PASSMARK®
SOFTWARE

Consumer Security Products Performance Benchmarks (Edition 1)

Antivirus & Internet Security
Windows 10

November 2017

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Revision History

Rev	Revision History	Date
Edition 1	Initial version of this report.	10 November 2017

References

Ref #	Document	Author	Date
1	**What Really Slows Windows Down** (URL)	O. Warner, The PC Spy	2001-2017

Executive Summary

PassMark Software® conducted objective performance testing on fifteen (15) security products. This report presents our results and findings as a result of performance benchmark testing conducted on these products.

For more details on which versions were tested, please see the section *"**Products and Versions**"*.

Testing included twenty-three (23) performance metrics. These performance metrics are as follows:

- Boot Time;
- Scan Time;
- User Interface Launch Time;
- Memory Usage during System Idle;
- Memory Usage during Initial Scan;
- Browse Time;
- Edge Launch Time;
- Installation Time;
- Installation Size;
- File Copy, Move and Delete;
- Installation of Third Party Applications;
- Network Throughput (previously named "Binary Download Test");
- File Format Conversion;
- File Compression and Decompression;
- PE Scan Time;
- File Copy Disk to Disk;
- File Copy Over Network;
- File Download;
- PCMark 8 Home Score;
- Word Document Launch and Open Time;
- Run Excel Macro;
- Save Word Document as PDF; and
- USB 3.0 File Copy.

Overall Score

PassMark Software assigned every product a score depending on its ranking in each metric compared to other products in the same category.

Security Software

In the following table the highest possible score attainable is 345; in a hypothetical situation where a product has attained first place in all 23 metrics. Internet Security products have been ranked by their overall scores:

Product Name	Overall Score
Norton Security	264
ESET Smart Security	218
F-Secure SAFE	215
McAfee Internet Security	203
Panda Internet Security	189
Bitdefender Internet Security	182
Avira Internet Security	175
Windows Defender	174
Kaspersky Internet Security	166
Trend Micro Internet Security	166
G Data Internet Security	163
Trend Micro Virus Buster	162
SourceNext ZERO	155
AVG Internet Security	148
Avast Internet Security	142

Products and Versions

The names and versions of the two security products tested are as follows:

Manufacturer	Product Name	Release Year	Product Version	Date Tested
Symantec Corporation	Norton Security	2017	22.11.0.41	Oct 2017
Panda Security SL	Panda Internet Security	2016	17.0.1	Nov 2017
AVG Technologies	AVG Internet Security	2017	17.7.3032	Nov 2017
Intel Security Group	McAfee Internet Security	2017	16.0.3	Sep 2017
F-Secure Corporation	F-Secure Internet Security	2017	17.192 build 128	Oct 2017
Avira Operations GmbH	Avira Internet Security	2017	15.0.32.12	Nov 2017
ESET, spol. s r.o.	ESET Internet Security	2017	10.1.219.0	Oct 2017
Trend Micro Inc.	Trend Micro Internet Security	2017	12.0.1153	Oct 2017
Trend Micro Inc.	Trend Micro Virus Buster	2017	12.0.1153	Oct 2017
G Data Software AG	G Data Internet Security	2017	25.4.0.2	Nov 2017
Kaspersky Lab	Kaspersky Internet Security	2017	22.9.0.68	Sep 2017
SourceNext Corporation	SourceNext ZERO	2017	21.2.25.23	Oct 2017
Avast Software	Avast Internet Security	2017	17.7.2314	Sep 2017
Microsoft Corporation	Windows Defender	2017	Windows 10 Home 1703 OS Build 15063.540	Aug 2017
Bitdefender	Bitdefender Internet Security	2017	22.0.10.141	Sep 2017

Performance Metrics Summary

We have selected a set of objective metrics which provide a comprehensive and realistic indication of the areas in which a security product may impact system performance for end users. Our metrics test the impact of the security software on common tasks that end-users would perform on a daily basis.

All of PassMark Software's test methods can be replicated by third parties using the same environment to obtain similar benchmark results. Detailed descriptions of the methodologies used in our tests are available as "*Appendix 2 – Methodology Description*" of this report.

Benchmark 1 – Boot Time

This metric measures the amount of time taken for the machine to boot into the operating system. Security software is generally launched at Windows startup, adding an additional amount of time and delaying the startup of the operating system. Shorter boot times indicate that the application has had less impact on the normal operation of the machine.

Benchmark 2 – Scan Time

All security solutions have functionality designed to detect viruses and various other forms of malware by scanning files on the system. This metric measured the amount of time required to scan a set of clean files. Our sample file set comprised a total file size of 982 MB and was made up of files that would typically be found on end-user machines, such as media files, system files and Microsoft Office documents.

Benchmark 3 – User Interface Launch Time

This metric provides an objective indication as to how responsive a security product appears to the user, by measuring the amount of time it takes for the user interface of the security software to launch from Windows. To allow for caching effects by the operating system, both the initial launch time and the subsequent launch times were measured. Our final result is an average of these two measurements.

Benchmark 4 – Memory Usage during System Idle

This metric measures the amount of memory (RAM) used by the product while the machine and security software are in an idle state. The total memory usage was calculated by identifying all security software processes and the amount of memory used by each process.

The amount of memory used while the machine is idle provides a good indication of the amount of system resources being consumed by the security software on a permanent basis. Better performing products occupy less memory while the machine is idle.

Benchmark 5 – Memory Usage during Initial Scan

This metric measures the amount of memory (RAM) used by the product during an initial security scan. The total memory usage was calculated by identifying all security software processes and the amount of memory used by each process during the scan.

Benchmark 6 – Browse Time

It is common behavior for security products to scan data for malware as it is downloaded from the internet or intranet. This behavior may negatively impact browsing speed as products scan web content for malware. This metric measures the time taken to browse a set of popular internet sites to consecutively load from a local server in a user's browser window.

Benchmark 7 – Edge Launch Time

This metric is one of many methods to objectively measure how much a security product impacts on the responsiveness of the system. This metric measures the amount of time it takes to launch the user interface of Microsoft Edge. To allow for caching effects by the operating system, both the initial launch time and the subsequent launch times were measured. Our final result is an average of these two measurements.

Benchmark 8 – Installation Time

The speed and ease of the installation process will strongly influence the user's first impression of the security software. This test measures the minimum installation time required by the security software to be fully functional and ready for use by the end user. Lower installation times represent security products which are quicker for a user to install.

Benchmark 9 – Installation Size

In offering new features and functionality to users, security software products tend to increase in size with each new release. Although new technologies push the size limits of hard drives each year, the growing disk space requirements of common applications and the increasing popularity of large media files (such as movies, photos and music) ensure that a product's installation size will remain of interest to home users.

This metric aims to measure a product's total installation size. This metric is defined as the total disk space consumed by all new files added during a product's installation.

Benchmark 10 – File Copy, Move and Delete

This metric measures the amount of time taken to move, copy and delete a sample set of files. The sample file set contains several types of file formats that a Windows user would encounter in daily use. These formats include documents (e.g. Microsoft Office documents, Adobe PDF, Zip files, etc), media formats (e.g. images, movies and music) and system files (e.g. executables, libraries, etc).

Benchmark 11 – Installing Third Party Applications

This metric measures the amount of time taken to install and uninstall third party programs. The installation speed of third party applications may be impacted by security behavior such as heuristics or real time malware scanning.

Benchmark 12 – Network Throughput

The metric measures the amount of time taken to download a variety of files from a local server using the HyperText Transfer Protocol (HTTP), which is the main protocol used on the web for browsing, linking and data transfer. Files used in this test include file formats that users would typically download from the web, such as images, archives, music files and movie files.

Benchmark 13 – File Format Conversion

This test measures the amount of time taken to convert an MP3 file to a WAV and subsequently, convert the same MP3 file to a WMA format.

Benchmark 14 – File Compression and Decompression

This metric measures the amount of time taken to compress and decompress different types of files. Files formats used in this test included documents, movies and images.

Benchmark 15 – File Download

This test measures the amount of time taken to download a set of setup files from a local server using the HyperText Transfer Protocol (HTTP). The data set comprised a total file size of 290MB, and the formats used include executables and Microsoft installation packages.

Benchmark 16 – PE Scan Time

All security solutions have functionality designed to detect viruses and various other forms of malware by scanning files on the system. This metric measured the amount of time required to scan a set of PE (Portable Executable) files. Our sample file set comprised a total file size of 2.03GB and consisted of .exe (329MB), .dll (920MB) and .sys files (827MB).

Benchmark 17 – File Copy Disk To Disk

This test measures the amount of time taken to copy files between two local drives. The data set comprised a total file size of 5.44GB, and the formats used included documents, movies, images and executables.

Benchmark 18 – File Copy Over Network

This test measures the amount of time taken to copy files from a local drive to a local server. The data set comprised a total file size of 5.44GB, and the formats used included documents, movies, images and executables.

Benchmark 19 – PCMark 8 Home Score

This test measures the overall performance as an overall score over a range of areas, including memory, video, gaming, music, communications, productivity and HDD performance.

Benchmark 20– Word Document Launch and Open Time

This metric measures how much security software impacts on the responsiveness and performance of the system. This metric measures the amount of time it takes to open a large, mixed media document with Microsoft Word. To allow for caching effects by the operating system, both the initial launch time and the subsequent launch times were measured. Our final result is an average of these two measurements.

Benchmark 21 – Run Excel Macro

This test measures the amount of time taken to open an Excel document and run a macro to perform a range of operations. The test is run five times with a reboot in between each run. Our final result is taken as an average of these five measurements.

Benchmark 22 – Save Word Document as PDF

This test measures the amount of time taken to open a large Word document and save it in PDF format. The test is run five times with a reboot in between each run. Our final result is taken as an average of these five measurements.

Benchmark 23 – USB 3.0 File Copy

This test measures the amount of time taken to copy files from a USB 3.0 drive to a local disk. The data set comprised a total file size of 6.06GB, and the formats used included documents, movies, system files and executables.

Internet Security Software – Test Results

In the following charts, we have highlighted the results we obtained for Norton Security in yellow. The average has also been highlighted in blue for ease of comparison.

Benchmark 1 – Boot Time (seconds)

The following chart compares the average time taken for the system to boot (from a sample of five fast boots) for each Internet Security product tested. Products with lower boot times are considered better performing products in this category.

Product	Boot Time (s)
Windows Defender	6.8
Panda Internet Security	6.8
F-Secure SAFE	7.1
ESET Internet Security	7.1
Avira Internet Security	7.1
Norton Security	7.1
Trend Micro Virus Buster	7.3
Avast Internet Security	7.6
Trend Micro Internet Security	7.6
Average	7.7
McAfee Internet Security	7.7
G Data Internet Security	7.9
AVG Internet Security	8.0
SourceNext ZERO	8.0
Kaspersky Internet Security	8.2
Bitdefender Internet Security	10.6

Benchmark 2 – Scan Time (seconds)

The following chart compares the average time taken to scan a set of 6159 files (totaling 982 MB) for each Internet Security product tested. This time is calculated by averaging the initial (Run 1) and subsequent (Runs 2-5) scan times. Products with lower scan times are considered better performing products in this category.

Product	Scan Time (s)
Bitdefender Internet Security	3
G Data Internet Security	7
Norton Security	13
ESET Internet Security	18
SourceNext ZERO	41
Trend Micro Virus Buster	42
Trend Micro Internet Security	43
Avira Internet Security	49
Avast Internet Security	51
Average	51
Panda Internet Security	52
Kaspersky Internet Security	55
F-Secure SAFE	61
Windows Defender	86
AVG Internet Security	87
McAfee Internet Security	213
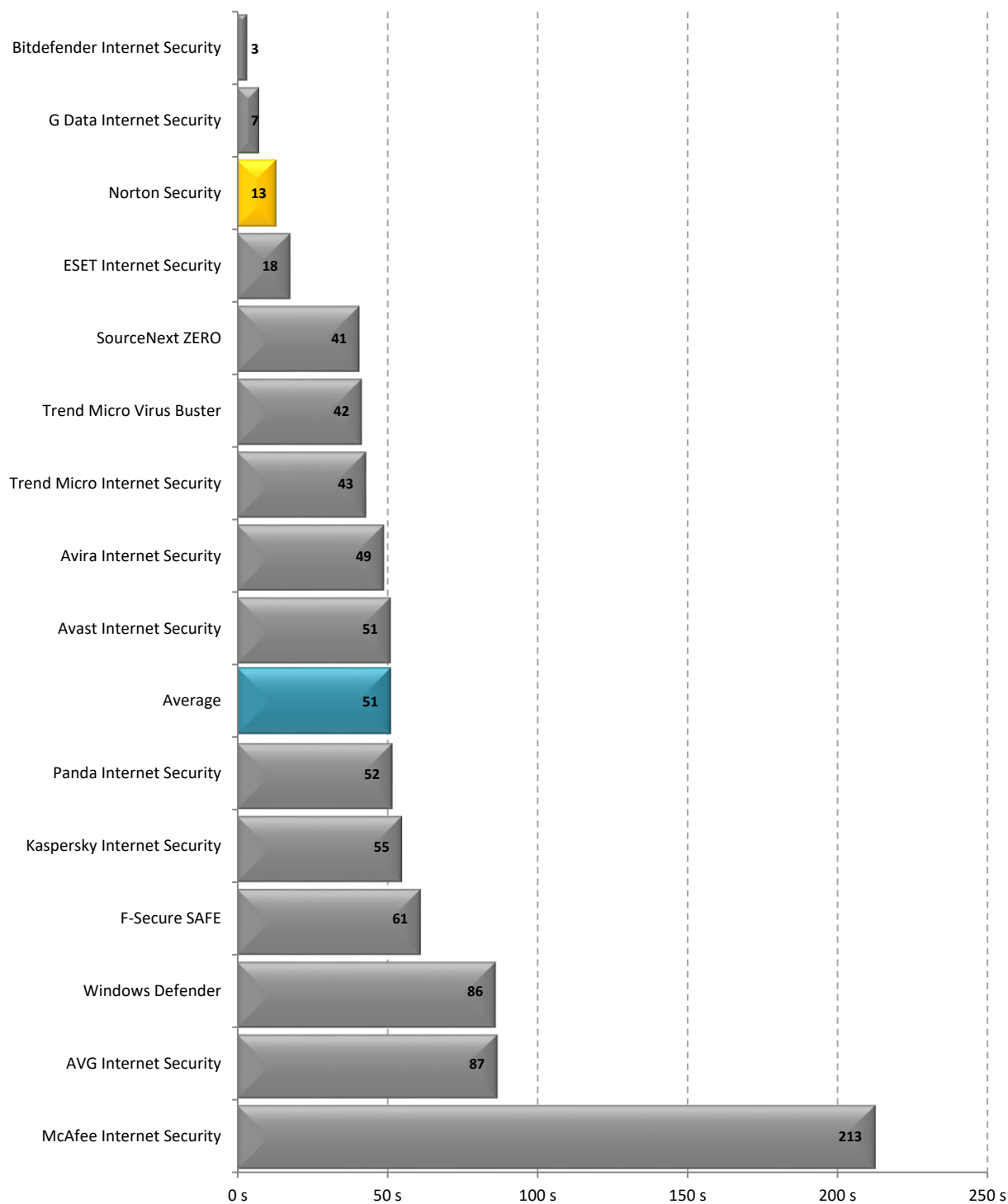
Benchmark 3 – User Interface Launch Time (milliseconds)

The following chart compares the average time taken to launch a product's user interface. Products with lower launch times are considered better performing products in this category.

