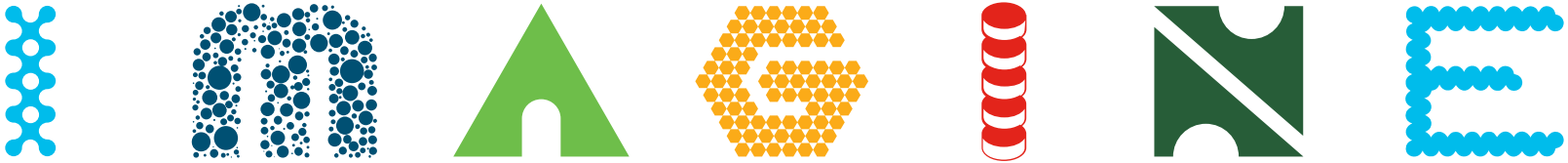
Cisco live!

January 28 - February 1, 2019 • Barcelona

cisco



INTUITIVE

DEVWKS-1381

Introduction to Using gRPC-based Protocol

For Model-Driven Management of IOS-XR

Michael Cho, Software Engineer

Suprita, Software Engineer

Cisco live!

Agenda

- Introduction
  - YANG & OpenConfig
  - gRPC & gNMI
  - Streaming Telemetry
- Lab
- Q & A
- Topics to Explore

"This lab session will introduce model-driven router management using gRPC-based protocol on Cisco IOS-XR devices. Participants will interact with OpenConfig data models as a vendor-neutral means of configuration and streaming telemetry. The lab topology will be a simplified Service Provider prototype, with IGP as ISIS and BGP for external peering, to represent a real-use case. The hands-on will be done using a basic gRPC client. The lab will be a beginner-level IOS-XR network programmability hands-on lab."

DEVWKS-1381 Abstract

What the workshop will cover...

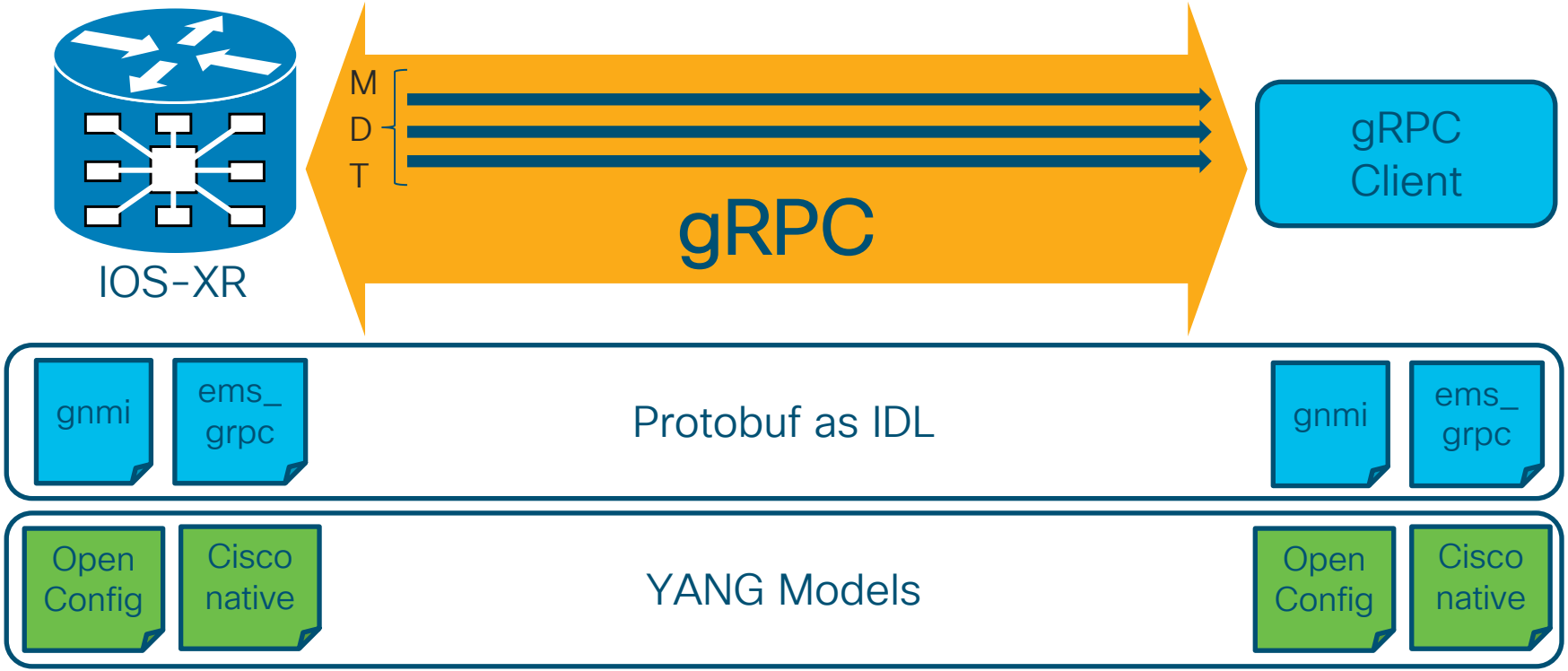
- Introductory information on concepts like YANG, OpenConfig, streaming telemetry, gRPC, and gNMI
- Learning how to perform basic network management operations using an open-source gNMI shell-based client
- Using gNMI with OpenConfig models to configure an interface to be advertised to IS-IS and verify via streaming telemetry
- Using gNMI with OpenConfig models to configure a BGP neighbor and verify via streaming telemetry

What the workshop will not cover...

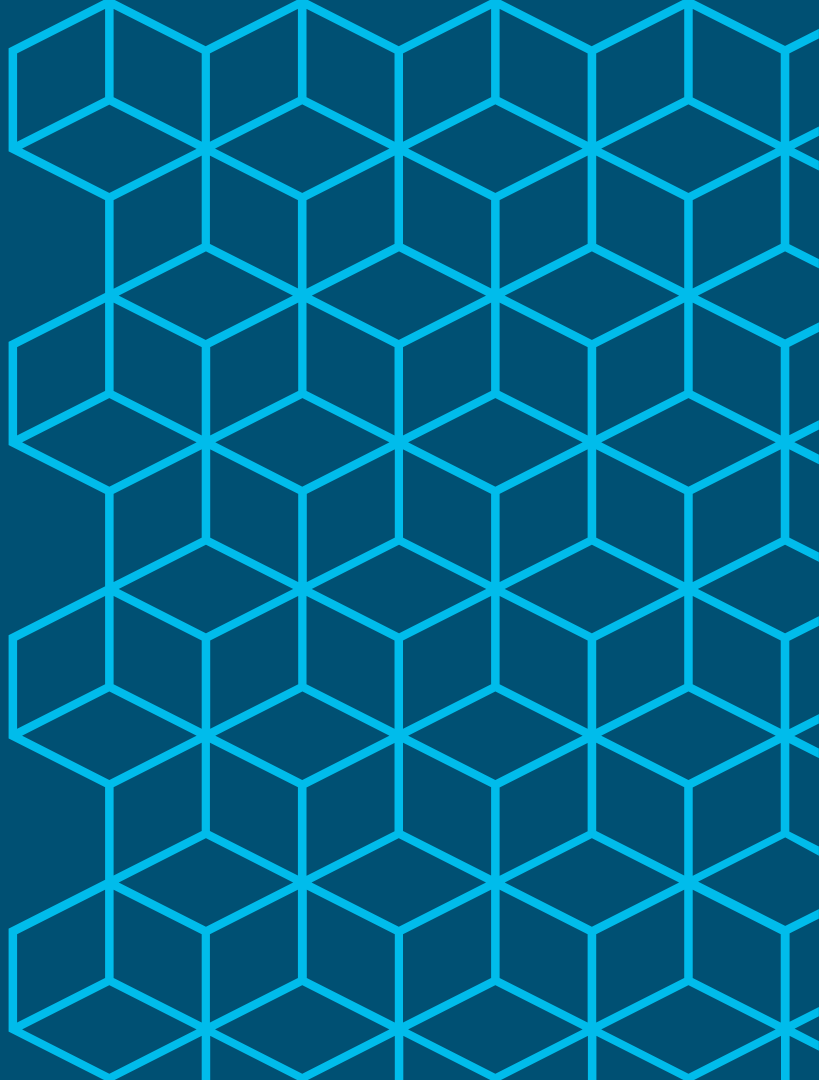
- Details on routing protocols interacted with, i.e. IS-IS and BGP
- Comparison to alternative network management protocols like NETCONF (RFC6241) and RESTCONF (RFC8040)
- Writing code to programmatically interact with gNMI and OpenConfig models

