

Network Automation: Are We There Yet?







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- Frank Seesink (UNC Chapel Hill)
- Will Whitaker (UNC Chapel Hill)
- Karl Newell (Internet2)
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- AJ Ragusa (Indiana U./GlobalNOC)
- Byron Hicks (LEARN)



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Why this session?



Short History Lesson



October 2017
San Francisco
Internet2 Technology Exchange
Network Automation Workshop



So Why Ansible?



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



After 2017...

Internet2 created

- ntac-
networkautomation@internet2.edu
mailing list
- <https://internet2.slack.com/>
 - #i2-network-automation
 - #i2-ntac



2019

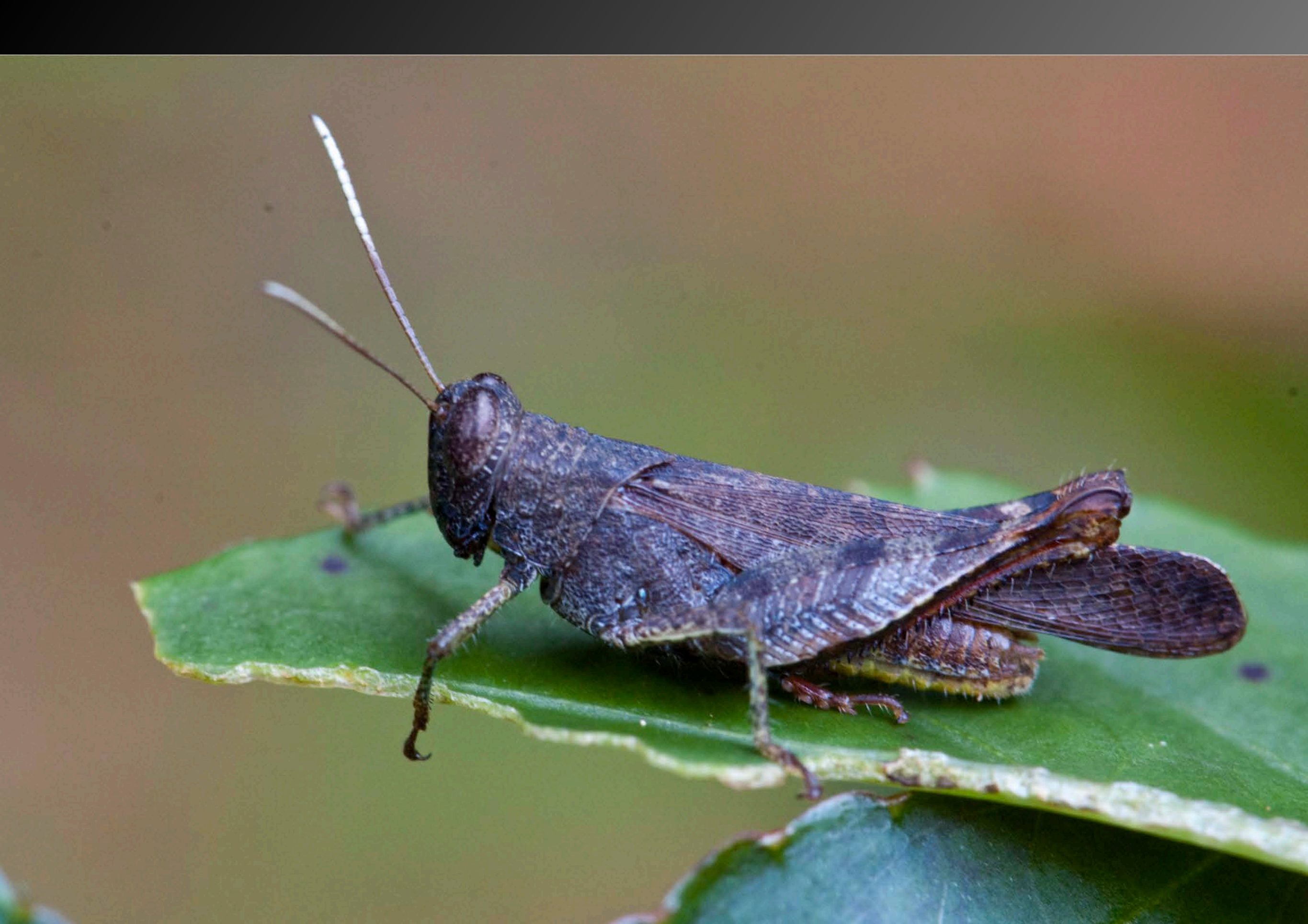


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And now in 2022... ?



