IDS , IPS , FIREWALL & HONEYPOT

IDS, IPS, Firewall, and Honeypot: Detailed Explanation

1. Intrusion Detection System (IDS)

1.1 What is IDS?

An **Intrusion Detection System (IDS)** is a security technology designed to monitor network or system activities for malicious activities or policy violations. It detects suspicious behavior and alerts administrators but does **not** block or prevent the activity.

1.2 Types of IDS

- **Network-based IDS (NIDS):** Monitors network traffic for suspicious patterns.
  - Example: Snort, Suricata.
- **Host-based IDS (HIDS):** Monitors activities on a specific host or device.
  - Example: OSSEC, Tripwire.

1.3 Detection Methods

- **Signature-based Detection:** Compares network traffic or system activity against a database of known attack signatures.
  - Pros: Accurate for known threats.
  - Cons: Cannot detect zero-day or unknown attacks.
- **Anomaly-based Detection:** Establishes a baseline of normal behavior and flags deviations.
  - Pros: Can detect unknown attacks.

- Cons: Higher false positive rate.

1.4 IDS Workflow

1. Capture network packets or system logs.
2. Analyze data using detection methods.
3. Generate alerts on suspicious activity.
4. Log events for further analysis.

1.5 Use Cases

- Monitoring network traffic for attacks.
- Detecting unauthorized access or policy violations.
- Forensic analysis after incidents.

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2. Intrusion Prevention System (IPS)

2.1 What is IPS?

An **Intrusion Prevention System (IPS)** is an extension of IDS that not only detects but also **actively blocks or prevents** detected malicious activities in real-time.

2.2 Types of IPS

- **Network-based IPS (NIPS):** Monitors and blocks malicious network traffic.
- **Host-based IPS (HIPS):** Monitors and blocks malicious activities on a host.

2.3 IPS Capabilities

- Drop malicious packets.
- Reset connections.
- Block offending IP addresses.
- Integrate with firewalls and other security devices.

2.4 IPS vs IDS

Feature	IDS	IPS
Action	Detects and alerts	Detects and blocks
Placement	Passive (out-of-band)	Inline (in-band)
Impact on Traffic	No impact	Can introduce latency
Use Case	Monitoring and alerting	Active defense

2.5 Use Cases

- Real-time blocking of attacks.
- Automated response to threats.
- Reducing false positives by immediate action.

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3. Firewall

3.1 What is a Firewall?

A **Firewall** is a network security device or software that monitors and controls incoming and outgoing network traffic based on predetermined security rules. It acts as a barrier between trusted and untrusted networks.

3.2 Types of Firewalls

- **Packet Filtering Firewall:** Inspects packets based on IP addresses, ports, and protocols.
- **Stateful Inspection Firewall:** Tracks the state of active connections and makes decisions based on context.
- **Proxy Firewall:** Intercepts and inspects traffic at the application layer.
- **Next-Generation Firewall (NGFW):** Combines traditional firewall with IDS/IPS, application awareness, and deep packet inspection.

3.3 Firewall Functions

- Allow or block traffic based on rules.
- NAT (Network Address Translation).
- VPN support.
- Logging and alerting.

3.4 Firewall Rules Example

Source IP	Destination IP	Protocol	Port	Action
Any	192.168.1.10	TCP	80	Allow
Any	Any	ICMP	Any	Block

3.5 Use Cases

- Enforcing network segmentation.
- Protecting internal networks from external threats.
- Controlling access to services.

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4. Honeypot

4.1 What is a Honeypot?

A **Honeypot** is a decoy system or resource designed to attract attackers, detect unauthorized access, and study attack methods. It appears as a legitimate target but is isolated and monitored.

4.2 Types of Honeypots

- **Low-Interaction Honeypots:** Simulate limited services or vulnerabilities.
  - Easier to deploy, less risk.
- **High-Interaction Honeypots:** Fully functional systems that allow attackers to interact extensively.
  - Provide detailed intelligence but higher risk.

4.3 Honeypot Purposes

- Detect and analyze attack techniques.
- Divert attackers from real assets.
- Collect threat intelligence.
- Improve security defenses.

4.4 Honeypot Deployment

- Placed in DMZ or isolated network segments.

- Monitored continuously.
- Logs and alerts are analyzed for attacker behavior.

4.5 Honeypot vs Honeynet

- **Honeynet:** A network of honeypots designed to simulate a real network environment.

