Automating Multi-Vendor Networks

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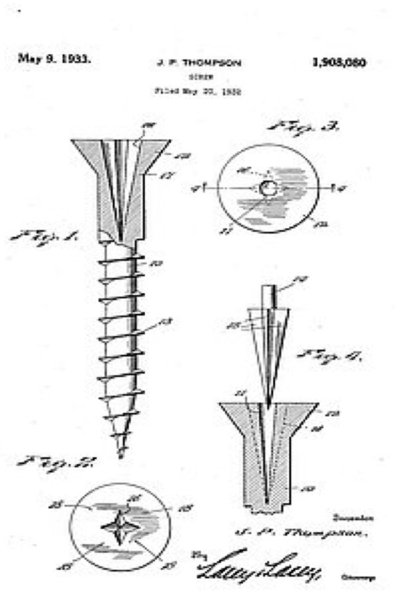
Arista Networks

The “Crosshead” screw

- Credited to John P. Thompson in 1932
- Sold to Henry F. Phillips in 1935
- Thompson struggled to get into manufacturing and gain industry support
- Granted the first patent in 1932 for the screw and in 1933 for the screwdriver



Why Did We Need Another?

- The slot varied by screw size and required a closely matched bit on the driver
- Alignment with the bit to the screw aperture is difficult
- The bit often slips out since both ends are open

The Right Tool For the Job

- The Phillips screw overcomes the problems of the slotted screw

  However….

- Single slot screws (aka flat head) are still quite prevalent
- In certain applications, one may be better than the other
- Hardware stores sell both along with many other types

How’s this tie into Multi-Vendor Network Automation?

- Lots of choices when it comes to automation
  - Choose the one that’s right for ***you***

- Ansible, Puppet, Chef, Salt etc are all great and very powerful

So what/where to start?

“ *The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency - Bill Gates*

Napalm

Network Automation and Programmability Abstraction Layer with Multivendor support

- Napalm simplifies the communication to network devices
- Uses modern API’s for interaction
- Simply provide the credentials and transport and you’re off!

Napalm

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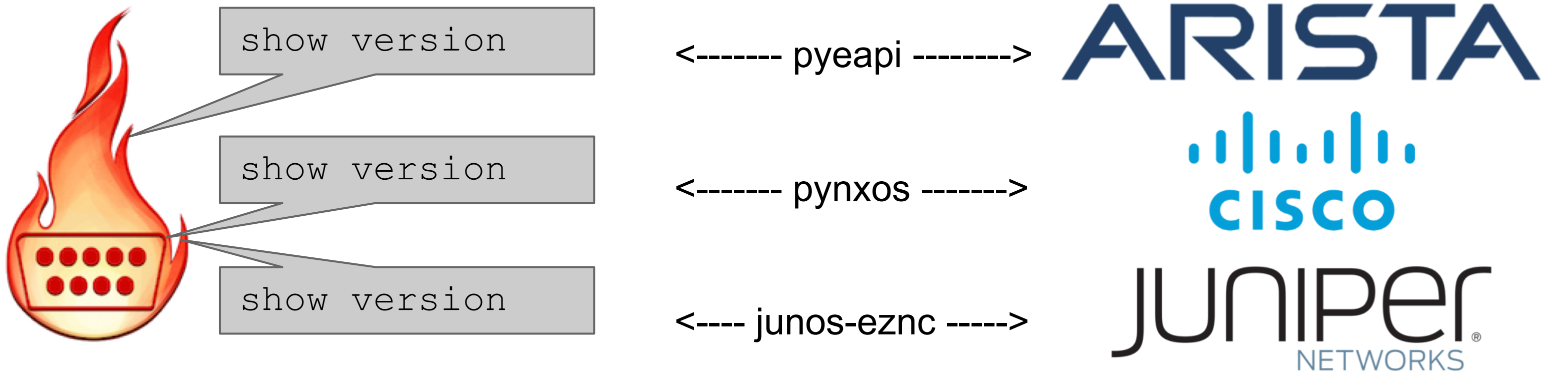
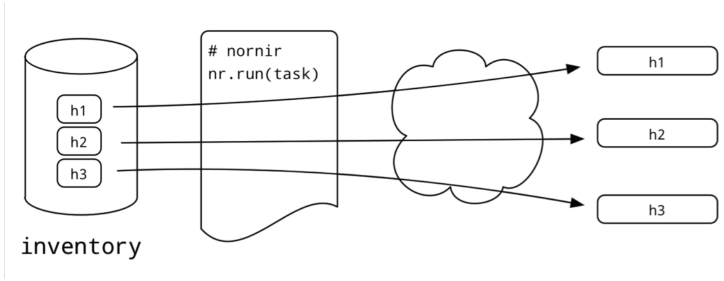


Why not netmiko or paramiko?