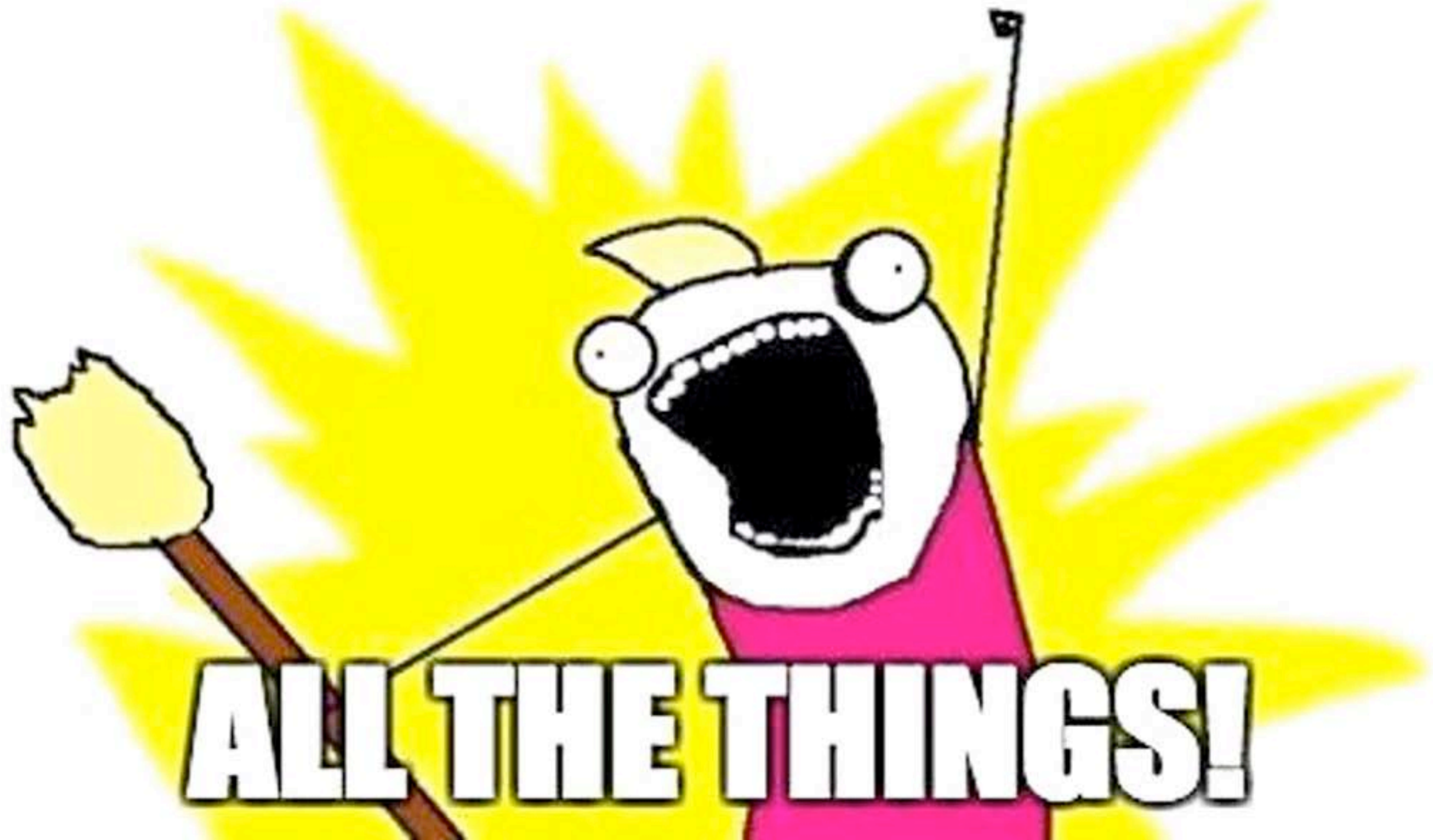


So...

