-1# show lldp neighbor-info

LLDP Neighbor Information
=========================

Total Neighbor Entries          : 2
Total Neighbor Entries Deleted  : 1
Total Neighbor Entries Dropped  : 0
Total Neighbor Entries Aged-Out : 0

LOCAL-PORT  CHASSIS-ID         PORT-ID          PORT-DESC                TTL      SYS-NAME
-------------------------------------------------------------------------------------------
1/1/1       08:00:09:2b:b4:1f  1/1/1            1/1/1                    120      CX-2
1/1/2       08:00:09:15:59:db  1/1/2            1/1/2                    120      CX-3



CX-1# show ip ospf neighbors
OSPF Process ID 1 VRF default
==============================

Total Number of Neighbors: 2

Neighbor ID      Priority  State             Nbr Address       Interface
-------------------------------------------------------------------------
192.168.4.5      1         FULL/BDR          192.168.4.2        1/1/1

192.168.4.6      1         FULL/BDR          192.168.4.10       1/1/2



CX-1# show ip route

Displaying ipv4 routes selected for forwarding

'[x/y]' denotes [distance/metric]

192.168.1.3/32, vrf default
        via  192.168.4.10,  [110/100],  ospf
192.168.4.0/30, vrf default
        via  1/1/1,  [0/0],  connected
192.168.4.1/32, vrf default
        via  1/1/1,  [0/0],  local
192.168.4.4/30, vrf default
        via  192.168.4.2,  [110/200],  ospf
        via  192.168.4.10,  [110/200],  ospf
192.168.4.8/30, vrf default
        via  1/1/2,  [0/0],  connected
192.168.4.9/32, vrf default
        via  1/1/2,  [0/0],  local



CX-1# traceroute 192.168.1.3
traceroute to 192.168.1.3 (192.168.1.3), 1 hops min, 30 hops max, 3 sec. timeout, 3 probes
  1   192.168.1.3  87.993ms  9.617ms  6.145ms
```

Note: the nominal path from CX-1 to reach loopback of CX-3 is through the direct link between CX-1 and CX-3.

CX2

```
CX-2# show lldp neighbor-info

LLDP Neighbor Information
=========================
```

```
Total Neighbor Entries          : 2
Total Neighbor Entries Deleted  : 0
Total Neighbor Entries Dropped  : 0
Total Neighbor Entries Aged-Out : 0

LOCAL-PORT  CHASSIS-ID         PORT-ID          PORT-DESC                TTL      SYS-NAME
-------------------------------------------------------------------------------------------
1/1/1       08:00:09:b2:87:f5  1/1/1            1/1/1                    120      CX-1
1/1/2       08:00:09:15:59:db  1/1/1            1/1/1                    120      CX-3


CX-2# show ip ospf neighbors
OSPF Process ID 1 VRF default
==============================

Total Number of Neighbors: 2

Neighbor ID      Priority  State             Nbr Address       Interface
-------------------------------------------------------------------------
192.168.4.1      1         FULL/DR           192.168.4.1        1/1/1

192.168.4.6      1         FULL/BDR          192.168.4.6        1/1/2


CX-2# show ip route

Displaying ipv4 routes selected for forwarding

'[x/y]' denotes [distance/metric]

192.168.1.3/32, vrf default
        via  192.168.4.6,  [110/100],  ospf
192.168.4.0/30, vrf default
        via  1/1/1,  [0/0],  connected
192.168.4.2/32, vrf default
        via  1/1/1,  [0/0],  local
192.168.4.4/30, vrf default
        via  1/1/2,  [0/0],  connected
192.168.4.5/32, vrf default
        via  1/1/2,  [0/0],  local
192.168.4.8/30, vrf default
        via  192.168.4.6,  [110/200],  ospf
        via  192.168.4.1,  [110/200],  ospf
```

CX3

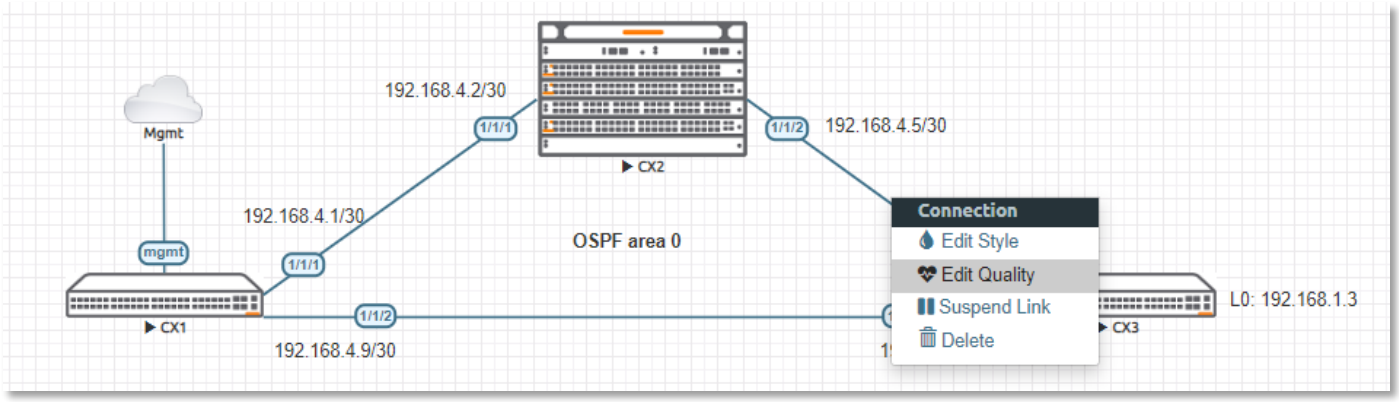
```
CX-3# show lldp neighbor-info

LLDP Neighbor Information
=========================

Total Neighbor Entries          : 2
Total Neighbor Entries Deleted  : 0
Total Neighbor Entries Dropped  : 0
Total Neighbor Entries Aged-Out : 0

LOCAL-PORT  CHASSIS-ID         PORT-ID          PORT-DESC                TTL      SYS-NAME
-------------------------------------------------------------------------------------------
1/1/1       08:00:09:2b:b4:1f  1/1/2            1/1/2                    120      CX-2
1/1/2       08:00:09:b2:87:f5  1/1/2            1/1/2                    120      CX-1


CX-3# show ip ospf neighbors
OSPF Process ID 1 VRF default
==============================

Total Number of Neighbors: 2

Neighbor ID      Priority  State             Nbr Address       Interface
-------------------------------------------------------------------------
192.168.4.5      1         FULL/DR           192.168.4.5        1/1/1
```

```
192.168.4.1      1          FULL/DR           192.168.4.9       1/1/2


CX-3# show ip route

Displaying ipv4 routes selected for forwarding

'[x/y]' denotes [distance/metric]

