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NetDevOps Network Automation

(Build, Test, Stage, and Apply using Cisco CML, pyATS, Ansible, and GitLab CI/CD)

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Session ID: LTRENS-2687



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Agenda

- Introduction to NetDevOps
- How to leverage Cisco pyATS
- Automation & Validation
- Setting up environment
- Hands-on
- Q&A

This session is about

Introduction to:
NetDevOps (automation)
pyATS
CI/CD
CML

Automation use-case/lab demo

This session is NOT about

In-depth theory or hands-on:
pyATS, Ansible, Parse, Python
Parsers, Docker, CML
General software development
Software Delivery methodologies

CLI & TEXT

Manual testing of networking infrastructures has become a complex mix of nonintegrated procedures and tools that are prone to errors. This situation is true when the network grows or is subjected to frequent changes. The Cisco pyATS solution helps you automate the testing process.

```
show interfaces
show ip protocols
show ip ospf
show ip ospf mpls ldp interface
show show bgp all detail
show show bgp all neighbor
show show bgp all summary
show show bgp all clusterids
show show bgp all
show show ip bgp template peersession <WORD>
show show ip bgp template peerpolicy <WORD>
show show ip bgp all dampening parameters
show show ip bgp <af_name> [ vrf <vrf_id> ] <ipv4prefix>
show show bgp vrf [vrf_id] <af_name> <ipv6prefix>
show show bgp <af_name> <ipv6prefix>
show show bgp all neighbors <neighbor> policy
show show ip route bgp
show show ip route vrf <WORD> bgp
show show ipv6 route bgp
show show ipv6 route vrf <WORD> bgp
show show vrf detail
```

