

Network Automation Overview

Published
2023-08-18

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Network Automation Overview

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The information in this document is current as of the date on the title page.

YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

END USER LICENSE AGREEMENT

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Table of Contents

About the Documentation | iv

Documentation and Release Notes | iv

Documentation Conventions | iv

Documentation Feedback | vii

Requesting Technical Support | vii

Self-Help Online Tools and Resources | viii

Creating a Service Request with JTAC | viii

1

Automation Overview

Introduction to Automation | 10

What Is Automation? | 10

Why Invest in Network Automation? | 11

Automating Network Configuration Changes Using Scripts | 12

Using Configuration Management Tools to Automate Network Configuration. | 13

Automating the Provisioning of New Devices | 14

About the Documentation

IN THIS SECTION

- Documentation and Release Notes | iv
- Documentation Conventions | iv
- Documentation Feedback | vii
- Requesting Technical Support | vii

Use this guide to get a high-level overview of network automation on devices running Junos OS.

Documentation and Release Notes

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at <https://www.juniper.net/documentation/>.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at <https://www.juniper.net/books>.

Documentation Conventions

[Table 1 on page v](#) defines notice icons used in this guide.

Table 1: Notice Icons







Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page v defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> Introduces or emphasizes important new terms. Identifies guide names. Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> A policy <i>term</i> is a named structure that defines match conditions and actions. <i>Junos OS CLI User Guide</i> RFC 1997, <i>BGP Communities Attribute</i>

Table 2: Text and Syntax Conventions (*continued*)

Convention	Description	Examples
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# set system domain-name <i>domain-name</i>
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none">• To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level.• The console port is labeled CONSOLE.
< > (angle brackets)	Encloses optional keywords or variables.	stub <default-metric <i>metric</i>>;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast multicast (<i>string1</i> <i>string2</i> <i>string3</i>)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Encloses a variable for which you can substitute one or more values.	community name members [<i>community-ids</i>]
Indentation and braces ({ })	Identifies a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		

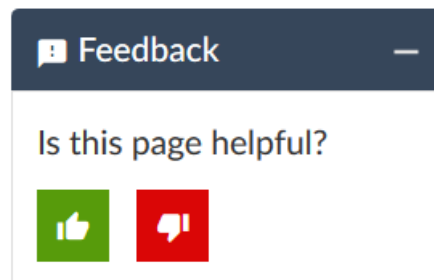
Table 2: Text and Syntax Conventions (*continued*)

Convention	Description	Examples
Bold text like this	Represents graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> In the Logical Interfaces box, select All Interfaces. To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

We encourage you to provide feedback so that we can improve our documentation. You can use either of the following methods:

- Online feedback system—Click TechLibrary Feedback, on the lower right of any page on the [Juniper Networks TechLibrary](#) site, and do one of the following:



- Click the thumbs-up icon if the information on the page was helpful to you.
- Click the thumbs-down icon if the information on the page was not helpful to you or if you have suggestions for improvement, and use the pop-up form to provide feedback.
- E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active Juniper Care or Partner Support Services support contract, or are

covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at <https://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.
- Product warranties—For product warranty information, visit <https://www.juniper.net/support/warranty/>.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: <https://www.juniper.net/customers/support/>
- Search for known bugs: <https://prsearch.juniper.net/>
- Find product documentation: <https://www.juniper.net/documentation/>
- Find solutions and answer questions using our Knowledge Base: <https://kb.juniper.net/>
- Download the latest versions of software and review release notes: <https://www.juniper.net/customers/csc/software/>
- Search technical bulletins for relevant hardware and software notifications: <https://kb.juniper.net/InfoCenter/>
- Join and participate in the Juniper Networks Community Forum: <https://www.juniper.net/company/communities/>
- Create a service request online: <https://myjuniper.juniper.net>

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: <https://entitlementsearch.juniper.net/entitlementsearch/>

Creating a Service Request with JTAC

You can create a service request with JTAC on the Web or by telephone.

- Visit <https://myjuniper.juniper.net>.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see <https://support.juniper.net/support/requesting-support/>.

