



REVIEW ARTICLE

Evaluation of ChatGPT's Configuration Support for Network Connectivity and Security

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ABSTRACT

ChatGPT is the world's most famous AI interface that operates by analyzing the prompt input text and generating coherent responses that predict effectively your query by utilizing the knowledge it has acquired from its training data. Although this process may appear straightforward and authentic, it may give misleading results for more deep analysis, especially for the network engineers. In this paper, an evaluation of ChatGPT's configuration support for network connectivity and security will be analyzed, by applying the commands generated by the ChatGPT AI to configure and secure an enterprise network designed with simulated Cisco hardware, and analyzing the full network connectivity and security to determine if the ChatGPT AI prediction was accurately sufficient to run a full network.

Keywords: ChatGPT, computer networks, cyber security, CISCO networks, artificial intelligence

INTRODUCTION

Networks have experienced significant changes due to internet and network technology advancements, network devices, security demands, and evolving internet preferences.^[1] OpenAI's latest version of ChatGPT, which is a model chat for a large language generative pre-trained transformer (GPT), can drive innovation and enhance operational efficiency in the communication industry. At present, network management resources, configuration, control, and operation are still in their early stages. What distinguishes ChatGPT is its capability to generate engaging and coherent responses, which can be credited to its learning technique usage of the reinforcement cycle. Based on the architecture of the neural network transformer recognized for the generation and analysis of text capabilities, ChatGPT uses a multi-step workflow. It analyzes operator input, then generates dialogue responses, and actively includes user feedback to improve its performance as shown in Figure 1 the learning process of ChatGPT.^[2]

Network design encompasses a broad range of tasks, such as configuring, connecting, operating, and maintaining computer network devices.^[3] These tasks involve activities such as enabling interfaces, activating routing protocols, ensuring port security, implementing VLANs, and more. Managing communications between the networks requires expert operators of network engineers to configure low-level configuration commands and use more complicated high-level network policies and commands to ensure security, maintenance, and efficient operating.^[4] This

is where ChatGPT can be an invaluable tool, demonstrating its ability to generate diverse commands for operating, generating, and modifying code, as well as providing instructions for analyzing the best network device configuration. Therefore, the objective of this research is to investigate and assess the accuracy associated with integrating ChatGPT into network design commands and operating a full-scale network, where the analysis of the results will be discussed and tested using real ChatGPT commands and procedures. Furthermore, in this paper, CISCO software, namely, cisco packet tracer will be used to simulate the network design. Network configuration can be written and managed through a network manager; therefore, it is not easy to write all the corrected configurations to guarantee the full connectivity and security of the network.

The structure of the paper will be as follows, Section 2 discusses related work investigation, Section 3 provides a

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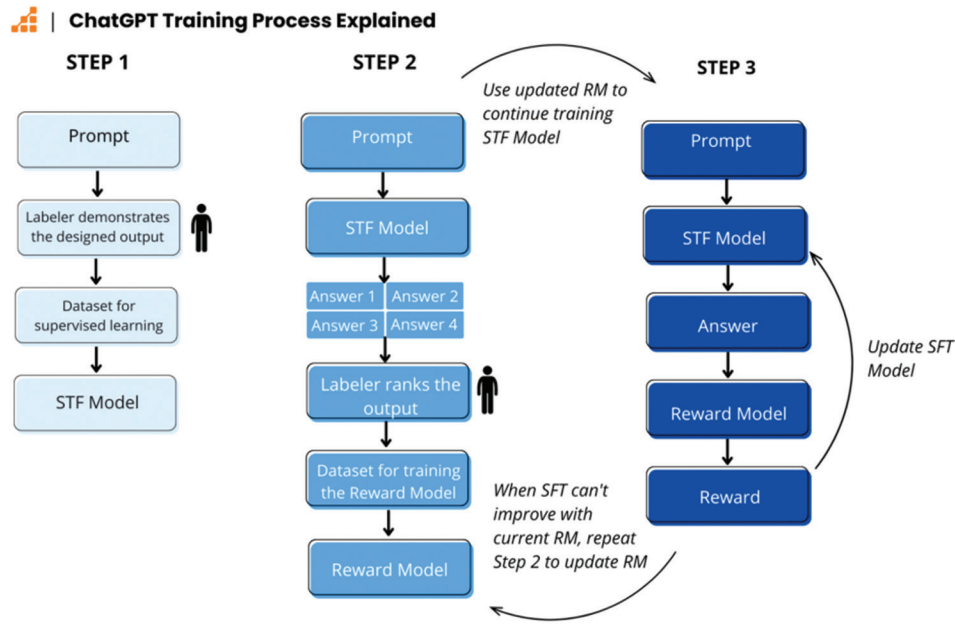