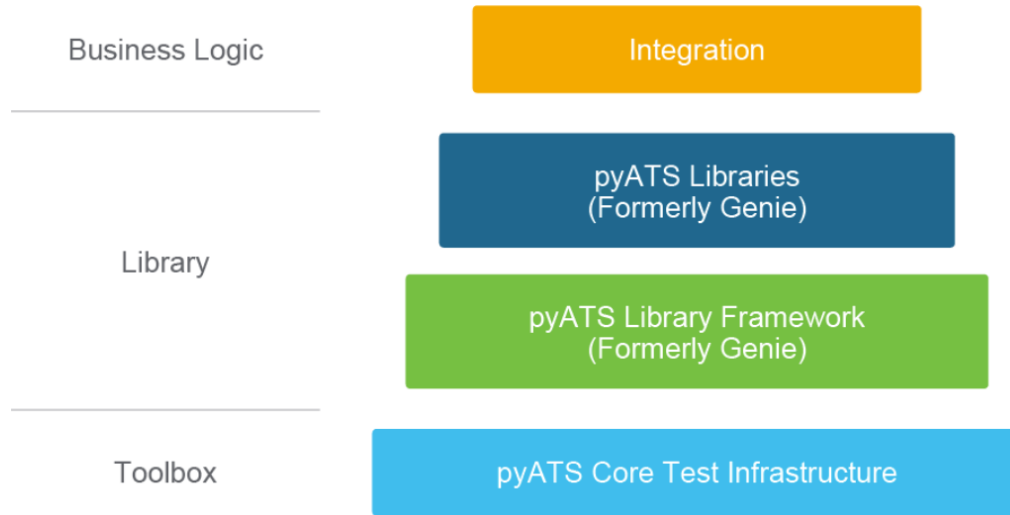
```
N93_2# show interface
Ethernet1/1 is up
admin stat N93_2# show bgp vrf all all
Hardware BGP routing table information for VRF default, address family IPv4 Unicast
MTU 1500 BGP table version 1
reliabil Status: s-su N93_2# show ip interface vrf all
Encapsul Path type: i
full-dup Origin codes
Beacon i Ethernet1/1.1, Interface status: protocol-up/link-up/admin-up, ioid: 134,
Input fl IP address: 201.0.11.2, IP subnet: 201.0.11.0/24 route-preference: 0, tag: 0
Auto-Neg Network IP broadcast address: 255.255.255.255
Auto-mdi >=183.0.0.0/ IP multicast groups locally joined:
Switchpo >=183.0.0.0/ 224.0.0.6 224.0.0.5 224.0.0.2 224.0.0.1 224.0.1.40 224.0.1.39
EtherTyp >=183.0.1.0/ 224.0.0.13
EEE (eff >=183.0.2.0/ IP MTU: 1500 bytes (using link MTU)
Last lin >=183.0.3.0/ IP primary address route-preference: 0, tag: 0
Last cle >=183.0.4.0/ IP proxy ARP : disabled
2 interf >=183.0.4.0/ IP Local Proxy ARP : disabled
Load-int >=183.0.4.0/ IP multicast routing: enabled
30 sec >=183.0.4.0/ IP icmp redirects: enabled
input >=183.0.4.0/ IP directed-broadcast: disabled
Load-int >=183.0.4.0/ IP Forwarding: disabled
300 se >=183.0.4.0/ IP icmp unreachable (except port): disabled
input >=183.0.4.0/ IP icmp port-unreachable: enabled
Load-int >=183.0.4.0/ IP unicast reverse path forwarding: none
300 se >=183.0.4.0/ IP load sharing: none
input >=183.0.4.0/ IP interface statistics last reset: never
RX >=183.0.4.0/ IP interface software stats: (sent/received/forwarded/originated/consumed)
0 unic >=183.0.4.0/ Unicast packets : 238/357/232/6/12
0 inpu >=183.0.4.0/ Unicast bytes : 17220/24461/16592/628/1328
0 jumb >=183.0.4.0/ Multicast packets : 1200/1518/0/1200/2075
0 runt >=183.0.4.0/ Multicast bytes : 110456/95636/0/110456/94466
0 inpu >=183.0.4.0/ Broadcast packets : 0/0/0/0/0
0 watc >=183.0.4.0/ Broadcast bytes : 0/0/0/0/0
0 inpu >=183.0.4.0/ Labeled packets : 0/0/0/0/0
0 Rx p >=183.0.4.0/ Labeled bytes : 0/0/0/0/0
Origin codes WCCP Redirect outbound: disabled
WCCP Redirect inbound: disabled
WCCP Redirect exclude: disabled
Network Ethernet1/1.2, Interface status: protocol-up/link-up/admin-up, ioid: 135,
>=183:/112 IP address: 201.1.11.2, IP subnet: 201.1.11.0/24 route-preference: 0, tag: 0
IP broadcast address: 255.255.255.255
IP multicast groups locally joined: none
IP MTU: 1500 bytes (using link MTU)
IP primary address route-preference: 0, tag: 0
IP proxy ARP : disabled
IP Local Proxy ARP : disabled
IP multicast routing: disabled
```

To Err Is Human...

