

Talos Vulnerability Report

TALOS-2022-1455

TCL LinkHub Mesh Wifi confsrv set_mf_rule stack-based buffer overflow vulnerability

AUGUST 1, 2022

CVE NUMBER

CVE-2022-23919,CVE-2022-23918

SUMMARY

A stack-based buffer overflow vulnerability exists in the confsrv set_mf_rule functionality of TCL LinkHub Mesh Wifi MS1G_00_01.00_14. A specially-crafted network packet can lead to stack-based buffer overflow. An attacker can send a malicious packet to trigger this vulnerability.

CONFIRMED VULNERABLE VERSIONS

The versions below were either tested or verified to be vulnerable by Talos or confirmed to be vulnerable by the vendor.

TCL LinkHub Mesh Wifi MS1G_00_01.00_14

PRODUCT URLS

LinkHub Mesh Wifi - <https://www.tcl.com/us/en/products/connected-home/linkhub/linkhub-mesh-wifi-system-3-pack>

CVSSV3 SCORE

8.8 - CVSS:3.0/AV:A/AC:L/PR:N/UI:N/S:U/C:H/I:H/A:H

CWE

CWE-121 - Stack-based Buffer Overflow

DETAILS

The LinkHub Mesh WiFi system is a node-based mesh system designed for wifi deployments across large homes. These nodes include most features standard in current WiFi solutions and allow for easy expansion of the system by adding nodes. The mesh is managed solely by a phone application and the routers have no web-based management console.

The LinkHub Mesh system uses protobufs to communicate both internally on the device as well as externally with the controlling phone application. These protobufs can be sent to port 9003 while on the WiFi provided by the LinkHub Mesh in order to issue commands much like the phone application would. Once the protobuf is received, it is routed internally starting from the ucLoud binary and is dispatched to the appropriate handler.

In this case, the handler is `confsrv` which handles many message types, in this case we are interested in `mf_lists`

```
message mf_rule {
    required string ethaddr = 1;           [1]
    optional string name = 2;             [2]
}
message mf_lists {
    required int32 mode = 1;
    repeated MESSAGE_NOT_RESOLVED rules = 2; //This is not optional, so it must
    be resolved by hand to compile to .proto
    optional uint64 timestamp = 3;
}
```

Using [1] and [2] we have control over both `ethaddr` and `name` in the packet, the parsing of the data within the protobuf is `conf_set_mf_cfg`

```

004141f0  int32_t conf_set_mf_cfg(int32_t arg1, int32_t arg2, int32_t arg3)

00414210      arg_0 = arg1
0041421c      int32_t $a3
0041421c      arg_c = $a3
0041423c      void var_108
0041423c      memset(&var_108, 0, 0x80)
00414264      void var_88
00414264      memset(&var_88, 0, 0x80)
00414288      struct MfLists* pkt = mf_lists__unpack(0, arg3, arg2)
[3]
0041429c      int32_t $v0_2
0041429c      if (pkt == 0) {
004142c8          printf("[%s][%d][niuwu] Unpack failed %d...", "conf_set_mf_cfg",
0x103, arg3, 0x4ae4b0)
004142d4          $v0_2 = 0xffffffff
004142d4      } else {
004142e8          clear_all_mf_mib()
00414300          set_mf_rule(pkt: pkt)
[4]
00414314          if (pkt->is_timestamp_present != 0) {
00414344              sprintf(&var_88, "%llu", pkt->timestamp.d, pkt->timestamp:4.d,
0x4ae4b0)
00414368              SetValue(name: "sys.cfg.stamp", input_buffer: &var_88)
0041435c          }
...

```

At [3] the protobuffer is unpacked into a structure and then at [4] the structure is passed into set_mf_rule

```

00413b2c  int32_t set_mf_rule(struct MfLists* pkt)

00413b54      uint8_t ethAddrBuffer[0x12]
00413b54      ethAddrBuffer[0].d = 0
00413b58      ethAddrBuffer[4].d = 0
00413b5c      ethAddrBuffer[8].d = 0
00413b60      ethAddrBuffer[0xc].d = 0
00413b64      ethAddrBuffer[0x10].w = 0
00413b84      uint8_t nameBuffer[0x40]
00413b84      memset(&nameBuffer, 0, 0x40)
00413bac      uint8_t var_150[0x40]
00413bac      memset(&var_150, 0, 0x40)
00413bd4      uint8_t var_110[0x80]
00413bd4      memset(&var_110, 0, 0x80)
00413bfc      uint8_t var_90[0x80]
00413bfc      memset(&var_90, 0, 0x80)
00413c08      int32_t var_1a8 = 0
00413c0c      int32_t var_1ac = 0
00413c18      int32_t var_1b8 = 0
00413c1c      int32_t var_1ac_1 = 0
00414080      int32_t $v0_31
00414080      while (true) {
00414080          $v0_31 = var_1ac_1 < 2 ? 1 : 0
00414084          if ($v0_31 == 0) {
00414084              break
00414084          }
00413c2c          int32_t var_1b0_1
00413c2c          if (var_1ac_1 != 0) {
00413c48              var_1b0_1 = 5
00413c48          } else {
00413c38              var_1b0_1 = 2
00413c38          }
00413f54      uint8_t (* var_1c8)[0x40]
00413f54      for (int32_t loop_idx = 0; loop_idx < pkt->rules_count; loop_idx
= loop_idx + 1) {
00413c6c          struct MfRule* $v0_6 = *(pkt->rules + (loop_idx << 2))
00413c8c          memset(&ethAddrBuffer, 0, 0x12)
00413cb0          memset(&nameBuffer, 0, 0x40)
00413cc0          if ($v0_6 != 0) {
00413cd0              if ($v0_6->ethAddr != 0) {
?00413d18                  memcpy(&ethAddrBuffer, $v0_6->ethAddr, strlen($v0_6-
>ethAddr))
00413ce4              }
00413d2c              if ($v0_6->name != 0) {
?00413d74                  memcpy(&nameBuffer, $v0_6->name, strlen($v0_6->name))
00413d40              }
00413d40          }
00413d40      }
00413d40      ....