Product	Time (ms)
Norton Security	106
Windows Defender	117
F-Secure SAFE	118
Trend Micro Virus Buster	123
Avira Internet Security	137
Kaspersky Internet Security	140
G Data Internet Security	204
ESET Internet Security	334
McAfee Internet Security	663
Average	673
Trend Micro Internet Security	793
Panda Internet Security	878
Avast Internet Security	1089
AVG Internet Security	1600
SourceNext ZERO	1800
Bitdefender Internet Security	1990
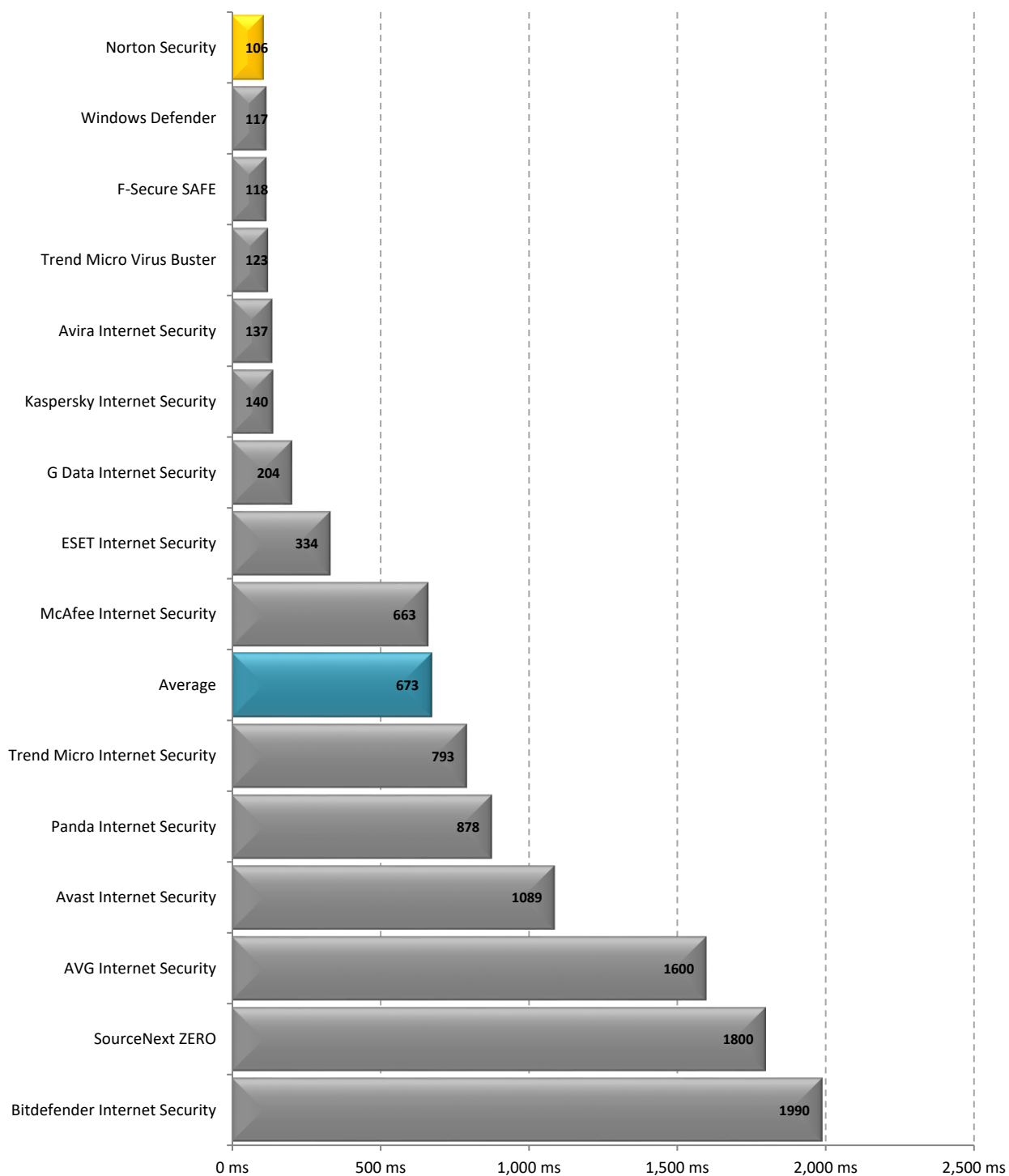
Benchmark 4 – Memory Usage during System Idle (megabytes)

The following chart compares the average amount of RAM in use by an Internet Security product during a period of system idle. This average is taken from a sample of ten memory snapshots taken at roughly 60 seconds apart after reboot. Products with lower idle RAM usage are considered better performing products in this category.[1]

Product	MB
Norton Security	28.7
Panda Internet Security	59.2
Kaspersky Internet Security	96.9
F-Secure SAFE	99.5
G Data Internet Security	112.9
McAfee Internet Security	138.2
Trend Micro Virus Buster	161.6
Average	180.2
Trend Micro Internet Security	227.1
Avira Internet Security	275.6
Bitdefender Internet Security	383.0
SourceNext ZERO	399.7
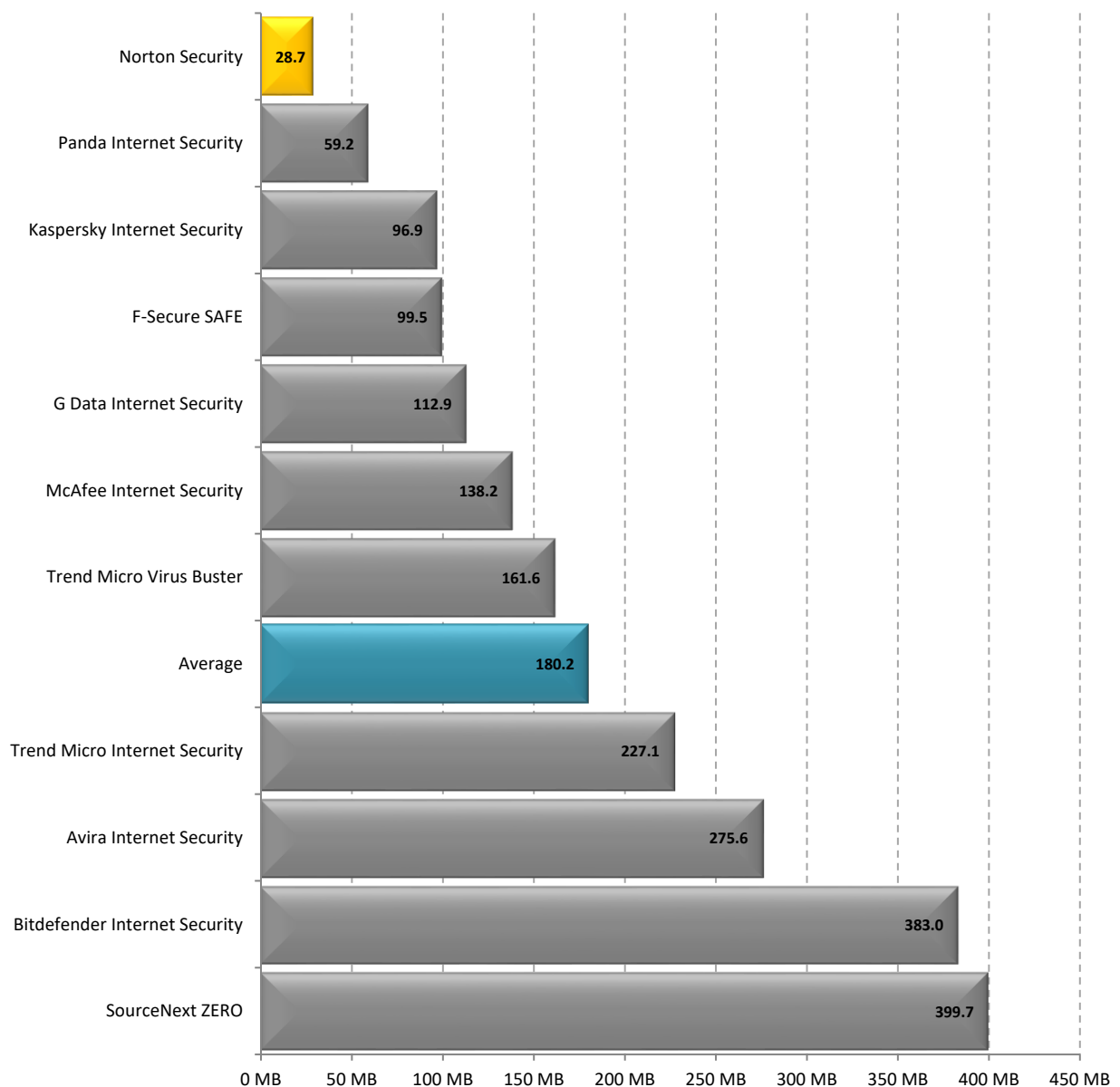
[1] ESET, Windows Defender, AVG, and Avast were excluded from this test because not all their processes could be seen by the memory logger

Benchmark 5 – Memory Usage during Initial Scan (megabytes)

The following chart compares the average amount of RAM in use by an Internet Security product during a scan. This average is taken from a sample of ten memory snapshots taken at roughly 12 seconds apart. Products with lower idle RAM usage are considered better performing products in this category.[2]

Product	MB
Trend Micro Virus Buster	131.3
Trend Micro Internet Security	133.2
Norton Security	136.0
Panda Internet Security	167.3
Kaspersky Internet Security	243.1
Average	313.8
G Data Internet Security	346.2
McAfee Internet Security	371.9
Avira Internet Security	409.9
F-Secure SAFE	418.4
SourceNext ZERO	531.1
Bitdefender Internet Security	563.5
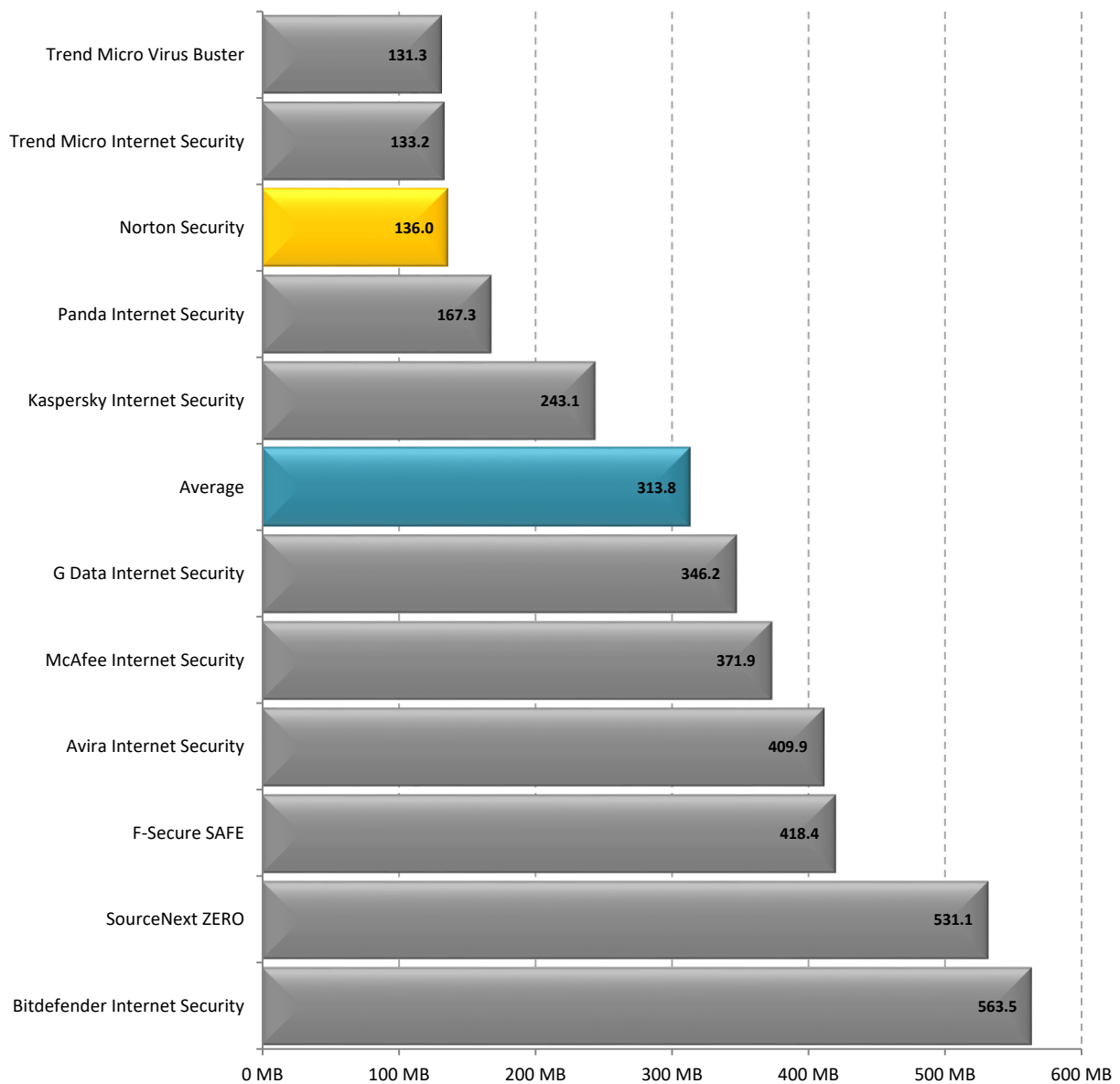
[2] ESET, Windows Defender, AVG, and Avast were excluded from this test because not all their processes could be seen by the memory logger.

Benchmark 6 – Browse Time (seconds)

The following chart compares the average time taken for the default browser Microsoft Edge to successively load a set of popular websites through the local area network from a local server machine. Products with lower browse times are considered better performing products in this category.[3]

Product	Browse Time (s)
Windows Defender	9.7
McAfee Internet Security	10.2
Norton Security	10.3
Kaspersky Internet Security	10.7
G Data Internet Security	13.9
ESET Internet Security	14.2
Bitdefender Internet Security	14.4
Panda Internet Security	14.9
Average	16.1
Trend Micro Internet Security	16.1
Trend Micro Virus Buster	18.5
Avira Internet Security	21.5
SourceNext ZERO	29.7
F-Secure SAFE	32.1

[3] AVG and Avast were excluded from this test as the test script was blocked by the application's firewall.

