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Author: Ruby Girjashankar kannaujiya Intern ID:-309

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Tools POC Report – Binwalk & Foremost

🛠 Tool Name: Binwalk

History:

Binwalk was developed by the ReFirm Labs team to aid in reverse-engineering firmware images. It's widely used by security researchers, especially in embedded systems.

Description:

Binwalk is an open-source tool used to analyze, extract, and reverse-engineer firmware images. It scans binary files for embedded file systems and other data using signature analysis.

What Is This Tool About?

Binwalk extracts files or data embedded within firmware images. It is essential in digital forensics, malware analysis, and embedded security research.

Key Characteristics / Features:

1. Scans binary images for embedded files
2. Supports entropy analysis
3. Extracts file systems (e.g., SquashFS, JFFS2)
4. Custom signature support
5. Fast and accurate matching

6. Integrates with gzip, tar, lzma, etc.
7. Useful for reverse-engineering
8. Command-line interface
9. Plugin extensibility
10. Works on Linux/macOS

Types / Modules Available:

- Signature Analysis Module
- Extraction Module
- Entropy Analysis
- Plugin Support
- Recursive Extraction

How Will This Tool Help?

- Extracts hidden firmware content
- Speeds up forensic analysis of IoT devices
- Helps discover malware in firmware
- Supports embedded systems reverse engineering

15-Liner Summary:

1. Scans binary files
2. Firmware reverse-engineering
3. CLI based, fast
4. Plugin support
5. Linux/macOS compatible
6. File carving
7. Detects compression/encryption
8. Recursive extraction
9. Open-source
10. Forensics-friendly
11. Embedded file system detection
12. Bulk extraction
13. Malware investigation aid
14. Saves time in analysis
15. Easy automation

⏱Time to Use / Best Case Scenarios:

- During firmware analysis
- After embedded system acquisition
- While auditing IoT devices
- During malware investigation in devices

When to Use During Investigation:

- Post device seizure
- While profiling IoT threats
- When investigating smart devices
- After firmware dump extraction

Best Person to Use & Required Skills:

User: Embedded Security Researcher / Forensic Analyst
Skills:

- Linux command-line
- Firmware structure knowledge
- Basic file systems
- Forensics awareness

Flaws / Suggestions to Improve:

- No GUI interface
- May not support proprietary formats
- Needs better visualization
- Doesn't detect encrypted partitions
- Output could be more readable

✅ Good About the Tool:

- Lightweight and fast

- Very accurate
- Highly automatable
- Great for reverse engineering
- Open-source with community support

🛠 Tool Name: Foremost

History:

Foremost was developed by the U.S. Air Force Office of Special Investigations and the Naval Postgraduate School for file recovery in digital forensics.

📄 Description:

Foremost is a command-line program used to recover deleted files from raw disk images using file headers and footers. It is powerful in forensic recovery.

What Is This Tool About?

Foremost scans disks for known byte patterns of file headers/footers and reconstructs deleted or lost files — even from damaged drives.

Key Characteristics / Features:

1. File carving based on headers/footers
2. Recovers deleted data
3. Works without needing file system structure
4. CLI interface
5. Lightweight and fast
6. Supports JPG, PNG, PDF, DOC, ZIP, etc.
7. Generates recovery logs
8. Very accurate pattern matching
9. Configurable via `foremost.conf`
10. Works on Linux

Types / Modules Available:

- File Carving Module
- Configuration File Module
- Logging & Output Module

How Will This Tool Help?

