The bridge to possible

Practical Approach to Programmability

Mike Korshunov, TME @ Provider Connectivity Group

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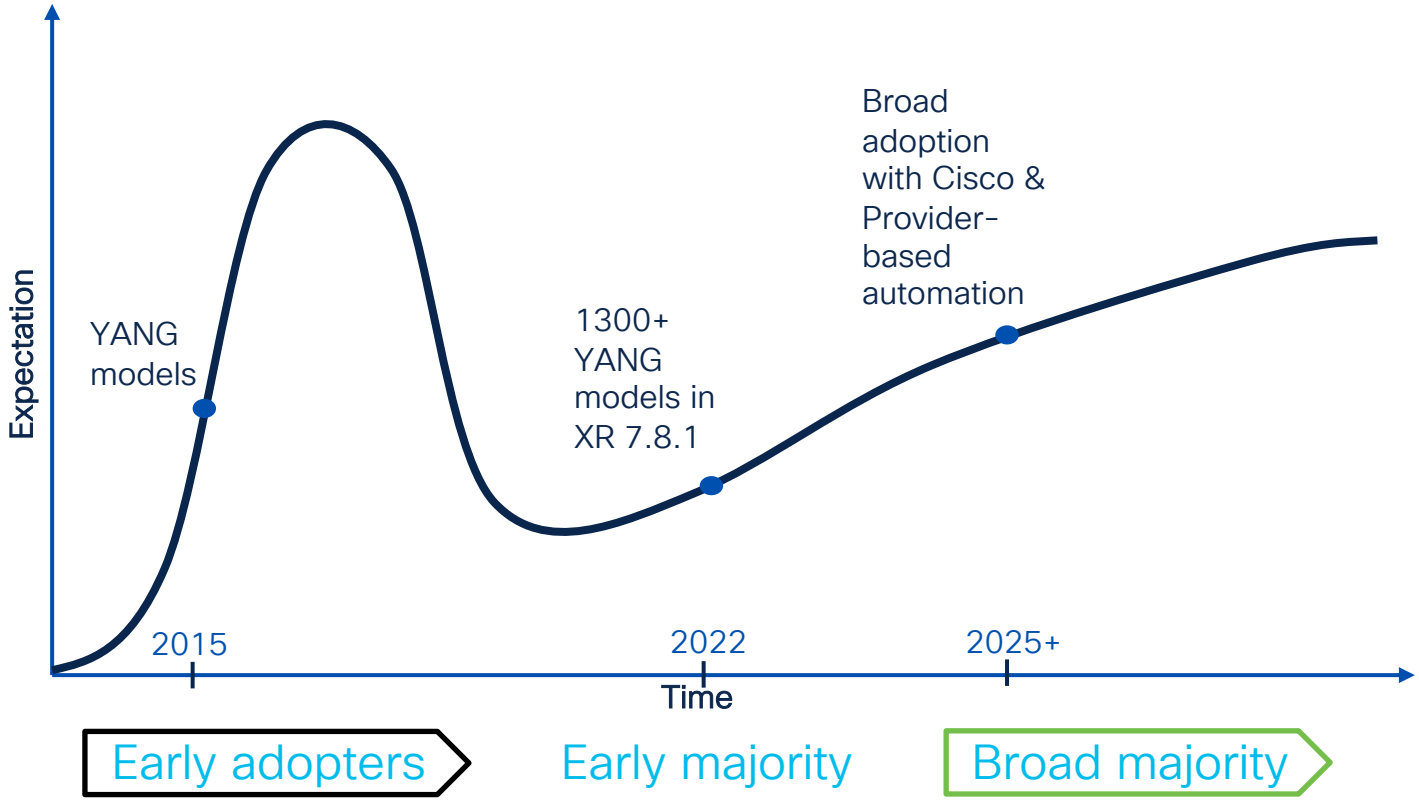
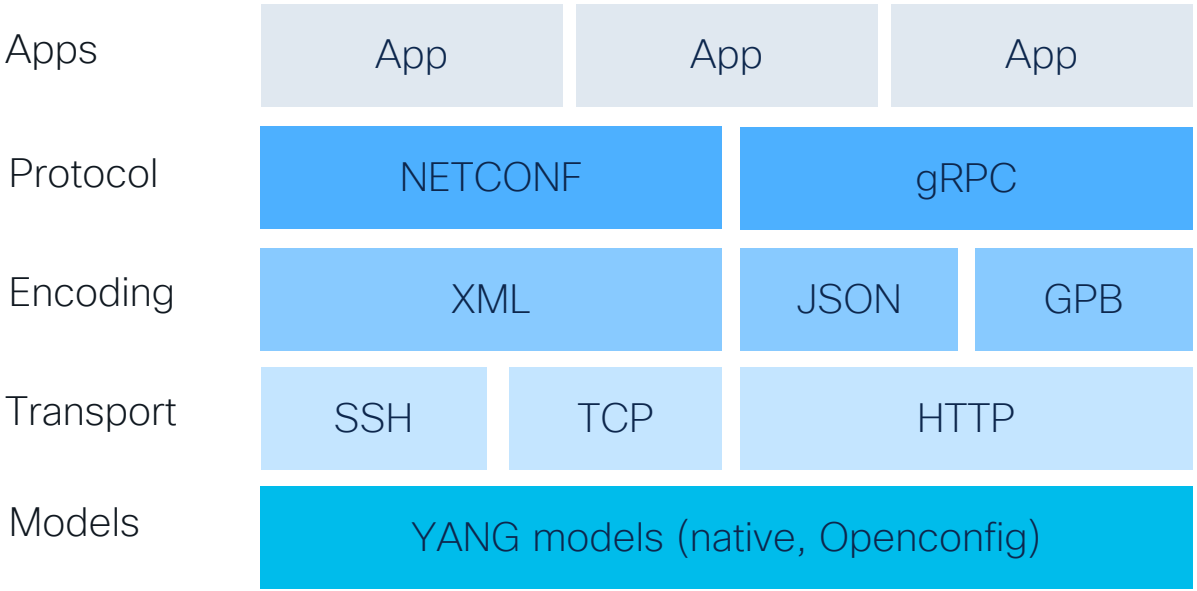
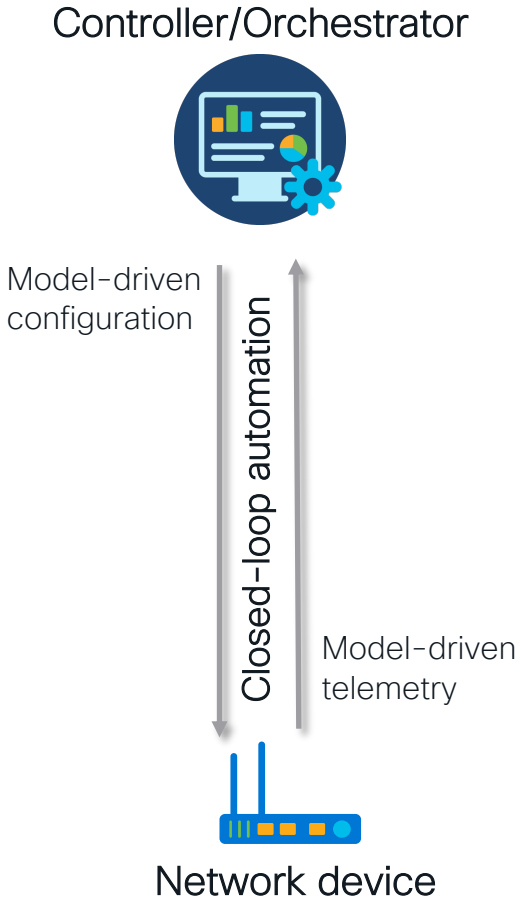
XR Model-Driven Programmability Evolution

