${f Topics}$	Enumeration2-1	.00
	Logon Event2-	
Incident Response Steps1-20-21	Tracking Administrator2-	
1. Preparation1–20	Tracking Creation2-	
2. Identification1–20	Tracking Usage2-	
3. Containment1–21	Tracking Usage (RDP)2-	-89
4. Eradication 1–21	Usage (RDP)2-	
5. Recovery1–21	AceHash2–10, 2–24, 2–	
6. Lessons Learned1–21	ACMRU4-	
	Active Defense1–	
Service Name	Admin Shares2-1	
${\tt DcomLaunch} \hspace{0.1in} \dots \hspace{0.1in} 1-76$	Destination Artifacts2-1	.34
LocalServiceAndNoImpersonation $\dots 1-76$	Source Artifacts	.33
LocalServiceNetworkRestricted $\dots 1-76$	ADMIN\$ W-2.4	<u>l</u> –7
${\tt LocalServiceNoNetwork} \ \dots \dots 1-76$	Advanced NTFS Journal Parser (ANJP)4-1	.92
$\verb netsvcs 1-76$	Alternate Data Stream	.71
NetworkService $\dots 1-76$	Amcache.hve2-	-55
RPCSS $1-76$	Parsing 2-	
	AmcacheParser.exe2-	-58
Windows Process	$AMSI \rightarrow Anti-Malware Scanning Interface \dots$	
csrss.exe1-77	Analysis Scenario2–	-72
explorer.exe	AnalyzeMFT4–157, 4–1	
$\verb lsaiso.exe $	$ANJP \rightarrow Advanced NTFS Journal Parser$	
LSASS.exe1-79	ANONYMOUS LOGON2-	-83
ntoskrnl.exe1-80	Anti-Forensics	.19
${\tt RuntimeBroker.exe} \ \dots \dots 1-80$	Anti-Malware Script Obfuscation2-1	.70
services.exe1-77	Anti-Virus	
${\tt smss.exe} \hspace{0.1in} 1-77$	Bypass1-	-67
$\verb svchost.exe $	Logs2-1	.56
${\tt System} \hspace{0.1cm} \dots \hspace{0.1cm} 176$	$AppCompatCache \rightarrow Application Compatibility$	
taskhostw.exe1-79	Cache	
userinit.exe	${\tt AppCompatCacheParser.exe} \hspace*{0.5cm} \dots \hspace*{0.5cm} 2$	-54
wininit.exe $1 ext{-}78,1 ext{-}80$	Application Compatibility Cache 4–12, 2–	
winlogon.exe	Application Deployment Software2-1	.48
	APT193-	
wmic	Archives (embedded timestamp)4-	-39
$\verb group \dots 1-109$	Armoring1-	
$\verb netuse \dots 1-109$	Artifacts4	
process $\dots 1-109$	Account Usage4-	
qfe(KBpatch listing)1-109	Browser Usage4-	
$\mathtt{startup} \dots 1 - 109$	Deleted file or File Knowledge4-	
$\verb"useraccount" 1-109"$	File Opening/Creation4-	
	Network 3-1	
	Network Shares2-1	
#	OS Unusual1-	
π	Physical Location4-	
\$STANDARD_INFORMATION 4–38, 4–154, 4–156	PowerShell2-1	
\$FILE_NAME4-154, 4-157	Program Execution 4-	
\$DATA4-168	PsExec	
\$logfile Operation Codes4–186	Remote Desktop Protocol (RDP) 2–130-1	
\$UsnJrnl	Remote Service	
Parsing4–190	Scheduled Tasks2–1	
Reason Code	USB or Drive Usage4-	
	WMI2-1	
A	at.exe	
${f A}$	ATT&CK1-	
Λ	Collection1-	
Account Built-in accounts 2–83	Command and Control1-	-45
13000 = 10 accounts 7=83		

Credential Access1–45	Common Information Model (CIM)1–107
Defense Evasion	Compromise Type1–55
Discovery1–45	Conficker
Execution	Containment
Exfiltration	CozyDuke3–101
Impact	CreateInstance
Initial Access	CreateRemoteThread3–134, 135
Lateral Movement	creddump2–10, 2–24, 2–28
Persistence	Credential 10, 2 24, 2 20
Privilege Escalation	Attacks (evolution)2-8
<u> </u>	
Attack Lifecycle	Availability
	Harvesting
