

Insights from Operator Survey & Outreach

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(On Behalf of IAB NEMOPS PC)

Operator Survey

Network operators survey was conducted to help understand the current network management practices, challenges, and future needs -

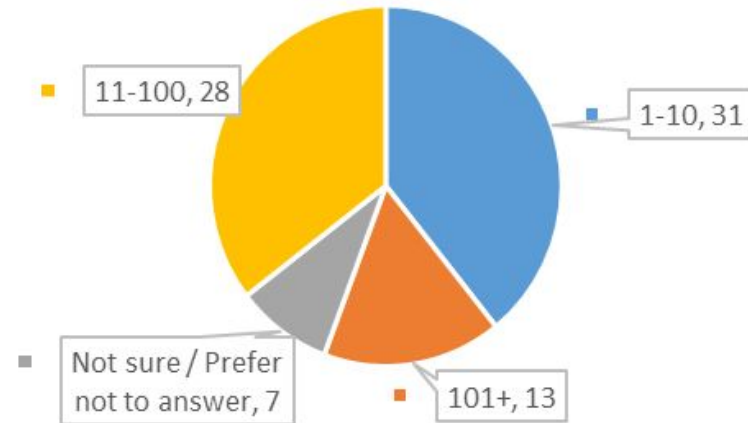
https://ietf.iad1.qualtrics.com/jfe/form/SV_9vQxBRiZqDntarc

The survey results are shown without drawing any definitive conclusions.

Background: Organization

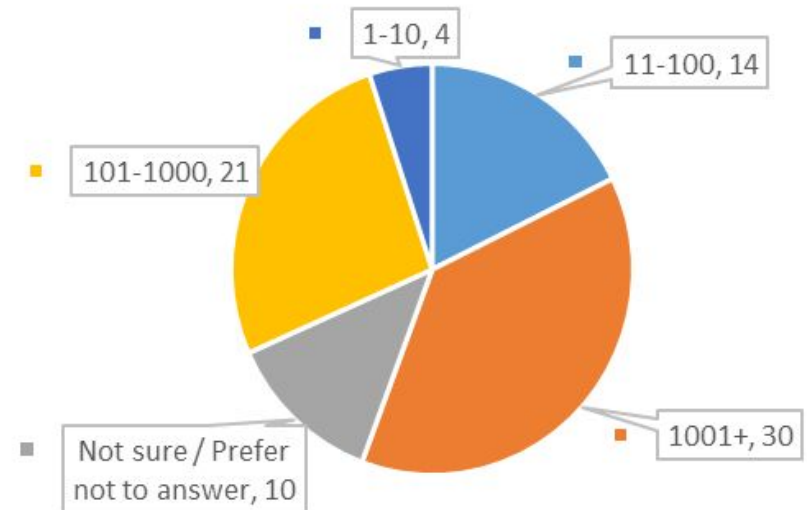
How many network engineers are there in your organization?

■ 1-10 ■ 101+ ■ Not sure / Prefer not to answer ■ 11-100



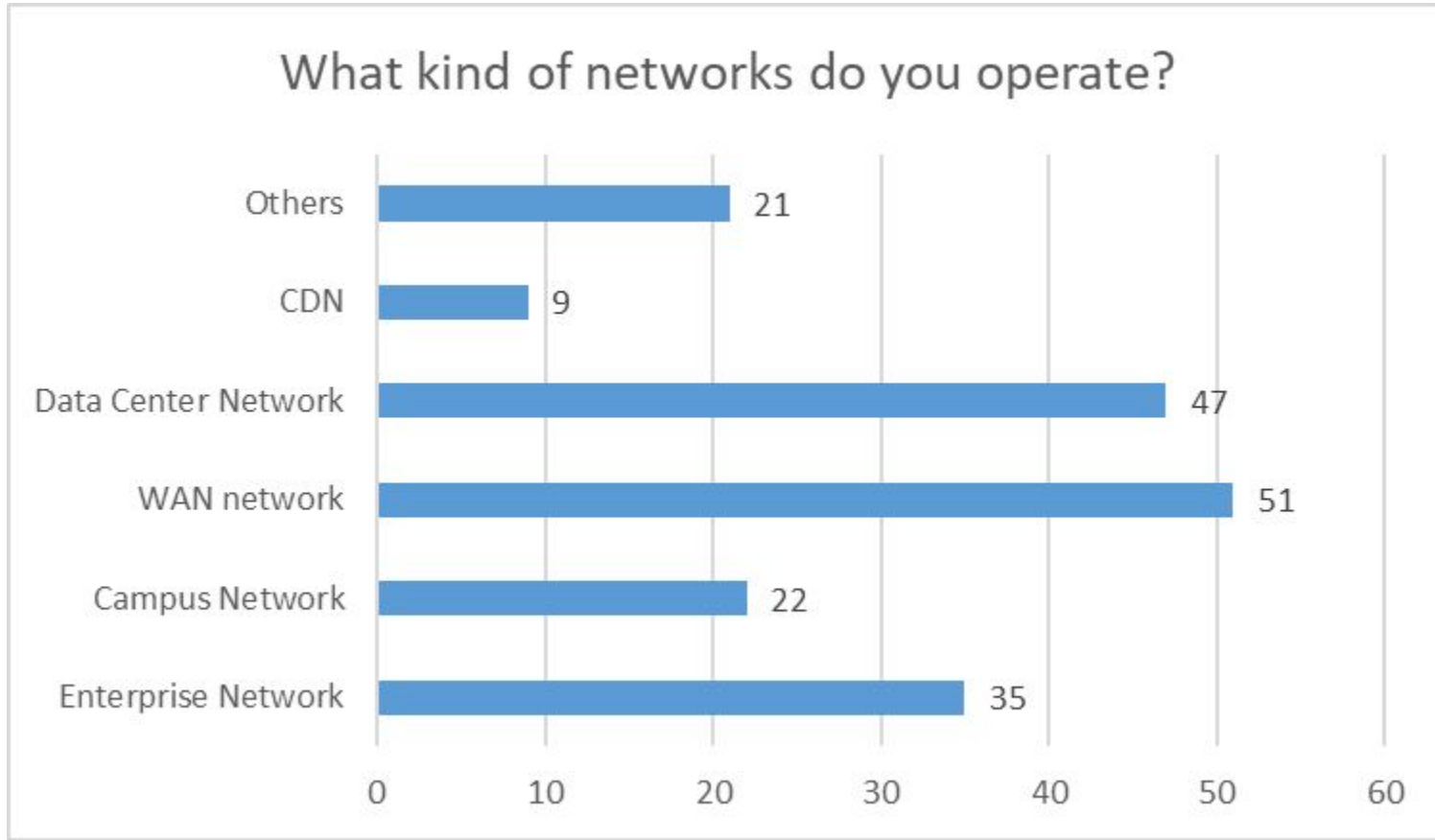
How many nodes in your network?