2 show interface	2 show interface	2 show interface
3 mgmt0 is up	3 mgmt0 is up	3 mgmt0 is up
4 admin state is up,	4 admin state is up,	4 admin state is up,
5 Hardware: Ethernet, address: 5e00.8003.0000 (bia 5e00.8003.0000)	5 Hardware: Ethernet, address: 5e00.8003.0000 (bia 5e00.8003.0000)	5 Hardware: Ethernet, address: 5e00.8003.0000 (bia 5e00.8003.0000)
6 Internet Address is 172.16.1.82/24	6 Internet Address is 172.16.1.82/24	6 Internet Address is 172.16.1.82/24
7 MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec	7 MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec	7 MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec
8 reliability 255/255, txload 1/255, rxload 1/255	8 reliability 255/255, txload 1/255, rxload 1/255	8 reliability 255/255, txload 1/255, rxload 1/255
9 Encapsulation ARPA, medium is broadcast	9 Encapsulation ARPA, medium is broadcast	9 Encapsulation ARPA, medium is broadcast
10 full-duplex, 1000 Mb/s	10 full-duplex, 1000 Mb/s	10 full-duplex, 1000 Mb/s
11 Auto-Negotiation is turned on	11 Auto-Negotiation is turned on	11 Auto-Negotiation is turned on
12 Auto-mdix is turned off	12 Auto-mdix is turned off	12 Auto-mdix is turned off
13 EtherType is 0x0000	13 EtherType is 0x0000	13 EtherType is 0x0000
14 1 minute input rate 1425896 bits/sec, 1347 packets/sec	14 1 minute input rate 1390384 bits/sec, 1311 packets/sec	14 1 minute input rate 1390384 bits/sec, 1311 packets/sec
15 1 minute output rate 144 bits/sec, 0 packets/sec	15 1 minute output rate 136 bits/sec, 0 packets/sec	15 1 minute output rate 136 bits/sec, 0 packets/sec
16 Rx	16 Rx	16 Rx
17 15153308 input packets 2314 unicast packets 15137206 multicast packets	17 15256760 input packets 2329 unicast packets 15240578 multicast packets	17 15256760 input packets 2329 unicast packets 15240578 multicast packets
18 13788 broadcast packets 2010655640 bytes	18 13853 broadcast packets 2024379737 bytes	18 13853 broadcast packets 2024379737 bytes
19 Tx	19 Tx	19 Tx
20 2582 output packets 2315 unicast packets 258 multicast packets	20 2598 output packets 2330 unicast packets 259 multicast packets	20 2598 output packets 2330 unicast packets 259 multicast packets
21 9 broadcast packets 296264 bytes	21 9 broadcast packets 298025 bytes	21 9 broadcast packets 298025 bytes
22	22	22
23 Ethernet1/1 is up	23 Ethernet1/1 is down (Link not connected)	23 Ethernet1/1 is down (Link not connected)
24 admin state is up, Dedicated Interface	24 admin state is up, Dedicated Interface	24 admin state is up, Dedicated Interface
25 Hardware: 100/1000/10000 Ethernet, address: 5e00.8003.0007 (bia 5e00.8003.0008)	25 Hardware: 100/1000/10000 Ethernet, address: 5e00.8003.0007 (bia 5e00.8003.0008)	25 Hardware: 100/1000/10000 Ethernet, address: 5e00.8003.0007 (bia 5e00.8003.0008)
26 MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec	26 MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec	26 MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec
27 reliability 255/255, txload 1/255, rxload 1/255	27 reliability 255/255, txload 1/255, rxload 1/255	27 reliability 255/255, txload 1/255, rxload 1/255
28 Encapsulation ARPA, medium is broadcast	28 Encapsulation ARPA, medium is broadcast	28 Encapsulation ARPA, medium is broadcast
29 full-duplex, 1000 Mb/s	29 auto-duplex, 1000 Mb/s	29 auto-duplex, 1000 Mb/s
30 Beacon is turned off	30 Beacon is turned off	30 Beacon is turned off
31 Auto-Negotiation is turned on FEC mode is Auto	31 Auto-Negotiation is turned on FEC mode is Auto	31 Auto-Negotiation is turned on FEC mode is Auto
32 Input flow-control is off, output flow-control is off	32 Input flow-control is off, output flow-control is off	32 Input flow-control is off, output flow-control is off
33 Auto-mdix is turned off	33 Auto-mdix is turned off	33 Auto-mdix is turned off
34 Switchport monitor is off	34 Switchport monitor is off	34 Switchport monitor is off
35 EtherType is 0x8100	35 EtherType is 0x8100	35 EtherType is 0x8100
36 EEE (efficient-ethernet) : n/a	36 EEE (efficient-ethernet) : n/a	36 EEE (efficient-ethernet) : n/a
37 Last link flapped 04:14:34	37 Last link flapped 00:00:17	37 Last link flapped 00:00:17
38 Last clearing of "show interface" counters never	38 Last clearing of "show interface" counters never	38 Last clearing of "show interface" counters never
39 2 interface resets	39 2 interface resets	39 2 interface resets

pyATS Framework

The pyATS solution is modular, and its framework has multiple layers.

