

AI for network management

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Topics

- Why consider AI for network management?
- Can AI really help?
- Research challenges
- Discussion

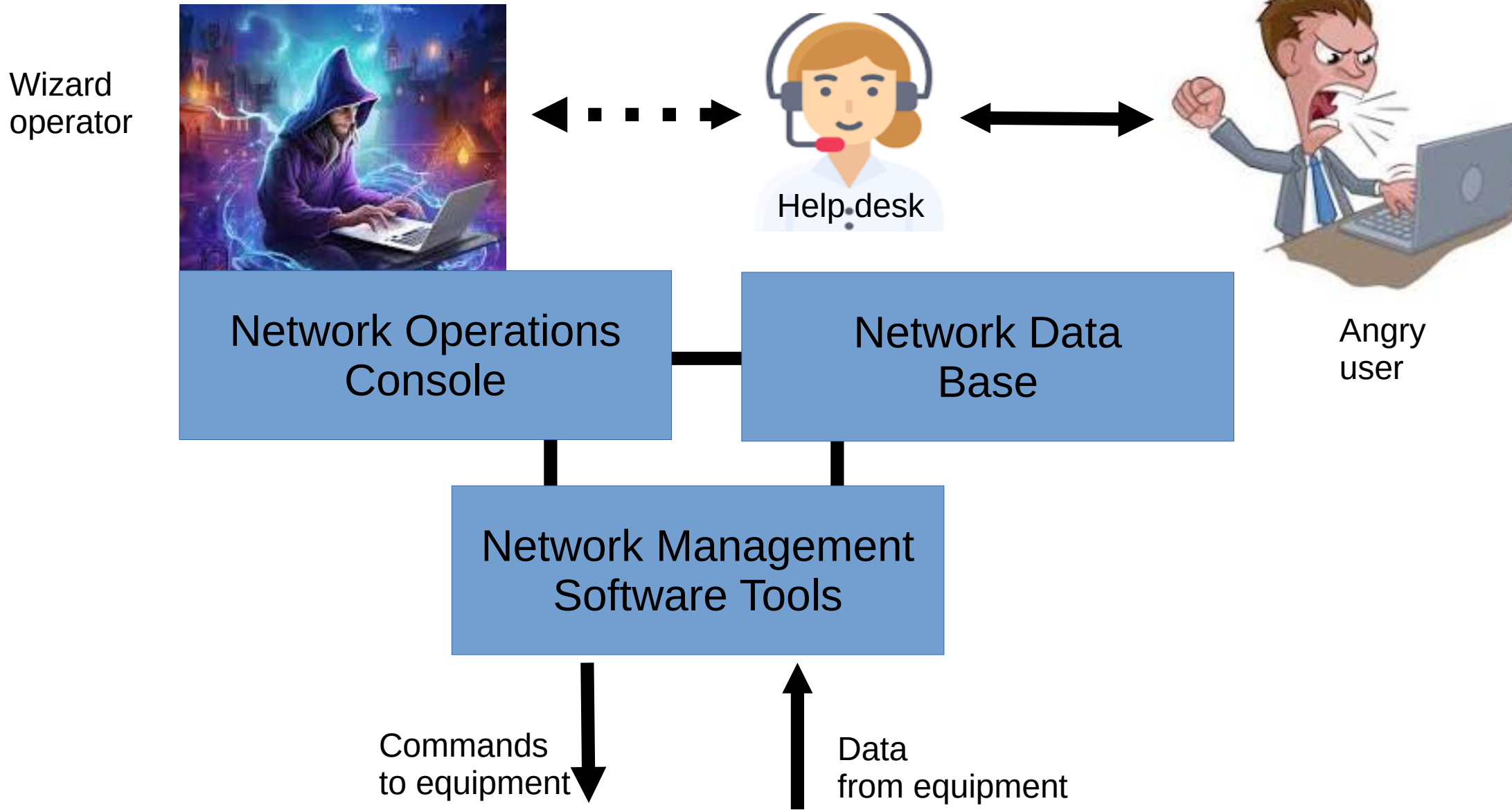
Networks are big

- A typical campus network might have
 - hundreds of routers & switches
 - thousands of devices (computers, phones)
 - thousands of cables & connectors
- A *small* ISP has 100,000 broadband users
- 2degrees Mobile uses more than 2,156 cell towers
- Humans cannot keep track of this

