



Cloud

How Malicious Actors Abuse Native Linux Tools in Attacks

Through our honeypots and telemetry, we were able to observe instances in which malicious actors abused native Linux tools to launch attacks on Linux environments. In this blog entry, we discuss how these utilities were used and provide recommendations on how to minimize their impact.

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Introduction

Container adoption has become mainstream, with usage having risen across organizations globally. Based on a **survey from CNCF**, 93% of respondents are currently using or planning to use containers in their production. Container orchestration projects like Kubernetes and other tools available in the cloud and across the internet has led to a wave of transformations in how organizations operate, from monolithic architectures to the creation of distributed systems consisting of microservices.

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Business



deployments. **Cloud security** is further complicated by the fact that patch management can often be an enormous undertaking for organizations, which means that updates are not always implemented in a timely manner.

When it comes to public-facing web applications, we have been observing critical vulnerabilities arising from a wide range of sources, ranging from vulnerable open-source libraries (**Log4Shell** and **Spring4Shell**) to frameworks (**Apache Struts** and **Drupal**), and even applications such as **Atlassian Confluence**, **Oracle WebLogic Server**, and **Apache HTTP Server**. Once proof-of-concepts (POCs) for vulnerabilities are disclosed, attackers can exploit them to perform malicious tasks from mining cryptocurrency to, at times, deploying **ransomware**.

From the perspective of a defender, the ideal outcome would be to prevent the attacker from even gaining an initial foothold. However, this isn't what always the case. If an attacker does manage to enter the system, it is the defender's job to make it more difficult for attackers to successfully pull off their routines by **using defense-in-depth strategies**.

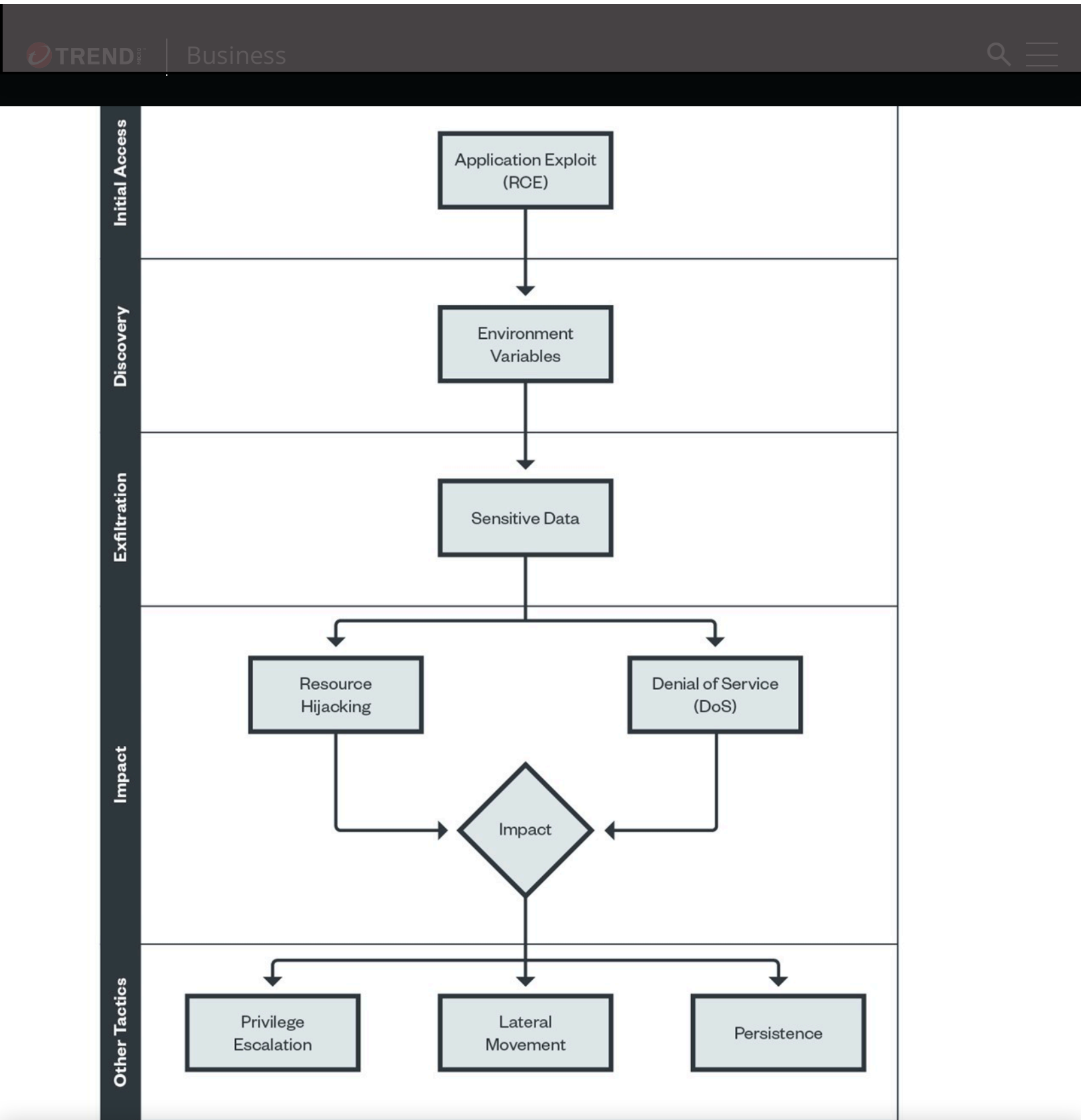
Through our network of honeypots and verbose telemetry, we were able to observe some interesting characteristics for most of the successful exploit attempts, particularly, how attackers use native Linux tools in their routines.

Examining attacks using legitimate utilities and tools on Linux environments

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into the environment (which we can now consider as compromised). From there, an attacker may take different paths to move further inside the compromised environment:

1. Enumerating the context of the current environment (**Discovery**)
2. Exfiltrating sensitive data from the environment (**Exfiltration, Impact**)
3. Performing a denial-of-service attack by removing the application (**Impact**)
4. Mining cryptocurrency by downloading miners (**Impact**)
5. Attempting other techniques (**Privilege Escalation, Lateral Movement, Persistence, or Credential Access**)