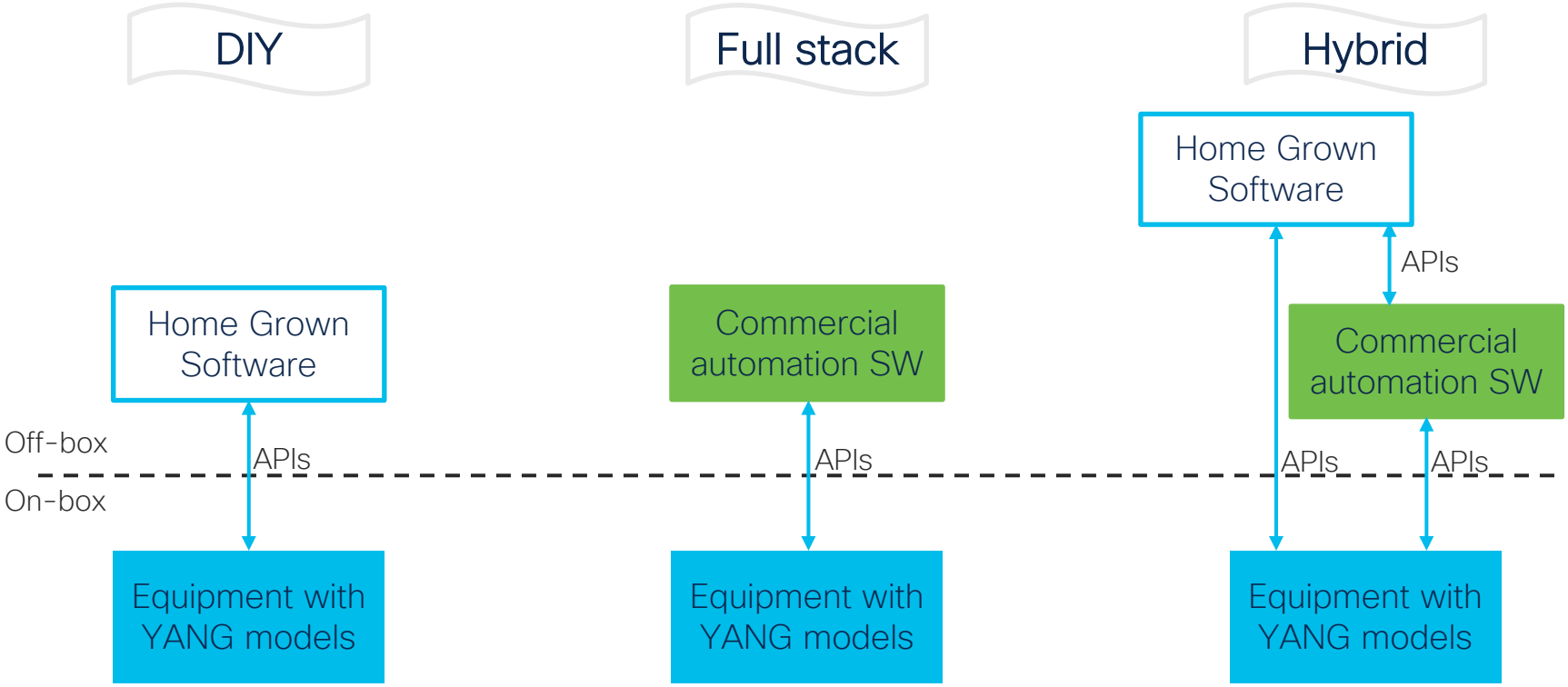


Integration Layers



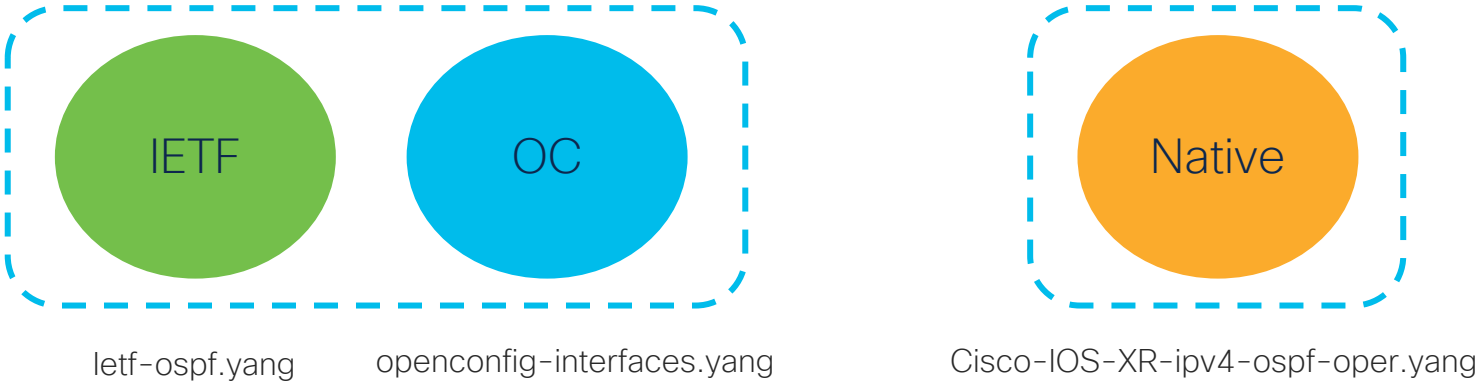


Customer Deployment Styles



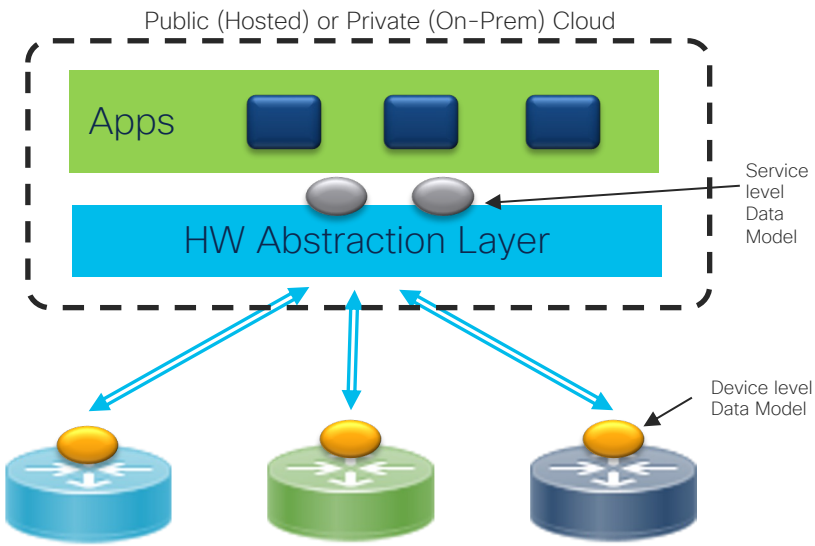
Data Models and YANG

- Data model explicitly and precisely determines the structure, syntax, semantics of the data which is externally available and visible;
- Ensures completeness and consistency of interactions between systems and clients.