192.168.1.3/32, vrf default
        via  loopback0,  [0/0],  local
192.168.4.0/30, vrf default
        via  192.168.4.9,  [110/200],  ospf
        via  192.168.4.5,  [110/200],  ospf
192.168.4.4/30, vrf default
        via  1/1/1,  [0/0],  connected
192.168.4.6/32, vrf default
        via  1/1/1,  [0/0],  local
192.168.4.8/30, vrf default
        via  1/1/2,  [0/0],  connected
192.168.4.10/32, vrf default
        via  1/1/2,  [0/0],  local
```

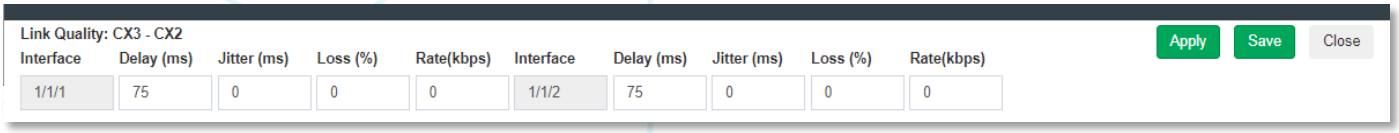
Task 2 - Add Latency

In EVE-NG or GNS3, there is possibility to adjust link latency. Set latency to 75ms between CX-2 and CX-3

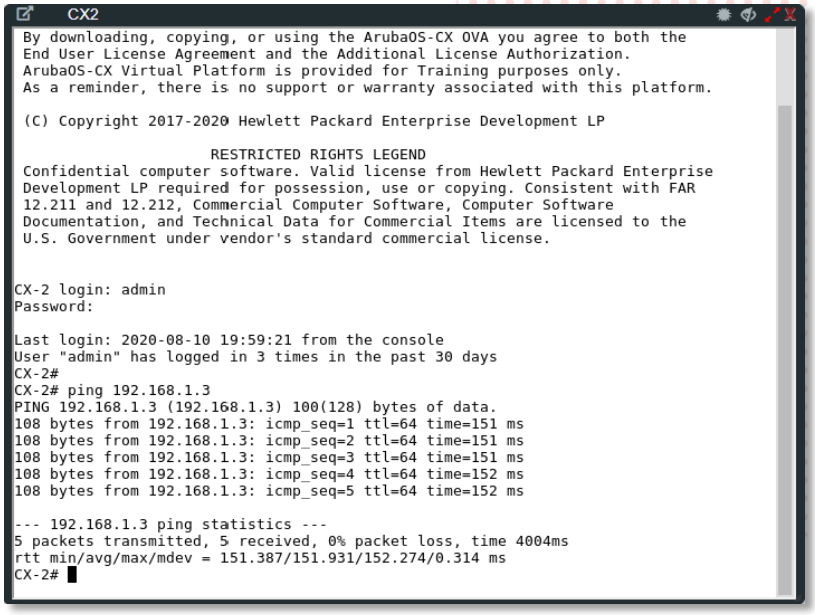
In **EVE-NG**, select the link and right-click:



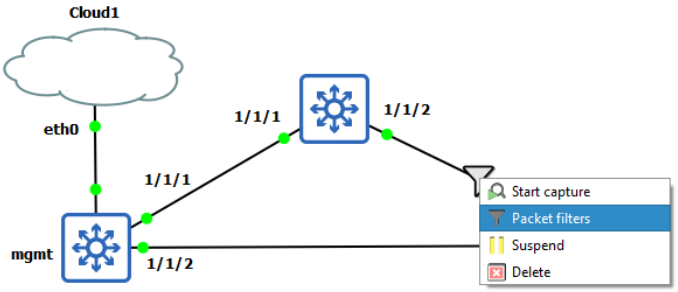
- Click on Edit Quality. In the pop-up, set symmetric delay to 75ms.



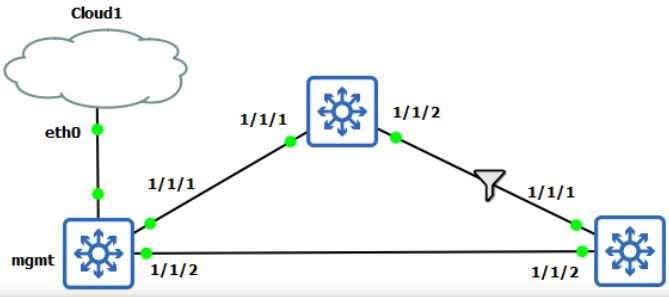
- Ping from CX-2 the CX-3 Loopback0, and check that RTT (Round Trip Time) is increased by 150ms (2x75).

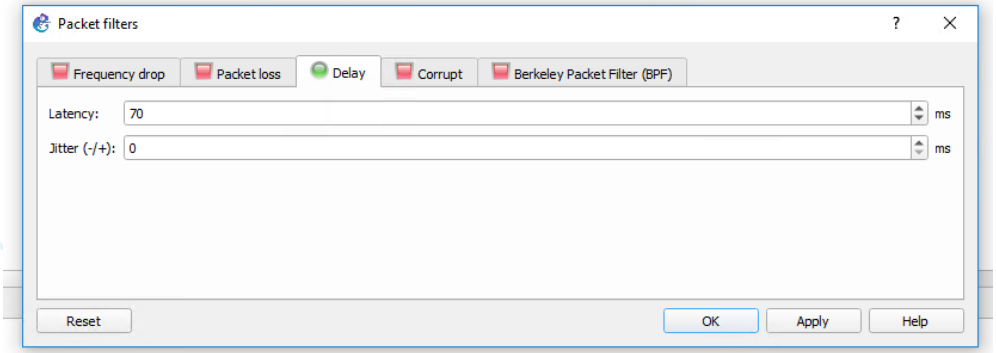


- In **GNS3**: similarly right-click on the link and select packet filter:



- Select Delay tab and set the latency to 75 as below:





Task 3 - Configure IP-SLA

IP-SLA is configured on CX-1 with the very basic ICMP-echo probe mechanism, target IP being the loopback of CX-3 and period being 5s for demo purpose.

CX1(config)#

```
ip-sla sla1
    icmp-echo 192.168.1.3 probe-interval 5
    start-test
```

After a while, check IP-SLA results: [75]

CX1

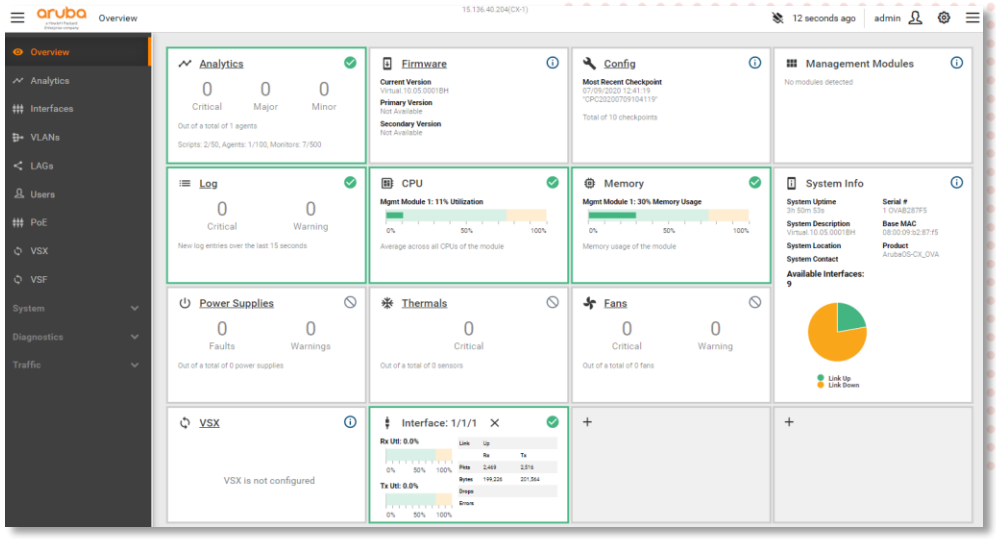
```
CX-1# show ip-sla sla1 results

