

A Build Process of extensible YANG Datastore Server using NuDesign's ndCONF Agent Development Studio Tools

NETCONF / RESTCONF / CLI & SNMP Access

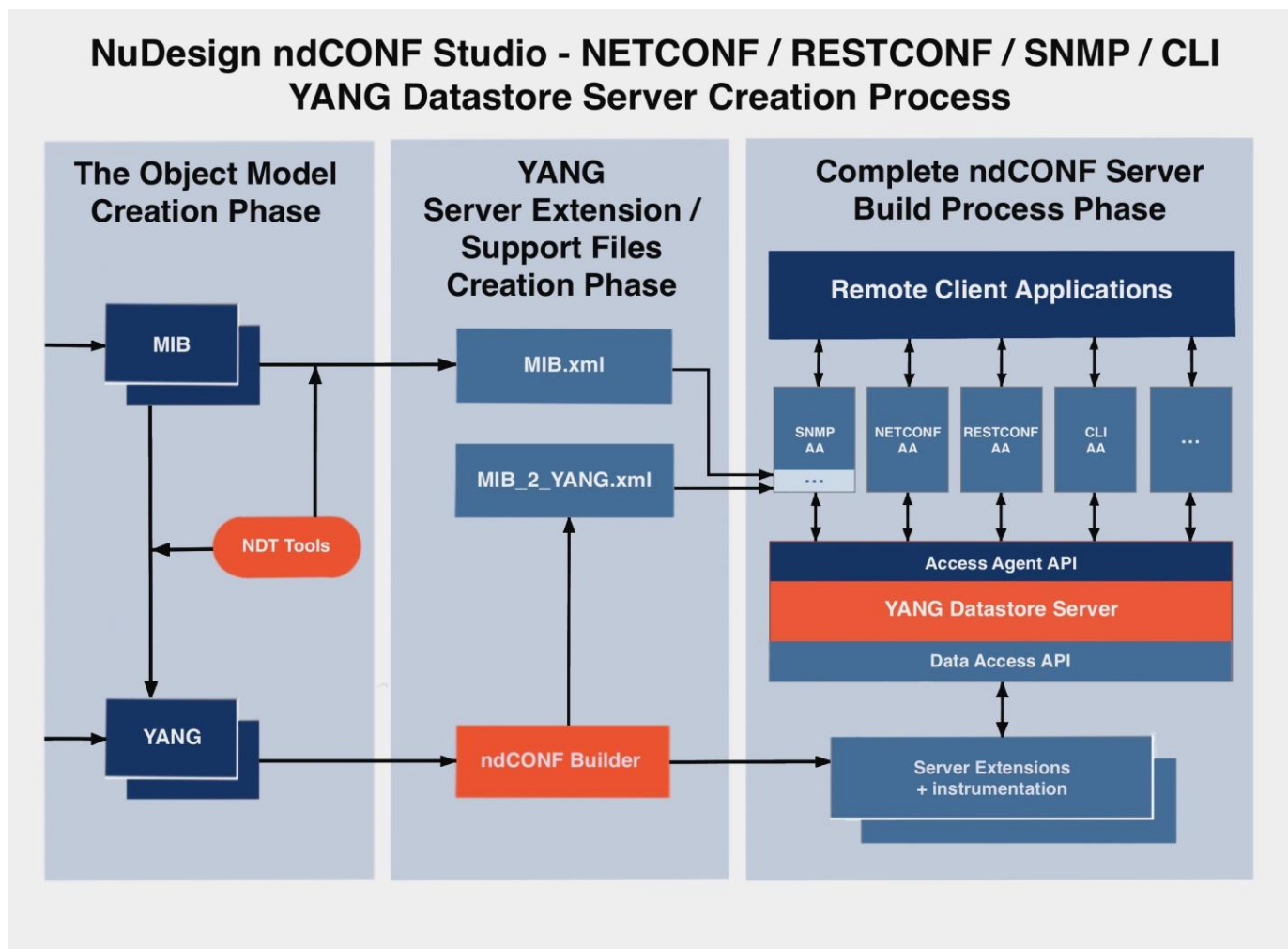
An Overview of ndCONF extensible YANG Datastore Server Build Process

NuDesign's Linux based software development tools & SDK libraries enable automated building of secure ndCONF Agent, based on rfc6020 / rfc7950 YANG data modelling language. Its extensible ndCONF Server component provides access to management information via NETCONF, RESTCONF, CLI and / or SNMPv3 protocols.