■ 11-100 ■ 1001+ ■ Not sure / Prefer not to answer ■ 101-1000 ■ 1-10



Background: Network

What kind of networks do you operate?



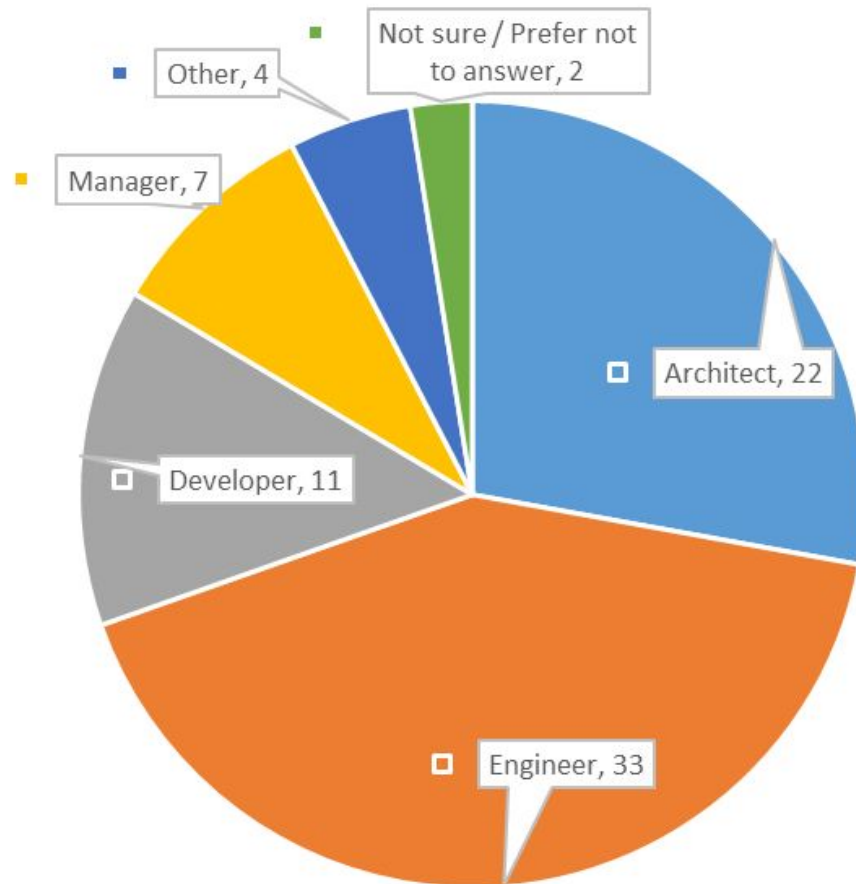
Others Network Types mentioned:

- National layer2 wholesale internet last mile network covering 9.2million square kilometers
- Tier 1 ISP
- Telecom Service Provider network
- Transit Provider
- Service Provider
- Residential DSL, Mobile, SD-WAN, B2B
- Internet Service Provider
- IP MPLS BACKBONE
- Lab Networks meant for experimentation and research
- Cellular & Satellite Networks
- OT network

Background: Role

What is your primary role when you manage/operate the network?