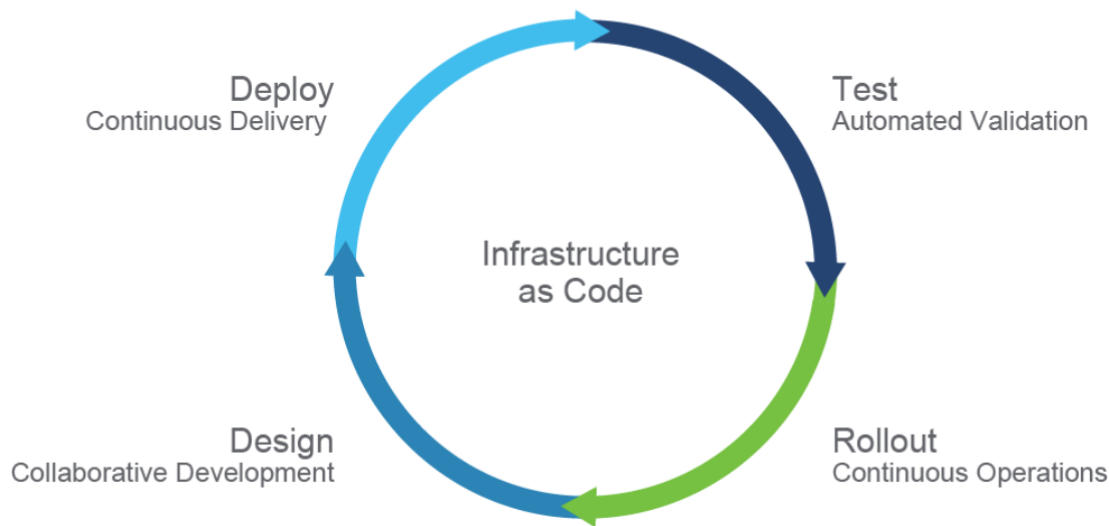


The original pyATS base platform framework is at the core of the pyATS framework. It is considered the toolbox that handles device connection setup, device command execution, and testbed management. It also provides reporting capabilities.

The pyATS Library framework and libraries, formerly known as Genie, are on top of the core. This standard open-source platform and vendor-agnostic automation library system is capable of parsing CLI output and generating the appropriate commands per operating system device type. It has libraries for configuring, retrieving, and testing topologies. The libraries are redefining how network test scripters interact with devices to avoid functional programming. The pyATS core and Genie solution were developed side by side within the same team.

Automate the Testing Phase with pyATS

You can use pyATS to automate the testing phase of IaC.



The testing phase is where you can use pyATS to automate all testing workflows, such as managing connections to devices, profiling the operational network state, performing configuration changes, and comparing profiled information. This process replaces human intervention and improves productivity and efficiency.