Goes back to the

Nornir - Formally Brigade

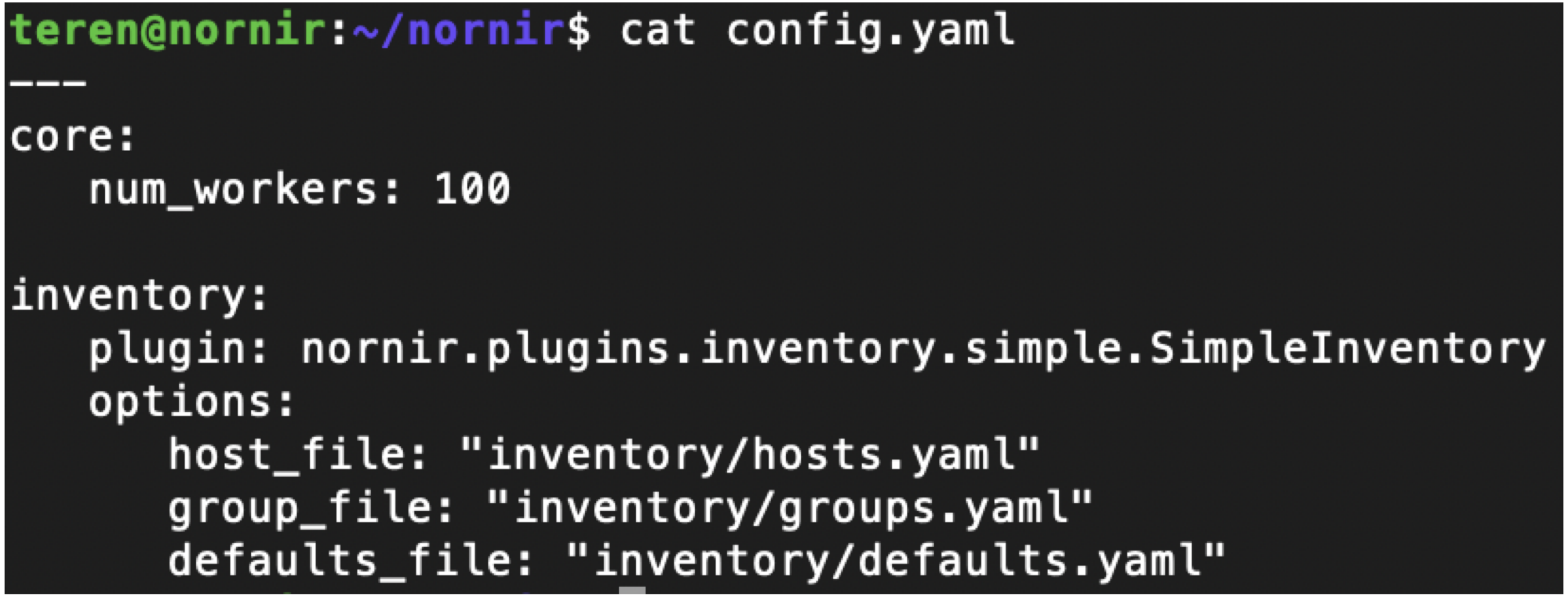
- Written completely in Python
- Purpose built for network automation
- Easy to debug - use Python tools!
- Manages inventory of devices



Parallel Task Execution

- Allows you to define how many “workers” you’d like (default is 20)
- 1 worker means everything is processed serially
- Tasks create more tasks which then run in serial

