The bridge to possible

Learning YANG Data Modeling

By Playing in the NSO Playground

Jason Belk
@renobelk

DEVNET - 1085

cisco Live!

Cisco Webex App

https://ciscolive.ciscoevents.com/ciscolivebot/#DEVNET-1085

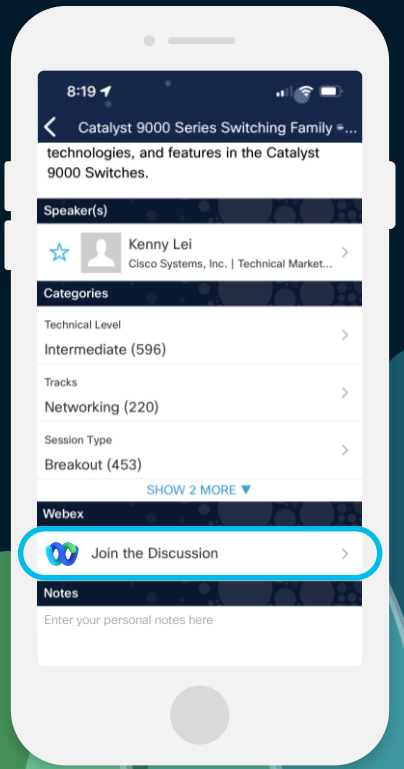
Questions?

Use Cisco Webex App to chat with the speaker after the session

How

1. Find this session in the Cisco Live Mobile App
2. Click “Join the Discussion”
3. Install the Webex App or go directly to the Webex space
4. Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until June 7, 2024.



Agenda

- Structured vs Unstructured Data
- YANG Statements
- YANG Data Types
- Cisco NSO Playground Overview
- Live Demo

CLI vs API: Audience Matters

```
router name          rno4-gw-1
router address       10.20.30.40
router operational-status up
```

Easy to Read, Hard to Parse

Hard to Read, Easy to Parse

```
<config xmlns="http://tail-f.com/ns/config/1.0">
    <router xmlns="http://com/example/routermodel">
        <name>rno4-gw-1</name>
        <address>10.20.30.40</address>
        <operational-status>up</operational-status>
    </router>
</config>
```

Unstructured Data: Not Always Easy to Read

```
access-list 101 permit tcp any host 192.168.1.10 eq 80
```

What do these commands mean?

```
ip route 192.168.10.0 255.255.255.0 10.10.20.1
```

How would a machine know the data types and relationships between them?

Structured Data: Who defines the structure?

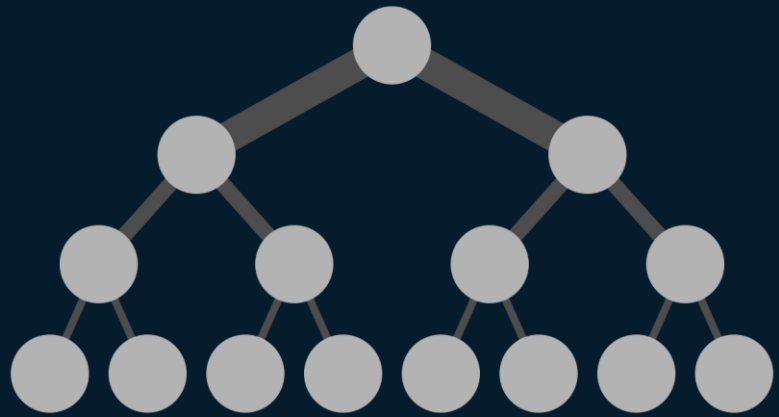
```
module router-model {
  namespace "http://com/example/routermodel";
  prefix router-model;
  import ietf-inet-types {
    prefix inet;
  }
  container router {
    leaf name {
      type string;
    }
    leaf address {
      type inet:ipv4-address;
    }
    leaf operational-status {
      type enumeration {
        enum up;
        enum down;
      }
    }
  }
}
```

```
<config xmlns="http://tail-f.com/ns/config/1.0">
  <router xmlns="http://com/example/routermodel">
    <name>rno4-gw-1</name>
    <address>10.20.30.40</address>
    <operational-status>up</operational-status>
  </router>
</config>
```

YANG defines the structure of the data (data modeling language)

Things to Know about YANG

- Yang is a tree hierarchy
  - Start at the root (top)
- Defines the structure
- Agnostic whether the data is XML, JSON, something else
- Helps automation tooling know
  - What features are available
  - Expected input / output data types



The Basic Building Blocks of YANG

```
module router-model {
  namespace "http://com/example/routermodel";
  prefix router-model;
  import ietf-inet-types {
    prefix inet;
  }
  container router {
    leaf name {
      type string;
    }
    leaf address {
      type inet:ipv4-address;
    }
    leaf operational-status {
      type enumeration {
        enum up;
        enum down;
      }
    }
  }
}
```

- Container statement
  - Group stuff together (no data)
- Leaf statements
  - A single unit of data
- (Lists will be covered later)