The design process starts with the developer using a commercially available, or an open source, YANG module editor and a validation tool to create a standard-compliant, YANG data module.

Then NuDesign's commercial software is used: ndCONF Builder, a C++ code generator of Loadable Data Handler (LDH) Server extensions which, together with the extensible YANG Datastore Server, NETCONF / YANG SDK libraries & protocol Access Agent modules, provide for implementation of a complete multi-protocol, configuration, automation and management ndCONF Agent supporting NETCONF, RESTCONF, CLI and / or SNMPv3 access.

A Detailed Review of ndCONF Server Build Process



The current release of NuDesign ndCONF Agent Development Studio supports Linux targets, the development process has been tested on these Linux distributions: Fedora, RHEL, Debian, Ubuntu and OpenSUSE, primary x86_64bit and ARM_32/64bit versions.

1. Using your preferred YANG editing tool create YANG modules (or translate existing MIBs into YANG modules, using NuDesign Visual MIBuilder's rfc6643 compliant translator), to capture the design project's configuration and management objectives.
2. Using PYANG, a YANG module validation tool, validate your YANG modules' syntax. PYANG also creates a "plug-in-ready" framework for design tools extensions, such as NuDesign's C++ code generator of YANG Datastore Server extensions, the ndCONF Builder.
3. Using NuDesign's ndCONF Builder (installed as a PYANG plug-in), generate the YANG Datastore Server's LDH extension's C++ source code & data templates project for the YANG modules of interest. To complete the process perform:
 - a. add instrumentation logic to the module's leaf objects and build LDH extensions using NuDesign's NETCONF / YANG SDK libraries.
 - b. configure the project into a complete YANG Datastore Server, using the APIs to protocol Access Agents & APIs to the YANG Datastore object providers (LDH extension modules).
4. If providing SNMP access to the YANG Datastore Server with a "MIB view" of your YANG modules, then in addition to the MIB module, the following MIB access support files need to be generated for use in the final software configuration:
 - a. a MIB_2_YANG.xml mapping file, binding SNMP MIB OIDs to YANG leaf objects, and auto-produced by NuDesign's ndCONF Builder for MIB OID annotated YANG modules.
 - b. a compiled MIB, MIB.xml file, preserving certain SMI parameters of MIB objects, and produced by NuDesign's mib_2_xml compiler tool.
5. Loading the NuDesign YANG Datastore Server with so created extension LDHs, optionally with the above MIB access support files, and a selected set of NuDesign's protocol specific Access Agents, such as: NETCONF, RESTCONF, CLI and / or SNMPv3, completes the build of a fully featured, multiprotocol configuration, automation and management ndCONF Agent.

Note that instrumentation logic is common for all Access Agents. A NETCONF access request for object A of the YANG Datastore model, or SNMP or any other supported protocol access to object A of the YANG Datastore Server, all invoke the same instrumentation code in the Server.

Object Model Development Scenarios – YANG (optionally MIB) Module Creation

Development starts with creation of YANG modules (and the MIB modules if SNMP access is desired). Where YANG modelled management objects overlap with MIB objects, they will automatically share the same instrumentation code. Generally, the following data modelling scenarios are used:

1. A YANG module is created, using commercially available or an open source YANG editor.

To enable the SNMP access as well, these additional support files are required:

- a. an SNMP MIB module, with MIB object definitions using objects defined in the YANG model. While creating such MIB module, a manually created MIB OID annotation directive should be added to YANG module's object definition. See the example in the enclosed documentation.
 - b. a compiled MIB.xml file, provides MIB object's SMI properties, created by mib_2_xml tool.
 - c. an OID mapping file, MIB_2_YANG.xml, that binds the MIB objects to appropriate leafs of a YANG module. Auto created by ndCONF Builder for MIB OID annotated YANG modules.
2. Alternatively, a developer starts from an existing MIB module and using NuDesign's MIBuilder tool, auto-translates it into the equivalent YANG module (an rfc6643 compliant process), possibly enhancing it with the additional constructs and a structure better aligned to the desired CLI access.