Introduction

A high-level view on key concepts



YANG & OpenConfig



Yet another next gen

- YANG standard -
  - **RFC6020 (1)** & RFC7950 (1.1)
- Modeling language for config & operational state data
- Defined schema shared between client & server
- Designed for machine-to-machine usage

```
module openconfig-interfaces {
 ...
 grouping interfaces-top {
   description
    "Top-level grouping for interface configuration and
    operational state data";

   container interfaces {
    description
     "Top level container for interfaces, including
configuration
     and state data.";

    list interface {
     key "name";
     description
      "The list of named interfaces on the device.";

     leaf name {
      type leafref {
       path "../config/name";
      }
      ...
     }
```

Variants of YANG Models

- Vendor-specific (native)

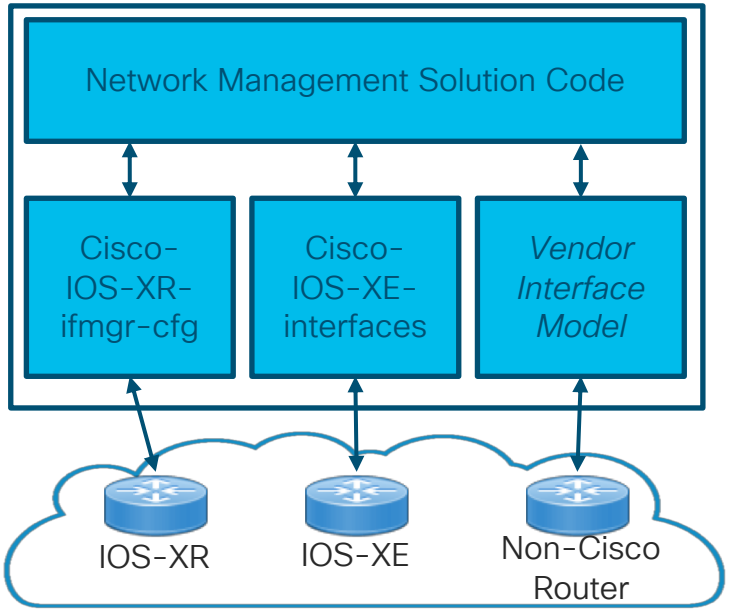
```
module: Cisco-IOS-XR-ifmgr-cfg
  +--rw global-interface-configuration
  |  +--rw link-status?   Link-status-enum
  +--rw interface-configurations
    +--rw interface-configuration* [active interface-name]
      +--rw dampening
      |  +--rw args?               enumeration
      |  +--rw half-life?          uint32
      |  +--rw reuse-threshold?    uint32
      |  +--rw suppress-threshold? uint32
      |  +--rw suppress-time?      uint32
      |  +--rw restart-penalty?    uint32
      +--rw mtus
      |  +--rw mtu* [owner]
      |     +--rw owner    xr:Cisco-ios-xr-string
      |     +--rw mtu      uint32
      +--rw encapsulation
      |  +--rw encapsulation?        string
      |  +--rw capsulation-options?  uint32
      +--rw shutdown?                empty
```

- Vendor-neutral (e.g. OpenConfig)

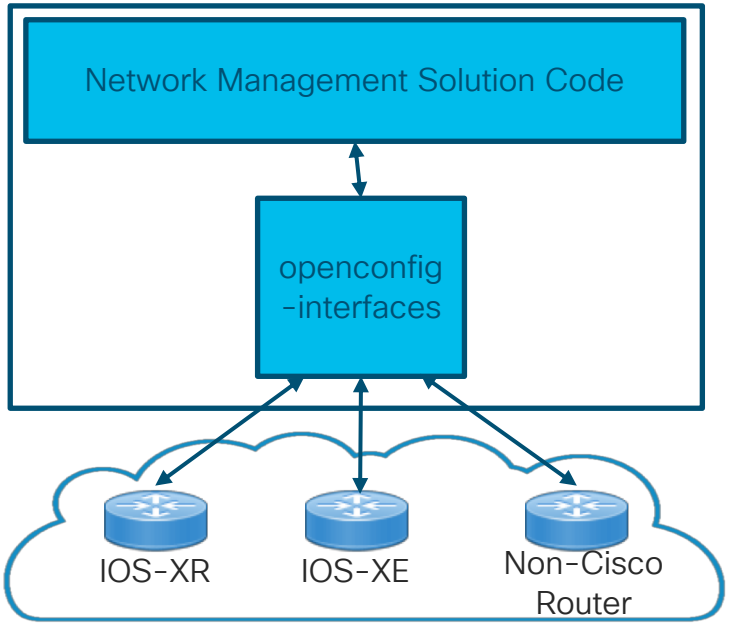
```
module: openconfig-interfaces
  +--rw interfaces
    +--rw interface* [name]
      +--rw name                -> ../config/name
      +--rw config
      |  +--rw type          identityref
      |  +--rw mtu?          uint16
      |  +--rw name?         string
      |  +--rw description?  string
      |  +--rw enabled?      boolean
      +--ro state
      |  +--ro type          identityref
      |  +--ro mtu?          uint16
      |  +--ro name?         string
      |  +--ro description?  string
      |  +--ro enabled?      boolean
      |  +--ro ifindex?      uint32
      |  +--ro admin-status  enumeration
      |  +--ro oper-status   enumeration
      |  +--ro last-change?  yang:timeticks
```

