Network Automation: Are We There Yet?
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- Will Whitaker (UNC Chapel Hill)
- Karl Newell (Internet2)
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Why this session?
Short History Lesson
October 2017
San Francisco
Internet2 Technology Exchange
Network Automation Workshop

“Necessity is the mother of invention.”
“Desperation is the mother of…”

So Why Ansible?
After 2017...

Internet2 created

- ntac-networkautomation@internet2.edu mailing list
- https://internet2.slack.com/
  - #i2-network-automation
  - #i2-ntac
And now in 2022... ?
So...

Problem solved, right?
AUTOMATE

ALL THE THINGS!
Or... ?
[Dramatic Pause]
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Thank You

https://frank.seesink.com/presentations/Internet2TechEx-Fall2022/

Frank Seesink
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frank@unc.edu
Notes

- **Session in Schedule**
- **Session Abstract**
Network Automation - Are we there yet? - GlobalNOC

A.J. Ragusa - Manager Network Automation and Performance Team
Automation at the GlobalNOC

- GNAT - GlobalNOC Network Automation tool
  - AWX/Ansible, Git/GitHub, GlobalNOC DB, and custom playbooks with a WebUI
  - “Things that are the same across devices” - Think Radius Config, NTP, Syslog, root passwords, ACLs, etc... (this is a surprising size of configuration on many devices)
  - Periodic network configuration validation (verify devices are configured as expected)
- GSCS - GlobalNOC Service Configuration System
  - YANG based configuration tool to generate templates on “services”
  - “Things that are different” - BGP peerings, VLAN configs, VRFs, VPN configurations, etc..
  - GSCS pushes changes into GNAT
- Network Troubleshooter
  - Ultimate goal - automatically fix the network when its possible... currently this is in its first steps
Diff Files

```bash
< line con 0
< line vty 0 4
< access-class 150 in
< exec-timeout 15 0
< ipv6 access-class vty in
< transport preferred ssh
< transport input ssh
< transport output all
< line vty 5 15
< access-class 150 in
< exec-timeout 15 0
< ipv6 access-class vty in
< transport preferred ssh
< transport input ssh
< transport output ssh
< exception crashinfo file flash:crashinfo
< ntp server 207.216.151.9 prefer source loopback100
< ntp server 67.218.95.5 source loopback100
end
\ No newline at end of file
```
Service

Name
VPN-S01503

Nodes

Name
rtr3.ictc.vpn.gnrc.iu.edu

Outside Interface
GigabitEthernet0/0

Type
local

Use No Monitor Flag

Use Pending Flag

View config for node:
rtr3.ictc.vpn.gnrc.iu.edu

Language:

groups {
  VPN-S01503 {
    security {
      zones {
        security-zone INSIDE {
          interfaces {
            st0.11;
          }
        }
      }
    }
    ike {
      policy IKE_POLICY_PennREN_ {
        mode main;
        proposals IKE_PROPOSAL;
        pre-shared-key ascii-text 11;
      }
      gateway GATEWAY-PennREN- {
        ike-policy IKE_POLICY_
        address 1.1.1.1;
        local-identity inet 1.1.1.1;
        external-interface GigabitEthernet0/0;
      }
    }
  }
}

INC0121887

Critical since Tue Nov 01 11:11:00 EDT 2022
core1.atla.net.internet2.edu
BGP to [RE] MISSION - AS396926 & #124 I2-S12530 is down (State: Last down time is within threshold of 30 minutes.). [CLEARED]

Log messages
Show the log matched on keywords 'BGP' and 2607:f4a0:5010:8::1
Command: show logging | include 2607:f4a0:5010:8::1 | include BGP

RP/0/RP0/CPU0:Nov 29 15:57:50.363 UTC: local_dlrsc[136]: %SECURITY-LOCALD-6-LOCAL_CMD_ACCT : CLI CMD: "show logging | include 2607:f4a0:5010:8::1 | include BGP" by ansible from TTY / dev/pts4 140.182.45.18
RP/0/RP0/CPU0:Nov 29 16:37:30.607 UTC: local_dlrsc[136]: %SECURITY-LOCALD-6-LOCAL_CMD_ACCT : CLI CMD: "show logging | include 2607:f4a0:5010:8::1 | include BGP" by ansible from TTY / dev/pts4 140.182.45.18
RP/0/RP0/CPU0:Nov 29 16:42:11.903 UTC: local_dlrsc[136]: %SECURITY-LOCALD-6-LOCAL_CMD_ACCT : CLI CMD: "show logging | include 2607:f4a0:5010:8::1 | include BGP" by ansible from TTY / dev/pts5 140.182.45.18