Benchmark 7 – Edge Launch Time (milliseconds)

The following chart compares the average launch times of the Microsoft Edge after rebooting the machine for each Internet Security product we tested. Products with lower launch times are considered better performing products in this category.
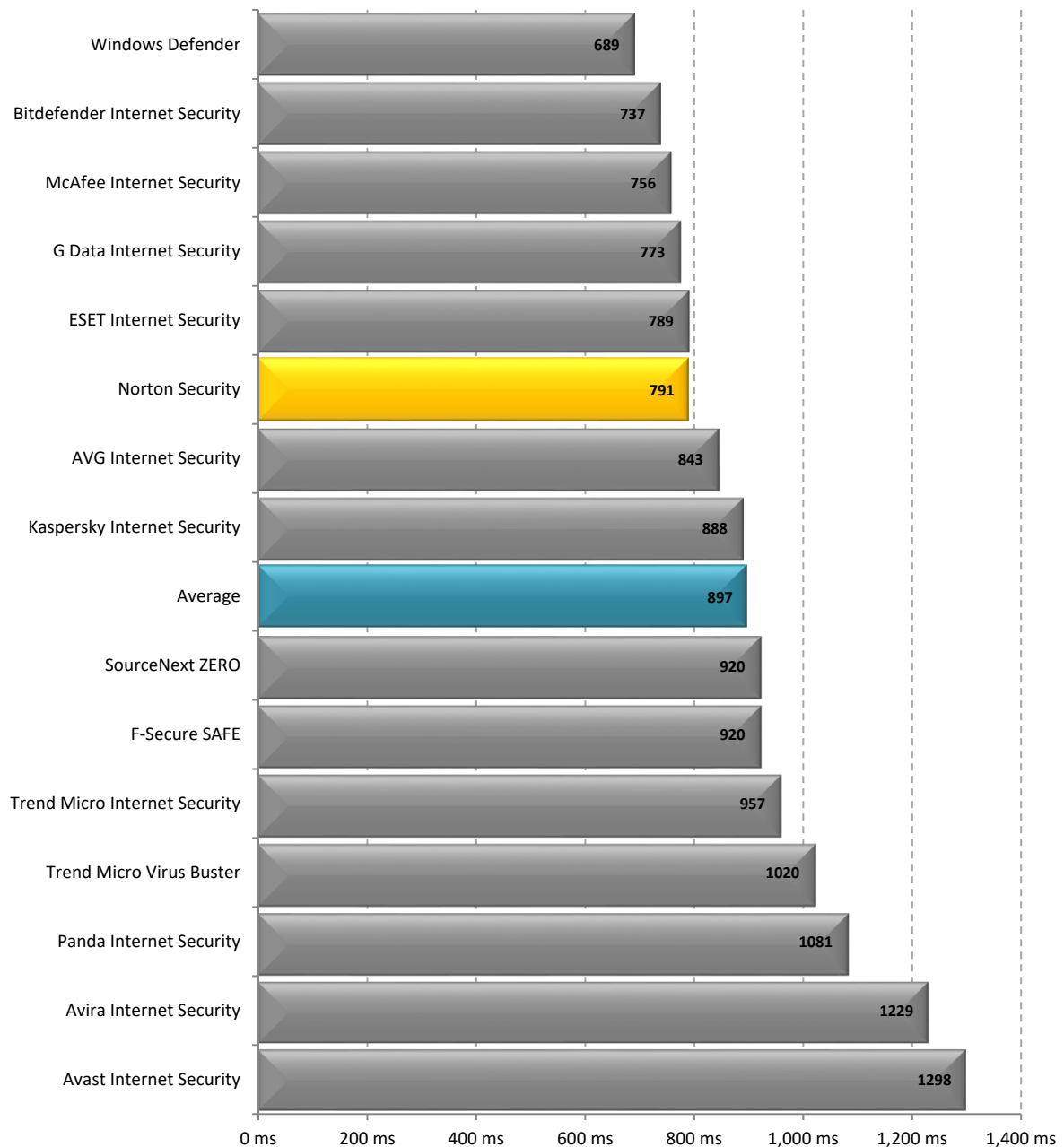
Benchmark 8 – Installation Time (seconds)

The following chart compares the minimum time it takes for security products to be fully functional and ready for use by the end user. Products with lower installation times are considered better performing products in this category.

Product	Time (s)
Kaspersky Internet Security	35
Norton Security	41
ESET Internet Security	45
F-Secure SAFE	76
Trend Micro Internet Security	86
Panda Internet Security	102
Avast Internet Security	131
AVG Internet Security	153
Trend Micro Virus Buster	170
Avira Internet Security	179
Bitdefender Internet Security	196
Average	196
SourceNext ZERO	409
McAfee Internet Security	454
G Data Internet Security	670

0 s   100 s   200 s   300 s   400 s   500 s   600 s   700 s   800 s

Benchmark 9 – Installation Size (megabytes)

The following chart compares the total size of files added during the installation of security products. Products with lower installation sizes are considered better performing products in this category.

Product	Installation Size (MB)
F-Secure SAFE	165
Panda Internet Security	352
Kaspersky Internet Security	557
McAfee Internet Security	649
ESET Internet Security	668
Norton Security	669
Trend Micro Internet Security	727
Avira Internet Security	777
Trend Micro Virus Buster	777
Average	945
Bitdefender Internet Security	996
AVG Internet Security	1546
SourceNext ZERO	1605
Avast Internet Security	1680
G Data Internet Security	2068

Benchmark 10 – File Copy, Move and Delete (seconds)

The following chart compares the average time taken to copy, move and delete several sets of sample files for each Internet Security product tested. Products with lower times are considered better performing products in this category.

Product	Time (s)
McAfee Internet Security	3.2
AVG Internet Security	3.5
Bitdefender Internet Security	3.5
Norton Security	3.6
Avast Internet Security	3.6
ESET Internet Security	3.9
Panda Internet Security	4.6
Trend Micro Virus Buster	4.7
Trend Micro Internet Security	5.0
Average	5.0
SourceNext ZERO	5.4
Kaspersky Internet Security	5.5
G Data Internet Security	5.6
F-Secure SAFE	7.6
Avira Internet Security	7.9
Windows Defender	10.3
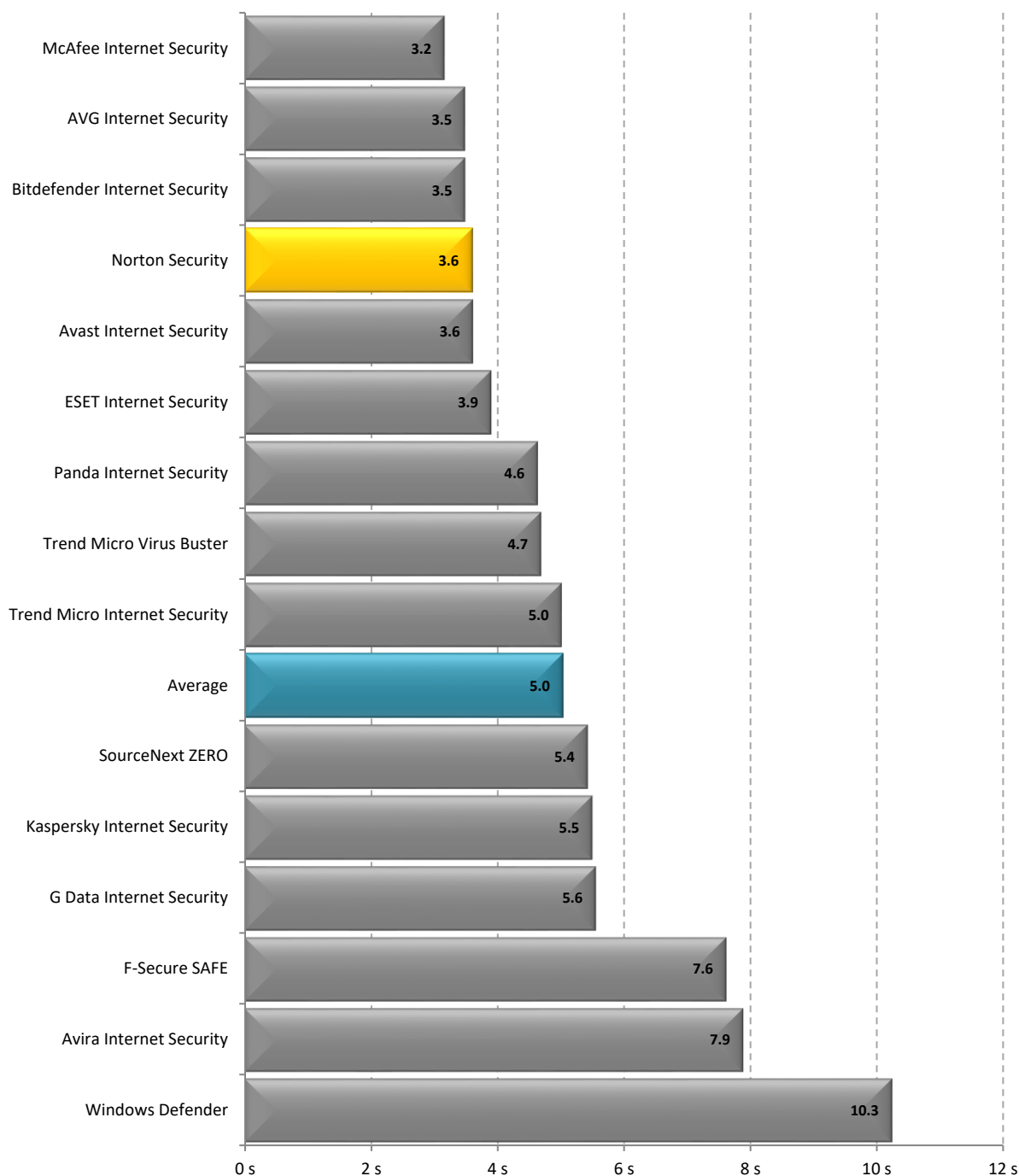
Benchmark 11 – Installation of Third Party Applications (seconds)

The following chart compares the average time taken to install 3 different third-party applications for each Internet Security product tested. Products with lower times are considered better performing products in this category.

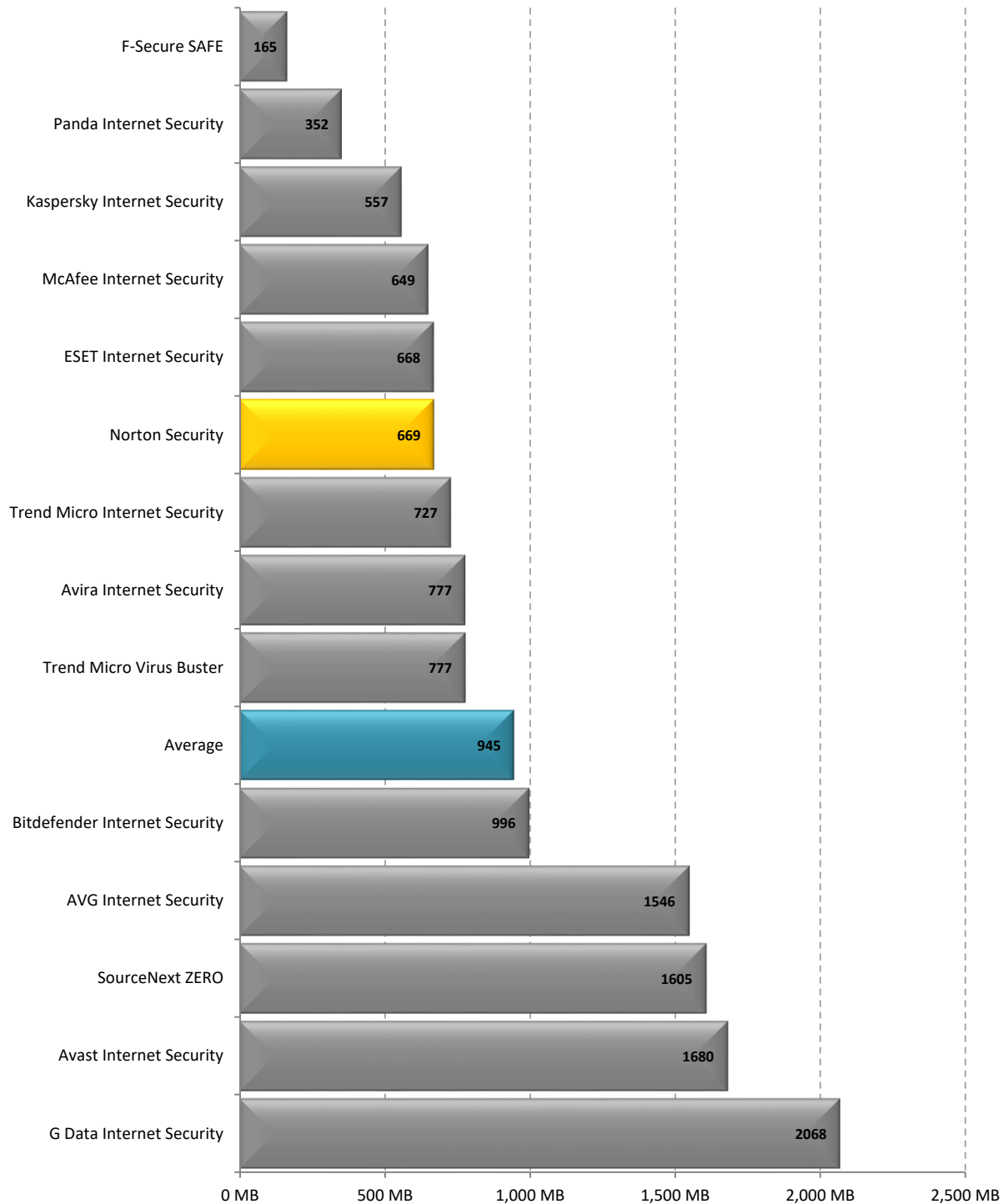| Product	Time (s)
SourceNext ZERO	7.1
G Data Internet Security	8.5
Bitdefender Internet Security	8.9
Norton Security	9.4
Windows Defender	9.6
F-Secure SAFE	9.7
ESET Internet Security	9.7
McAfee Internet Security	10.4
AVG Internet Security	10.7
Average	10.7
Avast Internet Security	11.4
Trend Micro Virus Buster	12.4
Avira Internet Security	12.7
Trend Micro Internet Security	13.4
Panda Internet Security	14.1
Kaspersky Internet Security	16.1
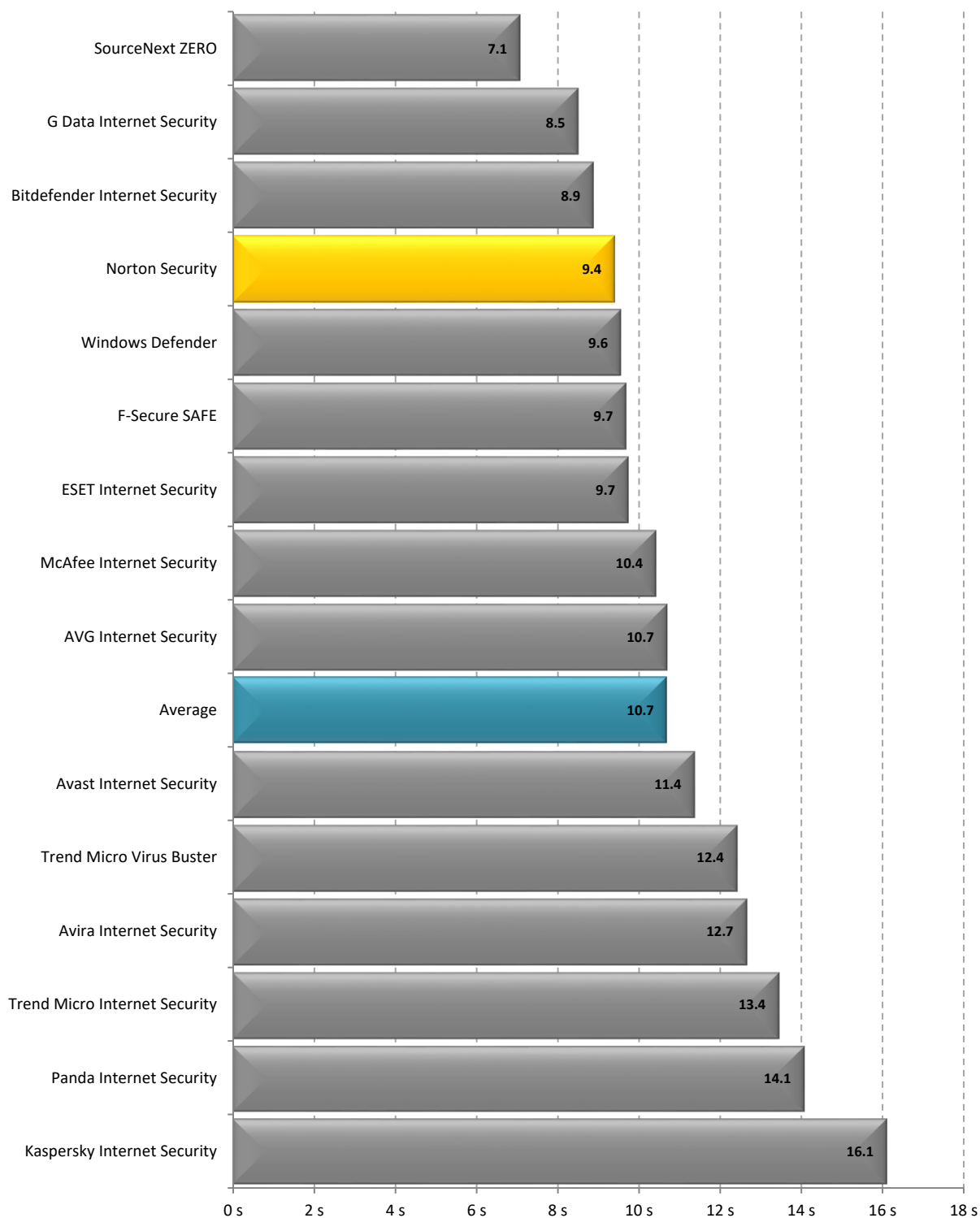
Benchmark 12 – Network Throughput (seconds)

The following chart compares the average time to download a sample set of common file types for each Internet Security product tested. Products with lower times are considered better performing products in this category.