Variants of YANG Models impact on solutions

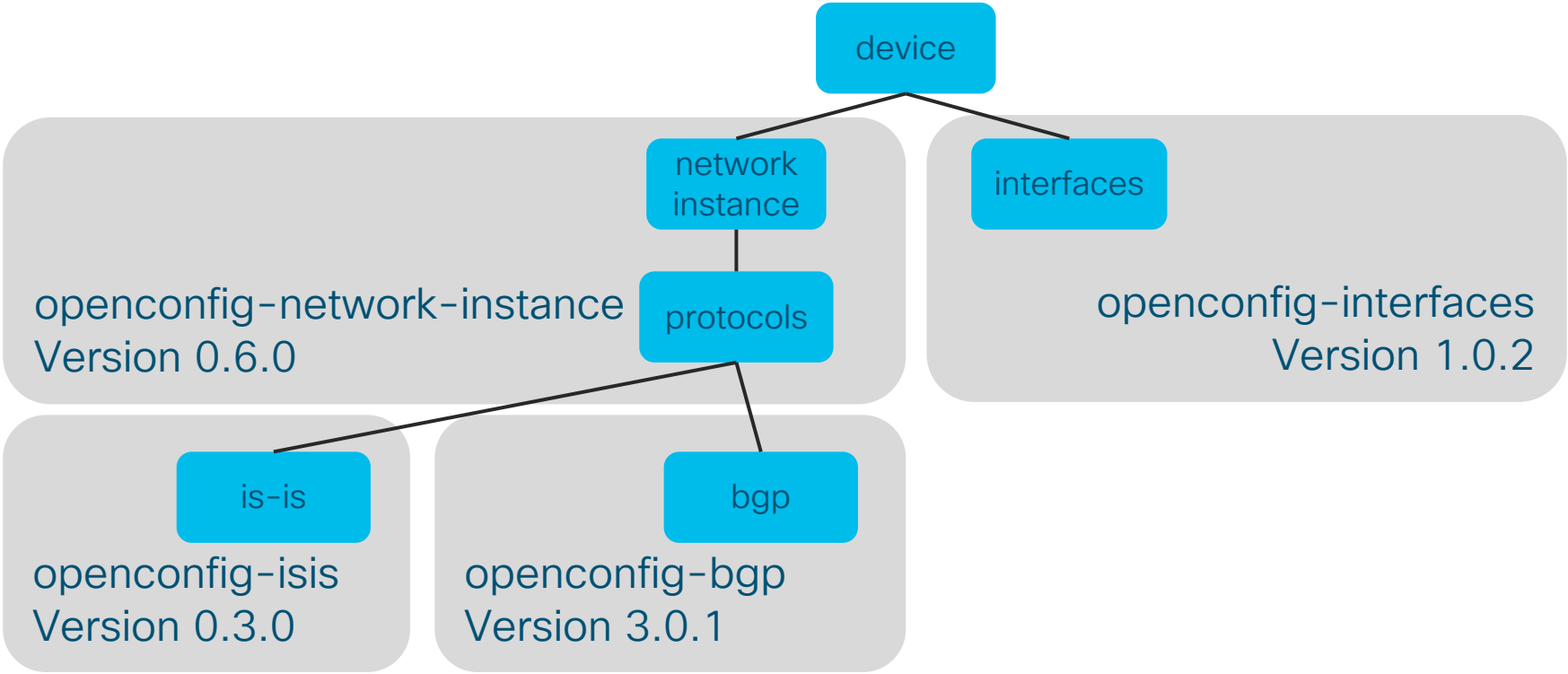
- Vendor-specific (native)



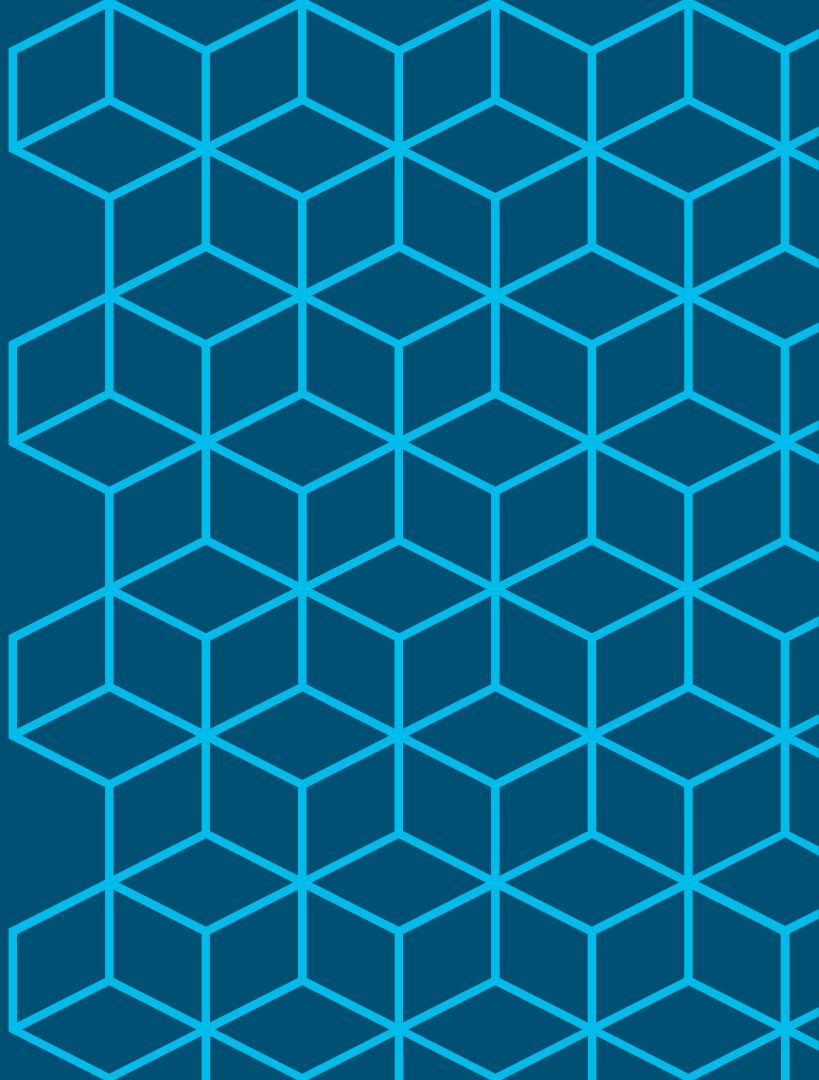
- Vendor-neutral (e.g. OpenConfig)



