

In-the-wild Ransomware Protection Comparative Analysis 2016 Q3

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1 Introduction

"Ransomware is a Cryptovirology attack carried out using covertly installed malware that encrypts the victim's files and then requests a ransom payment in return for the decryption key that is needed to recover the encrypted files. Thus, ransomware is an access-denial type of attack that prevents legitimate users from accessing files since it is intractable to decrypt the files without the decryption key". ¹ Before ransomware was trendy among cyber-criminals, a malware infection was not a high priority for most users. Financial malware could be defeated via fraud detection, spammed Facebook walls were cleaned, and life could continue uninterrupted. Sometimes, the presence of the malware was not even noticed for months. But this has changed since ransomware became prevalent. The use of crypto-currencies like Bitcoin made it easy to cash out quickly. And because the malware has to only run for some minutes on the victim's computer, most reactive protections failed quickly, and left the users unprotected against these cybercriminals. Multiple generic ransomware protection emerged to solve this issue.

WatchDogDevelopment.com, LLC commissioned MRG Effitas to conduct a comparative analysis of its Watchdog Anti-Malware product, and other prevalent generic ransomware tools.

1.1 Watchdog Anti-Malware

Watchdog Anti-Malware is a second-opinion malware scanner designed to rescue a computer from malware that has infected the computer despite all the security measures taken. It uses cloud-based scanning to reduce detection time for new virus outbreaks and to improve scanning performance. The tested version was 2.21.186.139. Besides the default settings used, Pandora Cloud-Sandbox Technology was turned on. Pandora works as a combination of cloud reputation database (blocking previously unknown files), and a cloud sandbox, where suspicious samples are sent to the cloud, and analyzed there. If a sample is detected as malicious, all Watchdog users (even where Pandora is turned off) are protected in the future against that specific threat.

	Set	tings	Ę	🕸 💑 🖉 🛛
General Scan Real Time Protection Exclusions Check for Updates Advanced	👿 Pandora Cloud-Sandb	attempts before they harm your		Clear Histo
1	Path	Action:	Date and Time	

¹ https://en.wikipedia.org/wiki/Ransomware

1.2 Competitor products tested

- BitDefender Anti-ransomware 1.0.12.1
- Cryptoprevent 7.4.21.0
- MalwareBytes Anti-Ransomware Beta 0.9.16.484, 1.0.0
- Hitmanpro Alert build 3.1.10 373

1.3 Watchdog reputation based on detection vs generic detection

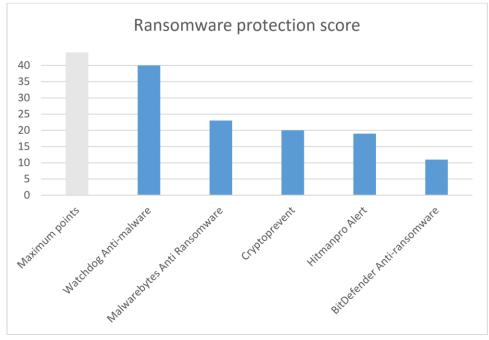
Watchdog works differently to the other generic ransomware detection tools. Some of those tools detect generic ransomware behaviour, for example, injecting into explorer.exe, or overwriting structured data with high entropy (encrypted) unstructured data. Other tools create white-lists on folders usually used by ransomware.

Meanwhile, Watchdog uses its cloud reputation system to check for unknown binaries. One might ask the question, "how can we test known malware against these different detection techniques?" Because of this, we tested Watchdog in two configurations, one where we used the original dropper, and one where we changed the hash of the dropper – thus it was totally new and unknown to Watchdog. Due to the way Pandora technology works in Watchdog, the results were the same, and all malware samples were blocked from execution. The good thing with this approach is that even Patient Zero does not get infected.

1.4 Executive summary

We tested the ransomware protection tools against eleven different ransomware, which have been prevalent inthe-wild over the past 3-4 years. First, we installed the protection tool into the system, then started the ransomware (or ransomware dropper), and when the ransomware process exited (or was killed), we scanned the system for the presence of encrypted files.