Networks are complex

- A typical campus network might have
 - hundreds of routers & switches
 - thousands of user devices (computers, telephones)
 - multiple operating systems
 - multiple applications
 - potentially, $100 * 1000 * 10 * 100 = 100$ million interactions
- Humans cannot understand such complexity

Traditional solutions (simplified)

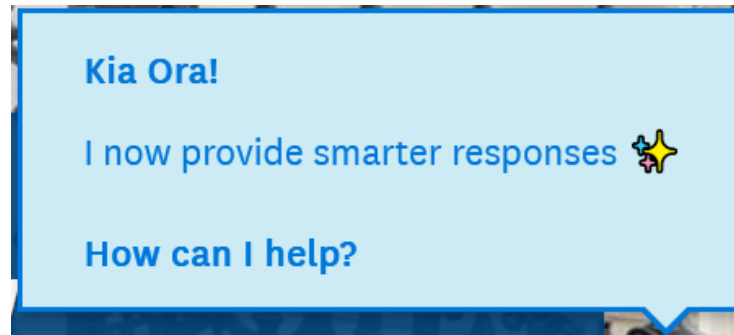


Flow of help desk calls

- 1) The help desk person evaluates whether there's a technical problem, or if it's "just" user error (estimated up to 80% of calls).
- 2) They communicate the problem to the operations staff (speaking their language, not the user's language).
- 3) Then the operations staff figure out what the underlying problem is, among the possible 100 millions of interactions.
- 4) Then they have to know how to fix it.
 - Human bottleneck at each step
 - Each step is a target for AI

The future is already (partly) here

- AI chatbots are replacing humans for stage 1.



- Many users hate them, and mainly they just send users to existing documentation. At best they handle “user errors” but they do handle large scale.



Interesting topics for the next stage

- Can an AI describe a problem in technical terms, after eliminating user error?
- Can an AI use the network database and real time data
 - to analyse a problem & identify the cause?
 - to predict a problem before it happens?
- Can an AI then generate the system commands to fix the problem (or, worst case, to dispatch a technician with spare parts)?

Is AI capable of such things (1)?

- **Me:** *If many users of a network say they cannot access Google, what is the likely problem?*
- **ChatGPT:** Likely causes are:
 - DNS Problems (Most Likely)...
 - Routing or Firewall Issues...
 - ISP-Level Blocking or Outage...
 - Local Misconfiguration or Malware...
 - Next steps...

Is AI capable of such things (2)?

- **ChatGPT:** DNS Problems (Most Likely)
 - Test: Try accessing Google via its IP address (e.g., <http://142.250.74.14>). If that works, it's almost certainly a DNS issue.
 - Fix: Switch DNS settings to a public DNS (like 8.8.8.8 or 1.1.1.1).

Is AI capable of such things (3)?

- **ChatGPT: Next Steps**
 - Check DNS first – switch to a known-good public DNS and retest.
 - Ping and traceroute Google.
 - Try accessing via another network (e.g., mobile hotspot).
 - Check network firewall/router logs, if accessible.

How did ChatGPT do?

- Compared to a traditional help desk
 - Worse?
 - Same?
 - Better?



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Free advice:
don't plan on a
career as a help
desk person.



Preliminary conclusion

- LLM based AI appears to be capable of analysing network problems and proposing user level solutions.
- But can it also fix or predict technical problems?
- Let's try...

Can an AI fix problems (1)?