Figure 1: ChatGPT learning process^[2]

methodology background of the ChatGPT and the importance of network commands, Section 4 will give a simulation scenario design and generated parameters and the final result will be showed in Section 5, finally, in Section 6 the conclusion and future work of the paper will be presented.

RELATED WORK

As ChatGPT is new, there are diminutive research papers that discuss its involvement in computer networks, in^[5] the author gives environment development configuration for analyzing computer network packet traffic using a GPT, and the result shows that ChatGPT can architect design the network simulation scenarios and can assist in the computer network configuration, also it describes the actions needed to design and analyze network environment. The author in^[6] proposes a novel architecture for network artificial intelligence with the name of NetLM, this model is designed to comprehend the sequence structure in the data packets and analyze its dynamic, the result shows that the NetLM proposed is generating framework to solve the problems of different abstraction levels. While the author in^[7] is comparing and describing two methods' results, both methods use ChatGPT but with different constructing scenarios, the first one executing repeatedly the same prompt to the ChatGPT system, while the second decomposing the network into sublayers and identifying the problem and solution for each layer. The result shows that the first method gives lower result compared to the second method as it gives more analyze to determine the best solution for any problem.

METHODOLOGY

ChatGPT, developed and trained by OpenAI since 2018, is an innovative and advanced language model that works by analyzing the input text and considering the context of the conversation, ChatGPT generates responses that are natural

and relevant. This feature makes it highly valuable for various applications, including answering questions generating images, and many more. The true significance of ChatGPT lies in its ability to simulate human-like conversations and produce contextually appropriate and authentic responses.^[8] This makes it an invaluable tool for businesses and organizations that aim to establish personalized and interactive communication with their customers or users.

Large language models like ChatGPT are trained on extensive amounts of text data, such as books, articles, and websites, to grasp the intricacies of language as seen in Figure 2.^[9]

By leveraging this knowledge, it can predict the next words in a sentence or suggest missing words in a given text. Consequently, they can generate answers to specific questions. These language models have a wide range of practical applications, from enhancing search engine results to generating automated responses in customer service. Moreover, they can even generate fresh text, such as news articles, product descriptions, or creative writing. During the training process, ChatGPT meticulously analyzed the provided text, comprehending the patterns and structures of language. This understanding enabled it to construct a language model capable of generating new text.

However, it is important to acknowledge that ChatGPT has certain limitations. It can still make mistakes or provide responses that lack coherence. This is because the quality of its responses is dependent on the data, it was trained on and the patterns, it has learned.^[10] Furthermore, ChatGPT may unintentionally generate biased or inappropriate responses due to the patterns it has learned from its training data. Addressing this challenge is a priority for developers, as it is a common issue faced by all AI technologies.

In computer networks, designing the network is not enough to make the network work, the main importance of the

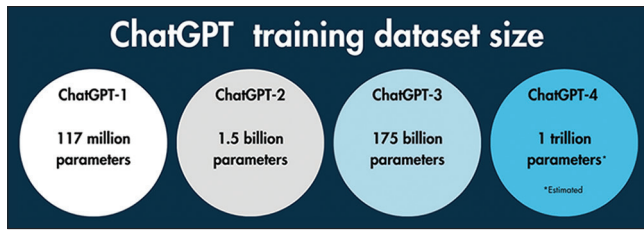


Figure 2: Shows the ChatGPT training data size^[9]

design is to write the correct configuration for each device in the network, the configuration of the network is the procedure of writing and enabling the network controls, settings, flows, and policies.^[11] Therefore, change network configuration using network simulators because real physical appliances used in networks are replaced by operating software, which makes it easier to configure and test the network before operating the real network.