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5. Comparison and Integration

Feature	IDS	IPS	Firewall	Honeypot
Primary Function	Detect intrusions	Detect and prevent intrusions	Control traffic flow	Attract and analyze attackers
Traffic Handling	Passive	Inline	Inline	Passive
Action	Alert	Block/Prevent	Allow/Block	Monitor and log
Deployment	Network or Host	Network or Host	Network or Host	Isolated or DMZ
Use Case	Monitoring and alerting	Active defense	Access control	Threat intelligence

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6. Practical Considerations in Penetration Testing

- **IDS/IPS Testing:** Verify detection and prevention capabilities by simulating attacks.
- **Firewall Testing:** Assess rule effectiveness, bypass techniques, and logging.
- **Honeypot Deployment:** Use honeypots to study attacker behavior and gather intelligence.
- **Avoid Disruption:** Test in controlled environments or with explicit permission.
- **Logging and Reporting:** Collect and analyze logs for comprehensive reports.

Hands-On Practical Guide: IDS, IPS, Firewall, and Honeypot

1. Intrusion Detection System (IDS) Hands-On

Tool: Snort (Network-based IDS)

Setup and Installation (Ubuntu/Debian)

```
bashCopy
sudo apt update
sudo apt install snort
```

- During installation, configure the network interface to monitor (e.g., eth0).
- Default config file: `/etc/snort/snort.conf`

Basic Usage

- Run Snort in IDS mode (packet capture and alert):

```
bashCopy
sudo snort -A console -q -c /etc/snort/snort.conf -i eth0
```

- `A console`: Alerts to console.
- `q`: Quiet mode (less verbose).
- `c`: Config file.
- `i`: Interface.

Testing IDS

- From another machine, run a simple port scan:

```
bashCopy
nmap -sS <snort_machine_ip>
```

- Snort should detect and alert on suspicious scan activity.

Customize Rules

- Add custom rules in `/etc/snort/rules/local.rules`:

Example rule to detect ping:

```
Copy
alert icmp any any -> any any (msg:"ICMP Packet Detected"; sid:1000001; r
ev:1;)
```

- Reload Snort to apply changes.

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2. Intrusion Prevention System (IPS) Hands-On

Tool: Snort in Inline Mode or Suricata

Snort Inline Mode Setup

- Requires enabling inline mode and running Snort between network segments.

Example command:

```
bashCopy
sudo snort -Q --daq afpacket -c /etc/snort/snort.conf -i eth0
```

- `Q`: Inline mode.
- `-daq afpacket`: Use AF_PACKET for inline packet capture.

Testing IPS

- Run a SYN flood attack from attacker machine:

```
bashCopy
sudo hping3 -S --flood -p 80 <ips_machine_ip>
```

- IPS should detect and drop malicious packets.

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3. Firewall Hands-On

Tool: iptables (Linux Firewall)

Basic Commands

- List current rules:

```
bashCopy
sudo iptables -L -v
```

- Block incoming ICMP (ping) requests:

```
bashCopy
sudo iptables -A INPUT -p icmp --icmp-type echo-request -j DROP
```

- Allow HTTP traffic:

```
bashCopy
sudo iptables -A INPUT -p tcp --dport 80 -j ACCEPT
```

- Save rules (Ubuntu):

```
bashCopy
sudo iptables-save > /etc/iptables/rules.v4
```

Testing Firewall

- From another machine, try to ping the firewall machine (should be blocked).
- Try accessing HTTP service (should be allowed).

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4. Honeypot Hands-On

Tool: Cowrie (SSH and Telnet Honeypot)

Installation (Ubuntu)

```
bashCopy
sudo apt update
sudo apt install git python3-virtualenv python3-pip libssl-dev libffi-dev buil
```

```
d-essential libpython3-dev python3-minimal authbind
git clone https://github.com/cowrie/cowrie.git
cd cowrie
virtualenv --python=python3 cowrie-env
source cowrie-env/bin/activate
pip install --upgrade pip
pip install -r requirements.txt
```

Configuration

- Edit `cowrie.cfg` to set listening ports (default SSH 2222).
- Use `authbind` to allow non-root binding to port 22 if needed.

Running Cowrie

```
bashCopy
bin/cowrie start
```

Testing Honeypot

- From attacker machine, connect via SSH:

```
bashCopy
ssh -p 2222 user@<cowrie_ip>
```

- Cowrie logs all commands and interaction in `cowrie/var/log/cowrie/`.

Summary Table

Technology	Tool	Key Commands/Steps	Testing Method
IDS	Snort	`snort -A console -q -c /etc/snort/snort.conf -i eth0`	Run nmap scan to trigger alerts
IPS	Snort (inline) / Suricata	`snort -Q --daq afpacket -c /etc/snort/snort.conf -i eth0`	Run SYN flood with hping3
Firewall	iptables	`iptables -A INPUT -p icmp --icmp-type echo-request -j DROP`	Ping test blocked, HTTP allowed

Technology	Tool	Key Commands/Steps	Testing Method
Honeypot	Cowrie	`bin/cowrie start`	SSH connection to honeypot port

Additional Tips

- Always run these tools in isolated lab environments.
- Monitor logs continuously during tests.
- Adjust configurations to reduce false positives.
- Document all findings and behaviors.

