



Information/Data Models at the IETF

Benoit Claise,
Operations & Management Area Director

Disclaimer

- Selected as Operations and Management Area Director
 - Focusing on data models and management protocol
 - IETF: The Standard Development Organization that specifies the YANG language, some YANG data models and the NETCONF/RESTCONF protocols
- However,
 - The IETF is a voluntary-based organization
 - Where we participate as individual contributors
- So,
 - I don't speak for the IETF
 - I can't commit IETF resources

“We reject kings, presidents and voting. We believe in rough consensus and running code.”, Dave Clark



High Level Points from Previous Presentation

- We don't specify many information models (any longer), we focus on data models
- YANG as THE data model language for configuration
- Data models create the APIs
- The IETF mainly focused on network element YANG models (as opposed to services)

NETCONF/RESTCONF Progress

- RESTCONF protocol
 - In the RFC-editor queue
- YANG Patch (for RESTCONF)
 - In the RFC-editor queue

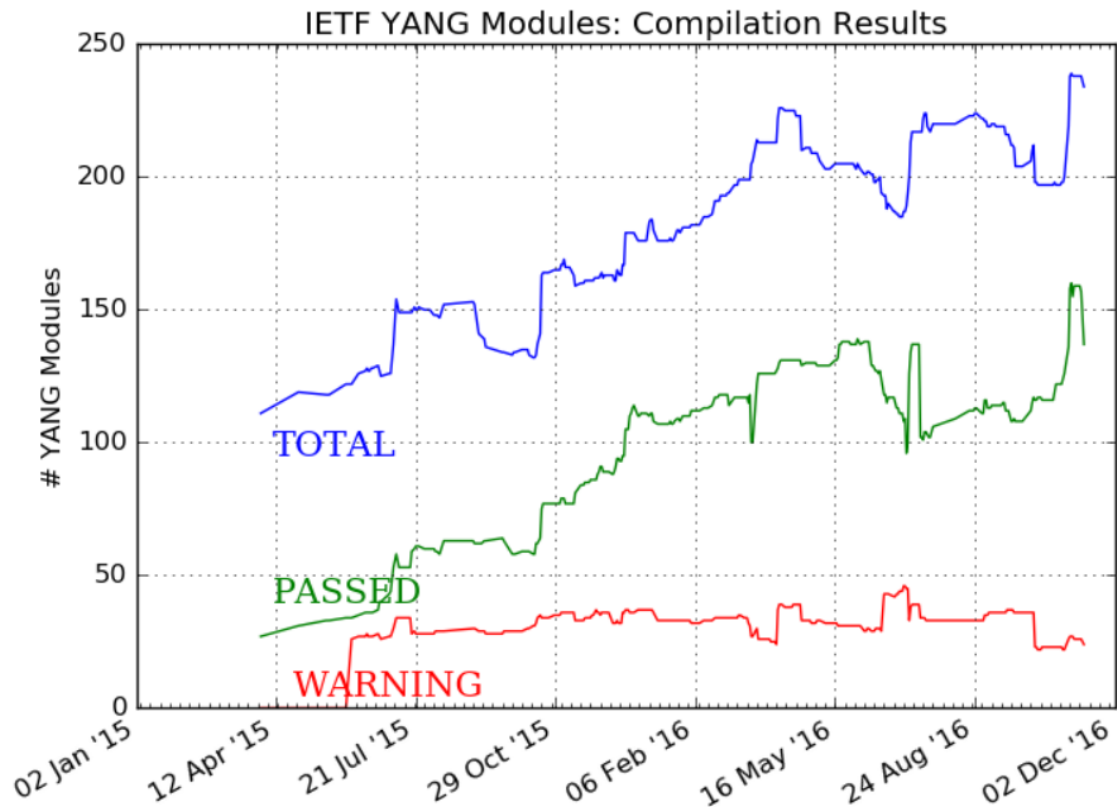
YANG Progress

- [RFC 7950](#): The YANG 1.1 Data Modeling Language
 - This new RFC does NOT obsolete [YANG 1.0 \(RFC 6020\)](#).
 - We should start using YANG 1.1 in our Cisco YANG models ONLY IF we need the [extra YANG 1.1 capabilities](#).
- [RFC 7951](#): JSON Encoding of Data Modeled with YANG
 - For RESTCONF
- [RFC 7952](#): Defining and Using Metadata with YANG
 - YANG extension that allows for defining metadata annotations in YANG modules