```

CVE-2022-23918 - ethAddr stack buffer overflow

As seen above at [5] the ethAddr memcpy occurs into a stack-based buffer of size 0x12.

```

00413cd8 2000c28f lw      $v0, 0x20($fp) {var_1b8_1}
00413cdc 0c00508c lw      $s0, 0xc($v0) {MfRule::ethAddr}
00413ce0 2000c28f lw      $v0, 0x20($fp) {var_1b8_1}
00413ce4 0c00428c lw      $v0, 0xc($v0) {MfRule::ethAddr}
00413ce8 21204000 move    $a0, $v0
00413cec c08a828f lw      $v0, -0x7540($gp) {strlen}          [9]
00413cf0 21c84000 move    $t9, $v0
00413cf4 09f82003 jalr    $t9
00413cf8 00000000 nop
00413cfc 1800dc8f lw      $gp, 0x18($fp) {var_1c0}
00413d00 3400c327 addiu   $v1, $fp, 0x34 {ethAddrBuffer}
00413d04 21206000 move    $a0, $v1 {ethAddrBuffer}
00413d08 21280002 move    $a1, $s0
00413d0c 21304000 move    $a2, $v0
00413d10 b88b828f lw      $v0, -0x7448($gp) {memcpy}
00413d14 21c84000 move    $t9, $v0
00413d18 09f82003 jalr    $t9
00413d1c 00000000 nop

```

At [7] and [9] we can see that the length of the memcpy is not the static size of the buffer, but instead the strlen of the user data provided from the protobuf packet. This results in a simple stack buffer overflow.

Crash Information

Program received signal SIGSEGV, Segmentation fault.

0x41414141 in ?? ()

[Legend: Modified register | Code | Heap | Stack | String]

----- registers -----

\$zero: 0x0
\$at : 0x806f0000
\$v0 : 0x0
\$v1 : 0x2
\$a0 : 0x11
\$a1 : 0x2
\$a2 : 0x200
\$a3 : 0x0
\$t0 : 0x1
\$t1 : 0x41414141 ("AAAA"?)
\$t2 : 0x41414141 ("AAAA"?)
\$t3 : 0x41414141 ("AAAA"?)
\$t4 : 0x41414141 ("AAAA"?)
\$t5 : 0x41414141 ("AAAA"?)
\$t6 : 0x41414141 ("AAAA"?)
\$t7 : 0x41414141 ("AAAA"?)
\$s0 : 0x41414141 ("AAAA"?)
\$s1 : 0x7fe05d48 → 0x82011507
\$s2 : 0x772f6a60 → "uc_api_lib.c"
\$s3 : 0x0
\$s4 : 0x772f7be4 → "_session_read_and_dispatch"
\$s5 : 0x772dd090 → 0x3c1c0003
\$s6 : 0x1b6
\$s7 : 0x10
\$t8 : 0x1
\$t9 : 0x76ee752c → 0x3c1c0002
\$k0 : 0x0
\$k1 : 0x0
\$s8 : 0x41414141 ("AAAA"?)
\$pc : 0x41414141 ("AAAA"?)
\$sp : 0x7fe05af8 → 0x004bbfe8 → 0x772d1c28 → 0x28aaeef9
\$hi : 0x5
\$lo : 0x19999999
\$fir : 0x0
\$ra : 0x41414141 ("AAAA"?)
\$gp : 0x004ae4b0 → 0x00000000

----- stack -----

0x7fe05af8	+0x0000:	0x004bbfe8	→	0x772d1c28	→	0x28aaeef9	← \$sp
0x7fe05afc	+0x0004:	0x000001ae					
0x7fe05b00	+0x0008:	0x7fe05d6c	→	0xa9120108			
0x7fe05b04	+0x000c:	0x00000000					
0x7fe05b08	+0x0010:	0x004ae4b0	→	0x00000000			
0x7fe05b0c	+0x0014:	0x00000000					
0x7fe05b10	+0x0018:	0x004bbfe8	→	0x772d1c28	→	0x28aaeef9	
0x7fe05b14	+0x001c:	0x00000000					

----- code:mips:MIPS32 -----

[!] Cannot disassemble from \$PC

[!] Cannot access memory at address 0x41414140

_____ threads _____
[#0] Id 1, stopped 0x41414141 in ?? (), reason: SIGSEGV
_____ trace _____

CVE-2022-23919 - name stack buffer overflow

As seen above at [5] the name memcpy occurs into a stack-based buffer of size 0x40.

