

Merovingio

Mislead the malware

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NAVAJA NEGRA
CONFERENCE

- **Malware Analysis**
 - what else?
 - state of art
 - why?
- **PebHooking**
- **Merovingio**
 - Sandboxie
 - Merovingio Agent
- **DorianIA**
- **Merovingio Website**

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What else?

- New techniques
- Avoid signatures
- The market is dozed
- A lot of new samples every day
- It's ~~expensive~~ complicated to have people focused on malware analysis in a CSIRT

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State of art

- Commercial products are similar
 - Same VM.
 - Same drivers.
 - Same look&feel.
 - **SAME RESULTS.**
- The commercial products are the same limits
 - One sample on each VM.
 - Wait to reboot/reset the VM to start another analysis.
 - The analysis spend 2-3 minutes all times. This time is not based on the behavior of the sample.
 - Attached to the company for any grown.
 - And... the source code is not our.

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Why?

- Need “anything” to detect the new samples and **behaviors**
- Avoid the dependencies of the antivirus
- Avoid the problems with VM.
 - One sample on each VM
 - Samples are out of control on execution
- Accelerate the analysis
- Include some control on the execution
- Create a system to simulate behaviors

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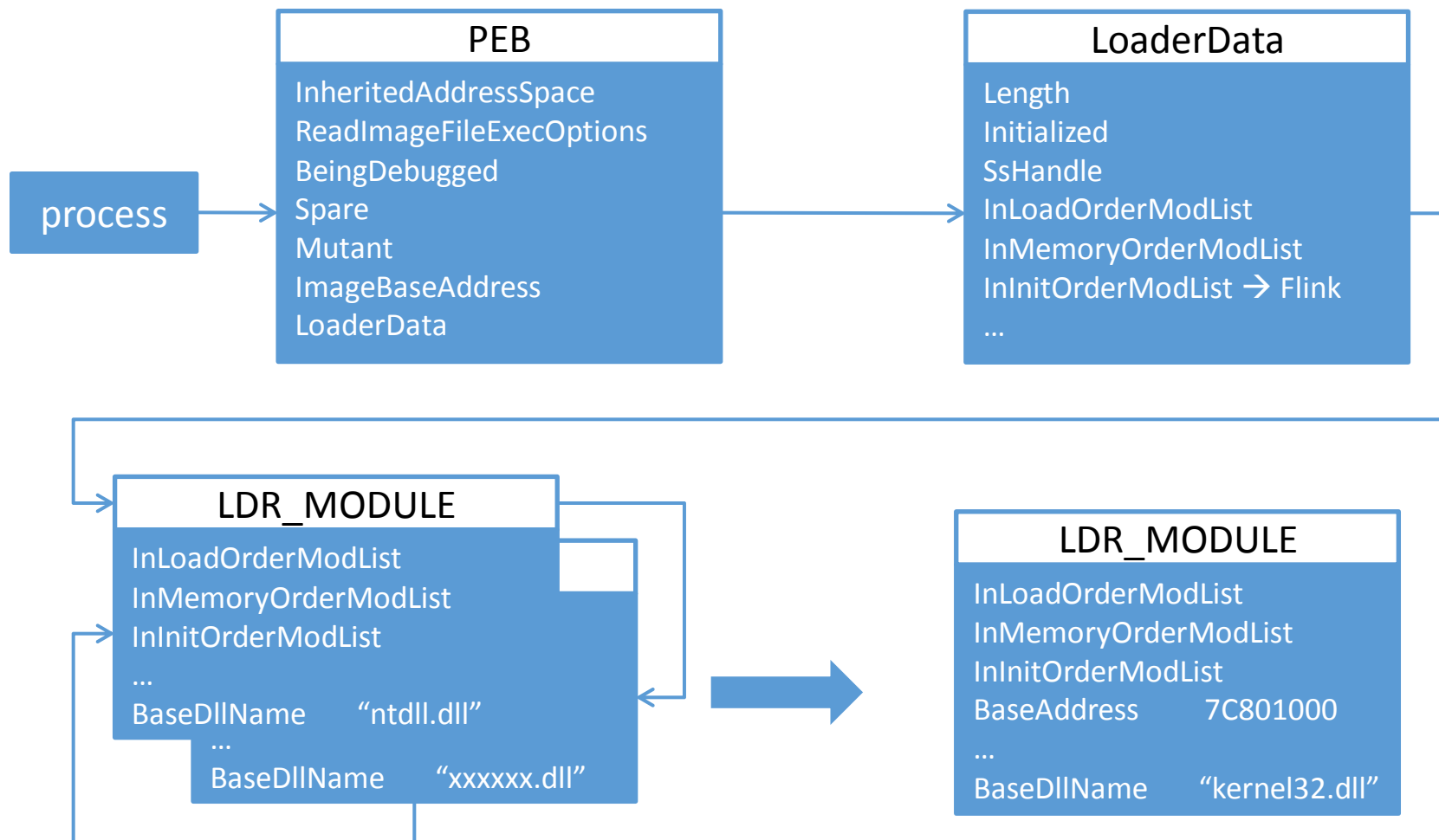
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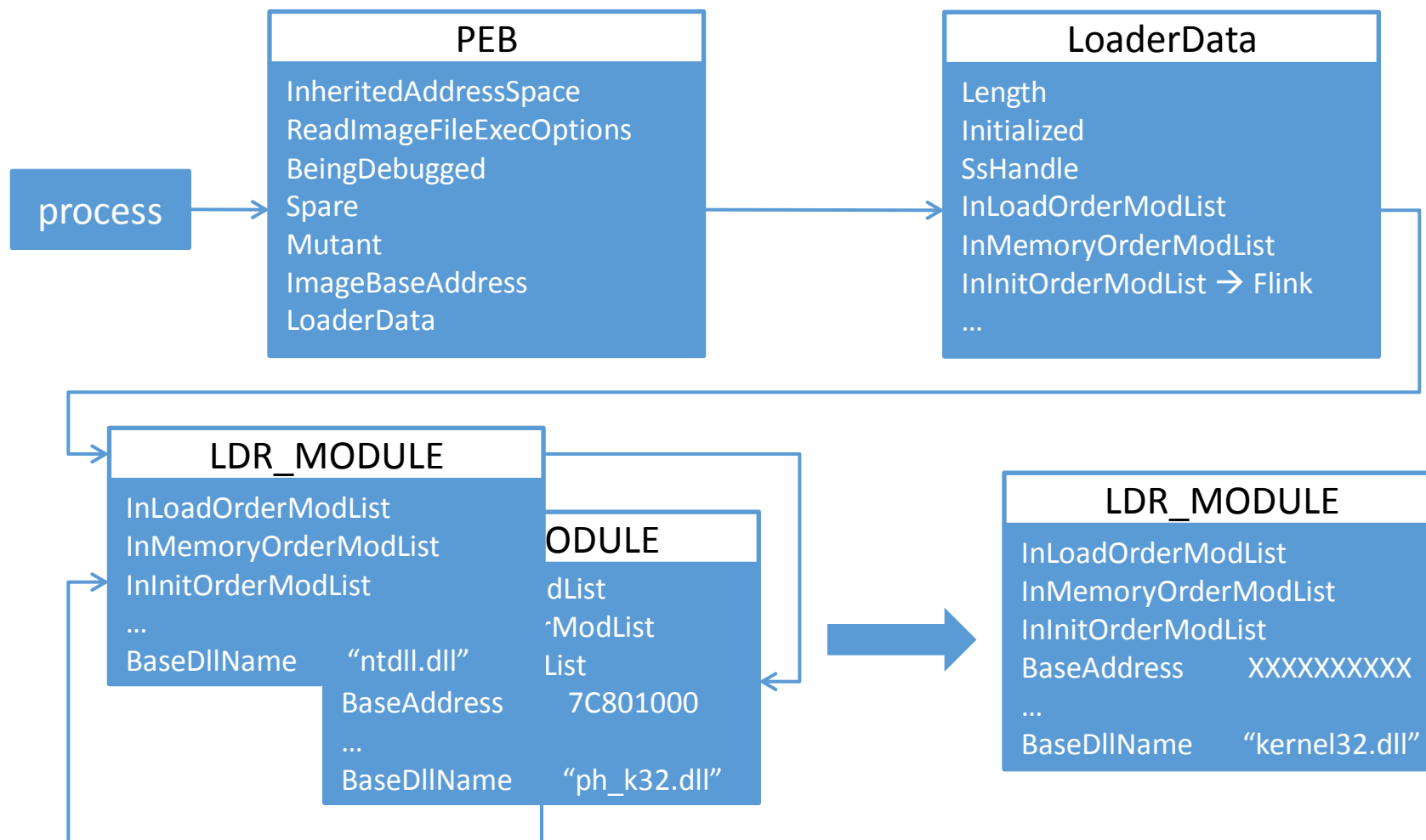
- Published in Phrack #65
 - Dreg and [Shearer]
- Modify the PEB in the process to exchange real libraries for our libraries
- All dynamic loaded libraries will be hooked
- Only is necessary repair the main IAT