Product	Time (s)
Windows Defender	6.5
McAfee Internet Security	6.6
ESET Internet Security	6.8
AVG Internet Security	8.0
Norton Security	8.7
Kaspersky Internet Security	8.8
Panda Internet Security	8.9
Avast Internet Security	9.2
Bitdefender Internet Security	9.6
Average	10.8
Avira Internet Security	12.1
SourceNext ZERO	12.2
Trend Micro Internet Security	12.3
F-Secure SAFE	17.1
Trend Micro Virus Buster	18.2
G Data Internet Security	21.6

Benchmark 13 – File Format Conversion (seconds)

The following chart compares the average time it takes for five sample files to be converted from one file format to another (MP3 ↔WMA, MP3 ↔WAV) for each Internet Security product tested. Products with lower times are considered better performing products in this category.

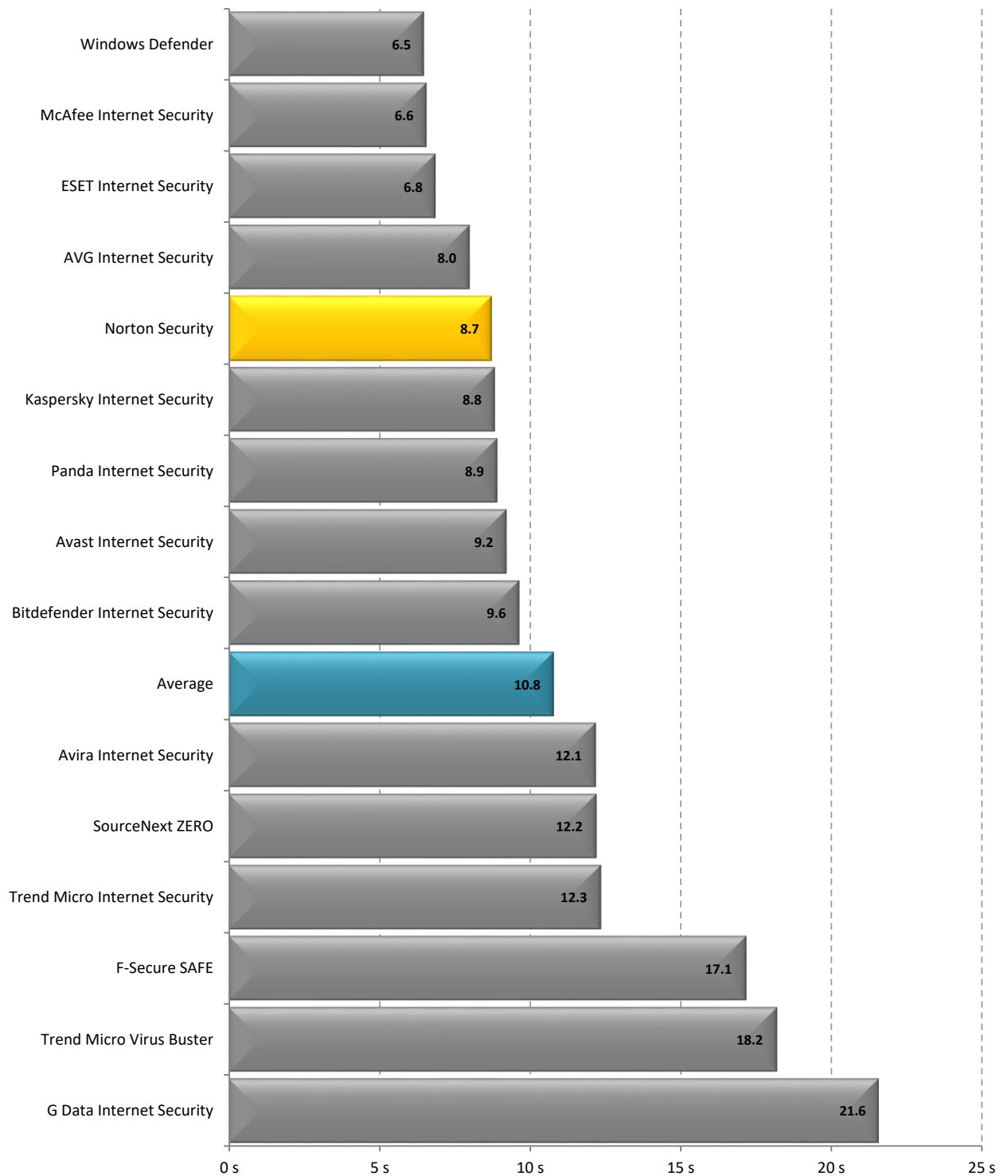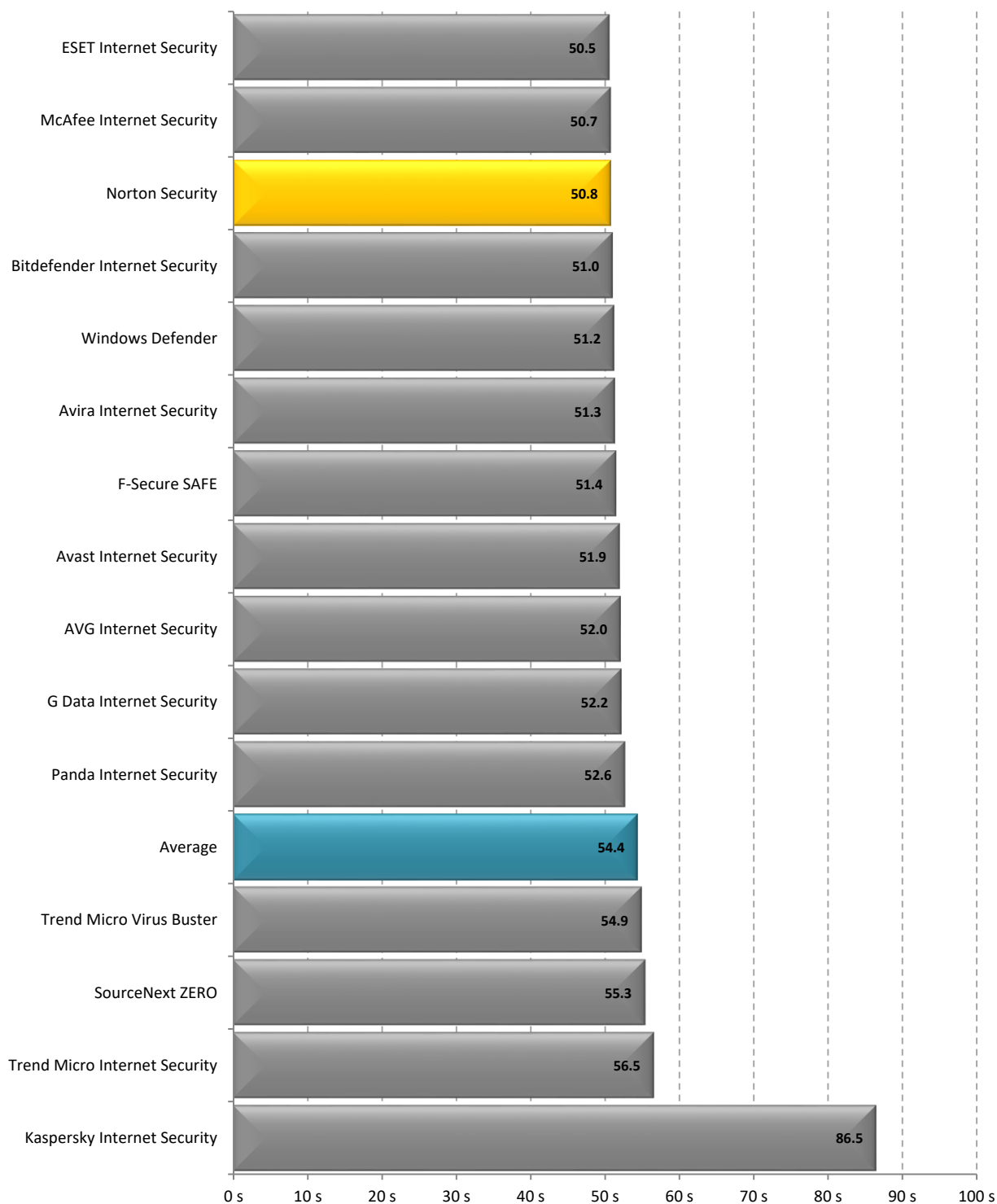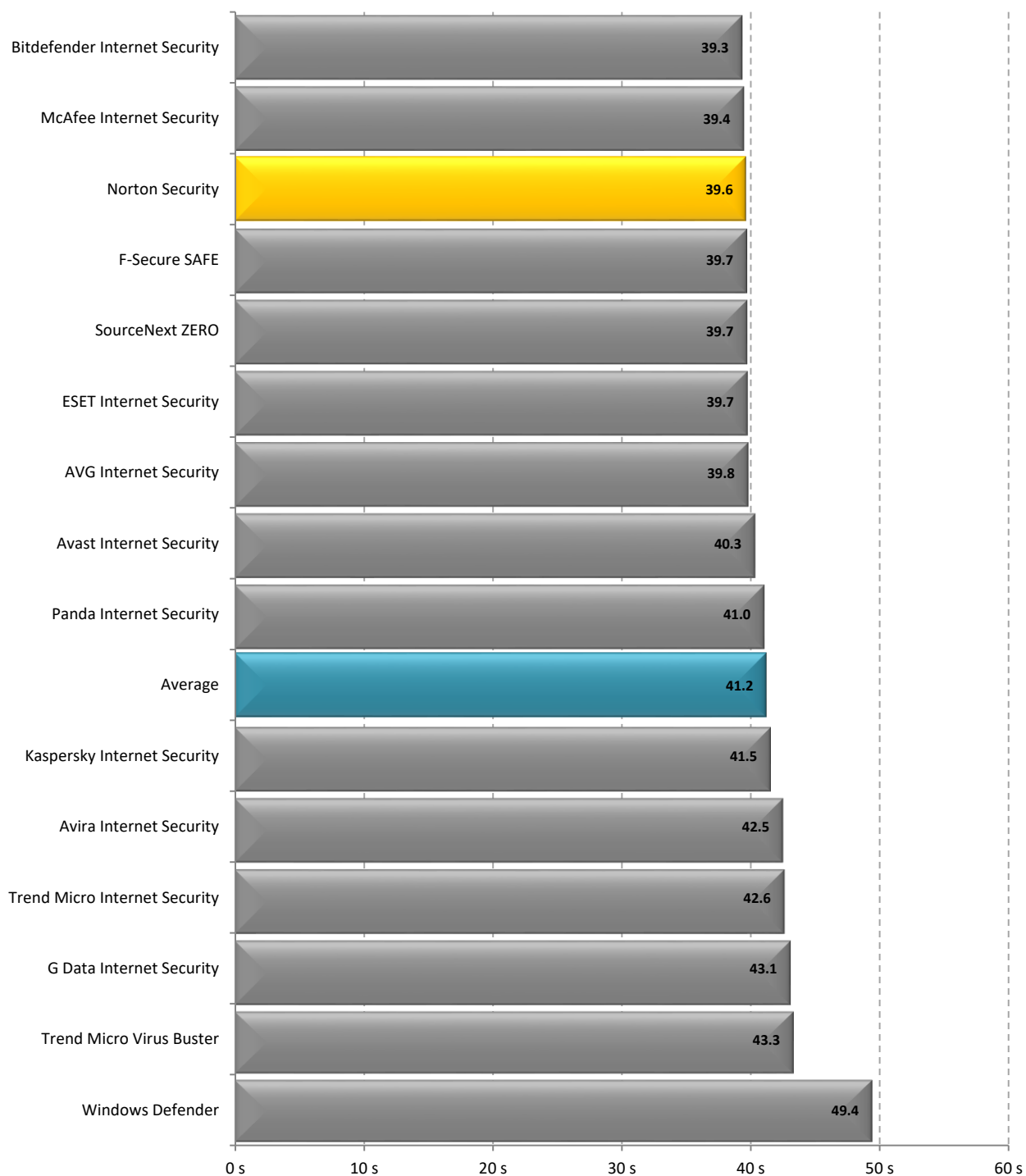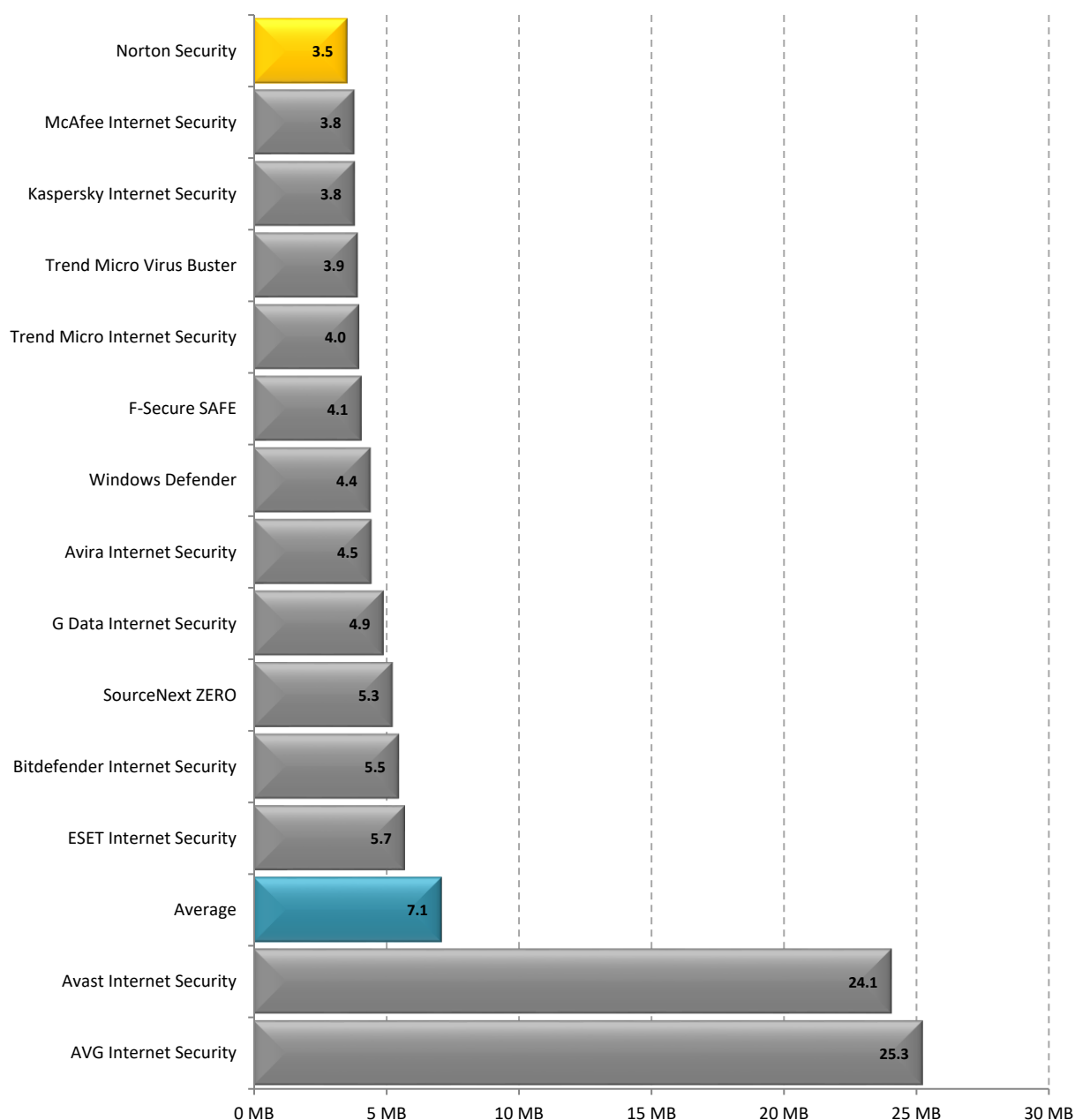| Product	Time (s)
ESET Internet Security	50.5
McAfee Internet Security	50.7
Norton Security	50.8
Bitdefender Internet Security	51.0
Windows Defender	51.2
Avira Internet Security	51.3
F-Secure SAFE	51.4
Avast Internet Security	51.9
AVG Internet Security	52.0
G Data Internet Security	52.2
Panda Internet Security	52.6
Average	54.4
Trend Micro Virus Buster	54.9
SourceNext ZERO	55.3
Trend Micro Internet Security	56.5
Kaspersky Internet Security	86.5