Problem solved, right?



AUTOMATE



ALL THE THINGS!



Or... ?



[Dramatic Pause]



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Thank You



[https://frank.seesink.com/presentations/
Internet2TechEx-Fall2022/](https://frank.seesink.com/presentations/Internet2TechEx-Fall2022/)

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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

Render and Diff
 Only Diff
 Diff and Deploy

Project

OSHEAN

Branch

core-and-mp

Selected Devices

Filter: Show all

Search

Description

AJ Demo



Git Token

.....

Default Device Execution Order



Submit

- ncs-core
 - ncs-core1.nav400min.mgmt.oshean.org active
 - ncs-core1.ner1summer.mgmt.oshean.org active
 - ncs-core1.osh210benef.mgmt.oshean.org active
 - ncs-core1.osh235prome.mgmt.oshean.org active
 - ncs-core1.sto320washn.mgmt.oshean.org active
 - ncs-core1.ton10beacha.mgmt.oshean.org install
 - ncs-core1.uri1bairdhi.mgmt.oshean.org active
 - ncs-core1.whe26emain.mgmt.oshean.org active
 - ncs-core2.nav400min.mgmt.oshean.org active
 - ncs-core2.ner1summer.mgmt.oshean.org active
 - ncs-core2.osh210benef.mgmt.oshean.org active
 - ncs-core2.osh235prome.mgmt.oshean.org active
 - ncs-core2.sto320washn.mgmt.oshean.org install
 - ncs-core2.ton10beacha.mgmt.oshean.org install
 - ncs-core3.osh210benef.mgmt.oshean.org install
 - ncs-core3.osh235prome.mgmt.oshean.org active

Current batch: No active batch [View All Batch Info](#)

Current host:

- > iBossUpdate / CEN-diff (successful)
- > iBossUpdate / CEN-deploy (successful)

Diff Files

Search diffs

```
< ~ unauthorized access strictly prohibited ~
< *
< *****
< ^C
< 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 207.210.151.9 prefer source Loopback100
< ntp server 67.218.95.9 source Loopback100
< end
\ No newline at end of file
---
> route-target export 22742:6050
> exit-address-family
\ No newline at end of file
```

Service

[View History](#)

Name

VPN-S01503

Nodes



Name

rtr3.ictc.vpn.grnoc.iu.edu

Outside Interface

GigabitEthernet0/0

Type

local

Use No Monitor Flag Use Pending Flag

Service Details

View config for node:

Language:

rtr3.ictc.vpn.grnoc.iu.edu

junos

```
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

Alarm1

Alarm2

Critical since Tue Nov 01 11:11:00 EDT 2022

core1.atla.net.internet2.edu

BGP to [RE] MISSION ~ AS396926 | 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: locald_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/pts/4 140.182.45.18
RP/0/RP0/CPU0:Nov 29 16:37:30.607 UTC: locald_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/pts/4 140.182.45.18
RP/0/RP0/CPU0:Nov 29 16:42:11.903 UTC: locald_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/pts/5 140.182.45.18
```

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
- 7 backup Periodic ASCII backup Mon Nov 28 19:59:00 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?

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- 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

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- 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 7<sup>th</sup>, 2022



# Are We There Yet?

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- 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

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- Ansible
  - Playbook
- Python
  - scripting
- Manual
  - Only used to change mastership RE
- Microsoft Excel
  - Compare/validate
- Visual Studio Code
  - Development

# Lessons Learned – JUNOS Upgrades

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- 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