To operate networks, operators must configure all devices to guarantee traffic flow through every network device; also it can enhance and support network stability and security. Moreover, the main use of command configuration tools such as ChatGPT and other AI text generators can provide benefits, such as undoing network settings and bulks to a previous configuration, automated data logging, reporting, and tracking, reduced downtime, increased maintenance efficiency and decrease network devices and connection repair time, and the ability to relaunch a device when it fails, and many more.^[12]

Since ChatGPT publicity in recent years, network engineers have thought about using ChatGPT in their daily life tasks, to make it easier for them to finish the job in less time and more accuracy. Nevertheless, using AI tasks can add complex tasks and more steps than the manual process, while in other fields it can make the task easier. Therefore, ChatGPT can be a success, rather than a threat, to network fields. It can help with network segmentation, troubleshooting, improving architecture design, and increasing the performance of the network. Modern IT networks are complex combinations of firewalls, routers, switches, servers, workstations, and other devices.^[13]

CHATGPT AI NETWORK DESIGN AND CONFIGURATION

The IT infrastructure is critical to today's enterprise networks, but it can be complex and difficult to manage, and IT teams often require specific, high-level skills to identify, troubleshoot, and solve network problems. In addition, network managers are bombarded with alerts from all angles that can be difficult to sift through and prioritize. All of this is complicated by the ongoing talent shortage of IT workers, which makes automation an urgent matter.^[14]

AI networking seeks to transform traditional IT operations and make networks more intelligent, self-adaptive, efficient, and reliable. The technology uses machine learning, deep learning, natural language processing, generative AI, and other methods to monitor, troubleshoot, and secure networks. In recent years, AI networking has automated tasks including network configuration, monitoring, and troubleshooting. This

helps to improve performance, optimize resource allocation, and reduce downtime. Tasks including configuration and incident management, software updating, and others are also automated, as are recommendations and responses.^[15]

The main design of any WAN network according to AI's ChatGPT must consist of the following devices:

- **Routers:** These devices are essential for connecting multiple networks. They handle the routing of data packets between different networks and ensure that data reaches its intended destination.
- **Switches:** Switches are used to create local area networks (LANs) within the enterprise and connect various devices within the LAN.
- **Firewalls:** Firewalls are crucial for network security and protect the network from unauthorized access, viruses, and other cyber threats. They monitor incoming and outgoing network traffic and apply security policies.
- **Virtual Private Network (VPN) Concentrators:** VPN concentrators enable secure remote access to the enterprise network. They establish encrypted connections for remote workers or branch offices to access resources within the network.
- **Load Balancers:** Load balancers distribute network traffic evenly across multiple servers or network devices, ensuring efficient utilization of resources and enhancing network performance.
- **WAN Optimization Appliances:** These devices optimize network performance and improve the utilization of WAN links by compressing data, caching, and eliminating redundant data.
- **Network Management Systems:** These systems provide centralized management and monitoring of the network. They typically include tools for configuration, monitoring, troubleshooting, and performance analysis.
- **Access Points:** Access points are required for implementing wireless connectivity within the enterprise network. They allow devices to connect wirelessly to the LAN as they are used in different types of networks.^[16]
- **Modems:** Modems are used to establish a connection to the internet or external networks. They convert digital signals from the network into analog signals for transmission over telephone lines or other mediums.
- **Network Cables and Connectors:** Ethernet cables, fiber optic cables, and connectors are necessary for connecting devices and establishing network connectivity.