Benchmark 14 – File Compression and Decompression (seconds)

The following chart compares the average time it takes for sample files to be compressed and decompressed for each Internet Security product tested. Products with lower times are considered better performing products in this category.

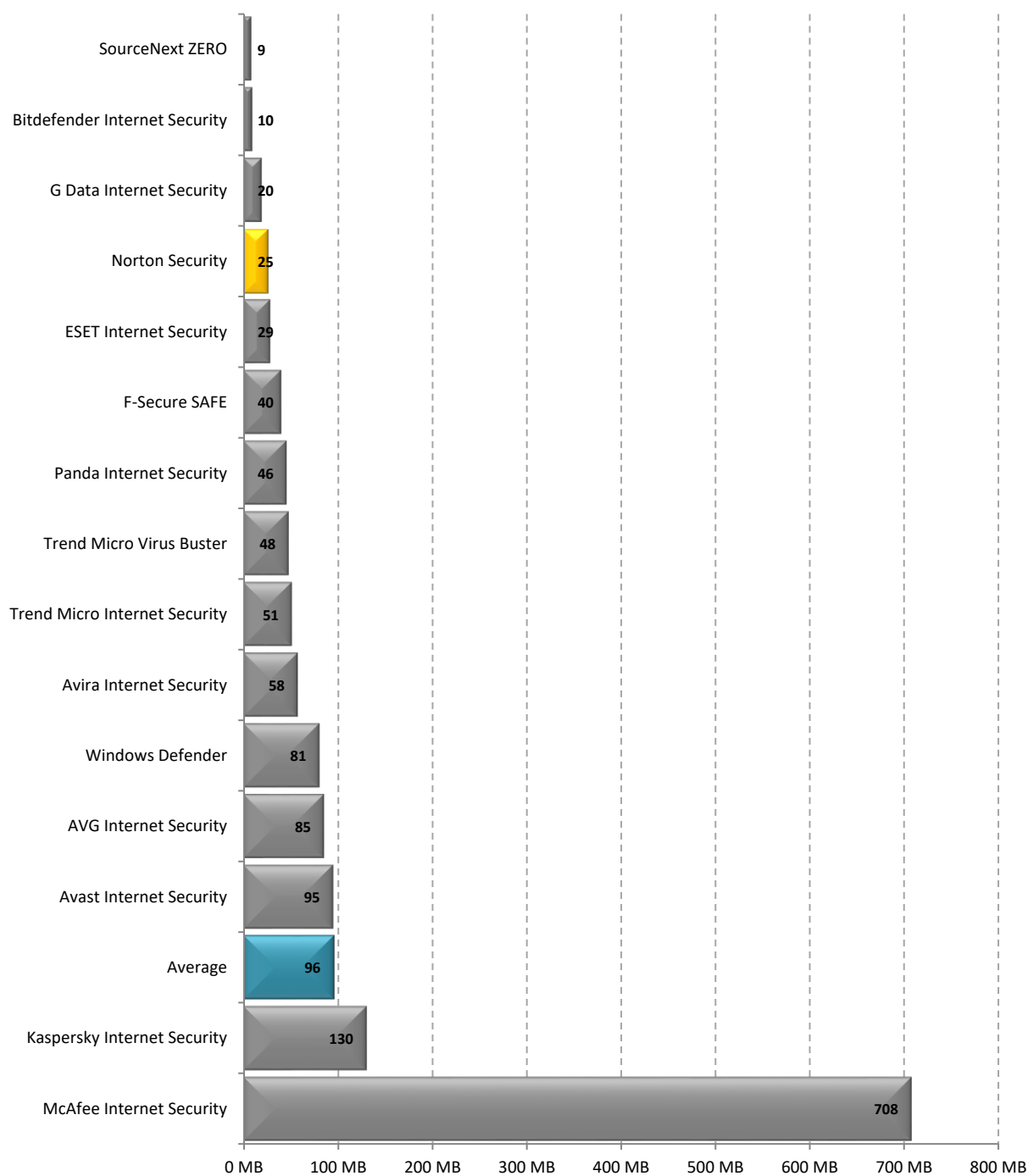| Product	Time (s)
Bitdefender Internet Security	39.3
McAfee Internet Security	39.4
Norton Security	39.6
F-Secure SAFE	39.7
SourceNext ZERO	39.7
ESET Internet Security	39.7
AVG Internet Security	39.8
Avast Internet Security	40.3
Panda Internet Security	41.0
Average	41.2
Kaspersky Internet Security	41.5
Avira Internet Security	42.5
Trend Micro Internet Security	42.6
G Data Internet Security	43.1
Trend Micro Virus Buster	43.3
Windows Defender	49.4

Benchmark 15 – File Download (seconds)

The following chart compares the average time taken to download a set of setup files from a local server. The test was performed 5 times, and the average of all 5 runs was taken as the result. Products with lower times are considered better performing products in this category.[4]

Product	Time (seconds)
Norton Security	3.5
McAfee Internet Security	3.8
Kaspersky Internet Security	3.8
Trend Micro Virus Buster	3.9
Trend Micro Internet Security	4.0
F-Secure SAFE	4.1
Windows Defender	4.4
Avira Internet Security	4.5
G Data Internet Security	4.9
SourceNext ZERO	5.3
Bitdefender Internet Security	5.5
ESET Internet Security	5.7
Average	7.1
Avast Internet Security	24.1
AVG Internet Security	25.3

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[4] Panda Internet Security was excluded from this test as the test script was blocked by the application.
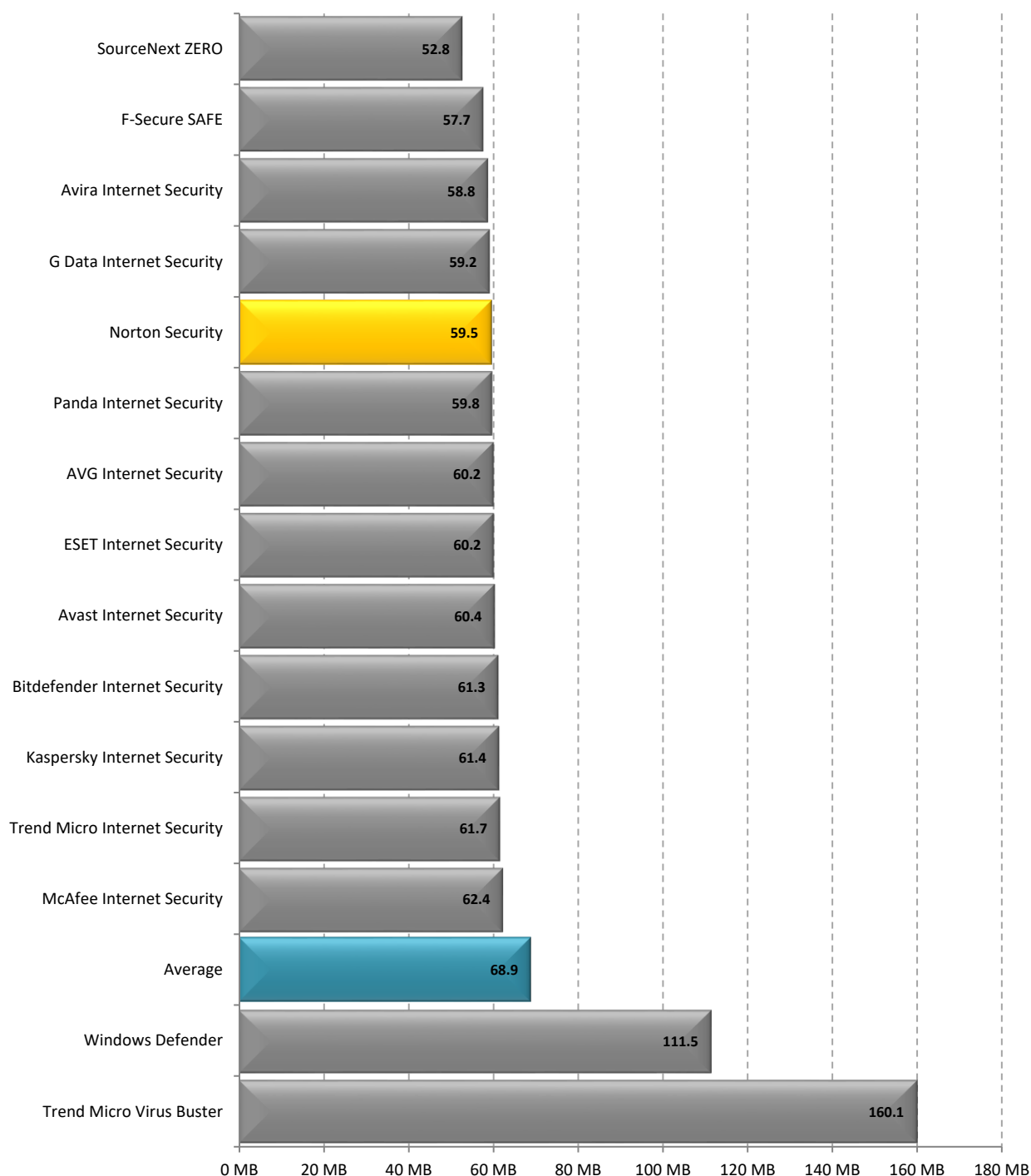
Benchmark 16 – PE Scan Time (seconds)

The following chart compares the average time taken to scan a set of 6351 portable executable files (totaling 2076 MB) for each Internet Security product tested. This time is calculated by averaging the initial (Run 1) and subsequent (Runs 2-5) scan times. Products with lower scan times are considered better performing products in this category.

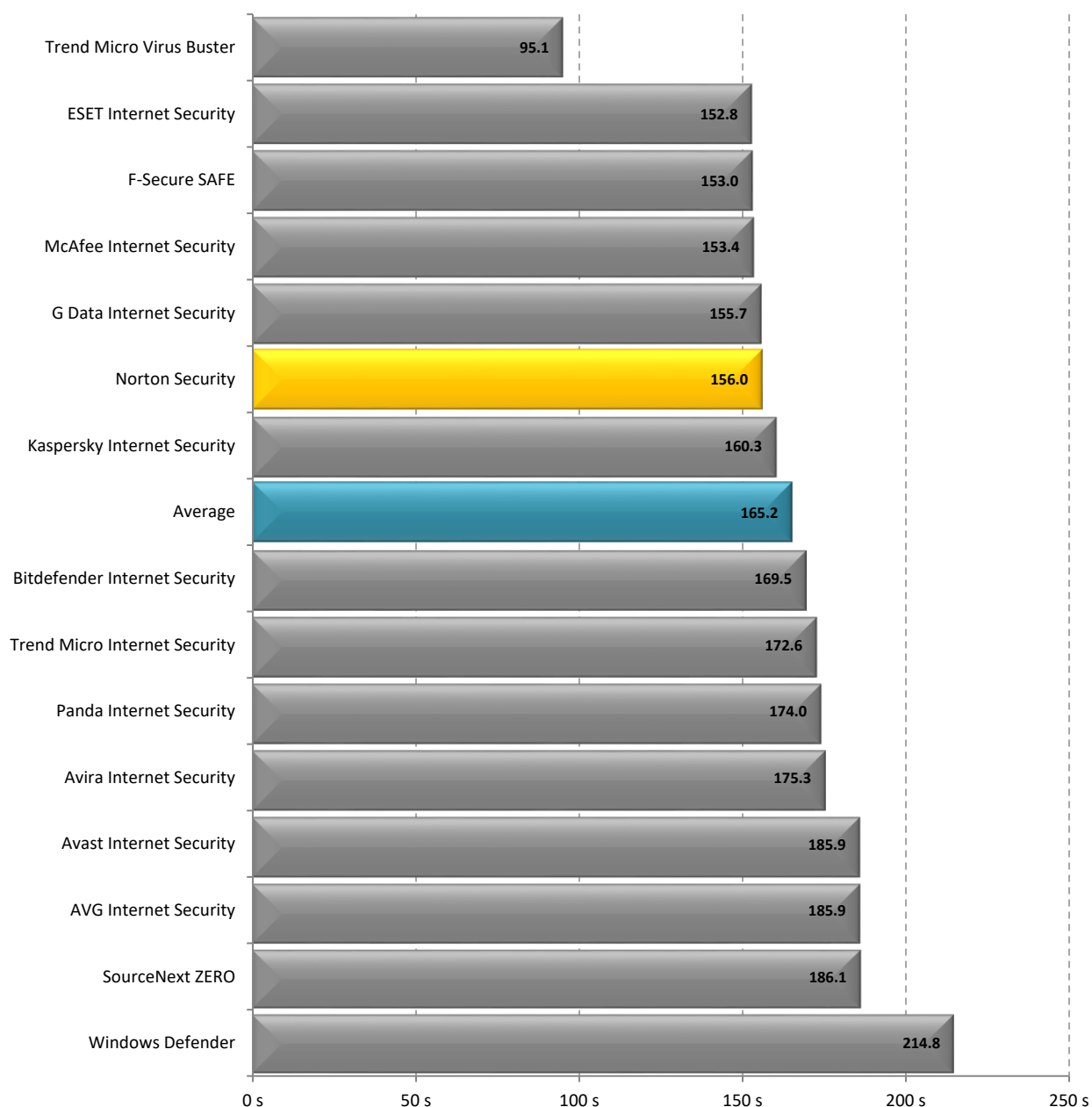| Product	Value
SourceNext ZERO	9
Bitdefender Internet Security	10
G Data Internet Security	20
Norton Security	25
ESET Internet Security	29
F-Secure SAFE	40
Panda Internet Security	46
Trend Micro Virus Buster	48
Trend Micro Internet Security	51
Avira Internet Security	58
Windows Defender	81
AVG Internet Security	85
Avast Internet Security	95
Average	96
Kaspersky Internet Security	130
McAfee Internet Security	708

Benchmark 17 – File Copy Disk to Disk (seconds)

The following chart compares the average time taken to copy a total of 8,501 files, with a total file size of 5.44GB files, from one local drive to another local drive for each Internet Security product tested. The test was performed 5 times, and the average of all 5 runs was taken as the result. Products with lower times are considered better performing products in this category.

