

SMB : SHARING MORE THAN JUST YOUR FILES

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Who are we ?

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Presented at Blackhat/Defcon/CCC/HITB...

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Who are we ?

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Security Researcher

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First time speaker at Blackhat
Co-author of the first remote exploit against Windows 10
Co-author of the first remote exploit against Microsoft Edge

Agenda



Agenda

- Introduction to SMB
- Previous Work
- SMB Relay Rebooted
- Root cause analysis
- French Kiss (attack)
- Syphilis (attack)
- Ménage à Trois (attack)
- Mitigation

Introduction to SMB



Demo : Previous Work



Introduction to SMB

What is SMB ?

A network file sharing protocol

Requires Authentication

Designed for Local networks

Introduction to SMB

What is NTLM ?

NT LAN Manager: Suite of security protocols NTLMv2
Challenge response authentication protocol
Cannot be replayed

SMB Relay

Very old exploit

Known since 2001 implemented by Sir Dystic (Cult of the Dead Cow)

Very good exploits

Alberto Solino (Core Security) smbrelayx.py

Metasploit module

How it works

Using the hash produced to re-authenticate
against another service on the (same) machine.

SMB Relay

Original attack scenario

Attacker is on local intranet

Victim visits attackers website with file:// in img tag

IE auto authenticates to attacker

Attacker replays the hash back to the same victim (SMB Reflection :
CVE2008-4037)

SMB Relay

Limits of this attack

Attacker needs to be on the same local network
NOT accessible over the Internet.

SMB Credential Reflection Vulnerability

(CVE2008-4037)

Microsoft issued a partial fix (MS08-068)

Prevents replay of hash to the same machine

Does not stop the attacker from

Relaying the hash to another machine

Breaking the hash

Contribution

We're extending previous research :
SMB Relaying,
Breaking hashes...

this time, remotely over the internet

SMB Relay : Rebooted



DEMO : French Kiss Attack (IE to SMB)



Affected Software

All versions of Windows are affected

First remote exploit against Windows 10

First remote exploit against Microsoft Edge

SMB Relay Rebooted

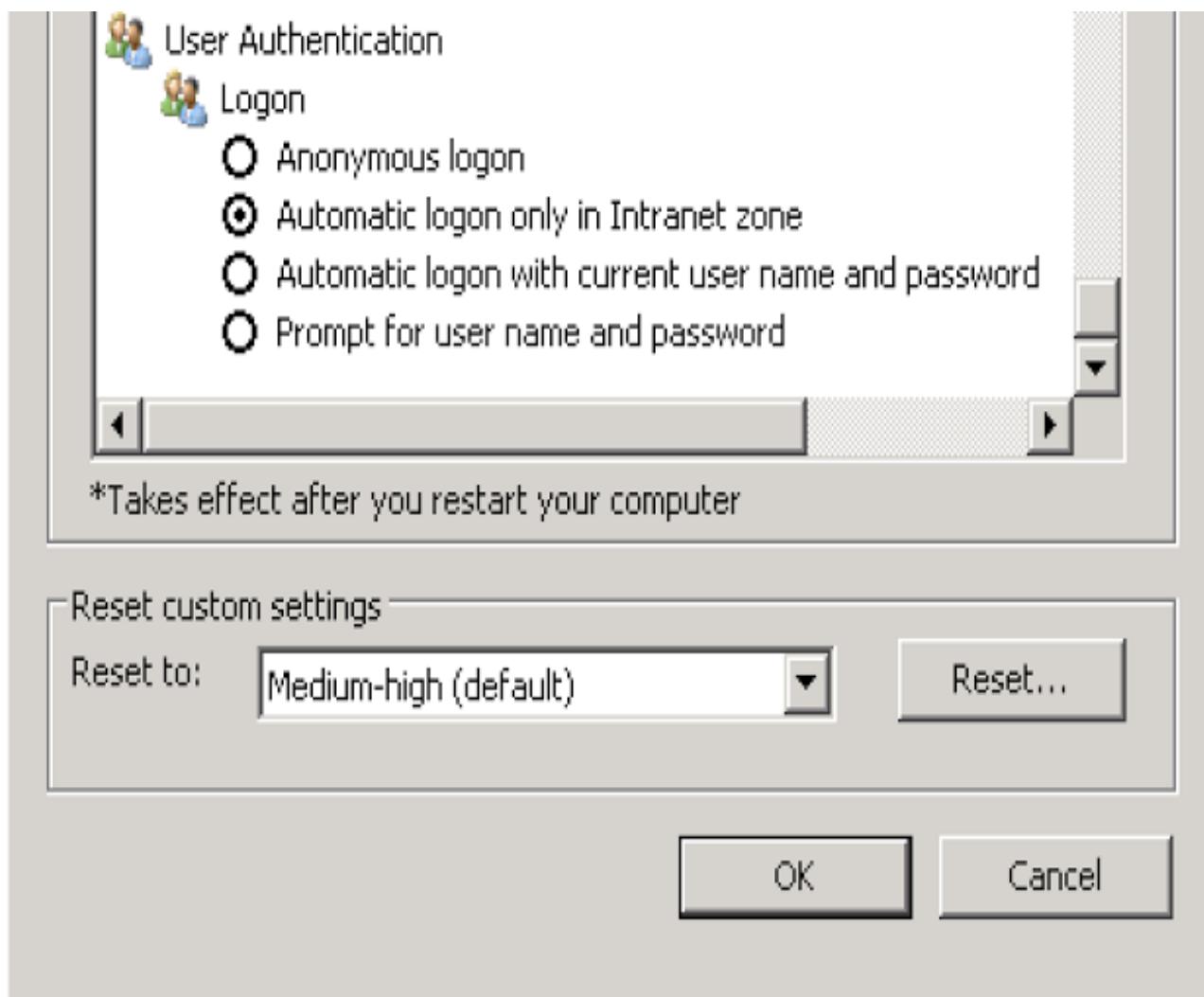
Main Assumption is Attacker is on the victim's network.