■ Architect ■ Engineer ■ Developer ■ Manager ■ Other ■ Not sure / Prefer not to answer

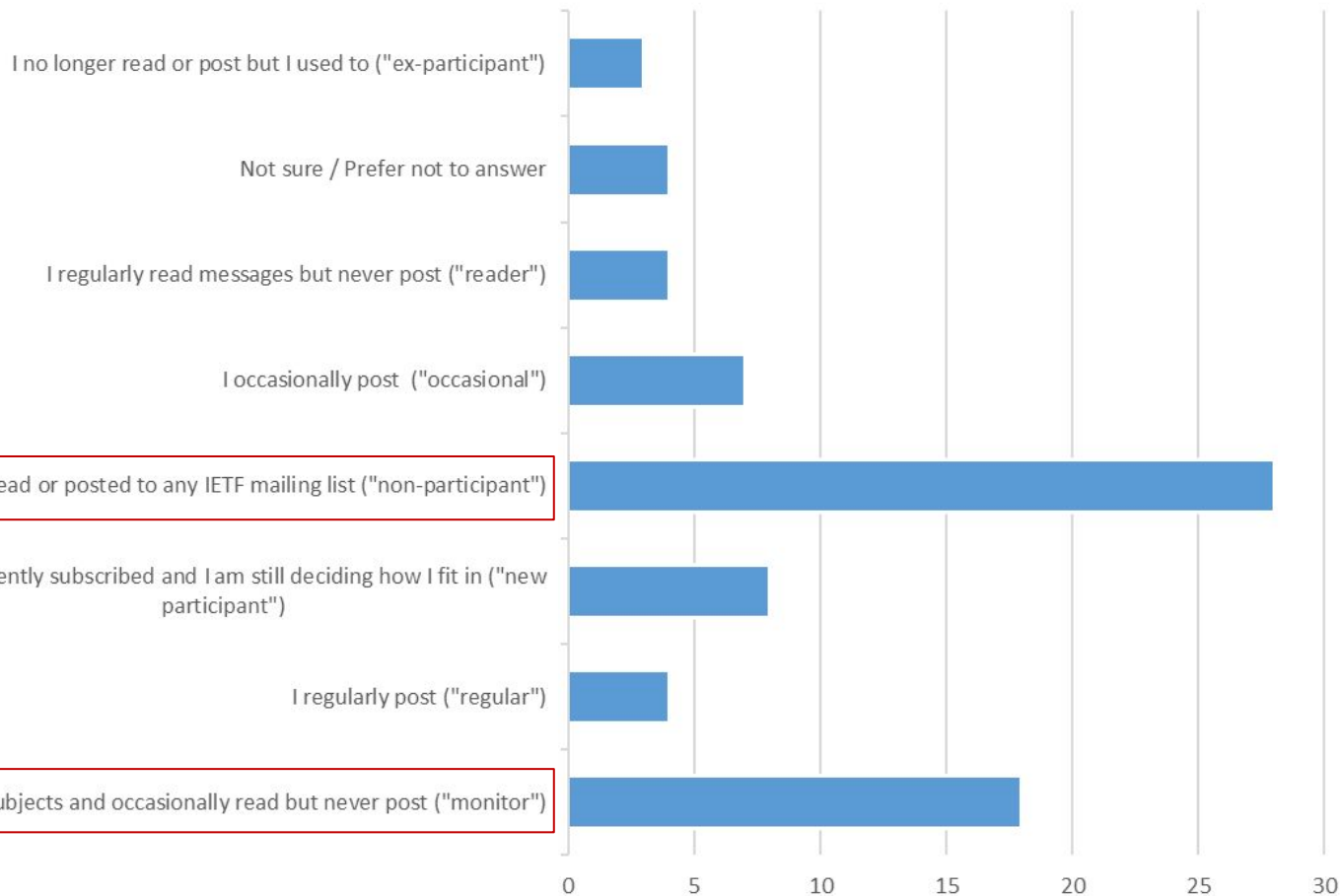


Others Roles mentioned :

- advisor to the operations team
- Researcher
- Operations

Background: Participation

How would you best describe your participation in IETF mailing lists?