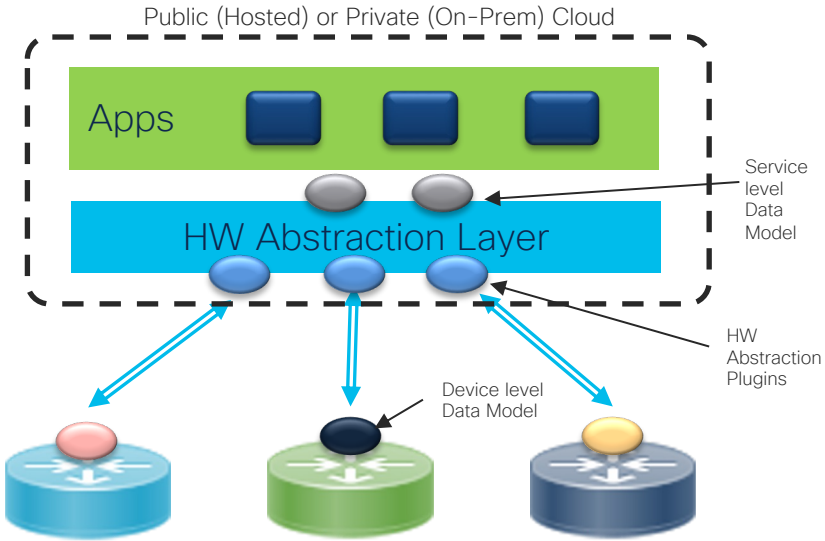
Vendor Neutrality – Options for Operators

Device Level Vendor Neutrality



= E.g. OpenConfig

Network Level Vendor Neutrality



= E.g. NSO NED

How to find the data you want to stream?

All the information is formatted using YANG models. Don't stream everything, find what you need inside the model and configure the full path for your telemetry. Use pyang for this, it shows any model in a nice way.