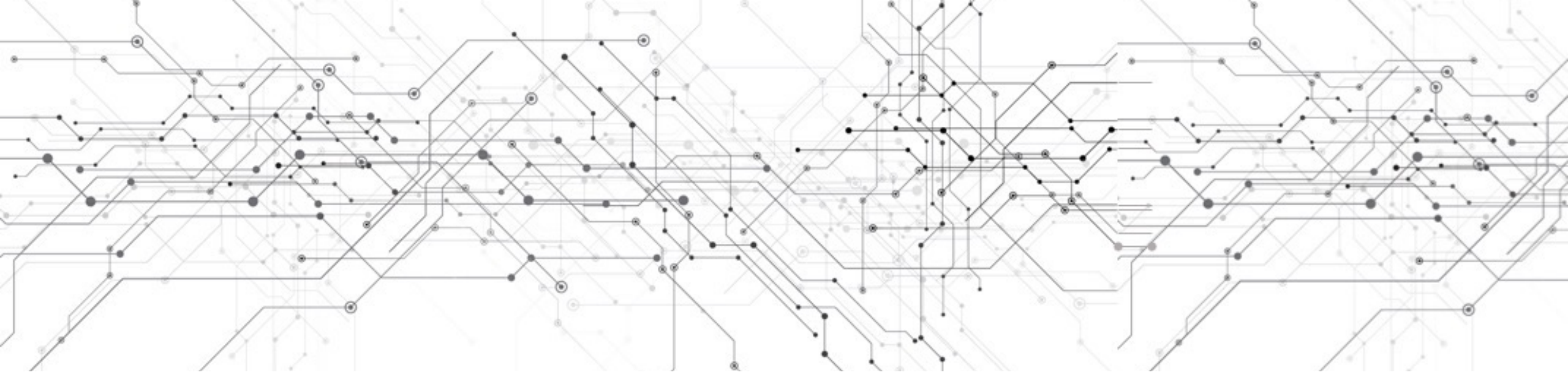


# LEARN Automation Next Steps

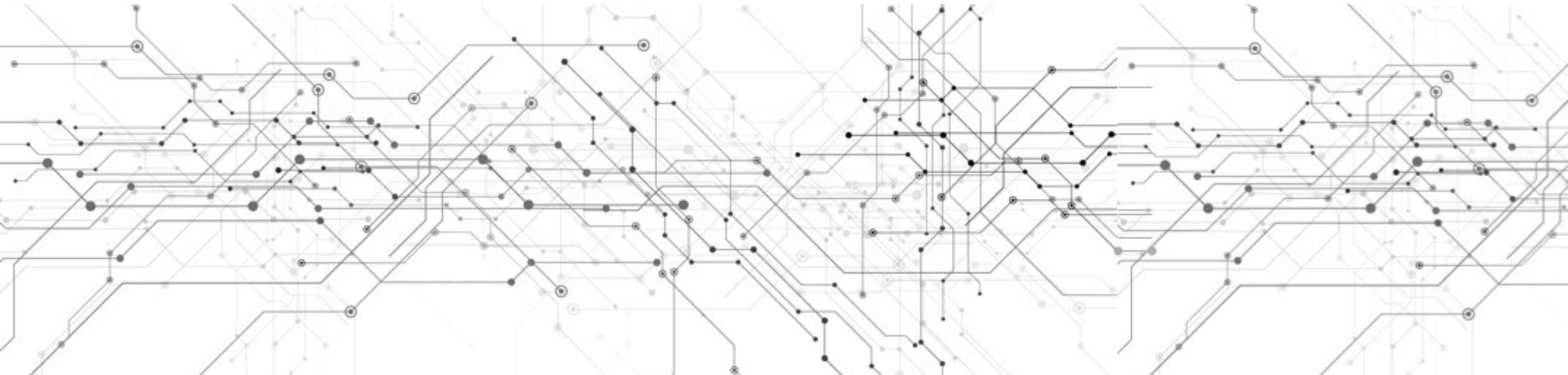
---



- 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?**



INTERNET2

# 2022 TECHNOLOGY exchange

Automation: Are We There Yet?