Final results



Based on this report, Watchdog Anti-Malware proved to be the best ransomware protection among the tested products during the test. These scores are not normalized with the prevalence of the ransomware samples. Usually, the most prevalent samples are included in these generic protections, but as always, life (and IT Security) is never simple.

2 Tests employed and results

This ransomware protection test was performed as follows: We created generic documents and pictures on the user's desktop folder, installed the generic ransomware protection system on a clean machine, acquired a dropper for the ransomware and started the ransomware. Then, if the ransomware was detected or blocked by the protection, after the full remediation took place we checked the filesystem for encrypted files. The scoring is based on the level of protection and remediation.

When conducting these tests, we tried to simulate normal user behaviour. We are aware that a "Real World" test cannot be conducted by a team of professionals inside a lab because we understand how a ransomware works, how it attacks and how such attacks could be prevented. Simulating normal user behaviour means that we paid special attention to all alerts given by security applications.

All tests were carried out in a virtualized environment, where malware cannot detect the presence of virtualization, on a fully patched Windows 10 64-bit. All Smartscreen protections (URL, download, execute) from Windows have been turned off, and Defender was turned off as well.

The test was carried out between June 20 and July 14, 2016.

2.1 High-level overview of the tests

Sample selection is of fundamental importance to this and all similar tests. The type of samples used is selected by MRG Effitas on the basis of a mixture of criteria, centred on key relevancies:

- 1. Prevalence they are widespread (among ransomware) and so represent the most common threats.
- 2. Innovation they employ innovative techniques to counter security measures.
- 3. It is malware having ransomware capabilities, by encrypting user files and demanding ransomware in exchange.

During our tests we did not use the latest zero day ransomware, because it is very hard to acquire working recent samples from 10 different families, as usually only 4-5 different families are active at a specific point in time. What made this test challenging is that most malware won't be working if the C&C server is down. And for some ransomware, the C&C is only up for 1-2 days. For others, it can be up for months. On a side note, if the ransomware was not designed to run without the C&C but it encrypted the files, chances are that even after paying the ransom, the files won't be decrypted.

All samples started the encryption instantly; there was no need to wait. We monitored file system changes, thus we had good list of candidates to check for and knew where we can check for encrypted files.

After we confirmed that the ransomware was working as expected on a non-protected system, we installed the generic ransomware protection tool, updated it to the latest version (both program and signatures), and started with default configuration. Cloud connectivity was allowed. Whenever the software detected the presence of the ransomware, we executed the default action (quarantine or delete). If the protection software demanded a computer reboot for remediation, we rebooted the computer.

The small number of test cases (10 in-the-wild ransomware + one ransomware simulator) is due to the fact that ransomware tests cannot be done automatically, and all remediation has to be followed by a forensics analysis, which is time consuming. Also, instead of using 100 different samples from the same ransomware family, we tested with diverse sets of ransomware. We would love to test more families, but it is not easy to find working samples. For example, one ransomware (CryptXXX) started to encrypt files on an unprotected system, then crashed.

2.2 Scoring

As there are different levels of remediation, we came up with the following scoring system. Each software was able to collect points on every test, and the security software received:

- 0 points whenever the ransomware was not detected or remediated, and all files in scope for the ransomware have been encrypted.
- I point if the ransomware was detected and blocked, but a large portion of the files remained encrypted after remediation.
- 3 points when the ransomware was detected and blocked, but only a small portion of the files remained encrypted.
- 4 points when the rootkit was detected, fully remediated, and no files have been encrypted at the end.

2.3 Ransomware tested and results

We tested the following ransomware samples against the generic ransomware prevention tools:

2.3.1 CTB Locker

CTB-Locker was distributed via exploit kits and spam. It usually injects itself into the explorer.exe process, and start the encryption from that process. The sample is from December, 2014. SHA-256: 8567d46ff961222a2f084286b5750e462df681f4d4ea5bb7875148cb4ab25be4