SourceNext ZERO — 52.8
F-Secure SAFE — 57.7
Avira Internet Security — 58.8
G Data Internet Security — 59.2
Norton Security — 59.5
Panda Internet Security — 59.8
AVG Internet Security — 60.2
ESET Internet Security — 60.2
Avast Internet Security — 60.4
Bitdefender Internet Security — 61.3
Kaspersky Internet Security — 61.4
Trend Micro Internet Security — 61.7
McAfee Internet Security — 62.4
Average — 68.9
Windows Defender — 111.5
Trend Micro Virus Buster — 160.1

0 MB   20 MB   40 MB   60 MB   80 MB   100 MB   120 MB   140 MB   160 MB   180 MB
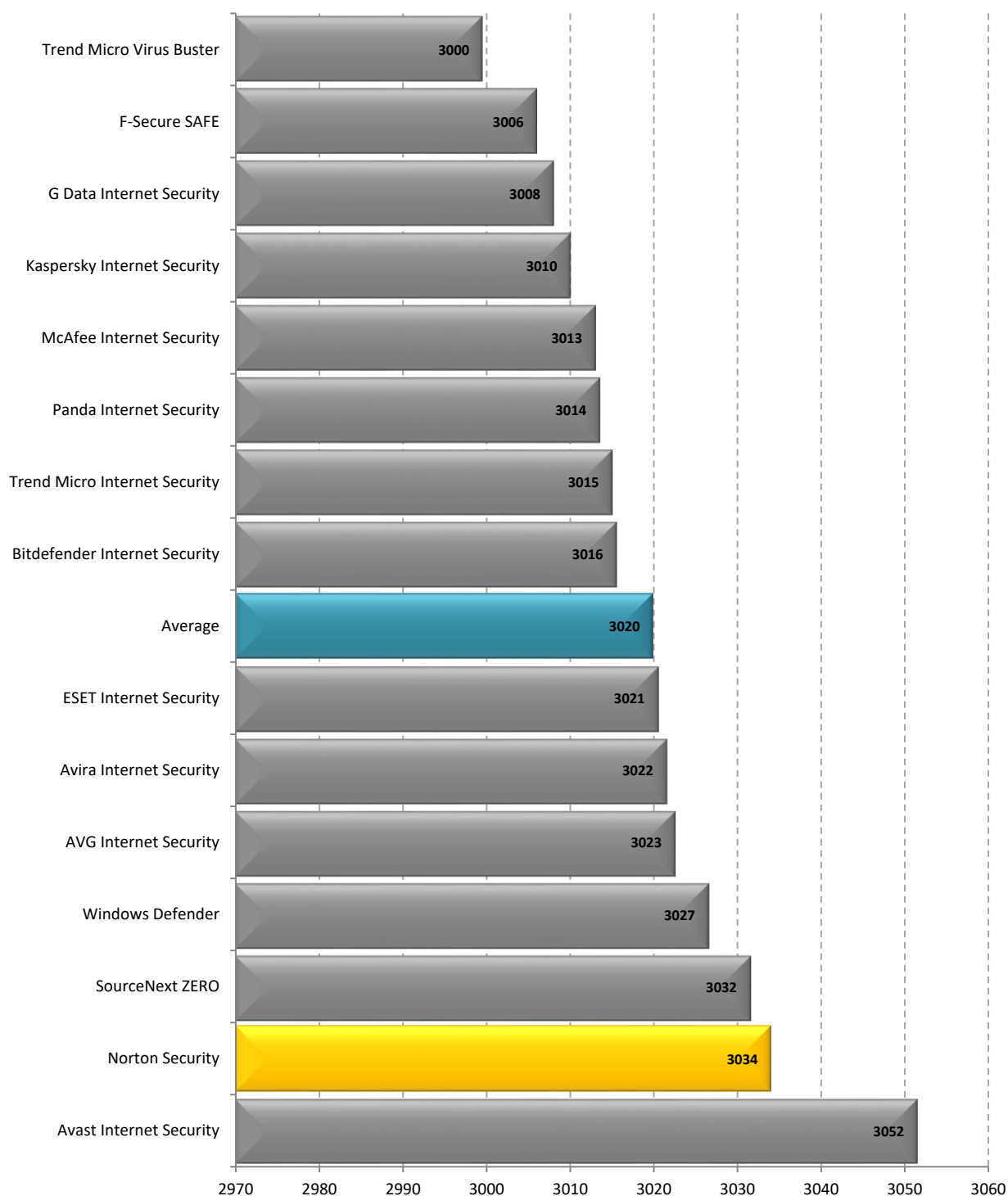
Benchmark 18 – File Copy Over Network (seconds)

The following chart compares the average time taken to transfer a total of 8,501 files over the local network, with a total file size of 5.44GB files, from a local drive on the test machine to a local server. The test was performed 5 times, and the average of all 5 runs was taken as the result. Products with lower times are considered better performing products in this category. [5]

Product	Seconds
Trend Micro Virus Buster	95.1
ESET Internet Security	152.8
F-Secure SAFE	153.0
McAfee Internet Security	153.4
G Data Internet Security	155.7
Norton Security	156.0
Kaspersky Internet Security	160.3
Average	165.2
Bitdefender Internet Security	169.5
Trend Micro Internet Security	172.6
Panda Internet Security	174.0
Avira Internet Security	175.3
Avast Internet Security	185.9
AVG Internet Security	185.9
SourceNext ZERO	186.1
Windows Defender	214.8

[5] AVG was excluded from this test as the test script was blocked by the application's firewall.
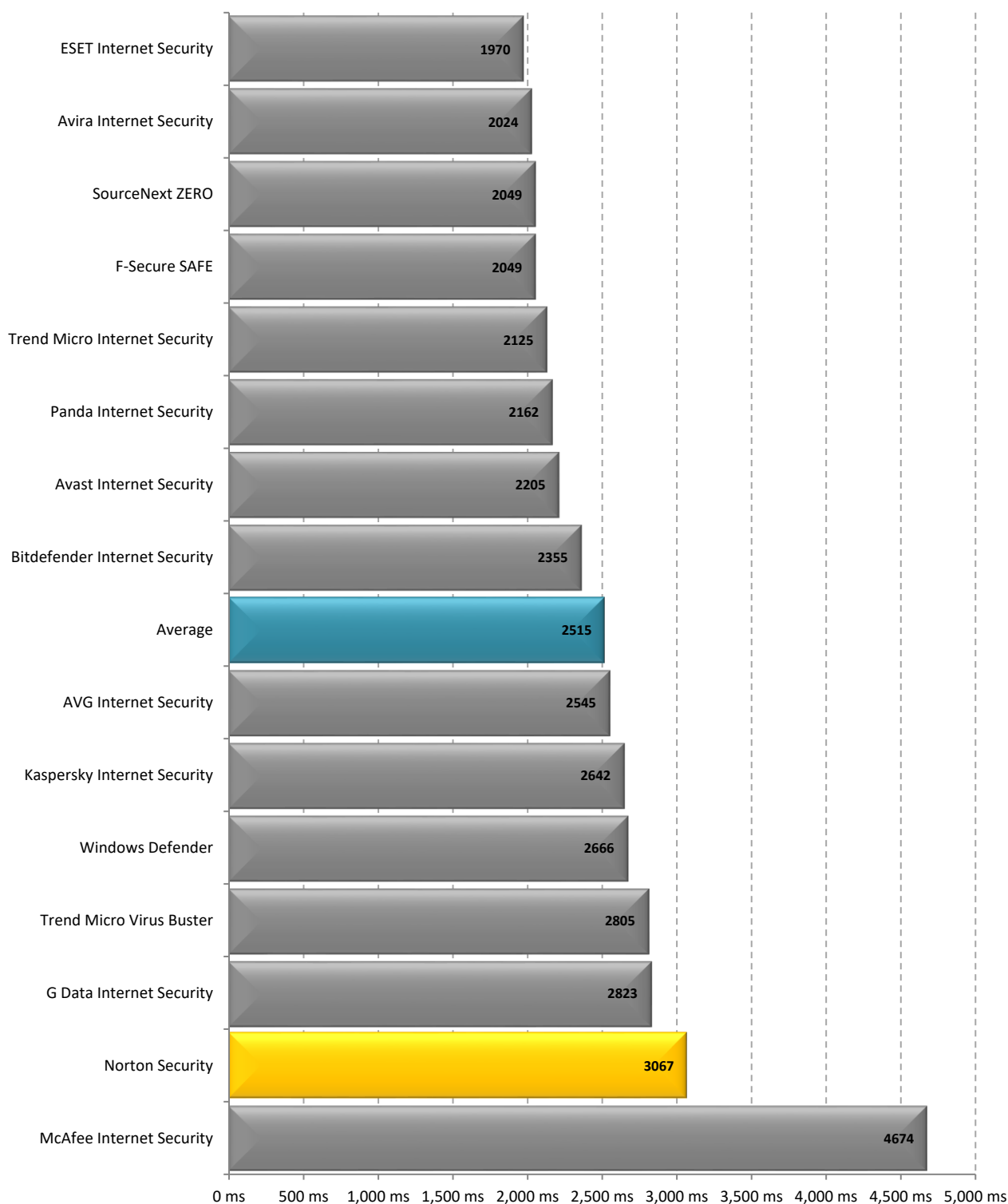
Benchmark 19 – PCMark 8 Home Score

The following chart compares the average PCMark 8 Home score for each Internet Security product tested. The test was performed 2 times, and the average of both runs was taken as the result. Products with higher scores are considered better performing products in this category.
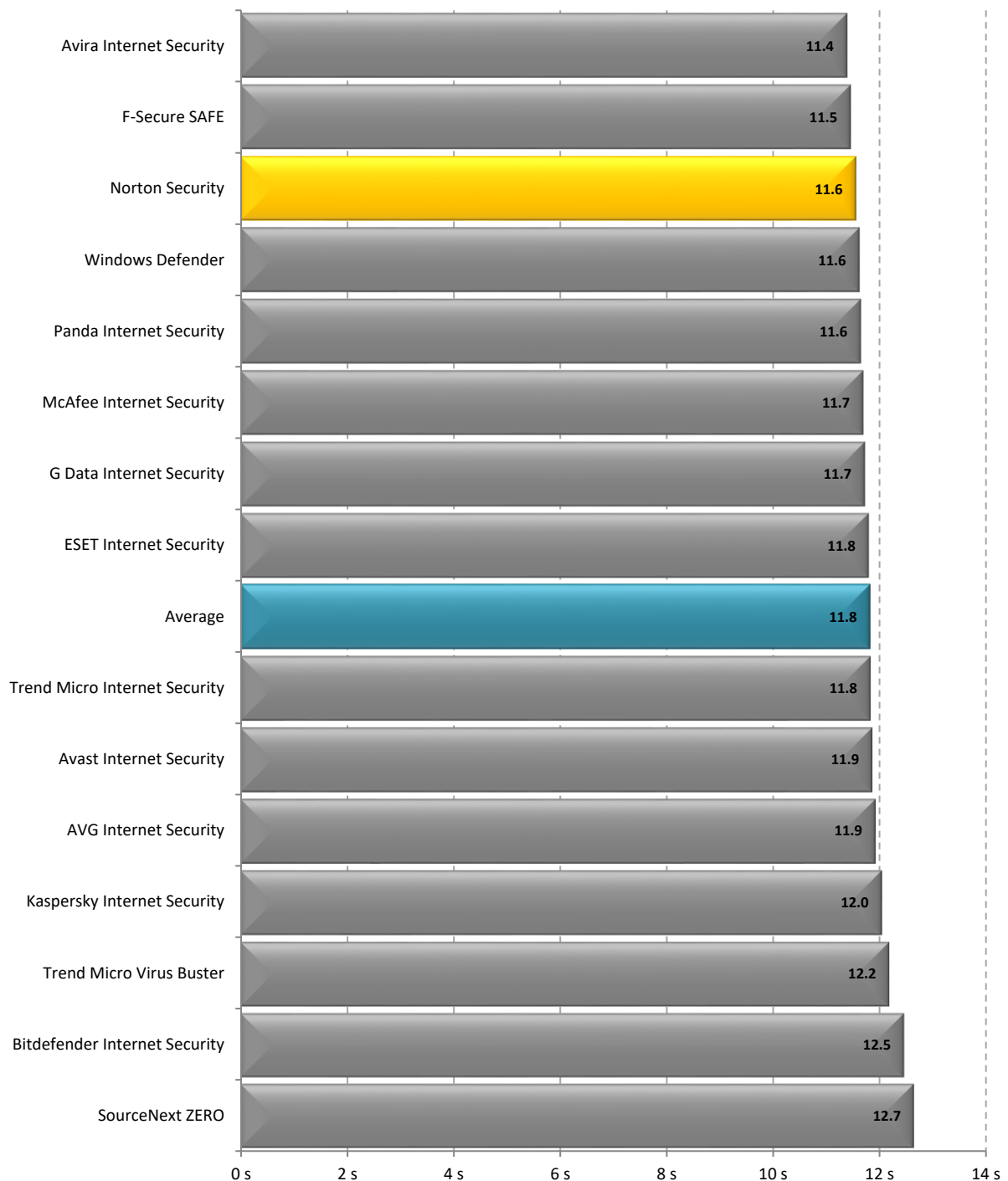
Product	Score
Trend Micro Virus Buster	3000
F-Secure SAFE	3006
G Data Internet Security	3008
Kaspersky Internet Security	3010
McAfee Internet Security	3013
Panda Internet Security	3014
Trend Micro Internet Security	3015
Bitdefender Internet Security	3016
Average	3020
ESET Internet Security	3021
Avira Internet Security	3022
AVG Internet Security	3023
Windows Defender	3027
SourceNext ZERO	3032
Norton Security	3034
Avast Internet Security	3052

Benchmark 20 – Word Document Launch and Open Time (milliseconds)