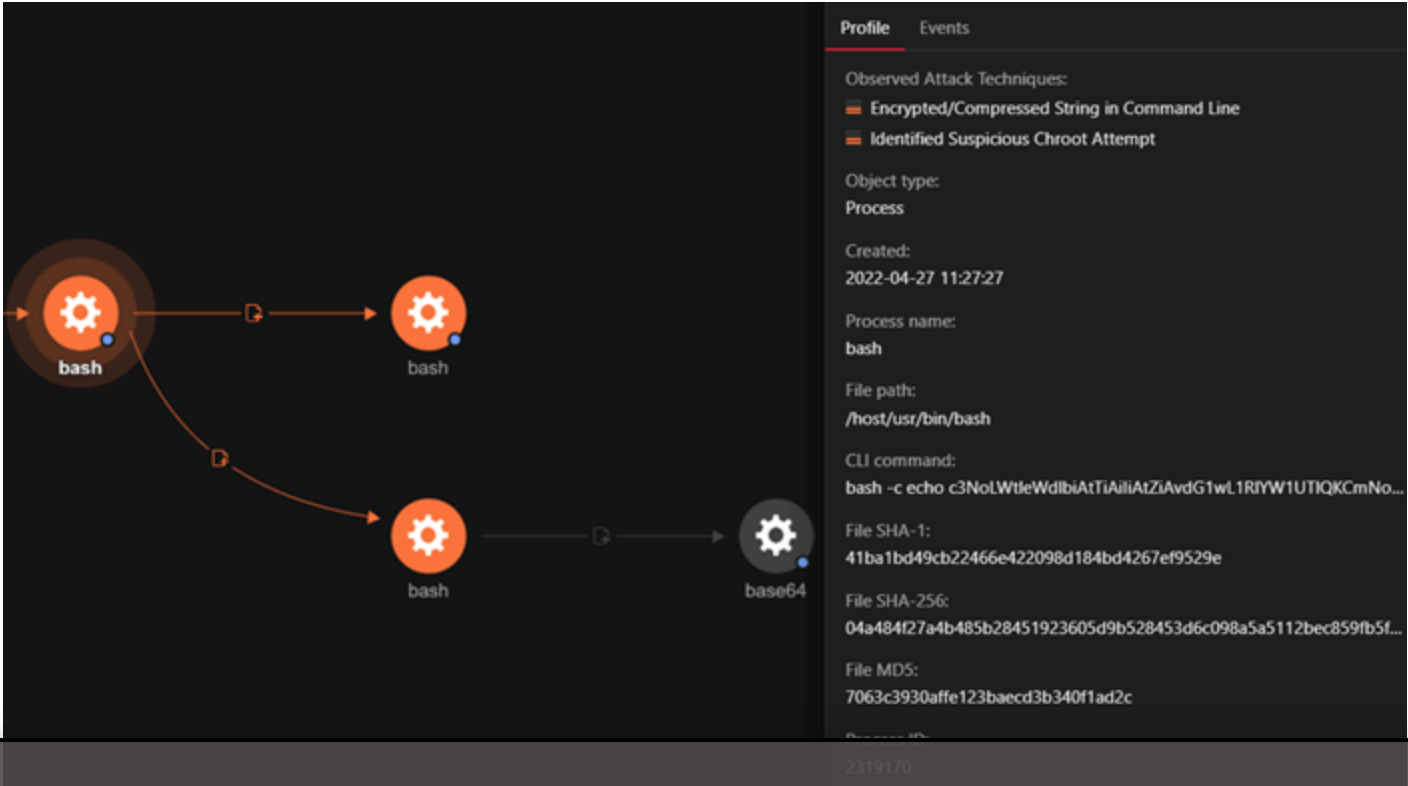




Based on real-world attacks and our honeypots, we observed that malicious actors use a variety of enabled tools that come bundled with Linux distributions, such as curl, wget, chmod, chattr, ssh, base64, chroot, crontab, ps, and pkill, that are abused by attackers for nefarious purposes.

We have seen malicious actors abusing these tools in the wild. The presence of these utilities, especially inside container environments, should be at least considered, since they provide additional avenues for attackers.

Let’s examine some real-world attacks and instances of abuse that we observed via Trend Micro Cloud One™ and Vision One.



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evade detection ([T1027](#)), a technique we describe in detail in our previous article [The Evolution of Malicious Shell Scripts](#).

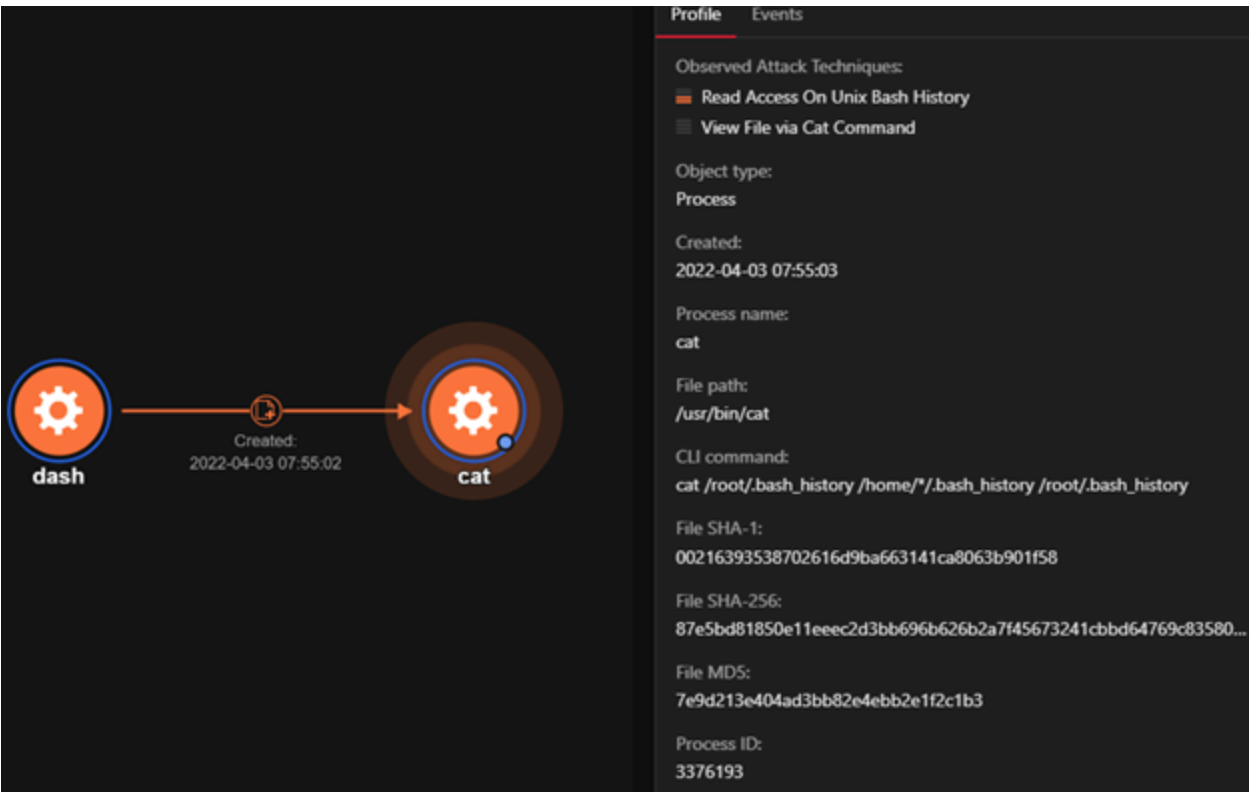


Figure 3. Using the “cat” process to view the .bash_history for all users

The .bash history file, which is stored in the user’s home directory, logs the commands executed by users on their bash shell. Attackers have been known to extract information from these files to understand the context of the current environment, as we previously detailed in another article — [Misconfigured Docker Daemon API Ports Attacked for Kinsing Malware Campaign](#).

