VPN Comparative Test

A test commissioned by Kaspersky and performed by AV-TEST GmbH.
Date of the report: December 07th, 2022.

Executive Summary

In September 2022, AV-TEST performed a test of Virtual Private Network (VPN) solutions and compared them to normal unencrypted reference connections. The VPNs have been reviewed for their download- and upload- performances, for torrent download performance, measured latency and ability to stream different resolutions through YouTube at three geographical locations - the US west coast, the Netherlands and Japan. All tests were conducted for the “best” local connection as well as 2 geographical overseas connections.

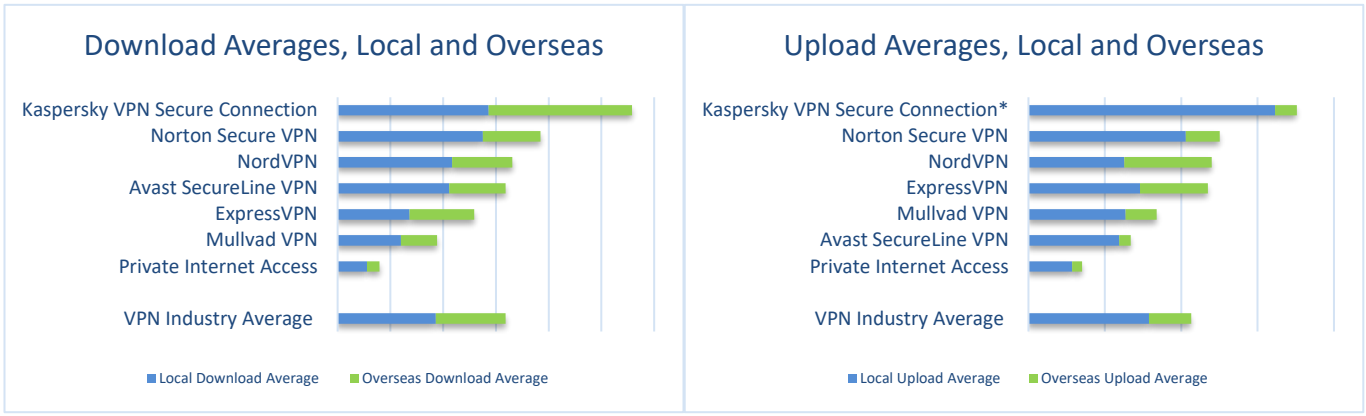
The test was performed simultaneously with the public certification test of VPN solutions and in full accordance with its methodology for the solutions performance measurement. The report is prepared with no exclusion of any result reached by any of the products initially requested into the test.

We perform this test in parallel for all products multiple times a day for an entire week, which provides an extract of the performance provided by the VPN products.

The presented evaluation assesses Avast SecureLine VPN, ExpressVPN, Kaspersky VPN Secure Connection, Mullvad VPN, NordVPN, Norton Secure VPN and Private Internet Access.

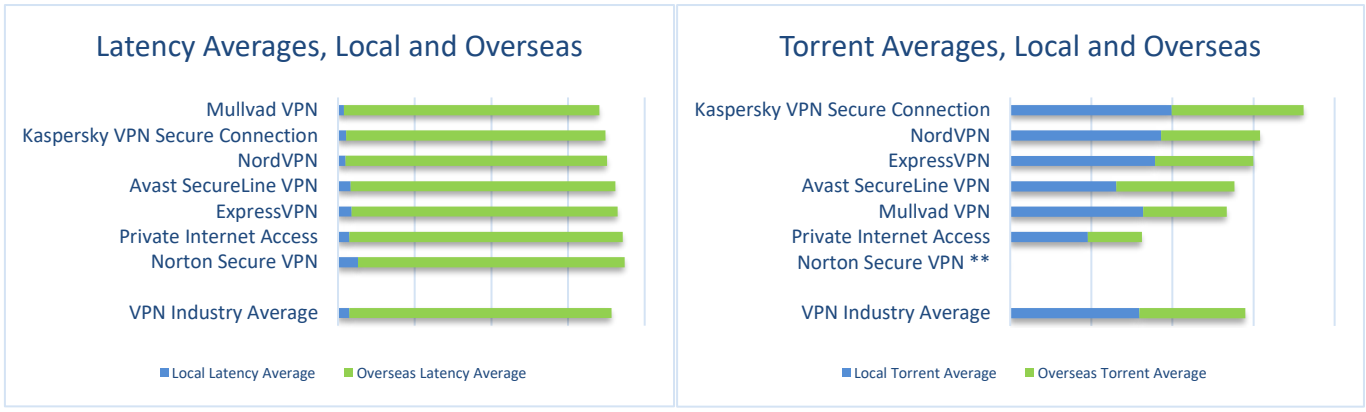
Kaspersky VPN Secure Connection is the obvious winner in the performed speed tests. The VPN doubles the performance of the next competitor for tested torrents and downloads for local and overseas connections. Kaspersky VPN Secure Connection is among the best three for local and overseas latency performances. Local uploads are performed at twice the speed of the industry average. Meanwhile in the scenario “Upload Oversea” Kaspersky works on performance improvements for getting better results in the next period. Kaspersky VPN Secure Connection had no issue playing test video in 4k video from local or overseas connection.

Below are the main findings visualized to show a comparison between the products. The graphs are ranked, starting with the best overall product. For the download, upload and torrent performance the higher the values the better. For the latency, this is reversed and the lower values represent better performances.



* prior to performance patch

Figure 1, the combined averages for the download and upload performances for local and overseas connected VPN servers (the more the better).



** Norton Secure VPN doesn't support torrent on tested servers

Figure 2, the combined averages for the torrent download speeds (the more the better) and for measured latency for local and overseas connected VPN servers (the less the better).

Contents

1. Test Methodology

- The test has been carried out as described in this document.
- The report contains all results initially requested for testing. No data was excluded from the report.
- The results were independently measured.

1.1. Tested solutions

The tested products are listed below.

Product name	Product version
Avast SecureLine VPN	5.19.6435
ExpressVPN	10.30.0 (0)
Kaspersky VPN Secure Connection	21.7.7.393
Mullvad VPN	2022.3
NordVPN	6.48.18.0
Norton Secure VPN	5.2.0.30
Private Internet Access	3.3.1 (build 06924)

1.2. Performance Test scenarios

The Performance measurement methodology for this report is the same as that used for the public VPN certification test.

In the performance test, we run the following measurement scenarios:

1. Download and Upload speed, Latency
   We use the third-party command-line application provided by speedtest.net to measure the Download-, Upload- and Latency performances. To our knowledge, there is no known affiliation between the site and its holding company Ookla LLC and the tested VPN products. The performance testing tool was set to independently choose the optimal server test location. All tests were run five times with a minute break in between.
   For the comparative purpose, the server IDs are independently chosen by the testing tool during the unencrypted reference test and used to test the performance on the non-encrypted connection to the overseas locations.

2. Torrent
   The torrent download speed is measured through a third-party torrent client. The final test time is the time between the start of the torrent download and the finishing of writing the torrent file on the hard drive.

3. Video streaming.
   The streaming ability is evaluated by running an 8k Youtube video. All resolutions up to the maximum of 4k are played for 90 seconds. The actual playtime and progress of youtube playtime are measured and compared. The dropped frames for the 90 seconds intervals are read from YouTube's own "Stats for nerds" which is activated at the beginning of each test.

Every VPN solution is tested on local and overseas traffic. For the local traffic test, both client and the server are to be located in the same geographical locations. For the overseas traffic test, the performance is measured for connections between different geographical locations.

