

# IP Shuffle: Random IP Address Assignment for Network Interfaces

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## Abstract

This paper introduces a Bash script designed to dynamically assign a random IP address to a computer's network interface. The script generates a random IP address within a specified range, checks its availability, and ensures proper configuration. It achieves efficient and reliable IP address assignment through distinct functions for IP address generation, availability verification, network configuration validation, and gateway reachability testing. The IP-shuffle script provides a practical solution for scenarios that require dynamic IP address allocation and streamlining network management processes. Its robustness is further enhanced by comprehensive error handling and compatibility with Linux and BSD systems.

## 1 Introduction

The Moving Target Defense (MTD) technique we're working towards is IP shuffling, aimed at complicating lateral movement reconnaissance. This strategy involves dynamically changing the IP addresses of systems on a network. In our model, we have a private subnet containing three virtual machines that perform IP address rotation, periodically or erratically shifting across 254 different IP addresses. Our diagram illustrates a scenario where one of these machines, denoted as Computer 2, has been compromised. By continuously changing IP addresses in an unpredictable manner, IP shuffling impedes attackers' reconnaissance efforts, making it difficult for them to identify and exploit vulnerabilities. The diagram delineates the intricate architecture of our network infrastructure, illustrating the hierarchical arrangement of networks, subnets, and their corresponding topological relationships. Within this schematic representation, the compromised computer is depicted, providing a visual reference to its position within the broader network.

## 2 Threat Background

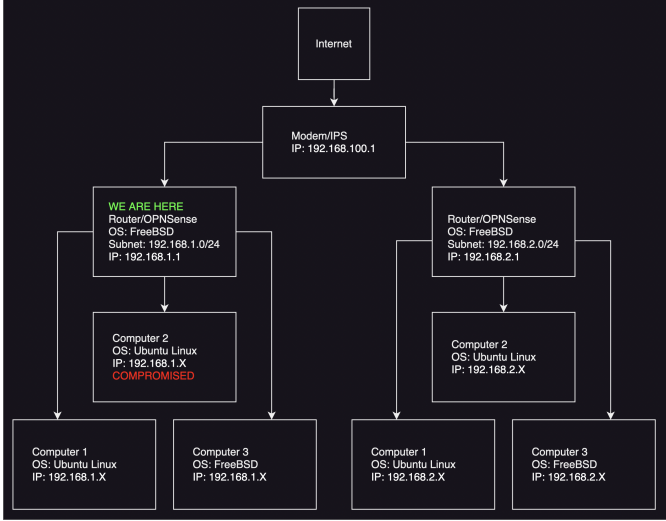
In the realm of network security, Moving Target (MT) techniques have gained significant traction. These techniques operate across various facets of computer systems, aiming to alter elements susceptible to exploitation by potential attackers. Dynamic IP address assignment, as employed in IP shuffling, emerges as a prominent example when considering the application of MT techniques in network defense strategies. By dynamically changing IP addresses, network interfaces can obscure targets from potential attackers, making it more challenging for them to identify and exploit vulnerabilities. This proactive approach aligns with the broader goals of MT techniques, which prioritize enhancing system resilience against cyber threats. While certain MT techniques like Address Space Layout Randomization (ASLR) have achieved widespread adoption in modern operating systems, implementing IP shuffling provides an additional layer of defense that can complement existing security measures. By adopting IP shuffling and other MT techniques, organizations can strengthen their overall security posture and mitigate the impact of cyber threats. For instance, dynamically changing IP addresses, randomizing memory layouts, and employing temporary encryption for memory contents fall within the spectrum of MT techniques [2].

## 3 System Design

The IP-shuffle script offers a systematic approach to dynamic IP address assignment for network interfaces in Linux and FreeBSD environments. Built around Bash scripting, it seamlessly orchestrates the IP address allocation process. By default, the program runs every 3 minutes, based on the provided cronjob. During execution, the script dynamically configures the IP address, gateway, network interface details, and other parameters, providing a flexible framework for network configuration. Through dedicated functions such as

```
generate_random_ip (),
```

Figure 1: Network Topology Diagram



```
check_ip_availability(),
and validate_network_config(),
```

the script ensures that the assigned IP addresses are compatible with the network infrastructure. It also incorporates error-trapping mechanisms and support for common Unix signals to enhance reliability and resilience, safeguarding against potential errors or interruptions. The script's flexibility is maintained through adherence to modular design principles, allowing seamless adaptation to diverse network configurations and environments. However, since the IP addresses are not persistent after a reboot for DHCP-configured machines, the script includes functions like `reset_network()` for error recovery. The IP-shuffle script encapsulates a robust solution for automating network interface configuration tasks, embodying a sophisticated yet accessible approach to dynamic IP address management.

## 4 Evaluation

This is our evaluation.

## 5 Conclusion

Moving Target Defense (MTD) is proposed as one of the "game-changing" themes in cybersecurity. Its vision is described as follows: to create, evaluate, and deploy mechanisms and strategies that are diverse, continually shifting, and changing over time to increase complexity and costs for attackers, limit the exposure of vulnerabilities and opportunities for attack, and increase system resiliency [1]. The IP-shuffle script provides a robust solution for dynamically allocating random IP addresses to network interfaces, a critical component of network security strategies to deter potential attack-

ers. Leveraging Bash scripting, it offers functionalities for generating IP addresses, checking availability, and validating network configurations, ensuring efficient and reliable IP address assignment. Its error-handling capabilities and responsiveness to Unix signals improve reliability during execution, strengthening network resilience against errors or disruptions. Additionally, its modular design allows for easy adaptation to different network setups and environments, making it a valuable tool for automating tasks related to network interface configuration. Furthermore, IP-shuffle embodies the concept of IP shuffling, a technique designed to complicate attackers' reconnaissance efforts by constantly changing IP addresses unpredictably. By dynamically assigning random IP addresses, IP-shuffle enhances organizations' proactive defense stance, increasing the difficulty for attackers to identify and exploit vulnerabilities. In essence, IP-shuffle represents a sophisticated yet user-friendly approach to managing dynamic IP addresses, empowering organizations to enhance their overall security posture and mitigate the impact of cyber threats.

## References

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- [2] Hamed Okhravi, Thomas Hobson, David Bigelow, and William Streilein. Finding focus in the blur of moving-target techniques. *IEEE Security & Privacy*, 12(2):16–26, 2013.