



User Manual

HYPERION

**System for Performance Evaluation of Broadband
Connection Services**



EETT

HELLENIC TELECOMMUNICATIONS & POST COMMISSION

Version 2.0

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1 About the HYPERION system

HYPERION is an innovative and easy to use system for measuring the quality of broadband connections, available to all users.

Using the Network Diagnostic Tool (NDT), users are able to measure the following parameters of their wired connection: speed (throughput), Round Trip Time (RTT), jitter and packet loss.

The basic features of HYPERION:

- A pioneering Web 2.0 application
- User-friendly
- Based on open measuring standards and platforms
- Guarantees accurate and reliable measurements
- Based on a technology-neutral, transparent methodology
- Monitored and improved on a permanent basis

HYPERION was developed by the [Hellenic Telecommunications and Post Commission \(EETT\)](#) in collaboration with the [Measurement Lab partnership \(M-Lab\)](#) for the following purposes:

- Providing the consumer with responsible information regarding the provided broadband services
- Providing equal access to competitive services for all
- Protecting the consumer against unlawful practices and creating transparency within his relation with providers of fixed broadband services
- Developing the first map showing the qualitative features of broadband connections in Greece

An important aspect of EETT's mission as the Independent Regulatory Authority in the sector of electronic communications is to ensure transparency, reliability and quality of broadband services provided to the consumer as well as developing the broadband market by strengthening fair competition.

M-Lab aims to promote network research and to assist the general public with useful information regarding their broadband connections, thus enhancing Internet transparency.

1.1 Benefits of user registration

By registering to Hyperion, users can store their measurements and produce individual statistics. A user can link more than one connections to a single account, e.g. a home and a country house connection. It is then possible to see the measurement history per connection and export measurement details. The analysis of measurements from registered users also contributes to area statistics, which are anonymously shown on the measurements map.

1.2 Measurements map

Measurement results from registered users, and statistics based on these measurements are projected on a map of Greece. The map is based on the Google Maps service.

User positions on the map are shown by using the Google Maps Geocoding API, based on the address provided by each user. In case automatic geolocation fails (e.g. due to an incomplete or erroneous address field), the user has the possibility to drag the pin to his/her exact location, either at registration or at any other time, through the account settings.

Registered users play a key role in establishing a complete overview of broadband connections in Greece, because their measurements are shown on the map and statistically processed. They are the ones who primarily contribute to developing the first digital map showing the qualitative features of the country's broadband connections.

Nevertheless, a user is not required to register with the system in order to conduct a simple measurement (without keeping a record or projection on the map).

1.3 Additional possibilities for users

By observing and analyzing their measurement history, HYPERION users can:

- Assess the qualitative features of their broadband connection for a specific period of time. They are also able to identify any variations in connection performance depending on the time of day (e.g. low speeds at peak times).
- Compare performance between cable (Ethernet) and wireless connections (WiFi).

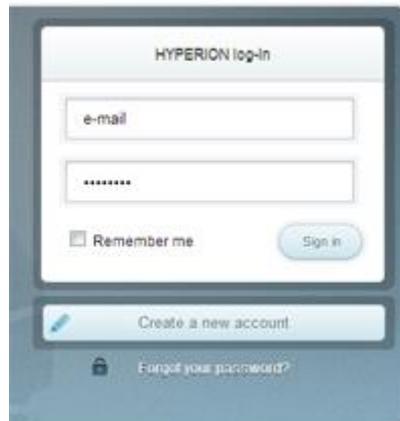
1.4 Useful information

1. Your measurements are only recorded and projected on the map once you have registered with the system. As registered users you have access to the records of your measurements and to statistical breakdowns.
2. The use of a computer that can be directly connected by cable (Ethernet) to your broadband connection's modem/router is recommended. Using a wireless network (WiFi) may restrict connection performance.
3. Before starting to measure, ensure that your broadband connection is not being used by any other software, computer or other type of appliance in your local network (e.g. pay-TV decoders, security cameras, file sharing programs). Network traffic from other data transmission sources affects the measurement results.
4. HYPERION uses the M-Lab measuring system, which automatically allocates each measurement to the nearest available server. When all the servers in the country are busy with other users' connection measurements, it is possible that your measurement may be conducted by a server in another country. In that case, for registered users the measurement results will not be included in the statistics produced by HYPERION.

More detailed information is available on the [Network Diagnostic Tool \(NDT\)](#) website.

2 User Registration

Each user enters the system through the log-in page (HYPERION log-in), as shown below:



If the user has already registered during a previous visit, he enters his e-mail address and the password selected during the registration process in order to log in to the system. He may opt to select the [Remember me](#) option so that he is automatically logged in during future visits.