Three geographical locations are used in the test: the US location on the West Coast, the European location in the Netherlands and the East-Asian location in Japan.

Each product is tested for all three VPN locations. When the VPN location is the same as the geographical location the “default connection” is chosen, otherwise the VPN location is manually selected to connect to the overseas VPN server locations previously mentioned.
The VPN locations to be tested were in geographical proximity to the VM host location. Not all products allow such specifics but instead allow the overall country.

Additionally, we perform a test for all described Test Scenarios on a reference system with no active VPN deployed in all three geographical locations with the same testing tools. The results are used as the benchmark to compare the VPN products and subsequently evaluate them.

1.3. Configuration

The tests were performed on Virtual Machines hosted on Microsoft Azure cloud computing service. All test devices were of identical hardware configurations. All patches available in September 2022 were previously installed.

There are a few general principles that were followed:

(1) **Product cloud/Internet connection**. The Internet was available to all tested products.
(2) **Product configuration**. All products were run with their default, out-of-the-box configuration. Including the default protocol used

1.4. Limitations

The test is measured at a certain point in time and may not reflect the average performance over a longer period of time.

Also, the test was performed in parallel for all locations which means that the workload will have differed for each location because of the different times of day in each location.

Nevertheless, it does give a glimpse of the capabilities and services provided by the different VPN providers.

2. Industry Average

2.1. Industry average: scenarios “Download and Upload”

Due to the nature of the technology, using a VPN connection will almost always have a performance-reducing impact compared to an unsecured connection. The reduction is shown in the following graph.

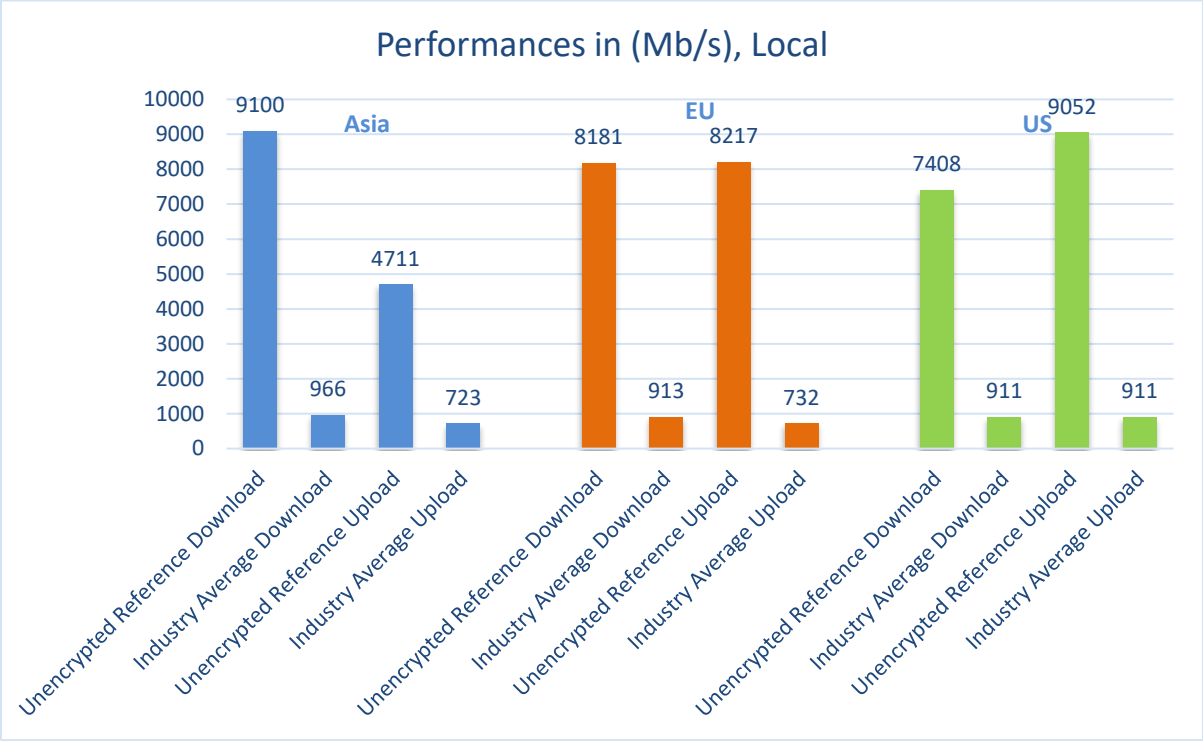


Figure 5, the comparative local results for the unencrypted down- and upload performances and the industry averages for all three tested locations.

The differences between secured and unsecured connections for the local download and upload speed are quite significant in all locations. The encrypted VPN performance drops by tenfold for both download and upload speeds compared to the unencrypted reference connection.

The only meaningful difference observed between encrypted connections is for the local upload speeds. On average the US servers outperform the Asian and EU servers by around 25%.

Download performance for the unencrypted reference is almost identical in all three locations and also identical to the upload performance in the EU and US. The noticeable deviation is in the upload performance for Asia. It is about half of the EU and US servers but didn’t noticeably influence the gathered results for the products.

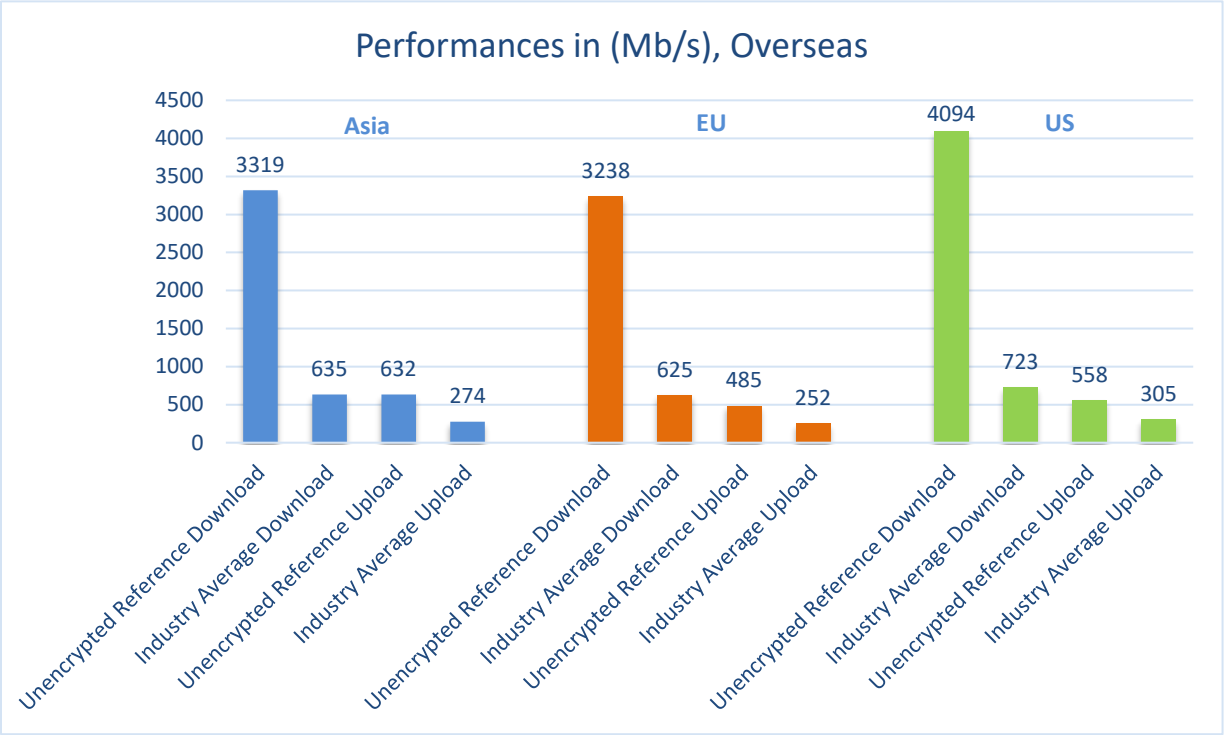


Figure 6, the comparative overseas results for the unencrypted down- and upload performances and the industry averages for all three tested locations.