High privileges lateral movement cycle 1–36	Credential Guard2–9
Initial Compromise1–36	CredSSP
Low privileges lateral movement cycle1–36	CRITS
AutoRun	Cyber Threat Intelligence
AutoRunsc.exe	CyberChef
AutoStart (ASEPs)1-69	
В	D
Ъ	DarkComet
BadRabbit	Data Encryption
base64	dc3dd
Beacons	Deep Panda
Behavior Detection Anomaly	Defense Manipulation
BelgaSoft3–39	densityscout
Binary Padding1–67	Device Guard
blkls	Direct Kernel Object Manipulation (DKOM) 3–168
Bloodhound2–100	Directory Table Base (DTB)3–50
Browser	$DKOM \rightarrow Direct Kernel Object Manipulation$
Cache4–24	DLL Hijacking
Cookies	DLL Search Order Hijacking1–74
Flash & Supercookies	DLL Side-Loading
History	Phantom DLL Hijacking
Search Terms	DLL Injection
Session Restore	DLL Lists
Brute-Force Password Attack2–81	Domain Protected User
bstring.exe	Download.sqlite
BulkExtractor	Driver Acquisition
bytehist	Driver Letter
5) COMPS	$DTB \rightarrow Directory Table Base \dots 4 21$
	DumpIt
\mathbf{C}	Dun and Bradstreet Rating
	DWM
Cached Credentials2–24	D W WI
Defense2–27	
cachedump2-24	${f E}$
Cain2–28	
Certification Authority	E-mail Attachments 4–11
Chat threads	ECTXtract2–183
$CIM \rightarrow Common Information Model \dots$	$EDR \rightarrow Endpoint Detection and Response \dots$
cmd.exe	Endpoint Detection and Response (EDR)3–29
Code Injection1–74, 3–134	Challenge3–31
Reflective	Importance
Review	Memory
Code Signing	EPROCESS
Malware	Eradication Without Identification1–22
Command Line Tracking2–158	Event Log Explorer

Event Viewer	fxsst.dll	1–75
EventLog		
Application	${f G}$	
Clearing		1 00
Clearing (Selective)	Get-Alias	
Deletion 4–121	Get-ChildItem	
EventID2–191	Get-LsaSecret.ps1	
Extraction2–183	Get-Process	
Forwarding	Get-Service	
PowerShell2–185	Get-SvcFail.ps1	
Security2-68	Get-WinEvent	
Security Event	Get-WmiObject	
Service2-67	GlassRAT	
Summary2–182	Golden Ticket	
Tampering4–121	gpedit.msc	
Types2-66	grep	
eventlogedit2–126	Group Enumeration	
eventvwr.exe2-74	Group Managed Service Account	
EVT	GRR	
evtwalk2–183	${\tt gsecdump} \ \dots \dots 2 10,$	2-13, 2-28
EVTX2-64		
evtx_view2–183	\mathbf{H}	
Executive Process Block		
	Handle	
D	Hashes	
${f F}$	Defense	
	Hibernation Files	,
F-Response	Windows 10	3–47
Acquire Memory3-18	Hibernation Recon	3-43
Agent Service3-15	hibr2bin	3–43
Attach Remote Drive	Hiding in Plain Sight	1–59
Enterprise3-8	Historical Data	4–124
GPO3–14	Hunting 1–2	29, 1–31-34
MSI3–12	Automated to Manual	1-56
SIFT3–39	Steps (Roadmap)	1–54
Fast forensics		
fgdump2–10	I	
File	-	
Delete4–119	I/O Request Packet (IRP)	3–161
Download4–11	$IAT \rightarrow Import Address Table \dots$	
Handle3–111	$IDT \rightarrow Interrupt Descriptor Table \dots$	
Wiping4–119	Import Address Table (IAT)	
File System	Incident Response	
Journaling4–182-185	Remote	
Filename	Team	1–32
Hijacking1-67	Incognito	
Filename	Incognito mode	
filter_windows 4–81	Index.dat	
Firmware	Indicator of Compromise	
fls	Atomic	