YANG Data Models Progress

- [RFC 7895](#): YANG Module Library
- [RFC 8022](#), A YANG Data Model for Routing Management
- L3VPN service YANG model
 - In the RFC-editor queue

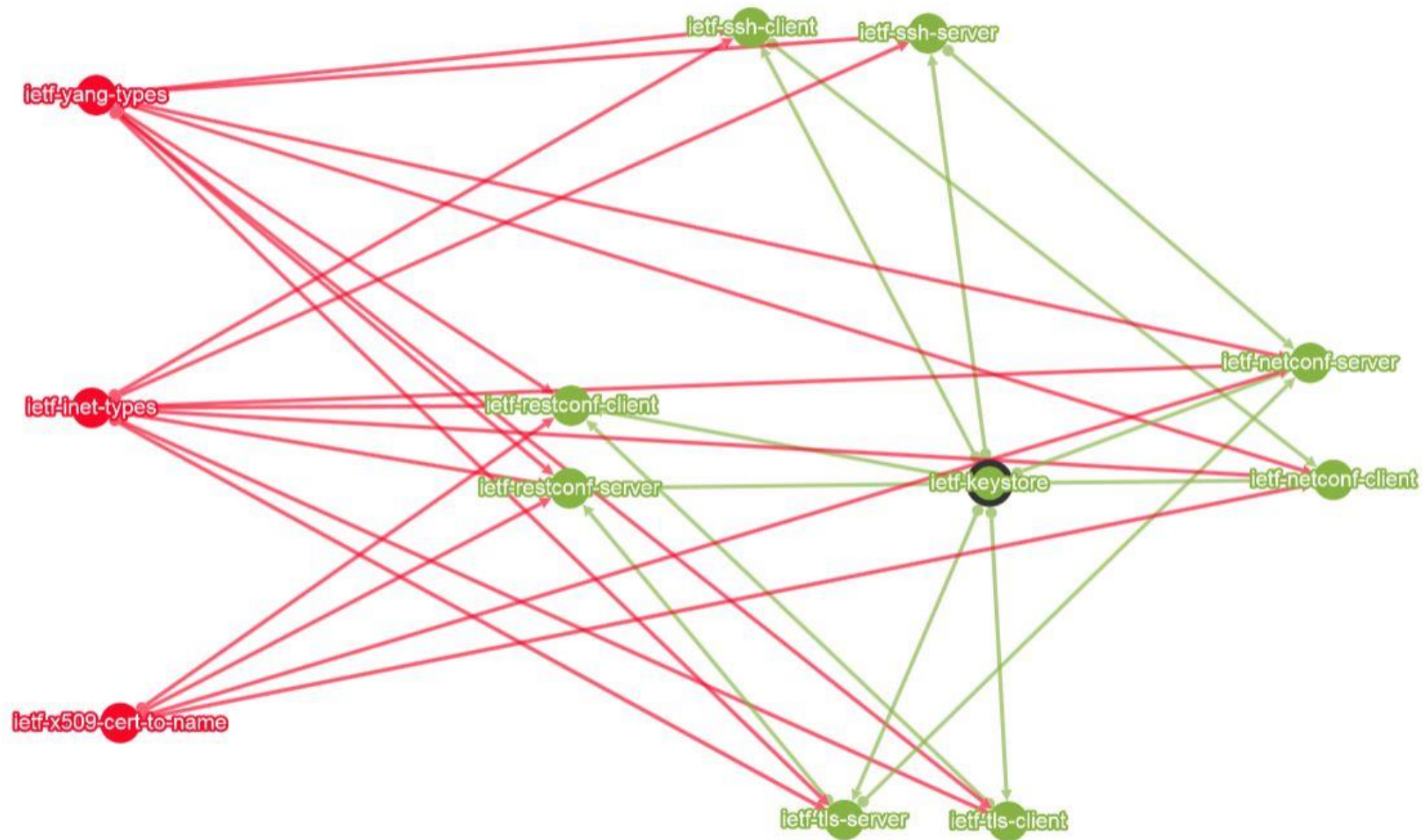
IETF YANG Models Growth



<http://claise.be/IETFYANGPageCompilation.png>

YANG Tools Progress

- YANG modules validation
 - <http://www.claise.be/2016/07/ietf-yang-modules-statistiques/>
 - 2 new YANG validators (yangdump-pro, yanglint), next to pyang and confdc
 - Validate YANG models from IETF, IEEE, BBF, MEF, openconfig, ONF, ODL, sysrepo
 - If you have more, let me know
- YANG validator
 - yangvalidator.org
- YANG impact analysis
 - http://www.yangcatalog.org/yang-search/impact_analysis.php
 - Example [here](#)



YANG Tools Progress

- YANG DB search
 - <http://www.yangcatalog.org/yang-search/yang-search.php>
 - Not populated with all YANG modules for now
- YANG Catalog
 - <http://www.yangcatalog.org/>
 - Mainly interesting for its metadata ([draft-openconfig-netmod-model-catalog](#))
 - Metadata example: implementation details, [classification information](#), dependencies, revisions
 - Once fully populated, will be using the YANG DB search

YANG DB Search

Enter your search term(s) below:

Search Options

 Case Sensitive Regular Expression Include MIBs

Schema Types

 All Typedef Grouping Feature Identity Extension RPC Container List Leaf-List Leaf Notification

YANG DB Search Results for 'router.*id.*'

Show entries

Search: Entire Table

Name <input type="button" value="↑↓"/>	Schema Type <input type="button" value="↑↓"/>	Path <input type="button" value="↑↓"/>	Module <input type="button" value="↑↓"/>	Origin <input type="button" value="↑↓"/>	Organization <input type="button" value="↑↓"/>	Maturity <input type="button" value="↑↓"/>	Description <input type="button" value="↑↓"/>
router-id	typedef	/sr:router-id	ietf-segment-routing (Impact Analysis)	Industry Standard	ietf	DRAFT	OSPF/BGP router id or ISIS system ID.