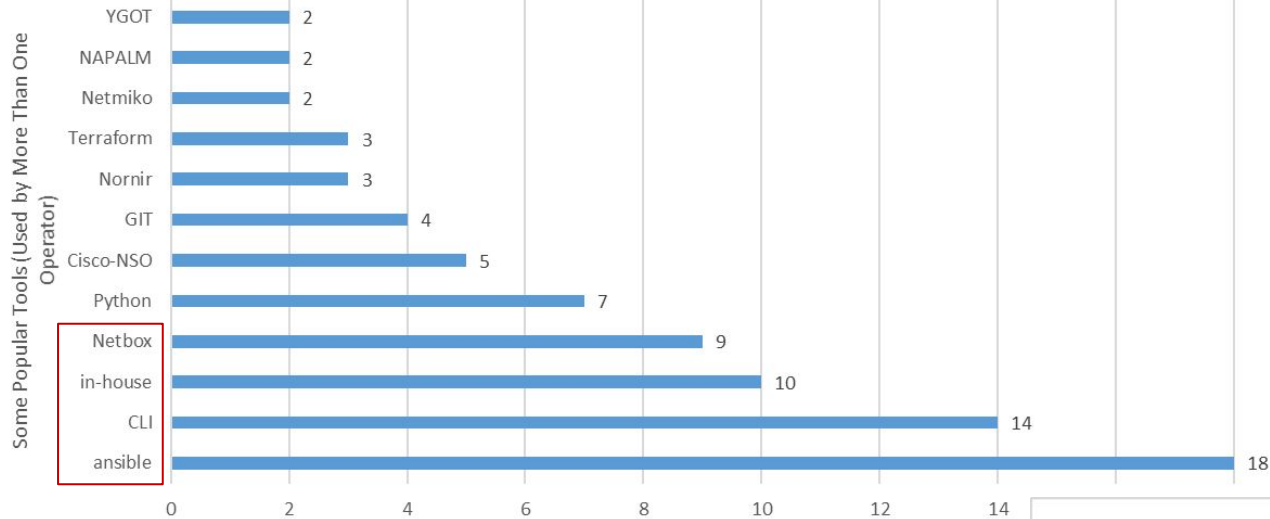


Other operator or standards organizations

- RIPE
- NANOG
- IEEE
- BBF
- TM Forum
- ITU
- OpenConfig
- ETSI
- 3GPP
- GSMA
- Network Automation Forum
- SwiNOG
- LACNIC

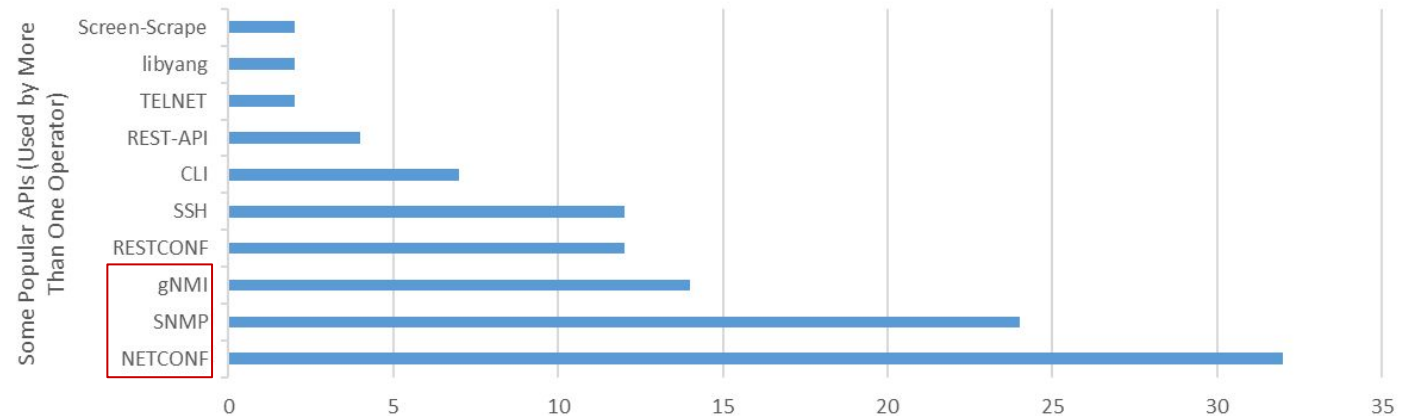
Configuration: Tools, Protocols & APIs

What tools do you use for configuration management?



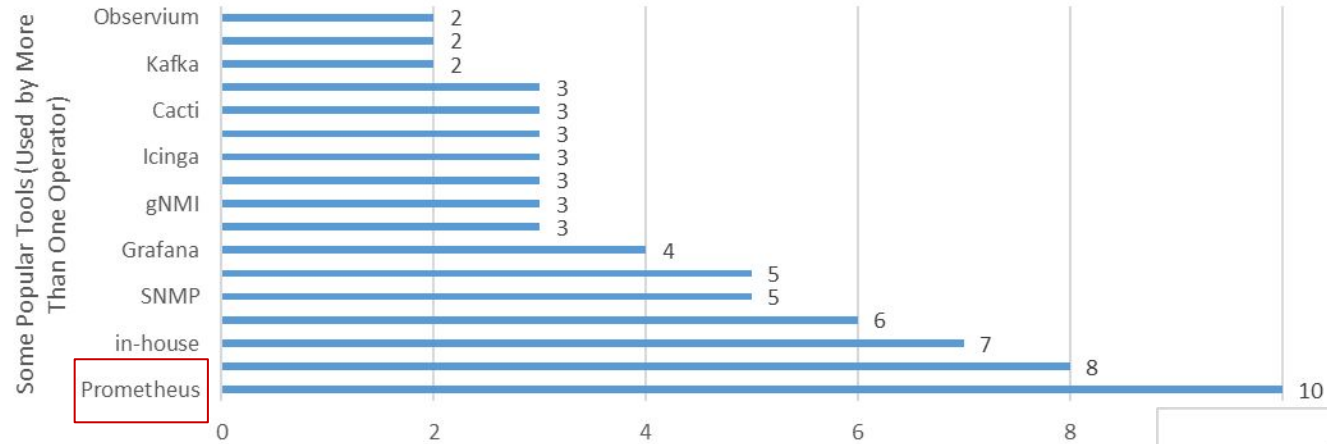
- As per the survey,
 - Most popular configuration tools are Ansible and CLI
 - Most popular protocol/APIs is NetConf
 - Some consider SNMP as an configuration API