foremost	Behavioral	
Forensics (Remote)	Computed	
Format-Wide	Language	
fr_ace	InInitializationOrderModule List	
add3–16	Inline API	
mount	InLoadOrderModule List	
query	InMemoryOrderModule List	
Frequent Compilation	Intelligence Development	
FU Rootkit	Internet Evidence Finder	
1: 1/ HAMMAH	THICH HELLINGUE HELD CELL	

Interrupt Descriptor Table (IDT)	Scheduled Tasks 2–112 Shares 2–106 Tracking 2–105
$IRP \rightarrow I/O$ Request Packet	Least frequency of occurence analysis
${f J}$	Living off the Land Binaries (LOLbin)1-60 LoadLibrary3-134, 3-149
	Local Account2–95
jobparser.py2-115	Abuse2–98
jp4-191	Local Admin (Limitations)2-6-7
Jump List4–13	Local Administrator Password Solution (LAPS)2–17
	LOCAL SERVICE2–83
${f K}$	Location: Internet Explorer
Kansa	Arguments 4-70 Device examples 4-73
3 rd party tools1–99	Parser lists
Configuration1–95	VSS
Get-AutoRunsc.ps11-99	Logon 4–131
Get-CertStore.ps1	Error Code2–96
Get-FlsBodyfile.ps1	Event
Get-Handle.ps11-99	Last
Get-LogparserStack.ps11-100	Session Identification2–79
Get-ProcDump.ps11-99	Success/Failure
${\tt Get-RekalPslist.ps1} \ \dots \dots 1-99$	Type2–12, 4–23
Remote W-1.5-6	Type Codes2–77
Run 1–97	LSA Secret2–28
KAPE3–22	Defense2-30
Collection	LSASS2-10
Options	Security EventLog
$KDBG \rightarrow Kernel Debugger Datablock \dots$	${f M}$
KdCopyDataBlock 3-59 Kerberoasting 2-31, 2-34	1V1
Kerberos	MACB4–35-36
Attacks	mactime
Attacks (Defense)	MagnetForensics
Kernel Debugger Datablock (KDBG)3-50	Malware
Identification3-59	Code Signing1-63
Kernel Patch Protection3–164	Dormant1–55, 1–67
Kernel Processor Control Region (KPCR) 3–50	Evasion techniques1-61
Kill Chain1–38	Execution2–155
Actions on Objectives1–41	Fileless
Delivery 1–40	
	Identification1-81
Exploitation	Identification 1-81 Locations 1-59
Persistence	$ \begin{array}{cccc} \text{Identification} & & & 1-81 \\ \text{Locations} & & & 1-59 \\ \text{Names} & & & 1-59 \\ \end{array} $
Persistence .1-40-41 Reconnaissance .1-40	$ \begin{array}{ccc} \text{Identification} & & 1-81 \\ \text{Locations} & & 1-59 \\ \text{Names} & & 1-59 \\ \text{Paradox} & & 1-53 \\ \end{array} $
Persistence .1-40-41 Reconnaissance .1-40 kpartx .3-17	$ \begin{array}{cccc} & & & & & & & & & & & & & \\ & & & & & $
Persistence .1-40-41 Reconnaissance .1-40 kpartx .3-17 kpartx W-3.1-16	$ \begin{array}{cccc} I dentification & 1-81 \\ Locations & 1-59 \\ Names & 1-59 \\ Paradox & 1-53 \\ Malware Persistence & 1-68 \\ AutoStart Locations & 1-69 \\ \end{array} $
Persistence .1-40-41 Reconnaissance .1-40 kpartx .3-17	Identification 1-81 Locations 1-59 Names 1-59 Paradox 1-53 Malware Persistence 1-68 AutoStart Locations 1-69 BIOS Flashing 1-78
Persistence .1-40-41 Reconnaissance .1-40 kpartx .3-17 kpartx W-3.1-16	Identification 1-81 Locations 1-59 Names 1-59 Paradox 1-53 Malware Persistence 1-68 AutoStart Locations 1-69 BIOS Flashing 1-78 DLL Hijacking 1-74