router-id	typedef	/rt-types:router-id	ietf-routing-types (Impact Analysis)	Industry Standard	ietf	DRAFT	A 32-bit number in the dotted quad format assigned to each router. This number uniquely identifies the router within an Autonomous System.
te-node-id	typedef	/te-types:te-node-id	ietf-te-types (Impact Analysis)	Industry Standard	ietf	DRAFT	An identifier for a node in a topology. The identifier is represented as 32-bit unsigned integer in the dotted-quad notation. This attribute is mapped to Router ID in RFC3630, RFC5329, RFC5305, and RFC6119.
Mpls-ldp-router-id	typedef	/mpls-ldp-cfg-datatypes:Mpls-ldp-router-id	Cisco-IOS-XR-mpls-ldp-cfg-datatypes (Impact Analysis)	Vendor-Specific	cisco	N/A	Mpls ldp router id

YANG Tools Progress: Generating Code

- YANG Explorer
- YANG Development Kit

<http://www.claise.be/2016/12/yang-opensource-tools-for-data-modeling-driven-management/> for the details

Two Key Topics for This Workshop

- Industry-wide consistency, integration, and coordination of YANG data models
 - The solution is around tooling
 - Need help from the different groups in this workshop to populate the YANG catalog, including the metadata
 - All these YANG models must be coordinated
- Documenting (standardizing?) the service YANG models
 - The YANG catalog might be the solution



BACKUP SLIDES FROM THE PREVIOUS WORKSHOP

Benoit Claise,
Operations & Management Area Director

Internet Engineering Task Force

- The mission
 - Produce high quality, relevant technical and engineering documents that influence the way people design, use, and manage the Internet in such a way as to make the Internet work better.
 - These documents include protocol standards, best current practices, and informational documents of various kinds. [RFC 3935]
- Open process for Internet Standards
- “We make the net work”
- The Standard Development Organization that specifies the YANG language, some YANG data models and the NETCONF/RESTCONF protocols

Clarification on IM versus DM

“The main purpose of an IM is to model managed objects at a conceptual level, independent of any specific implementations or protocols used to transport the data.
[...]