Commit History
Show commit history to determine if any recent changes affected the BGP status
Command: show configuration history last 15

Sno. Event Info Time Stamp
1 backup Periodic ASCII backup Mon Nov 28 23:54:07 2022
2 commit id 1000001063 Mon Nov 28 23:43:08 2022
3 commit id 1000001062 Mon Nov 28 23:39:00 2022
4 backup Periodic ASCII backup Mon Nov 28 21:09:05 2022
5 commit id 1000001061 Mon Nov 28 21:07:56 2022
6 commit id 1000001060 Mon Nov 28 21:01:09 2022
Automation at the GlobalNOC cont.

- GlobalNOC Network Maintenance Sanity Checker
  - Runs a set of commands and stores the results before and after the maintenance and compares the results to verify the status of the network before and after maintenances (can be integrated into GNAT)

- Lots of “one off” automation pieces
  - DDoS remediation for Indiana GigaPOP
  - Version validation
  - Juniper device upgrades – NWave process
  - Cisco IOS-XR upgrades – OSHEAN process
  - Interface Description updates
  - IPv6 Deployments
Sounds great does it work?

---

- Ya, mostly...
  - Currently support over 400 devices at 80% configured via Automation
  - Another 200 devices at about 20%
  - More devices and networks every day
- Constantly trying to add features and work with network engineers to improve workflows
- Starting is the hard part!
How did we get there?

---

- Dedicated team of developers
  - Lots of interacting with network engineers at different organizations to get requirements, feedback, and improvements
- Already had experience with NetConf, working with device configurations
- Already had a Centralized Database (GlobalNOC DB) of network devices, and other information to start with
- Testlab is critical!
Lessons Learned from Automation Deployments

- Starting is the hardest part
  - Lots of excuses on why not (time, experience, not ready, etc)
  - Pick something small and easy that is a time saver (changing root password)
  - Don’t need NSO/Ansible/Puppet/Chef, can just start with a perl Script

- Try different things
  - What works for one task might not work for another

- Re-evaluate and move forward
  - What has been successful? What hasn’t and why?
  - Pick one more thing to work towards
    - ACL updates, Prefix-List updates, Firmware upgrade

- Just START! You need to gain some experience to figure out what tools you want to use, and get ideas on how to go forward.
Network Automation: Are We There Yet? - LEARN

Byron Hicks
Network Services Director

2022 Internet2 Technology Exchange
December 7th, 2022
Are We There Yet?

• Where is LEARN in the process?
  • Early Days

• Automation test bed set up
  • Can push changes to routers/switches
  • Fully automated JUNOS upgrades
Tools Used – JUNOS Upgrades

- **Ansible**
  - Playbook
- **Python**
  - scripting
- **Manual**
  - Only used to change mastership RE
- **Microsoft Excel**
  - Compare/validate
- **Visual Studio Code**
  - Development
Lessons Learned – JUNOS Upgrades

• Automation - faster pre-loading JunOS on both Routing Engines
• “Get Facts” – script used to compare information before and after upgrade
• Backup RE did not reboot – there is a process to remotely reboot
LEARN Automation Next Steps

• Packet RFP
  • Analyzing responses now
  • Automation platforms part of RFP request

• “Source of Truth” Documentation
  • Presently using Netbox 2.10.10 in production
  • Debating Netbox vs Nautobot today
  • Getting information about existing services to make transition to different hardware vendor easier.
Questions?
Automation: Are We There Yet?

Shannon Byrnes
Sr. Software Engineer, Internet2
(But! Campus Automation Engineer in her previous life)
A million different PIDs probably
Automation Tools in the Campus
(That I used, anyway.)

