2023
State of Network Automation
Survey Results

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NANOG 88
13 June 2023
Seattle, USA
Who’s This Grundemann Guy?

Co-Founder & CSO at FullCtl
Co-Founder of IX-Denver, Director at OIX
Interconnection and Automation for about 20 years

Past Lightning Talks:
- Will I be replaced by a script?
- The API is the new CLI?
- WTF is SDN?

Man of many hats…
Network Automation is HOT
With Good Reason

Networks are getting larger and more complex

WE DO THIS NOT BECAUSE IT IS EASY,
BUT BECAUSE WE THOUGHT IT WOULD BE EASY
But Where Are We Really?
We Launched a Survey at N87 to Find Out!

2023 State of Network Automation Survey

Anonymized results will be provided to all participants, as well as presented at one or more major networking conference(s).

chris@fullctl.com Switch account

* Required
The Results Are In
First: Who answered the survey?

- 78 Responses Total
- 20 Countries Represented
- 14 Different Types of Organizations
- 9 Distinct Job Roles/Functions
- Wide Range of Network Scale
Who answered the survey (Country)?

In which country do you live?
78 responses

- Canada: 57.7%
- Mexico: 12.8%
- United States: 28.5%
- Afghanistan: 6.4%
- Akrotiri: 0.1%
- Albania: 0.1%
- Algeria: 0.1%
- American Samoa: 0.1%
## Who answered the survey (Country)?

<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>1</td>
</tr>
<tr>
<td>Australia</td>
<td>1</td>
</tr>
<tr>
<td>Canada</td>
<td>10</td>
</tr>
<tr>
<td>Denmark</td>
<td>1</td>
</tr>
<tr>
<td>France</td>
<td>3</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1</td>
</tr>
<tr>
<td>Ireland</td>
<td>1</td>
</tr>
<tr>
<td>Italy</td>
<td>1</td>
</tr>
<tr>
<td>Netherlands</td>
<td>4</td>
</tr>
<tr>
<td>Nigeria</td>
<td>1</td>
</tr>
<tr>
<td>Norway</td>
<td>1</td>
</tr>
<tr>
<td>Philippines</td>
<td>1</td>
</tr>
<tr>
<td>Singapore</td>
<td>1</td>
</tr>
<tr>
<td>Spain</td>
<td>1</td>
</tr>
<tr>
<td>Sweden</td>
<td>1</td>
</tr>
<tr>
<td>Tanzania</td>
<td>1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1</td>
</tr>
<tr>
<td>United States</td>
<td>45</td>
</tr>
</tbody>
</table>
Who answered the survey (Org)?

What type of organization does "your" network support?

78 responses

- Internet Service Provider (ISP) 28.2%
- Network Service Provider (NSP) 15.4%
- Managed Service Provider (MSP) 11.5%
- Public Cloud Operator (IaaS) 9%
- Software as a Service Provider (SaaS) 9%
- Content Delivery Network (CDN) 9%
- Internet Exchange Fabric (IXP) 1.1%
- Enterprise IT Network 1.1%
Who answered the survey (Org)?

- Internet Service Provider (ISP) - 23
- Enterprise IT Network - 13
- Public Cloud Operator (IaaS) - 9
- Network Service Provider (NSP) - 8
- Public Sector - 7
- Software as a Service Provider (SaaS) - 7
- Managed Service Provider (MSP) - 5
- Other - 6
Who answered the survey (Role)?

Which job function / role most closely matches your position?

78 responses

- Network Technician or Administrator: 24.4%
- Network Engineer or Operator: 26.9%
- Network Architect or Designer: 14.1%
- Network Automation Engineer or Developer: 9%
- Peering Manager: 20.5%
- Network Team Manager or Director: 9%
- Executive Leadership: 9%
- All of the above (except Team Manager): 14.1%
Who answered the survey (Role)?

Network Architect or Designer - 21
Network Engineer or Operator - 19
Network Team Manager or Director - 16
Network Automation Engineer or Developer - 11
Executive Leadership - 7
Other - 4
Who answered the survey (Scale)?

How many IX does your network connect to?

78 responses
Who answered the survey (Scale)?

<table>
<thead>
<tr>
<th>Number of IX:</th>
<th>Number of Routers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min: 0</td>
<td>Min: 2</td>
</tr>
<tr>
<td>Max: 60</td>
<td>Max: 30,000</td>
</tr>
<tr>
<td>Mean: 8.7</td>
<td>Mean: 1,918</td>
</tr>
<tr>
<td>Median: 4</td>
<td>Median: 93</td>
</tr>
</tbody>
</table>
Alright Already

What Did They Say?
How Automated Are We?