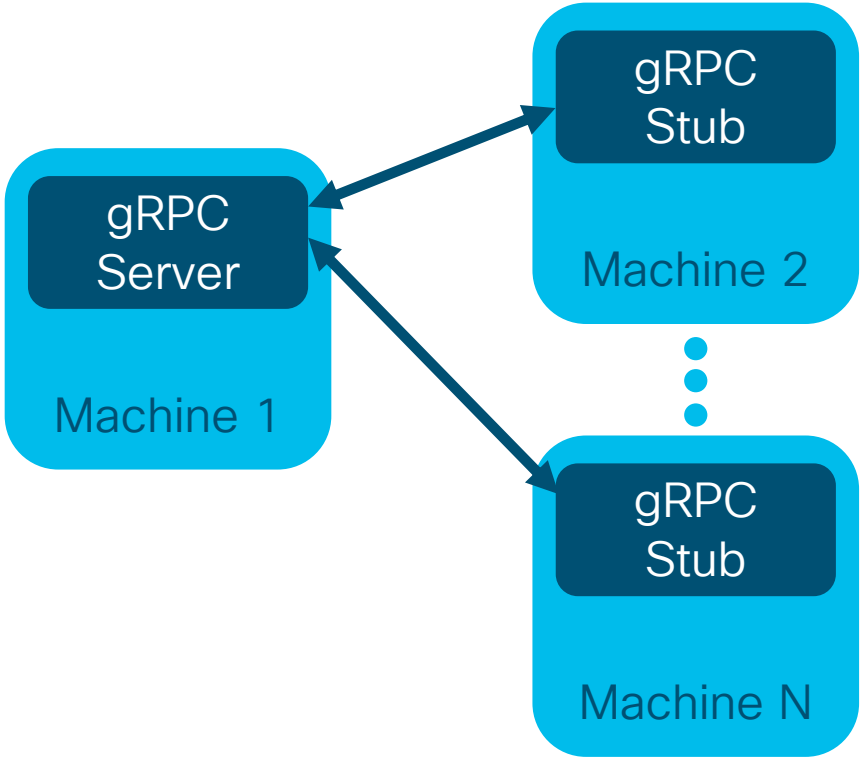
Explore related OpenConfig YANG Models



gRPC & gNMI



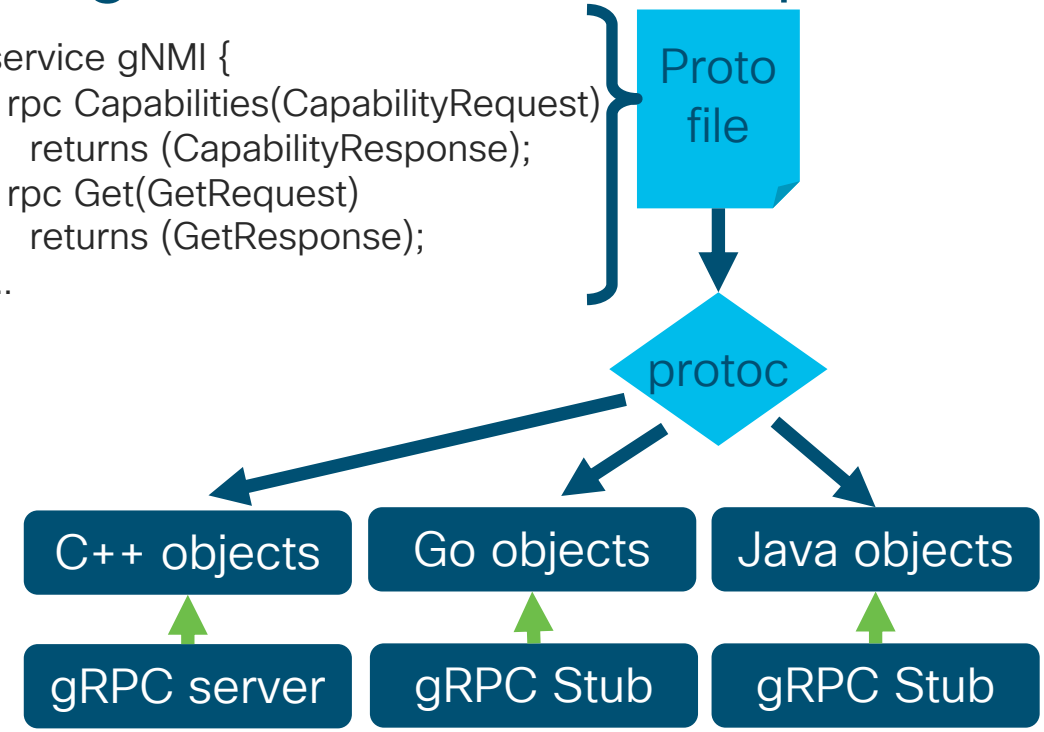
gRPC is a high-performance RPC framework



- Designed for modern, large-scale architectures
- Can easily build APIs like REST
- Usually makes use of HTTP/2 and protocol buffers
- Is used in IOS XR as protocol for streaming telemetry and other network management interfaces

gRPC benefits from protocol buffers

```
service gNMI {
  rpc Capabilities(CapabilityRequest)
    returns (CapabilityResponse);
  rpc Get(GetRequest)
    returns (GetResponse);
...
```



- Protocol buffers serialize data in binary format
- Acts as Interface Definition Language (IDL) and message interchange format
- Many advantages vs XML[1]
  - Simpler
  - 3–10x smaller
  - 20–100x faster
  - Less ambiguous

[1] https://developers.google.com/protocol-buffers/docs/overview. Retrieved 14 January 2019.

gRPC-based protocols on Cisco IOS XR

- Cisco's EMS-gRPC
  - Early design when gNMI wasn't ready.
  - Proprietary behavior
  - Support for Cisco's action RPCs
- OpenConfig's gNMI
  - Common method designed to be used by all vendors
  - Support for config management and telemetry dial-in
  - No support for vendor RPCs (instead uses gNOI)

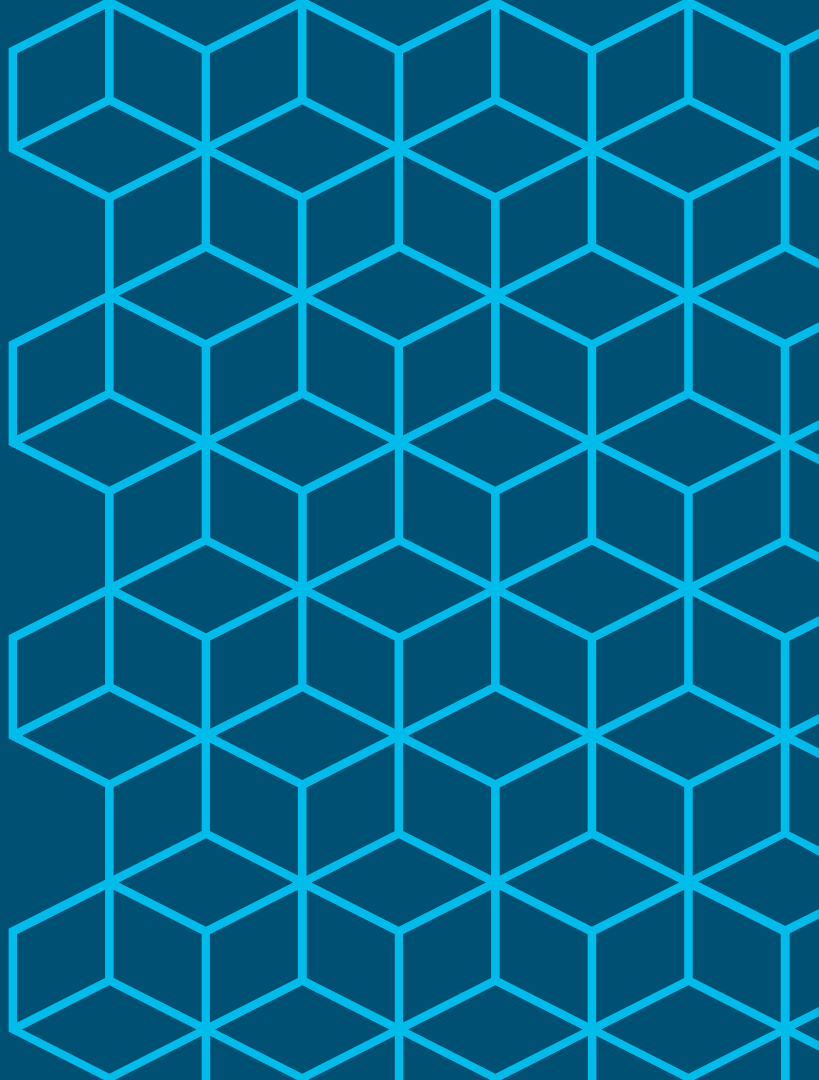
Comparison between gRPC-based protocols

EMS-gRPC	gNMI
GetModels	Capabilities
GetConfig	Get
GetOper	Get
MergeConfig	Set
DeleteConfig	Set
ReplaceConfig	Set
SubscribeTelemetry	Subscribe
ActionJSON / CommitReplace / ...	