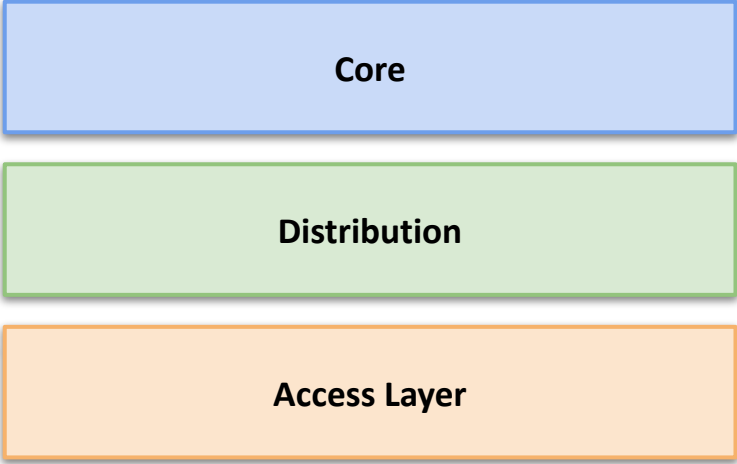
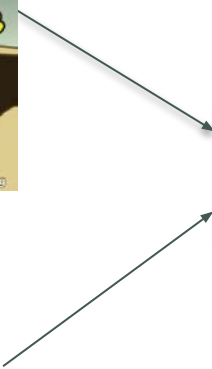
Shannon Byrnes

Sr. Software Engineer, Internet2

(But! Campus Automation Engineer in her previous life)



# Campus Automation



More Static

A million different PIDs probably



# Automation Tools in the Campus

(That I used, anyway.)

- Netmiko
- Nornir
- NAPALM
- NetBox

NETM<sup>ko</sup>KO



## 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

TechEx22



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*at* CHAPEL HILL

The background of the slide is a photograph of a university campus. The top half shows a dense canopy of green trees under a clear sky. The bottom half shows a grassy lawn with several people sitting or walking. A large, semi-transparent blue horizontal band covers the middle of the image, containing the title and subtitle in white text.

# Network Automation @ UNC

Are We There Yet?



A screenshot of a web browser window. The address bar shows 'https://rp.unc.edu'. The page content is split into two columns. The left column is titled 'Cisco Tools' and contains a list of links: 'Interface Statistics', 'Run an ICMP Command', 'Show Route' (with sub-links for IPv4 and IPv6), 'Show ARP' (with sub-links for IPv4 and IPv6), 'VLAN Trunking Change', 'Find L2 VLAN', 'Show Processes', 'Show ACL', and 'Show Logs'. The right column is titled 'Router: Datacenter-F' and contains text: 'IP Route Table for VRF "default"', '[x/y] denotes [preference/metric]', '% in via output denotes VRF', 'Routing entry for 152.2.90.97 in /', and 'Known via Datacenter-PAN, Vlan2715'.

← → ↻ 🏠 🔒 https://rp.unc.edu

### 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





- 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

RouterProxy Backlog

QUICK FILTERS: Only My Issues Recently Updated

RouterProxy Sprint 48 7 issues

- IN-375 Build a production environment (via routerproxy project in cloudapps or some dedicated server setup with docker) Dashboard
- IN-379 Acknowledge improvement: Add comment ability Dashboard
- IN-384 Traps: Improve the device lookup to support alternate source IP addresses on a single device. Also, no longer as... Dashboard
- IN-327 Add filtering to core switch comparison tool to reduce noise InspectorGadget
- IN-331 Create user interface for requests with different inputs (i.e. mac vs switch\_ip/port) Then
- IN-313 wipy error - wired oui tool Then
- IN-368 Supplement visualization with up/down data via akips/dashboard Then