IP-SLA session status
IP-SLA Name                          : sla1
IP-SLA Type                          : icmp-echo
Destination Host Name/IP Address     : 192.168.1.3
Source IP Address/IFName             :
Status                               : running

IP-SLA Session Cumulative Counters
Total Probes Transmitted             : 2241
Probes Timed-out                     : 0
Bind Error                           : 0
Destination Address Unreachable      : 0
DNS Resolution Failures              : 0
Reception Error                      : 0
Transmission Error                   : 0

IP-SLA Latest Probe Results
Last Probe Time                      : 2020 Jul 09 13:44:52
Packets Sent                         : 1
Packets Received                     : 1
Packet Loss in Test                  : 0.0000%

Minimum RTT(ms)                      : 9
Maximum RTT(ms)                      : 9
Average RTT(ms)                      : 9
DNS RTT(ms)                          :
```

Average latency should be very variable as this is a simulator; from ~5ms to >40ms. This variability is expected depending on the hosting server performance and is not considered as a problem in the demo.

Task 4 - Install IP-SLA Threshold NAE script

Install default script from Aruba Solution Exchange

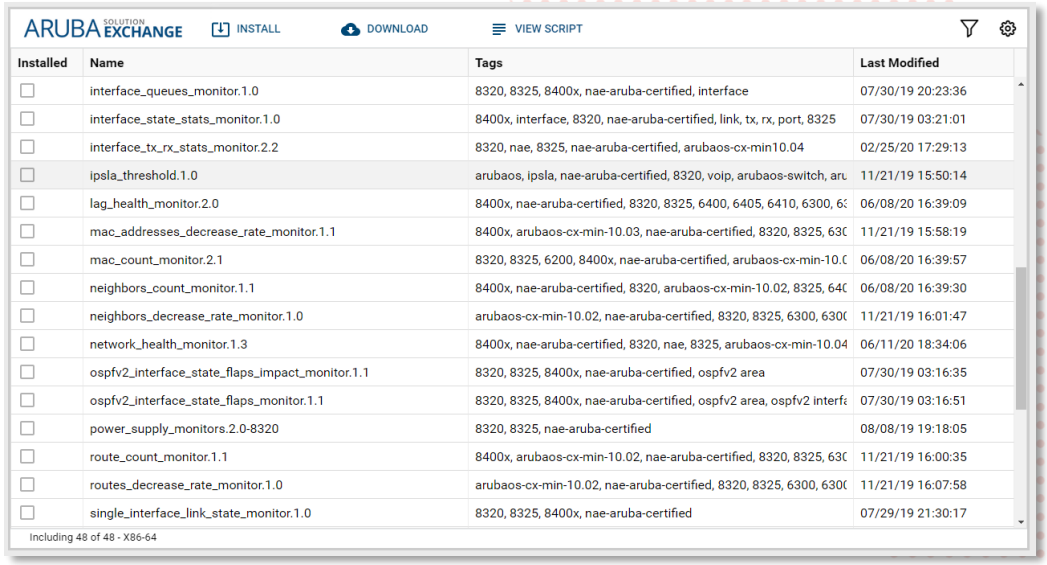
- Log into the CX-1 WEB-UI: https://<IP_ADDRESS_OF_MGMT_INTERFACE> with admin account (no password)
  Reminder: The IP address of the mgmt interface was retrieved with “show interface mgmt” on CX-1 console.

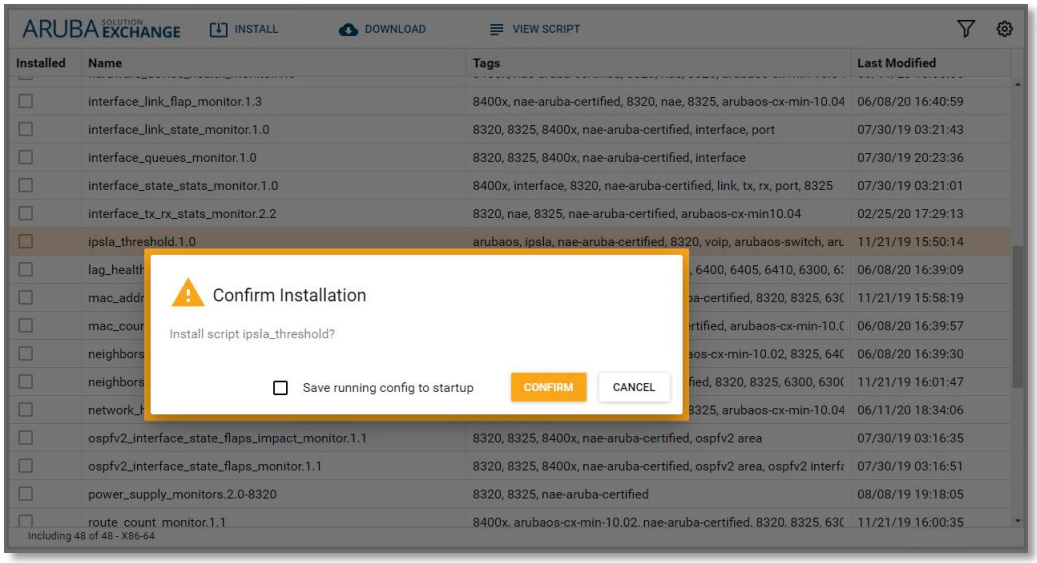


- On the left pane, select Analytics:

- Click on Aruba Solution Exchange Snippet and wait a while for the list of script to load. Select “ipsla_threshold.1.0” and click INSTALL

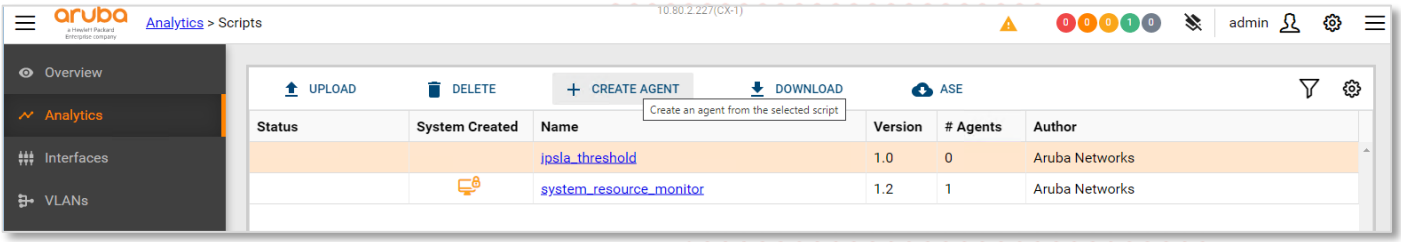
Note: this is not the CX switch which does connect to internet but your browser connects to internet, which will download the script.



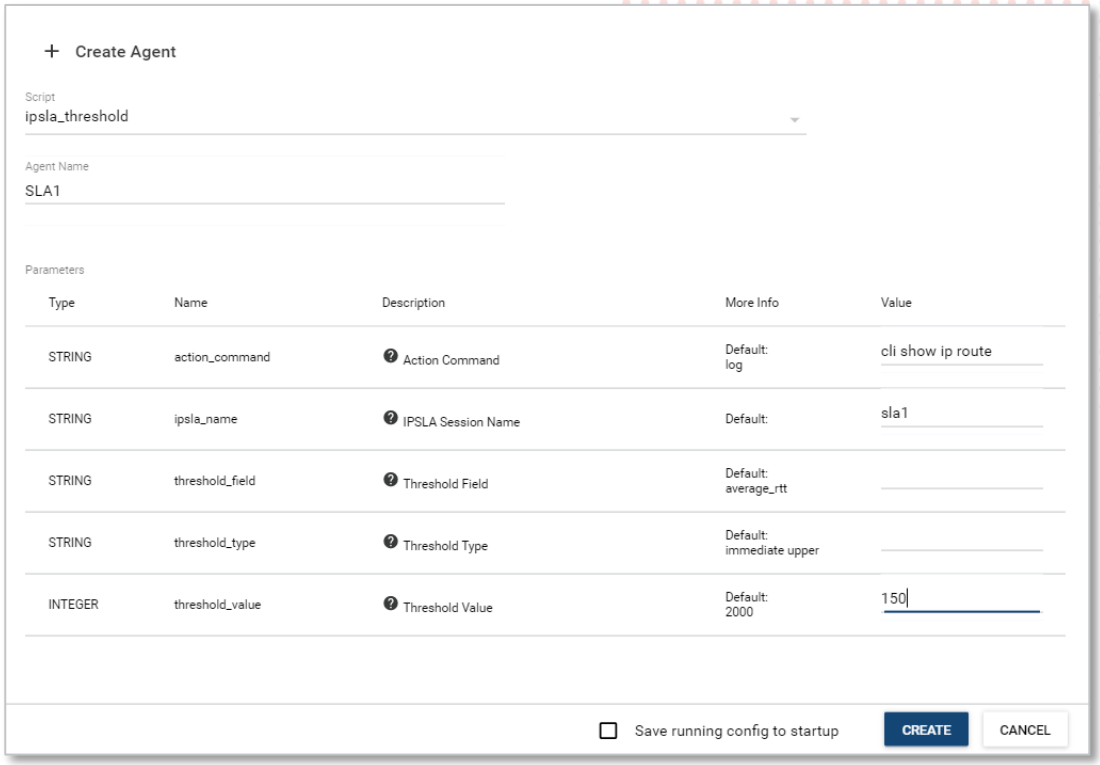


- Confirm installation:
- Close the “successfully installed” message.

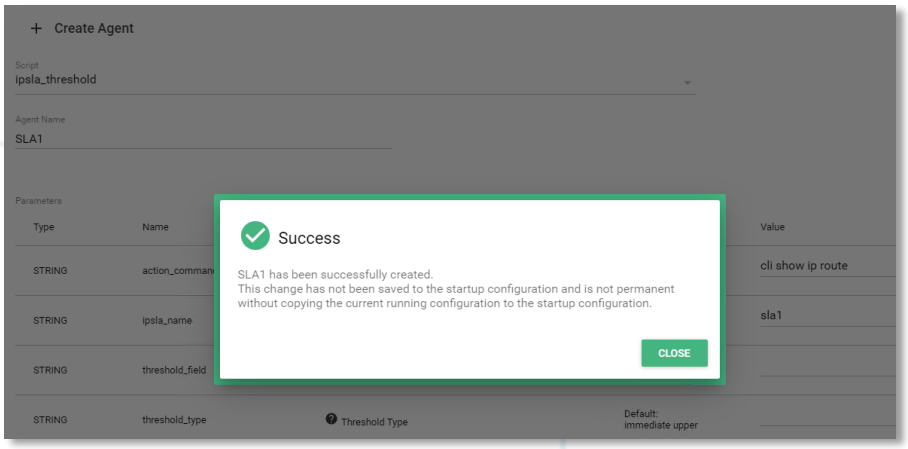
- Click on Scripts and select the newly installed script. Then click on “CREATE AGENT”.



- Fill the agent parameters as below and click create.



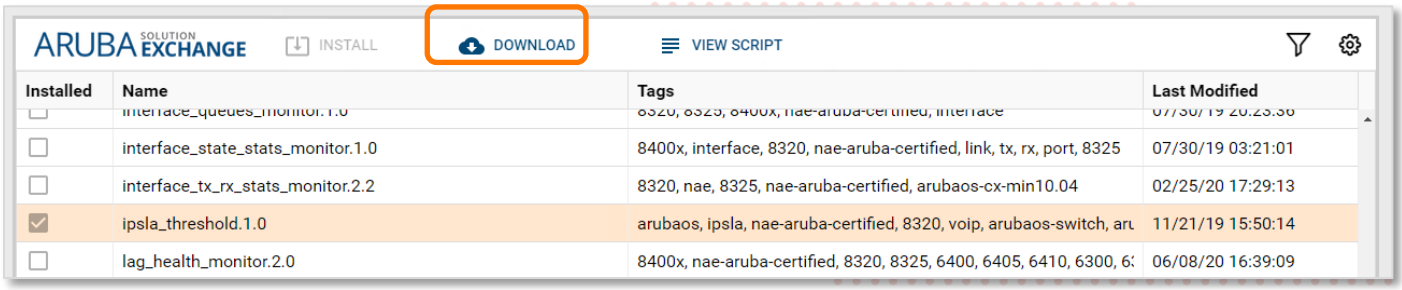
- Click on close



Alternative option: install customized script

In order to demonstrate how easily any NAE script can be customized, here is a proposed alternative to install your own customized script (based on the default NAE ipsla_threshold script downloaded from ASE).

- Instead of installing the default script as explained above, download the “ipsla_theshold” script:

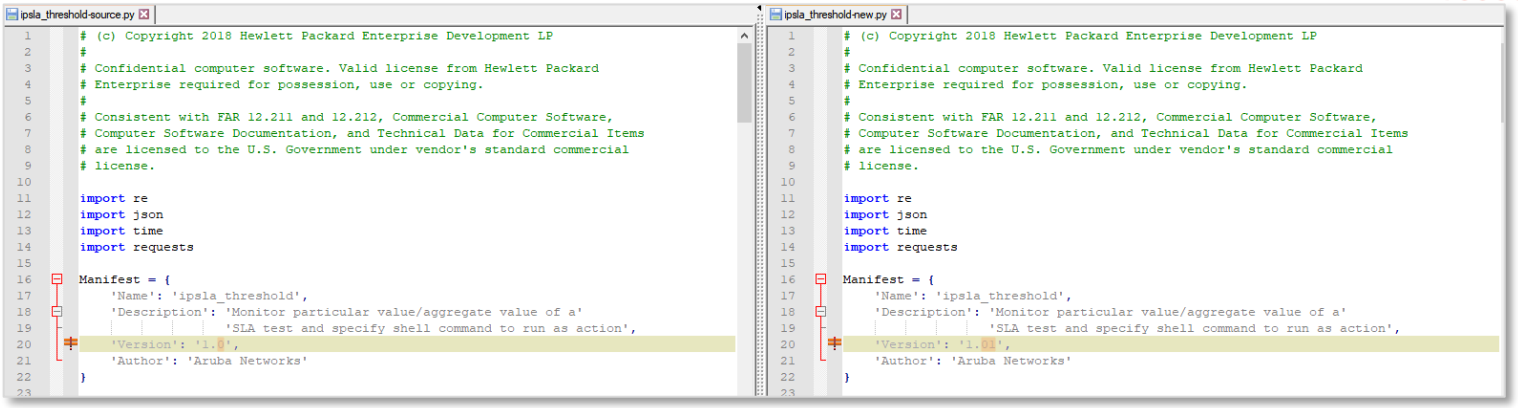


If you previously installed the default script and you want to use a custom script, you can either disable the existing SLA1 NAE agent or simply delete it by going to the Analytics>Agents menu.

- Once “ipsla_threshold.py” script has been downloaded on your laptop, copy it to “ipsla_threshold-new.py” and edit it with any editor of your choice to add the following lines:

  On the left side the initial script, on the right side the new modified/customized script

  - Change the Version from 1.0 to 1.01 for instance



  - Modify the **action_command** by adding these new lines after line 75 (‘Default’: ‘log’)