Issue Severity:

Note that attacks targeting this issue only work in the Intranet zone – Internet Explorer will not send credentials automatically in the Internet zone. This limits attacks to coming from within the same subnet

SMB Relay Rebooted

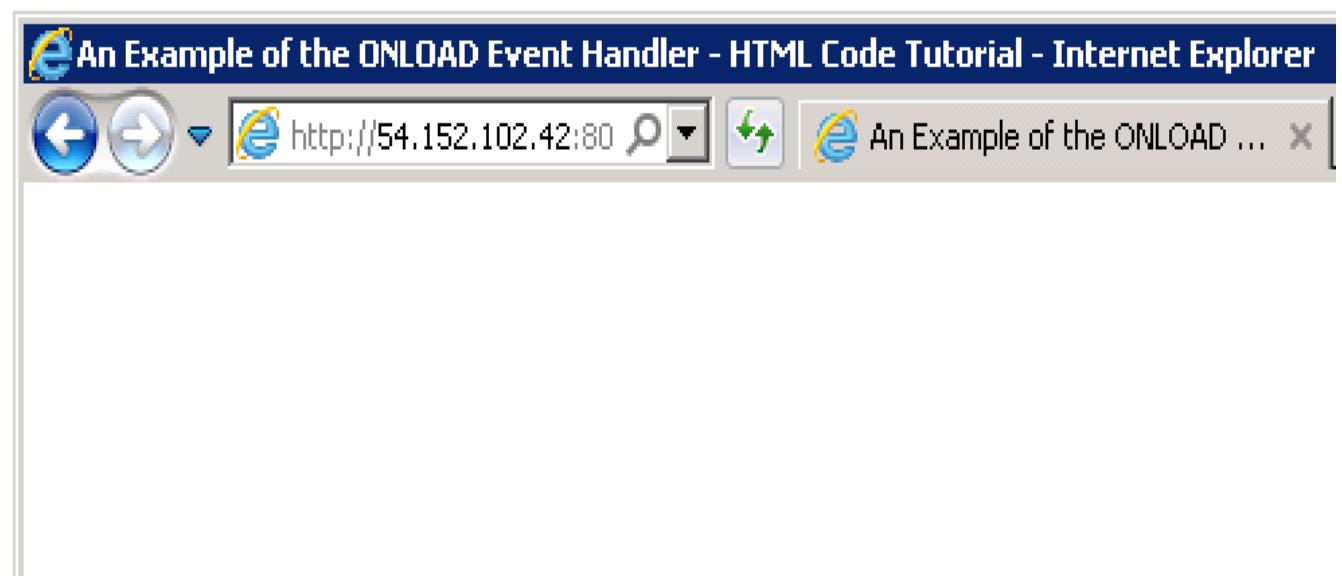
There's actually an IE setting for this :



The Mighty IMG tag

(Very) Basic trigger :

```
7 <BODY>
8 
9 </body>
10
```



SMB Relay Rebooted

59 38.3612930 172.31.39.166	54.209.109.93	TCP	54 50998+445 [ACK] Seq=1 ACK=1 Win=60036 Len=0
60 38.3613510 172.31.39.166	54.209.109.93	SMB	213 Negotiate Protocol Request
61 38.3624960 54.209.109.93	172.31.39.166	TCP	54 445+50998 [ACK] Seq=1 Ack=160 Win=30336 Len=0
62 38.3709730 54.209.109.93	172.31.39.166	SMB	173 Negotiate Protocol Response
63 38.3803440 172.31.39.166	54.209.109.93	SMB	193 Session Setup AndX Request, NTLMSSP_NEGOTIATE
64 38.4012130 54.209.109.93	172.31.39.166	SMB	426 Session Setup AndX Response, NTLMSSP_CHALLENGE, Error: STATUS_MORE_PROCESSING_REQUIRED
65 38.4015660 172.31.39.166	54.209.109.93	SMB	706 Session Setup AndX Request, NTLMSSP_AUTH, User: RELAY\hormazd
66 38.4136650 54.209.109.93	172.31.39.166	SMB	120 Session Setup AndX Response

What is going on here ?