- Netmiko
- Nornir
- NAPALM
- NetBox
A (very) few example projects

- Image upgrades across routers, L3/L2 switches
- Update of IP helpers for centralized DHCP servers
- Campus-wide deployment of closed dot1x
Network Automation
Cisco Tools

- Interface Statistics
- Run an ICMP Command
- Show Route
  - IPv4
  - IPv6
- Show ARP
  - IPv4
  - IPv6
- VLAN Trunking Change
- Find L2 VLAN
- Show Processes
- Show ACL
- Show Logs

Router: Datacenter-F

IP Route Table for VRF "default"
'[x/y]' denotes [preference/metric]
'%' in via output denotes VRF

Routing entry for 152.2.90.97 in /

Known via Datacenter-PAN, Vlan2715
The Goals

- Maintain essential functionality
  - Who are the users? What do they really need?
- Use a team approach
  - Spread skills over multiple people, avoid skill silos
  - Extend opportunity to other ITS departments
  - Grow expertise among members
- Embrace new development and deployment patterns
  - Set up for future growth
- Consider security and plan appropriately
Backlog Management
- Jira Scrum Board
- Sprint Planning
- Task Tracking
- Product Owners
Source Code Management
- Git basics
- Branch planning
- Coding conventions

Pipeline Automation
Django / Python
- Dynamic Content
- Function API

Device SSH
Netmiko
Service APIs

HTML/CSS
AJAX
REST API
Standardized requests and responses calls for operations interacting with other devices and APIs.
OpenShift (Cloudapps)
- Established campus offering
- Project layout
  - Production
  - Testing
- Triggered builds
<table>
<thead>
<tr>
<th>Feature Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>ping, arp, traceroute, vlan, interfaces, ACLs, block reporting</td>
</tr>
<tr>
<td>IPAM</td>
<td>Interface with Infoblox data, automate add/update/deletes</td>
</tr>
<tr>
<td>VPN Tools</td>
<td>AnyConnect client and group details, statistics</td>
</tr>
<tr>
<td>VoIP Tools</td>
<td>Automated porting between VoIP providers</td>
</tr>
<tr>
<td>Wireless Tools</td>
<td>AP management, bulk controller changes, reporting</td>
</tr>
<tr>
<td>RF Spectrum DB</td>
<td>RF usage, placement, ownership, mapping</td>
</tr>
</tbody>
</table>
Demonstration

Router Proxy

Home

About

RouterProxy intends to improve administrators' quality of life.

It is written in Python and hosted in CloudApps to facilitate repeatable processes and execute live commands on network infrastructure.

Monitoring and Alerting

• ServiceNow / Service Portal
• ITS Status
• Entuity
• Spectrum CloudClick / OneClick
• xMatters
• Nagios
• Zabbix

Configuration and Documentation

• NIT / PRT
• Netnag
• Panorama
• Mobix
• VMware vSphere
• Confluence
• SecureW2 Management
• eduroam-US Administration

Troubleshooting and Performance

• Voyage
• AKIPS
• Cacti
• Smokeping
• Splunk
• nPart
• Okla Speedtest
• perfStoran

Recent Users (last 24 hours)

<table>
<thead>
<tr>
<th>Login</th>
<th>Name</th>
<th>Department</th>
<th>Access</th>
<th>Special Permissions</th>
<th>Last Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>www</td>
<td>William Whitsker, Jr</td>
<td>ITS - IT Infrastructure</td>
<td>Admin</td>
<td>Core</td>
<td>Dec. 6, 2022, 11:29 p.m.</td>
</tr>
<tr>
<td>eliseman</td>
<td>Dave Eliseiman</td>
<td>ITS - Information Security</td>
<td>User</td>
<td>Core</td>
<td>Dec. 6, 2022, 4:36 p.m.</td>
</tr>
<tr>
<td>foscue</td>
<td>Mary Wenzlyk</td>
<td>ITS - IT Infrastructure</td>
<td>User</td>
<td>Core, Trunk</td>
<td>Dec. 8, 2022, 2:38 p.m.</td>
</tr>
<tr>
<td>kmdsley</td>
<td>Kevin Clayton</td>
<td>ITS - IT Infrastructure</td>
<td>User</td>
<td>Trunk</td>
<td>Dec. 6, 2022, 12:58 p.m.</td>
</tr>
<tr>
<td>waddie</td>
<td>Chad Wade</td>
<td>ITS - IT Infrastructure</td>
<td>User</td>
<td>Core, Trunk, WiFi</td>
<td>Dec. 6, 2022, 12:32 p.m.</td>
</tr>
</tbody>
</table>