DMs, conversely, are defined at a lower level of abstraction and include many details. They are intended for implementors and include protocol-specific constructs.”

-- *RFC 3444 On the Difference between Information Models and Data Models*

IETF and IM/DM

- We don't specify many IM (any longer), we focus on DM
 - With YANG as THE data model language for configuration
- Why?
 - Timing: We need to move faster
 - Opensource: pressure versus standards
 - Operators: « give me something I could use », for automation
 - IETF: rough consensus and running code
- However, IM
 - Is good as a starting point
 - Should lead/help to DM definition

IETF NETCONF Working Group

- Network Configuration (NETCONF) working group:
<http://datatracker.ietf.org/wg/netconf/>
- Specified the NETCONF and RESTCONF protocols
- New charter as of October 2015:
 - “Develop a subscription and push mechanism that allows client applications to request notifications for changes in the datastore.”
 - Also called telemetry
 - “Update RFC 6536 (NETCONF Access Control Model) to introduce access control rights associated with actions“
 - “Enhance RFC 5277 (Event Notifications) with the ability to delete subscriptions without closing the client session, to modify existing subscriptions, and to have multiple subscriptions on a established client session.”

IETF NETMOD Working Group

- Network Modeling (NETMOD) working group:
<http://datatracker.ietf.org/wg/netmod/>
 - YANG language itself
 - YANG data models (access-list, syslog, QoS)
- New charter as of last week:
 - “The NETMOD working group has defined the data modeling language YANG, which can be used to specify network management data models that are **transported over such protocols as NETCONF and RESTCONF**. “
 - OLD: "manipulated by the NETCONF protocol"

Data Models Create the APIs

- The industry migrates from [CLI to API](#)
- APIs derived from the data models:
 - The protocol: NETCONF or RESTCONF
 - The encoding: JSON or XML
 - The language: Python, Ruby, Java, C, Erlang, ...
- Industry focusing on YANG as *the* data modeling language for services and devices
- Scripting: easy to create, hard to maintain/clean-up
=> Data model-driven set of APIs

Data Models = APIs

YANG – A Data Modeling Language for Networking

- Human readable and easy to learn
- Hierarchical configuration data models
- Reusable types and groupings (structured types)
- Extensibility through augmentation
- Formal constraints for configuration validation
- Data modularity through modules and sub-modules...
- Well defined versioning rules

Why you should care:

YANG is a full, formal contract language with rich syntax and semantics to build applications on

```
list interface {
    key "name";
    unique "type location";

    leaf name {
        type string;
        reference
            "RFC 2863: The Interfaces Group MIB - ifName";
    }

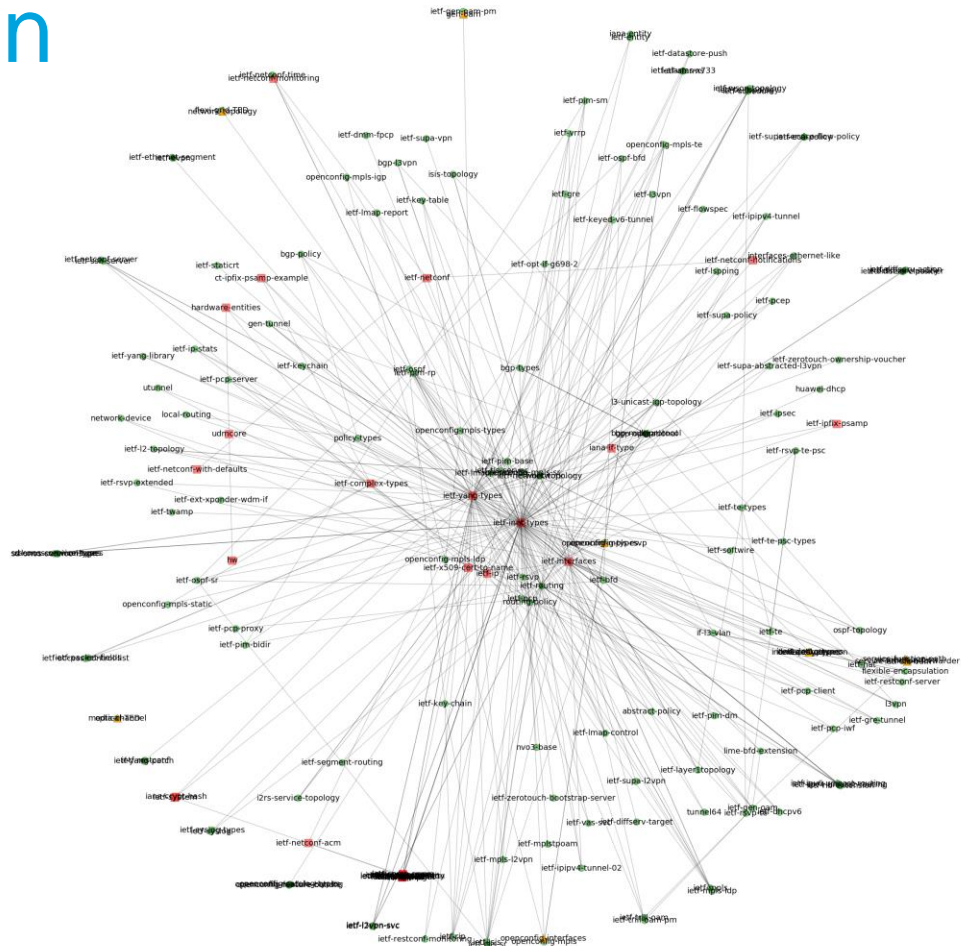
    leaf description {
        type string;
    }

    container statistics {
        config false;
        leaf discontinuity-time {
            type yang:date-and-time;
        }
    }

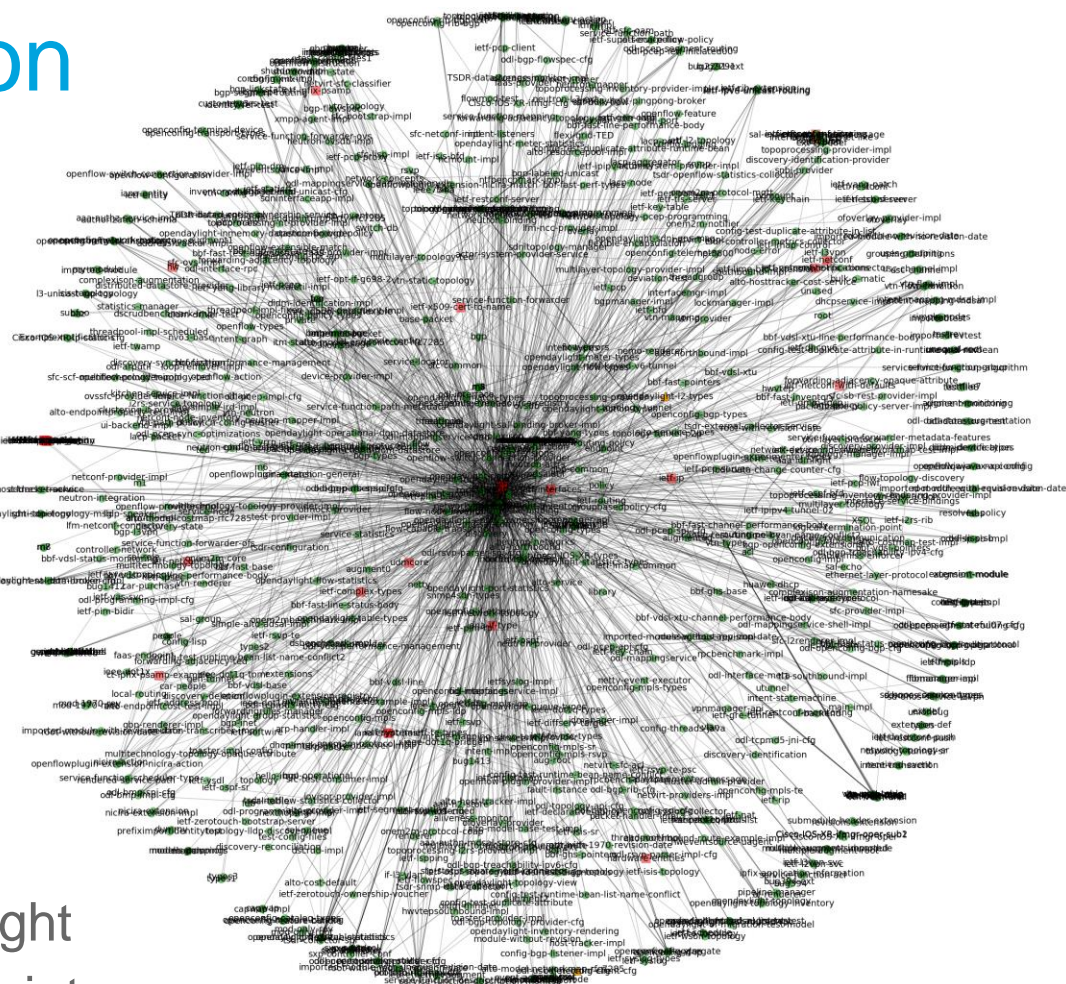
    leaf in-octets {
        type yang:counter64;
        reference
            "RFC 2863: The Interfaces Group MIB - ifHCInOctets";
    }
}
```