- **Me:** *A Cisco router seems to have lost its routing table*. What should the operator do?*

- **ChatGPT:**

1. Check Routing Table

Use the command:

```
> show ip route
```

This confirms whether the routing table is truly empty or missing expected routes.

* By the way, I gave the AI a very big hint. Could it have found the faulty router on its own?

Can an AI fix problems (2)?

- ChatGPT:

2. Check Interface Status

Ensure interfaces are up and configured correctly:

```
> show ip interface brief
```

Look for interfaces that are administratively down or down/down, which could prevent route learning.

Can an AI fix problems (3)?

- ChatGPT:

3. Check Configuration

Verify that static routes and routing protocols are properly configured:

```
> show running-config
```

Look for missing:

- Static routes (ip route ...)

- Routing protocol configuration (e.g., router ospf, router bgp, etc.)

Can an AI fix problems (4)?

- ChatGPT:

7. Reload or Restore

If the routing configuration is lost and not recoverable, you can:

Manually re-enter the routing configuration

Restore from a recent backup:

```
> copy tftp://[server]/backup-config  
running-config
```

or use a configuration management tool.

Can an AI predict problems (1)?

- **Me:** *Can you predict network failures?*

- **ChatGPT:**

If you provide things like:

Syslog entries

SNMP alerts

...

Ping/latency test results

Configuration snapshots

...then I can assist by identifying warning signs

Can an AI predict problems (2)?

- ChatGPT:

For example:

Interface errors increasing → cable or port might fail soon

High CPU usage on a router → may crash under load

Frequent BGP session resets → possible upstream instability

ARP table filling up → potential DoS or misconfiguration

Spanning Tree flaps → Layer 2 instability ahead

How did ChatGPT do?

- Compared to a wizard operator
 - Worse? Quite a bit
 - Same? Not really
 - Better? No way



There will still be jobs for wizards.

Challenges for the next stage

- Developing AI LLMs that can significantly assist the wizard operator.
 - Seems feasible but faces significant challenges.
- The following challenges are interesting research problems.

Challenges (1)

- 1) AI development has been largely driven by image, natural language and signal processing requirements. Networks are not easily mapped onto those formats.
- 2) AI techniques require very large representative datasets. Where will these come from for network management?

Challenges (2)

3) Analysis of network datasets could access sensitive and personally identifiable information, risking breach of privacy and even abuse.

4) Current network operation often involves semi-automated software procedures using existing management tools. Seamless integration of AI with these procedures is not easy.

Challenges (3)

- 5) LLM AIs make mistakes (“hallucinations”). How are these detected and blocked?
- 6) AI solutions must be acceptable to network administrators and operators.
- 7) There are potential legal or regulatory issues with decisions made by AI in place of humans.

Reading list

- These are *research drafts* only and may contain nonsense:

J. François, A. Clemm, D. Papadimitriou, S. Fernandes, S. Schneider, *Research Challenges in Coupling Artificial Intelligence and Network Management*, 2025,
<https://datatracker.ietf.org/doc/draft-irtf-nmrg-ai-challenges/>

J. Rosenberg and C. F. Jennings, *Framework, Use Cases and Requirements for AI Agent Protocols*, 2025,
<https://datatracker.ietf.org/doc/draft-rosenberg-ai-protocols/>

C. Guo, *Large Model based Agents for Network Operation and Maintenance*, 2025
<https://datatracker.ietf.org/doc/html/draft-chuyi-nmrg-ai-agent-network/>

M. Han, N. Zhang and J. Zhao, *Considerations of AI-powered Autonomic Service Agent Communication*, 2025,
<https://datatracker.ietf.org/doc/draft-han-anima-ai-asa/>

R. Rokui, C. Li, D. King, *Artificial Intelligence (AI) for Network Operations*, 2025,
<https://datatracker.ietf.org/doc/draft-king-rokui-ainetops-usecases/>

Discussion...