+ Create issue

7 Issues Estimate 0

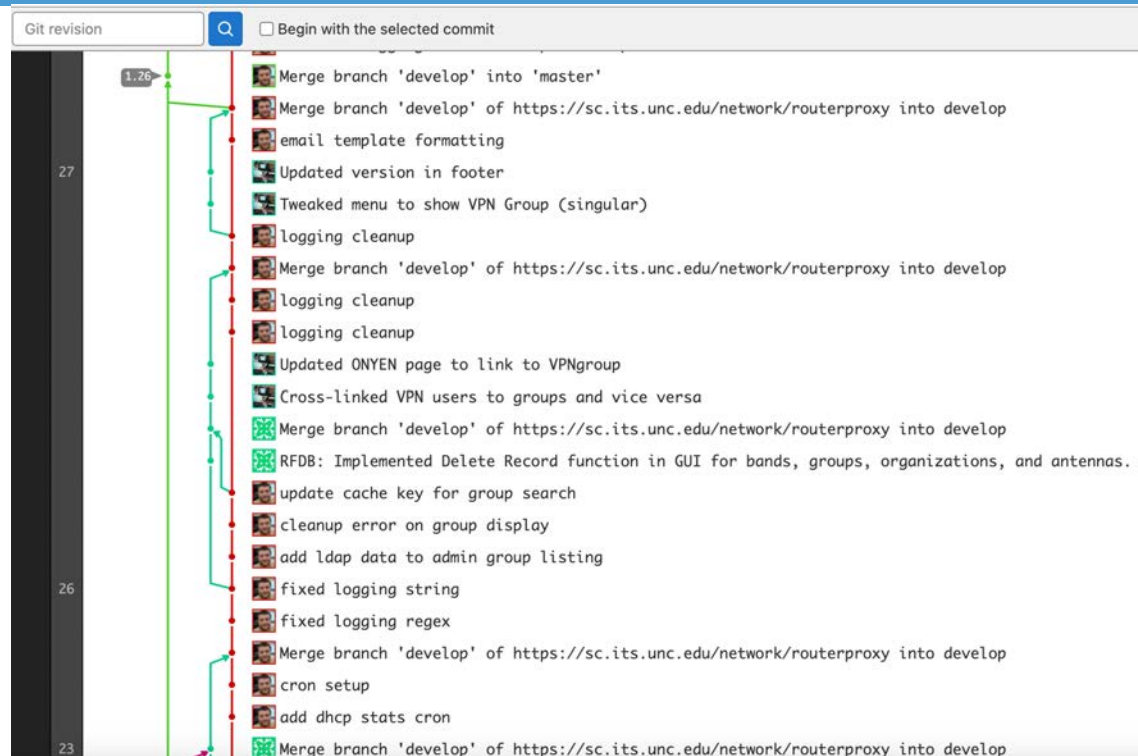
Backlog 83 issues

- IN-153 Improve user flow from show route to firewall interface details
- IN-139 GUI interface for device provision wizard Datacenter Wizard
- IN-132 Build an MLAG (pod switches) Datacenter Wizard
- IN-387 Look at AKIPS backup/recovery model, document and update. Dashboard