Nornir Initialization



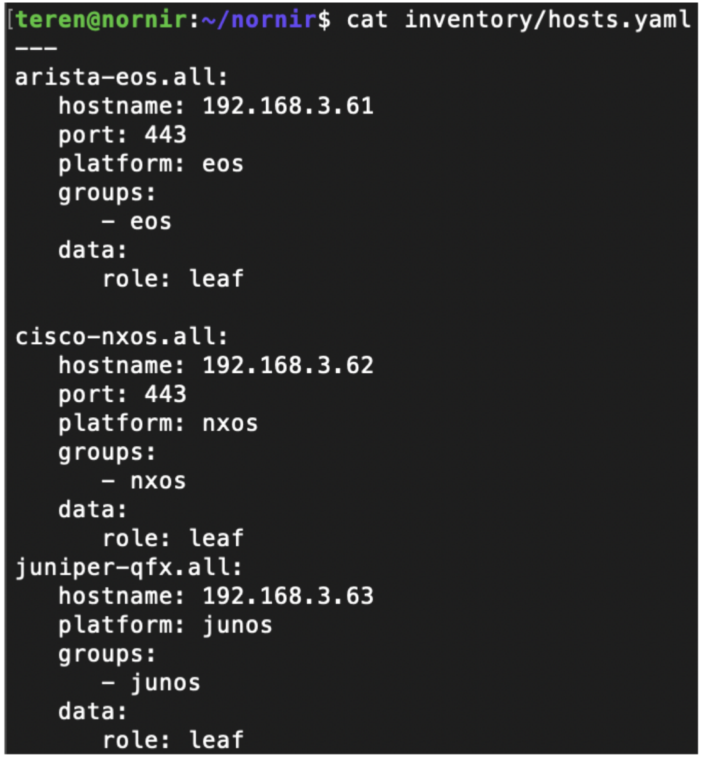
```
teren@nornir:~/nornir$ cat config.yaml
---
core:
   num_workers: 100

inventory:
   plugin: nornir.plugins.inventory.simple.SimpleInventory
   options:
      host_file: "inventory/hosts.yaml"
      group_file: "inventory/groups.yaml"
      defaults_file: "inventory/defaults.yaml"
```

Nornir - Inventory

- Inventory consists of three items:
  - Hosts - Individual devices
  - Groups - Groups of devices
  - Defaults - Default values for all devices

- SimpleInventory (default) uses YAML
  - Network Source of Truth (NSOT)
  - Netbox
  - Ansible

Sample inventory/hosts.yaml

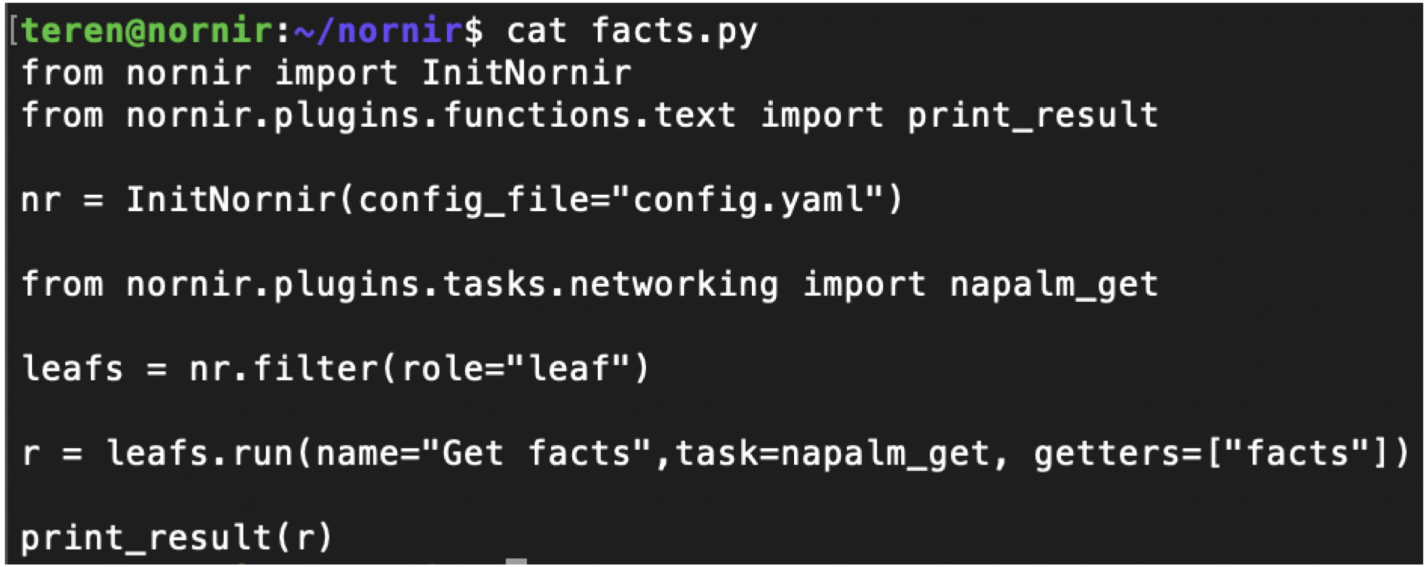


```
[teren@nornir:~/nornir$ cat inventory/hosts.yaml
---
arista-eos.all:
   hostname: 192.168.3.61
   port: 443
   platform: eos
   groups:
      - eos
   data:
      role: leaf

cisco-nxos.all:
   hostname: 192.168.3.62
   port: 443
   platform: nxos
   groups:
      - nxos
   data:
      role: leaf
juniper-qfx.all:
   hostname: 192.168.3.63
   platform: junos
   groups:
      - junos
   data:
      role: leaf
```