The download speed for the encrypted overseas VPN connections is about a fifth of the unencrypted reference. The average encrypted upload speed drops by around half compared to the tenfold drops at the encrypted local connections.

The VPN industry averages for download and upload for all three overseas locations are very similar.

The upload speed for the unencrypted connection is between 5 to 7 times slower than the download speed for the three different locations. Which again doesn't seem to influence the average product performance.

2.2. Industry average: scenario “Latency”

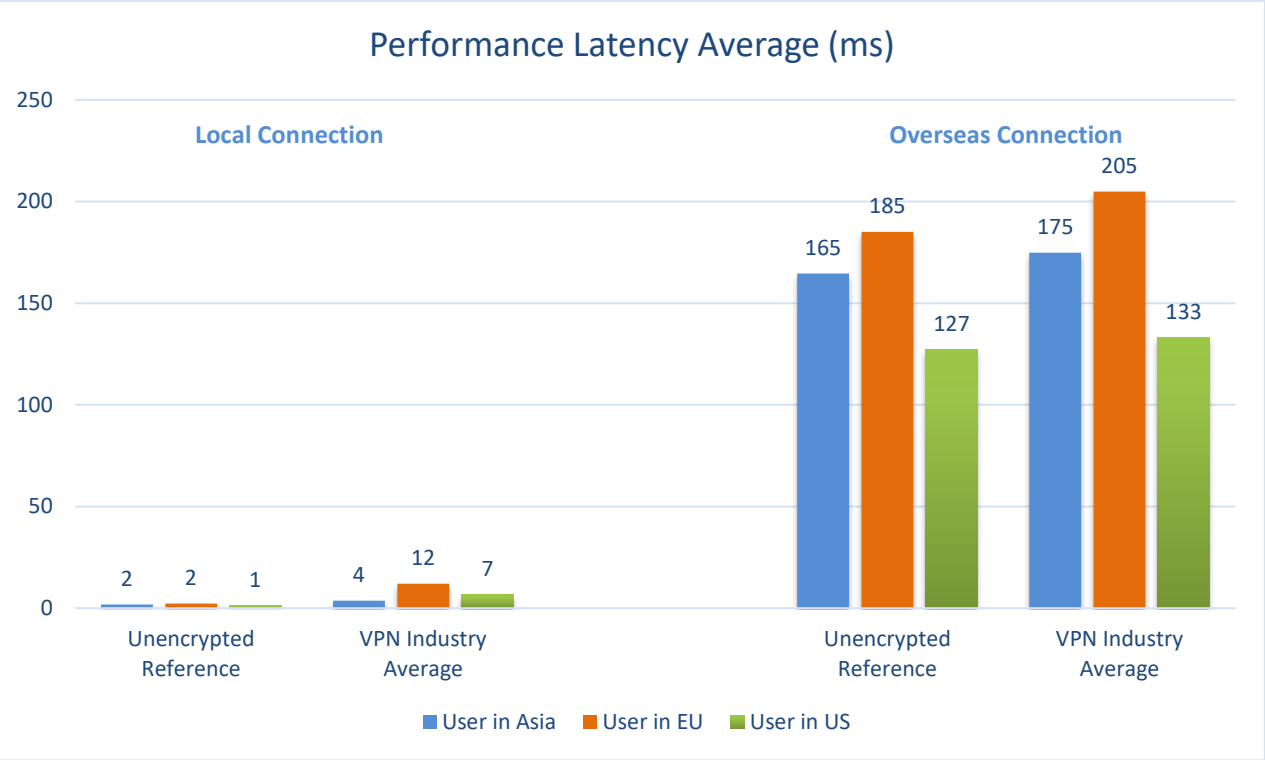


Figure 7, the comparative local and overseas results for the measured latency for the unencrypted reference and industry average for all three tested locations.

As to be expected, the overseas performances for the latency are much slower than the local connections. The measured difference in performance is up to 100 times slower.

The measured local latency for the unencrypted reference connection is between 1ms and 2ms. When connected through the encrypted VPN it doubles for Asia to 4ms, increases to 7ms for the US and is the slowest for the EU with 12ms.

There is little to no performance reduction between an overseas encrypted VPN and an unencrypted connection. The fastest overseas connection is from the US which is 30% faster than the EU connections and around 50% faster than Asia connections.

2.3. Industry average: scenario “Torrent”

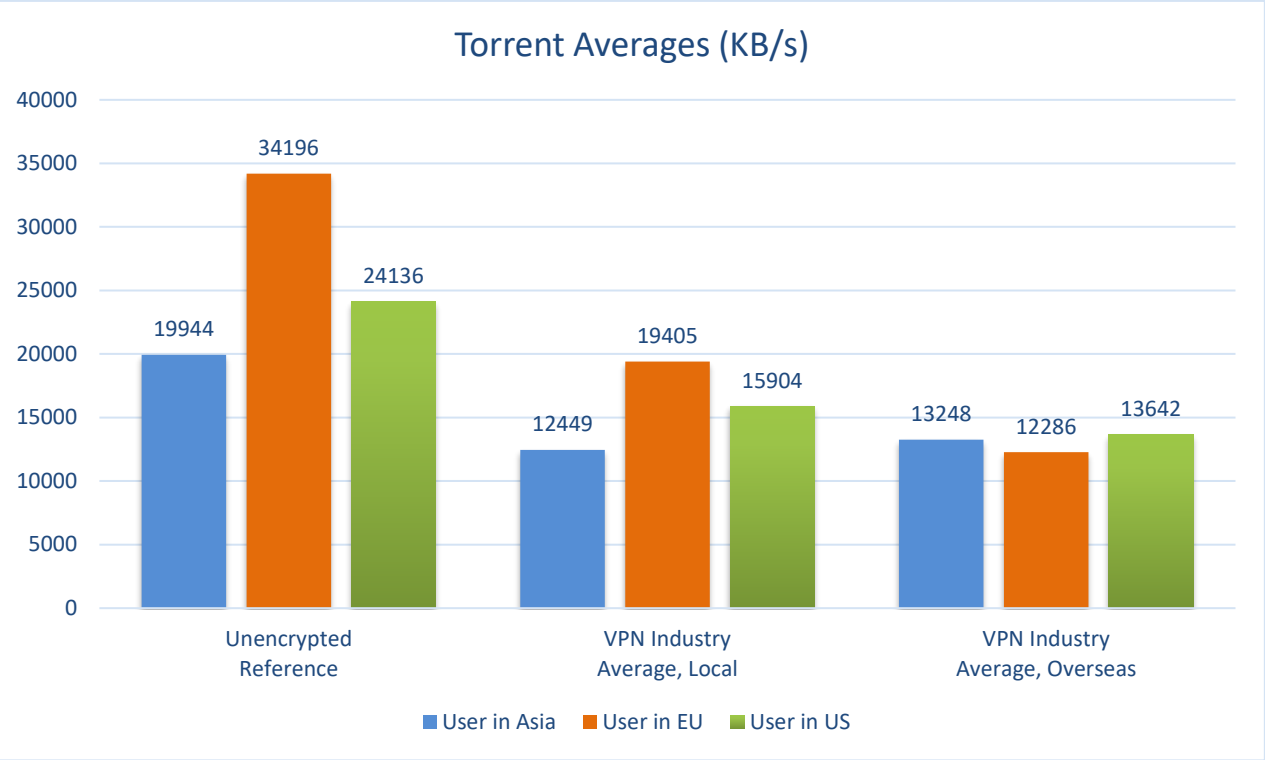


Figure 8, the comparative local and overseas results for torrent downloads for the unencrypted reference and industry average for all three tested locations.