- Recovers lost or deleted files
- Works on disk images, memory cards, USBs
- Useful in law enforcement and cybercrime
- Doesn’t rely on file system integrity

15-Liner Summary:

1. CLI-based file recovery
2. Carves files from raw images
3. Lightweight tool
4. Works on Linux
5. Easy config file
6. Fast scan & extract
7. No need for file system
8. Recovers photos/docs/zips
9. Used in forensics
10. Output with logs
11. No installation needed
12. Effective on corrupted data
13. Open-source
14. Trusted by experts
15. Great for deep data recovery

Time to Use / Best Case Scenarios:

- After accidental deletion
- Post-drive format
- Memory card recovery
- USB and disk corruption

When to Use During Investigation:

- File recovery from seized devices
- Inspecting formatted drives
- Child protection cases
- Cybercrime involving hidden data

Best Person to Use & Required Skills:

User: Forensics Investigator / Data Recovery Specialist
Skills:

- Linux terminal usage
- File header structure understanding
- Disk image analysis

Flaws / Suggestions to Improve:

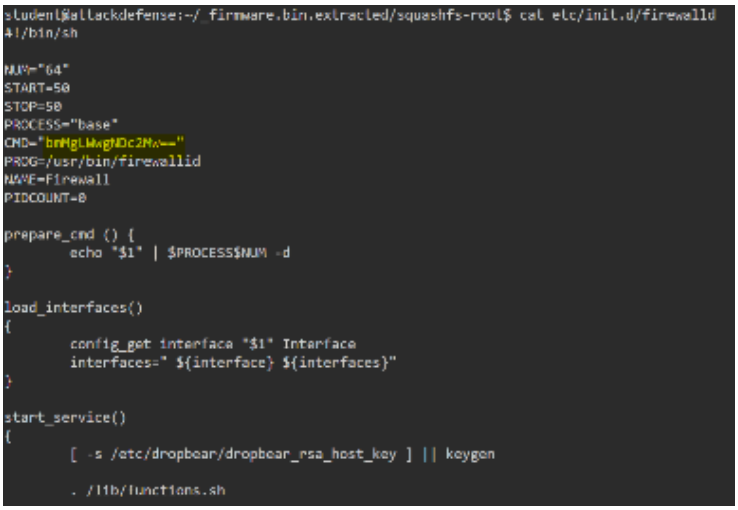
- No GUI
- Doesn’t support encrypted recovery
- Might miss fragmented files
- Basic configuration
- Limited to known file types

✅ Good About the Tool:

- Open-source and free
- Reliable in recovery
- Lightweight
- Fast scanning
- Simple usage

Binwalk in Action

Figure 1: Firmware Extraction Using Binwalk



This screenshot shows the **Binwalk tool scanning a firmware binary image**. The terminal output reveals recognized embedded file systems and data types like gzip, squashfs, or ELF binaries. It also auto-extracts the files into separate folders for detailed investigation, making it easier for analysts to reverse-engineer embedded software or find suspicious components.

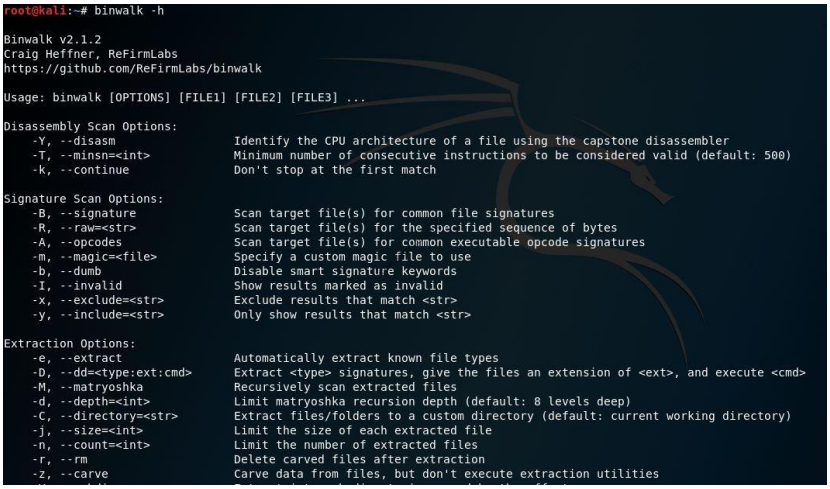
Entropy Analysis with Binwalk

Figure 2: Entropy Graph of Firmware Regions

The entropy graph generated by Binwalk visually represents regions of **high entropy**, often indicating compressed or encrypted data. This helps investigators quickly focus on areas that may contain obfuscated or sensitive files such as malware payloads or encrypted configurations.