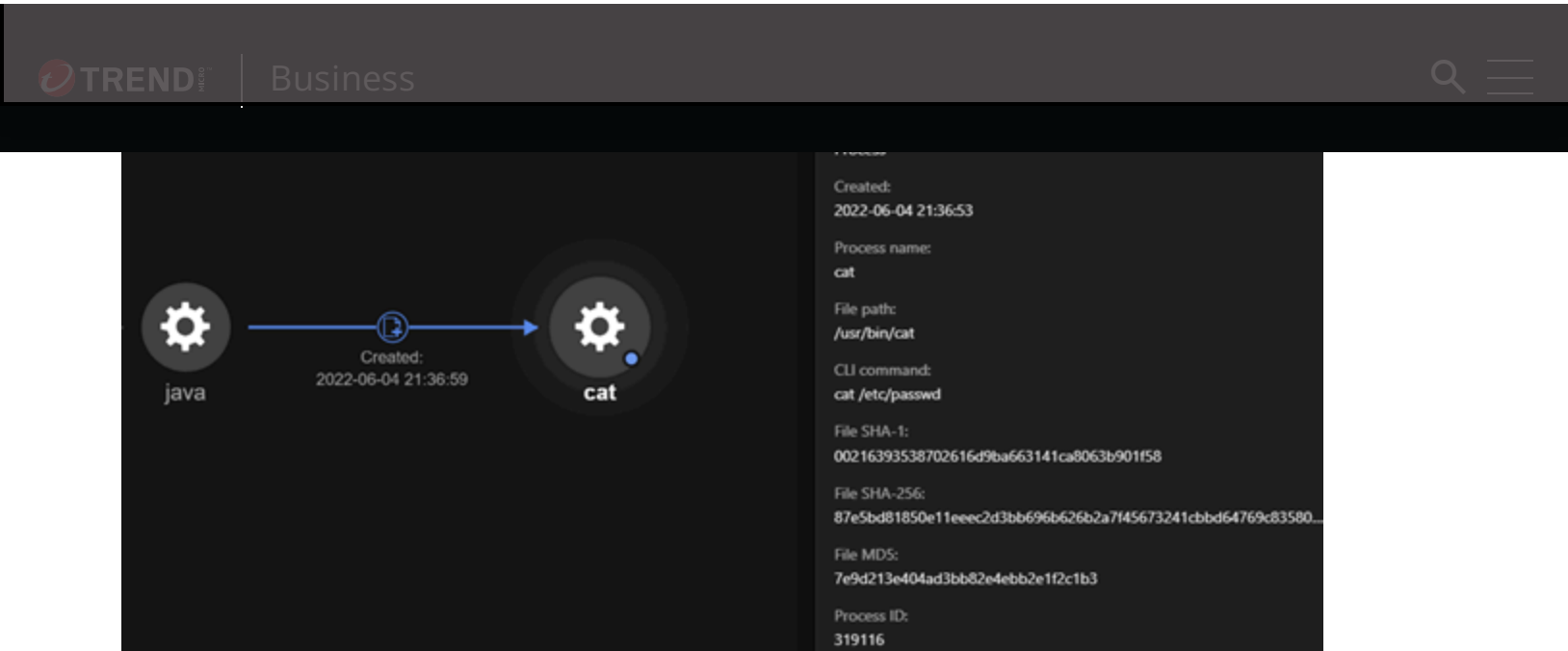


Figure 4. Using the “cat” process to view '/etc/passwd'

As a part of the enumeration step, the attacker accesses the */etc/passwd* file, which contains a list of the registered users within the environment and shows whether a given user has an associated shell with their login. This information helps the attacker understand the environment and pinpoint users of value. (T1003.008)

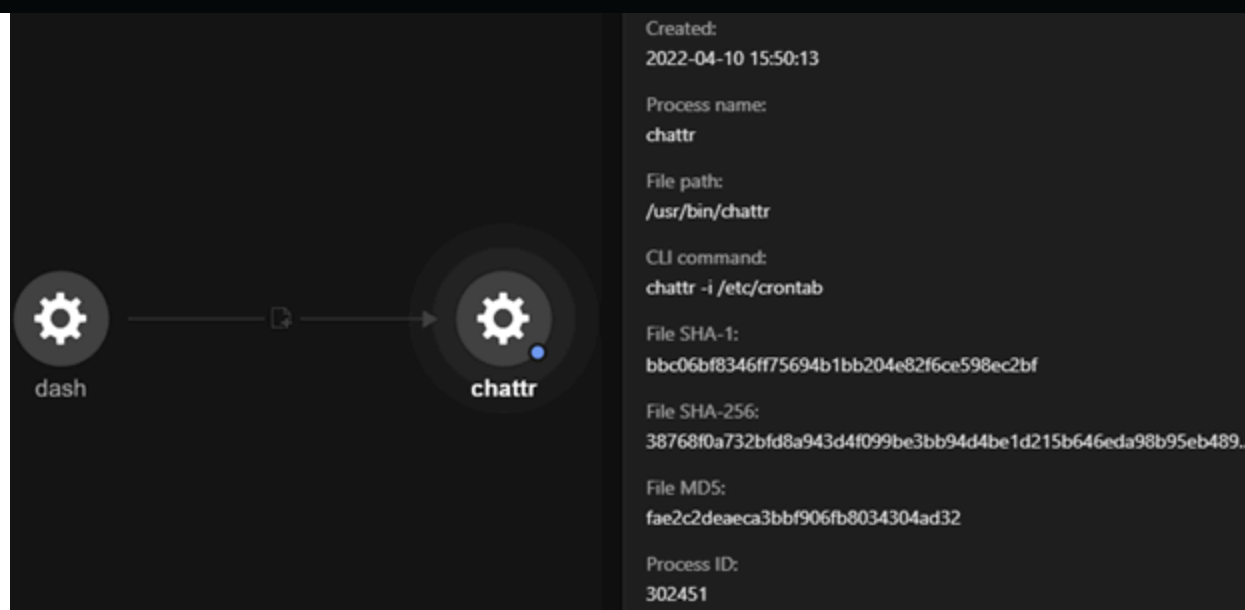


Figure 5. Using “chattr” to modify the /etc/crontab file to be mutable

The chattr utility is used to alter file and folder attributes to control sudden operations like the deletion and modification of files. The example in Figure 4 shows that the attributes of the `/etc/crontab` file has been altered, making the file unsecure. This utility has previously been observed to be abused by TeamTNT, as discussed in our white paper, [Tracking the Activities of TeamTNT](#).



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the `ugettyd` file at the path `/tmp` being set with the executable bit.