The performance for the test torrent file is best in the EU followed by the US and trailed by Asia. This might be due to a concentration of available torrent file seeders in those regions, which may also influence the measured results of the products to some degree.

The local torrent performance is ranked the same as for the unencrypted connection with the EU having a significant drop in performance but still outperforming the US, with a smaller margin and Asia.

The overseas torrent speed is on average very similar for all three regions.

2.4. Industry average: scenario “Video streaming”

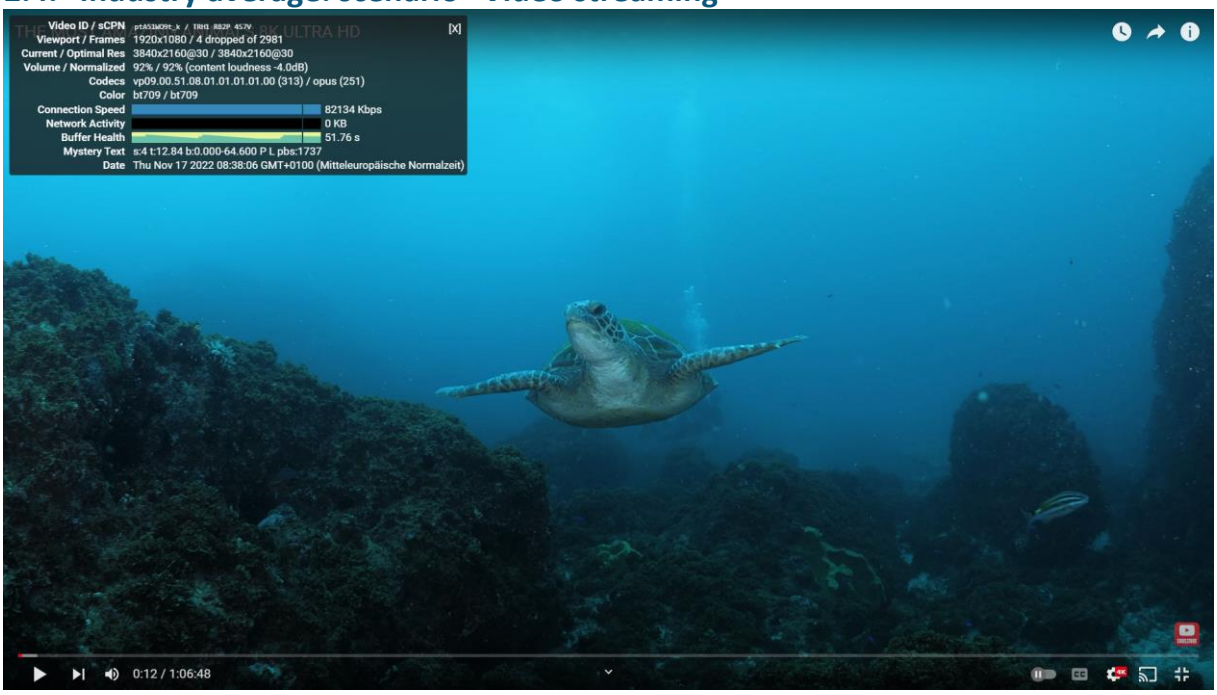


Figure 9, a screenshot from the Youtube test video with “Stats for nerds” feature enabled.

YouTube's own “Stats for nerds” was used to measure performances of Video with resolutions up to a 4k resolution.

The video is played for 90 seconds, and dropped frames and play time delay are measured.

All products managed to play the 4k video for the set time with little issues which will be non-noticeable for user experiences, such as a few dropped frames and the delay is usually in a milliseconds range.

3. VPN solutions results

3.1. VPN solutions results: scenario “Download”

Following are the graphs representing the measured download performances for the three different world regions tested for a local and overseas connection.

For the local averages, each product is connected to the local server, either by choosing the “best option” in the VPN client or manually connecting to the local server.

For the overseas averages, the closest server to the test servers is selected for the test. This means for example; a user in the US connects to the EU and Asia and the averages of these results are evaluated.

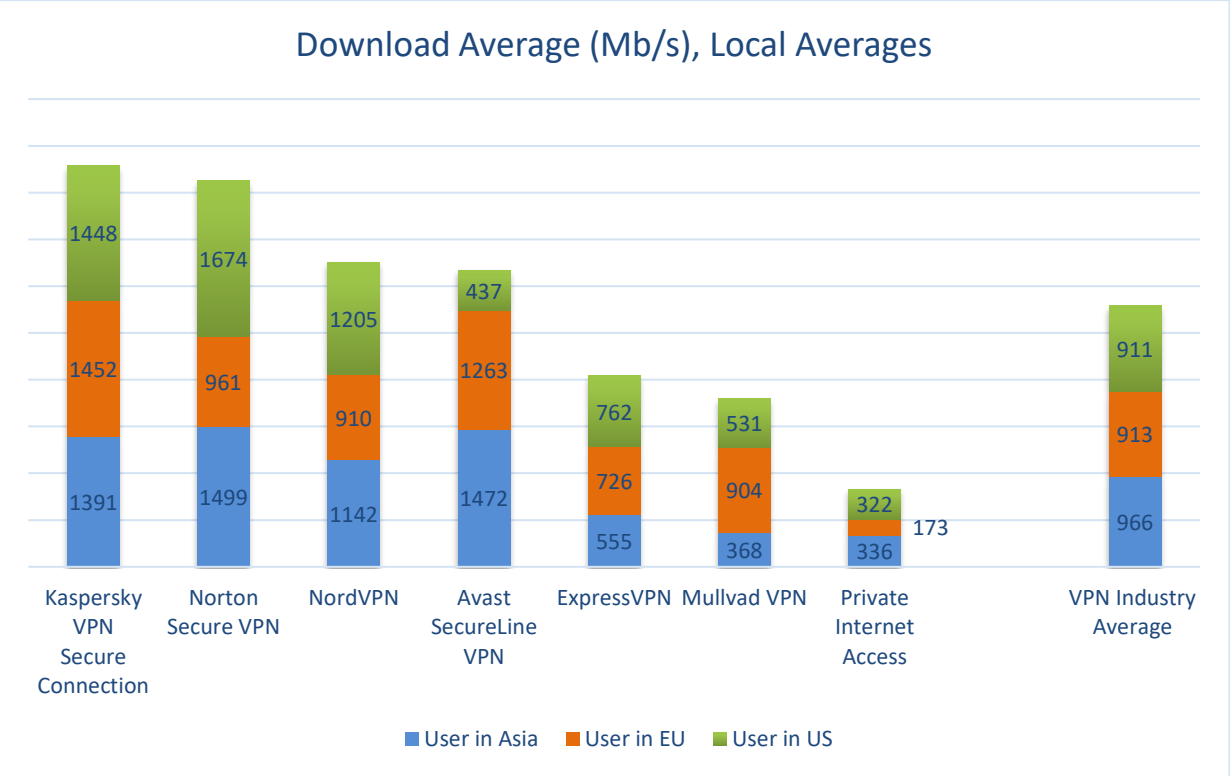


Figure 10, the cumulative local average download speed for all three locations and the industry average.