Parsers

Converting/formatting command output into Python data structures

```
show bgp all neighbors
For address family: IPv4 Unicast
BGP neighbor is 2.2.2.2, remote AS 65000, internal link
BGP version 4, remote router ID 2.2.2.2
BGP state = Established, up for 4d00h
Last read 00:00:50, last write 00:00:44, hold time is 180, keepalive interval is 60 seconds
Neighbor sessions:
  1 active, is not multisession capable (disabled)
Neighbor capabilities:
  Route refresh: advertised and received(new)
  Four-octets ASN Capability: advertised and received
  Address family IPv4 Unicast: advertised and received
  Enhanced Refresh Capability: advertised
  Multisession Capability:
  Stateful switchover support enabled: NO for session 1
Message statistics:
  InQ depth is 0
  OutQ depth is 0

      Sent       Rcvd
Opens:          1         1
Notifications:  0         0
Updates:         2         2
Keepalives:    6369      5780
Route Refresh:  0         0
Total:         6372      5783
Do log neighbor state changes (via global configuration)
Default minimum time between advertisement runs is 0 seconds

Address tracking is enabled, the RIB does have a route to 2.2.2.2
Route to peer address reachability Up: 3; Down: 0
  Last notification 4d00h
Connections established 1; dropped 0
Last reset never
Interface associated: (none) (peering address NOT in same link)
Transport(tcp) path-mtu-discovery is enabled
Graceful-Restart is disabled
SSO is disabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Minimum incoming TTL 0, Outgoing TTL 255
Local host: 1.1.1.1, Local port: 179
Foreign host: 2.2.2.2, Foreign port: 36402
Connection tableid (VRF): 0
Maximum output segment queue size: 50

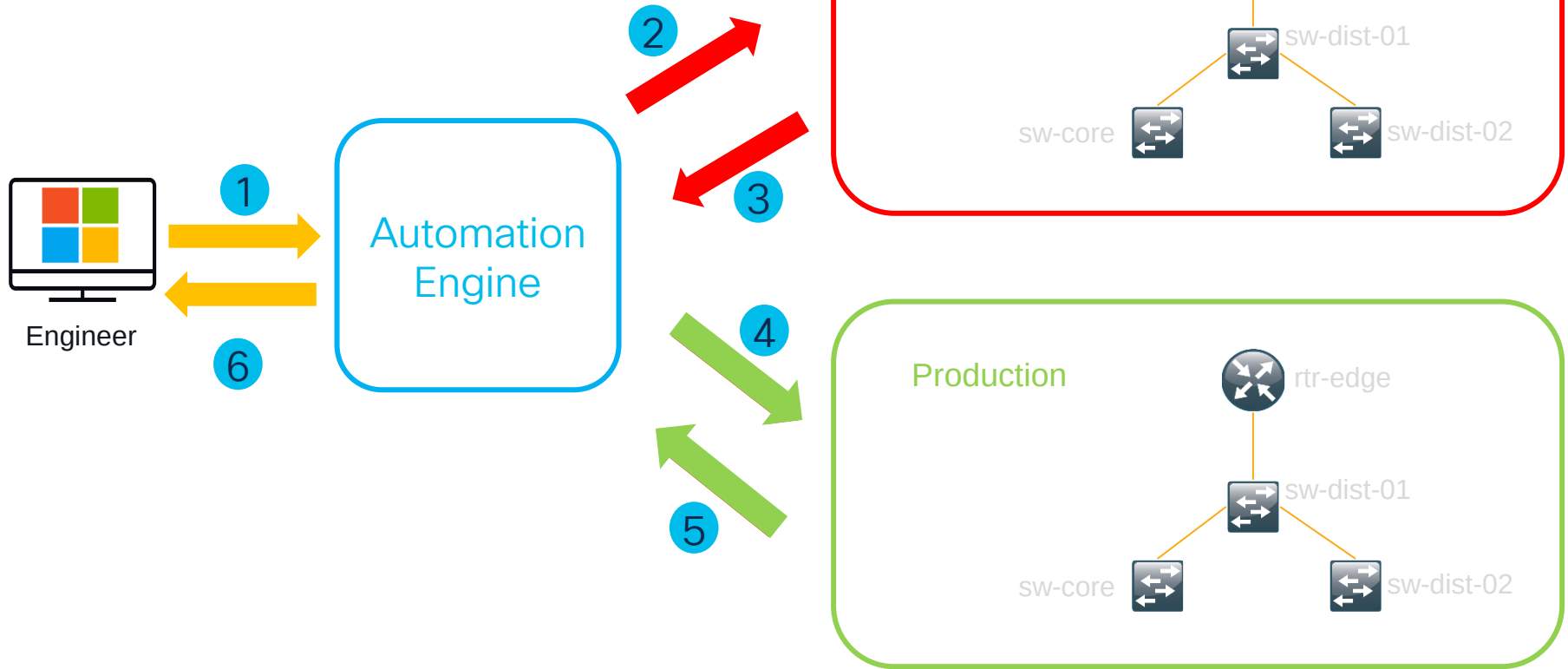
Enqueued packets for retransmit: 0, input: 0 mis-ordered: 0 (0 bytes)

Event Timers (current time is 0x14B4F1B9):
Timer      Starts   Wakeups   Next
Retrans    6371      0         0x0
TimeWait   0         0         0x0
AckHold    5783     5667      0x0
```