Thinking of the entire network lifecycle, from design through deployment and provisioning and on to maintenance and troubleshooting (including all po...): How much of your network is automated today?

78 responses

0% - Nothing is automated, everything is always done manually.

100% - Everything is automated, nothing is ever done manually.
So, How Automated Are We?

0% - 20% = 24
30 - 40% = 17
50 - 60% = 20
70 - 80% = 17
90 - 100% = 0

50% and Below: 50
50% and Above: 37
Mean: 42.43%
Median: 40%
# What is Being Automated?

## Which specific tasks and functions are fully automated in your network today? (Select all that apply)

77 responses

<table>
<thead>
<tr>
<th>Task/Function</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Design</td>
<td>30 (39%)</td>
</tr>
<tr>
<td>Device Deployment (not including VNF)</td>
<td>10 (13%)</td>
</tr>
<tr>
<td>VNF Deployment (turning up)</td>
<td>-17 (22.1%)</td>
</tr>
<tr>
<td>Service Provisioning (for internal IP address)</td>
<td>-22 (28.6%)</td>
</tr>
<tr>
<td>eBGP &amp; Interconnection Provisions</td>
<td>-22 (28.6%)</td>
</tr>
<tr>
<td>Traffic Engineering Related</td>
<td>-8 (10.4%)</td>
</tr>
<tr>
<td>Other Non-Provisioning Configurations</td>
<td>-11 (14.3%)</td>
</tr>
<tr>
<td>Troubleshooting (collection of network events)</td>
<td>-11 (14.3%)</td>
</tr>
<tr>
<td>Firmware &amp; Software Upgrades</td>
<td>-22 (28.6%)</td>
</tr>
<tr>
<td>Capacity Planning (e.g. auto scaling)</td>
<td>25 (32.5%)</td>
</tr>
</tbody>
</table>

## Which specific tasks and functions are partially automated in your network today? (Select all that apply)

77 responses

<table>
<thead>
<tr>
<th>Task/Function</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Design</td>
<td>24 (31.2%)</td>
</tr>
<tr>
<td>Device Deployment (not including VNF)</td>
<td>25 (32.5%)</td>
</tr>
<tr>
<td>VNF Deployment (turning up)</td>
<td>-7 (9.1%)</td>
</tr>
<tr>
<td>Service Provisioning (for internal IP address)</td>
<td>-16 (20.8%)</td>
</tr>
<tr>
<td>eBGP &amp; Interconnection Provisions</td>
<td>-13 (16.9%)</td>
</tr>
<tr>
<td>Traffic Engineering Related</td>
<td>-16 (20.8%)</td>
</tr>
<tr>
<td>Other Non-Provisioning Configurations</td>
<td>-24 (31.2%)</td>
</tr>
<tr>
<td>Troubleshooting (collection of network events)</td>
<td>-28 (36.4%)</td>
</tr>
<tr>
<td>Firmware &amp; Software Upgrades</td>
<td>-27 (35.1%)</td>
</tr>
<tr>
<td>Capacity Planning (e.g. auto scaling)</td>
<td>-15 (19.5%)</td>
</tr>
<tr>
<td>Device Deployment (not including VNF)</td>
<td>-7 (9.1%)</td>
</tr>
<tr>
<td>None fully. This is a very variable config repository</td>
<td>-1 (1.3%)</td>
</tr>
<tr>
<td>Pretty much nothing</td>
<td>-1 (1.3%)</td>
</tr>
<tr>
<td>Configuration for New Devices and Templates</td>
<td>-1 (1.3%)</td>
</tr>
<tr>
<td>Working on ZTP</td>
<td>-1 (1.3%)</td>
</tr>
<tr>
<td>Basic Firewall Rules</td>
<td>-1 (1.3%)</td>
</tr>
<tr>
<td>Backup</td>
<td>-1 (1.3%)</td>
</tr>
</tbody>
</table>
What is Being Automated?

Device Deployment: 26+32=58
Service Provisioning: 31+25=56
Firmware Upgrades: 22+28=50
Other Non-Provisioning: 22+24=46
Capacity Planning: 26+15=41
Troubleshooting: 11+28=39
eBGP & Interconnection: 22+13=35
VNF Deployment: 17+8=25
Traffic Engineering: 8+16=24
Network Design: 2+10=12
How Is It Being Automated?