	I files are encrypted by CTB-Locker. abases and other important files have been encrypted with strongest enerated for this computer.
Private decryption key is sto you pay and obtain the privat	red on a secret Internet server and nobody can decrypt your files until e key.
	ndow, follow the instructions on the locker. Overwise, it's seems that the locker program. Now you have the last chance to decrypt your files
Open http://5kiuc45pat3qr6 They are public gates to the s	gd.onion.cab or http://5kiuc45pat3qr6gd.tor2web.org in your browser ecret server.
If you have problems with ga	tes, use direct connection:
1. Download Tor Browser fro	m http://torproject.org/
	e http://5kiuc45pat3qr6gd.onion/ ilable via Tor Browser only. Retry in 1 hour if site is not reachable.
MFS76A-W4RXV2-BLCTV5-E CAPOGL-S2GJBT-YNS4SA-2	key in the input form on server. Avoid missprints. LENEL-QCODER-TZRHED-CSNSR-E2G6HP LZHEC-WFQBGE-ROP2(L-ST 62H-MOOTHK S2NLYW-JCOAUC-FGCS6J-A2X42Y-Q71YVB
Follow the instructions on the	e server.
These instructions are also so open it and use copy-paste fo	aved to file named DecryptAllFiles.txt in Documents folder. You can r address and key.

	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	4	4	4	3

2.3.2 Petya

The Petya ransomware is very different from the common ransomware. It installs itself to start before Windows, causes a BSOD in Windows, and after Windows restarts, it mimics a file repair, but in reality, it encrypts the MFT (Master File Table). The sample is from March 2016. SHA-256:

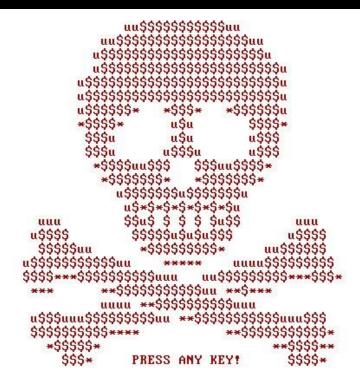
26b4699a7b9eeb16e76305d843d4ab05e94d43f3201436927e13b3ebafa90739

Repairing file system on C:

The type of the file system is NTFS. One of your disks contains errors and needs to be repaired. This process may take several hours to complete.It is strongly recommended to let it complete.

WARNING: DO NOT TURN OFF YOUR PC! IF YOU ABORT THIS PROCESS, YOU COULD DESTROY ALL OF YOUR DATA! PLEASE ENSURE THAT YOUR POWER CABLE IS PLUGGED IN!

CHKDSK is repairing sector 110954 of 246784 (44%)





You became victim of the PETYA RANSOMWARE!

The harddisks of your computer have been encrypted with an military grade encryption algorithm. There is no way to restore your data without a special key. You can purchase this key on the darknet page shown in step 2.

To purchase your key and restore your data, please follow these three easy steps:

- Download the Tor Browser at "https://www.torproject.org/". If you need help, please google for "access onion page".
- 2. Visit one of the following pages with the Tor Browser:

http://petya37h5tbhyvki.onion/5aV6XV http://petya5koahtsf7sv.onion/5aV6XV

3. Enter your personal decryption code there:

 $\label{eq:separate} 3ePUAW-ovNzkg-LLMJE2-7SCxQQ-DbWSvu-EFJmWU-QWvUpj-CXRshz-TJGxwj-2YJ5zX-owosUn-LGTGvS-Qih1VU-TTG8ce-xqBtdR$

If you already purchased your key, please enter it below.

Key:

Test results

	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	0	0	0	0

Because Petya works totally different than other ransomware, most generic ransomware protection was totally ineffective against this threat.

2.3.3 TeslaCrypt

This malware was usually distributed via the Angler exploit-kit. It has multiple anti-debug features, and injects itself into other processes before encrypting. It also deletes shadow copy files. The sample is from April, 2016. SHA-256: d8ee200589d8e7d72878ea79bcfc9d18ee52569c046df74fa0dfe7e33d9ec422

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	Watchdog Anti-malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	3	4	3	3

2.3.4 Cerber

Cerber is a very recent ransomware. It can work offline by design; thus it can more easily attack enterprise systems. It can also bypass UAC for better destruction. The sample is from June, 2016. SHA-256: 7b6c225989d2a1f1bd845fa620c1fc2e5196ab2673cca16a05b9929c152e7d65