Available gRPC Tools

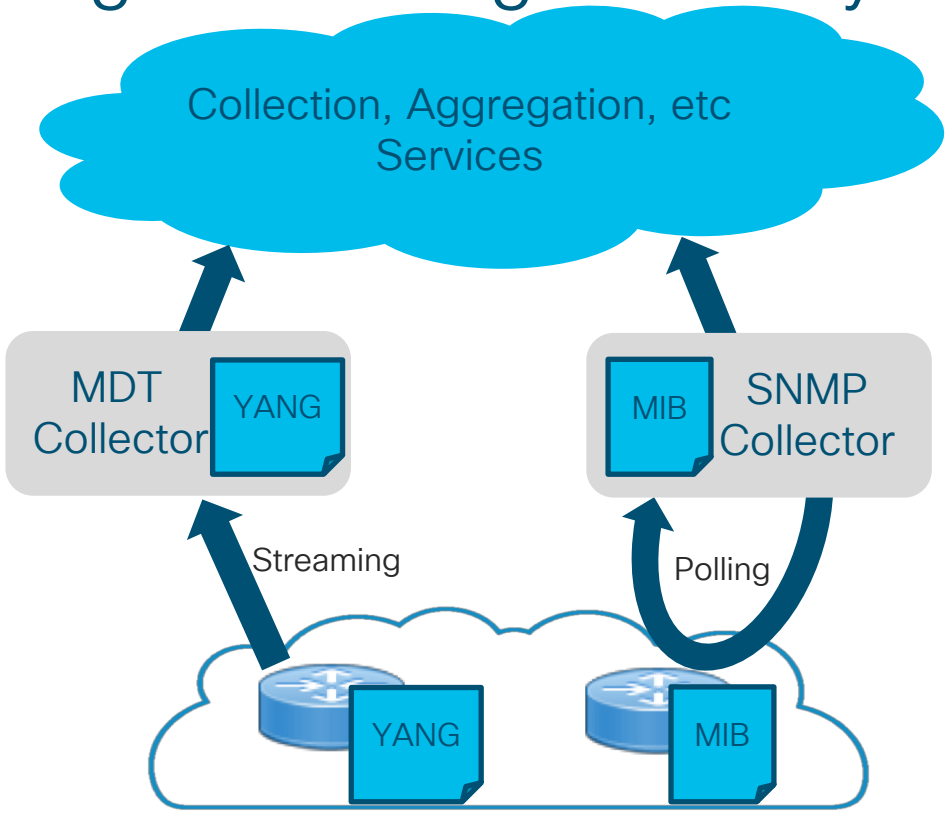
- Open-source gNMI CLI Tools
  - https://github.com/openconfig/gnmi
  - https://github.com/google/gnxi
- gNMI CLI Tool
  - gnmi_client (GET/SET)
  - client (SUBSCRIBE)
- gRPC EMS CLI Tool
  - client (get-config/merge-config/replace-config/action-json/...)

Streaming Telemetry



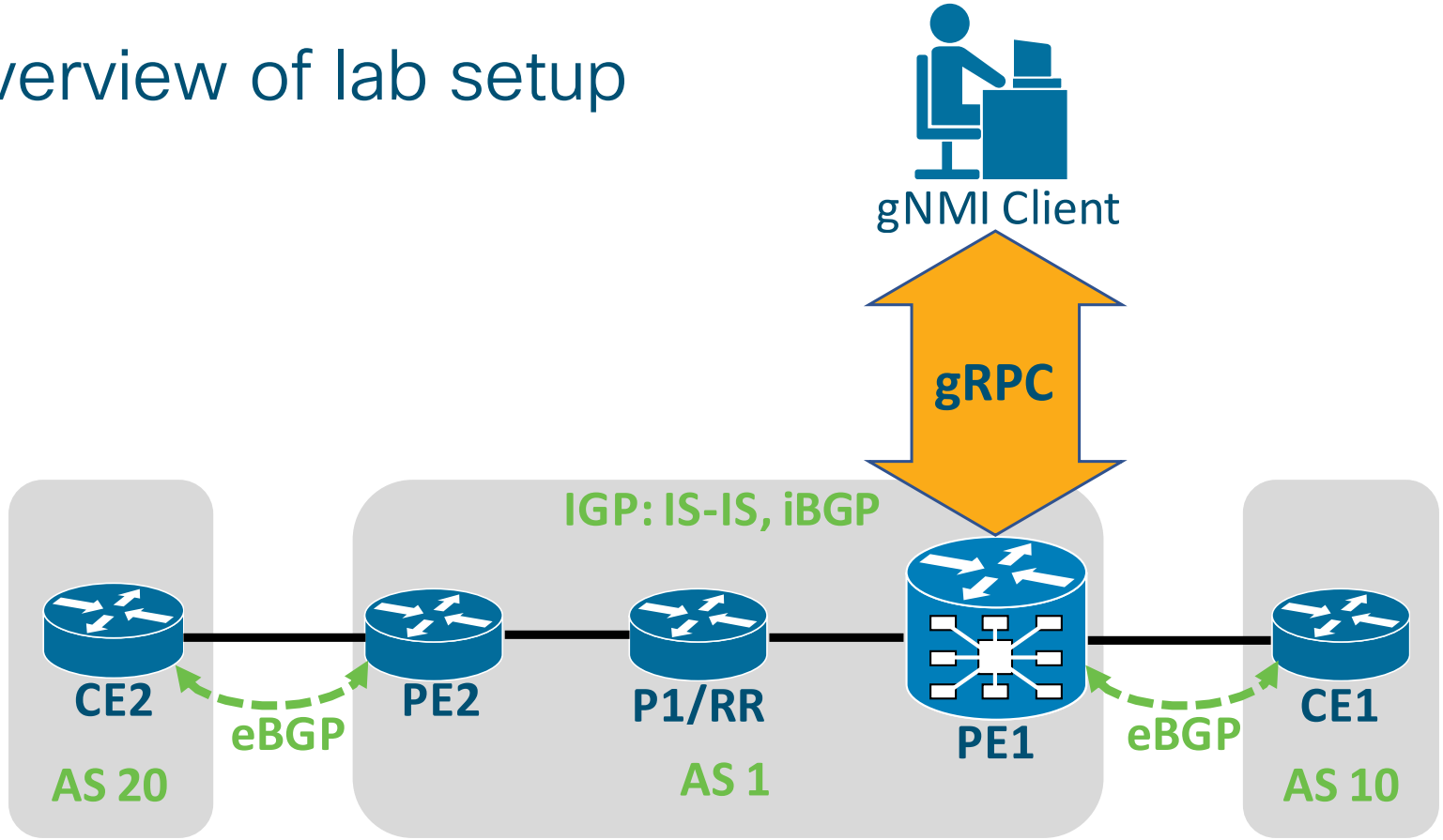
Improved monitoring through streaming telemetry

- Designed as modern, scalable replacement for SNMP monitoring
- Usually makes use of YANG and gRPC
- Benefits include:
  - Performance (Stream vs Poll)
  - Coverage (YANG vs MIB)
  - Active development (collection stacks, closed-loops, automated systems)