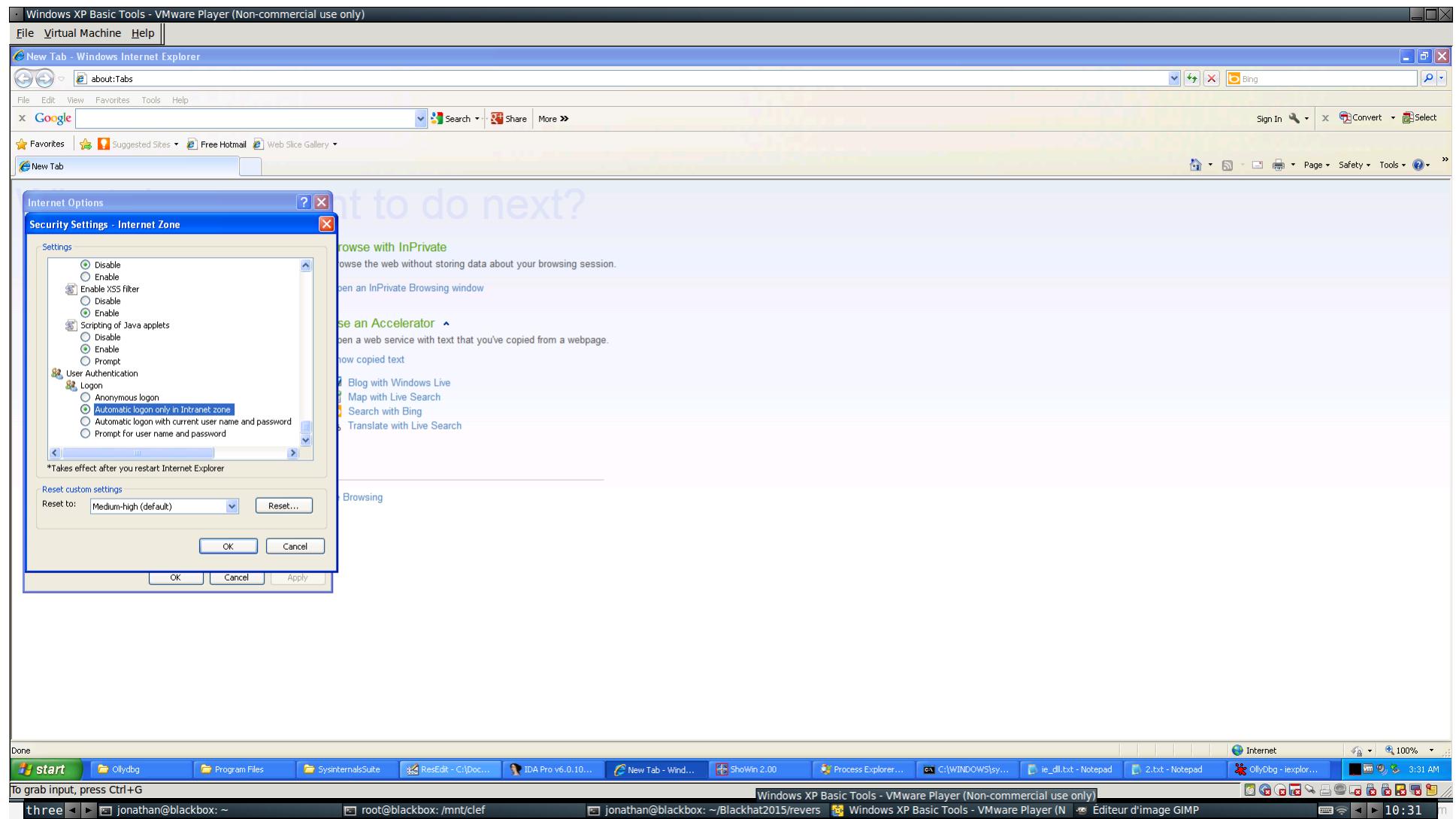
SMB Relay Rebooted

Authentication is actually happening silently !