Foremost CLI Usage

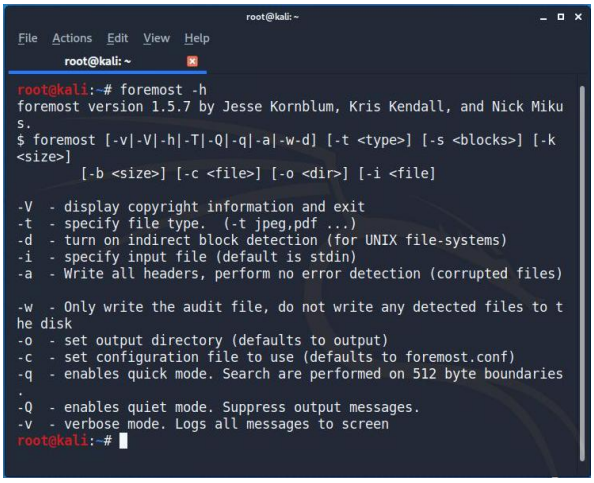
Figure 3: Foremost Command-Line Help Output



This image displays the `foremost -h` command output, listing all available options. It highlights supported file types, configuration flags, and output settings. This quick reference is essential for forensic investigators who rely on **Foremost's accuracy in recovering deleted files** from raw disk images.

📁 Recovered Files Using Foremost

Figure 4: Directory View of Carved Files



After executing Foremost, recovered files are automatically saved in categorized folders (e.g., `jpg`, `pdf`). This screenshot shows a typical output directory after carving files from a USB or disk image. It demonstrates **Foremost's usefulness in recovering evidence from deleted or corrupted data sources**.

Sample Use Case:

Scenario:
A cybersecurity team is handed a suspicious firmware dump from a smart doorbell suspected to be leaking user data.

- They first use **Binwalk** to extract the embedded file system and identify suspicious scripts.
- Then, they use **Foremost** to **carve deleted image and document files** from the raw memory of the firmware to check for evidence of stored logs or user images.

✅ Both tools help reconstruct the attacker's trail and present valid forensic evidence.

Comparison – Binwalk vs. Foremost:

Feature	Binwalk	Foremost
Tool Type	Firmware analysis & extraction	File recovery from raw images
Usage Level	Intermediate to Advanced	Beginner to Intermediate
Interface	CLI	CLI
Best For	Embedded devices, firmware	Disk/memory file carving

Feature	Binwalk	Foremost
Output Format	Extracted folders, logs	Recovered files + logs
Speed	Fast	Fast
Extensibility	Plugin support	Config file based
GUI Support	❌	❌
Forensics Role	Reverse engineering	Data recovery

Real-World Applications:

🔹 Binwalk:

- Analyzing firmware in **IoT devices** for hidden malware
- Auditing embedded systems in **cybersecurity firms**
- Used in **vulnerability research labs**

🔹 Foremost:

- Recovering deleted files in **child exploitation cases**
- Used by **law enforcement** to inspect suspect USB drives
- Helps in **accidental data recovery** and **evidence collection**

Why Use Both Together?

Using Binwalk and Foremost in **combination** gives forensic analysts a powerful edge:

- Binwalk uncovers structured embedded data (e.g., scripts, configs)
- Foremost recovers **hidden/deleted** files that Binwalk might miss

Together, they provide both surface and deep-dive insights into suspicious digital evidence.

✅ Conclusion:

Binwalk and Foremost are essential tools in the **digital forensics toolkit**. While Binwalk is ideal for analyzing firmware and embedded content, Foremost excels in recovering deleted files from raw storage. Their combined usage can significantly **enhance the accuracy and depth of any investigation**.