The logo features the words "NAVAJA NEGRA" in a bold, yellow, distressed font. The letters are set against a dark, textured background that resembles a close-up of a rock surface with some cracks and mineral inclusions.

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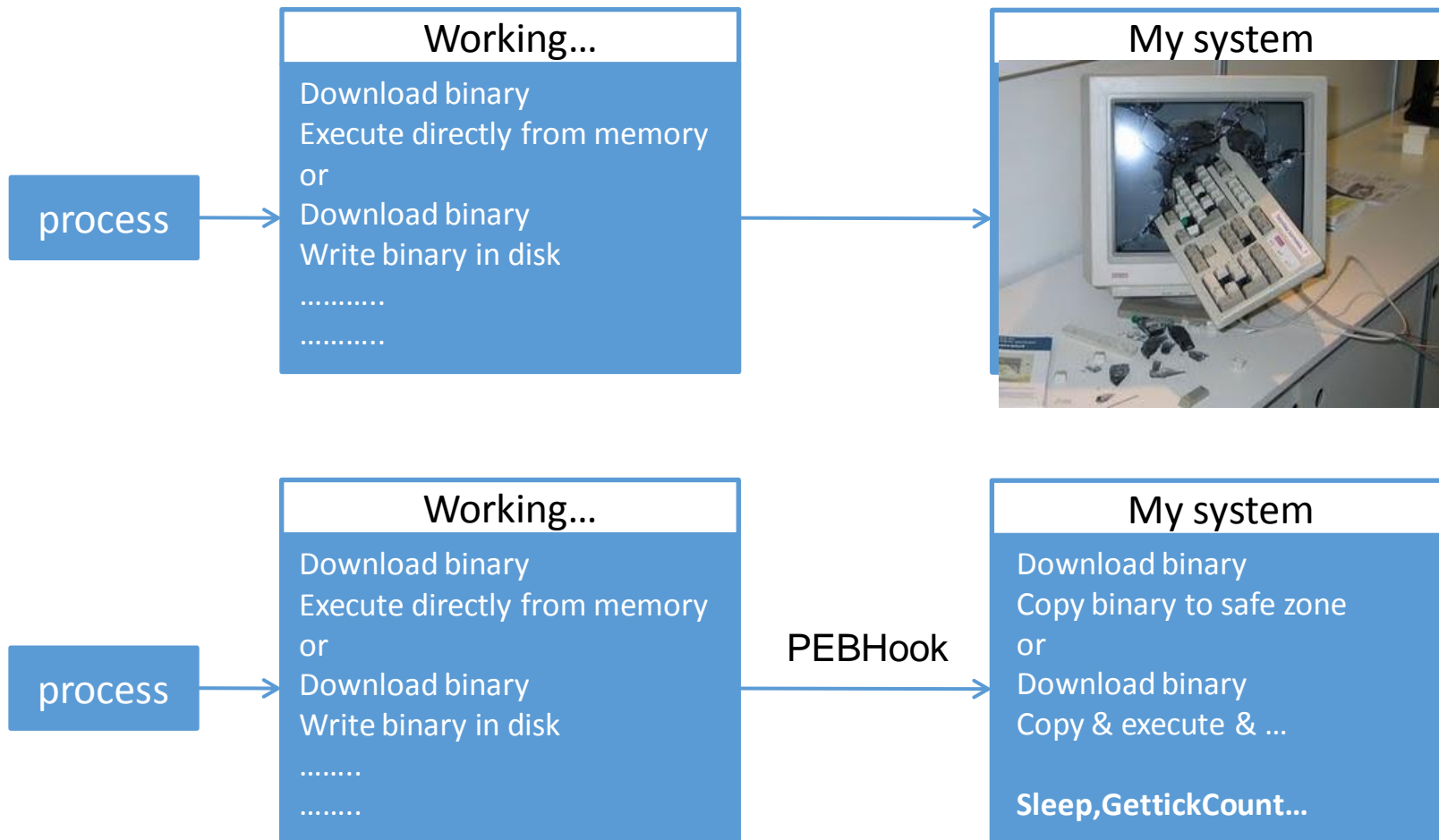
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- ph_ker32.dll
 - Export the same functions that kernel32.dll
 - We must do a specific dll for each service pack
 - The functions exported have the same ordinal as the original function
 - We can manage any function we want
 - Store the return value
 - Modify params in runtime
 - Block the execution on any API