What types of automation tools do you use in your network today? (Select all that apply)

78 responses

- Homebrew scripts written in house: 69 (88.5%)
- Open source applications w/out paid support: 61 (78.2%)
- Open source applications with paid support: 10 (12.8%)
- Proprietary commercial applications: 24 (30.8%)
- Open source applications with paid support: 3 (3.8%)
How Is It Being Automated?

“Homebrew” - 69 (89%)
OSS w/out support - 61 (78%)
Commercial app - 24 (31%)
OSS with paid support - 13 (17%)
How Is It Being Automated (Languages)?

Python - 73 (of 76)
Shell (bash) - 25
Pearl - 24
Golang - 13
PHP - 12
Ansible - 7
Expect - 4
Ruby - 3
C - 3
TCL - 2

Also:
awk
Erlang
excel
Fish
grep
Jinja2

JSON
powershell
Puppet
Rust
salt
## How Is It Being Automated (OSS)?

<table>
<thead>
<tr>
<th>Tool</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ansible</td>
<td>36</td>
</tr>
<tr>
<td>NetBox</td>
<td>12</td>
</tr>
<tr>
<td>Nautobot</td>
<td>5</td>
</tr>
<tr>
<td>Nornir</td>
<td>5</td>
</tr>
<tr>
<td>NAPALM</td>
<td>5</td>
</tr>
<tr>
<td>Salt(stack)</td>
<td>4</td>
</tr>
<tr>
<td>Git</td>
<td>3</td>
</tr>
<tr>
<td>Peering Manager</td>
<td>3</td>
</tr>
<tr>
<td>Rancid</td>
<td>3</td>
</tr>
<tr>
<td>Elastiflow</td>
<td>2</td>
</tr>
<tr>
<td>IXP Manager</td>
<td>2</td>
</tr>
<tr>
<td>Netmiko</td>
<td>2</td>
</tr>
<tr>
<td>Puppet</td>
<td>2</td>
</tr>
<tr>
<td>Rundeck</td>
<td>2</td>
</tr>
<tr>
<td>Terraform</td>
<td>2</td>
</tr>
<tr>
<td>Workflow Orchestrator</td>
<td>2</td>
</tr>
<tr>
<td>Zabbix</td>
<td>2</td>
</tr>
<tr>
<td>Python libraries</td>
<td>~4</td>
</tr>
</tbody>
</table>

*Python libraries (~4)
How Is It Being Automated ($W)?

28 Total Responses:
Cisco NSO - 7 (10 Cisco total)
Ansible (Tower) - 4
Kentik - 3
Nokia NSP - 2 (4 Nokia total)
Arista CloudVision - 2

19 Other Tools Mentioned Once
Paths to More Automation
Spending Comparison

Roughly how much does your company spend on interconnection fees each month? (Total costs across all transit, IX, cloud connection, and third party connection, etc.)
78 responses

- Under $10,000 per Month: 30.8%
- $10,000 - $25,000 per Month: 30.8%
- $25,000 - $50,000 per Month: 12.8%
- $50,000 - $100,000 per Month: 10.3%
- $100,000 - $250,000 per Month: 17.9%
- Over $250,000 per Month: 16.7%
- I don't know: 10.3%

Roughly how much does your company spend on automation tooling each month? (Total costs across all application license fees, software support, etc.)
78 responses

- Under $1,000 per Month: 52.6%
- $1,000 - $2,500 per Month: 24.4%
- $2,500 - $5,000 per Month: 8.4%
- $5,000 - $10,000 per Month: 7.8%
- $10,000 - $25,000 per Month: 4.9%
- $25,000 - $50,000 per Month: 4.9%
- $50,000 - $100,000 per Month: 4.9%
- Over $100,000 per Month: 1.3%
Spending Comparison

Interconnection Fees

< $10,000 Monthly: 13%
$10k-$100k Monthly: 36%
> $100,000 Monthly: 21%
Don’t Know / Opt Out: 31%

Automation Tooling

< $1,000 Monthly: 55%
> $1,000 Monthly: 13%
Don’t Know / Opt Out: 32%
Staffing Comparison

How many dedicated interconnection engineers and/or peering managers work on your network?
78 responses

- Zero: 48.7%
- One: 14.1%
- Two: 12.8%
- 3 - 5: 12.8%
- Over 5: 11.5%

How many dedicated automation engineers work on your network?
78 responses

- Zero: 55.1%
- One: 11.5%
- Two: 11.5%
- 3 - 5: 12.8%
- 6 - 10: 11.5%
- Over 10: 11.5%
## Staffing Comparison