Note that the specific devices required for designing a WAN enterprise network may vary depending on the specific requirements, size, and complexity of the network. It is important to assess the network requirements and consult with network engineers or experts when designing and implementing a WAN.

Therefore, according to the requirement of AI's ChatGPT network design, the following topology in Figure 3 will be constructed from the given devices.

NETWORK CONFIGURATION AND RESULT

To start the configuration of the network, a question regarding command configuration for each network device was given to ChatGPT as shown in Table 1.

Table 1: ChatGPT's questions and answers

Q. No	ChatGPT question	ChatGPT answers
1	What are the Cisco switch configurations for port security and VLAN	<p>Port Security:</p> <ol style="list-style-type: none"> 1. Enable port security on the interface: <code>`switchport port-security`</code> 2. Set the maximum number of allowed MAC addresses on the interface: <code>`switchport port-security maximum <number >`</code> 3. Specify the action to be taken when a violation occurs: <code>`switchport port-security violation <action >`</code> 4. Optionally, configure a secure MAC address on the interface: <code>`switchport port-security mac-address <mac_address >`</code> <p>Create a VLAN:</p> <ol style="list-style-type: none"> 1. <code>`vlan <vlan_id >`</code> 2. Assign an interface to a VLAN: <code>`interface <interface_name >` `switchport mode access` `switchport access vlan <vlan_id >`</code> 3. Configure a trunk port to allow multiple VLANs: <code>`interface <interface_name >` `switchport mode trunk` `switchport trunk allowed vlan <vlan_list >`</code>
2	What are the secure connection commands between two Cisco switches model 2960?	<ol style="list-style-type: none"> 1. Enable SSH (Secure Shell) for remote management: <code>`crypto key generate rsa` `ip ssh version 2`</code> 2. Configure a username and password for SSH access: <code>`username <username > privilege 15 secret <password >`</code> 3. Enable Telnet access: <code>`Line vty 0 15` `transport input ssh telnet`</code>
3	What are the commands to connect two Cisco switches model 2960 together	<ol style="list-style-type: none"> 1. Connect the switches using an Ethernet cable: <ul style="list-style-type: none"> • Plug one end of the cable into an available Ethernet port on the first switch. • Plug the other end of the cable into an available Ethernet port on the second switch. 2. Configure the interfaces on both switches: <code>`enable` `configure terminal`</code> 3. Configure the interface on the first switch: <code>`interface <interface_name >` `switchport mode trunk` `switchport trunk encapsulation dot1q` `switchport trunk allowed vlan all` `no shutdown`</code> 4. Configure the interface on the second switch: <code>`interface <interface_name >` `switchport mode trunk` `switchport trunk encapsulation dot1q` `switchport trunk allowed vlan all` `no shutdown`</code>
4	How to configure a wireless Cisco router from GUI	<ol style="list-style-type: none"> 1. Connect to the router: connect to the router wirelessly, and launch a web browser 2. Enter the router's IP address: often 192.168.1.1 or 192.168.0.1. 3. Enter login credentials: By default, the username is often "admin" and the password is either "admin" or "password." 4. Navigate the GUI: Look for sections related to wireless settings, such as "Wireless," "Wireless Settings," or "Wi-Fi." 5. Configure wireless settings: Within the wireless settings section, you can set the SSID (network name), security type (WPA2 is recommended), passphrase (password), channel selection, and other relevant options. 6. Apply and save changes: Apply and save the settings within the GUI. The router may require a reboot for the changes to take effect.
5	What are the commands to configure two Cisco routers to work as redundant routers	<p>HSRP Configuration:</p> <ol style="list-style-type: none"> 1. Enable HSRP on the interface: <code>`interface <interface_name >` `standby <group_number > ip <virtual_ip_address >`</code> 2. Specify the priority of the router (higher priority becomes the active router): <code>`standby <group_number > priority <priority_value >`</code> 3. Set the IP address of the active router: <code>`standby <group_number > preempt`</code>
6	What are the commands ASA Cisco firewall to secure and monitor traffic on wan network	<ol style="list-style-type: none"> 1. Access Control Lists (ACLs): Create an ACL to define traffic rules: <code>`access-list <acl_name > <permit/deny > <source > <destination > <protocol >`</code> 2. Apply the ACL to an interface: <code>`access-group <acl_name > in/out`</code> 3. Network Address Translation (NAT): Configure NAT for outbound traffic: <code>`nat (inside, outside) <source > <destination > <translated_address >`</code> Configure NAT exemption for specific traffic: <code>`nat (inside, outside) 0 <source > <destination >`</code> 4. Threat Detection: Enable threat detection: <code>`threat-detection basic-threat`</code> Configure threat detection settings: <code>`threat-detection <option >`</code> 5. Logging and Monitoring: Enable logging: <code>`logging enable`</code> - Set logging level: <code>`logging <level >`</code> - View logs: <code>`show logging`</code> 6. Intrusion Prevention System (IPS): Enable IPS: <code>`ips <name >`</code> Configure IPS policies: <code>`ips policy <name >`</code> Apply IPS policy to an interface: <code>`ips inline <interface >`</code> 7. Quality of Service (QoS): Configure QoS policies: <code>`qos <policy_name >`</code> Apply QoS policy to an interface: <code>`service-policy <policy_name > <interface >`</code>
TOTAL Commands		33