Putting Nornir and Napalm together

- Napalm is a plugin for Nornir
  - Could use netmiko or paramiko instead
- Nornir uses Napalm to handle all device communication

Putting Nornir and Napalm together

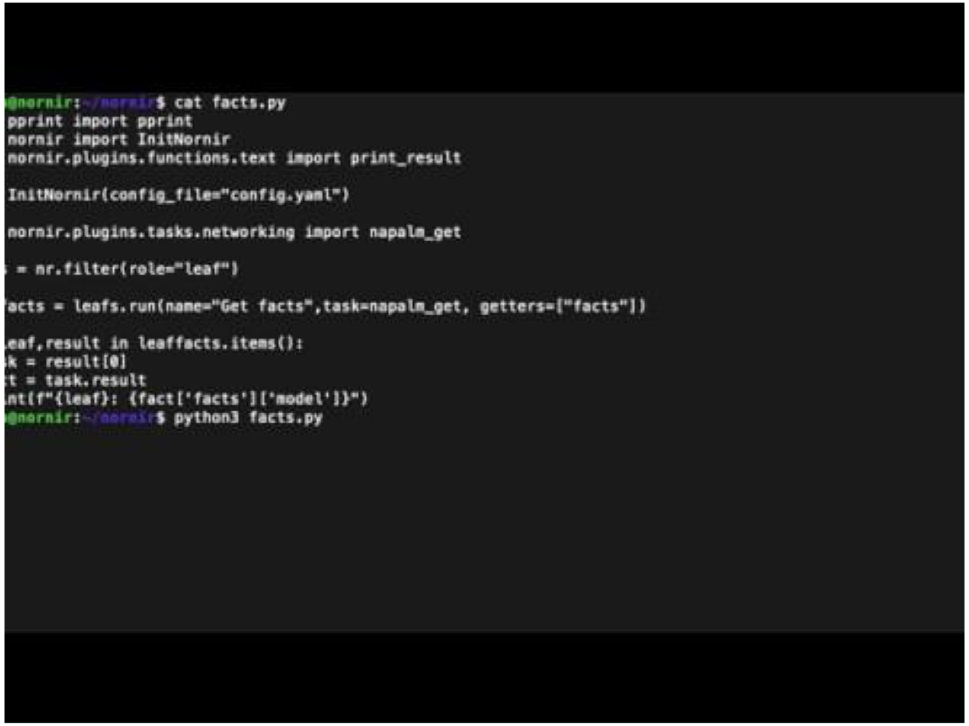


```
[teren@nornir:~/nornir$ cat facts.py
from nornir import InitNornir
from nornir.plugins.functions.text import print_result

nr = InitNornir(config_file="config.yaml")

from nornir.plugins.tasks.networking import napalm_get

leafs = nr.filter(role="leaf")

r = leafs.run(name="Get facts",task=napalm_get, getters=["facts"])

print_result(r)
```