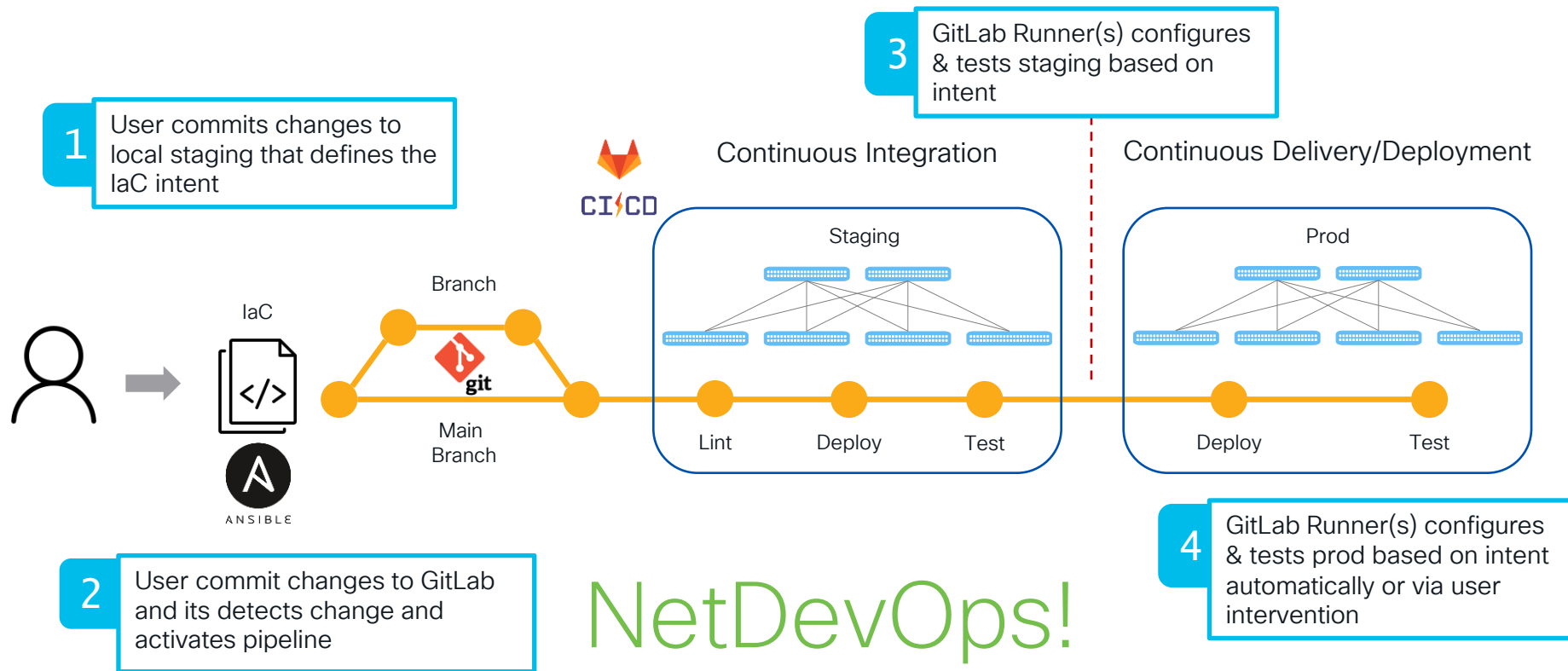


```
{
  "list_of_neighbors": [
    "2.2.2.2",
    "3.3.3.3",
    "2001:2:2:2::2",
    "2001:3:3:3::3",
    "2.2.2.2",
    "3.3.3.3",
    "2001:2:2:2::2",
    "2001:3:3:3::3"
  ],
  "vrf": {
    "VRF1": {
      "neighbor": {
        "2.2.2.2": {
          "address_family": {
            "vpnv4 unicast": {
              "current_time": "0x1E778CE1",
              "last_read": "00:00:51",
              "last_write": "00:00:43",
              "session_state": "Established",
              "up_time": "5d21h"
            }
          },
          "bgp_event_timer": {
            "next": {
              "ackhold": "0x0",
              "deadwait": "0x0",
              "giveup": "0x0",
              "keepalive": "0x0",
              "linger": "0x0",
              "pmtuager": "0x0",
              "processq": "0x0",
              "retrans": "0x0",
              "sendwnd": "0x0",
              "timewait": "0x0"
            }
          }
        }
      }
    }
  }
}
```

Organisation



Infrastructure as Code for Network Ops



Hands-on



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