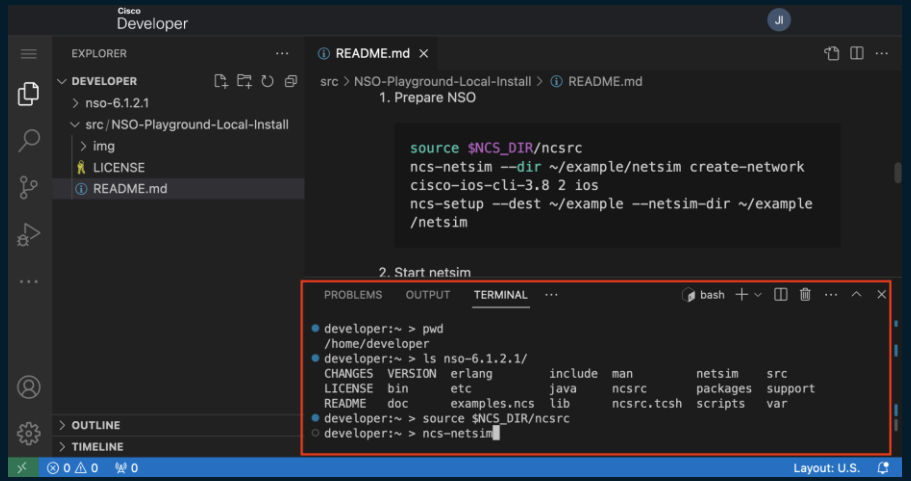
YANG Data Types

```
module router-model {
  namespace "http://com/example/routermodel";
  prefix router-model;
  import ietf-inet-types {
    prefix inet;
  }
  container router {
    leaf name {
      type string;
    }
    leaf address {
      type inet:ipv4-address;
    }
    leaf operational-status {
      type enumeration {
        enum up;
        enum down;
      }
    }
  }
}
```

- String
  - A flexible mix of numbers, letters & punctation
- Custom Imported Types
  - Hidden regular expressions enforcing ipv4 syntax
- Enumeration
  - Choose one from pre-defined set of values
  - Has additional enum for each value

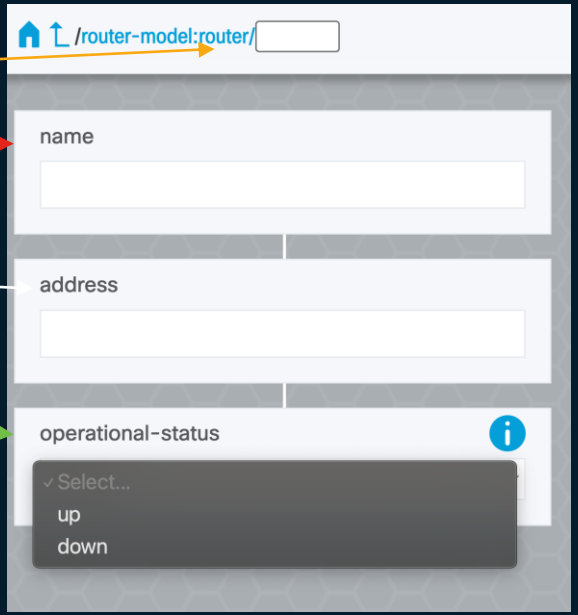
The Cisco NSO Playground

- Cisco NSO uses YANG
- Using Cisco NSO to visualize YANG
- Cisco NSO Playground
  - Faster than DevNet sandbox to learn
  - Tied to specific Code Exchange Repos



YANG Statements Visualized: GUI

```
module router-model {
  namespace "http://com/example/routermodel";
  prefix router-model;
  import ietf-inet-types {
    prefix inet;
  }
  container router {
    leaf name {
      type string;
    }
    leaf address {
      type inet:ipv4-address;
    }
    leaf operational-status {
      type enumeration {
        enum up;
        enum down;
      }
    }
  }
}
```



YANG Statements Visualized: CLI

```
module router-model {
  namespace "http://com/example/routermodel";
  prefix router-model;
  import ietf-inet-types {
    prefix inet;
  }
  container router {
    leaf name {
      type string;
    }
    leaf address {
      type inet:ipv4-address;
    }
    leaf operational-status {
      type enumeration {
        enum up;
        enum down;
      }
    }
  }
}
```