00413d34	2000c28f	lw	\$v0, 0x20(\$fp) {var_1b8_1}	
00413d38	1000508c	lw	\$s0, 0x10(\$v0) {MfRule::name}	
00413d3c	2000c28f	lw	\$v0, 0x20(\$fp) {var_1b8_1}	
00413d40	1000428c	lw	\$v0, 0x10(\$v0) {MfRule::name}	
00413d44	21204000	move	\$a0, \$v0	
00413d48	c08a828f	lw	\$v0, -0x7540(\$gp) {strlen}	[10]
00413d4c	21c84000	move	\$t9, \$v0	
00413d50	09f82003	jalr	\$t9	
00413d54	00000000	nop		
00413d58	1800dc8f	lw	\$gp, 0x18(\$fp) {var_1c0}	
00413d5c	4800c327	addiu	\$v1, \$fp, 0x48 {nameBuffer}	
00413d60	21206000	move	\$a0, \$v1 {nameBuffer}	
00413d64	21280002	move	\$a1, \$s0	
00413d68	21304000	move	\$a2, \$v0	
00413d6c	b88b828f	lw	\$v0, -0x7448(\$gp) {memcpy}	
00413d70	21c84000	move	\$t9, \$v0	
00413d74	09f82003	jalr	\$t9	
00413d78	00000000	nop		

At [8] and [10] we can see that the length of the memcpy is not the static size of the buffer, but instead the strlen of the user data provided from the protobuf packet. This results in a simple stack buffer overflow.

Crash Information

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0x41414141 in ?? ()

[Legend: Modified register | Code | Heap | Stack | String]

———— registers ————

\$zero: 0x0
\$at : 0x806f0000
\$v0 : 0x0
\$v1 : 0x2
\$a0 : 0x11
\$a1 : 0x2
\$a2 : 0x200
\$a3 : 0x0
\$t0 : 0x0
\$t1 : 0x41414141 ("AAAA"?)
\$t2 : 0x004bc828 → 0x0045d3e0 → <add_results_timeout_check+0> lui gp, 0x5
\$t3 : 0x5
\$t4 : 0xffffffffc
\$t5 : 0xfffffffffe
\$t6 : 0x770bd534 → 0x00000000
\$t7 : 0x0
\$s0 : 0x41414141 ("AAAA"?)
\$s1 : 0x7f9a90b8 → 0x82011507
\$s2 : 0x774a6a60 → "uc_api_lib.c"
\$s3 : 0x0
\$s4 : 0x774a7be4 → "_session_read_and_dispatch"
\$s5 : 0x7748d090 → 0x3c1c0003
\$s6 : 0x1b3
\$s7 : 0x10
\$t8 : 0x264
\$t9 : 0x7709752c → 0x3c1c0002
\$k0 : 0x0
\$k1 : 0x0
\$s8 : 0x41414141 ("AAAA"?)
\$pc : 0x41414141 ("AAAA"?)
\$sp : 0x7f9a8e68 → 0x004bb610 → 0x77481c28 → 0x28aaeef9
\$hi : 0x31a
\$lo : 0x1cbe9
\$fir : 0x0
\$ra : 0x41414141 ("AAAA"?)
\$gp : 0x004ae4b0 → 0x00000000

———— stack ————

0x7f9a8e68	+0x0000:	0x004bb610	→	0x77481c28	→	0x28aaeef9	← \$sp
0x7f9a8e6c	+0x0004:	0x000001ab					
0x7f9a8e70	+0x0008:	0x7f9a90dc	→	0xa6120108			
0x7f9a8e74	+0x000c:	0x00000000					
0x7f9a8e78	+0x0010:	0x004ae4b0	→	0x00000000			
0x7f9a8e7c	+0x0014:	0x00000000					
0x7f9a8e80	+0x0018:	0x004bb610	→	0x77481c28	→	0x28aaeef9	
0x7f9a8e84	+0x001c:	0x00000000					

———— code:mips:MIPS32 ————

[!] Cannot disassemble from \$PC

[!] Cannot access memory at address 0x41414140


```
_____ threads _____  
[#0] Id 1, stopped 0x41414141 in ?? (), reason: SIGSEGV
```

```
_____ trace _____
```

TIMELINE

2022-02-08 - Initial Vendor Contact

2022-02-09 - Vendor Disclosure

2022-08-01 - Public Release

CREDIT

Discovered by Carl Hurd of Cisco Talos.

VULNERABILITY REPORTS

PREVIOUS REPORT

NEXT REPORT

TALOS-2022-1454

TALOS-2022-1456