```
},
    'traceroute_ip': {
        'Name': 'Traceroute IP Address',
        'Description': 'The Traceroute IP Address that will be tested against as\n'
                       'an alert action.',
        'Type': 'string',
        'Default': '192.168.1.1'
    },
    'traceroute_vrf': {
        'Name': 'Traceroute VRF',
        'Description': 'The VRF which the Traceroute command will run on as\n'
                       'an alert action.',
        'Type': 'string',
        'Default': 'default'
```

```
    'action_command': {
        'Name': 'Action Command',
        'Description': ('The script supports 4 action commands:\n'
                        '"cli cmd" (where "cmd" is the intended CLI command)\n'
                        '"log" (A SYSLOG message is logged when an alert '
                        'is raised)\n"cli-log cmd" (Execute CLI command '
                        '"cmd" and also log a SYSLOG message\n'
                        '"schedule session_name" (Start the mentioned '
                        'pre-configured IP SLA session)'),
        'Type': 'string',
        'Default': 'log'
    },
    'traceroute_ip': {
        'Name': 'Traceroute IP Address',
        'Description': 'The Traceroute IP Address that will be tested against as\n'
                       'an alert action.',
        'Type': 'string',
        'Default': '192.168.1.1'
    },
    'traceroute_vrf': {
        'Name': 'Traceroute VRF',
        'Description': 'The VRF which the Traceroute command will run on as\n'
                       'an alert action.',
        'Type': 'string',
        'Default': 'default'
    }
}

class Agent(NAE):
    URI_PREFIX = '/rest/v1/system/ipsla_sources/'
    URI_FIELDS_RESULT = '?attributes=sla_results.'
    URI_STATUS = '?attributes=status.'
    URI_STATS = '?attributes=statistics.'
```

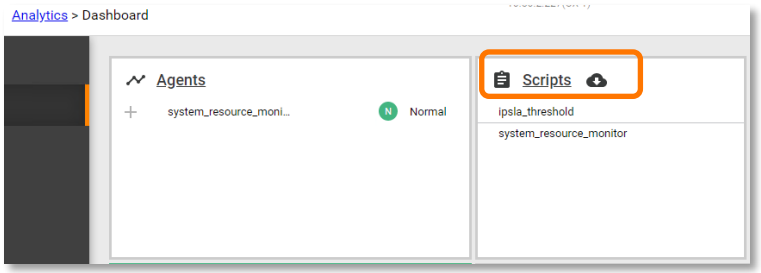
- Modify the **default_actions** function by adding these new lines after line 361 (self.set_alert_level(AlertLevel.MINOR))