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```
CloseHandle=_CloseHandle@4           0 50
CompareStringA=_CompareStringA@24     0 56
CompareStringW=_CompareStringW@24     0 57
CreateFileW=_CreateFileW@28           0 83
CreateFileA=_CreateFileA@28           0 80
CreateProcessA=_CreateProcessA@40     0 99
CreateProcessW=_CreateProcessW@40     0 103
CreateRemoteThread=_CreateRemoteThread@28 0 104
DeleteFileA=_DeleteFileA@4           0 130
DeleteFileW=_DeleteFileW@4           0 131
DeviceIoControl=_DeviceIoControl@32   0 137
ExitProcess=_ExitProcess@4           0 183
ExitThread=_ExitThread@4             0 184
LoadLibraryA=_LoadLibraryA@4         0 578
LoadLibraryW=_LoadLibraryW@4         0 581
MapViewOfFile=_MapViewOfFile@20       0 600
MapViewOfFileEx=_MapViewOfFileEx@24   0 601
OpenProcess=_OpenProcess@12           0 629
OutputDebugStringA=_OutputDebugStringA@4 0 636
OutputDebugStringW=_OutputDebugStringW@4 0 637
ReadFile=_ReadFile@20                0 676
ReadProcessMemory=_ReadProcessMemory@20 0 679
Sleep=_Sleep@4                        0 831
SleepEx=_SleepEx@8                   0 832
WinExec=_WinExec@8                   0 896
WriteFile=_WriteFile@20               0 908
WriteProcessMemory=_WriteProcessMemory@20 0 917
lstrcmpA=_lstrcmpA@8                 0 936
lstrcmpW=_lstrcmpW@8                 0 937
```

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```
/****** OpenProcess */  
DLLEXPORT  
HANDLE _stdcall _OpenProcess( DWORD dwDesiredAccess, BOOL bInheritHandle, DWORD dwProcessId )  
{  
    char log[MAX_PATH*2];  
    char * pname;  
    HANDLE hProcess = OpenProcess( dwDesiredAccess, bInheritHandle, dwProcessId );  
  
    pname = showProcessInformation( dwProcessId );  
    if (pname != 0)  
    {  
        sprintf(log, "0x%x|%s|0x%x", hProcess, pname, dwProcessId );  
        free(pname);  
    }  
    ApiLogger( "OpenProcess", log );  
  
    return hProcess;  
}
```

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Pebhooking: Source ReadProcessMemory

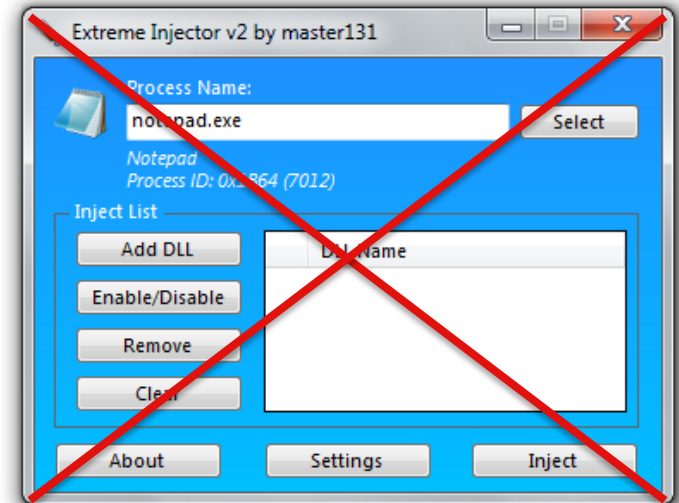
```
/****** ReadProcessMemory */  
DLLEXPORT  
BOOL _stdcall _ReadProcessMemory( HANDLE hProcess, LPCVOID lpBaseAddress,  
    LPVOID lpBuffer, SIZE_T nSize, SIZE_T *lpNumberOfBytesRead )  
{  
    char * b64str;  
    char * logentry;  
    size_t b64_size;  
    BOOL ret = ReadProcessMemory( hProcess, lpBaseAddress, lpBuffer,  
        nSize, lpNumberOfBytesRead );  
  
    // Alloc buffers  
    logentry = VirtualAlloc(NULL, nSize*3, MEM_COMMIT, PAGE_READWRITE);  
  
    // Base64  
    build_decoding_table();  
    b64str = base64_encode( lpBuffer, nSize, &b64_size );  
    b64str[b64_size] = '\\x00';  
    base64_cleanup();  
  
    // Log the API  
    sprintf(  
        logentry,  
        "0x%x|0x%x|0x%x|s",  
        hProcess,  
        lpBaseAddress,  
        nSize,  
        b64str  
    );  
    ApiLogger( "ReadProcessMemory", logentry );  
  
    // Free mem  
    free(b64str);  
    VirtualFree(logentry, 0, MEM_RELEASE);  
  
    return ret;  
}
```

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- **Merovingio**
 - Origin
 - Sandboxie
 - Merovingio Agent
- **DorianIA**
- **Merovingio Website**

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- Need to inject DLL in all processes
- Retrieves logs and info
- Avoid infecting the machine
- Multithread
- Does a lot of analysis
- Use(r) friendly
- Controls the previous analysis
- ...