Table 2: ChatGPT's failure result commands

Q. No	Network device	Failure status	No non-working commands
1	Switch	Command rejected: FastEthernet0/1 is a dynamic port.	1
2	Switch	Please define a hostname other than Switch.	1
3	Switch	Invalid input detected at '^' marker.	2
4	Wireless router	All Commands Working	0
5	Router	The command should not be the same for both routers	2
6	Firewall	Invalid input detected at '^' marker.	4
TOTAL			10

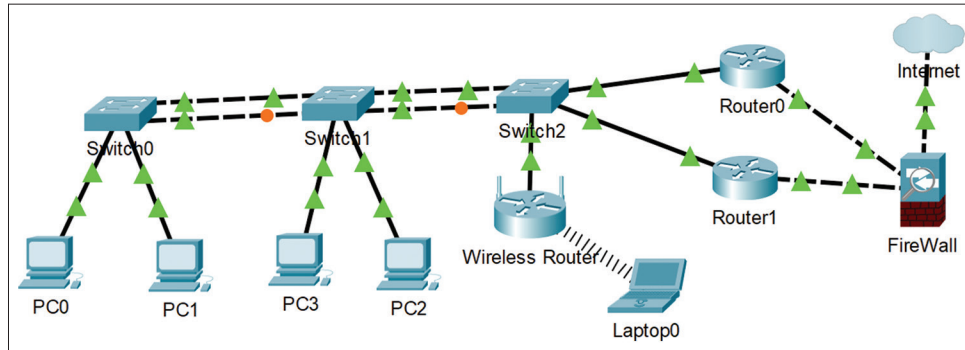


Figure 3: AI's ChatGPT network design of enterprise network

After applying all 33 commands in the simulation and testing the network devices, the following Table 2 shows the result of the failed commands.

From the above table, the total commands were 33 commands, and only 23 commands were accurately working while a total of 10 commands were not working. The efficiency rate is calculated from the below equation (1) as follows:

$$\text{Total Accuracy Percentage} = 23/33 * 100 = 69.6\% \dots \text{eq (1)}$$

Recent research done by researchers from an integrated health-care system Mass General Brigham MGB^[17] concluded that ChatGPT and AI text generator websites were accurate by about 72% in total decision generating and making, from starting with possible analyses of the scenario to generating the final management decisions. The ChatGPT performed equally well in general.

Figure 1 demonstrates the success/failure commands for all network devices used in the topology, as it can be shown that the most accuracy was with basic devices (wireless router) that need minimum commands to test and run, as the devices get more complicated the accuracy drop down and more unsuitable commands was suggested, switches had more wrong commands as they require accurate and dynamic commands to be used. Figure 4 shows ChatGPT Success/failure commands for each device.