What APIs and/or protocols do those configuration management tools use?



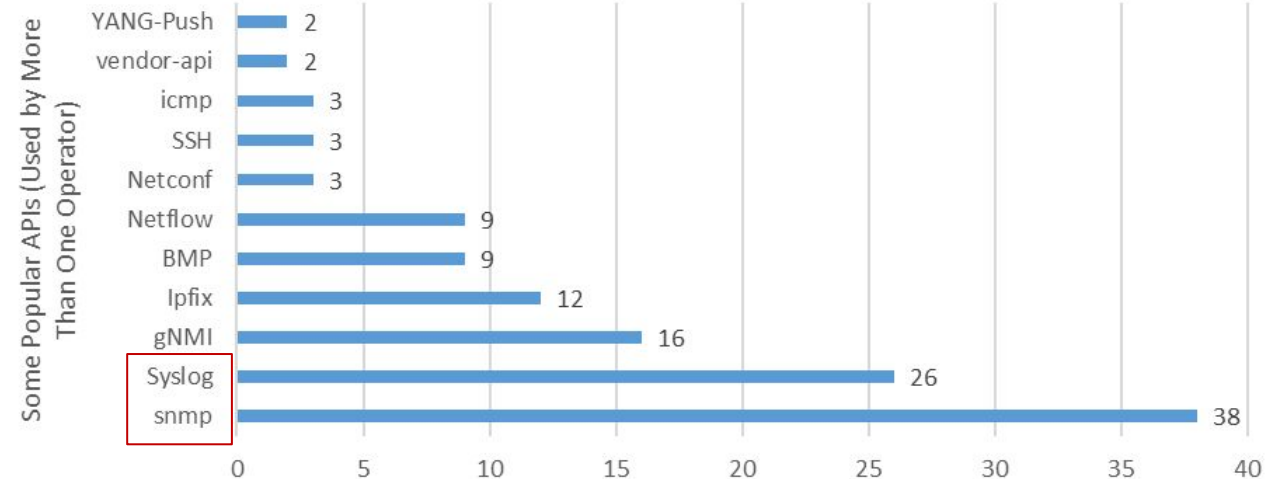
Monitoring: Tools & APIs

What tools do you use for network monitoring?