Persistence .1-40-41 Reconnaissance .1-40 kpartx .3-17 kpartx W-3.1-16	Identification 1-81 Locations 1-59 Names 1-59 Paradox 1-53 Malware Persistence 1-68 AutoStart Locations 1-69 BIOS Flashing 1-78
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Identification 1-81 Locations 1-59 Names 1-59 Paradox 1-53 Malware Persistence 1-68 AutoStart Locations 1-69 BIOS Flashing 1-78 DLL Hijacking 1-74 Local Group Policy 1-78
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Identification 1-81 Locations 1-59 Names 1-59 Paradox 1-53 Malware Persistence 1-68 AutoStart Locations 1-69 BIOS Flashing 1-78 DLL Hijacking 1-74 Local Group Policy 1-78 MS Office Add-in 1-78
Persistence	Identification 1-81 Locations 1-59 Names 1-59 Paradox 1-53 Malware Persistence 1-68 AutoStart Locations 1-69 BIOS Flashing 1-78 DLL Hijacking 1-74 Local Group Policy 1-78 MS Office Add-in 1-78 Scheduled Tasks 1-73 Service Creation/Replacement 1-71 Service Failure Recovery 1-72
Persistence	Identification 1-81 Locations 1-59 Names 1-59 Paradox 1-53 Malware Persistence 1-68 AutoStart Locations 1-69 BIOS Flashing 1-78 DLL Hijacking 1-74 Local Group Policy 1-78 MS Office Add-in 1-78 Scheduled Tasks 1-73 Service Creation/Replacement 1-71

Master File Table (MFT) 4-147 File Record Header 4-152 Outlier 4-166	
Sequential Entries 4-151 Structure 4-148	Index slack space 4–180 System Files 4–144
Memory	Timestamp 4–36
Acquisition	NTLM2–10
Analysis 3–49	ntoskrnl.exe
Analysis 🤻	
Compression	
Dump3–39	O
Finding the first hit3-66	
Forensics	Office Recent Files4–15
Advantages3–37	Open/Save MRU4-11, 4-14
Motivations	OpenIOC1–49
Windows 10 3–45	Order of Volatility1–95
Offset3–79	${\tt Out\text{-}GridView} \hspace{1cm} 1-88$
Page Execute ReadWrite3-150	Overpass the Hash2–34
Virtual Machine 3-41	
Metadata Layer	₽.
MetaSploit2-10, 2-19, 2-24, 2-28, 2-39	P
$MFT \rightarrow Master File Table \dots$	
MFTECmd $4-30, 4-46, 4-157$	Packing 1–67
Microsoft Online Accounts2–79	Page Directory Offset (PDB)3–78
Mimikatz2–9, 10, 2–15, 2–20, 2–28, 2–32	Page File
EventLog Clearing	Pass-the-hash attacks
MOF1–112	Mitigations
$MOF \rightarrow WMI/MOF $ Files	Pass-the-ticket
mofcomp.exe	Passware
mount	Password
MountPoints24-43, 1-75, 2-133	Last change
MsCash2	PatchGuard
mstsc.exe	$PDB \rightarrow Page \ Directory \ Offset \ \dots \dots$
Mutant	PEB → Process Environment Block
Mutex	PECmd.exe2-47
MZ	Perimeter
112 11111111111111111111111111111111111	Persistance
	$\mathtt{pescan} \dots 1-82, \ 1-87$
${f N}$	Phishing Attack
	pinfo
net.exe1-75, 2-133	pinfo 4-60
net1.exe2-133	Pivot
netstat.exe1-88	Places.sqlite
NetTraveler	Plaso
Network Artifacts	Linux/Android/Mac Parsers
Review 3–129	mactime
Network History	Registry Parsers 4–63
NETWORK SERVICE2–83	Web History Parsers 4–65
Network Shares	Windows Parsers
Admin2–133	Plug-and-Play Event Log4–22
Tracking2–106	PlugX1–75
New-PSDrive1-88	Poison Ivy1–103
Nishang2–29	Ports W-3.4-4
NotPetya1–111	powercfg.exe3-43
NTDS.DIT 2–39	PowerShell
ntdsdump2-39	Authentication