To enable SNMP access with this approach, note that the MIB OID annotations are added to the YANG module by the MIBuilder tool, and the ndCONF Builder generates the MIB_2_YANG.xml OID mapping file automatically. A compiled MIB file, MIB.xml, needs to be created using the provided mib_2_xml compiler tool.

The second approach might be a requirement for projects with a large base of legacy SNMP instrumentation code, since it provides for re-use of this code in the instrumentation phase of YANG Datastore Server's LDH extensions.

About current release of NuDesign ndCONF Agent Development Studio

The following software development tools & SDK libraries for building of secure NETCONF, RESTCONF, CLI and SNMPv3 Agents are provided:

1. ndCONF Builder – a PYANG plug-in, C++ source & project generator of YANG Datastore Server LDH extension code. It also generates MIB_2_YANG.xml mapping file for MIB OID annotated YANG modules.
2. extensible YANG Datastore Server with APIs to Access Agents such as NETCONF, RESTCONF, CLI and / or SNMPv3 and APIs to the YANG Datastore object providers (LDH extension modules).
3. NETCONF / YANG Datastore SDK libraries, implementing standard RFCs, with basic CLI Access Agent.
4. NETCONF & RESTCONF Access Agents – runtime NETCONF & RESTCONF protocol modules, which when coupled with YANG Datastore Server convert it into a complete NETCONF / RESTCONF Agent.
5. NETCONF & RESTCONF sample Clients apps for testing NETCONF / RESTCONF access to the Agent.
6. additional tools and components are available if SNMP access is required:
 - a. SNMPv3 Access Agent - runtime SNMPv3 protocol Access Agent module, when coupled with the YANG Datastore Server and the above listed MIB access support files, it becomes a complete SNMPv3 Agent.
 - b. mib_2_xml compiler tool - converts MIB module into a MIB.xml support file, a list of SMI properties of MIB objects in the "MIB view" of a YANG Datastore Server.
 - c. Visual MIBuilder - a Windows application, contains a MIB to YANG rfc6643 compliant translator. It is used to build a custom MIB or to perform translation of any MIB into a YANG module, with MIB OID annotations.
 - d. Visual MIBrowser Pro - a Windows application, an SNMP Client for testing SNMP access to the NETCONF / CLI / SNMP ndCONF Agent based on the YANG Datastore Server.

Summary

The tools of ndCONF Agent Development Studio provide for building of integrated multiprotocol ndCONF Agent with the NETCONF / RESTCONF / base CLI and SNMPv3 support.

The ndCONF tools, with exception of Windows based SNMP Visual MIBuilder and Visual MIBrowser Pro, are Linux hosted, the Agent's targets are Linux and QNX operating systems.

Please also review these NuDesign's [Technical Briefs](#):

1. ndCONF Agent Studio Evaluation Package Quick Start.
2. Overview of NuDesign's ndCONF Agent Development Studio Tools for NETCONF, RESTCONF, CLI & SNMP Access.
3. Overview of NuDesign's ndCONF Agent Development Studio Evaluation Package with NETCONF, RESTCONF, CLI & SNMP Access.

The resource links below provide additional information.

NETCONF / YANG / PYANG Web Accessible Resources

1. NETCONF - <https://datatracker.ietf.org/wg/netconf/documents>
2. YANG - <https://datatracker.ietf.org/wg/netmod/documents>
3. SNMPv3 - <https://datatracker.ietf.org/wg/snmpv3/documents/>
4. YANG Editors and PYANG Validating Tools Resources - <https://1.ieee802.org/yangsters/tools-for-yang/>
5. YANG Modeling for Network Automation - <https://www.linkedin.com/pulse/quick-look-yang-data-modeling-network-automation-sachin-verma/>

About NuDesign Technologies

NuDesign Technologies, Inc., based in Toronto, ON, Canada, specializes in providing NETCONF, RESTCONF, CLI & SNMPv3 Agent & Manager development applications, tools, libraries and consulting services to developers and networking OEMs worldwide. The benefits of deploying NuDesign's management software technologies are reliable, low risk, well integrated and quick-to-market solutions, supporting remote management operations over secure networks in Telco carrier, campus, enterprise and IoT settings.

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