1

CHAPTER

Automation Overview

Introduction to Automation | 10

What Is Automation? | 10

Why Invest in Network Automation? | 11

Automating Network Configuration Changes Using Scripts | 12

Using Configuration Management Tools to Automate Network Configuration. | 13

Automating the Provisioning of New Devices | 14

Introduction to Automation

Juniper Networks devices running the Junos[®] operating system (Junos OS) support comprehensive automation facilities. Almost all aspects of the operation of your network can be managed programmatically or with scripts. Each of these automation modalities are well documented individually, but if you are new to automation, you might not know where to start.

To make learning about automation easier, we have broken down the automation features based on the order of their complexity. By following this guide, you can start with easier (yet still valuable) tasks, and work up to more complicated network management workflows.

This overview is deliberately selective rather than comprehensive about the tools it describes. This is intended to facilitate a quick ramp-up. For example, automation examples are done using the Python language (where possible), because it is easy to learn, free, and widely supported. Python is also easy to read, serving as an effective model for solutions crafted with other languages or tools.

RELATED DOCUMENTATION

[Day One books on Junos OS XML scripting](#)

[Juniper PyEZ Getting Started Blog Post](#)

What Is Automation?

Automation is configuring a machine to do something for you that you can already do manually. You might want to automate a task because it is tedious, repetitive, error prone, or some combination of these three. For example, you might want to configure a device running Junos OS to automatically enforce parts of your networking policies, or to have the device send e-mail to staff when an event occurs.

The approaches to automating a device running Junos OS can be categorized as either *on-box*, *off-box*, or a combination of both.

On-box scripts are installed on devices running Junos OS. These scripts are invoked either directly or as a result of certain conditions being met. The two examples mentioned previously would be implemented with an on-box script. This type of automation tends to be less complicated and can be a good place to start if you are not familiar with automation. For more information about on-box scripts, see the [Automation Scripting Feature Guide](#).

In contrast, *off-box* automation is managing a device running Junos OS over a network from another system. The other system could be a network management system (NMS) or it could be your laptop. The advantages

of this approach are the availability of modern languages and tools, such as the Python language, as well as the ability to manage multiple devices from a single system.

Why Invest in Network Automation?

Done properly, automating the management of your network can significantly reduce your operating expenses. While capital expenses of networking are shrinking, operating expenses might continue to grow due to increased complexity of your network, causing an increase in total cost of ownership. The best way to reduce these costs is through the automation of your network operations. Paired with proper testing regimes, reliability and service levels also improve, freeing you to focus on adding greater value to your business.

Of course, it takes time and commitment to implement automation solutions that include properly automated tests. Many well-intentioned organizations feel intimidated by the time and effort required to implement automation; they are already occupied with their normal day-to-day tasks. Fortunately, you do not have to automate your entire network at once.

Typically, the best approach is to start with small-scale projects in order to gain experience and confidence with the tools you choose to use for your implementation. One way to keep the projects small and to enable rapid iteration and adaptation is to embrace Agile methodologies, which have been used successfully for software development. Agile software development is an umbrella term for a number of iterative and incremental development methodologies, which favor small-scale, well-defined tasks over larger, less precise ones.

Many organizations create Methods of Procedure (MOP) documents. The purpose of these documents is to act as a checklist for any network changes, encapsulating the business policies and best practices of an organization. These documents are a great resource when automating the management of your network. Start with the most basic procedures and automate them. As you learn and become more confident, you can tackle more involved procedures.

The remaining topics in this overview are presented in order of complexity. It is recommended (though not required) that you gain experience with the earlier topics before embarking on later topics.