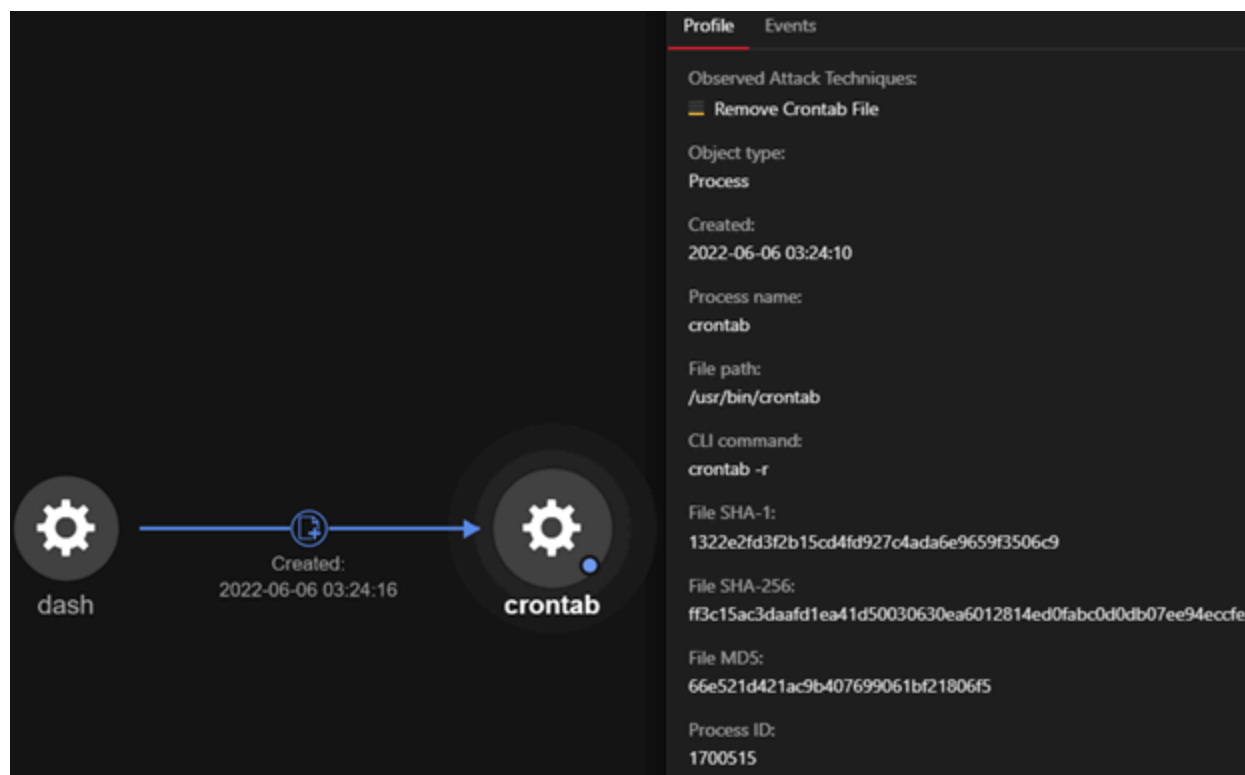


Figure 7. Using "crontab" to remove all existing cron jobs

A cron job is a utility used to schedule tasks (or jobs). Attackers have been known to abuse cron jobs and modify the 'crontab' to perform execution, persistence, and, at times, privilege escalation techniques ([T1053.003](#)). The example in Figure 7 shows the removal of existing cron jobs. This is a common occurrence where cryptocurrency miners compete against each other by removing traces of other miners to hijack the maximum amount of resources possible. Our blog entry, [War of Linux Cryptocurrency Miners: A Battle for Resources](#), discusses these activities in-depth.

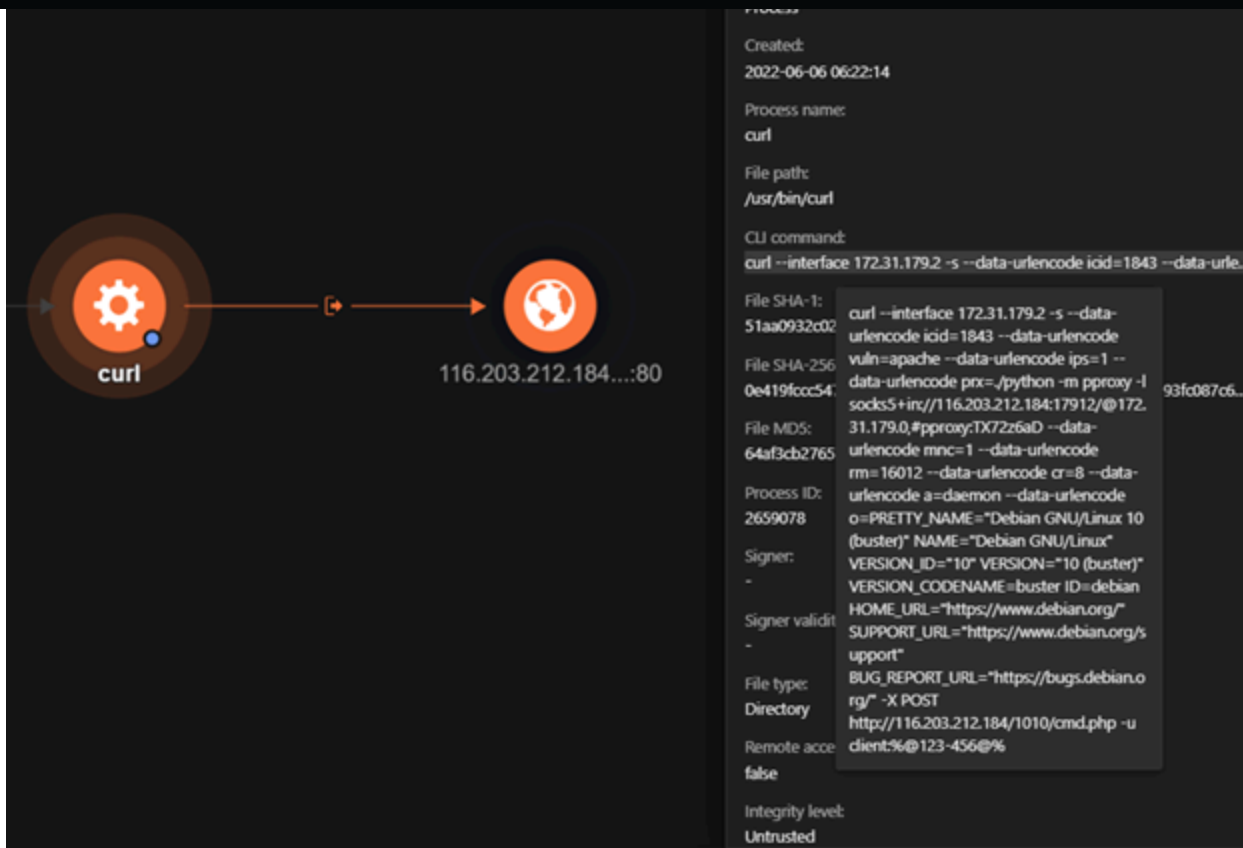


Figure 8. Using “curl” to exfiltrate system information to the attacker

The curl, or cURL, utility is used to transfer data across different protocols, such as HTTP, HTTPS, and File Transfer Protocol (FTP). The example in Figure 8 shows that system information such as the OS version and release version is sent as a POST request to the attacker’s infrastructure.



Figure 9. Using “curl” to download xmrig binaries from GitHub

In this case, curl is used to download binaries of the XMRig miner from Github. Attackers have been known to abuse legitimate platforms like Github and Netlify to serve crypto-mining tools, as we explain in our previous blog: [Vulnerabilities Exploited for Monero Mining Malware Delivered via GitHub, Netlify](#).

