

NETCONF Interoperability Lab

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Need for interoperability testing

Within the Internet Engineering Task Force (IETF), interoperability reports are needed in order to advance specifications on the standards-track because interoperability helps:

- to uncover errors and ambiguities in standards.
- to identify human programming errors.
- to resolve different interpretations of the standard.
- to evaluate different choice of options allowed by the standard.

Background

The Network Configuration (NETCONF) protocol [1] and the associated YANG data modeling language [2] are foundations of a new network management framework evolving in the IETF. Here is a list of recent events related to NETCONF interoperability testing:

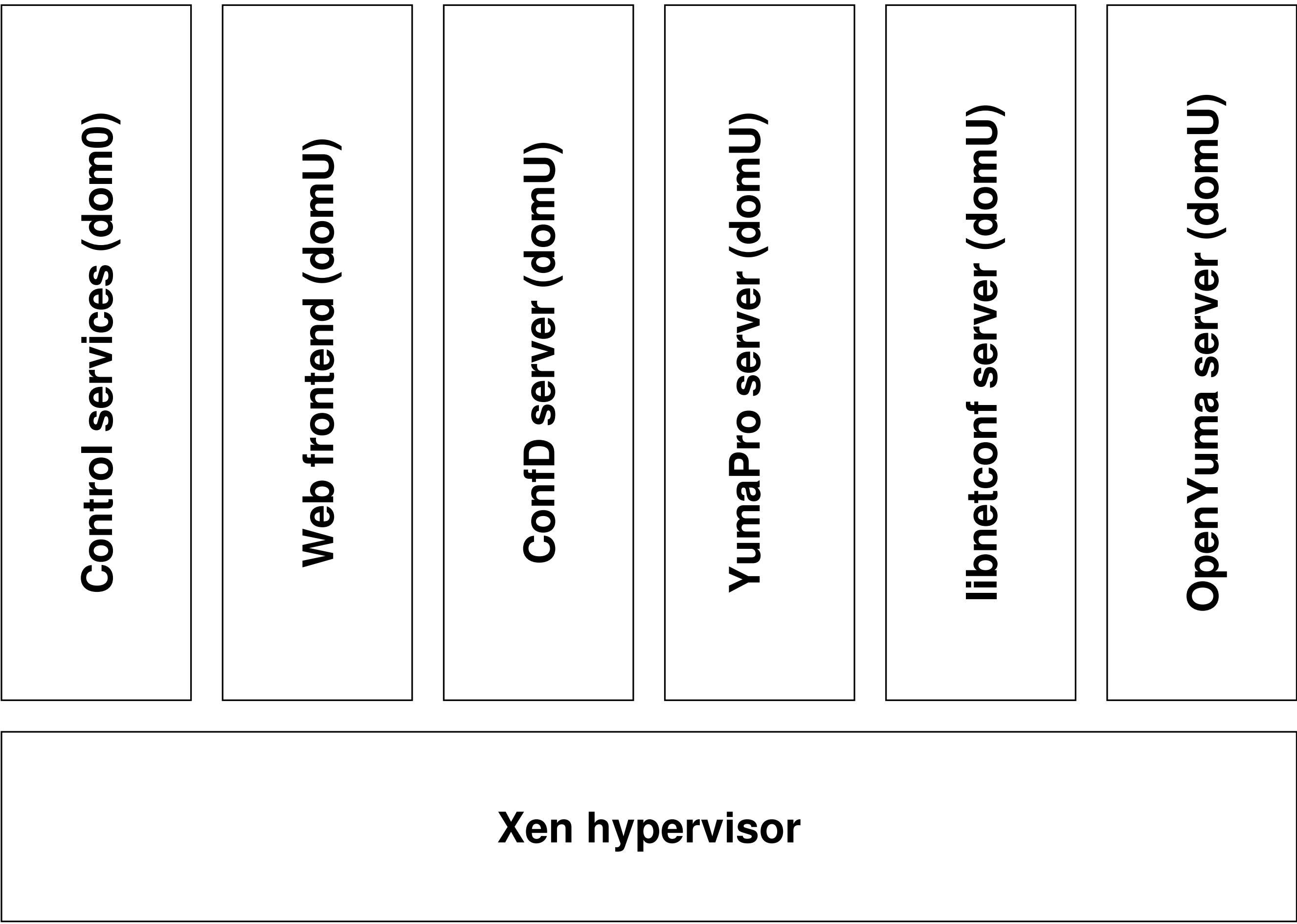
- Early work on NETCONF interoperability testing published in 2009 [3].
- NETCONF interoperability testing event at IETF 85 in 2012: <http://internetsociety.org/articles/successful-netconf-interoperability-testing-announced-ietf-85>

Research Contribution

An online NETCONF interoperability testing lab that is openly accessible 24 hours a day:

- to improve NETCONF interoperability.
- to foster community-based NETCONF education.

System Architecture



- Separate virtual machines running Debian are used for each NETCONF server.
- The hypervisor is based on Xen using a Debian Xen dom0.
- A separate virtual machine is deployed to provide the web frontend.
- The NETCONF servers are dual-stacked and reachable both over IPv4 and IPv6.