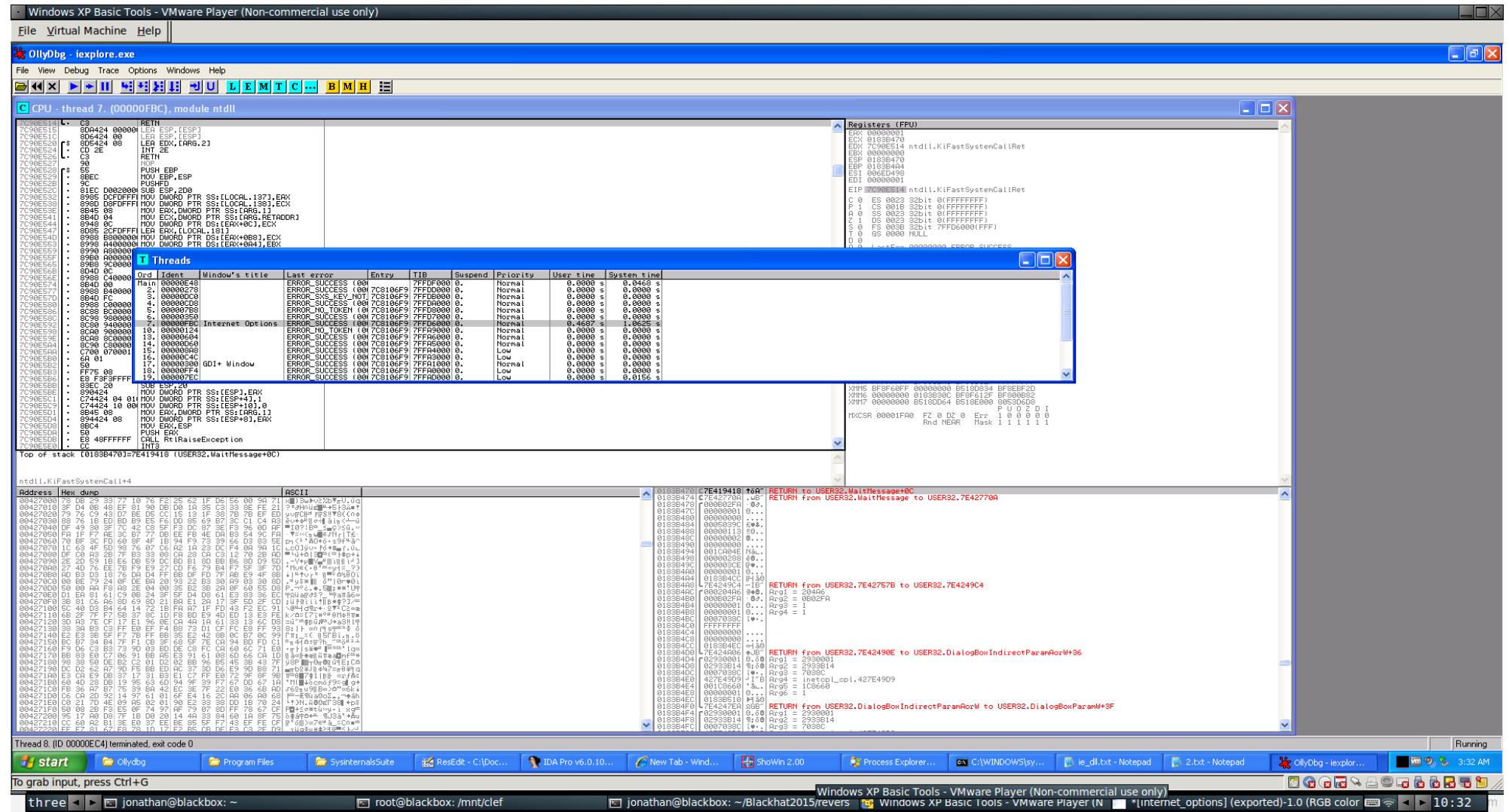
Root Cause Analysis



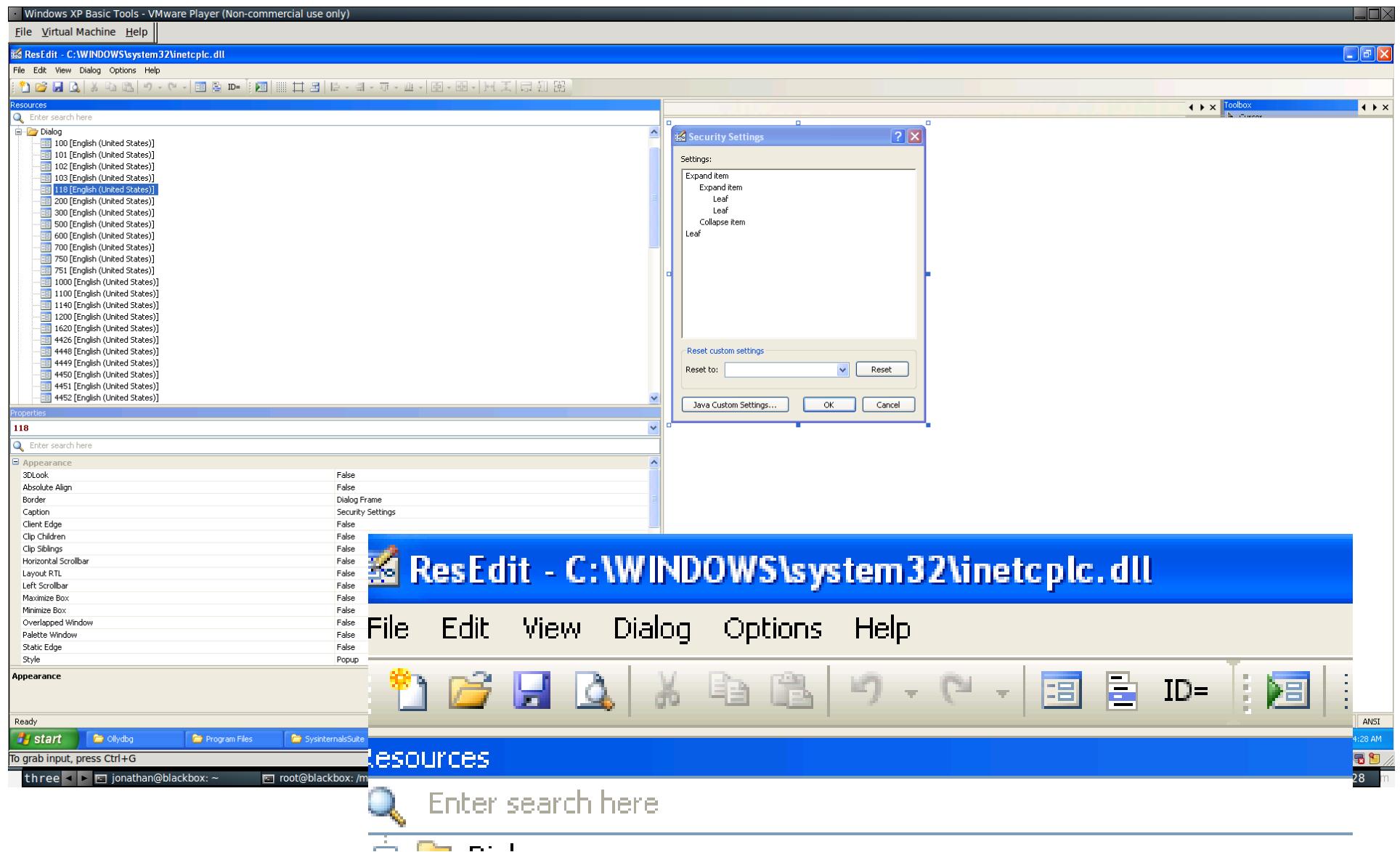
Root Cause Analysis



Root Cause Analysis



Root Cause Analysis



Diffing the registry

The screenshot shows the Kompare application interface comparing two registry files: `prompt_user.reg` and `automatic_logon_internet.reg`. The comparison results are displayed in a four-column grid:

Source File	Destination File	Source Line	Destination Line	Difference
<code>prompt_user.reg</code>	<code>automatic_logon_internet.reg</code>	222	222	Changed 1 line

The main pane displays the registry differences, with line numbers on the left. A specific difference is highlighted at line 222:

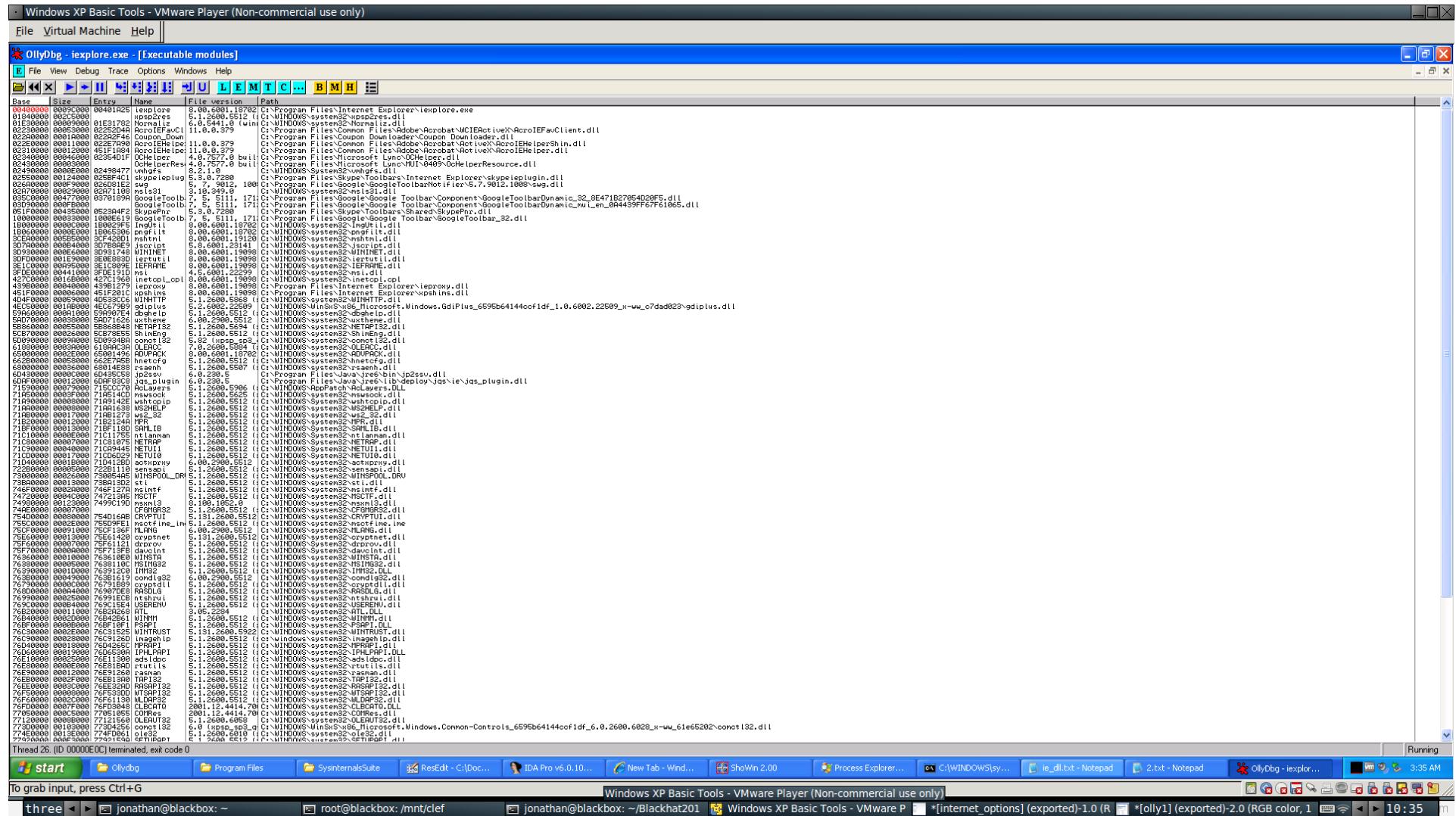
```
187 [HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Internet  
188 @=""  
189 "DisplayName"="Internet"  
190 "Description"="This zone contains all websites you haven't placed in other zones"  
191 "Icon"="inetcpl.cpl#001313"  
192 "CurrentLevel"=dword:00000000  
193 "MinLevel"=dword:00011000  
194 "RecommendedLevel"=dword:00011000  
195 "Flags"=dword:00000001  
196 "1001"=dword:00000001  
197 "1004"=dword:00000003  
198 "1200"=dword:00000000  
199 "1201"=dword:00000003  
200 "1206"=dword:00000003  
201 "1400"=dword:00000000  
202 "1402"=dword:00000000  
203 "1405"=dword:00000000  
204 "1406"=dword:00000003  
205 "1407"=dword:00000001  
206 "1601"=dword:00000000  
207 "1604"=dword:00000000  
208 "1605"=dword:00000000  
209 "1606"=dword:00000000  
210 "1607"=dword:00000003  
211 "1608"=dword:00000000  
212 "1609"="0"  
213 "1800"=dword:00000001  
214 "1802"=dword:00000000  
215 "1803"=dword:00000000  
216 "1804"=dword:00000001  
217 "1805"=dword:00000001  
218 "1806"=dword:00000001  
219 "1807"=dword:00000001  
220 "1808"=dword:00000000  
221 "1809"=dword:00000000  
222 "1A00"=dword:00010000  
223 "1A02"=dword:00000000  
224 "1A03"=dword:00000000  
225 "1A04"=dword:00000003  
226 "1A05"=dword:00000001  
227 "1A06"=dword:00000000  
228 "1A10"=dword:00000001  
229 "1C00"=dword:00010000  
187 [HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\3]  
188 @=""  
189 "DisplayName"="Internet"  
190 "Description"="This zone contains all websites you haven't placed in other zones"  
191 "Icon"="inetcpl.cpl#001313"  
192 "CurrentLevel"=dword:00000000  
193 "MinLevel"=dword:00011000  
194 "RecommendedLevel"=dword:00011000  
195 "Flags"=dword:00000001  
196 "1001"=dword:00000001  
197 "1004"=dword:00000003  
198 "1200"=dword:00000000  
199 "1201"=dword:00000003  
200 "1206"=dword:00000003  
201 "1400"=dword:00000000  
202 "1402"=dword:00000000  
203 "1405"=dword:00000000  
204 "1406"=dword:00000003  
205 "1407"=dword:00000001  
206 "1601"=dword:00000000  
207 "1604"=dword:00000000  
208 "1605"=dword:00000000  
209 "1606"=dword:00000000  
210 "1607"=dword:00000003  
211 "1608"=dword:00000000  
212 "1609"="0"  
213 "1800"=dword:00000001  
214 "1802"=dword:00000000  
215 "1803"=dword:00000000  
216 "1804"=dword:00000001  
217 "1805"=dword:00000001  
218 "1806"=dword:00000001  
219 "1807"=dword:00000001  
220 "1808"=dword:00000000  
221 "1809"=dword:00000000  
222 "1A00"=dword:00000000  
223 "1A02"=dword:00000000  
224 "1A03"=dword:00000000  
225 "1A04"=dword:00000003  
226 "1A05"=dword:00000001  
227 "1A06"=dword:00000000  
228 "1A10"=dword:00000001  
229 "1C00"=dword:00010000
```