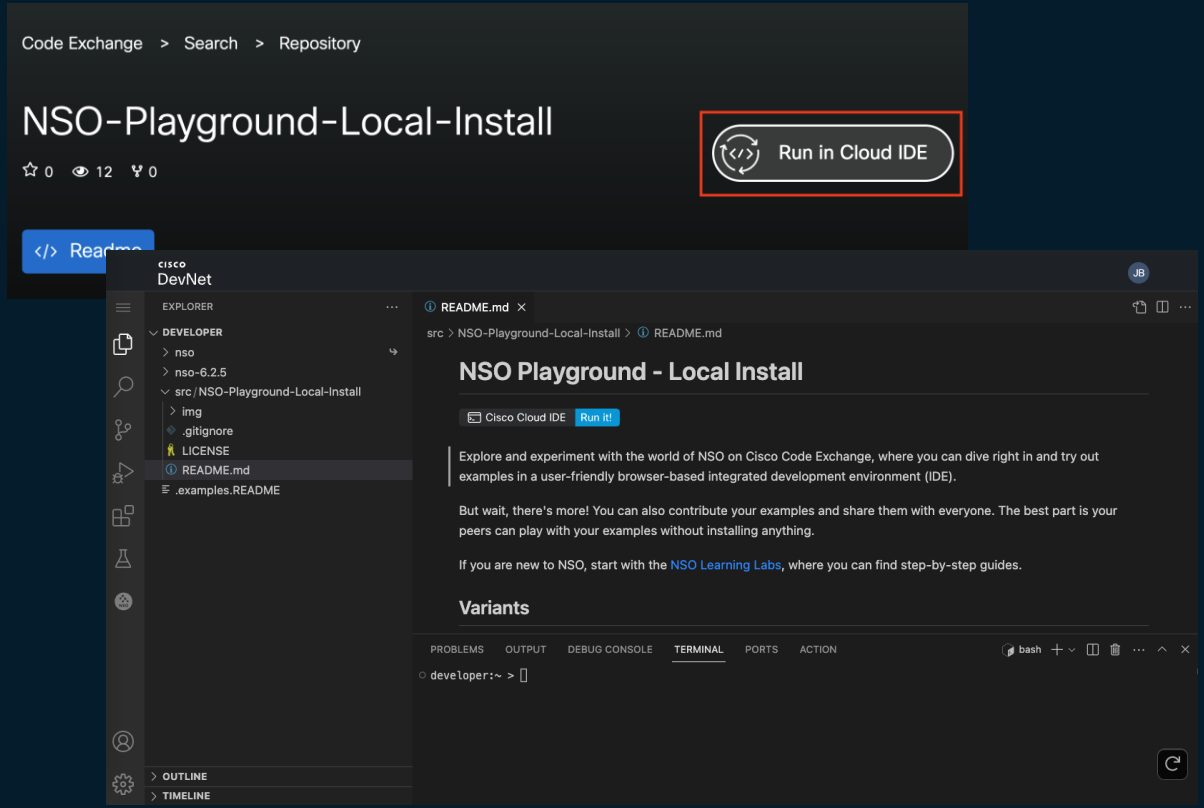
```
admin@ncs(config)# router ?
Possible completions:
  address  name  operational-status
admin@ncs(config)# router operational-status ?
Possible completions:
  down  up
admin@ncs(config)# router operational-status
```

YANG Data Types

```
module router-model {
  namespace "http://com/example/routermodel";
  prefix router-model;
  import ietf-inet-types {
    prefix inet;
  }
  container router {
    leaf name {
      type string;
    }
    leaf address {
      type inet:ipv4-address;
    }
    leaf operational-status {
      type enumeration {
        enum up;
        enum down;
      }
    }
  }
}
```

- String
  - A flexible mix of numbers, letters & punctation
- Custom Imported Types
  - Hidden regular expressions enforcing ipv4 syntax
- Enumeration
  - Choose one from pre-defined set of values
  - Has additional enum for each value

Getting Started with NSO Playground



- Click to spin up
- Don’t develop new work that isn’t backed up somewhere else
- Still need to set up an instance of NSO, but it is installed in the container

Creating an NSO Instance Steps

1. source $NCS_DIR/ncsrc
2. ncs-setup --dest ~/nso-instance
3. Copy over package directories to ~/nso-instance/packages through VS Code GUI drag and drop
4. cd ~/nso-instance
5. ncs
6. ncs_cli -C -u admin

Compile / Install YANG Packages

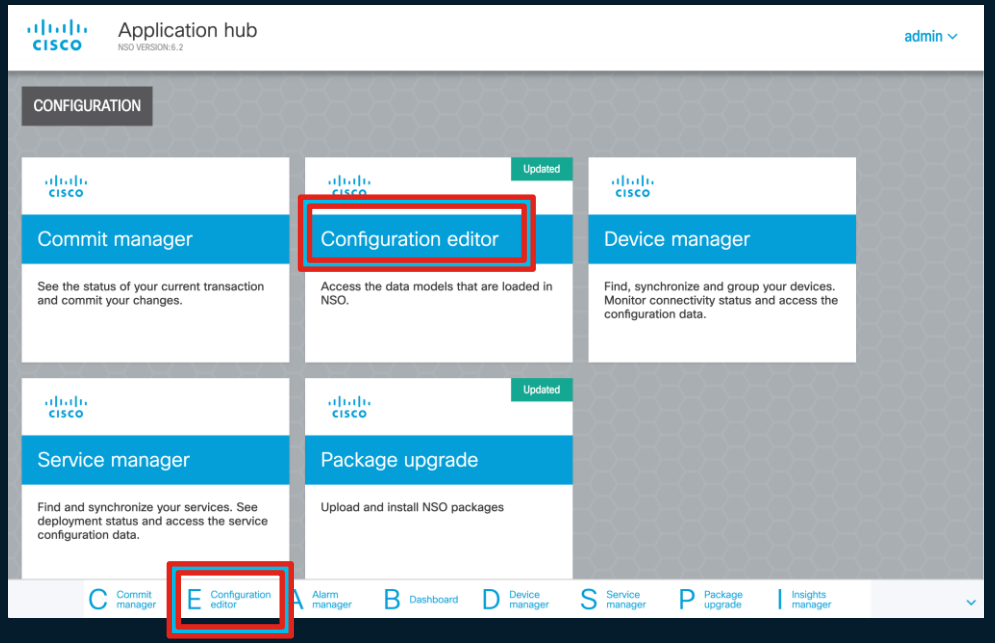
1. source $NCS_DIR/ncsrc
2. cd ~/nso-instance/packages/learn-yang/src
3. make clean all
4. cd ~/nso-instance/packages/router-model/src
5. make clean all
6. ncs_cli -C -u admin
7. packages reload force

```
src$ ncs_cli -C -u admin

User admin last logged in 2024-05
om 127.0.0.1 using cli-console
admin connected from 127.0.0.1 us
admin@ncs# packages reload force
reload-result {
    package learn-yang
    result true
}
reload-result {
    package router-model
    result true
}
admin@ncs# exit
```