Most products achieve different results in varying geographical locations, possibly reflecting different server capacities or different workloads between the regions.

Kaspersky VPN Secure Connection is the only product observed with almost equal results in all regions. It also manages to be the fastest product tested in the EU, the second fastest in the US and the third fastest in Asia taking the overall top spot in this test category.

Norton Secure VPN is the fast VPN in the US and the EU. It is the third fastest product in the EU but it is significantly slower than the second fastest product Avast SecureLine VPN and the fastest Kaspersky which is more than 50% faster.

NordVPN and Avast SecureLine VPN are close at third and fourth place. NordVPN manages pretty constant results in all three regions. Avast SecureLine VPN is the second fastest product in the EU and Asia but is also second to last for the US performance.

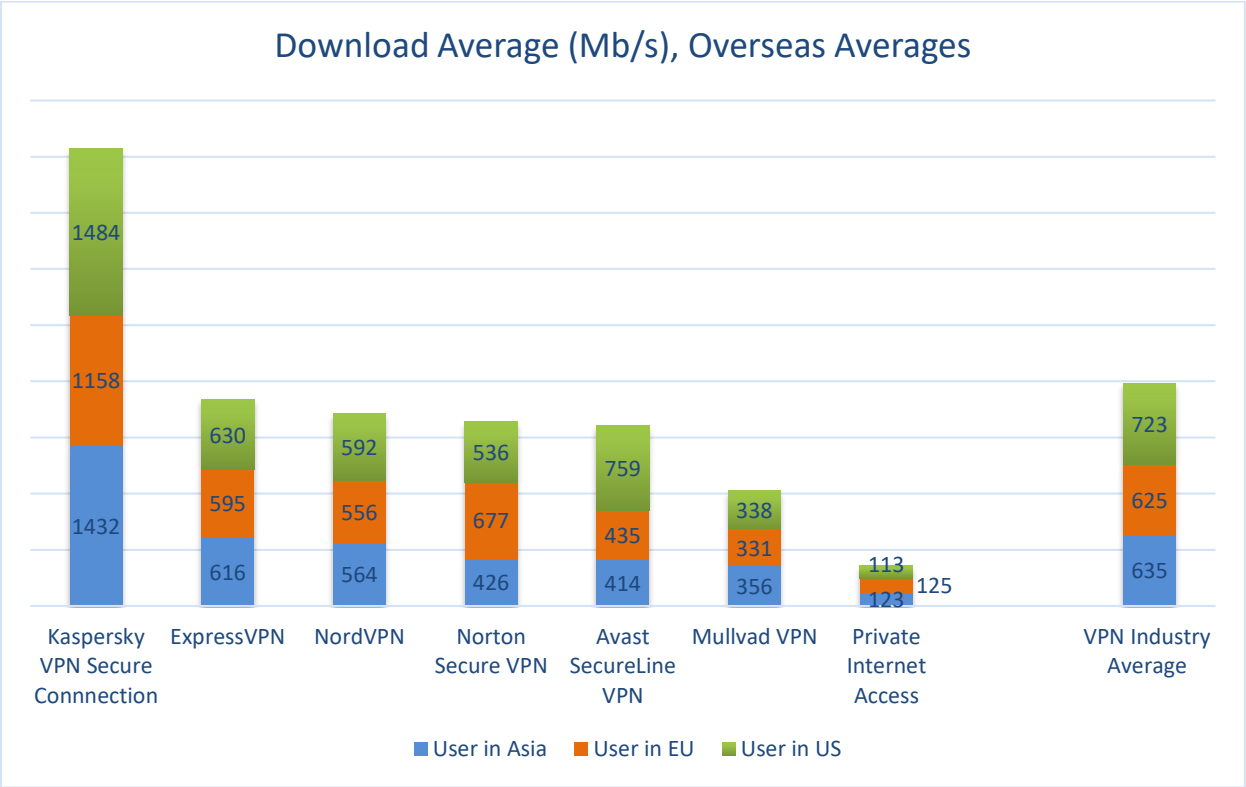


Figure 11, the cumulative overseas average download speed for all three locations and the industry average.

The differences in the overseas download performances are evident. Kaspersky VPN Secure Connection more than doubles the average performances of all products in all tested regions as well as more than doubles the second-placed product in all tested regions.

The next four products are very close in performance. ExpressVPN and NordVPN like Kaspersky VPN Secure Connection perform very balanced in all three tested regions. Norton Secure VPN in fourth place does better connecting overseas from the EU compared to the connection from Asia and Avast SecureLine VPN has twice the speed when connecting from the US compared to the EU and Asia.

3.2. VPN solutions results: scenario “Upload”

Following are the graphs representing the measured Upload performances for the three different world regions tested for the local and overseas connections.

For the local averages, each product is connected to the local server, either by choosing the “best option” in the VPN client or manually connecting to the local server.

For the overseas averages, the closest server to the test servers is selected for the test. This means for example; a User in the US connects to the EU and Asia and the averages of these results are evaluated.

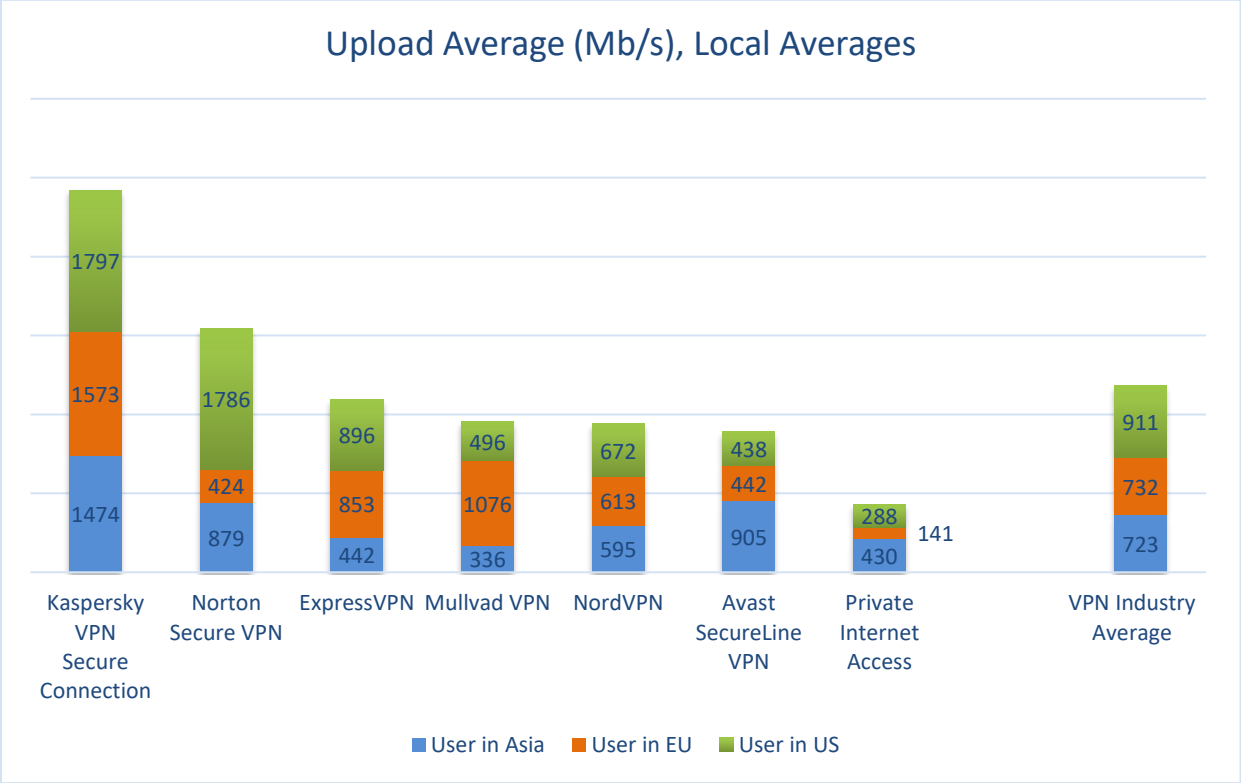


Figure 12, the cumulative local average upload speed for all three locations and the industry average.