At line 222, both files show the same value: `1A00` = `dword:00010000`.

At the bottom of the interface, status bars indicate:

- Comparing file file:///tmp/diff/prompt_user.reg with file file:///tmp/diff/automatic_logon_internet.reg
- 1 of 1 difference, 0 applied
- 1 of 1 file

Tracing



Tracing

Lessons learned

It's not just IE

All Windows applications relying on System dlls to fetch URLs are vulnerable (see C:\Windows\inetcplc.dll...).

Registry keys involved

HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones*

What's happening

Inetcplc.dll does save the settings properly in the registry.
Registry configuration is queried, and then ignored !

DEMO: French Kiss to Malware (Syphilis attack)



Syphilis attack

Time to attack via SMB relay

Fool user into visiting malicious website (r/netsec ?)

Relay credentials to DC on the same network

Maybe attack NTLM over HTTP server auth?

Attack Limitations

Packet signing needs to be disabled (only for relaying malware)

Recommended to improve performance

SMB outbound needs to be enabled

Failing egress filtering at Firewall level (common)

In regards to packet signing...

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SMB Signing must be disabled for Windows NTLM authentication to work

Technical Articles ID: KB74145
Last Modified: 9/25/2013

Environment
McAfee Firewall Enterprise 8.3.x, 8.2.x

Summary
According Microsoft KB article 887429 (support.microsoft.com/kb/887429), you can configure SMB signing to be OFF, ON but not required, or ON and required for clients to login.

You must disable SMB signing (in other words, set it to OFF) for NTLM authentication via the firewall to work. You cannot set it to be ON but not required; you must completely disable it on the Windows server.