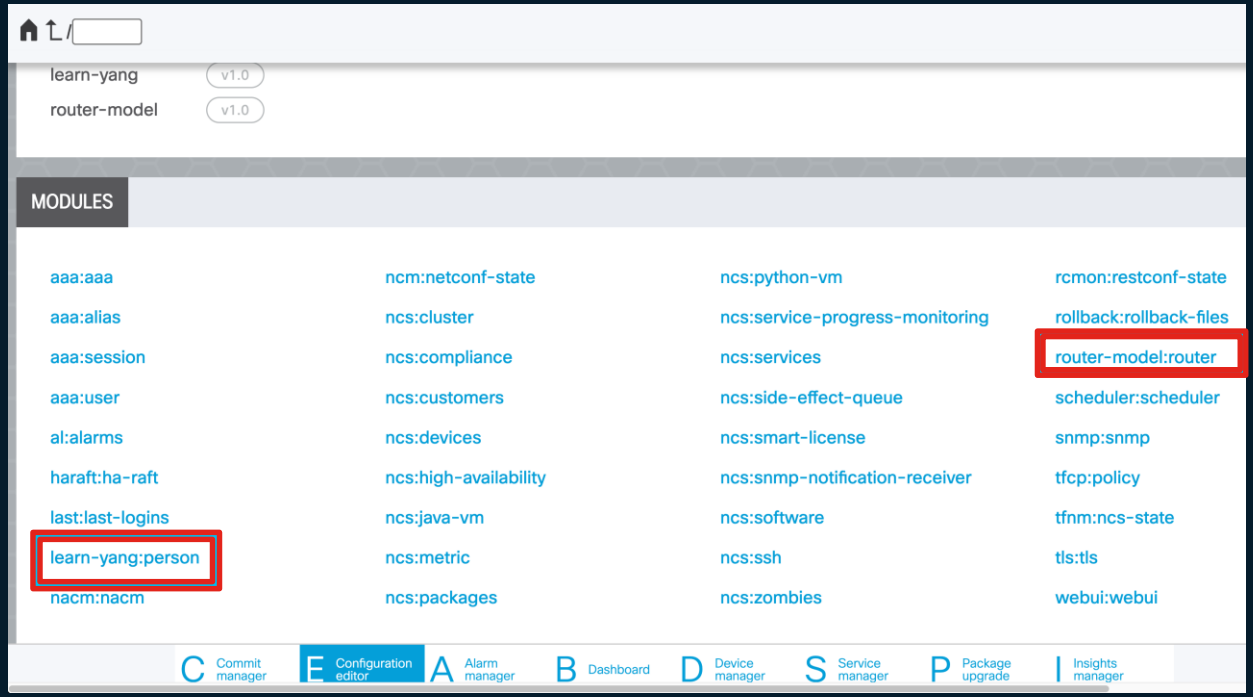
Accessing the GUI

1. echo $DEVENV_APP_8080_URL
2. Open browser to above URL
3. Credentials are ”admin” / “admin”
4. Click on ”E” – “Configuration Editor” on the bottom left (or on the tile in middle of screen)