Demo Time

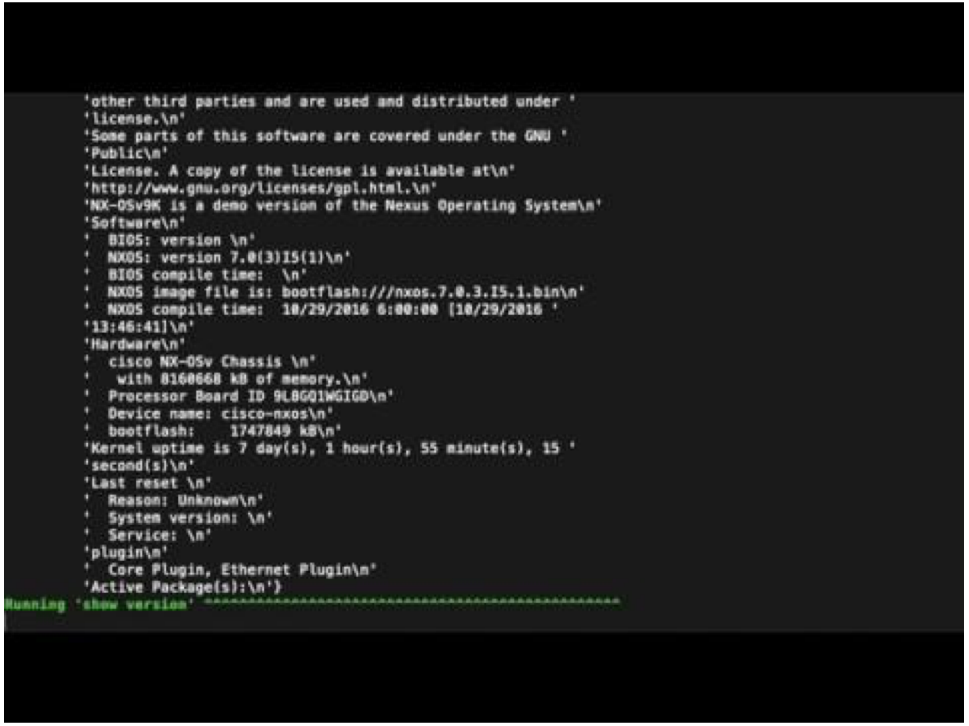
Configuration/state auditing and a few changes

Arista (eos), Cisco (nxos) and Juniper (junos)



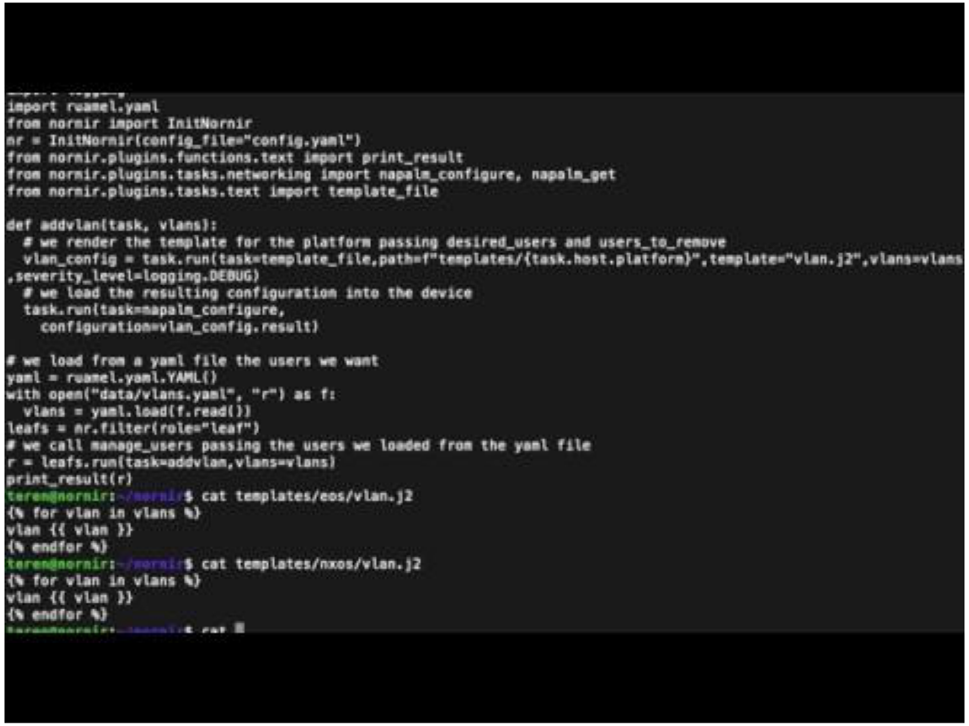
```
@nornir:~/nornir$ cat facts.py
 pprint import pprint
 nornir import InitNornir
 nornir.plugins.functions.text import print_result

 InitNornir(config_file="config.yaml")

 nornir.plugins.tasks.networking import napalm_get

 = nr.filter(role="leaf")

acts = leafs.run(name="Get facts",task=napalm_get, getters=["facts"])

eaf,result in leaffacts.items():
k = result[0]
t = task.result
nt(f"{leaf}: {fact['facts']['model']}")
@nornir:~/nornir$ python3 facts.py
```