For upload performances, Kaspersky VPN Secure Connection manages similar results as seen for the download test in all the local connections. It takes the top spot for the upload performance for the local connection, being the fastest product in all three regions and doubling the VPN averages for this test.

Norton Secure VPN takes a solid second place, being almost as fast as Kaspersky VPN Secure Connection in the US. In Asia, the product performance drops to half of the top spot speed and again drops another 50% for the EU connection where it performs at a rate which is second to last.

The next four places a close in performances. ExpressVPN has the third fastest performance in the EU and the US, and Mullvad VPN is the second fastest product in the EU. NordVPN is very consistent with its results and Avast SecureLine VPN has the second-fastest Asia Upload performance.

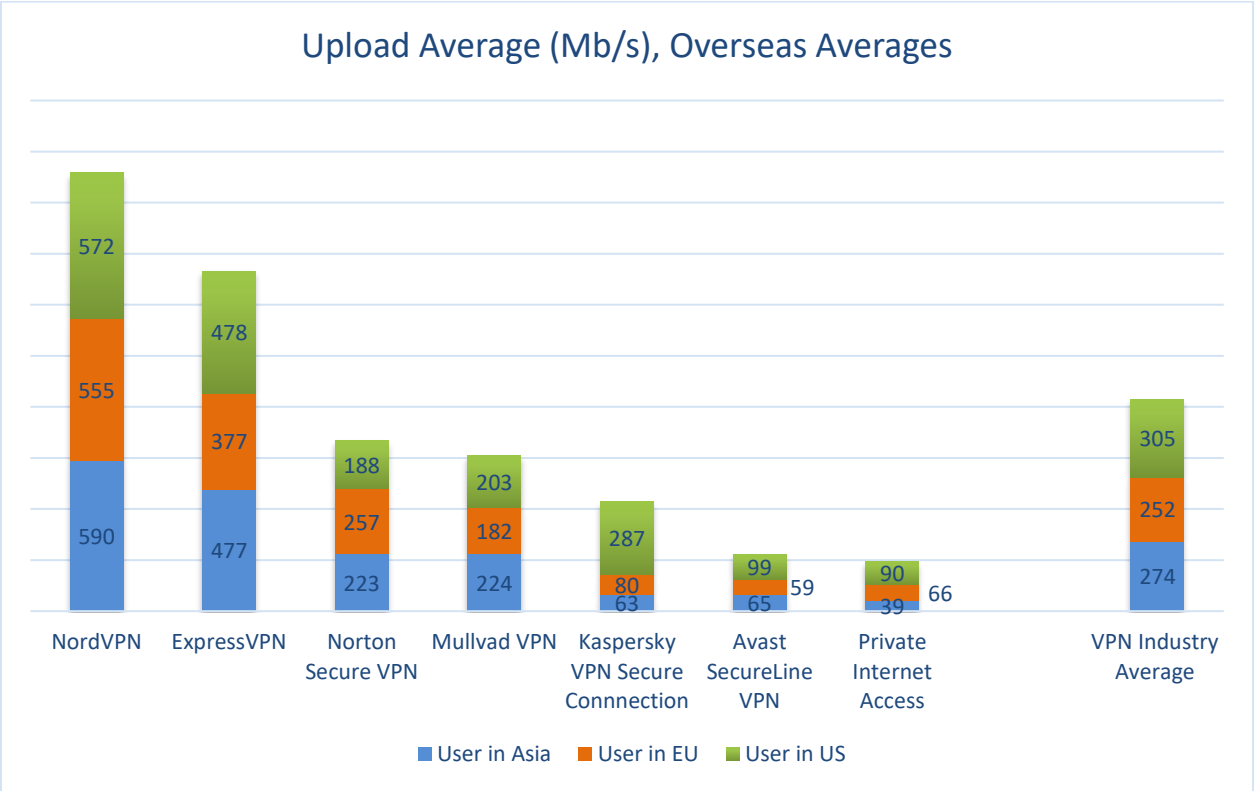


Figure 13, the cumulative overseas average upload speed for all three locations and the industry average.

The top spot in the overseas Upload performance goes to NordVPN. NordVPN's upload speed is more than twice the VPN product averages and is the fastest product in all locations tested.

Express VPN is in second place, it is 50% faster than the VPN product average also being the second fastest product in all tested categories.

Norton Secure VPN and Mullvad VPN are the third and fourth-best VPN products in the overseas upload test category, both are pretty close in performance with only some slight regional differences.

Kaspersky VPN Secure Connection achieves solid upload results from the US but falls short in the EU and Asia. This is due to an unpatched server problem, which hasn't been fixed by the time of the testing. Once the issues are resolved we expect similar results as seen for the US which would put Kaspersky VPN Secure Connection at a solid third place.

3.3. VPN solutions results: scenario “Latency”

Following are the graphs representing the measured Latency for the three different world regions tested for the local and overseas connections.

For the local averages, each product is connected to the local server, either by choosing the “best option” in the VPN client or manually connecting to the local server.

For the overseas averages, the closest server to the test servers is selected for the test. This means for example, a User in the US connects to the EU and Asia and the averages of these results are evaluated.