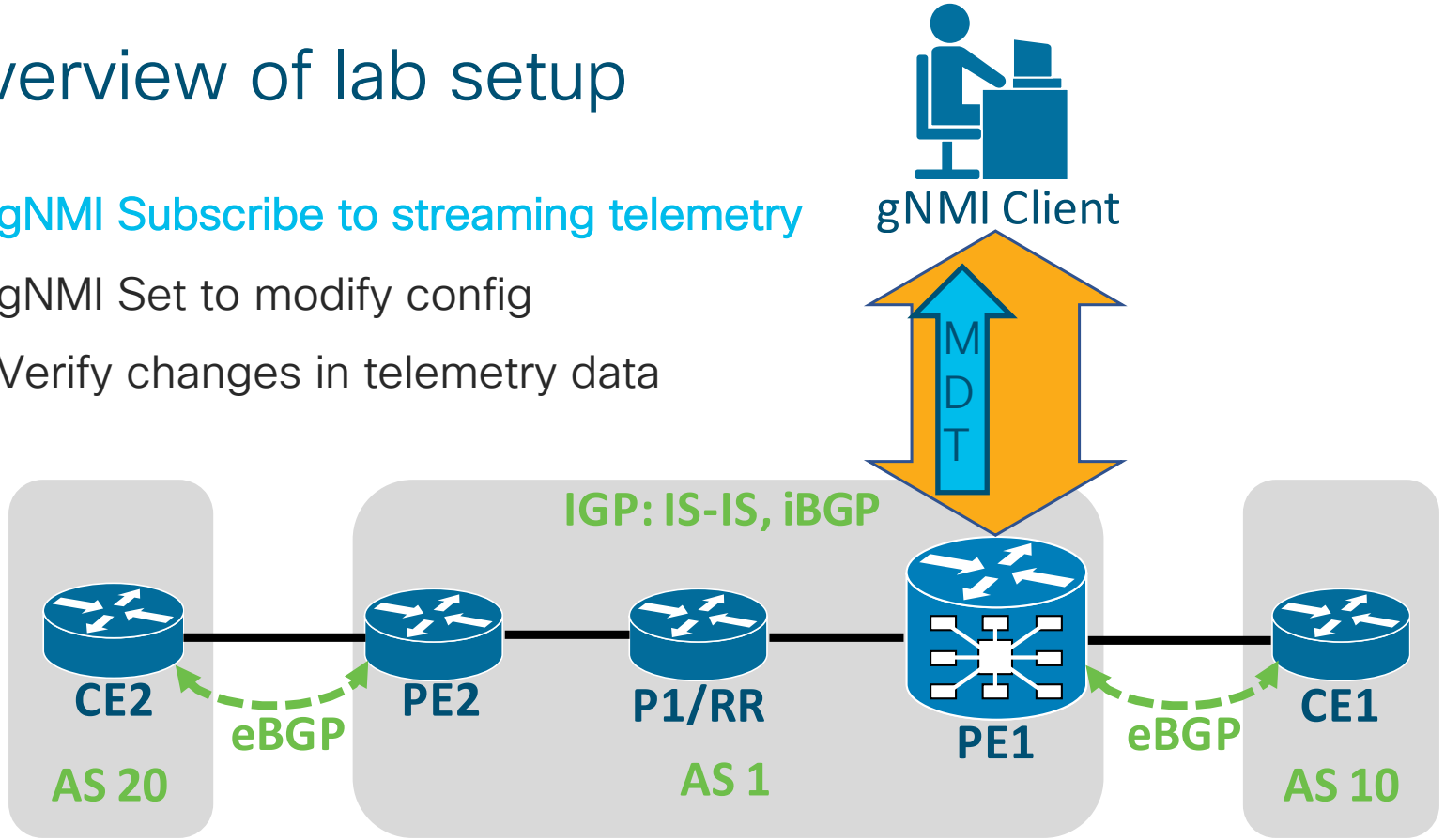
Lab

Overview of lab setup



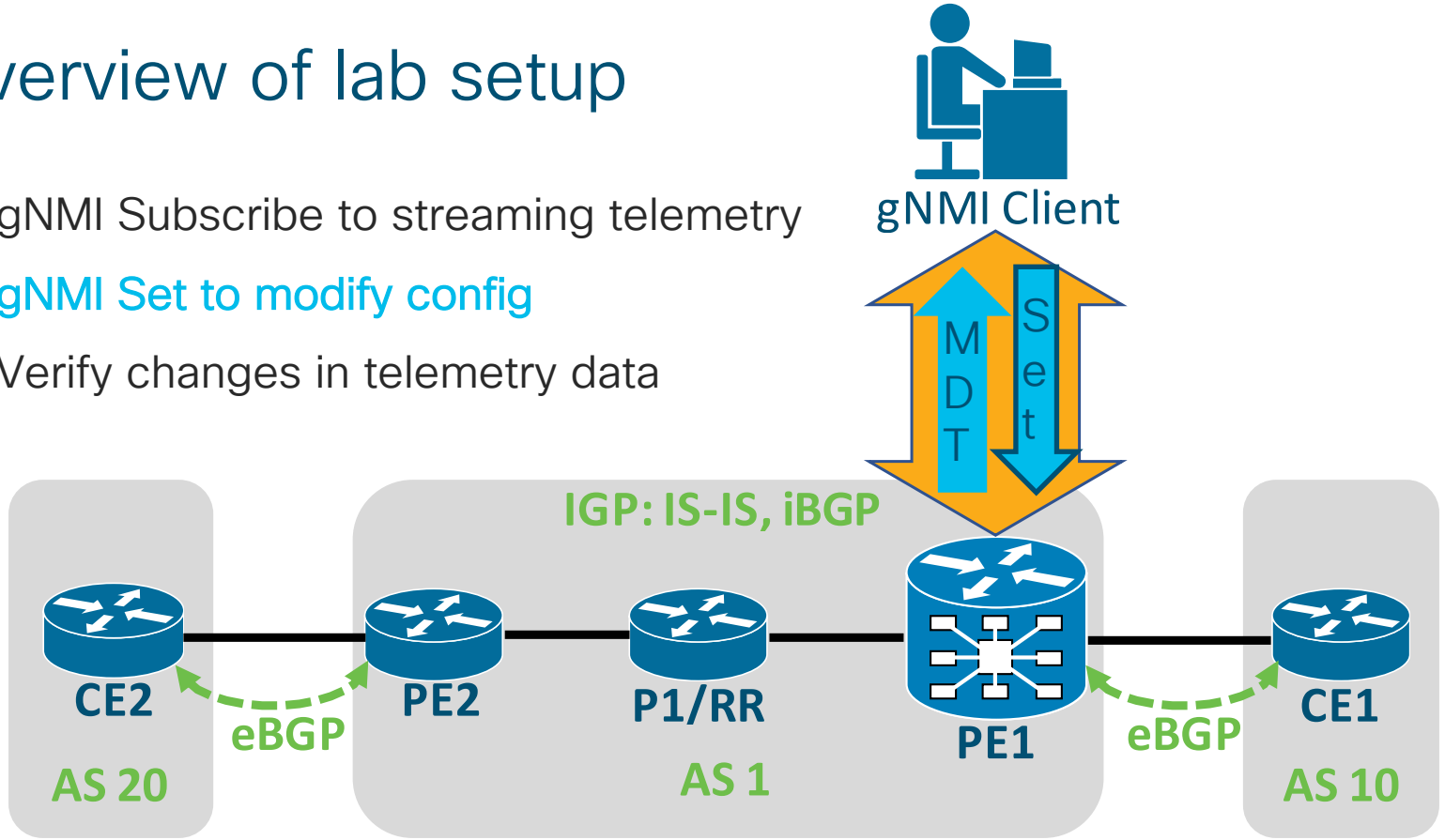
Overview of lab setup

1. gNMI Subscribe to streaming telemetry
2. gNMI Set to modify config
3. Verify changes in telemetry data