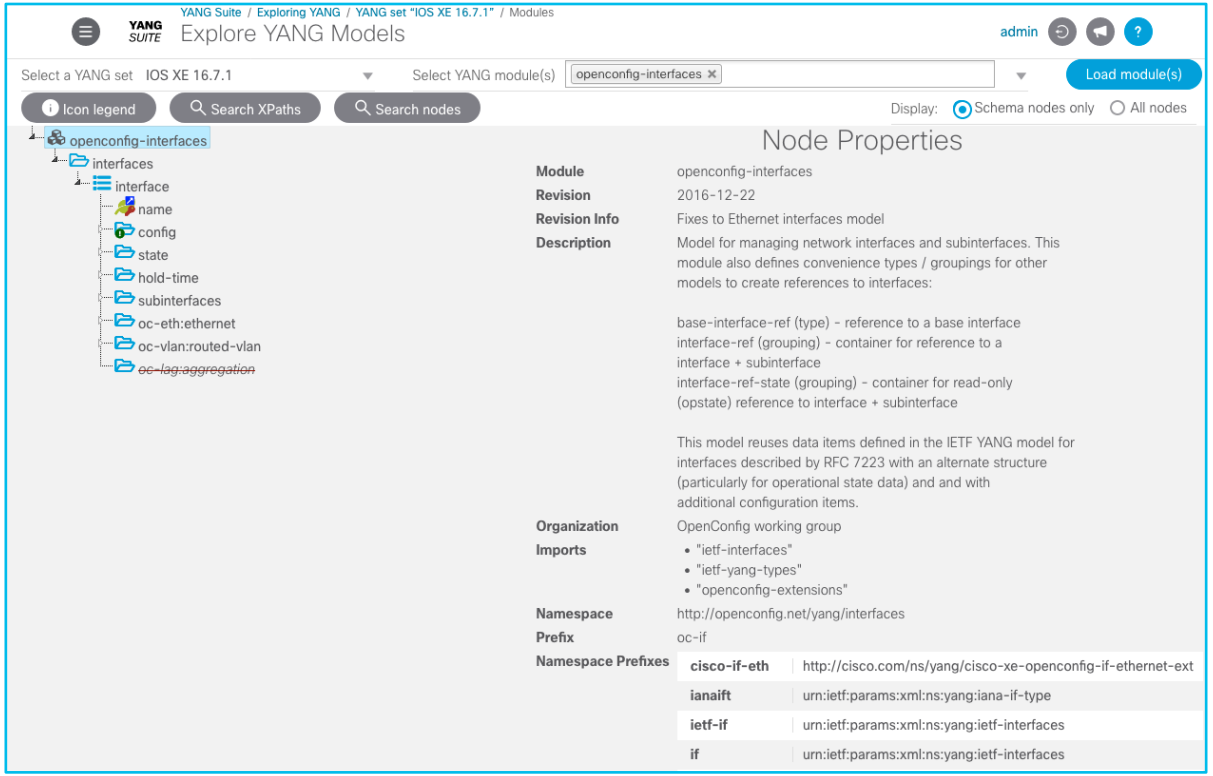
```
$ pyang -f tree Cisco-IOS-XR-infra-statsd-oper.yang --tree-path infra-statistics/interfaces/interface/latest/generic-counters

module: Cisco-IOS-XR-infra-statsd-oper
  +--ro infra-statistics
     +--ro interfaces
        +--ro interface* [interface-name]
           +--ro latest
              +--ro generic-counters
                 +--ro packets-received?                uint64
                 +--ro bytes-received?                  uint64
                 +--ro packets-sent?                    uint64
                 +--ro bytes-sent?                      uint64
                 +--ro multicast-packets-received?      uint64
                 +--ro broadcast-packets-received?      uint64
<output snipped for brevity>
```

You can start using pyang as is, without "--tree-path" to see all paths. This one just gives more exact view

You can see what is inside the path (this info will be streamed)

Cisco YANG Suite – explore models with Ease



https://developer.cisco.com/docs/yangsuite/

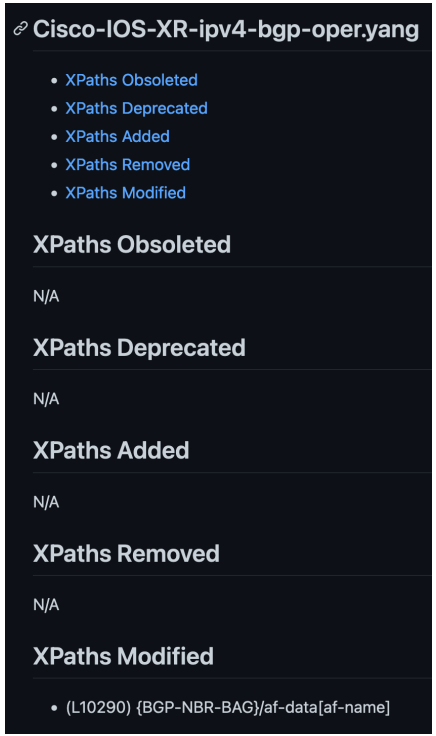
YANG Models Documentation - Github

- List of models per XR release: https://github.com/YangModels/yang/blob/main/vendor/cisco/xr/761/Available-Content.md