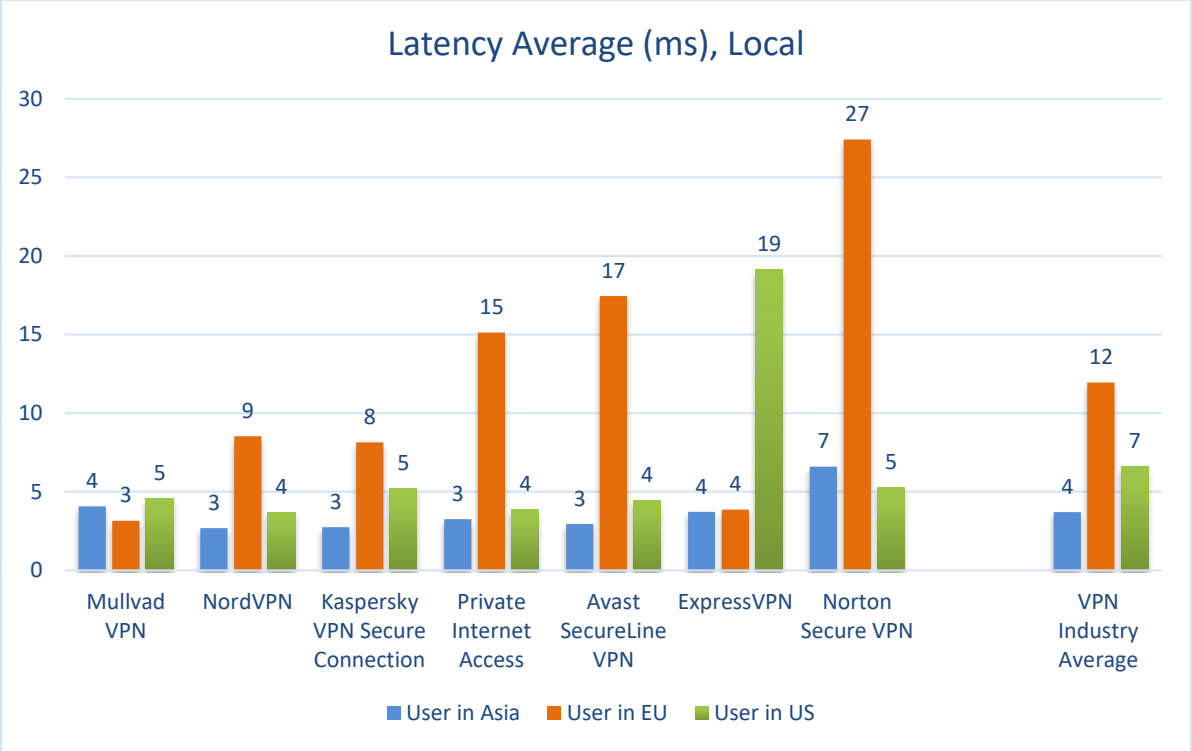


Figure 14, the measured local latency averages for all three locations and the industry averages.

Mullvad VPN takes the lead for latency performance. The latency averages never exceed 5 in any of the three regions. No other product manages to have no runaway performance in at least one of the locations.

NordVPN and Kaspersky VPN Secure Connection both take second place. NordVPN is slightly better than Mullvad in Asia and the US but has on average three times the latency in the EU. Kaspersky VPN Secure Connection is also better than Mullvad VPN in Asia and has the same latency in the US but doesn’t quite manage Mullvad VPNs' excellent value in the EU.

Private Internet Acces and Avast SecureLine VPN take the places four and five. Both are slightly better than Mullvad VPN in Asia and the US but again not able to reproduce these results in the EU.

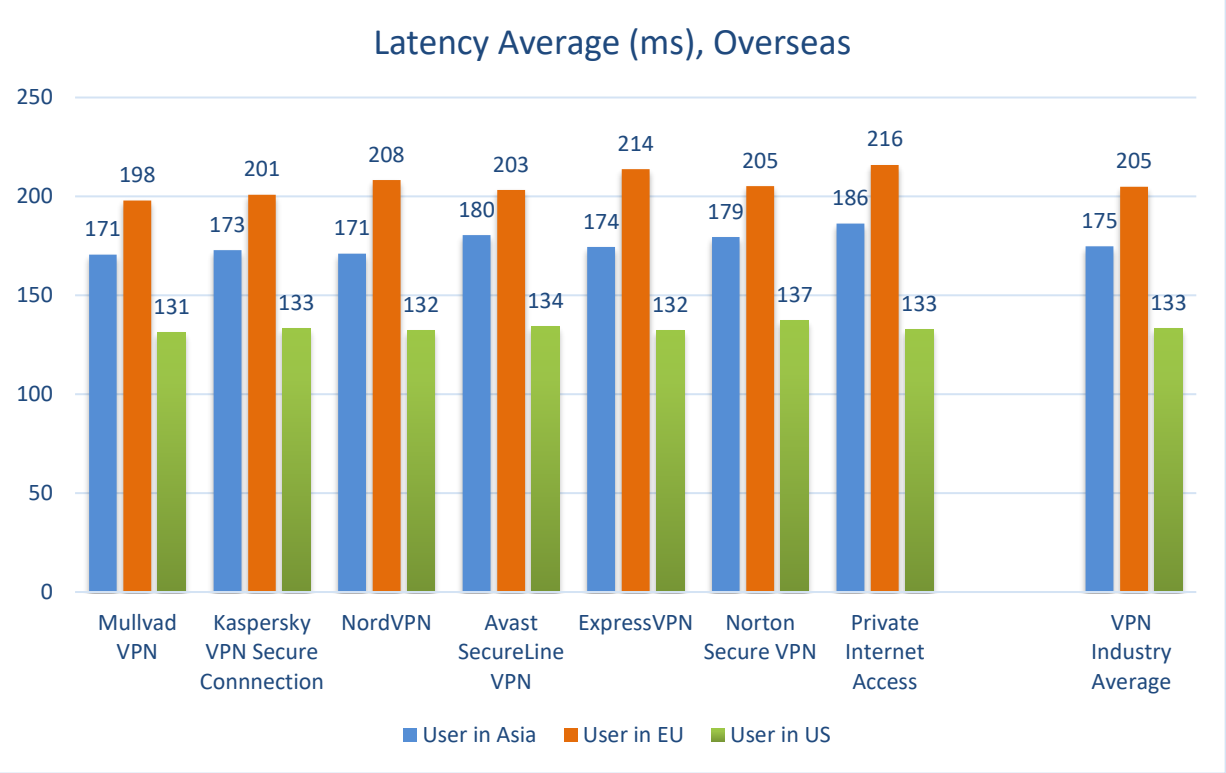


Figure 15, the measured overseas latency averages for all three locations and the industry averages.

For the overseas latency, we did not observe a change worthwhile mentioning when comparing the VPN products as well as comparing them to the unencrypted reference. There is very little difference between the products.

The main takeaway is that the latency from the US to an overseas destination is the fastest followed by Asia and the slowest latencies are observed when connecting the EU to overseas.

3.4. VPN solutions results: scenario Torrent

Following are the graphs representing the torrent download performance for the three different world regions tested for the local and overseas connections.

For the local averages, each product is connected to the local server, either by choosing the "best option" in the VPN client or manually connecting to the local server.

For the overseas averages, the closest server to the test servers is selected for the test. This means for example; a User in the US connects to the EU and Asia and the averages of these results are evaluated.

For the VPN server in the tested regions, Norton Secure VPN does not support torrenting during the time of testing and therefore no results are included.