	# DECRYPT MY FILES #.txt - Notepad
the state of the s	File Edit Format View Help
Your documents, photos, databases and other importan have been encrypted!	CERBER RANSOMWARE
If you understand all importance of the situation then we	****
to go directly to your personal page where you will receive	
instructions and guarantees to restore your file	Is the content of the files that you lo
There is a list of temporary addresses to go on your person	
	It is normal because the files' names, have been encrypted.
1. http://cerberhhyed5frqa.lfotp5.win/C6DC-1BF0-F68D-	Great!!! You have turned to be a part of a big c
2. http://cerberhhyed5frqa.vmfur5.win/C6DC-1BF0-F68D-	Tou have curried to be a part of a big t
3. http://cerberhhyed5frqa.5kti58.win/C6DC-1BF0-F68D-	*****
4. http://cerberhhyed5frqa.we34re.win/C6DC-1BF0-F68D-	
	<pre>!!! If you are reading this message it</pre>
5. http://cerberhhyed5frqa.cmr95i.win/C6DC-1BF0-F68D-	<pre>!!! "Cerber Ransomware" has been remov</pre>
6. http://cerberhhyed5frqa.onion/C6DC-1BF0-F68D-0072-	C
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	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	0	4	3	3

2.3.5 Mircop (Autoit)

When we tested this sample, three strange things happened. First, it was not documented anywhere on the Internet, so it was a totally new malware family at the time of test. Also, the amount of BTC is incredibly high. The usual amount is around ~2-3 BTC, not 48.48. Last but not least, there are no instructions how one can decrypt the files, or where to contact the ransomware operators. Which means, after paying, there is no way to get back the files via "official channels" – luckily, a decrypter tool is already available. The malware is usually distributed via spam, and uses DES to encrypt files. It can also steal credentials from popular software, and SHA-256: af84eda1d8264f2babf6d3771868eb2f7655d52b6d4e66675efd7e3a1101d9b0



	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	0	0	0	0

2.3.6 Crypt0L0cker

This ransomware is a descendant of the TorrentLocker ransomware. It is usually distributed via spam, uses geolocation check before infection, can bypass UAC, deletes shadow copy files, and encrypts files with AES-256 in CBC mode. The sample is from June, 2016. SHA-256:

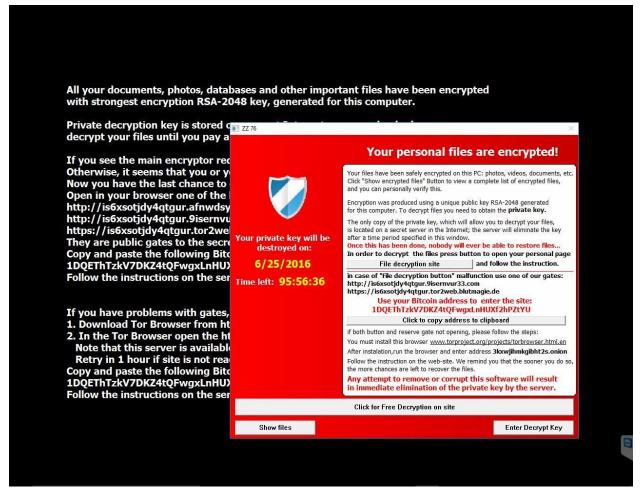
67fd7ec290f03bbd4a0a68eae1f28ea41036008883ee57e52092257	e6ced71c7
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	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	0	0	3	3

2.3.7 Alphacrypt

As other ransomware, this deletes the shadow copy before encryption. It was usually distributed via exploit kits (Angler). It can also delete shadow copy files, and uses AES to encrypt files. The sample is from March, 2015. SHA-256: 99fc04d82877aea0247286d41186b985ab773b19c8cef8786ffc1fa50e35af29



	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	0	4	3	4

2.3.8 ACCDFISA (Winrar based)

This ransomware is an old and strange one. It was usually distributed via unprotected RDP sessions. The authors did not bother to write their own encryption, they just used WinRAR to do that. The sample is from February, 2012. SHA-256: 59ed7a26c56a644bf3f5ba45459965be8a6e6b79dcf4f90a5c51f2bb12190bf9