Contiene: 637 archivos, 194 carpetas

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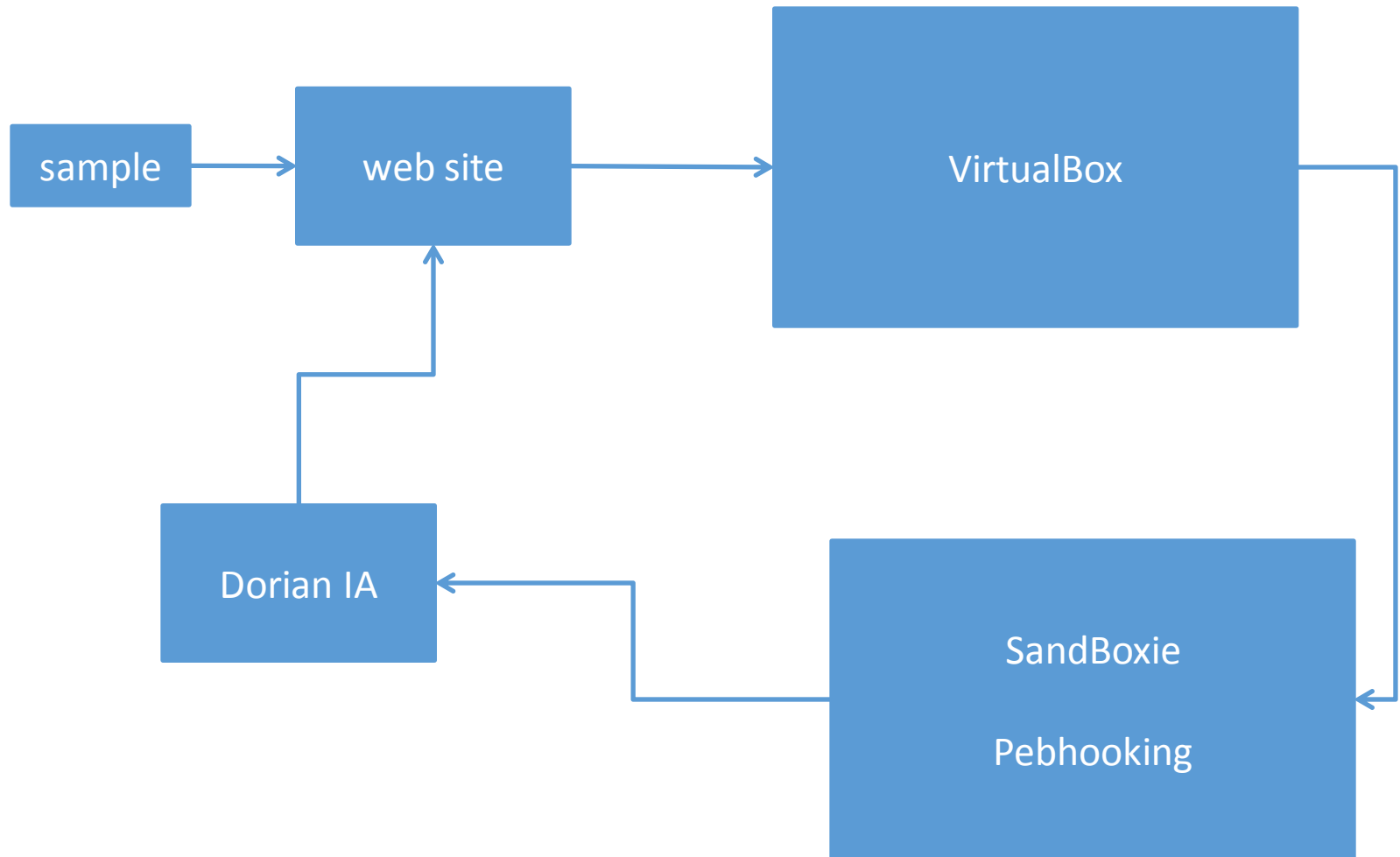
- “Virtual Machine”
- Sandboxie
- Pebhooking
- DorianIA



The screenshot shows a web interface for 'Merovingio'. At the top left, the word 'Merovingio' is written in red. Below it, the word 'Login' is displayed. To the right of 'Login', there are two input fields: the top one has a user icon to its left, and the bottom one has a key icon to its left. Below these fields are two buttons: 'Login' and 'Clear'. At the bottom right of the interface, the text '© INTECO - CERT 2014' is visible.

- And... this is the web! 😊

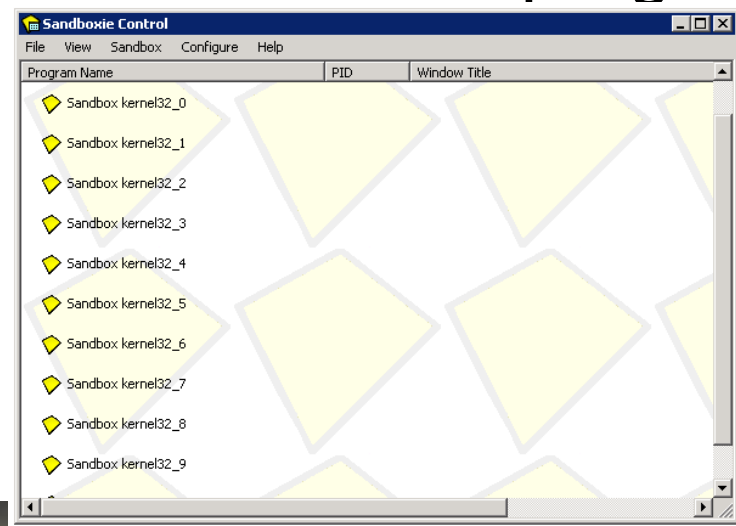
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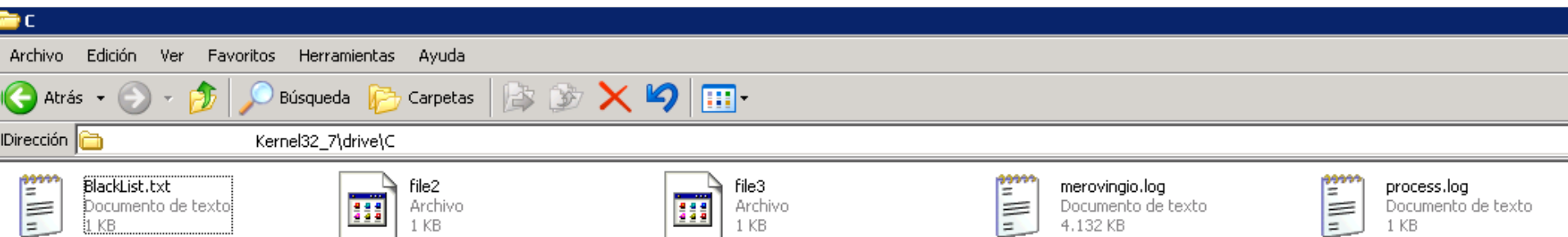
- Runs programs in a sandbox
- Prevents permanent changes on the system
- Helps us to load our libraries in each process
- Isolates each program execution