Coordination is Required

1.0
0.5
0.0
-0.5

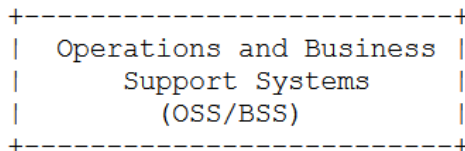


Coordination is Really Required, now!

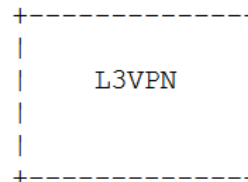
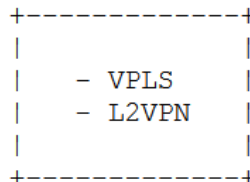
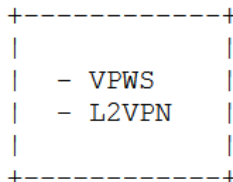


IETF, BBF, MEF,
IEEE, OpenDaylight
Openconfig, proprietary

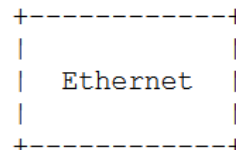
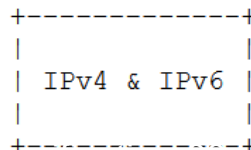
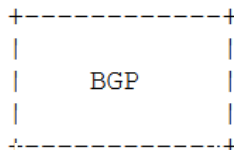
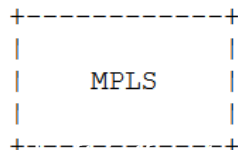
Data Model Location and Type



Network Service YANG data models



Network Element YANG data models



- Native models
- Standard models
- Proprietary extensions to standard models



IETF

YANG-related Activities

- L3SM Working Group, L3VPN Service YANG Module
 - Typically on top of a controller/orchestrator
 - Need to produce all device-central for this L3VPN Service YANG Module
- I2NSF, Interface to Network Security Functions
 - Focusing on security related YANG models
 - [Virtualized or not](#)
- SUPA Working Group, Simplified Use of Policy Abstractions
 - YANG data models for generic policies
- LIME Working Group, Layer Independent OAM Management in the Multi-Layer Environment
 - Focusing on OAM YANG data models for consistent configuration, reporting, and presentation