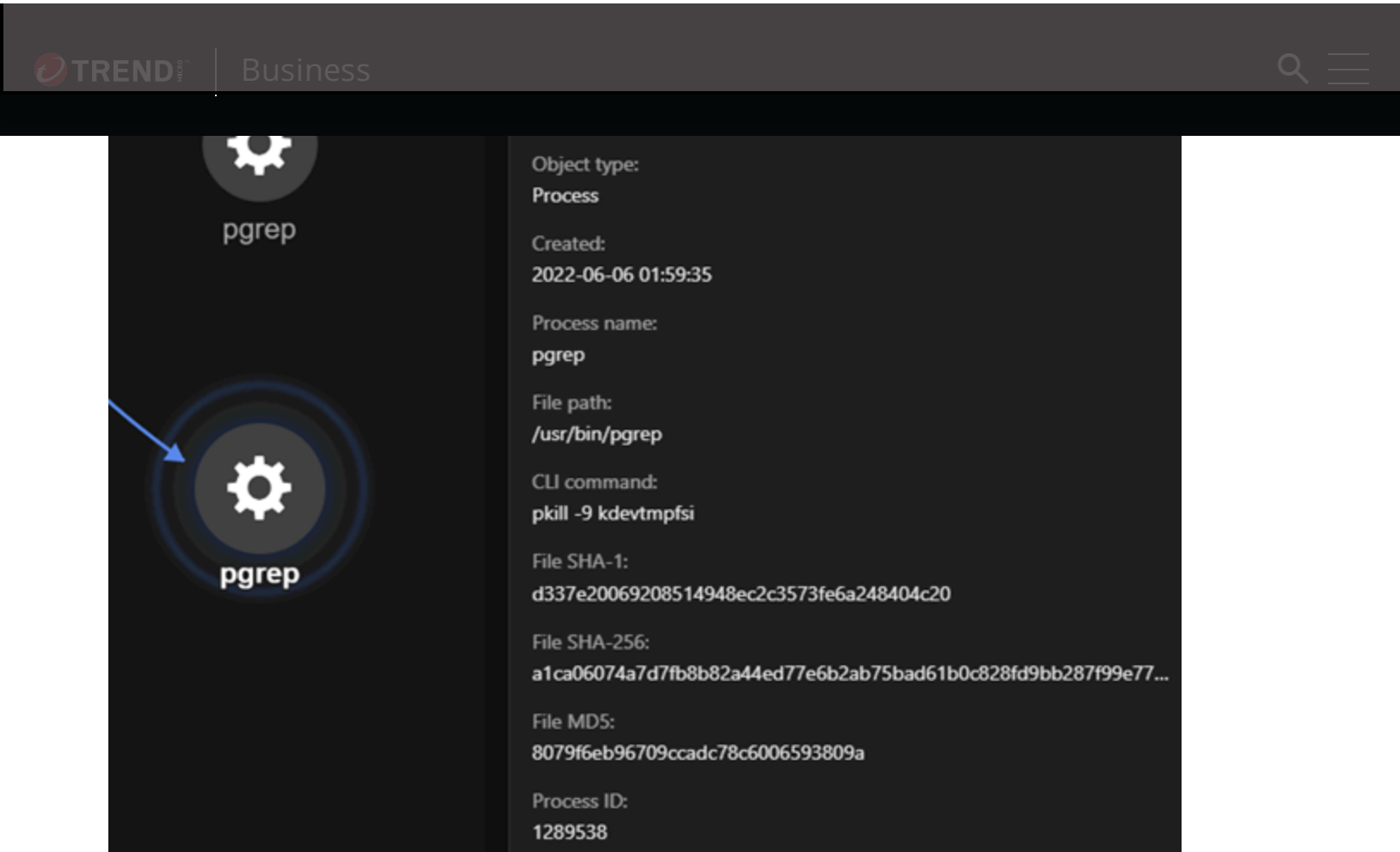


Figure 10. Using “pkill” to kill competing processes/coinminers

The kill suite utility is used to send signals to processes and, as illustrated in the example in Figure 10, it sends the SIGKILL signal to the process named “kdevtmpfsi”. We have been observing cryptocurrency miners named *kdevtmpfsi* as early as 2020. Our blog entry, [Analysis of Kinsing Malware's Use of Rootkit](#), shows another example of a competing miner being terminated.