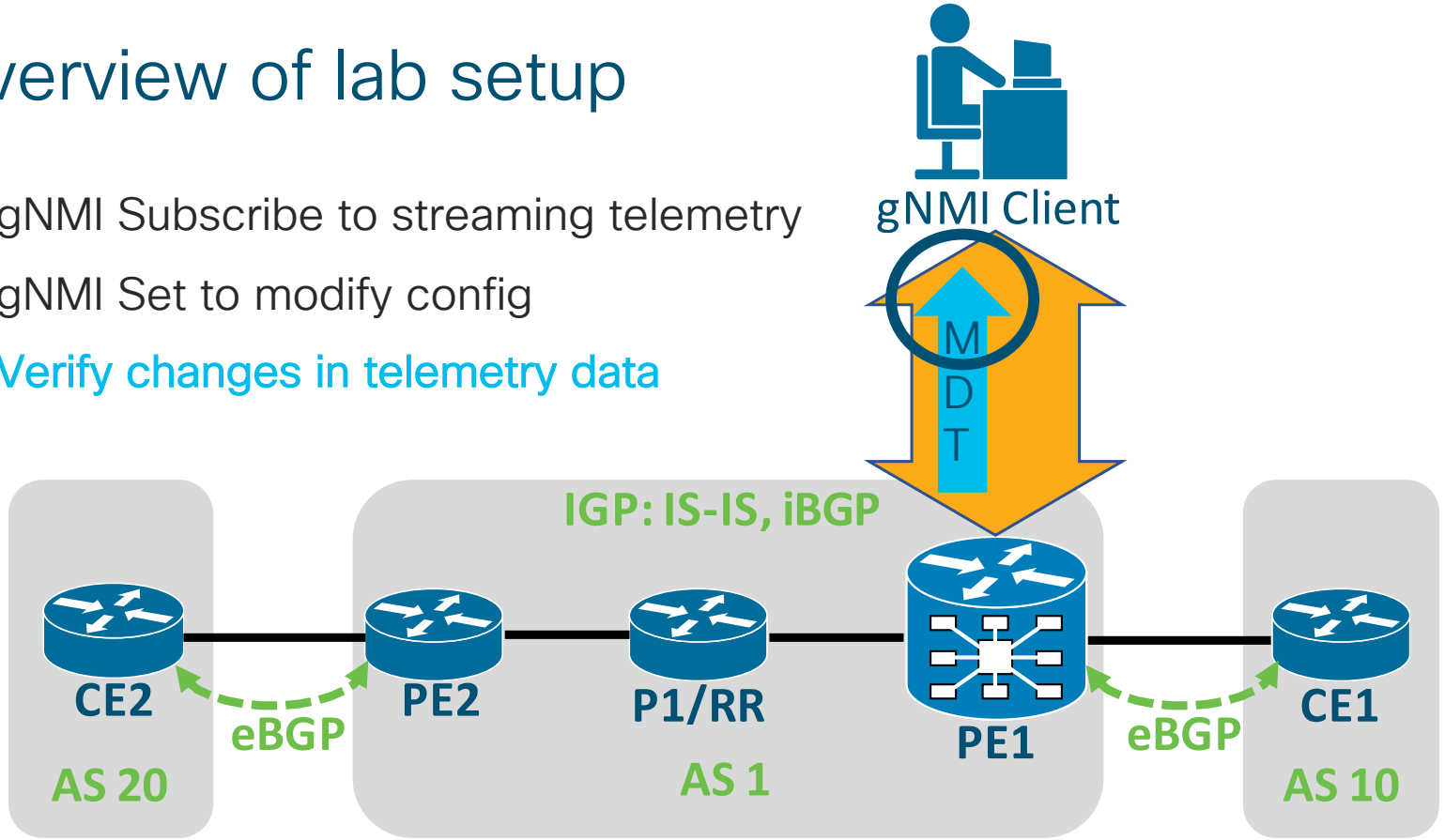
Overview of lab setup

1. gNMI Subscribe to streaming telemetry
2. gNMI Set to modify config
3. Verify changes in telemetry data