[kernel32_0]

```
InjectDll=C:\proyectos\phook\bin\windows_XP_SP2\ph_ker32.dll  
InjectDll=C:\windows\system32\user32.dll  
InjectDll=C:\windows\system32\advapi32.dll  
InjectDll=C:\windows\system32\SHELL32.dll  
InjectDll=C:\windows\system32\imagehlp.dll
```

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process.log - Bloc de notas

Archivo Edición Formato Ver Ayuda

```
0xe28|C:\Archivos de programa\Sandboxie\SandboxieRpcSs.exe
0xf98|C:\Archivos de programa\Sandboxie\SandboxieDcomLaunch.exe
0xffc|C:\Archivos de programa\Sandboxie\Start.exe
0xa78|C:\Merovingio\Analizando\ab0c0c78c8ecaaaae462579d4b0ceb674_6\Copia (3) de 6.exe
0xdb0|C:\Archivos de programa\Sandboxie\SandboxieRpcSs.exe
0xff0|C:\Archivos de programa\Sandboxie\SandboxieDcomLaunch.exe
0xb3c|C:\Archivos de programa\Sandboxie\Start.exe
0xb28|C:\Merovingio\Analizando\c196bf92d4d9d76a29d0d471b83f6915\7a453748b3ce91fa0fe82b36bdf5ae2b
0xfb4|C:\WINDOWS\system32\notepad.exe
```

BlackList.txt - Bloc de notas

Archivo Edición Formato Ver Ayuda

```
C:\Archivos de programa\Sandboxie\SandboxieRpcSs.exe
C:\Archivos de programa\Sandboxie\SandboxieDcomLaunch.exe
C:\Archivos de programa\Sandboxie\Start.exe
```

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- Tested in Windows XP and Windows 7
- Developed in Python v2.7
- Can manage as many sandboxed instances as we want
- Recover the logs and send us to next step
- Multithread
- Can receive more than one sample at the same time
- Decide on which instance must be executed the sample
 - Free slot
 - Specific analysis
- Monitorizes the analysis to detected when it is finishing

The logo features the words "NAVAJA NEGRA" in a bold, yellow, distressed font. The background is a dark, textured image of a desert landscape with a large, dark rock formation in the foreground.

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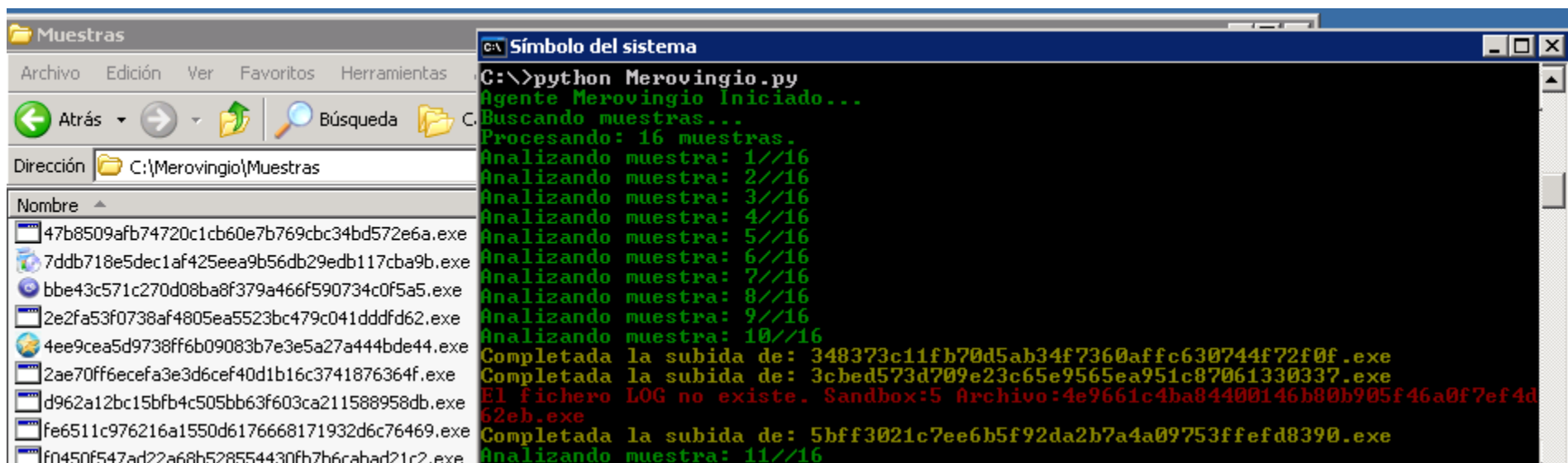

```
import threading
import sys
import os
import shutil
import hashlib
import time
import ftplib
from colorama import Fore, Back, Style
from array import *

RutaAnalisis = "C:\\Merovingio\\Analizando\\"
RutaMuestras = "C:\\Merovingio\\Muestras\\"
RutaMerovingio = "C:\\Merovingio\\"
RutaSandbox = "C:\\Sandbox\\tecnico\\"
NumSandbox = 40 #Ampliar en caso de querer utilizar más. Debe ampliarse en sandboxie
SandboxEnUso = array('i', [])
FTPServidor = '10.xx.xx.xx'
FTPUsuario = 'merovingio'
FTPClave = 'voyasubirelsueldoatodosmischicos'
TiempoAnalizando = 60 #Establecido en segundos

def main() :
    MensajeAplicacion ("Agente Merovingio Iniciado...")
    files = os.listdir(RutaAnalisis) #Limpia la carpeta de analisis. Por si hubo errores
    for file in files:
        shutil.rmtree (RutaAnalisis+file ,True)
    for i in range(NumSandbox):
        SandboxEnUso.append(int(i))
        SandboxEnUso[i] = 0
    HiloLimpiaSandbox = threading.Thread( target=Liberar_Sandbox, name='limpia sandbox')
    HiloLimpiaSandbox.start()
    MensajeAplicacion ("Buscando muestras...")
    while 1:
        Control_Muestras()
        time.sleep(5)
    return 0
```