## Source Code Management

- Git basics
- Branch planning
- Coding conventions

## Pipeline Automation

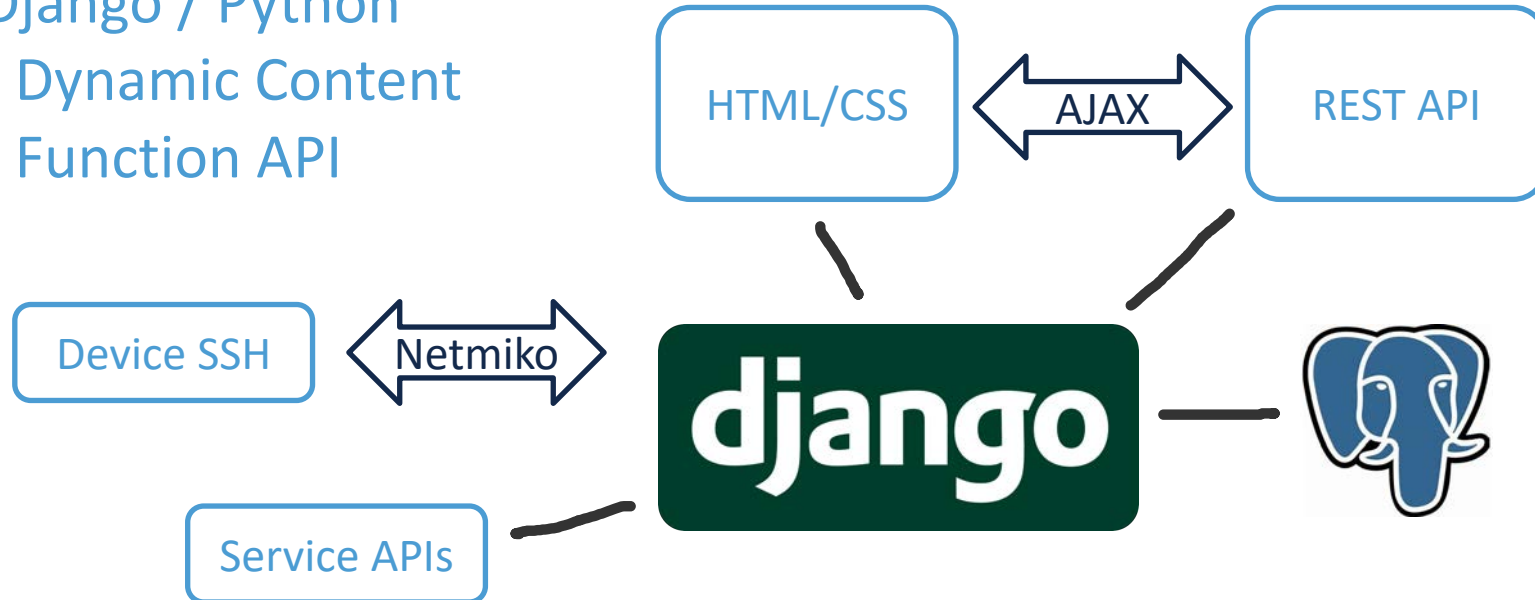


The screenshot displays the GitLab interface for a repository. At the top, there is a search bar for 'Git revision' and a checkbox labeled 'Begin with the selected commit'. The main area shows a commit history with a vertical timeline on the left and a list of commit messages on the right. The timeline has markers for revisions 1.26, 27, 26, and 23. The commit messages include:

- Merge branch 'develop' into 'master'
- Merge branch 'develop' of https://sc.its.unc.edu/network/routerproxy into develop
- email template formatting
- Updated version in footer
- Tweaked menu to show VPN Group (singular)
- logging cleanup
- Merge branch 'develop' of https://sc.its.unc.edu/network/routerproxy into develop
- logging cleanup
- logging cleanup
- Updated ONYEN page to link to VPNgroup
- Cross-linked VPN users to groups and vice versa
- Merge branch 'develop' of https://sc.its.unc.edu/network/routerproxy into develop
- RFDB: Implemented Delete Record function in GUI for bands, groups, organizations, and antennas.
- update cache key for group search
- cleanup error on group display
- add ldap data to admin group listing
- fixed logging string
- fixed logging regex
- Merge branch 'develop' of https://sc.its.unc.edu/network/routerproxy into develop
- cron setup
- add dhcp stats cron
- Merge branch 'develop' of https://sc.its.unc.edu/network/routerproxy into develop



Django / Python  
- Dynamic Content  
- Function API



A screenshot of a web browser's developer tools interface. The 'Name' pane on the left shows a request for 'ping?host=fluffypan-p.its.unc.edu&target=152.2.198.50'. The 'Preview' pane on the right shows the response as a JSON object: 

```
{success: true, message: "ping completed", ...}
```

 with additional details: 

```
cached: false
message: "ping completed"
output: "\nPING 152.2.198.50 (152.2.198.50) 56(84) bytes of data.\n64 by
success: true
time: 1670385444851.977
```