Expanded Hands-On and Practical Insights: IDS, IPS, Firewall, and Honeypot

1. Intrusion Detection System (IDS) — Advanced Practical Insights

1.1 Deep Dive into Snort Configuration

- **Rule Management:**
  - Snort uses rule files to detect threats. Rules are written in a specific syntax describing patterns to match.
  - Rules are organized in `/etc/snort/rules/` and include categories like `exploit.rules`, `dos.rules`, `policy.rules`.
  - Customize rules to reduce false positives by tuning thresholds and specifying IP ranges.
- **Preprocessors:**
  - Snort preprocessors analyze traffic before detection, e.g., HTTP normalization, TCP stream reassembly.
  - Enable preprocessors in `snort.conf` to improve detection accuracy.
- **Output Plugins:**

- Snort supports multiple output formats: unified2 (for SIEM integration), syslog, database logging.
- Integrate Snort with tools like **Barnyard2** to forward alerts to SIEMs (e.g., Splunk, ELK).

1.2 Practical Exercise: Detecting a Web Attack

- Use **OWASP ZAP** or **Burp Suite** to simulate web attacks (SQLi, XSS) against a test web server.
- Monitor Snort alerts for HTTP anomalies.
- Adjust Snort rules to detect specific payloads.

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2. Intrusion Prevention System (IPS) — Advanced Practical Insights

2.1 Suricata as an IPS

- Suricata is a modern IDS/IPS with multi-threading and protocol parsing.
- Install Suricata:

```
bashCopy
sudo apt install suricata
```

- Run Suricata in inline mode with NFQUEUE:

```
bashCopy
sudo suricata -c /etc/suricata/suricata.yaml -q 0
```

- Configure iptables to send packets to NFQUEUE:

```
bashCopy
sudo iptables -I INPUT -j NFQUEUE --queue-num 0
```

2.2 Practical Exercise: Blocking Malicious Traffic

- Launch a SYN flood or port scan.
- Observe Suricata dropping packets and generating alerts.

- Tune Suricata rules to balance detection and false positives.

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3. Firewall — Advanced Practical Insights

3.1 Using nftables (Modern Linux Firewall)

- `nftables` replaces `iptables` with a more flexible syntax.
- Example: Block SSH from specific IP range

```
bashCopy
sudo nft add table inet filter
sudo nft add chain inet filter input { type filter hook input priority 0 \; }
sudo nft add rule inet filter input ip saddr 192.168.1.0/24 tcp dport 22 drop
```

3.2 Stateful vs Stateless Rules

- Stateful firewalls track connection states (NEW, ESTABLISHED).
- Example: Allow established connections only

```
bashCopy
sudo iptables -A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
```

3.3 Practical Exercise: Create a DMZ

- Use firewall rules to isolate a web server in a DMZ.
- Allow only HTTP/HTTPS from outside, restrict other ports.
- Test access from internal and external networks.

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4. Honeypot — Advanced Practical Insights

4.1 Cowrie Customization

- Modify `cowrie.cfg` to emulate different SSH banners or fake file systems.
- Enable **Telnet** honeypot to attract IoT botnets.
- Integrate Cowrie logs with ELK stack for visualization.

4.2 Deploying a Honeynet

- Set up multiple honeypots simulating a network.
- Use **Honeyd** to create virtual hosts with different OS fingerprints.
- Monitor attacker lateral movement and tactics.

4.3 Practical Exercise: Analyze Attacker Behavior

- Deploy Cowrie and Honeyd.
- Attract attackers by exposing honeypot IPs.
- Analyze logs for common attack patterns, brute force attempts, and malware uploads.

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5. Integration and Automation

5.1 SIEM Integration

- Forward IDS/IPS/firewall logs to SIEM platforms (Splunk, ELK, QRadar).
- Correlate events for comprehensive threat detection.

5.2 Automated Response

- Use **Security Orchestration, Automation, and Response (SOAR)** tools.
- Automate blocking IPs on firewall or IPS based on IDS alerts.

5.3 Continuous Monitoring

- Set up dashboards for real-time monitoring.
- Schedule regular rule updates and system audits.

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6. Real-World Penetration Testing Tips

- **Test Detection:** Run stealthy scans and attacks to test IDS/IPS sensitivity.
- **Bypass Techniques:** Try fragmentation, encryption, or protocol evasion to bypass firewalls and IDS.
- **Log Analysis:** Review logs for missed detections or false positives.

- **Report Findings:** Document gaps and recommend tuning or additional controls.