NETCONF clients and servers

The following NETCONF client and server implementations have been considered for integration into the NETCONF interoperability lab:

- ConfD: <http://www.tail-f.com/confd>
- YumaPro: <http://www.yumaworks.com/yumapro>
- OpenYuma: <http://github.com/OpenClovis/OpenYuma>
- libnetconf: <https://code.google.com/p/libnetconf>

Available Services

The NETCONF interoperability lab provides the following services:

- Access to a set of NETCONF server implementations including supporting material.
- An online catalogue of NETCONF server implementations.
- An online catalogue of NETCONF client implementations.
- A collection of tests written in Python that can be used for testing of NETCONF servers.
- Possibility to execute tests against remote NETCONF servers.

Feature Comparison

The supported NETCONF capabilities and protocol extensions are enlisted below:

Capability	ConfD (v5.0)	YumaPro (v13.04)	OpenYuma (v2.2.5)	libnc (v0.6)
:base:1.0 [4, 1]	✓	✓	✓	✓
:base:1.1 [1]	✓	✓	✓	✓
:writable-running:1.0 [1]	✓	✗	✗	✓
:candidate:1.0 [1]	✓	✓	✓	✓
:rollback-on-error:1.0 [1]	✓	✓	✓	✓
:startup:1.0 [1]	✗	✗	✗	✓
:url:1.0 [1]	✓	✓	✗	✓
:xpath:1.0 [1]	✓	✓	✓	✗
:confirmed-commit:1.0 [4]	✓	✓	✓	✗
:confirmed-commit:1.1 [1]	✓	✓	✓	✗
:validate:1.0 [4]	✓	✓	✓	✓
:validate:1.1 [1]	✓	✓	✓	✓
:notification:1.0 [5]	✗	✓	✓	✓
:interleave:1.0 [5]	✗	✓	✓	✓
:partial-lock:1.0 [6]	✗	✓	✓	✗
:with-defaults:1.0 [7]	✓	✓	✓	✓

Table 1: NETCONF CAPABILITIES SUPPORT

The supported standardized YANG data models are enlisted below:

Data Models	ConfD (v5.0)	YumaPro (v13.04)	OpenYuma (v2.2.5)	libnc (v0.6)
ietf-inet-types [8]	✓	✓	✗	✗
ietf-yang-types [8]	✓	✓	✗	✗
ietf-netconf-monitoring [9]	✓	✓	✓	✓
ietf-netconf-notifications [10]	✓	✓	✗	✗
ietf-netconf-acm [11]	✓	✓	✗	✓
ietf-netconf-with-defaults [7]	✓	✓	✓	✗

Table 2: YANG DATA MODELS SUPPORT

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References

[1] R. Enns, M. Björklund, J. Schoenwaelder, and A. Bierman, “Network Configuration Protocol (NETCONF),” RFC 6241 (Proposed Standard), Internet Engineering Task Force, Jun. 2011. [Online]. Available: <http://www.ietf.org/rfc/rfc6241.txt>

[2] M. Björklund, “YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF),” RFC 6020 (Proposed Standard), Internet Engineering Task Force, Oct. 2010. [Online]. Available: <http://www.ietf.org/rfc/rfc6020.txt>

[3] H. Tran, I. Tumar, and J. Schönwälder, “NETCONF Interoperability Testing,” in *Scalability of Networks and Services*, ser. Lecture Notes in Computer Science, R. Sadre and A. Pras, Eds. Springer Berlin Heidelberg, 2009, vol. 5637, pp. 83–94. [Online]. Available: http://dx.doi.org/10.1007/978-3-642-02627-0_7

[4] R. Enns, “NETCONF Configuration Protocol,” RFC 4741 (Proposed Standard), Internet Engineering Task Force, Dec. 2006, obsoleted by RFC 6241. [Online]. Available: <http://www.ietf.org/rfc/rfc4741.txt>

[5] S. Chisholm and H. Trevino, “NETCONF Event Notifications,” RFC 5277 (Proposed Standard), Internet Engineering Task Force, Jul. 2008. [Online]. Available: <http://www.ietf.org/rfc/rfc5277.txt>

[6] B. Lengyel and M. Björklund, “Partial Lock Remote Procedure Call (RPC) for NETCONF,” RFC 5717 (Proposed Standard), Internet Engineering Task Force, Dec. 2009. [Online]. Available: <http://www.ietf.org/rfc/rfc5717.txt>

[7] A. Bierman and B. Lengyel, “With-defaults Capability for NETCONF,” RFC 6243 (Proposed Standard), Internet Engineering Task Force, Jun. 2011. [Online]. Available: <http://www.ietf.org/rfc/rfc6243.txt>

[8] J. Schoenwaelder, “Common YANG Data Types,” RFC 6991 (Proposed Standard), Internet Engineering Task Force, Jul. 2013. [Online]. Available: <http://www.ietf.org/rfc/rfc6991.txt>

[9] M. Scott and M. Björklund, “YANG Module for NETCONF Monitoring,” RFC 6022 (Proposed Standard), Internet Engineering Task Force, Oct. 2010. [Online]. Available: <http://www.ietf.org/rfc/rfc6022.txt>

[10] A. Bierman, “Network Configuration Protocol (NETCONF) Base Notifications,” RFC 6470 (Proposed Standard), Internet Engineering Task Force, Feb. 2012. [Online]. Available: <http://www.ietf.org/rfc/rfc6470.txt>

[11] A. Bierman and M. Björklund, “Network Configuration Protocol (NETCONF) Access Control Model,” RFC 6536 (Proposed Standard), Internet Engineering Task Force, Mar. 2012. [Online]. Available: <http://www.ietf.org/rfc/rfc6536.txt>