RELATED DOCUMENTATION

| AgileMethodology.org

Automating Network Configuration Changes Using Scripts

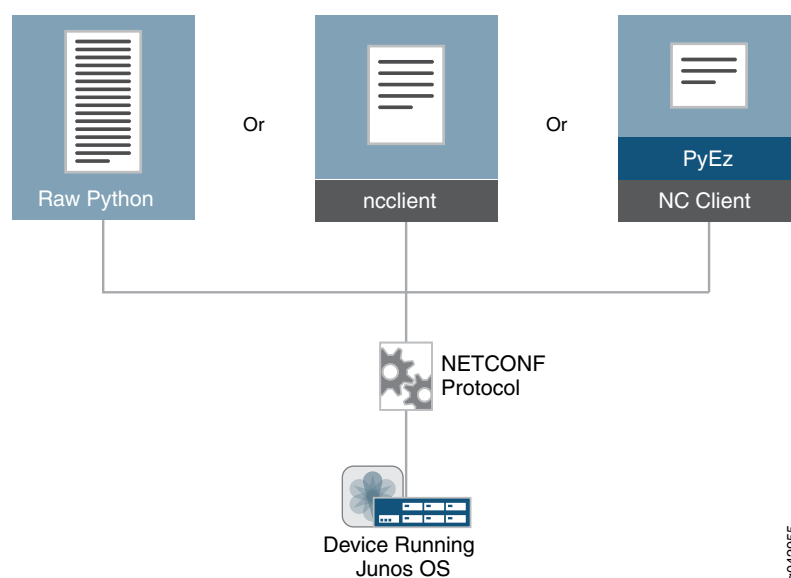
When making a change to an existing configuration, such as to accommodate new requirements, you might find it helpful to create scripts to capture the more mundane steps involved in such changes. If there are steps that you always (or often) have to perform when you make changes, you can collect those steps into a script to be run at the right time. The scripts can be run from the CLI manually by creating an operation (op) script, or they can be triggered when an event occurs by creating an event script.

In addition to achieving the desired outcome of your configuration change, you also want to make sure that there are no undesired outcomes. You can automate validation of future configuration changes by using a commit script, which is executed when a commit is issued. Commit scripts allow you to enforce custom configuration rules and to execute any additional steps that you want to run automatically.

Creating on-box scripts is detailed in the [Automation Scripting Feature Guide](#).

If you are interested in creating an off-box script or application, then a client that makes use of the NETCONF protocol is what you want. Raw NETCONF is not well suited for someone who is learning how to automate network operations. We recommend using Junos PyEZ. By using Python and the Junos PyEZ library, you can very quickly create scripts to manage your device running Junos OS. Junos PyEZ takes care of much of the overhead of connecting and communicating with the device. [Figure 1 on page 12](#) illustrates how, by leveraging Junos PyEZ, a NETCONF script written in Python is reduced from 48 lines to just 7.

Figure 1: Why We Call It Junos PyEZ



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By using Python and Junos PyEZ on any convenient system (for example, your laptop), you can connect to a device running Junos OS and quickly examine its attributes. From there you can add configuration change commands. A good approach to get started is to copy and run the Junos PyEZ samples, such as “Hello, World”, on your local system, and then run them successfully against your devices running Junos OS; the samples are available from [GitHub](#). This will help you gain familiarity and confidence in Junos PyEZ’s power and utility. The Junos PyEZ documentation is available at [Junos PyEZ](#). For a video demonstration of Junos PyEZ, see [Junos PyEZ - Hello, World](#).

RELATED DOCUMENTATION

[Junos PyEZ](#)

[Junos PyEZ on the TechWiki](#)

Using Configuration Management Tools to Automate Network Configuration.

If you plan to make changes to the configuration of your devices running Junos OS fairly often, and you need to make similar changes to multiple devices, then you should investigate configuration management products supported by Juniper Networks. Configuration management products currently supported include Ansible. You might already be using these products in your data centers. These configuration management systems are robust frameworks that support monitoring and management of your IT infrastructure, including your devices running Junos OS.

To learn more about DevOps and automation, see the following articles:

- [Transforming to DevOps with Junos OS](#)

RELATED DOCUMENTATION

[Ansible for Junos OS](#)

Automating the Provisioning of New Devices

As your business grows, you need to increase your networking capacity to handle that growth. It would be ideal if you could buy new hardware, plug it in, turn it on, and have it configure itself and start working right away. The good news is that you definitely can make this happen, but it takes some time to set up.

The technology that makes this possible is called zero touch provisioning (ZTP), which is very powerful. With ZTP, you can ship hardware to branch offices without having to send a network engineer to the sites. The hardware need only be installed and turned on. It automatically “phones home”, and a server fully configures it remotely. This is just one of the many applications of ZTP.

RELATED DOCUMENTATION

[Understanding Zero Touch Provisioning](#)

[Configuring Zero Touch Provisioning](#)