<table>
<thead>
<tr>
<th>Interconnection Staff</th>
<th>Automation Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero: 49%</td>
<td>Zero: 55%</td>
</tr>
<tr>
<td>One: 12%</td>
<td>One: 13%</td>
</tr>
<tr>
<td>Two: 13%</td>
<td>Two: 12%</td>
</tr>
<tr>
<td>3 to 5: 13%</td>
<td>3 to 5: 12%</td>
</tr>
<tr>
<td>&gt; 5: 14%</td>
<td>&gt; 5: 9%</td>
</tr>
</tbody>
</table>
Not Everyone Agrees On Automation

Which specific tasks and functions should be automated in your network, in your opinion? (Select all that apply)

77 responses

- Network Design: 14 (18.2%)
- Device Deployment (not incl...): 30 (39%)
- VNF Deployment (turning up...): 22 (28.6%)
- Service Provisioning (for inte...): 33 (42.9%)
- eBGP & Interconnection Pro...: 30 (39%)
- Traffic Engineering Related...: 28 (36.4%)
- Other Non-Provisioning Conf...: 43 (55.8%)
- Troubleshooting (collection o...): 43 (55.8%)
- Firmware & Software Upgra...: 40 (51.9%)
- Capacity Planning (e.g. auto...: 14 (18.2%)
- Device Deployment (not incl...: 1 (1.3%)

None: 1 (1.3%)
OSS/BSS Systems, IPAM (void): 1 (1.3%)
What Should be Automated?

Service Provisioning: 59%
Device Deployment: 58%
Firmware Upgrades: 56%
Troubleshooting: 55%
Capacity Planning: 53%
eBGP & Interconnection: 42%
Traffic Engineering: 39%
Other Non-Provisioning: 36%
VNF Deployment: 30%
Network Design: 18%
What Should be Automated?

Service Provisioning: 59%
Device Deployment: 58%
Firmware Upgrades: 56%
Troubleshooting: 55%
Capacity Planning: 53%
eBGP & Interconnection: 42%
Traffic Engineering: 39%
Other Non-Provisioning: 36%
VNF Deployment: 30%
Network Design: 18%
Automation Skills Gap?

Do you consider yourself a networking expert?
78 responses

- Yes: 65.4%
- No: 20.5%
- Maybe: 14.1%
Automation Skills Gap?

Do you consider yourself a networking expert?
78 responses

- Yes: 65.4%
- No: 20.5%
- Maybe: 14.1%

Do you consider yourself an interconnection expert?
78 responses

- Yes: 57.7%
- No: 19.2%
- Maybe: 23.1%
Automation Skills Gap?

Do you consider yourself a networking expert?
78 responses

- Yes: 65.4%
- No: 20.5%
- Maybe: 14.1%

Do you consider yourself an interconnection expert?
78 responses

- Yes: 57.7%
- No: 19.2%
- Maybe: 23.1%

Do you consider yourself a network automation expert?
78 responses

- Yes: 33.3%
- No: 39.7%
- Maybe: 26.9%
## Automation Skills Gap?

<table>
<thead>
<tr>
<th>Expert?</th>
<th>Yes</th>
<th>Maybe</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking</td>
<td>65%</td>
<td>21%</td>
<td>14%</td>
</tr>
<tr>
<td>Interconnection</td>
<td>58%</td>
<td>19%</td>
<td>23%</td>
</tr>
<tr>
<td>Automation</td>
<td>27%</td>
<td>33%</td>
<td>40%</td>
</tr>
</tbody>
</table>
## Automation Skills Gap?

<table>
<thead>
<tr>
<th>Expert?</th>
<th>Yes</th>
<th>Maybe</th>
<th>No</th>
</tr>
</thead>
<tbody>
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<td>14%</td>
</tr>
<tr>
<td>Interconnection</td>
<td>58%</td>
<td>19%</td>
<td>23%</td>
</tr>
<tr>
<td>Automation</td>
<td>27%</td>
<td>33%</td>
<td>40%</td>
</tr>
</tbody>
</table>

73% Uncertain of Automation Skills
Whaaaaaaaataat???  [summary]

78 Diverse Responses
40% of Network Automated (Median)
90% “Homebrewing” && 80% Using OSS (<31% $W)
94% Using Python && At Least 46% using Ansible
55% of Orgs have No Dedicated Automation Staff
73% of Respondents Uncertain of Automation Skills
Next: 2024 Survey!

- How can we improve the survey?
- What questions would you like to see asked?
- How can we increase participation?

Hit Me: chris@fullctl.com
Improvements…

- Higher Ed (org type)
- Security (role type)
- Backups && Firewall Rules (what’s automated)
- Google Form? (account required)