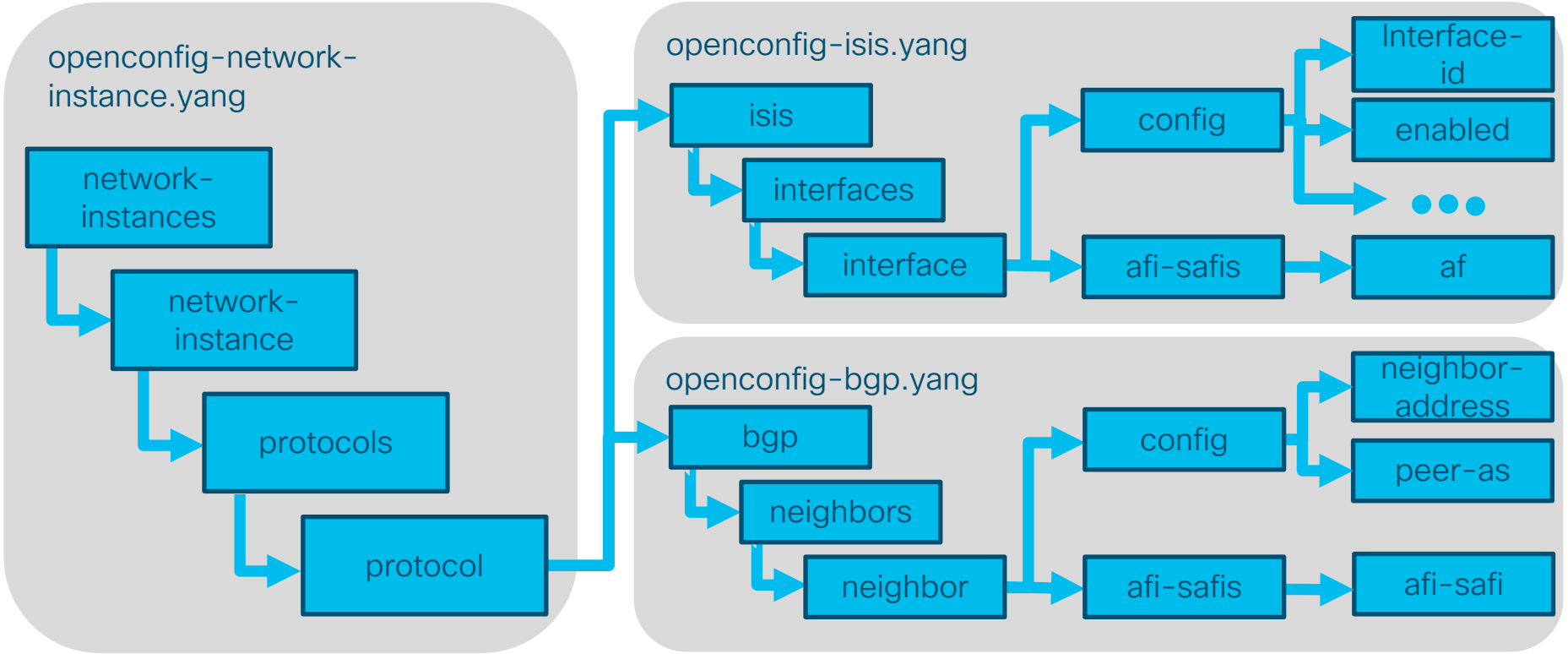


Overview of lab setup

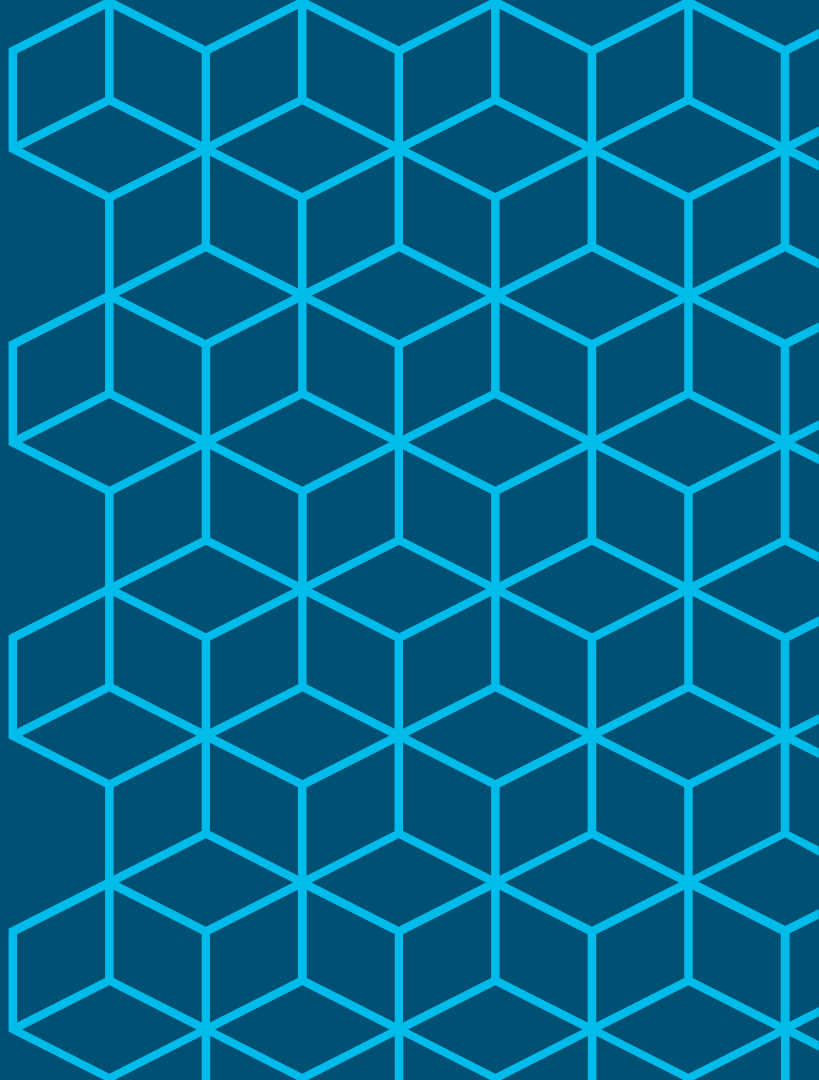
1. gNMI Subscribe to streaming telemetry
2. gNMI Set to modify config
3. Verify changes in telemetry data



Snippet of YANG nodes that will be manipulated



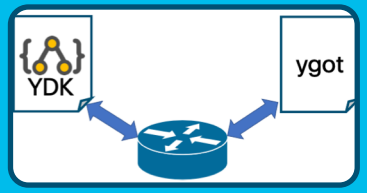
Start of Hands-On



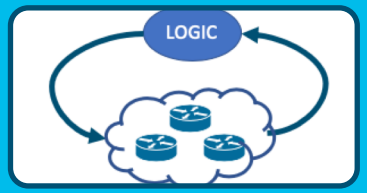
Q & A

Topics to Explore

Some paths to proceed from here...



Hands-on writing programs to utilize YANG + gNMI



Explore aggregation & closed-loop solutions

Deep-dive into gRPC and apply to your own network/project

Related sessions at Cisco Live

- Introductory:
  - Building IP Core Network with OpenConfig [DEVWKS-1644]
    Sakthi S Malli & Suprita, Cisco
- Intermediate:
  - Cisco IOS XR Programmability [LTRSPG-2601]
    Santiago Alvarez & David Smith, Cisco
  - Model-Driven Programmability for Cisco IOS XR [BRKSPG-2303]
    Santiago Alvarez, Cisco
  - Model-Driven Telemetry and Analytics [BRKNMS-3537]
    Steven Barth & Cristina Precup, Cisco

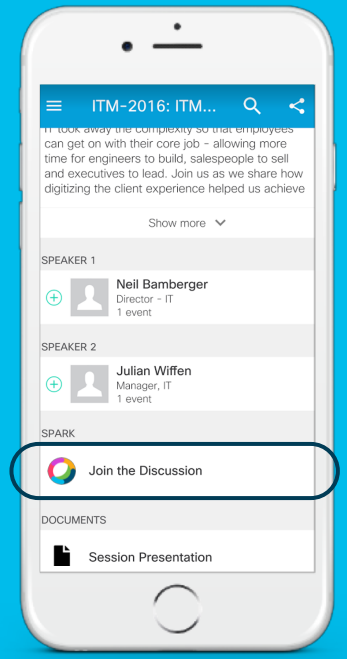
Related resources

- YANG 1.0 RFC – https://tools.ietf.org/html/rfc6020
- OpenConfig – http://www.openconfig.net/
- gRPC Documentation – https://grpc.io/docs/
- gNMI Specification – https://github.com/openconfig/reference/blob/master/rpc/gnmi/gnmi-specification.md
- gnmi_cli – https://github.com/openconfig/gnmi

Thank you

CISCO

INTUITIVE



cs.co/ciscolivebot#DEVWKS-1381

Cisco Webex Teams

Questions?

Use Cisco Webex Teams (formerly Cisco Spark) to chat with the speaker after the session

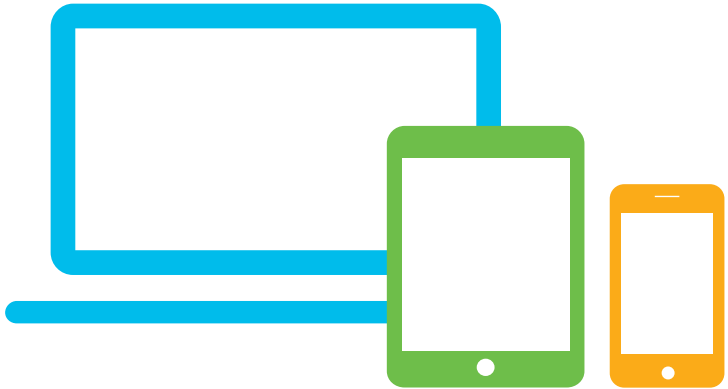
How

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

Complete your online session survey

- Please complete your Online Session Survey after each session
- Complete 4 Session Surveys & the Overall Conference Survey (available from Thursday) to receive your Cisco Live T-shirt
- All surveys can be completed via the Cisco Events Mobile App or the Communication Stations

Don't forget: Cisco Live sessions will be available for viewing on demand after the event at ciscolive.cisco.com



Continue Your Education