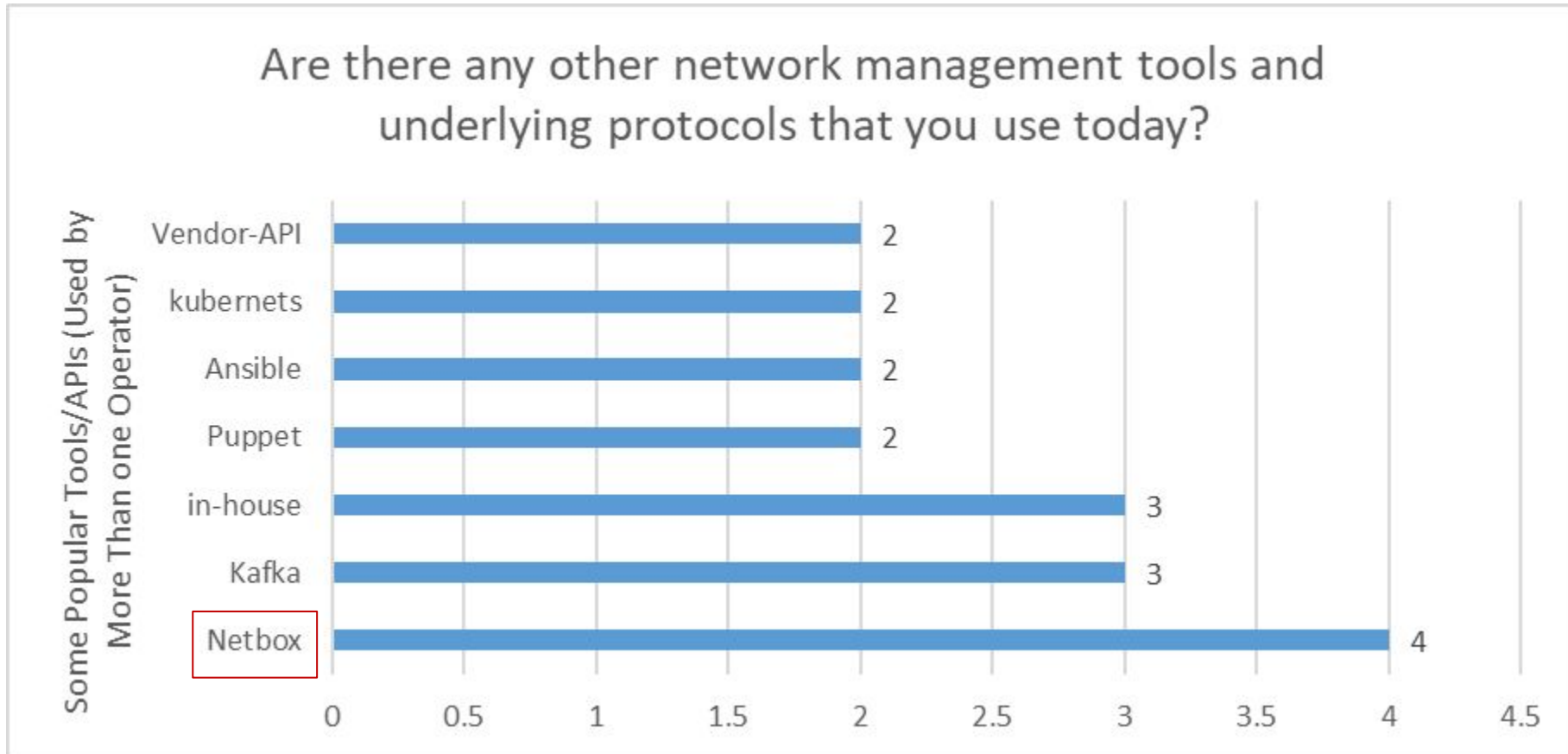


- As per the survey,
 - Most popular monitoring tools is Prometheus
 - Most popular protocol/APIs is still SNMP

What APIs and/or protocols do those monitoring tools use?

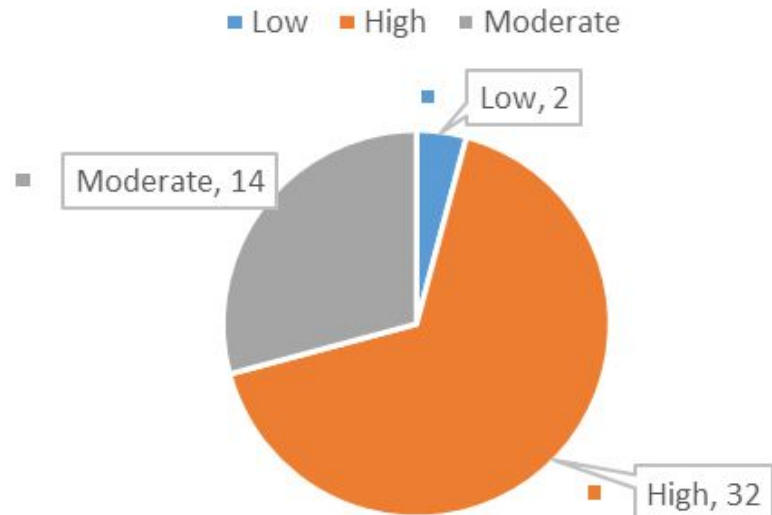


Others



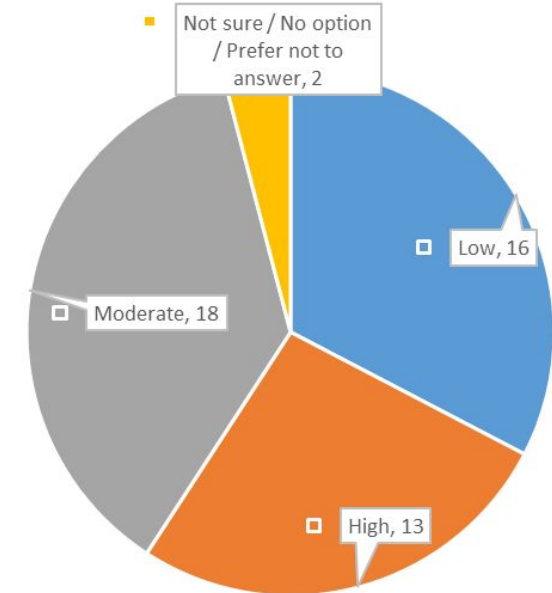
Network Automation

How important is network automation for your organization?