- Backwards-incompatible changes based on RFC 6020, Section 10 (since 7.0.2): https://github.com/YangModels/yang/tree/main/vendor/cisco/xr/761/BIC

- Check backwards-incompatibility

```
$ ./check-models.sh -b 751 # Check incompatibility between 7.6.1 and 7.5.1
```



XR 7.6.1

Monitor with Telemetry

Is It Enough To State gRPC Support?

Cisco gRPC call proto

```
service gRPCConfigOper {
    // Configuration related commands
    rpc GetConfig(ConfigGetArgs) returns(stream ConfigGetReply) {};
    rpc MergeConfig(ConfigArgs) returns(ConfigReply) {};
    rpc DeleteConfig(ConfigArgs) returns(ConfigReply) {};
    rpc ReplaceConfig(ConfigArgs) returns(ConfigReply) {};
    rpc CliConfig(CliConfigArgs) returns(CliConfigReply) {};
    rpc CommitReplace(CommitReplaceArgs)
      returns (CommitReplaceReply) {};
    // Do we need implicit or explicit commit
    rpc CommitConfig(CommitArgs) returns(CommitReply) {};
    rpc ConfigDiscardChanges(DiscardChangesArgs)
      returns(DiscardChangesReply) {};
    // Get only returns oper data
    rpc GetOper(GetOperArgs) returns(stream GetOperReply) {};
    // Get Telemetry Data
    rpc CreateSubs(CreateSubsArgs) returns(stream CreateSubsReply)
{};
}
```

https://github.com/cisco/bigmuddy-network-telemetry-proto/blob/master/staging/mdt_grpc_dialin/mdt_grpc_dialin.proto

Juniper gRPC call proto

```
service OpenConfigTelemetry {
    // Request an inline subscription for data at the specified path.
    // The device should send telemetry data back on the same
    // connection as the subscription request.
    rpc telemetrySubscribe(SubscriptionRequest)
      returns (stream OpenConfigData) {}
    // Terminates and removes an exisiting telemetry subscription
    rpc cancelTelemetrySubscription(CancelSubscriptionRequest)
      returns (CancelSubscriptionReply) {}
    // Get the list of current telemetry subscriptions from the
    // target. This command returns a list of existing subscriptions
    // not including those that are established via configuration.
    rpc getTelemetrySubscriptions(GetSubscriptionsRequest)
      returns (GetSubscriptionsReply) {}
    // Get Telemetry Agent Operational States
    rpc getTelemetryOperationalState(GetOperationalStateRequest)
      returns (GetOperationalStateReply) {}
    // Return the set of data encodings supported by the device for telemetry
    rpc getDataEncodings(DataEncodingRequest)
      returns (DataEncodingReply) {}
```

https://github.com/Juniper/jtimon/blob/master/telemetry/telemetry.proto

gNMI RPCs

- Capabilities – Initial handshake to exchange capability info (e.g. supported data models)
- Set – Modifies data from server (network device)
- Get – Retrieves data on server (network device)
- Subscribe – Control data subscriptions on server (network device)

https://github.com/openconfig/reference/blob/master/rpc/gnmi/gnmi-specification.md

gNMI support across Cisco Products

Protocol	IOS XR	IOS XE	NX OS
gNMI	6.5.1	16.12*	9.3(x)
NETCONF	4.1	16.6*	7.x

* Feature availability is platform dependent

Telemetry – Best Practices

- Telemetry requires Collector based architectures
  - Limited processing of data on the router due to limited compute
  - Generic Server compute with Data Lake type approach
- Key factors for scaling Telemetry
  - Cadence – Interval between Sensor path updates
  - Interfaces/Sensor paths – Amount of data to be streamed out of each device
  - Devices to Collector Ratio
    - Compute or Bandwidth should not be constrained
    - Distributed Collectors across the network
- Deployments case:
  - In production: around 30 Devices per Collector with aggregate of 1000 interfaces with 30 second cadence
  - In discussions: Varied Devices/Collector ratio at 1–10 min cadence

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