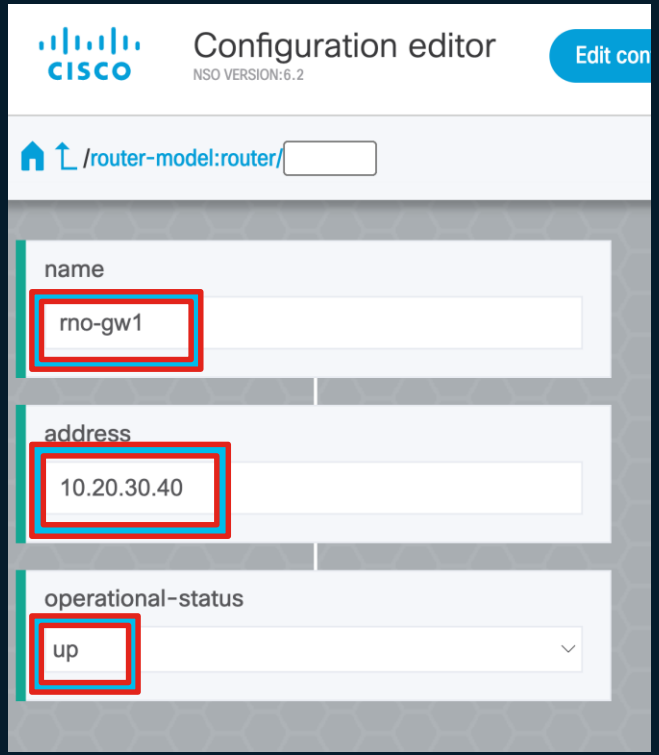
Accessing the Packages on the GUI

- The packages have their namespace prefix (namespace:package_name)
- Click on one of the two custom package names to edit the configuration
- There should be no values stored by default

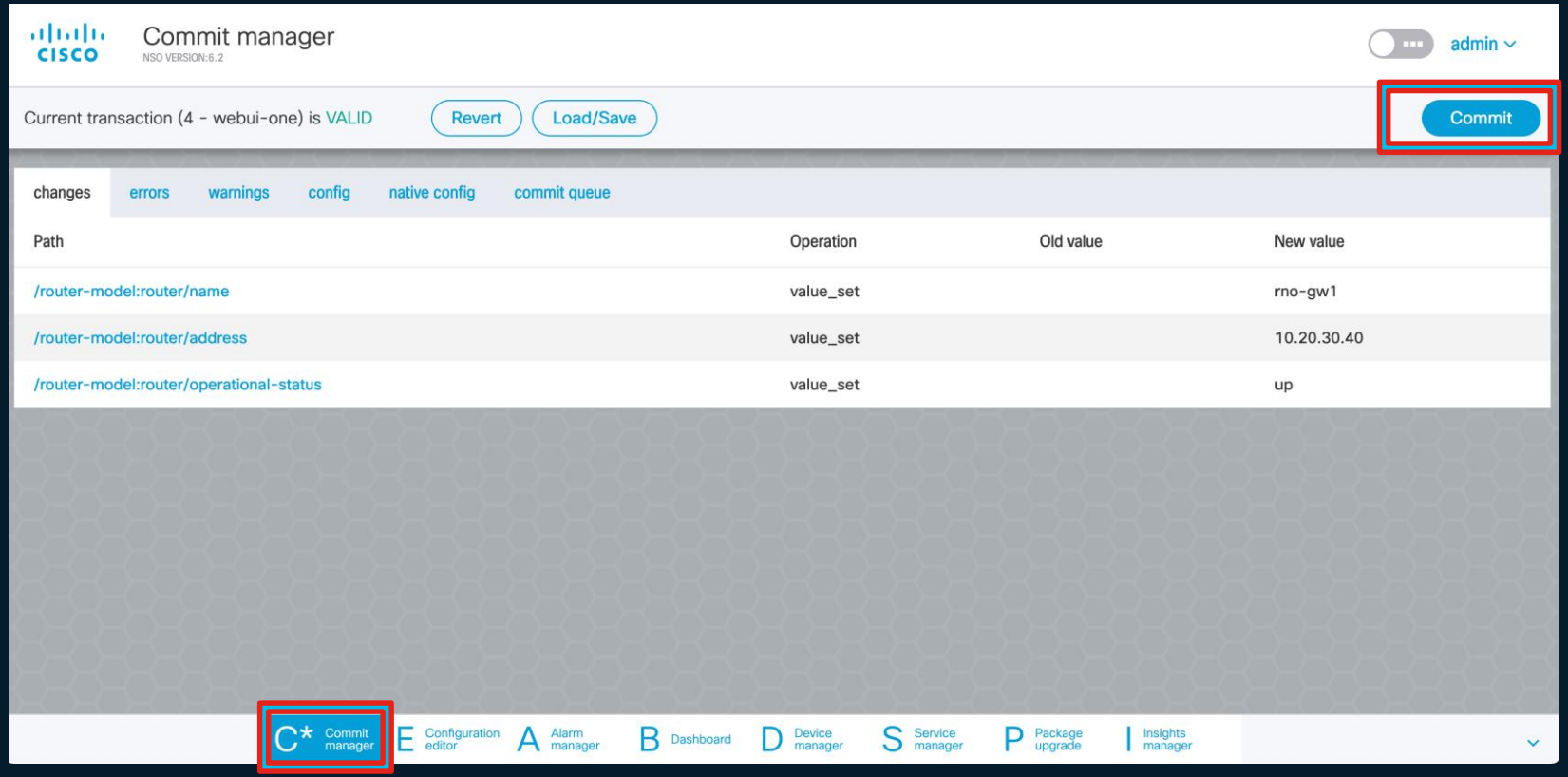


Adding Data

- Put a string for the name in “name”
- Put an IP address in the “address” field
- Select up or down for status
- Note:
  - Since the data model has a custom data type for IP Address validation, it will use RegEx to validate it is a valid IP address