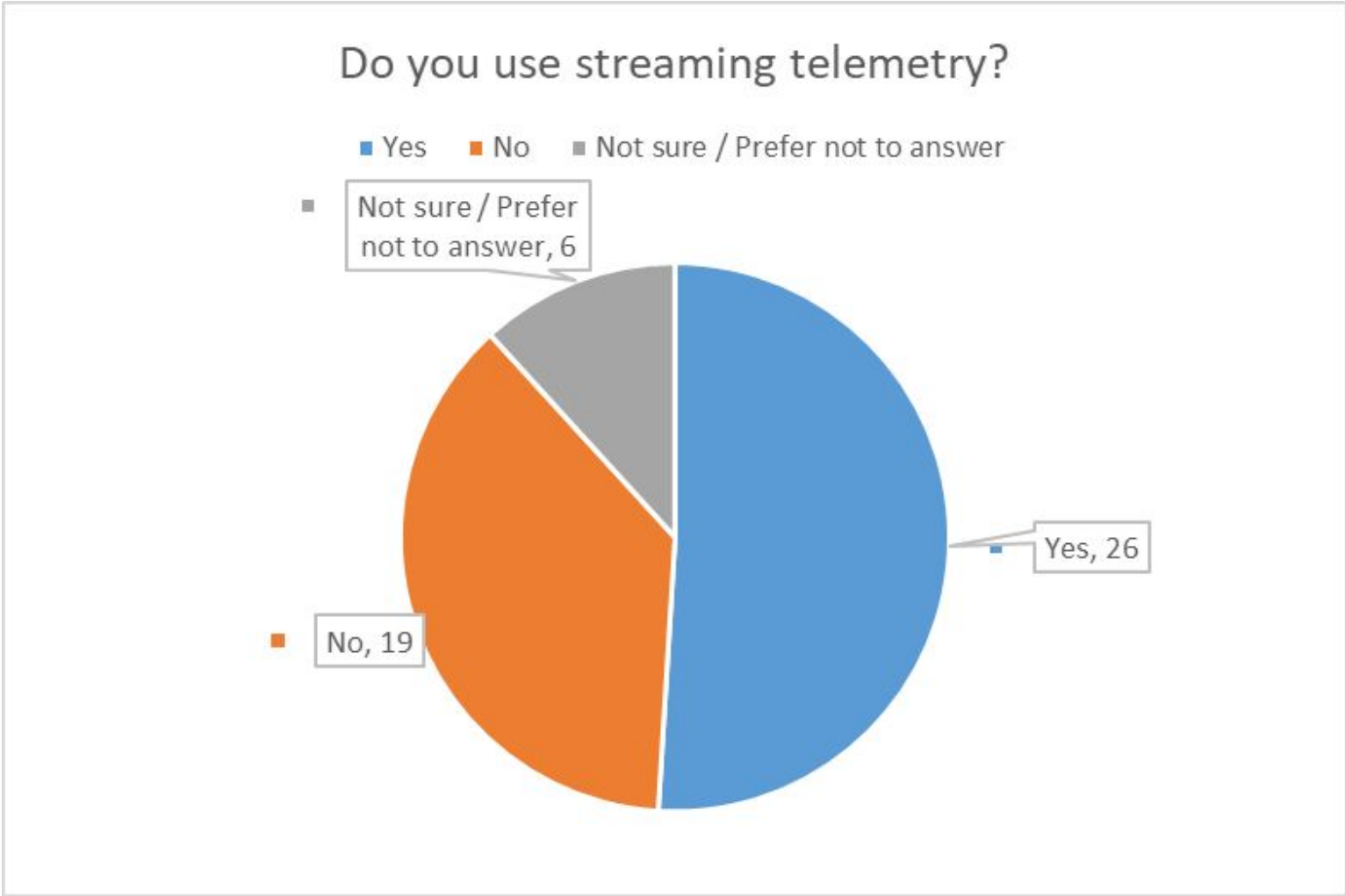


To what extent is your network automated?

■ Low ■ High ■ Moderate ■ Not sure / No option / Prefer not to answer



Streaming Telemetry



Issues/challenges with Tools and Protocols

Issues/Challenges with Tools and Protocol	Issues with Tools/Protocols/API	Major Challenges addressed by both Industry and IETF
Vendor issues	<ul style="list-style-type: none"> • Difficult to use due to Vendor-specific limitations (bugs, bad documentation SDK, issues in implementations). • Should all constraints be exposed using YANG model? • Lack Netflow Open source tools 	<ul style="list-style-type: none"> • Vendors are unwilling to open platform for use with open source tools • Commercial Silicon support for data Queuing and Monitoring • Time and resource commitment for Multi-Vendor support
YANG Model issues	<ul style="list-style-type: none"> • Mapping (e.g., from service YANG to vendor specific YANG, or from YANG to bindings) is complex and time consuming • YANG has very few libraries and software tooling 	<ul style="list-style-type: none"> • Make customer facing model consistent with/ easily mapped to resource facing model
Management Protocol issues	<ul style="list-style-type: none"> • NETCONF uses XML only • Bad Documentation for NC/RC • SNMP is slow and has scalability issue. • Not all data is available via one API • gNMI is not standardized and openconfig lack input from operators. 	<ul style="list-style-type: none"> • Make network management and operations more consumable • A standard and trustworthy way to communicate IP reputation data from servers to routers • Migration to IPv6
Monitoring Protocol issues	<ul style="list-style-type: none"> • SNMP is too slow and has lots of hardware limitation and performance bottleneck. • Poor documentation for telemetry <ul style="list-style-type: none"> • Syslog is unstructured and poorly documented • Proprietary telemetry protocols is annoying • Lack support to integrate with open source tools • Unable to tell if the requested data supports event based push or time based push 	<ul style="list-style-type: none"> • Restrict the volume of telemetry data to be streamed due to limited data storage.