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- Searches new samples on the path
- Copies the new samples and analyzes them
- Monitorizes Sandboxie's box
- Retrieve logs on the website



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```
int main( void )
{
    HANDLE hFile;
    HMODULE hModule;
    HKEY hKey;
    LONG lResult;
    DWORD dwValue, dwType, dwSize = sizeof(dwValue);
    LPTSTR lpValueName = "Install_Dir";
    DWORD dwDefault = 0x00000000;
    char data[100] = "TEST1";
    char out1[100] = "";
    char out2[100] = "";
    int b64_size = 0;

    // CreateFile
    hFile = CreateFileW( L"file1", GENERIC_WRITE, 0, NULL, CREATE_ALWAYS, 0, NULL );
    if ( hFile != INVALID_HANDLE_VALUE )
        CloseHandle( hFile );

    hFile = CreateFileA( "file2", GENERIC_WRITE, 0, NULL, CREATE_ALWAYS, 0, NULL );
    if ( hFile != INVALID_HANDLE_VALUE )
        CloseHandle( hFile );

    hFile = CreateFileW( L"file3", GENERIC_WRITE, 0, NULL, CREATE_ALWAYS, 0, NULL );
    if ( hFile != INVALID_HANDLE_VALUE )
        CloseHandle( hFile );

    // DeleteFile
    //DeleteFileA( "C:\\file3" );
    //DeleteFileW( L"C:\\file2" );
    DeleteFileA( "file1" );
}
```

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DEMO

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- It is based on the workflows of the neural networks
- Set the time in each received log
- Analyze the log looking for patterns
- Create execution blocks
- Try to link the different blocks to create behaviors
- Show the results in a new log that is send to the website
- At the moment it can learn new behaviors, our aim is to create a real AI

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Log from PebHooking

LoadLibraryW | IMM32.DLL
CreateFileW | C:\ikkka.exe | 0x178
CreateFileW | COMCTL32.DLL | 0x4C
LoadLibraryW | user32.dll
WriteFile | 0x178 | 0x22800 | XXXXXXXXXX
CloseHandle | 0x4C
CloseHandle | 0x178

Block

CreateFileW | C:\ikkka.exe | 0x178
WriteFile | 0x178 | 0x22800 | XXXXXXXXXX
CloseHandle | 0x178

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Log from PebHooking

```
LoadLibraryW | IMM32.DLL
CreateFileW | C:\itself.exe | 0x77
ReadFile | 0x22800 | XXXXXXXXXX
CloseHandle | 0x77
DeleteFile | C:\autoexec.bat
CreateFileW | C:\jkkka.exe | 0x178
CreateFileW | COMCTL32.DLL | 0x4C
LoadLibraryW | user32.dll
WriteFile | 0x178 | 0x22800 | XXXXXXXXXX
CloseHandle | 0x4C
CloseHandle | 0x178
```

- Read itself
- Write itself in other file
- Similar content: we use ssdeep to compare the information with threshold 95%

The sample was copied itself to another path.

Block

```
CreateFileW | C:\itself.exe | 0x77
ReadFile | 0x22800 | XXXXXXXXXX
CloseHandle | 0x77
```

Block

```
CreateFileW | C:\jkkka.exe | 0x178
WriteFile | 0x178 | 0x22800 | XXXXXXXXXX
CloseHandle | 0x178
```

Block

```
DeleteFile | C:\autoexec.bat
```

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Rules:

-Self replicate

-Duplicate others files

-Delete it self

-Open process

- ...

```
<sidsearch list="selfreplicate" param="param1" compareparam="process.i
  <desc>SELF-REPLICATE</desc>
  <showvalue values="3">[{}%]: "{}" => "{}"</showvalue>
  <malware>200</malware>
  <api>CreateFileA</api>
  <api>CreateFileW</api>
  <proc>ReadFile</proc>
  <related>WriteFile</related>
</sidsearch>
<!-- Locate replications -->
<sidsearch list="duplicatedfiles" param="param1" ssdeepcompare="param
  <desc>DUPLICATED FILES</desc>
  <showvalue values="3">[{}%]: {} => {}</showvalue>
  <malware>75</malware>
  <api>CreateFileA</api>
  <api>CreateFileW</api>
  <proc>ReadFile</proc>
  <related>WriteFile</related>
</sidsearch>
<!-- Locate self-delete -->
<sidsearch list="deleteitself" param="param1" funcparam="param1">
  <desc>DELETE ITSELF</desc>
  <malware>199</malware>
  <api>DeleteFileA</api>
  <api>DeleteFileW</api>
  <func>getProcessName</func>
</sidsearch>
<!-- Locate multiple OpenProcess -->
<sidsearch check="openprocess" times="5">
  <desc>MULTIPLE OPENPROCESS CALLED</desc>
  <malware>75</malware>
  <api>OpenProcess</api>
</sidsearch>
<!-- Locate remote threads -->
<sidsearch check="remotethread">
```

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- User management
- Able to upload different samples at the same time
- Hold the history to recover old reports
- Look for the samples by its filename or hash (SHA256,SHA1,MD5)
- All the communication with the agent is transparent to user
- Find malicious samples easily from the history

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Home page / Send samples

Merovingio [Home](#) [History](#) [Settings](#) [Logout](#)

New analisys

Choose files

Analyze

Logged in as [admin](#)
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Merovingio
[Home](#)
[History](#)
[Settings](#)
[Admin](#)
[Logout](#)

History

ID	Rate	Sha1	User	Date	Remove
69		47b8509afb74720c1cb60e7b769cbc34bd572e6a	api	15/09/2014 12:26	Remove
68	Suspicious	984e71ec6b2b13fd7d2ca40029a78f328a780a58	admin	15/09/2014 11:54	Remove
64	Malware	3c4735750c99c63e6861170a8c459a608594211e	api	15/09/2014 09:09	Remove
60	Clean	fa0aa4bf8d654a7aaa03ef33a10f8786cafc1258	api	13/09/2014 16:12	Remove
59	Suspicious	d54942675744020b0a12c8c30fafad7d7831bcf7	api	13/09/2014 06:20	Remove
58	Suspicious	e76c5d5859bf8d57d6e72f993321ecd0549167bf	api	12/09/2014 20:09	Remove
57	Suspicious	348373c11fb70d5ab34f7360affc630744f72f0f	api	12/09/2014 20:07	Remove
56	Suspicious	c124dd4bc67bc62381b6a9724c785966556ab6df	api	12/09/2014 19:12	Remove
55	Suspicious	b27a40a01f48518e2e56de79dda01ff0270a408a	api	12/09/2014 19:11	Remove
54	Suspicious	5bff3021c7ee6b5f92da2b7a4a09753ffefd8390	api	12/09/2014 19:11	Remove

Página 1 de 2
 [Siguiete](#)
 10 de 13 analysiss

Logged in as [admin](#)
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Raw log