NTDSXtract	Basics
NTFS	Command History 2–176
Alternate Data Stream4–171	Enabling logs2–166

Log hunting2–168	queryex1-74
Logs2–164	
Malicious (logs)2–167	${ m R}$
Obfuscation2–170	
Processes 3–87	rar.exe1-75
Remote Artifacts2–147	RasAuto1–72
Source Artifacts	rdpclip.exe2-132
Transcript Logs2–173-174	Reactive Response
PowerShell Authentication1–92	Recent Files4–14
CredSSP1–92	RecentFileCache.bcf2-55
${\tt Enter-PSSession} \hspace{0.1in} \dots \hspace{0.1in} 1-92$	Reconnaissance Tracking
PowerShell Remoting1–90	Recycle Bin
$\verb Enter-PSSession $	reg.exe1-75, 2-139
${\tt Invoke-Command} \hspace{0.5cm} \dots \hspace{0.5cm} 1-90$	Registry
WS-Management (WSMAN) $\dots 1-90$	Deletion
powershell.exe	Hiding Data 4–120
PowerView2–100	RegRipper1–98, 2–130
Prefetch	Rekall1–103, 3–210
First/Last Execution	Remediation
From memory4–137	Requirements1–28
prefetchparser 4-137	Steps1–29
Privileged Local Account Abuse2–98	Remote Credential Guard2–9
Proactive Response	Remote Desktop Protocol (RDP)
ProcDump1-75	Logging2–93
Process	Source Artifacts 2–130
Acquisition	Usage4–24
Analysis	Remote Service Artifacts2–141
Anomaly 🌯1–76	Restricted Admin2–9
Environment Block (PEB)3-50	RID 5002-7
Hollowing3–135	RIP Listener Service (IPRIP)1–71
Injection	rip.pl
Objects3–94, 3–121	Rogue Process Analysis3–94
Process tree3–33	Rootkit1-67, 1-74, 1-103
Rogue 1–73	Detection
Terminated	Hooking
Tracking2–158, 2–160	Run MRU
Command Line	1001 11100
Profiling Account Usage2–72	${f S}$
Protected Processes2–9	S
PsActiveProcessHead3-50	$SACL \rightarrow System Access Control List \dots$
PsExec2-10, 1-75, 2-121, 2-136	Sakula 1–103
Destination Artifacts	SAM Registry Hive2–10
Source Artifacts	${\tt sc.exe}$
psexesvc.exe2-137	Scheduled Tasks
PsLoggedOn	Artifacts
PsLogList	Artifacts (v1.2)
psort	at.exe1-73
psort 4-60	Logs2–114
PspCid	schtasks.exe
PSReadline	Tracking2–112
PWDumpX	schtasks.exe1-75, 2-139
PWDumpX	$SCM \rightarrow Service Control Manager \dots$
1 "Damph2-10	scrcons.exe
	Scripting
\mathbf{O}	Bash
~	PowerShell
qc1-74	WMI
qprivs1-74	Search (Win7-10)
qtriggerinfo	Search (XP)
· ~~	` ,

Security Identifier (SID)3-103, 3-107	Timeline
Security Tokens \rightarrow Tokens	Benefits 4-5
SeDebug2-85	Comparison
SeImpersonate2-19	Context4-29
Select-String1-88	Filesystem4-44
Service Control Manager2–119	Process Analysis
Service Events	Super Timeline
Service Hijacking1-67	Utopia and Reality
Service Replacement	Timestamp4-35-36
Services	Lateral Movement Analysis
Suspicious	Timestomp
Unknown	Detection
SeTakeOwnership	Evidence
SetWindowsHookEx	Timezone
Shell bags	Tokens
ShimCache	Defense
shimcache	Tracking
Shortcut (LNK) files	Account Creation
,	Account Usage
$SID \rightarrow Security Identifier \dots 1 82 1 80$	
sigcheck	Account Usage (RDP)
Silver Ticket	Command Line
Skeleton Key	Lateral Movement
Skype	Network Shares
SMB	Process
File copy4–43	Reconnaissance
SMBShell2–10	Scheduled Tasks