Solution
For instructions about turning SMB signing off, see [PD21455](#),

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 No

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Optional

Affected Products

DEMO: French Kiss to RDP



French Kiss to RDP

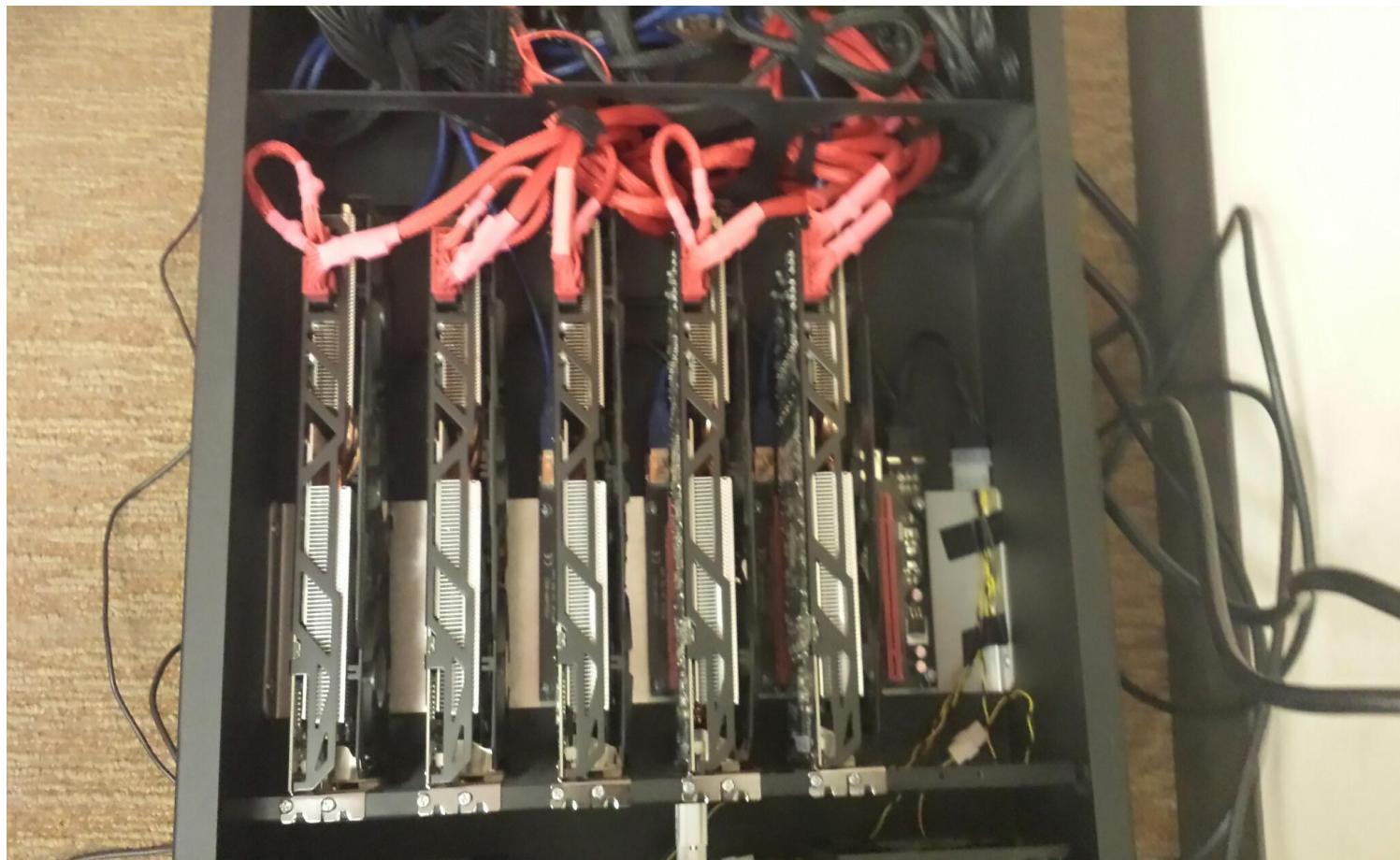
Hash cracking

GPU cracking Super fast (HashCat)

Our own cracking machine

Can crack 2.4 Billion hashes/sec

Hash Cracking Hardware



French Kiss to RDP

Key space of 68 characters

Uppercase

Lowercase

Alphanumeric

Special characters - !@#\$%&

8 Characters passwords

68^8 - 2 days and 5 hours to crack

NTLM authentication over the Internet

SHODAN realm="SMB" Search

Results 1 - 10 of about 1506 for WWW-Authenticate: Basic realm="SMB"

Services	Count	Details
HTTP	896	401 Unauthorized 219.85.116.80 Linux 2.6.x Sony Network Taiwan Limited Added on 12.01.2014 Taipei 219-85-116-80-adsl-TPE.dynamic.sonet.net.tw
HTTP Alternate	574	HTTP/1.0 401 Unauthorized Pragma: no cache Content-type: text/html Date: Sun, 12 Jan 2014 14:16:20 GMT Accept-Ranges: bytes Connection: close WWW-Authenticate: Basic realm="SMB"
HTTPS	33	
HTTPS Alternate	3	

Top Countries	Count	Details
India	1,273	
China	118	
Taiwan	102	401 Unauthorized 118.166.81.94 CHTD, Chunghwa Telecom Co., Ltd. Added on 12.01.2014 Taipei 118-166-81-94.dynamic.hinet.net
Mexico	5	HTTP/1.0 401 Unauthorized Pragma: no cache Content-type: text/html Date: Sun, 12 Jan 2014 13:04:45 GMT Accept-Ranges: bytes Connection: close WWW-Authenticate: Basic realm="SMB"
Hong Kong	3	

Details
401 Unauthorized 115.244.226.75 BSES TeleCom Limited Added on 01.01.2014 Pondicherry

HTTP/1.0 401 Unauthorized
Pragma: no cache
Content-type: text/html
Date: Wed, 01 Jan 2014 21:30:53 GMT

Impact

Retrive user credentials

Username sent in plain text

Password cracked

Remote code execution

Leveraging NTLM authentication over HTTP allows us to RCE

Billions of corporate users are vulnerable

IE is the market leader in Corporate environments

Other triggers



DEMO : Video trigger



Ménage à Trois



DEMO : Ménage à trois (SMB Relay to Exchange)



Ménage à Trois

Owning the cloud(s)

Demos done on Amazon AWS, Microsoft Azure

Thousands of servers allowing NTLM over HTTP

Unsafe defaults

Extended protection isn't enabled by default

Extended protection is hard to configure

Mitigations



How to protect yourself

Egress filtering at Perimeter level

Drop outgoing SMB on ports 137/138/139/445.

Host level hardening

Drop outgoing SMB on ports 137/138/139/445 to public IPs

Enable Packet Signing

Enable Extended Protection

Take away



Impact

We forced a victim to send us their credentials

Through a website

Through an email

Through a video...

Able to upload malware

Able to replay SMB to Exchange

Able to replay to any service using NTLMSSP

And all of this was done remotely from the Internet

All versions of Windows are affected

Windows 10 and Microsoft Edge are also vulnerable

Acknowledgements



Greetings

Special thanks to MSRC for working on those vulnerabilities with us for the past 9 months.

Questions ?