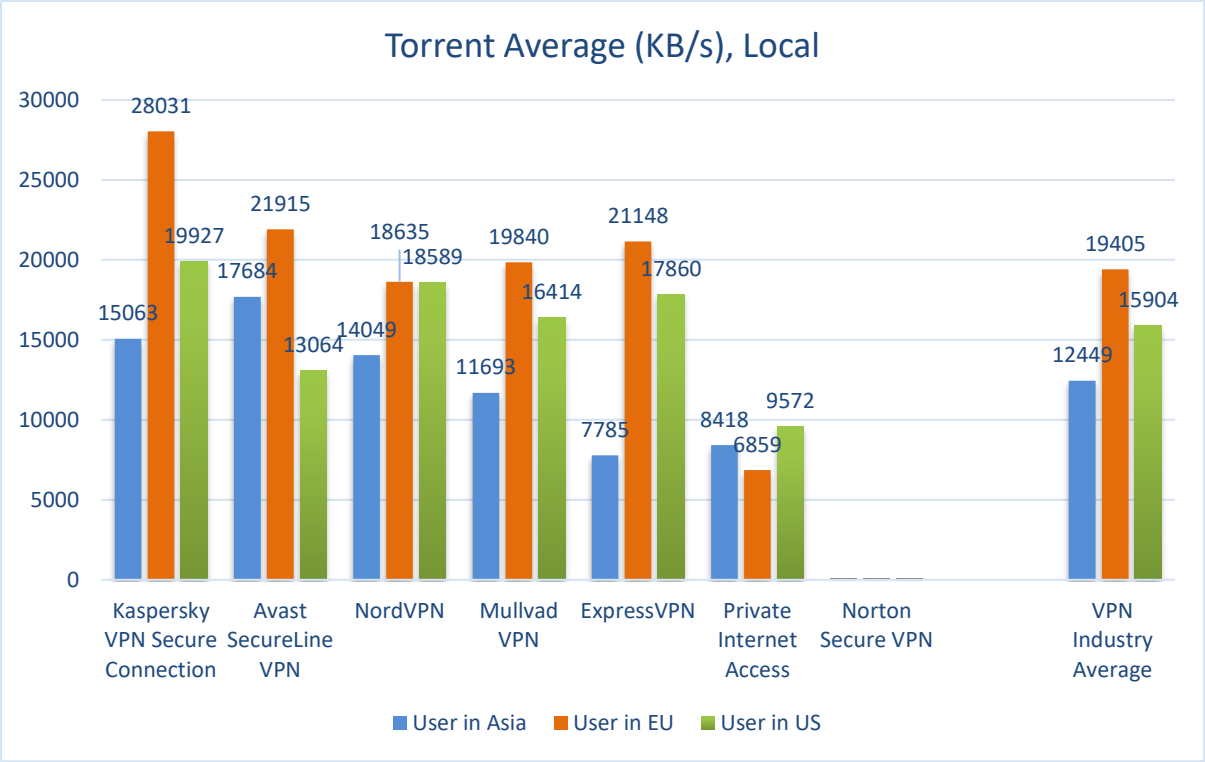


Figure 16, the cumulative local average download speed for all three locations and the industry averages. (Norton Secure VPN did not support torrents in the test locations).

For the local torrent download test, Kaspersky VPN Secure Connection is overall the fastest product. It is the second fastest product tested in Asia after the overall runner-up Avast SecureLine VPN, but it is the fastest product in the US and also in the EU where it is significantly faster than any other product.

Except for the top and the bottom products, most products perform similarly in the torrent download test. There are mostly regional differences between the products ranked second to fifth. For instance, ExpressVPN is the slowest product for the region of Asia but the third fastest in the EU and the US.

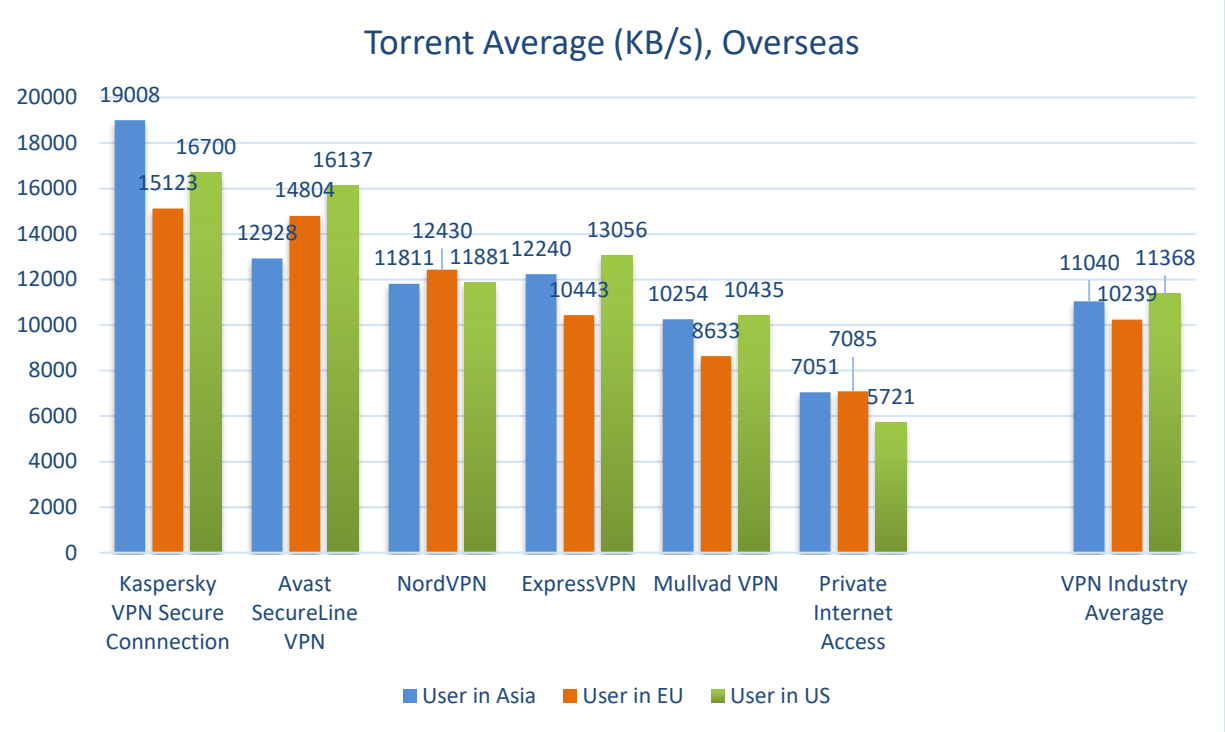


Figure 17, the cumulative overseas average download speed for all three locations and the industry averages. (Norton Secure VPN did not support torrents in the test locations).

For overseas connection torrent download, Kaspersky VPN Secure Connection is the fastest product in each of the tested regions. In Asia, it is almost 50% faster than its next competitor Avast SecureLine VPN.

Avast SecureLine VPN is the second fastest product in the torrent test, not just overall but in all tested regions. For the US and the EU, it is almost on par with the number one Kaspersky VPN Secure Connection.

NordVPN and ExpressVPN achieve almost identical overall results for the torrent test, with some small regional differences.

Conclusion

The objective of the here-presented tests was to assess the download, upload, latency, torrent download performances and the ability to stream high-resolution videos by VPN products.

With its second-to-none showing in the majority of speed tests conducted, Kaspersky VPN Secure Connection is the overall fastest VPN product tested in the performance test. Kaspersky VPN Secure Connection came first in most tested categories. It showed outstanding download- and torrenting speeds in both local and overseas scenarios. In particular, the solution outruns other participants with a minimum of double their performances for overseas data-transmissions. Kaspersky VPN Secure Connection is the leading product for the test scenario local “Upload” with its results two times exceeding the industry averages. The measured latency is among the top three for all tested products. Like all other products Kaspersky VPN Secure Connection had no issue playing test video in 4k video from local or overseas connection. Once the issue with the unpatched overseas servers is patched the currently less-than-average overseas upload performance is expected to significantly improve.

The second place is claimed by NordVPN. It is guaranteed to be top three in any test performed. It is the second-best product for overseas connections and third best product for local connections for all categories tested. Except for local torrent speed where it took third instead of second place. Between all the tested regions, the performances are very consistent.

The third place is a draw between Norton Secure VPN and ExpressVPN. Norton Secure VPN takes a top three spot in most categories, sometimes achieving the best performances for specific locations. It did especially well for local up- and download- performances. It didn’t support torrents in the tested servers. Observably underperforming was the local latency tested in the EU. ExpressVPN achieved its best performance for the overseas upload and download performances where it manages to come in at second place each time and overall takes third place for the overseas performances.

Avast SecureLine VPN is usually found around the industry average or below, except for the torrent performances where it achieved a respectable second placing for local and overseas connections.

Mullvad VPN is mostly settled in the midfield of tests but excels for measured latency performances being unbeaten for the local as well as overseas tests.

Private Internet Access is in the midfield for the local latency test. Other than that, its performance is underwhelming in all test scenarios.