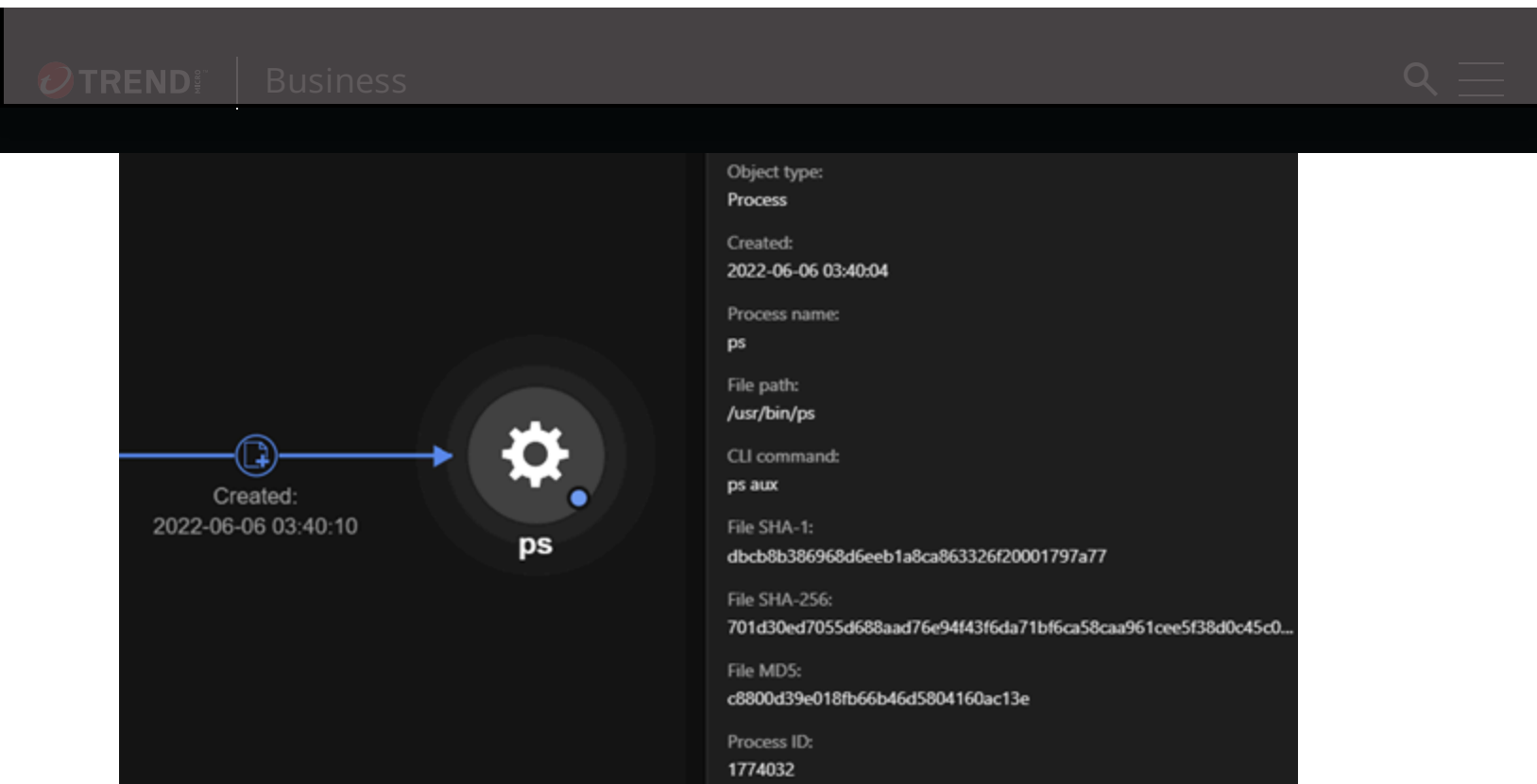


Figure 11. Using “ps” to view running processes

The `ps` utility is used to view the status of a process. Figure 11 shows the `ps aux` command fetching verbose information about the processes, such as currently running processes, process IDs, and process privileges, on the system. This information can aid attackers in performing discovery-related techniques (T1057 – Process Discovery) and gaining information about the environment they’re in.

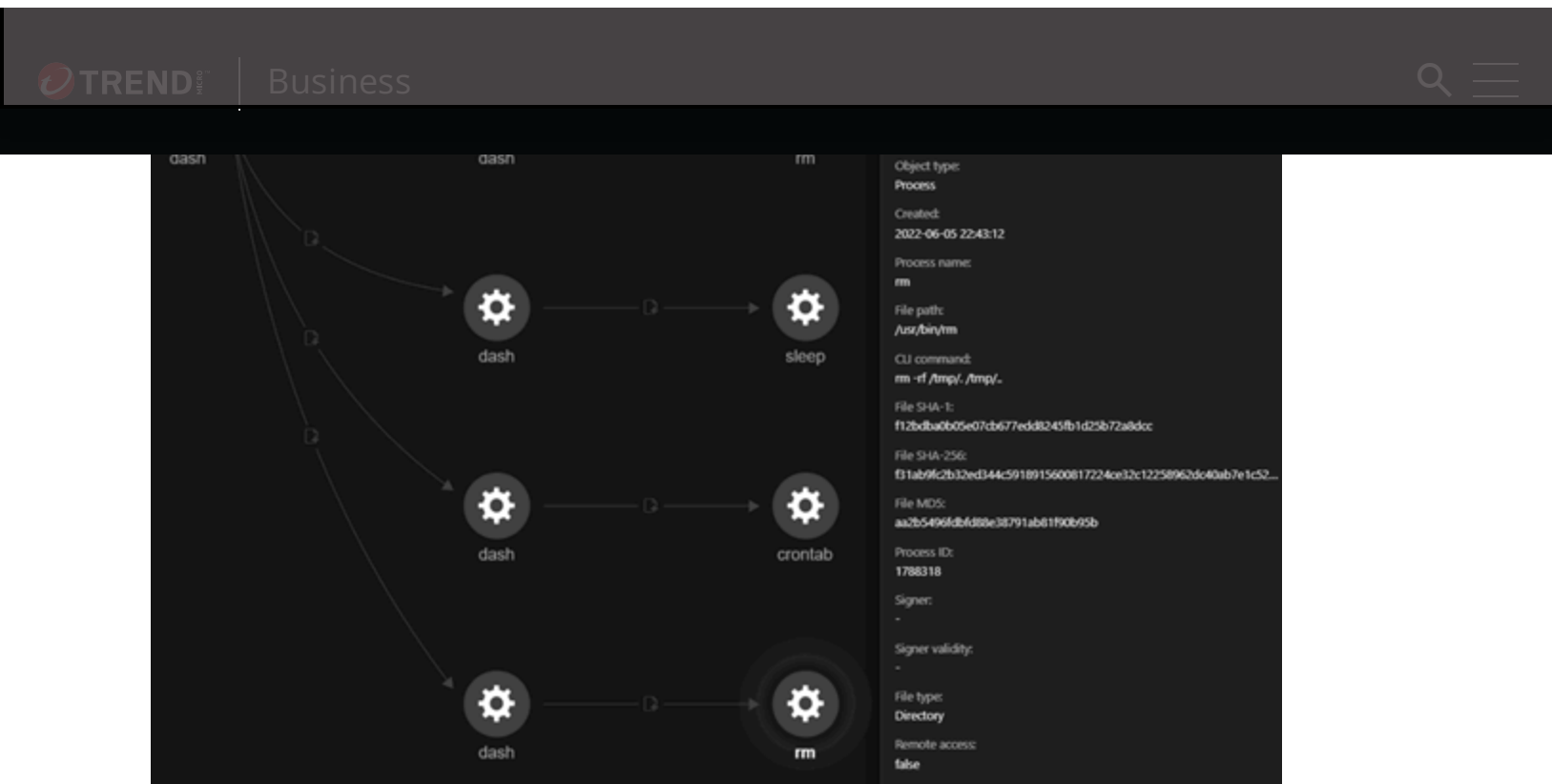


Figure 12. Using “rm” to remove hidden files from /tmp directory

In Figure 11, we see the rm tool being used to delete the hidden files and folders under the /tmp directory. Attackers can create hidden directories to evade detection by adding “.” before the file or folder name (Hide Artifacts: Hidden Files and Directories - T1564.001).