The following chart compares the average time taken to launch Microsoft Word and open a 10MB document. Products with lower launch times are considered better performing products in this category.
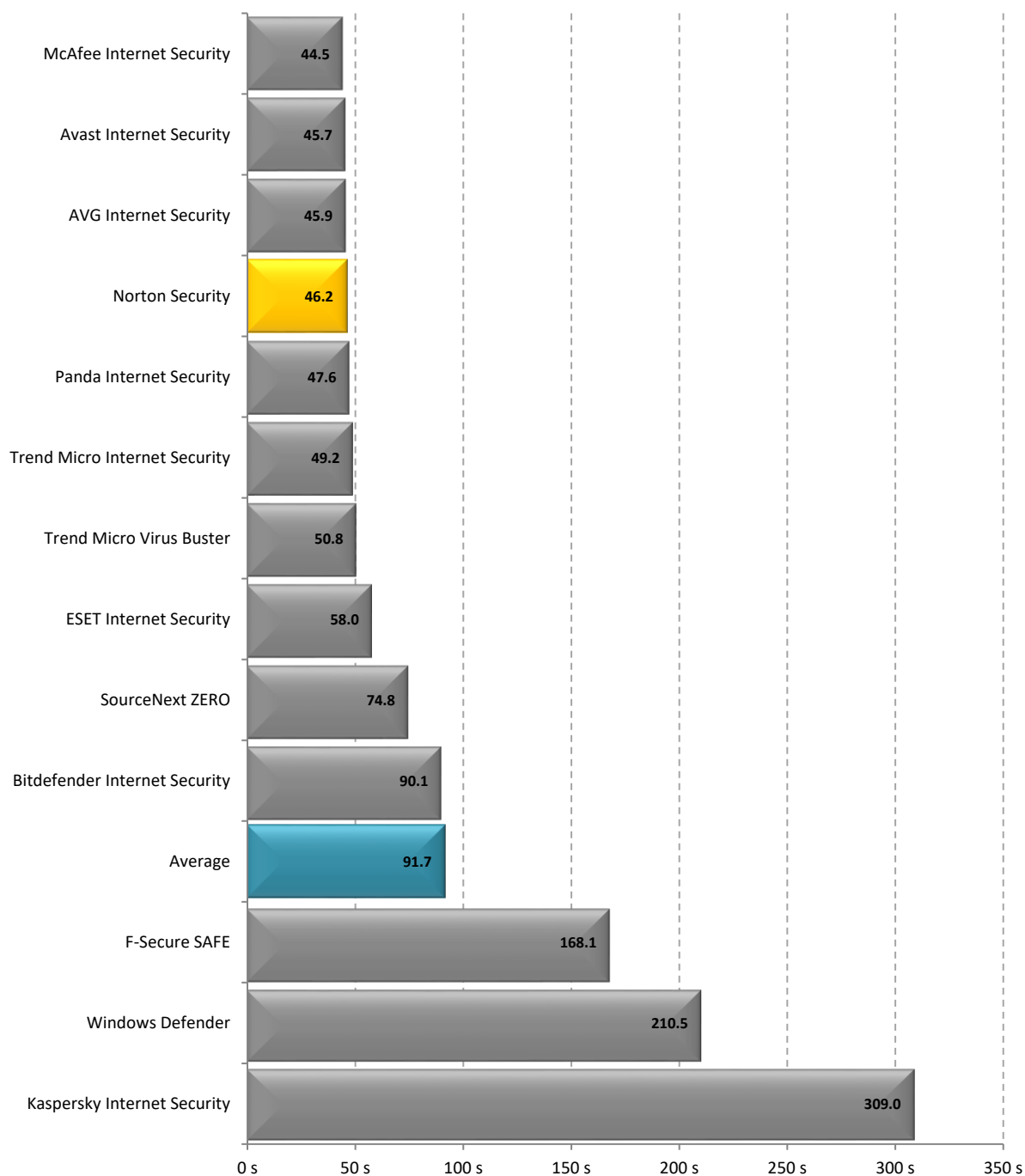
Product	Time (ms)
ESET Internet Security	1970
Avira Internet Security	2024
SourceNext ZERO	2049
F-Secure SAFE	2049
Trend Micro Internet Security	2125
Panda Internet Security	2162
Avast Internet Security	2205
Bitdefender Internet Security	2355
Average	2515
AVG Internet Security	2545
Kaspersky Internet Security	2642
Windows Defender	2666
Trend Micro Virus Buster	2805
G Data Internet Security	2823
Norton Security	3067
McAfee Internet Security	4674

Benchmark 21 – Run Excel Macro (seconds)

The following chart compares the average time taken to launch Microsoft Excel and run a macro. Products with lower times are considered better performing products in this category.

Product	Time (s)
Avira Internet Security	11.4
F-Secure SAFE	11.5
Norton Security	11.6
Windows Defender	11.6
Panda Internet Security	11.6
McAfee Internet Security	11.7
G Data Internet Security	11.7
ESET Internet Security	11.8
Average	11.8
Trend Micro Internet Security	11.8
Avast Internet Security	11.9
AVG Internet Security	11.9
Kaspersky Internet Security	12.0
Trend Micro Virus Buster	12.2
Bitdefender Internet Security	12.5
SourceNext ZERO	12.7

Benchmark 22 – Save Word Document to PDF (seconds)

The following chart compares the average time taken to launch Microsoft Word and open a 10MB document and save it as a PDF. Products with lower times are considered better performing products in this category.
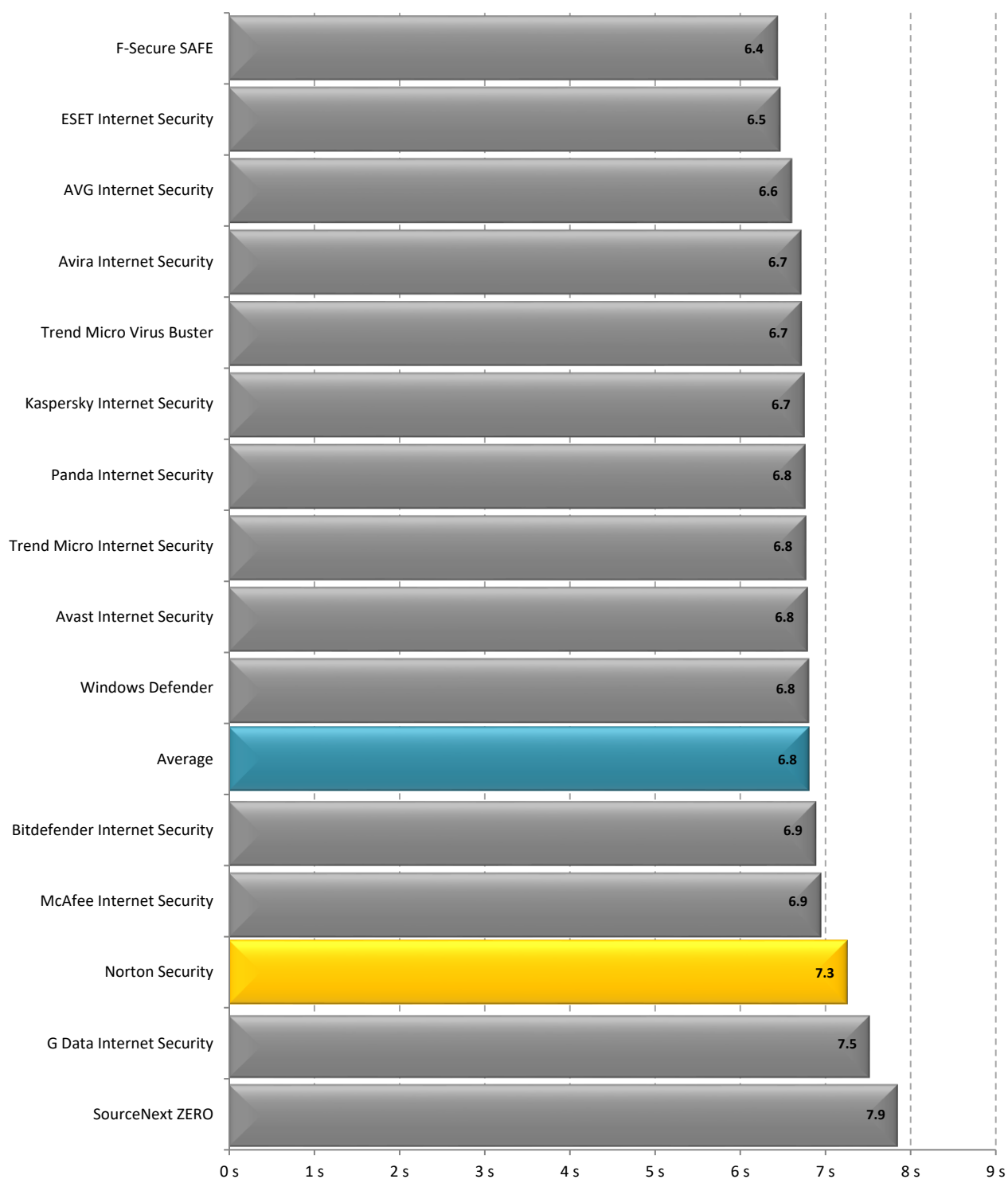
Benchmark 23 – USB 3.0 File Copy (seconds)

The following chart compares the average time taken to copy a set of files from an external USB 3.0 drive to a local disk. Products with lower times are considered better performing products in this category. [6]

Product	Time (s)
McAfee Internet Security	44.5
Avast Internet Security	45.7
AVG Internet Security	45.9
Norton Security	46.2
Panda Internet Security	47.6
Trend Micro Internet Security	49.2
Trend Micro Virus Buster	50.8
ESET Internet Security	58.0
SourceNext ZERO	74.8
Bitdefender Internet Security	90.1
Average	91.7
F-Secure SAFE	168.1
Windows Defender	210.5
Kaspersky Internet Security	309.0

[6] Avira and G Data were excluded from this benchmark because the security software blocked the test script from running to completion.

Disclaimer and Disclosure

This report only covers the versions that are listed in the "Products and Versions" section of this report.

Disclaimer of Liability

While every effort has been made to ensure that the information presented in this report is accurate, PassMark Software Pty Ltd assumes no responsibility for errors, omissions, or out-of-date information and shall not be liable in any manner whatsoever for direct, indirect, incidental, consequential, or punitive damages resulting from the availability of, use of, access of, or inability to use this information.

Disclosure

Symantec Corporation funded the production of this report, selected the test metrics and list of products to include in this report, and supplied some of the test scripts used for the tests.

Trademarks

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Appendix 1 – Test Environment

For our testing, PassMark Software used a test environment running Windows 10 Home (64-bit) with the following hardware specifications:

Windows 10 Home (64-bit) System

Model:	Lenovo H50W-50 i5
CPU:	Intel Core i5-4460 CPU @ 3.20GHz 3.20 GHz
Video Card:	NVIDIA GeForce GT 705
RAM:	8GB DDR3 RAM
SSD (Main Boot Drive):	Intel SSD 730 Series 240GB
2nd Drive:	Samsung 1000GB 7200RPM HD103UJ
Network:	Gigabit (1GB/s) switch
O/S:	Windows 10 Home 10.0 (Build 10240)

For network tests (wget, http), PassMark Software used a server with the following specifications:

Test Server – Windows Server 2012

CPU:	Intel Xeon E3-1220v2 CPU
Video Card:	Kingston 8GB (2 x 4GB) ECC
Motherboard:	Intel S1200BTL Server Motherboard
RAM:	4GB DDR3 RAM, 1333 Mhz
HDD:	Samsung 1.5TB 7200RPM
Network:	Gigabit (1GB/s) switch

Appendix 2 – Methodology Description

Windows 10 Image Creation

A bootable version of OSForensics was used to create a "clean" baseline image prior to testing. Our aim was to create a baseline image with the smallest possible footprint and reduce the possibility of variation caused by external operating system factors.

The baseline image was restored prior to testing of each different product. This process ensures that we install and test all products on the same, "clean" machine.

The steps taken to create the base Windows 10 image are as follows:

1.   Installation and activation of **Windows 10 Home** Edition.
2.   Disabled Automatic Updates.
3.   Changed User Account Control settings to "Never Notify".
4.   Disable Windows Defender automatic scans to avoid unexpected background activity.
5.   Disable the Windows firewall to avoid interference with security software.
6.   Disabled *Superfetch* to ensure consistent results.
7.   Installed *HTTP Watch* for Browse Time testing.
8.   Installed *Windows Performance Toolkit x64* for Boot Time testing.
9.   Installed Active Perl for interpretation of some test scripts.
10.   Install OSForensics for testing (Installation Size) purposes.
11.   Update Windows.
12.   Disable Windows Automatic Updates.
13.   Created a baseline image of the boot drive using OSForensics.

Benchmark 1 – Boot Time

PassMark Software uses tools available from the ***Windows Performance Toolkit*** (as part of the Microsoft Windows 10 ADK obtainable from the Microsoft Website).

The Boot Performance (fast startup) test is ran as an individual assessment via the Windows Assessment Console. The network connection is disabled and the login password is removed to avoid interruption to the test. The final result is taken as the total boot duration excluding BIOS load time.

Benchmark 2 – Scan Time

Scan Time is the time it took for each product to scan a set of sample files. The sample used was identical in all cases and contained a mixture of system files and Office files. In total there were 6159 files whose combined size was 982 MB. Most of these files come from the Windows system folders. As the file types can influence scanning speed, the breakdown of the main file types, file numbers and total sizes of the files in the sample set is given here:

File Extension	Number of Files	File Size
.dll	2589	490MB

.exe	695	102MB
.sys	332	23MB
.gif	302	1MB
.doc	281	64MB
.wmf	185	2MB
.png	149	2MB
.html	126	1MB
.nls	80	6MB
.jpg	70	1MB
.ini	59	2MB
.ico	58	<1MB
.mof	43	6MB
.ax	39	4MB
.xls	38	3MB
.ime	35	5MB
.drv	31	1MB
.txt	31	1MB
.chm	30	6MB
.cpl	29	4MB
.mfl	29	3MB
.inf	26	2MB
.hlp	22	3MB
.imd	20	18MB
.py	20	<1MB
.msc	18	1MB
.vbs	18	1MB
.xml	18	1MB
.rtf	16	62MB
.ocx	16	4MB
.tsp	14	1MB
.com	14	<1MB
.xsl	14	<1MB
.h	13	<1MB
.vsd	12	2MB
.scr	12	2MB
.aw	12	2MB
.js	12	1MB
.zip	11	25MB
.lex	9	10MB
.ppt	9	4MB
.acm	9	1MB
.wav	7	5MB
Total	6159	982

This scan was run without launching the product's user interface, by right-clicking the test folder and choosing the "Scan Now" option. To record the scan time, we have used product's built-in scan timer or reporting system. Where this was not possible, scan times were taken manually with a stopwatch.

In previous years of testing, we noticed many more products showing a substantial difference between the initial scan time (first scan) and subsequent scan times (scans 2 to 5). We believe this behavior is due to products themselves caching recently scanned files.

As a result of this mechanism, we have averaged the four subsequent scan times to obtain an average subsequent scan time. Our final result for this test is an average of the subsequent scan average and the initial scan time.

Benchmark 3 – User Interface Launch Time

The launch time of a product's user interface was taken using *AppTimer (v1.0.1006)*. For each product tested, we obtained a total of fifteen samples from five sets of three UI launches, with a reboot before each set to clear caching effects by the operating system. When compiling the results the first of each set was separated out so that there was a set of values for the initial launch after reboot and a set for subsequent launches.

We have averaged the subsequent launch times to obtain an average subsequent launch time. Our final result for this test is an average of the subsequent launch average and the initial launch time.

In some cases, *AppTimer* did not correctly record the time taken for UI launch. For instance, some applications would open their window and look like they were ready, but then continued to be unresponsive. Where the measurement from *AppTimer* appeared inaccurate, we have taken the time manually with a stop watch.

AppTimer is publically available from the PassMark Website.

Benchmark 4 – Memory Usage during System Idle

The *MemLog++* utility was used to record process memory usage on the system at boot, and then every minute for another fifteen minutes after. This was done only once per product and resulted in a total of 15 samples. The first sample taken at boot is discarded.

The *MemLog++* utility records memory usage of all processes, not just those of the anti-malware product. As a result of this, an anti-malware product's processes needed to be isolated from all other running system processes. To isolate relevant process, we used a program called *Process Explorer* which was run immediately upon the completion of memory usage logging by *MemLog++*. *Process Explorer* is a Microsoft Windows Sysinternals software tool which shows a list of all DLL processes currently loaded on the system.