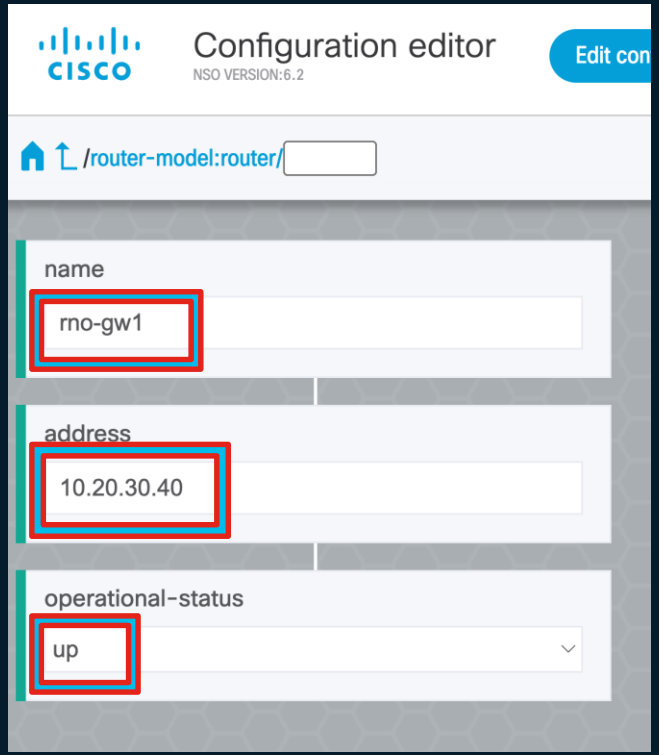


Saving the Data (and Yes, commit) to pop-up



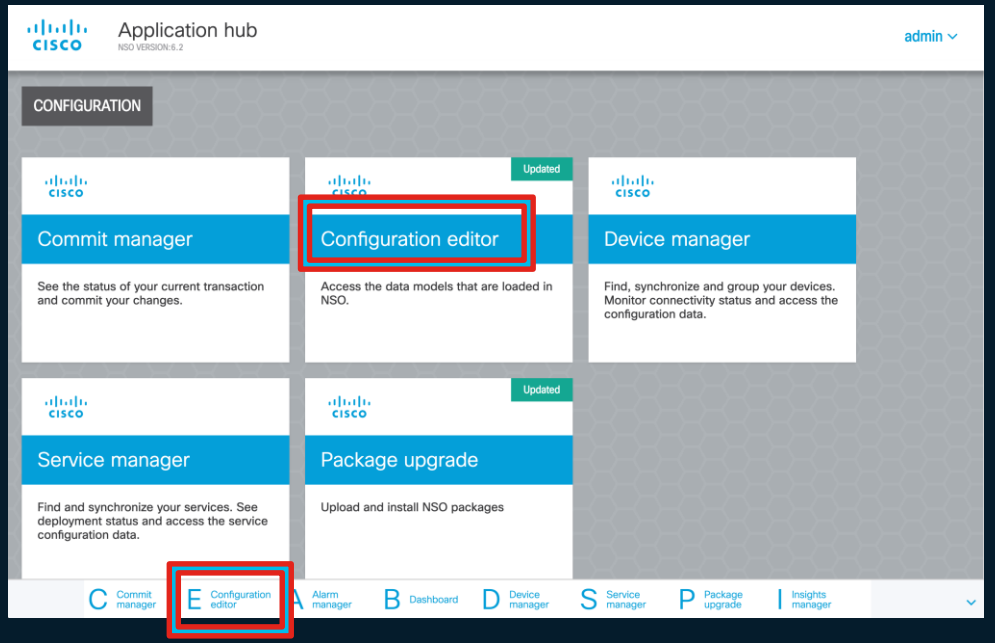
Viewing the Data from the CLI

- NSO stores its data in a CDB, which both the GUI and CLI access
- Access the CLI from the terminal
  - Make sure to source the following if you haven't already, or it is a new terminal session
    - source $NCS_DIR/ncsrc



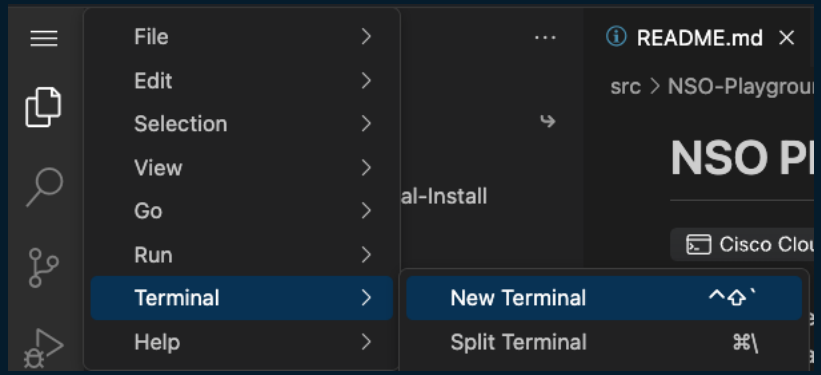
Accessing the CLI

1. echo $DEVENV_APP_8080_URL
2. Open browser to above URL
3. Credentials are ”admin” / “admin”
4. Click on ”E” – “Configuration Editor” on the bottom left (or on the tile in middle of screen)