$SSDT \rightarrow System Service Descriptor Table \dots$	Triage4-80
Stacking1–100	Filesystem Timeline4-35
Statistics (incident)	Trusted Code1-62
STIX1–49	TsPkg2–9, 10
Strings	tstheme.exe2-132
StuxNet1–112, 3–147	
Super Timeline4–53	\mathbf{U}
Creation steps 4–96	U
Filter4–78	$UAC \rightarrow User Acess Control \dots$
Output4–105	
Targeted 4–75	UMFD
Suspicious Services	USB First/Last Times
Swap File	USB Key Identification
$SxS \rightarrow DLL \; Hijacking/DLL \; Side-Loading \; \dots$	User Acess Control (UAC)2–8
SysMon	UserAssist
SYSTEM2–83	
System Access Control List	${f V}$
System Service Descriptor Table (SSDT) 3–161	•
SYSTEM32	$VAD \rightarrow Virtual Address Descriptor \dots$
SYSWOW64	Virtual Address Descriptor (VAD)3–50
515WOW04W-2.1-9	Virtual Secure Mode
	Virtual AllocEx
${f T}$	Visibility
±	VNC
Target Collection 2 25	Volatility
Target Collection	·
Task (Start time)	apihooks
TDL3/TDSS	baseline
TeamViewer	cmdline
Temporal proximity	cmdscan
Thumbnails	connections
Thumbs.db	connscan
Tickets	consoles $3-184, 3-197-198$
Defense2–36	devicetree3-172

\mathbf{W}	rara1-50
	Yara1–50
Exploitation	${f Y}$
Vulnerability	
VSSAdmin2–39	wsmprovhost.exe
$VSM \rightarrow Virtual Secure Mode \dots$	$\verb WriteProcessMemory $
$\verb vshadowmount $	$\verb WordWheelQuery $
${\tt vshadowinfo} \hspace{0.1in} \dots \hspace{0.1in} 4{-}127$	wmiprvse.exe
log2timeline	wmic.exe $1-75, 1-86, 3-87, 2-143$
Examination	WMI explorer1–118
Volume Shadow Copy	WBEM AutoRecover Key1–126
Volume Serial Number4–22	WBEM AutoRecover Folder1–125
Volume Name	Source Artifacts
Volume GUID	Reconnaissance
Usage	PyWMIPersistenceFinder.py1–119
Profile	mandLineEventConsumers)1–127
Image identification	Processes (svchost.exe/WmiPrvSE.exe for com-
Help3–56	sumers)
vainfo	Processes (scrons.exe for ActiveScriptEventCon-
vaddump	Processes
threadmap	Privilege Escalation
svcscan	PowerShell commands
ssdt	Persistence
sockscan	mof comp.exe
sockets	MOF Files
servicebl	Logs
psxview	Log Hunting2–180
pstree	Lateral Movement
pssist	Investigation
processol	Hunting tips
processbl	Event Filter (trigger)
openioc_scan	
netscan 3-125, 126 openioc_scan 3-212	Event Consumer types
mutantscan	Event Consumer Backdoor
modules	Destination Artifacts
modscan	Database
moddump	Binding
memdump	Attacks
malprocfind	WMI
malfind	wisp
ldrmodules	winrs.exe
kdbgscan	winrm.vbs
imageinfo	winpmem Driver3-39, 1-103
imagecopy	Windows Time Rules
idt	Windows Service
hollowfind	Windows Remote Management2–115, 2–139
hivelist	win32k.sys
handles	What is Normal?
getsids3-99, 3-103	What is Evil?
filescan	WebShell
$\texttt{dumpfiles} \dots 3-184, 3-201$	Web-Based Entreprise Managment (WBEM) 1–107
$\verb driverirp$	Web Server Intrusion
$\verb driverbl \dots \dots 3-91, 3-175 $	WDigest2–9, 10
dlllist	WCE2-10
$\verb"dlldump" \dots \dots$	$\mbox{WBEM} \rightarrow \mbox{Web-Based Entreprise Managment} \ \dots \dots \label{eq:wbemonstate}$

Zbot3–178	Zeus3–178
Zero Configuration	Zone Identifier