```
ActionCLI('traceroute ' + self.params['traceroute_ip'].value +
          ' vrf ' + self.params['traceroute_vrf'].value + '\n')
```

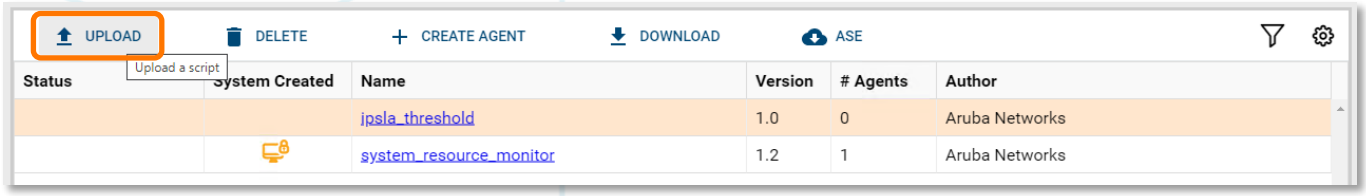
```
    def default_actions(self):
        session_name = self.params['ipsla_name'].value
        self.make_report()
        ActionCLI('show ip-sla ' + session_name + ' results')
        self.set_alert_level(AlertLevel.MINOR)
        ActionCLI('traceroute ' + self.params['traceroute_ip'].value +
                  ' vrf ' + self.params['traceroute_vrf'].value + '\n')
```

- Save the new script as “ipsla_threshold-new”

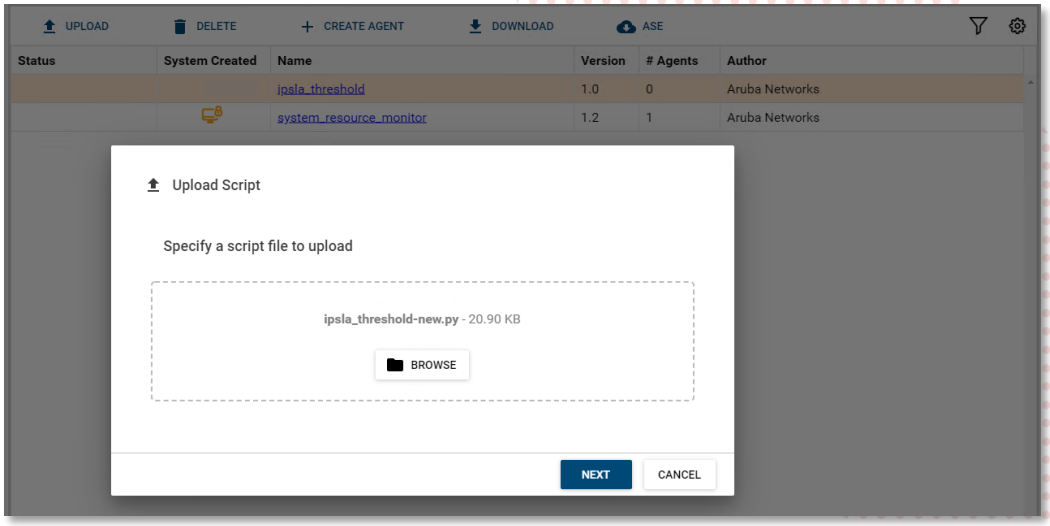
- Click on Scripts



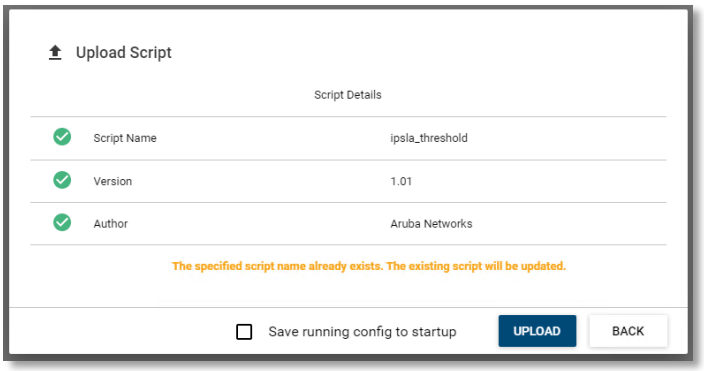
- Click on UPLOAD:



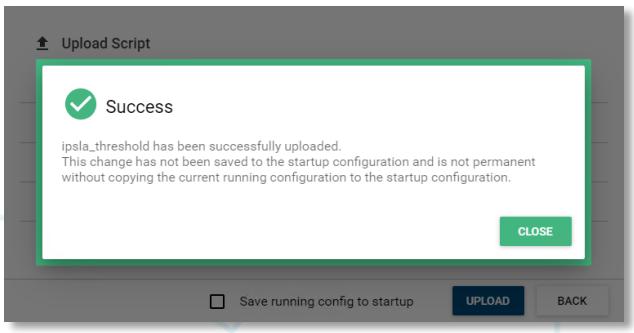
- Specify the new script file to upload and click next



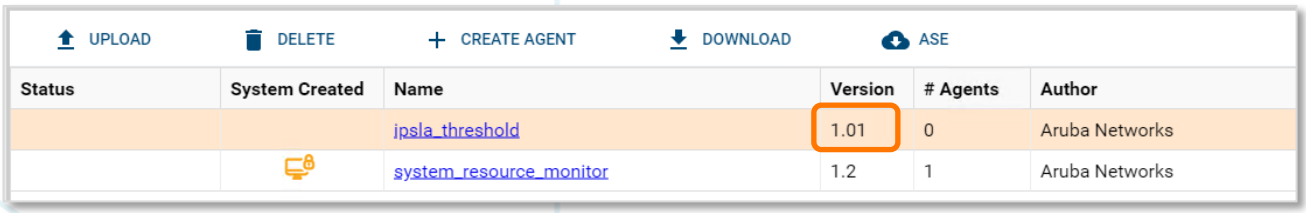
- If the default script was already installed, it will get updated with this new version. Click UPLOAD.



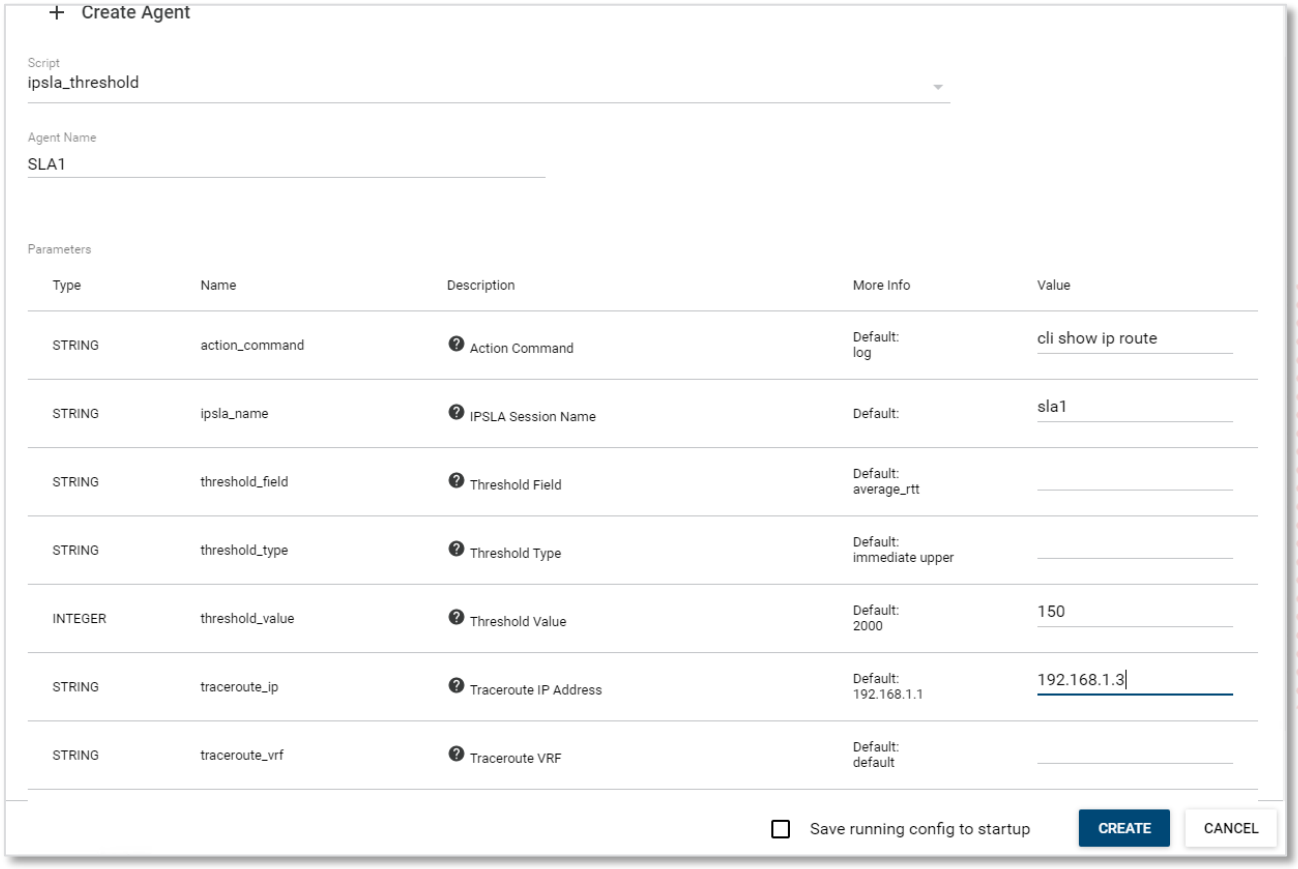
- Once successfully uploaded, CLOSE.