Accessing the CLI in the Terminal in the Browser

1. Use the terminal on the bottom of the screen
2. If it is not there open a new one on the left-hand navigation



Accessing the CLI in the Terminal in the Browser

1. source $NCS_DIR/ncsrc
2. ncs_cli -C -u admin
3. show running-config router
4. show running-config router | display json
5. show running-config router | display xml

```
admin@ncs# show running-config router
router name        rno-gw1
router address     10.20.30.40
router operational-status up
admin@ncs# show running-config router | display json
{
  "data": {
    "router-model:router": {
      "name": "rno-gw1",
      "address": "10.20.30.40",
      "operational-status": "up"
    }
  }
}
admin@ncs# show running-config router | display xml
<config xmlns="http://tail-f.com/ns/config/1.0">
  <router xmlns="http://com/example/routermodel">
    <name>rno-gw1</name>
    <address>10.20.30.40</address>
    <operational-status>up</operational-status>
  </router>
</config>
admin@ncs#
```

Change the Config & Try out the ? options

1. conf
2. router ?
3. router name ?

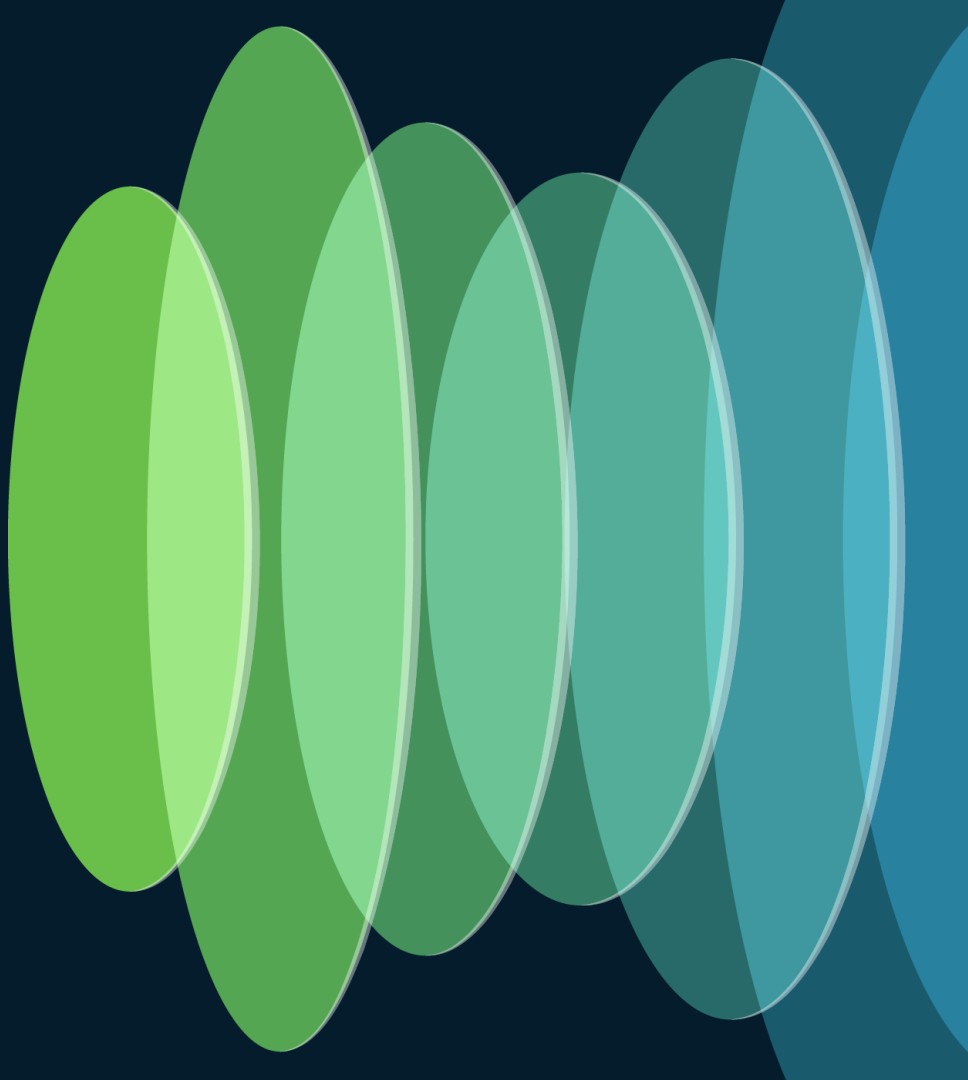
```
admin@ncs# conf
Entering configuration mode terminal
admin@ncs(config)# router ?
Possible completions:
  address  name  operational-status
admin@ncs(config)# router name ?
Possible completions:
  <string>[rno-gw1]
admin@ncs(config)# router name
```

Change the Config & Try out the ? options

1. router name sjc-gw2
2. commit
3. end
4. show running-config router

```
admin@ncs# conf
Entering configuration mode terminal
admin@ncs(config)# router ?
Possible completions:
  address  name  operational-status
admin@ncs(config)# router name ?
Possible completions:
  <string>[rno-gw1]
admin@ncs(config)# router name sjc-gw2
admin@ncs(config)# commit
Commit complete.
admin@ncs(config)# end
admin@ncs# show running-config router
router name         sjc-gw2
router address      10.20.30.40
router operational-status up
admin@ncs#
```

Live Demo



Complete Your Session Evaluations

Complete a minimum of 4 session surveys and the Overall Event Survey to be entered in a drawing to **win 1 of 5 full conference passes** to Cisco Live 2025.