Figure 5 shows that the efficiency of working commands for all network devices is between 33% and 100 % as the devices get more complicated, they need more experience in writing the commands the accuracy drops down.

The total efficiency for designing a network with ChatGPT is shown in Figure 6, as stated in eq (1), the calculated efficiency is about 69.6%. Which is not suitable for running a

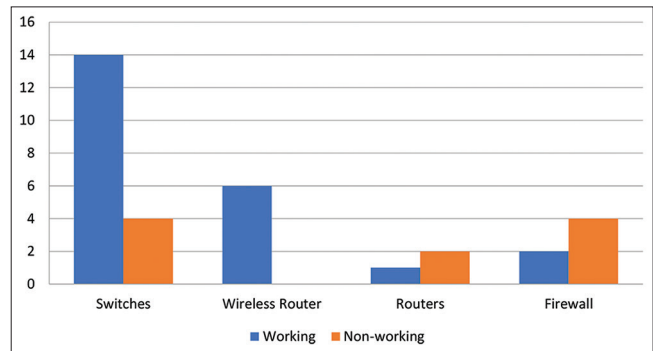


Figure 4: ChatGPT Success/failure commands for each device

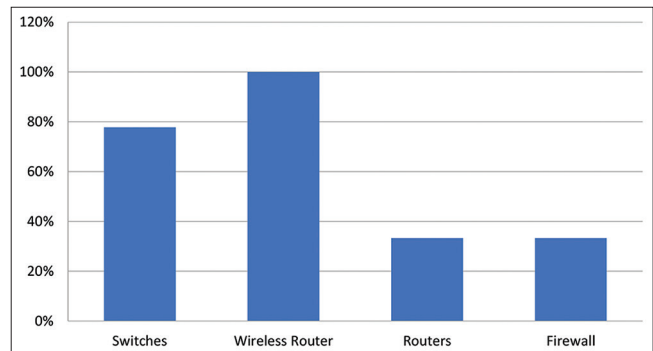


Figure 5: ChatGPT's working efficiency

fully secure network, as for security systems, 99% availability may be nowhere near good enough to be online; therefore, more training may increase the efficiency of ChatGPT decision-making as found in.^[18]

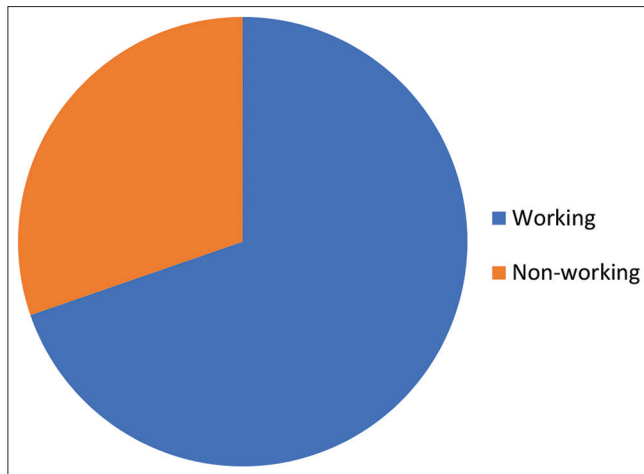


Figure 6: ChatGPT's total efficiency

CONCLUSION

The AI-changing technology is stirring many industries toward a better future very rapidly. However, the effect of AI in all work fields has not yet been tested. In this comprehensive paper on how ChatGPT could be used in network design and decision-making, a hypothesis tested that ChatGPT would be able to automate network commands, and ultimately make the final diagnosis.

The result shows that tools like ChatGPT can be integrated to be used in designing a network, but not fully automated and secured. The accuracy of generating the right commands is about 69% which is considered not good for enterprise networks that require an accuracy rate above 90%.

As for future work, AI model algorithms can be learned and tested for more data, and the output of AI can be separated from the original training data. Therefore, it truly controls and enhances the data and its value; therefore, more data must be generated and tested with more advanced techniques.

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