Getting basic info like model from the devices



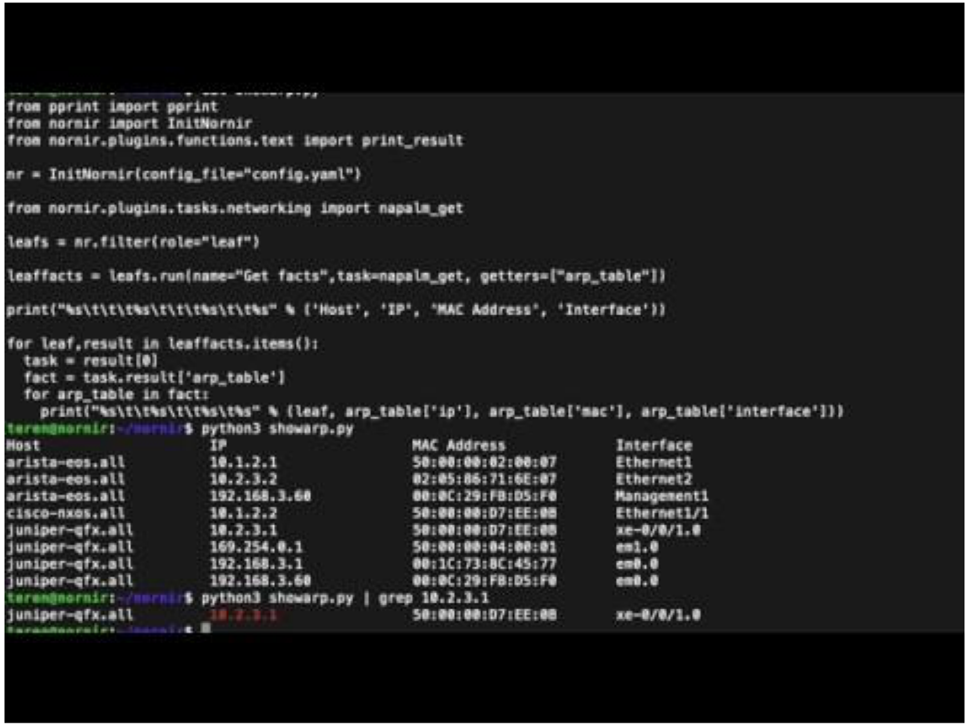
```
         'other third parties and are used and distributed under '
         'license.\n'
         'Some parts of this software are covered under the GNU '
         'Public\n'
         'License. A copy of the license is available at\n'
         'http://www.gnu.org/licenses/gpl.html.\n'
         'NX-OSv9K is a demo version of the Nexus Operating System\n'
         'Software\n'
         '  BIOS: version \n'
         '  NXOS: version 7.0(3)I5(1)\n'
         '  BIOS compile time:  \n'
         '  NXOS image file is: bootflash:///nxos.7.0.3.I5.1.bin\n'
         '  NXOS compile time:  10/29/2016 6:00:00 [10/29/2016 '
         '13:46:41]\n'
         'Hardware\n'
         '  cisco NX-OSv Chassis \n'
         '   with 8160668 kB of memory.\n'
         '  Processor Board ID 9L8GQ1WGIGD\n'
         '  Device name: cisco-nxos\n'
         '  bootflash:    1747849 kB\n'
         'Kernel uptime is 7 day(s), 1 hour(s), 55 minute(s), 15 '
         'second(s)\n'
         'Last reset \n'
         '  Reason: Unknown\n'
         '  System version: \n'
         '  Service: \n'
         'plugin\n'
         '  Core Plugin, Ethernet Plugin\n'
         'Active Package(s):\n'}
Running 'show version' ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
```