Benchmark 5 – Memory Usage during Initial Scan

The *MemLog ++* utility was used to record process memory during an on-demand scan of the boot drive over a 2 minute period. This was done only once per product and resulted in a total of 10 samples each.

The *MemLog ++* utility records memory usage of all processes, not just those of the anti-malware product. As a result of this, an anti-malware product's processes needed to be isolated from all other running system processes. To isolate relevant process, we used a program called *Process Explorer* which was run immediately upon the completion of memory usage logging by *MemLog ++*. *Process Explorer* is a Microsoft Windows Sysinternals software tool which shows a list of all DLL processes currently loaded on the system.

Benchmark 6 – Browse Time

We used Javascript to load a list of 103 'popular' websites consecutively from a local server.

On each page in the sample data, a few lines of javascript are added to the website's html to execute the javascript script that loads the next website in the chain. To begin with, once the first website has been loaded completely, the script is executed to load the second website in the chain. Once this has finished loading, the script is executed to then load the third website in the chain. This process is repeated until the final website in the chain has loaded.

The start time and end time of this process are recorded and the difference is calculated in seconds to get the final result.

For this test, we have used the default Windows browser *Microsoft Edge* (Version 38.143930.0).

The set of websites used in this test include front pages of high traffic pages. This includes shopping, social, news, finance and reference websites.

The Browse Time test is executed five times and our final result is an average of these five samples. The local server is restarted between different products and one initial 'test' run is conducted.

Benchmark 7 – Edge Launch Time

The average launch time of Microsoft Edge interface was taken using *AppTimer*. This test was practically identical to the User Interface launch time test. For each product tested, we obtained a total of fifteen samples from five sets of three Edge launches, with a reboot before each set to clear caching effects by the operating system. When compiling the results, the first of each set was separated out so that there was a set of values for the initial launch after reboot and a set for subsequent launches.

For this test, we have used *Microsoft Edge (Version 40.15063.0.0)* as our test browser.

We have averaged the subsequent launch times to obtain an average subsequent launch time. Our final result for this test is an average of the subsequent launch average and the initial launch time.

AppTimer is publicly available from the [PassMark Website](#).

Benchmark 8 – Installation Time

This test measures the minimum Installation Time a product requires to be fully functional and ready for use by the end user. Installation time can usually be divided in three major phases:

- The **Extraction and Setup phase** consists of file extraction, the EULA prompt, product activation and user configurable options for installation.

- The **File Copy phase** occurs when the product is being installed; usually this phase is indicated by a progress bar.

- The **Post-Installation phase** is any part of the installation that occurs after the File Copy phase. This phase varies widely between products; the time recorded in this phase may include a required reboot to finalize the installation or include the time the program takes to become idle in the system tray.

To reduce the impact of disk drive variables, each product was copied to the Desktop before initializing installation. Each step of the installation process was manually timed with a stopwatch and recorded in as much detail as possible. Where input was required by the end user, the stopwatch was paused and the input noted in the raw results in parenthesis after the phase description.

Where possible, all requests by products to pre-scan or post-install scan were declined or skipped. Where it was not possible to skip a scan, the time to scan was included as part of the installation time. Where an optional

component of the installation formed a reasonable part of the functionality of the software, it was also installed (e.g. website link checking software as part of an Internet Security Product).

Installation time includes the time taken by the product installer to download components required in the installation. This may include mandatory updates or the delivery of the application itself from a download manager. We have noted in our results where a product has downloaded components for product installation.

We have excluded product activation times due to network variability in contacting vendor servers or time taken in account creation.

Benchmark 9 – Installation Size

A product's Installation Size was previously defined as the difference between the initial snapshot of the Disk Space (C: drive) before installation and the subsequent snapshot taken after the product is installed on the system. Although this is a widely used methodology, we noticed that the results it yielded were not always reproducible in Vista due to random OS operations that may take place between the two snapshots. We improved the Installation Size methodology by removing as many Operating System and disk space variables as possible.

Using PassMark's **OSForensics** we created initial and post-installation disk signatures for each product. These disk signatures recorded the amount of files and directories, and complete details of all files on that drive (including file name, file size, checksum, etc) at the time the signature was taken.

The initial disk signature was taken immediately prior to installation of the product. A subsequent disk signature was taken immediately following a manual update and system reboot after product installation. Using **OSForensics**, we compared the two signatures and calculated the total disk space consumed by files that were new, modified, and deleted during product installation. Our result for this metric reflects the total size of all newly added files during installation.

Benchmarks 10 -15 – Real-Time Performance

We used a single script in testing Benchmarks 9-14. The script consecutively executes tests for Benchmarks 9-14. The script times each phase in these benchmarks using *CommandTimer.exe* and appends results to a log file.

Benchmarks 10 – File Copy, Move and Delete

This test measures the amount of time required for the system to copy, move and delete samples of files in various file formats. This sample was made up of 812 files over 760,867,636 bytes and can be categorized as documents [26% of total], media files [54% of total] and PE files (i.e. System Files) [20% of total].

The breakdown of the main file types, file numbers and total sizes of the files in the sample set is shown in the following table:

File format	Number	Size (bytes)
DOC	8	30,450,176
DOCX	4	13,522,409
PPT	3	5,769,216
PPTX	3	4,146,421

XLS	4	2,660,352
XLSX	4	1,426,054
PDF	73	136,298,049
ZIP	4	6,295,987
7Z	1	92,238
JPG	351	31,375,259
GIF	6	148,182
MOV	7	57,360,371
RM	1	5,658,646
AVI	8	78,703,408
WMV	5	46,126,167
MP3	28	191,580,387
EXE	19	2,952,914
DLL	104	29,261,568
AX	1	18,432
CPL	2	2,109,440
CPX	2	4,384
DRV	10	154,864
ICO	1	107,620
MSC	1	41,587
NT	1	1,688
ROM	2	36,611
SCR	2	2,250,240
SYS	1	37,528,093
TLB	3	135,580
TSK	1	1,152
UCE	1	22,984
EXE	19	2,952,914
DLL	104	29,261,568
AX	1	18,432
CPL	2	2,109,440
CPX	2	4,384
DRV	10	154,864
ICO	1	107,620
MSC	1	41,587
NT	1	1,688
ROM	2	36,611

SCR	2	2,250,240
SYS	1	37,528,093
TLB	3	135,580
TSK	1	1,152
UCE	1	22,984
Total	**812**	**760,867,636**

This test was conducted five times to obtain the average time to copy, move and delete the sample files, with the test machine rebooted between each sample to remove potential caching effects.

Benchmark 11 – Third Party Program Installation

This test measured how much time was required to install and uninstall a third party application. For this test, *CommandTimer.exe* timed how long it took to install and uninstall the following applications on the test machine:

- Firefox 3.6.3 (11,909 KB) (MSI File)
- Microsoft .NET 3.5 (34,121 KB) (MSI File)
- Steam (1,551 KB) (MSI File)

This test was conducted five times to obtain the average time to install/uninstall the above third party programs, with the test machine rebooted between each sample to remove potential caching effects.

Benchmark 12 – Network Throughput

This benchmark measured how much time was required to download a sample set of binary files of various sizes and types over a 100MB/s network connection. The files were hosted on a server machine running Windows Server 2008 and IIS 7. *CommandTimer.exe* was used in conjunction with *GNU Wget* (version 1.10.1) to time and conduct the download test.

The complete sample set of files was made up of 553,638,694 bytes over 484 files and two file type categories: media files [74% of total] and documents [26% of total]. The breakdown of the file types, file numbers and total sizes of the files in the sample set is shown in the following table:

File format	Number	Size (bytes)
JPEG	343	30,668,312
GIF	9	360,349
PNG	5	494,780
MOV	7	57,360,371
RM	1	5,658,646
AVI	8	78,703,408
WMV	5	46,126,167
MP3	28	191,580,387
PDF	73	136,298,049
ZIP	4	6,295,987

7Z	1	92,238
Total	**484**	**553,638,694**

This test was conducted five times to obtain the average time to download this sample of files, with the test machine rebooted between each sample to remove potential caching effects.

Benchmark 13 – File Format Conversion (MP3 → WAV, MP3 → WMA)

This test measured how much time was required to convert five (5) different MP3 files into WAV files and subsequently, convert the same MP3 samples into a WMA files. The total size of the five (5) MP3s used was 25,870,899 bytes.

To encode the MP3 into another format, we used an application called *ffmpeg.exe*. The format conversion process was timed using *CommandTimer.exe*.

This test was conducted five times to obtain the average conversion speed between these formats, with the test machine rebooted between each sample to remove potential caching effects.

Benchmark 14 – File Compression and Decompression

This test measured the amount of time required to compress and decompress a sample set of files. For this test, we used a subset of the media and documents files used in the *File Copy, Move and Delete* benchmark. *CommandTimer.exe* recorded the amount of time required for *7zip.exe* to compress the files into a *.zip and subsequently decompress the created *.zip file.

This subset comprised 1,218 files over 783 MB. The breakdown of the file types, file numbers and total sizes of the files in the sample set is shown in the following table:

File Type	File Number	Total Size
.xls	13	9.23 MB
.xlsx	9	3.51 MB
.ppt	9	7.37 MB
.pptx	11	17.4 MB
.doc	17	35.9 MB
.docx	19	24.5 MB
.gif	177	1.10 MB
.jpg	737	66.2 MB
.png	159	48.9 MB
.mov	7	54.7 MB
.rm	1	5.39 MB
.avi	46	459 MB
.wma	11	48.6 MB
.avi	46	459 MB

.wma	11	48.6 MB
Total	**1218**	**783 MB**

This test was conducted five times to obtain the average file compression and decompression speed, with the test machine rebooted between each sample to remove potential caching effects.

Benchmark 15 – File Download

This test measures the time it takes to complete an http download of a sample set of installation files over a 100MB/s network connection. The files are hosted on a local server machine running Windows Server 2013 and IIS 7. *CommandTimer.exe* was used in conjunction with the native .NET *DownloadFile()* method to time and conduct the download test. The file set includes the following:

- Firefox Setup 31.0 (30.7 MB) (EXE file)
- GIMP Setup 2.8.10 (86.2 MB) (EXE file)
- LibreOffice Installer Package 4.2.5 (209 MB) (MSI file)
- Adobe Reader Installer 3.5.4.25 (1.00 MB) (EXE file)

This test was conducted five times to obtain the average time to download this sample of files, with the test machine rebooted between each sample to remove potential caching effects.

Benchmark 16 – PE Scan Time

This test measures the on demand scan times of a file set comprised only of executable files (.exe, .dll and .sys files). We performed five scans of the sample file set, with a machine restart between each scan to remove possible caching effects. The time taken to scan the files is taken from a security product's scan logs, or where logs are not available, manually with a stopwatch. Scans were launched by right clicking on the folder to be scanned.

A breakdown of the sample file set is as follows:

File Type	Number of Files	File Size
Sys Files	2174	329MB
Dll Files	2037	920MB
Exe Files	2140	827MB
Total	**6351**	**2076MB**

We have averaged the four subsequent scan times to obtain an average subsequent scan time. Our final result for this test is an average of the subsequent scan average and the initial scan time.

Benchmark 17 – File Copy Disk to Disk

This test measures the amount of time taken to copy files between two local drives. The data set comprised of 8,501 files with a total file size of 5.44GB, and the formats used included documents, movies, images and executables. A breakdown of the sample file set is given below:

File Extension	Number of Files	File Size
.jpg	2903	588MB
.dll	773	25MB
.exe	730	197MB
.gif	681	63MB
.wav	430	260MB
.sys	501	79MB
.png	451	27MB
.mp3	333	2157MB
.wma	585	925MB
.docx	267	81MB
.avi	247	1079MB
.doc	160	57MB
.xls	329	132MB
.ppt	97	148MB
.zip	14	177MB
Total	**8501**	**5995MB**

A total of five runs of this test were performed, with a machine restart between each run. The time taken to copy files was measured and recorded by CommandTimer.exe. All the files were copied between a folder on the local drive and a 2nd folder on a different drive. Files were deleted from the 2nd drive once the copy was complete. The final result is calculated as an average of the five samples

Benchmark 18 – File Copy Over Network

This test measures the amount of time taken to transfer files from a local drive on the test machine to a shared folder on the local server. The data set comprised of 8,501 files with a total file size of 5.44GB, and the formats used included documents, movies, images and executables. A breakdown of the sample file set is given below:

File Extension	Number of Files	File Size
.jpg	2903	588MB
.dll	773	25MB
.exe	730	197MB
.gif	681	63MB
.wav	430	260MB

.sys	501	79MB
.png	451	27MB
.mp3	333	2157MB
.wma	585	925MB
.docx	267	81MB
.avi	247	1079MB
.doc	160	57MB
.xls	329	132MB
.ppt	97	148MB
.zip	14	177MB
Total	**8501**	**5995MB**

A total of five runs of this test were performed, with a machine restart between each run. The time taken to transfer files was measured and recorded by CommandTimer.exe. Files were deleted from the server once the copy was complete. The final result is calculated as an average of the five samples

Benchmark 19 – PCMark 8 Home Score

This test aims to benchmark the test machine's performance over a series of common home computing tasks. This includes web browsing, writing, photo editing, video chat, and casual gaming. For this benchmark we have installed *PCMark 8 Professional Edition* (Version 2.7.613). From the interface, the PCMark 8 Home test is launched in conventional mode. This Home test is run twice, with a reboot in between. The final result is an average of the overall scores of the two iterations.

Benchmark 20 – Word Document Launch and Open Time

The average launch time of Word interface was taken using *AppTimer*. This includes the time to launch the Word 2013 application and open a 10MB document. This test was practically identical to the User Interface launch time test. For each product tested, we obtained a total of fifteen samples from five sets of three Word launches, with a reboot before each set to clear caching effects by the operating system. When compiling the results, the first of each set was separated out so that there was a set of values for the initial launch after reboot and a set for subsequent launches.

We have averaged the subsequent launch times to obtain an average subsequent launch time. Our final result for this test is an average of the subsequent launch average and the initial launch time.

AppTimer is publically available from the PassMark Website.

Benchmark 21 – Run Excel Macro

This test measures the time it takes to open an excel document and run an excel macro. The macro performs a range of operations, including reading data from the file system, mathematical calculations, and writing data to the spreadsheet. This test is run using a Windows PowerShell script. We obtained a total of five samples with a reboot in between each to clear caching effects by the operating system. The final result is calculated as an average of the five samples.

Benchmark 22 – Save Word Document to PDF

This test measures the time it takes to open a large Word Document (~10 MB) and save it as a PDF document. This test is run using a Windows PowerShell script. We obtained a total of five samples with a reboot in between each to clear caching effects by the operating system. The final result is calculated as an average of the five samples.

Benchmark 23 – USB 3.0 File Copy

This test measures the amount of time taken to transfer files from an external drive to a local disk via a USB 3.0 connection. The data set comprised of 6,834 files with a total file size of 6.06GB, and the formats used included documents, movies, images, executables and system files. A breakdown of the sample file set is given below:

File Extension	Number of Files	File Size
.dll	1429	627MB
.doc	496	164MB
.docx	324	76MB
.exe	280	1.2GB
.jpg	1564	469MB
.mp3	394	1.06GB
.pdf	567	246MB
.pptx	556	1.06GB
.pst	2	59.1MB
.sys	568	145MB
.xlsx	584	81.0MB
.zip	70	911MB

A total of five runs of this test were performed, with a machine restart between each run. The time taken to transfer files was measured and recorded by CommandTimer.exe. Files were deleted from the local disk once the copy was complete. The final result is calculated as an average of the five samples