Warning! Your files are encrypted by polymorphic virus. Unfortunately polymorphic virus has been encoded all the data on your computer using AES encryption. To decrypt your files you need to do next steps: 1. Buy Moneypak, Paysafecard or Ukash card (100\$ or 100€) 2. Send us sms with your reference number: 576298615200 and card code. 3. Wait 1-5 hours while we decrypt your files and send you two passcodes. 4. Just paste your first passcode in the first field and second passcode in the second field. 5. Press button "Start Decrypt". 6. You will see Message when your files has decrypted (Dont close decrypt program until finished, because some files may be corrupted). Our special service phone number: +18722161445 or email: antispam@cyberservices.com (we will seend reply sms on your cell phone number or email with two passcodes) You can buy MoneyPak card at the nearest stores : Walgreens, walmart, CVS/ pharmacy, Kmart, SevenEleven, Rite Aid or go to www.moneypak.com to find location stores near you. To find Paysafecard location stores near you visit www.paysafecard.com or Ukash at www.ukash.com Total encrypted files: 679 Enter Control first and second passcodes to start decrypting your files: Now decrypting: Start Decrypt File Number: 00000 of 679 Anti Cyber Crime Department of Federal Internet Security Agency (ACCDFISA)	ACCDFISA Decrypt				×
To decrypt your files you need to do next steps: Image: Control of the state	Warning! Your files	are encrypted by polymo	orphic virus.	ſ	
 1. Buy Moneypak, Paysafecard or Ukash card (100\$ or 100€) 2. Send us sms with your reference number: 576298615200 and card code. 3. Wait 1-5 hours while we decrypt your files and send you two passcodes. 4. Just paste your first passcode in the first field and second passcode in the second field. 5. Press button "Start Decrypt". 6. You will see Message when your files has decrypted (Dont close decrypt program until finished, because some files may be corrupted). Our special service phone number: +18722161445 or email: antispam@cyberservices.com (we will send reply sms on your cell phone number or email with two passcodes) You can buy MoneyPak card at the nearest stores : Walgreens, walmart, CVS/ pharmacy, Kmart, SevenEleven, Rite Aid or go to www.moneypak.com to find location stores near you. To find Paysafecard location stores near you visit www.paysafecard.com or Ukash at www.ukash.com Total encrypted files: 679 Enter Control first and second passcodes to start decrypting your files: Now decrypting: Eile Number: 00000 of 679 	Unfortunately polymorp	hic virus has been encoded all t	he data on your computer using A	ES encryption.	
 2. Send us sins with your reference number: 576298615200 and card code. 3. Wait 1-5 hours while we decrypt your files and send you two passcodes. 4. Just paste your first passcode in the first field and second passcode in the second field. 5. Press button "Start Decrypt". 6. You will see Message when your files has decrypted (Dont close decrypt program until finished, because some files may be corrupted). Our special service phone number: +18722161445 or email: antispam@cyberservices.com (we will send reply sms on your cell phone number or email with two passcodes) You can buy MoneyPak card at the nearest stores : Walgreens, walmart, CVS/ pharmacy, Kmart, SevenEleven, Rite Aid or go to www.moneypak.com to find location stores near you. To find Paysafecard location stores near you visit www.paysafecard.com or Ukash at www.ukash.com Total encrypted files: 679 Enter Control first and second passcodes to start decrypting your files: Now decrypting: File Number: 00000 of 679 	To decrypt your files yo	u need to do next steps:			
(we will send reply sins on your cell phone number or email with two passcodes) You can buy MoneyPak card at the nearest stores : Walgreens, walmart, CVS/ pharmacy, Kmart, SevenEleven, Rite Aid or go to www.moneypak.com to find location stores near you. To find Paysafecard location stores near you visit www.paysafecard.com or Ukash at www.ukash.com Total encrypted files: 679 Enter Control first and second passcodes to start decrypting your files: Now decrypting: Start Decrypt File Number: 00000 of 679	 Send us sms with you Wait 1-5 hours while Just paste your first p Press button "Start E You will see Message 	ur reference number: 57629861 we decrypt your files and send y basscode in the first field and se ecrypt". e when your files has decrypted	5200 and card code. you two passcodes. cond passcode in the second field		
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Test results

	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	0	0	0	0

It is possible that generic detection did not work on this ransomware because it uses legitimate tools to encrypt files. It is quite interesting to see that primitive methods can bypass generic detection.

