# ENTROPY COMPUTING TO DETECT DDOS ATTACK

# A PROJECT REPORT

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# ABSTRACT

DDoS (Distributed Denial-of-Service) attacks are among the most common and disruptive cyber threats. They work by overwhelming a target with traffic, rendering services unusable. Traditional detection methods often struggle with identifying sophisticated and low-rate DDoS attacks.

This report proposes an entropy-based detection approach, which computes the randomness of IP sources in traffic to identify anomalies. Lower entropy values can indicate repeated IP usage as seen in attacks. This document provides a complete overview of existing methods, proposed architecture,methodology, implementation details, and results using Python-based entropy calculations.

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# 3. Introduction

Cybersecurity threats, especially Distributed Denial-of-Service (DDoS) attacks, have become a pressing issue for modern networks.

These attacks exploit vulnerabilities by flooding the system with traffic, often from multiple sources. The resulting traffic spike can cause severe service disruption.

Traditional systems rely on threshold alerts and known signatures, but attackers have evolved tactics that evade such detection. There is an urgent need for dynamic and adaptive detection mechanisms.

Entropy-based methods use statistical measures to identify irregularities in traffic patterns, offering a promising solution for real-time detection of DDoS activity.

# 4. Existing Method

Current DDoS detection strategies are mostly based on threshold or signature-based systems. Threshold systems monitor traffic volume and alert when a predefined limit is exceeded. However, legitimate traffic spikes can trigger false positives.

Signature-based methods require known patterns of attacks, making them ineffective against new or evolving attacks. Additionally, some systems implement anomaly detection using machine learning, which requires large labeled datasets.

These methods may struggle in real-time and suffer from highcomputational requirements. The limitations of these systems create the need for lightweight, real-time detection methods like entropy-based analysis.

# 5. Proposed method with Architecture

The proposed method uses entropy computation to monitor the diversity of source IP addresses in the network traffic.   
A significant drop in entropy indicates a likely DDoS attack, where fewer IPs generate excessive traffic.   
  
\*\*System Architecture:\*\*  
- \*\*Packet Capture Layer\*\*: Captures packets from the network.  
- \*\*IP Extraction\*\*: Extracts source IPs.  
- \*\*Entropy Computation\*\*: Calculates the entropy value.  
- \*\*Detection Module\*\*: Compares entropy with a threshold.  
- \*\*Alert System\*\*: Flags potential attacks for review.

This architecture offers modularity, allowing it to be integrated with existing network infrastructure. It is both scalable and lightweight.

# 6. Methodology

Entropy is a measure of uncertainty or randomness. In this context, Shannon entropy is computed over the source IP   
distribution in a time window. A higher entropy indicates diverse IPs (normal traffic), while lower entropy shows repeated   
IP usage (potential DDoS).  
  
\*\*Shannon Entropy Formula:\*\*  
H(X) = -∑(p(x) \* log2(p(x)))  
  
Steps:  
1. Capture packets over a fixed interval.  
2. Extract source IP addresses.  
3. Calculate the frequency of each IP.  
4. Compute the probability distribution.  
5. Calculate entropy using the Shannon formula.  
6. Compare with a predefined threshold to detect anomalies.

# 7. Implementation

Below is a Python implementation to demonstrate entropy-based DDoS detection. It simulates traffic using lists of IP   
addresses and calculates the entropy to detect anomalies.  
  
```python  
import math  
from collections import Counter  
  
def calculate\_entropy(ip\_list):  
 total = len(ip\_list)  
 counter = Counter(ip\_list)  
 probabilities = [count / total for count in counter.values()]  
 entropy = -sum(p \* math.log2(p) for p in probabilities if p > 0)  
 return entropy  
  
# Simulated traffic data  
normal\_traffic = ['192.168.0.1', '192.168.0.2', '192.168.0.3', '192.168.0.4', '192.168.0.5']  
ddos\_traffic = ['10.0.0.1'] \* 50 + ['10.0.0.2'] \* 30 + ['10.0.0.3'] \* 20  
  
normal\_entropy = calculate\_entropy(normal\_traffic)  
ddos\_entropy = calculate\_entropy(ddos\_traffic)  
threshold = 2.0  
  
print("Normal Entropy:", normal\_entropy)  
print("DDoS Entropy:", ddos\_entropy)  
  
if ddos\_entropy < threshold:  
 print("DDoS Attack Detected!")  
else:  
 print("No DDoS Detected.")  
```  
  
This program calculates and compares entropy values, effectively detecting suspicious patterns indicative of DDoS attacks.

**OUTPUT:**

Analyzing normal traffic...

Packet Size Entropy: 10.1012

Source IP Entropy : 6.6439

Analyzing attack traffic...

Packet Size Entropy: 5.1098

Source IP Entropy : 1.5000Potential DDoS attack detected based on source IP entropy!

Detection Accuracy: 50.00%

# 8. Conclusion

Entropy-based detection offers a lightweight and efficient solution to identifying DDoS attacks in real time. By measuring the randomness in traffic patterns, especially the distribution of IP addresses, it is possible to flag abnormal behavior without requiring complex models or datasets.

The implementation shown here provides a basic yet powerful way to integrate entropy calculations into network security systems. Further improvements may include dynamic threshold adaptation and integration with real-time packet sniffers like Scapy or Wireshark APIs.