Requirements for network management

Requirements /Features	Configuration Management	Network Monitoring	Other Management aspect	Missing Pieces which meet the needs
YANG Model	<ul style="list-style-type: none"> • Make YANG easier to use • Standardized device YANG-Models • Standardize service models and standardize model mapping (e.g., service model to vendor specific YANG model) 	<ul style="list-style-type: none"> • Align data streaming structures with TSDB Data storage format 	<ul style="list-style-type: none"> • Align with the developer community • Have all core functions support in a single open source tool 	
Protocol	<ul style="list-style-type: none"> • Legacy clients with SNMP/SSH support • Non-SSH support for future protocol • Encodings <ul style="list-style-type: none"> • Some efficient binary encoding for config & telemetry would be nice • More JSON and YAML (or less protobuf), less XML 	<ul style="list-style-type: none"> • Simplify YANG-push to the required essentials • Service Level monitoring with focus on point-to-point service • More standardized machine to machine encoding such as protobuf 	<ul style="list-style-type: none"> • Financial support for development • Tools for the most popular languages capable of generating programmatic structures from YANG • Develop Tools that can simplify and unify the process • More Vendor support for gNMI and OpenConfig 	<ul style="list-style-type: none"> • Role based Access control support • IGP protocol monitoring support similar to BMP • Automated data collection and processing chain • Enable easy data consumption and correlation for data processing • Automated & intelligent assurance as started with Knowledge Graph • Concrete definition of Capabilities
Tools/Vendor Support	<ul style="list-style-type: none"> • Multi-vendor compatibility Support • Ease of integration with third party controller 	<ul style="list-style-type: none"> • Multi-vendor compatibility Support • More running code 	<ul style="list-style-type: none"> • Tools for network status, i.e., traffic routes, congestion, BGP peering. 	<ul style="list-style-type: none"> • Container images support for test such as CI/CD pipeline

Operator Outreach

NEMOPS workshop program committee reached out to operator communities

NEMOPS Outreach Efforts

- LACNIC 42 2024-10-08 Benoit
 - NANOG 92 2024-10-21 Kent, Qin, and Warren
 - RIPE 89 2024-10-28 Benoit
 - AutoConn 2 2024-11-20 Mahesh
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- *We plan to continue to outreach after the workshop and present in APRICOT/APNIC and NANOG meetings in 2025.*

General Insights

1. In network deployments, operations are typically at the bottom of the ladder. It's the most squeezed for time and resources. Network engineers are not typically seasoned developers. Development of needed in-house tools often takes years to develop. There is a need for tools that are easy to use and just work.
2. Vast majority of smaller operators use CLI and open source to manage their networks.
3. There is debate fatigue. The protocol/model debate is a recurring conversation. The problem isn't going away.
4. It was suggested that other domains (e.g., K8N/automation) are years ahead of the current network engineering stack.
5. Support for multiple friendly, stable and feature rich libraries for programming languages is needed. Many DevOp routines use shell scripts, others use a high-level programming language. In any case, on the client-side, multiple programming languages are used.
6. Screen scraping is both necessary and evil. This most often occurs when interacting with a device having only a CLI.
7. It was noted that there could be an outreach to Academia to establish programs to teach lessons using modern management stacks, and then a new generation of engineers could be helping to improve tooling and automation, with university (and/or IETF) hackathons.

Insights specific to data models

1. In some network deployments, the focus is solely on service-level models, such that device-level protocols and device-level models are unimportant. This assumes the existence of a device adaptation layer to transcode service-level models to device-level models and conform to the device-specific protocol.
2. There is a need for solutions to not hide vendor-specific knobs. Currently vendors compete by differentiating their offerings in unique ways. The reason why an Operator may choose a particular vendor is because of its differentiating features. Whilst standard models enable conformance, they must not hide the vendor-specific knobs. YANG deviations are a partial solution to not hiding vendor knobs.
3. It was emphasized that streaming telemetry requires picking a model, and sticking with it. It is quite a commitment and the current environment makes the decision harder.
4. It was noted that IETF focus should be on defining abstract/service-level data models, since it is the only thing the community may ever agree on.
5. There was a point about navigating non device-specific models being difficult. If understood correctly, the Network Engineer knows the CLI command, but has trouble grepping for it in YANG modules defined by SDOs.
6. There was a wish that IETF and OpenConfig models would merge.

Questions / Comments