```
2014-03-10 14:46:30.35600|0xf4|zeus.exe|Sleep|20
2014-03-10 14:46:30.36700|0xf4|zeus.exe|Sleep|20
2014-03-10 14:46:30.37700|0xf4|zeus.exe|Sleep|20
2014-03-10 14:46:30.38700|0xf4|zeus.exe|Sleep|20
2014-03-10 14:46:30.39700|0xf4|zeus.exe|Sleep|20
2014-03-10 14:46:30.40700|0xf4|zeus.exe|Sleep|20
2014-03-10 14:46:30.41700|0xf4|zeus.exe|CreateFileW|C:\zeus.exe|0x174
2014-03-10 14:46:30.41700|0xf4|zeus.exe|ReadFile|0x174|0x22800|TVoAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
2014-03-10 14:46:30.43700|0xf4|zeus.exe|CloseHandle|0x174
2014-03-10 14:46:30.52700|0xf4|zeus.exe|CreateFileW|C:\Documents and Settings\Tecnico\Datos de programa\Tysow\ovcu.exe|0x174
2014-03-10 14:46:30.52700|0xf4|zeus.exe|WriteFile|0x174|0x22800|TVoAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
2014-03-10 14:46:30.52700|0xf4|zeus.exe|CloseHandle|0x174
2014-03-10 14:46:30.52700|0xf4|zeus.exe|CreateFileW|C:\Documents and Settings\Tecnico\Datos de programa|0x174
2014-03-10 14:46:30.52700|0xf4|zeus.exe|CloseHandle|0x174
2014-03-10 14:46:30.53700|0xf4|zeus.exe|CreateFileW|C:\Documents and Settings\Tecnico\Datos de programa\Tysow\ovcu.exe|0x174
2014-03-10 14:46:30.53700|0xf4|zeus.exe|CloseHandle|0x174
2014-03-10 14:46:30.53700|0xf4|zeus.exe|CreateFileW|C:\Documents and Settings\Tecnico\Datos de programa\Tysow|0xffffffff
2014-03-10 14:46:30.53700|0xf4|zeus.exe|CreateFileW|C:\Documents and Settings\Tecnico\Datos de programa\Teylq\episw.pua|0x174
2014-03-10 14:46:30.53700|0xf4|zeus.exe|CloseHandle|0x174
2014-03-10 14:46:30.53700|0xf4|zeus.exe|CreateFileW|C:\Documents and Settings\Tecnico\Datos de programa\Teylq|0xffffffff
2014-03-10 14:46:30.53700|0xf4|zeus.exe|CreateFileW|C:\Documents and Settings\Tecnico\Datos de programa|0x174
2014-03-10 14:46:30.54700|0xf4|zeus.exe|CloseHandle|0x17c
2014-03-10 14:46:30.55700|0xf4|zeus.exe|MapViewOfFile|0x180|0x22800
2014-03-10 14:46:30.55700|0xf4|zeus.exe|CloseHandle|0x180
2014-03-10 14:46:30.58700|0xf4|zeus.exe|CloseHandle|0x188
2014-03-10 14:46:30.58700|0xf4|zeus.exe|MapViewOfFile|0x18c|0x22800
2014-03-10 14:46:30.58700|0xf4|zeus.exe|CloseHandle|0x18c
```

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Analysis

Merovingio [Home](#) [History](#) [Settings](#) [Logout](#)

Result: MALWARE

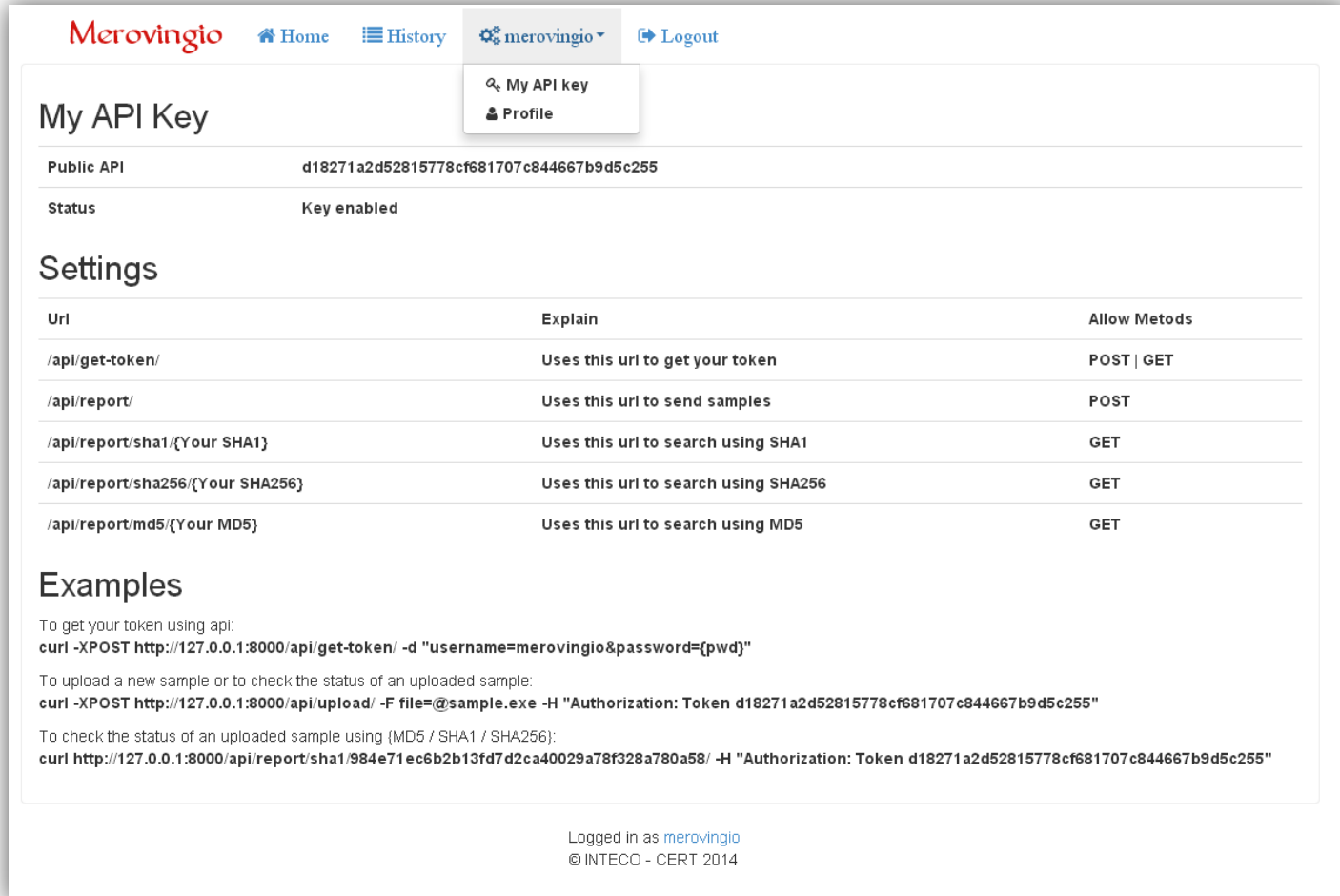
```
1 + INIT IA
2   + ANALYSING PROCESSES: 2
3   + ANALYSING PROCS: 230
4   + CREATING BLOCKS: 142
5   + LOADING RULES: rules.xml
6 + MALICIOUS BEHAVIOURS DETECTED
7   + SELF-REPLICATE
8     + [97%]: "C:\Merovingio\Analizando\854b6605fd318ce01336d9212412a9\94f37021ee819cc6c01247ddbcfb474a5a8540b8.exe" => "C:\Docur
9   + TRY TO READ/WRITE OTHER PROCESS
10  + TRY TO FOUND WINLOGON.EXE
11  + MULTIPLE OPENPROCESS CALLED
12 + OTHER INFORMATION
13   + MODIFIED FILES IN "Documents And Settings"
14     + "C:\Documents and Settings\tecnico\Datos de programa\0kzyv\uczyl.exe"
15   + MULTIPLE CALLS TO SLEEP
```

Details

User	admin
SHA1	94f37021ee819cc6c01247ddbcfb474a5a8540b8
Rate	MALWARE
Date	2014-05-27 13:45:22.969193+00:00
Remove	<input type="button" value="Remove"/>

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API



The screenshot shows the Merovingio web interface. At the top, there's a navigation bar with 'Home', 'History', 'merovingio' (with a dropdown menu), and 'Logout'. The dropdown menu contains 'My API key' and 'Profile'. The main content area is titled 'My API Key' and displays a 'Public API' key: 'd18271a2d52815778cf681707c844667b9d5c255'. Below this, the 'Status' is 'Key enabled'. A 'Settings' section follows, containing a table with API endpoints, their descriptions, and allowed methods.

Url	Explain	Allow Metods
/api/get-token/	Uses this url to get your token	POST GET
/api/report/	Uses this url to send samples	POST
/api/report/sha1/{Your SHA1}	Uses this url to search using SHA1	GET
/api/report/sha256/{Your SHA256}	Uses this url to search using SHA256	GET
/api/report/md5/{Your MD5}	Uses this url to search using MD5	GET

Below the table is an 'Examples' section with three curl commands:

```
To get your token using api:  
curl -XPOST http://127.0.0.1:8000/api/get-token/ -d "username=merovingio&password={pwd}"  
  
To upload a new sample or to check the status of an uploaded sample:  
curl -XPOST http://127.0.0.1:8000/api/upload/ -F file=@sample.exe -H "Authorization: Token d18271a2d52815778cf681707c844667b9d5c255"  
  
To check the status of an uploaded sample using (MD5 / SHA1 / SHA256):  
curl http://127.0.0.1:8000/api/report/sha1/984e71ec6b2b13fd7d2ca40029a78f328a780a58/ -H "Authorization: Token d18271a2d52815778cf681707c844667b9d5c255"
```

At the bottom, it says 'Logged in as merovingio' and '© INTECO - CERT 2014'.

NAVAJA NEGRA

- Max. runtime 2 minutes, but the analysis stop when it doesn't detect any new behavior
- The same machine can analyze over 20 samples both (VM or real)
- To grow we need add RAM memory to allocate more process or add a new machine to get 20 slots.
- Very cheap (information for 20 analysis):
 - Just one machine
 - 4Ghz CPU (4 cores) and 4Gb RAM
 - The analysis can be stopped when the sample finishes the execution



NAVAJA NEGRA

- **720** samples can be analyzed in each sandboxed instance daily
- **14.400** samples use 20 instances in the sandboxie
- Only 1 cheap machine to get this numbers

NAVAJA NEGRA

- Any doubts??
- Any questions??
- Any donations?? 😊
- Donaciones?? 😊 😊 😊



NAVAJA NEGRA

Gracias!!!

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The logo for the NAVAJA NEGRA CONFERENCE. It features the words "NAVAJA NEGRA" in a large, bold, yellow, distressed font. Below this, the word "CONFERENCE" is written in a similar yellow, distressed font, but it is contained within a solid yellow rectangular box. The background of the entire slide is a dark, textured image of what appears to be a rocky or metallic surface.