Running the ‘show version’ command on all devices



```
import ruamel.yaml
from nornir import InitNornir
nr = InitNornir(config_file="config.yaml")
from nornir.plugins.functions.text import print_result
from nornir.plugins.tasks.networking import napalm_configure, napalm_get
from nornir.plugins.tasks.text import template_file

def addvlan(task, vlans):
  # we render the template for the platform passing desired_users and users_to_remove
  vlan_config = task.run(task=template_file,path=f"templates/{task.host.platform}",template="vlan.j2",vlans=vlans
,severity_level=logging.DEBUG)
  # we load the resulting configuration into the device
  task.run(task=napalm_configure,
    configuration=vlan_config.result)

# we load from a yaml file the users we want
yaml = ruamel.yaml.YAML()
with open("data/vlans.yaml", "r") as f:
  vlans = yaml.load(f.read())
leafs = nr.filter(role="leaf")
# we call manage_users passing the users we loaded from the yaml file
r = leafs.run(task=addvlan,vlans=vlans)
print_result(r)
teren@nornir:~/nornir$ cat templates/eos/vlan.j2
{% for vlan in vlans %}
vlan {{ vlan }}
{% endfor %}
teren@nornir:~/nornir$ cat templates/nxos/vlan.j2
{% for vlan in vlans %}
vlan {{ vlan }}
{% endfor %}
teren@nornir:~/nornir$ cat
```

Adding a vlan to all devices



```
from pprint import pprint
from nornir import InitNornir
from nornir.plugins.functions.text import print_result

nr = InitNornir(config_file="config.yaml")

from nornir.plugins.tasks.networking import napalm_get

leafs = nr.filter(role="leaf")

leaffacts = leafs.run(name="Get facts",task=napalm_get, getters=["arp_table"])

print("%s\t\t\t%s\t\t\t%s\t\t%s" % ('Host', 'IP', 'MAC Address', 'Interface'))

for leaf,result in leaffacts.items():
  task = result[0]
  fact = task.result['arp_table']
  for arp_table in fact:
    print("%s\t\t%s\t\t%s\t%s" % (leaf, arp_table['ip'], arp_table['mac'], arp_table['interface']))
teren@nornir:~/nornir$ python3 showarp.py
Host                    IP                      MAC Address             Interface
arista-eos.all          10.1.2.1                50:00:00:02:00:07       Ethernet1
arista-eos.all          10.2.3.2                02:05:86:71:6E:07       Ethernet2
arista-eos.all          192.168.3.60            00:0C:29:FB:D5:F0       Management1
cisco-nxos.all          10.1.2.2                50:00:00:D7:EE:08       Ethernet1/1
juniper-qfx.all         10.2.3.1                50:00:00:D7:EE:08       xe-0/0/1.0
juniper-qfx.all         169.254.0.1             50:00:00:04:00:01       em1.0
juniper-qfx.all         192.168.3.1             00:1C:73:8C:45:77       em0.0
juniper-qfx.all         192.168.3.60            00:0C:29:FB:D5:F0       em0.0
teren@nornir:~/nornir$ python3 showarp.py | grep 10.2.3.1
juniper-qfx.all         10.2.3.1                50:00:00:D7:EE:08       xe-0/0/1.0
teren@nornir:~/nornir$
```

Show arp across all devices

Additional Resources

- https://github.com/dravetech/nornir-workshop - Start here!
- https://github.com/nornir-automation/nornir
- https://github.com/napalm-automation/napalm
- https://packetpushers.net/podcast/heavy-networking-445-an-introduction-to-the-nornir-automation-framework/

- Special thanks to David Barroso and the rest of the Nornir team

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ARISTA