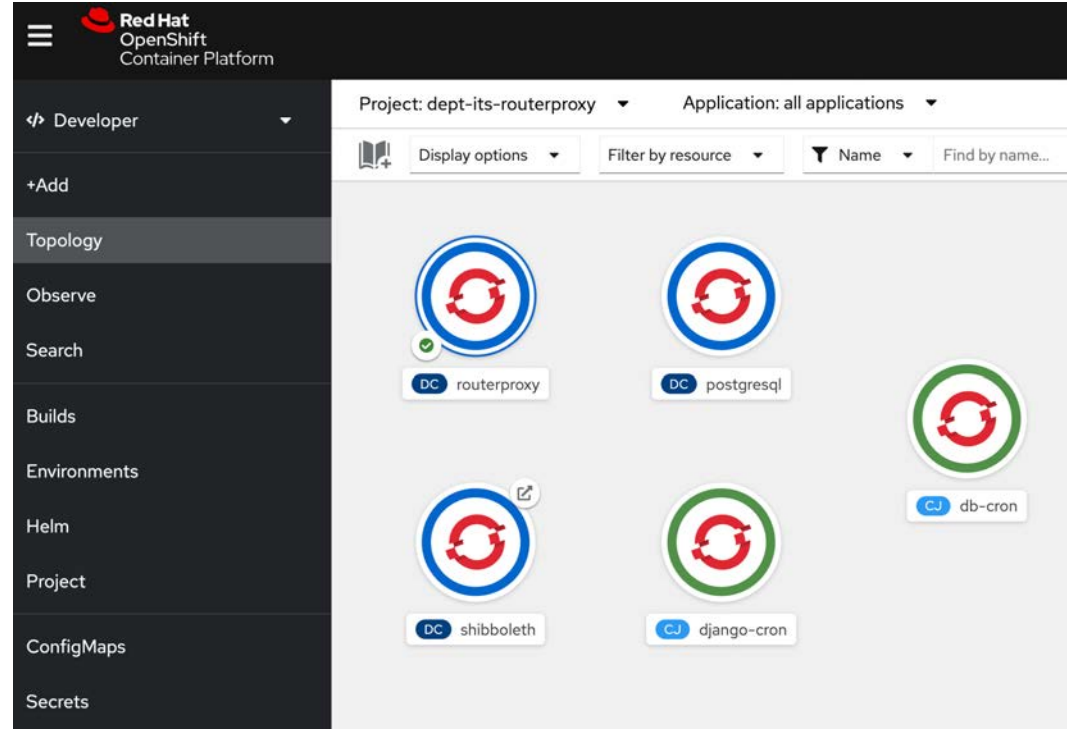
Standardized requests and responses calls for operations interacting with other devices and APIs.





## OpenShift (Cloudapps)

- Established campus offering
- Project layout
  - Production
  - Testing
- Triggered builds





|                |                                                                |
|----------------|----------------------------------------------------------------|
| Core           | ping, arp, traceroute, vlan, interfaces, ACLs, block reporting |
| IPAM           | Interface with Infoblox data, automate add/update/deletes      |
| VPN Tools      | AnyConnect client and group details, statistics                |
| VoIP Tools     | Automated porting between VoIP providers                       |
| Wireless Tools | AP management, bulk controller changes, reporting              |
| RF Spectrum DB | RF usage, placement, ownership, mapping                        |



Router Proxy

William Whitaker, Jr (wew)

- Home
- ROUTER PROXY APPLICATION
- ICMP Commands
- ARP Commands
- Show Route
- Find VLAN
- Show Blocks
- Interfaces
- Interface Details
- Show ACL
- Fluffy Port Toggle
- VLAN Trunk
- Device Inventory
- User Lookup
- User Access
- OTHER APPLICATIONS
- IPAM
- VPN Tools
- VniP Tools

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
- Cujo / Cujo Lite
- Entuity
- Spectrum CloudClick / OneClick
- xMatters
- Nagios
- Zabbix

**Configuration and Documentation**

- NIT / PIT
- Netsight
- Panorama
- Infoblox
- VMware vSphere
- Confluence
- SecureW2 Management
- eduroam-US Administration

**Network**  
ITS - Comm Technologies

GitLab Group Members

**Troubleshooting and Performance**

- Voyance
- AKIPS
- Cacti
- Smokeping
- Splunk
- nPerf
- Ookla Speedtest
- perfSonar

**Recent Users (last 24 hours)**

| Onyen    | Name                 | Department                 | Access | Special Permissions               | Last Access              |
|----------|----------------------|----------------------------|--------|-----------------------------------|--------------------------|
| wew      | William Whitaker, Jr | ITS - IT Infrastructure    | Admin  | Core IPAM Trunk Wifi Limited Test | Dec. 6, 2022, 11:29 p.m. |
| eiselman | Dave Eisman          | ITS - Information Security | User   | Core Security Trunk Test          | Dec. 6, 2022, 4:36 p.m.  |
| foscue   | Mary Wezyk           | ITS - IT Infrastructure    | User   | Core Trunk                        | Dec. 6, 2022, 2:36 p.m.  |
| kmclayto | Kevin Clayton        | ITS - IT Infrastructure    | User   | Core Trunk                        | Dec. 6, 2022, 12:58 p.m. |
| wadec    | Chad Wade            | ITS - IT Infrastructure    | User   | Core Trunk Wifi                   | Dec. 6, 2022, 12:32 p.m. |



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