Earn 100 points per survey completed and compete on the Cisco Live Challenge leaderboard.

Level up and earn **exclusive prizes!**

Complete your surveys in the **Cisco Live mobile app.**

Continue your education

- Visit the Cisco Showcase for related demos
- Book your one-on-one Meet the Engineer meeting
- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs
- Visit the On-Demand Library for more sessions at www.CiscoLive.com/on-demand

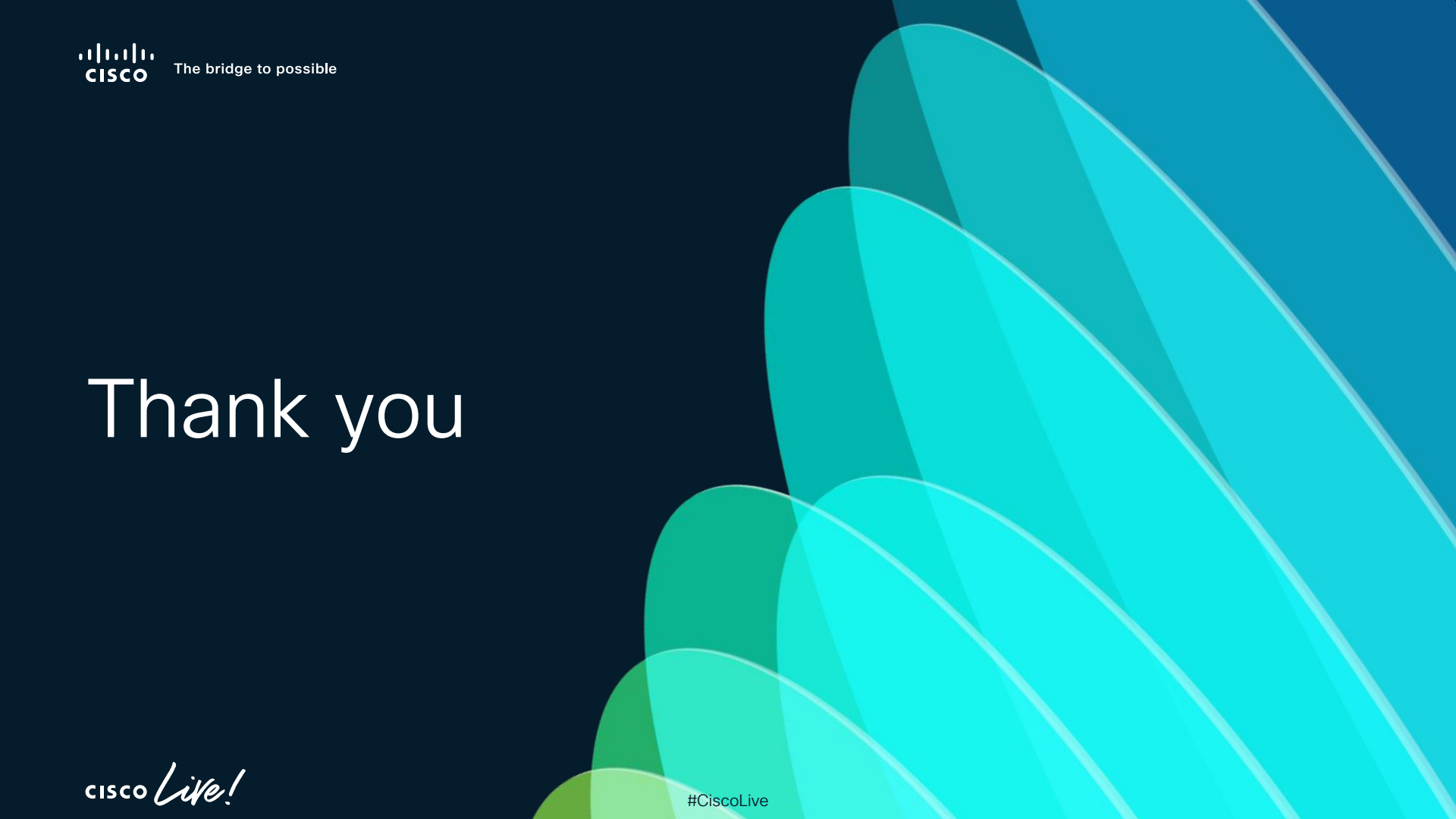
Contact me at: renobelk (Twitter / LinkedIn)

cisco Live!
DevNet

Continue your learning journey after the event with Cisco DevNet!

- Personalized learning modules
- Live interactive tooling
- Other resources

Scan to get started


The bridge to possible
Thank you
cisco Live!
#CiscoLive