2.3.9 Locky

The Locky sample was the most challenging of all to start, by far. It employs lot of different anti-sandbox features, and usually, the C&C is up for days only. Usually it is distributed via spam, and uses AES to encrypt precious user files. The sample is from June, 2016. SHA-256:

3f5ff5d9d06l5cc04e644297dcbfa999f6d6930850848f038464d0a486e6b8d0

III IMPORTANT INFORMATION IIII
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: 1. http://twbers4hmi6dx65f.tor2we 2. http://twbers4hmi6dx65f.onion.t 3. http://twbers4hmi6dx65f.onion.c
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: twbers4hmi6dx65f.onior 4. Follow the instructions on the site.
!!! Your personal identification ID:

Test results

	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	4	4	3	3

Although these generic protections worked fairly well against Locky, it is important to recognise that Locky is famously known to bypass most AV. Again, it is interesting that one of the most advanced ransomware is caught by generic detection.

2.3.10 Bart

Bart basically shares the code with Locky - probably, the same developers are behind this. The biggest difference is that it can operate in offline mode. Also, it uses different encryption technique, which is not yet detected by most generic ransomware protection. The sample is from June, 2016. SHA-256: 51ff4a033018d9343049305061dcde77cb5f26f5ec48d1be42669f368b1f5705

	🗐 recover.txt - Notepad –	. 🗆	×
	File Edit Format View Help		
	<pre>!!! IMPORTANT INFORMATION !!!</pre>		^
RTANT INFORMATION !!	All your files are encrypted.		
iles are encrypted.	<pre>Decrypting of your files is only possible with the private key, which is on our To receive your private key follow one of the links:</pre>	NLWbMGjOg bMGjOgyG7	gyG" 'G91
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khh5cmzh5q7yp7th.onio	3. Type in the address bar:		C
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Test results			

	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	4	0	0	0	4

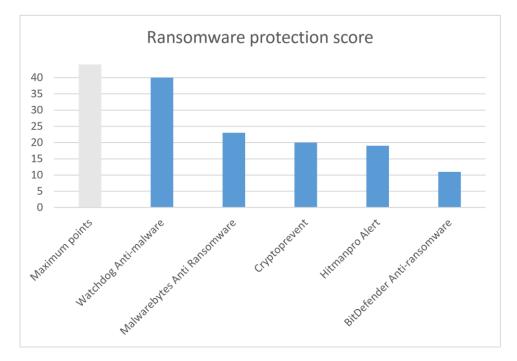
2.3.11 MRG Effitas ransomware simulator

We developed a sample ransomware simulator in Python, and compiled it to an EXE file via Py2EXE. Due to the sensitive nature of ransomware, we will not release the code to the public. As it is only a sample to test generic protection, it uses a fixed key, AES encryption, encrypts the following file types recursively in a specified directory: .pdf,.jpg..docx, .txt, .xlsx, .png, and has no C&C at all. First it creates the encrypted copy of the original file, then overwrites the original file with zeroes, and deletes it.

	Watchdog Anti-Malware	Bitdefender Antiransomware	<i>/</i> / /	Hitmanpro Alert	MalwareBytes Anti Ransomware
Scor	e O	0	0	0	0

3 Final results

	Watchdog Anti-Malware	Bitdefender Antiransomware	Cryptoprevent	Hitmanpro Alert	MalwareBytes Anti Ransomware
Score	40	11	20	19	23



Based on this report, Watchdog Anti-Malware proved to be the best ransomware protection among the tested products during the test. These scores are not normalized with the prevalence of the ransomware samples. Usually, the most prevalent samples are included in these generic protections, but as always, life (and IT Security) is never simple.