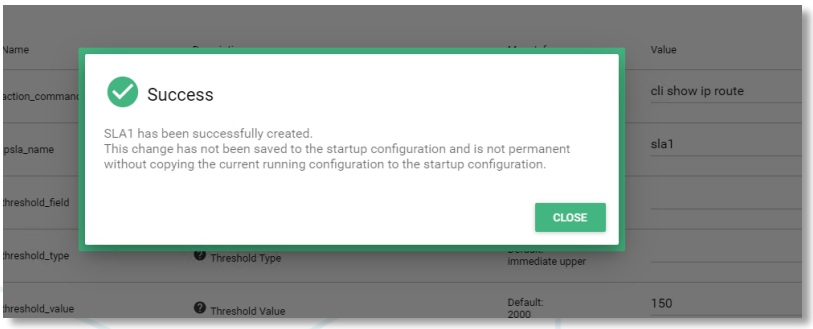
- The new version should appear:



- Create the agent as shown in default script example process, and fill the parameters as below:



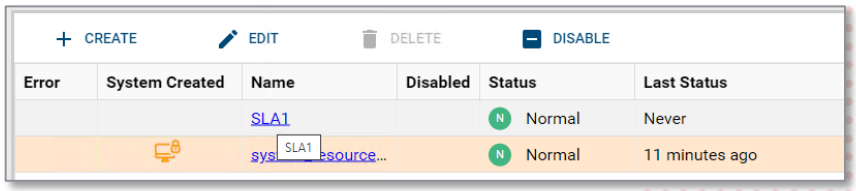
- Click on CLOSE



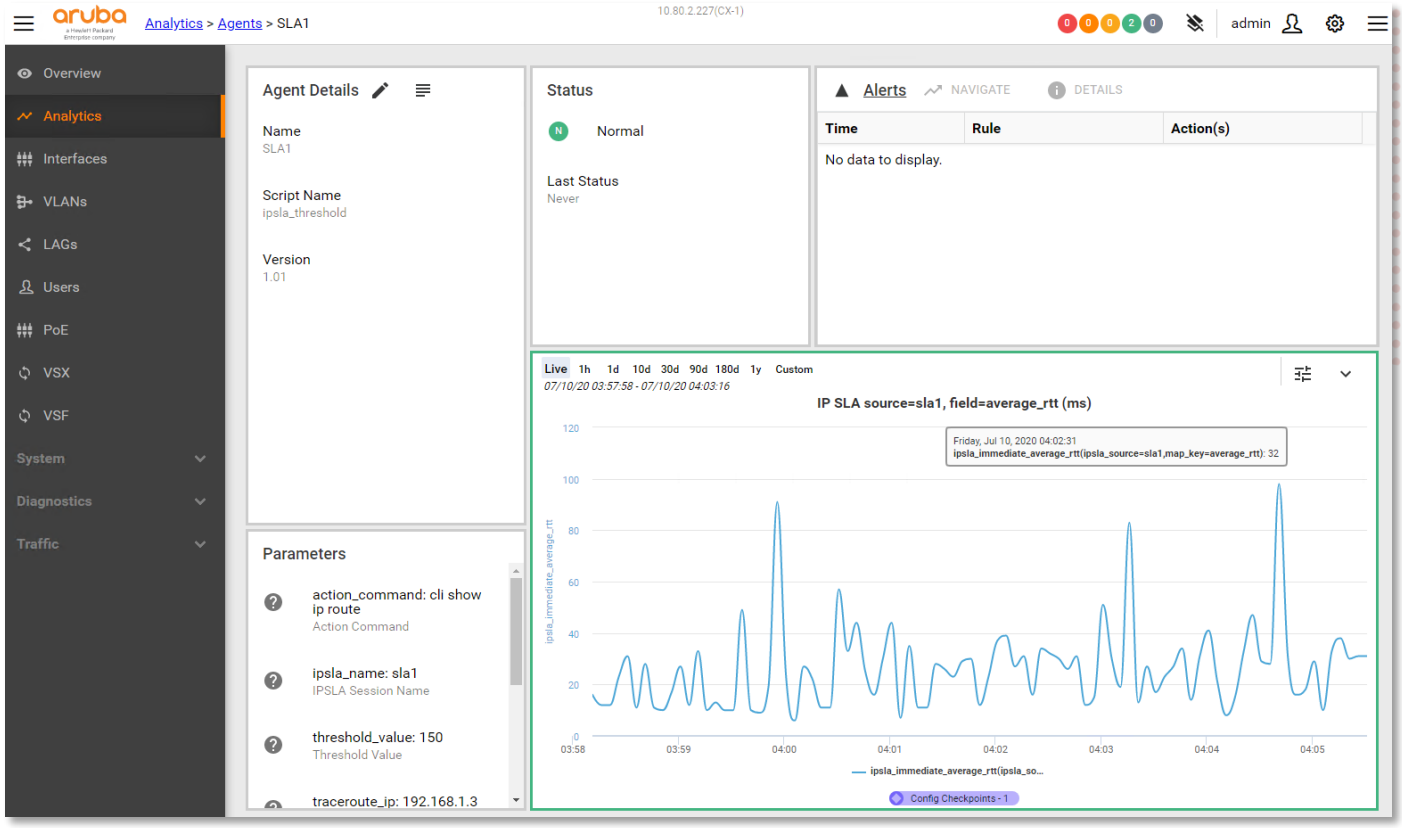
Task 5 - NAE Demonstration

Whatever the default ipsla_threshold or customized ipsla_threshold-new script is used, the following steps apply:

- From the Agents list, click on SLA1



- The graph represents the average RTT reported by the ip-sla probe sla1 configured on CX1.

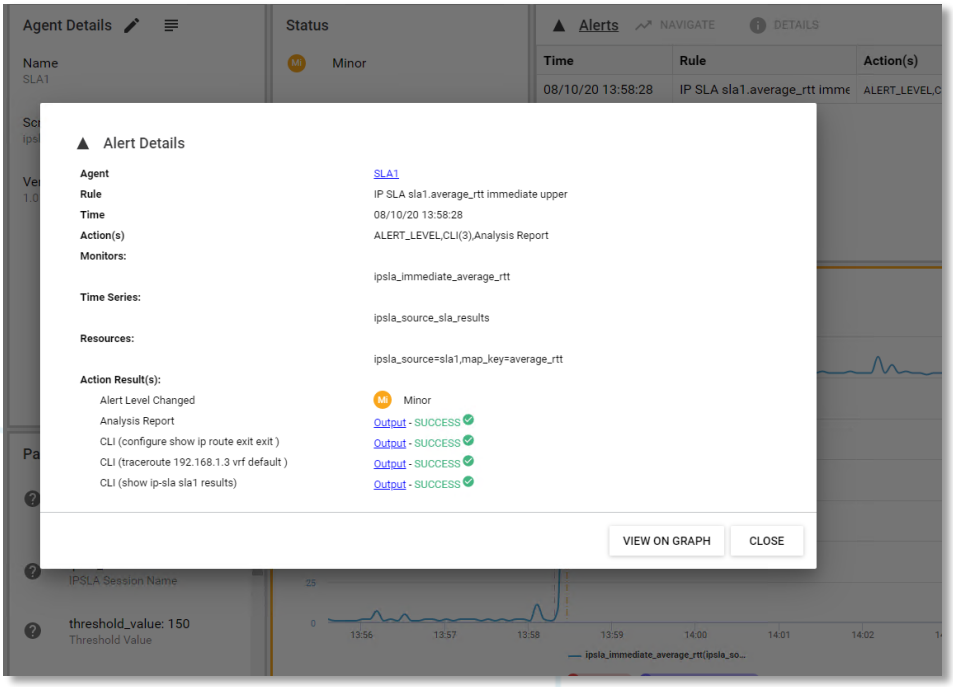


Note: your browser time/clock should be identical than the CX1 time, otherwise you may see a warning and won't be able to see Live NAE data.

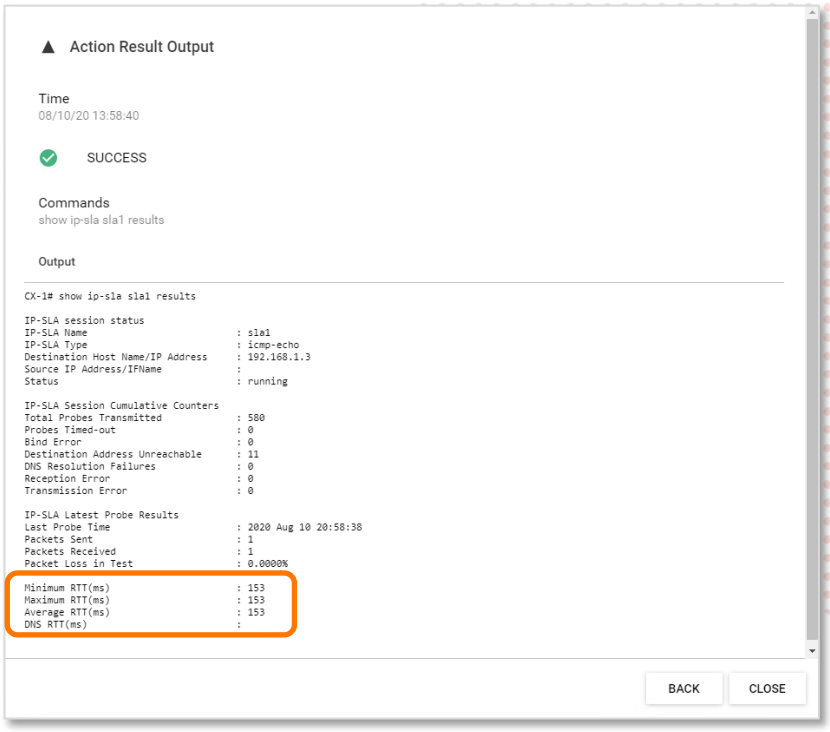
- Shutdown the circuit between CX-1 and CX3, i.e. shutdown interface 1/1/2 on CX1. Traffic will get re-routed through

CX-2 and you should see an alert popping-up:

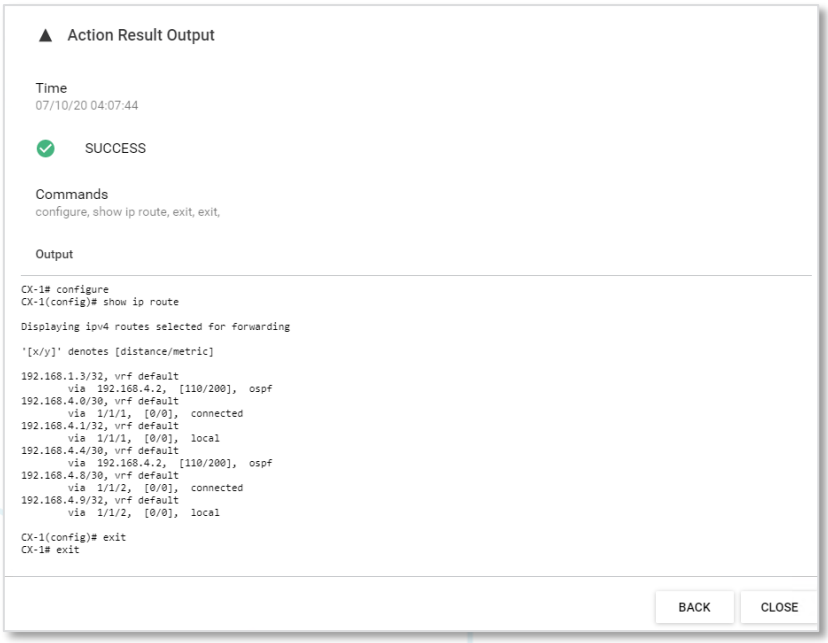
- Click on Orange triangle in the graph or select an alert on the alert list:



- Click on CLI (show ip-sla sla1 results), which provide details of measured RTT:



- Click on CLI action related to previous parameters :CLI (show ip route)



The next-hop to reach 192.168.1.3 has changed and it is now CX2 next-hop (192.168.4.2).

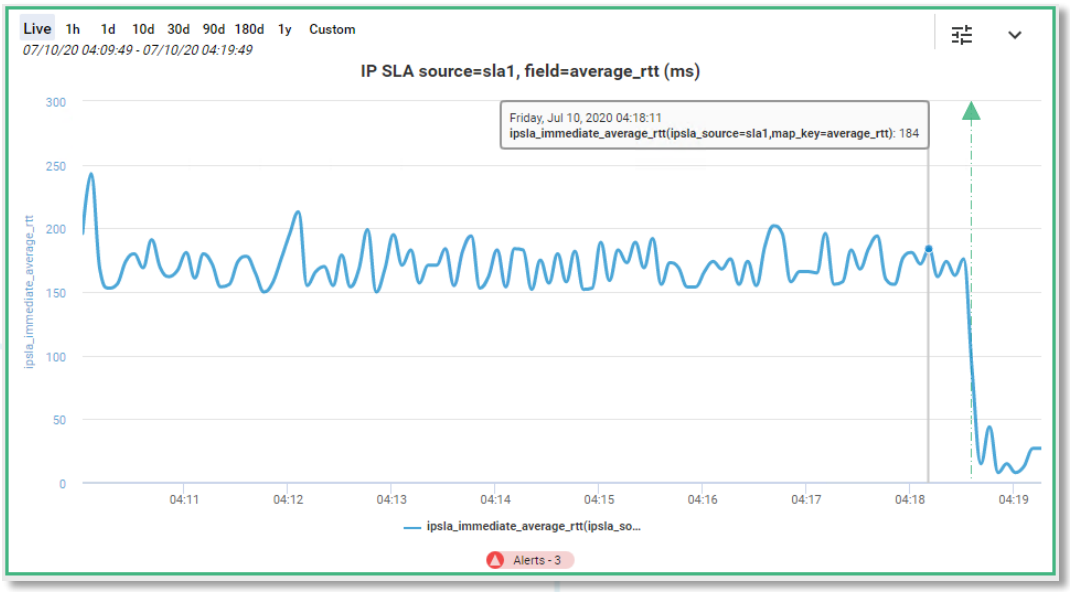
- For custom script, click on CLI action related to previous parameters : CLI (traceroute):

The traceroute indicates an intermediate hop that is not present in nominal situation.

DEMONSTRATION OUTCOME MESSAGING:

With these information from the NAE time-series database, the network admin can retrieve pre-computed information at the time the event/alert happened. This is extremely useful to find root cause of network incidents with better efficiency. NAE stores collected information for more than one year.

- To reset the demo, no shut interface 1/1/2 on CX1 and NAE agent graph should report latency back to normal:



This is the end of this lab.

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