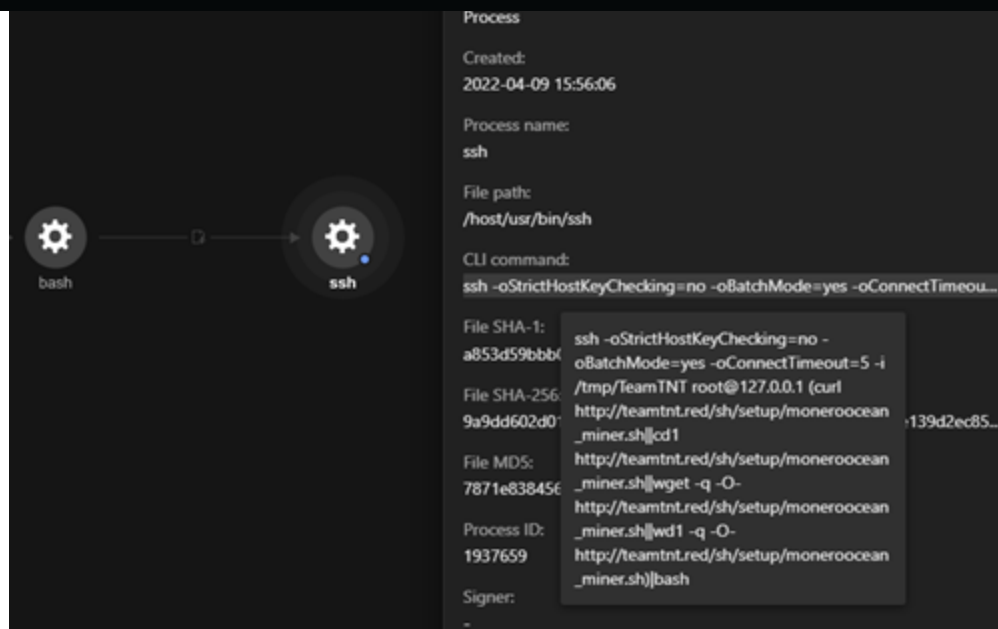


Figure 13. Using “ssh” to infect underlying host with XMR miners

The ssh utility is the remote client used for accessing systems over Secure Shell (SSH) in a worm-like fashion. In Figure 13, the attacker tries to download the Monero miner (using wget/curl) and infect the remote machine in which the SSH is being attempted (127.0.0.1). Once attackers mount the underlying host’s file system due to unsecure configuration (for example, privileged containers) of containers, they create new pairs of SSH keys, use it to establish an “ssh” session, and **infect the underlying host with cryptocurrency miners**.

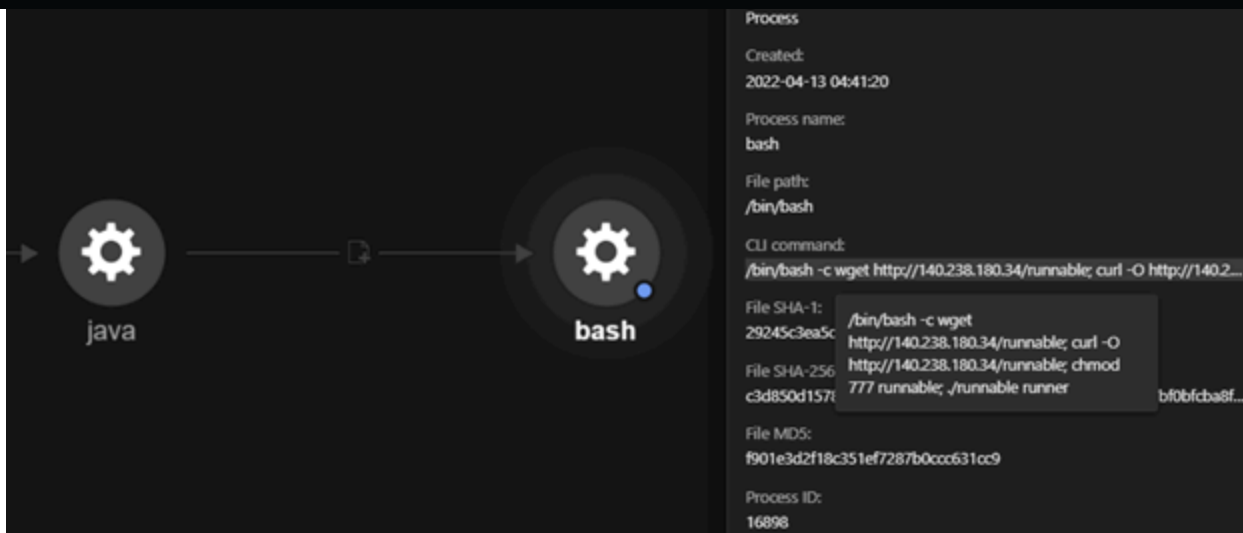
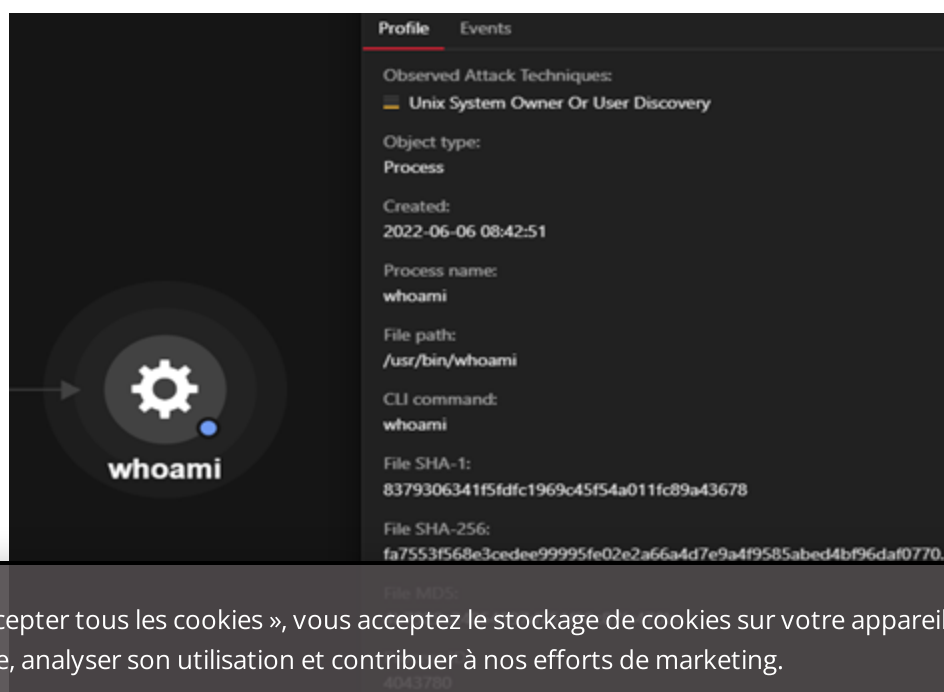


Figure 14. Using “wget”, “curl”, “chmod” to download and execute Mirai malware

In this example, we see the combined use of different Linux utilities wherein the binary is downloaded, permissions are modified, and then later executed. The executable named “runnable” is a Mirai sample delivered after the exploitation of the Log4shell vulnerability tracked under [CVE-2021-44228](#).



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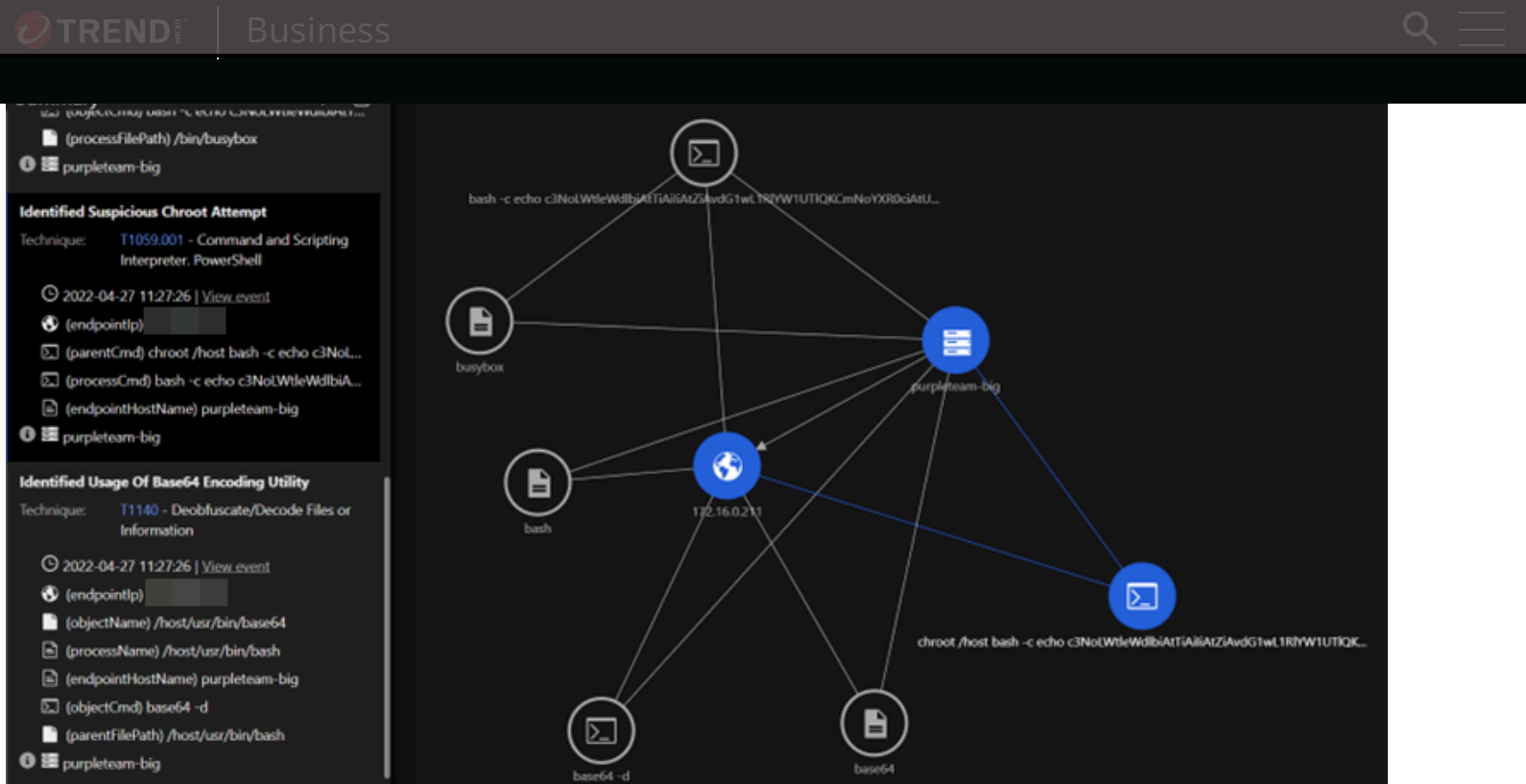


Figure 16. Workbench showing an attacker using “chroot” and “base64”

Using the Vision One workbench, we see the chroot and base64 utilities being used by an attacker. Note that chroot is used to change the root to the directory supplied (in this case, */host*), where the underlying host’s file system is mounted within the container. We explore the weakness posed by this function when granted to a container in our article, [Why A Privileged Container in Docker is a Bad Idea](#).

Best practices for protecting Linux systems from utility abuse

Using distroless images

By observing the techniques discussed in the previous section, we see that the attackers can use a set of tools that come bundled with a full-scale operating system. As

defenders, it would be safer to have container images that contain only the tools we
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to run also reduces the attack surface introduced by the dependency vulnerabilities in open-source libraries and tools. Here enters the concept of distroless images, which are **described as** images that contain only the application and its runtime dependencies, doing away with the programs you would expect to find in a typical Linux distribution such as package managers and shells.

Cloud One Workload Security – Application Control

From a defender's perspective, the focus should be on disabling, or rather, disarming the attacker via **defense-in-depth strategies**. While making changes to the system to minimize or even prevent abuse would help, a multilayered approach that leverages multiple security measures would provide the strongest level of security, ideally by combining best practices with effective defense technologies.

For non-containerized environments, Cloud One Workload Security provides the **Application Control** module, which monitors software changes and allows or blocks them based on the set configuration. It creates a baseline of the existing applications and applies the rules to the new applications that are downloaded and installed. It works based on the SHA256 hash for a binary.

It provides options for users to do the following:

1. **Block unrecognized software until explicitly allowed**
2. **Allow unrecognized software until explicitly blocked**



then configured with the Cloud One Workload Security agent running with the Application Control module set to 'Block' mode for unrecognized software. As shown in the Figure 17, the execution was prevented by Application Control.

```
ubuntu@ip-172-31-1-110:~$ wget https://github.com/andrew-d/static-binaries/raw/master/binaries/linux/x86_64/nmap
--2022-07-11 11:08:17-- https://github.com/andrew-d/static-binaries/raw/master/binaries/linux/x86_64/nmap
Resolving github.com (github.com)... 13.234.176.102
Connecting to github.com (github.com)|13.234.176.102|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://raw.githubusercontent.com/andrew-d/static-binaries/master/binaries/linux/x86_64/nmap [following]
--2022-07-11 11:08:18-- https://raw.githubusercontent.com/andrew-d/static-binaries/master/binaries/linux/x86_64/nmap
Resolving raw.githubusercontent.com (raw.githubusercontent.com)... 185.199.109.133, 185.199.110.133, 185.199.111.133, ...
Connecting to raw.githubusercontent.com (raw.githubusercontent.com)|185.199.109.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 5944464 (5.7M) [application/octet-stream]
Saving to: 'nmap'

nmap                                100%[=====>]  5.67M  --.-KB/s   in 0.06s

2022-07-11 11:08:19 (89.0 MB/s) - 'nmap' saved [5944464/5944464]

ubuntu@ip-172-31-1-110:~$ chmod +x nmap
ubuntu@ip-172-31-1-110:~$ ./nmap
-bash: ./nmap: Operation not permitted
ubuntu@ip-172-31-1-110:~$
```

Figure 17. Prevention the execution of the “nmap” binary using the Application Control module from Cloud One Workload Security

General

Tags

General Information

Time:

July 11, 2022 16:38:25

Event:

Execution of Unrecognized Software Blocked

Computer:

ip-172-31-1-110.ap-south-1.compute.internal

Event Origin:

Agent

Ruleset:

None

Reason:

Unrecognized Software

Details

Action:

Blocked

Path:

/home/ubuntu/

File:

nmap

MD5:

99D18866C3E87DD11A84829ABB5A6758

SHA1:

D65D416B9B0279A1789507289FB448D4209F04AD

SHA256:

353FD20C9EFC0D328CEA494F32D3650B9346FCDB458FE20D8DBEE2DD7B62CA62

User Name:

ubuntu

User ID:

1000

Group:

ubuntu

Group ID:

1000

Process ID:

20030

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Conclusion

With attackers making use of legitimate tools and utilities that are built into the operating system, defenders will need to prioritize how they can set up controls during the different phases of an attack. Minimizing the attack surface by using distroless images in containers and applying preventive controls like Cloud One Workload Security's Application Control go a long way in slowing down attackers targeting cloud environments. In cases where organizations cannot go with a distroless implementation, “slimmed-down” versions of the same images can also be used to reduce the attack surface and strengthen the security of cloud deployments.

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