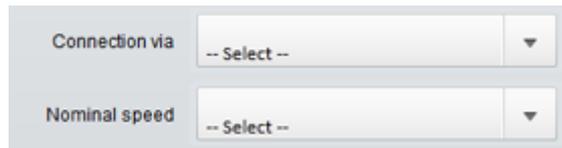
If he forgets his password, the [Forgot your password?](#) link takes him to the password reset page. Once he enters the e-mail address he used to register with the system in the form which appears, the user will receive a prompt reply at that address, providing him with a new password. He may subsequently change it through the settings page should he so wish.

The [Create a new account](#) link leads to the page where the user either enters his details for the first time or updates them if they have changed.

E-mail	demo@eett.gr
Password	*****
Confirm password	*****
Street	somestreet
Number	12
Postcode	15231
Municipality	Chalandri

The first set of fields requests the user's personal details. The password is entered twice to ensure it has been spelled correctly. The user is prompted by appropriate messages, either if he makes a mistake or if he fails to fill in a given field. The remaining fields relate to the user's broadband connection.

In the second section of the form, the user fills in the address corresponding to the connection to which his measurements will be related. This information is essential for providing and displaying statistical data by region. An auto-complete connection between the postcode and the municipality allows this data to be automatically entered to ensure it is correct. Once these fields have been filled in, the geographical location will be shown on the map along with the attendant geographical coordinates.



Connection via -- Select --
Nominal speed -- Select --

In the final section, by selecting the provider (ISP) and the agreed speed stipulated in the contract established between provider and user, connection features are defined.

Once all the data has been filled in and the user has confirmed its accuracy, the next step is for him to read and accept the terms of use, if he agrees with them. He may opt to receive informational e-mails from EETT relating to HYPERION.



Terms of use
1. General terms:
The HYPERION system is supplied as open source software, with a GNU General Public License v3, available in accordance with the terms and conditions stipulated on the following webpage: <http://www.gnu.org/licenses/gpl.html>
 I accept the above terms

Contact I wish to receive informational e-mails from EETT regarding HYPERION

Confirmation
Type the two words
Privacy & Terms

Create account Return

The registration process is completed by clicking on [Create account](#) and a message is sent to the e-mail address provided by the user. The message also contains the link to activate the new account. Clicking on [Return](#) cancels the procedure.

The registered user sees the same data form. He may change his details using the [Settings](#) option. The only significant difference is that changing the password is shown as optional, so that the user is not being obliged to change, in case he doesn't wish so.

Attention: If the user changes any of the address or connection details, a new connection and consequently, a new record of measurements is created.

3 About the Network Diagnostic Tool (NDT)

With the Network Diagnostic Tool (NDT), the user measures the performance of his/her connection and, more specifically, receives statistical data relating to its most important quality features: speed (throughput), Round Trip Time (RTT), jitter and packet loss rate.

When conducting a measurement, the user's computer communicates with a specially designed server having a high capacity connection and located at a central point of the network. By analyzing the communication between the server and the user's computer, the afore-mentioned parameters are calculated and presented to the user.

The duration of a measurement does not exceed 30 seconds. For using NDT, a modern browser is required that supports HTML5 and the WebSocket protocol.

3.1 Using NDT

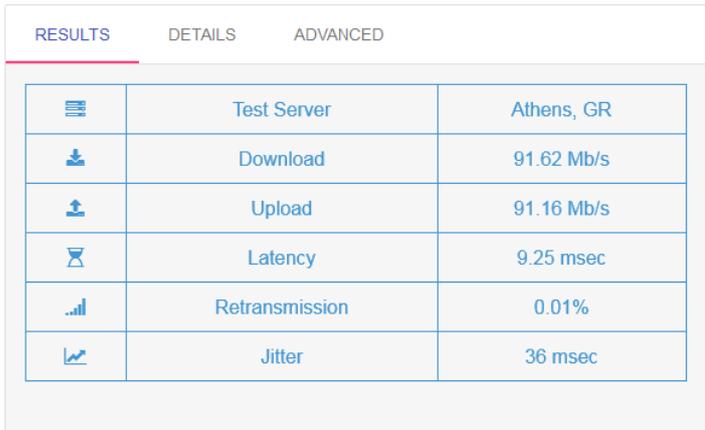
In the measurement page of NDT, users are asked to agree to the data policy before running a measurement. Then, by pressing the BEGIN button, the user executes a default set of measurements. At the start of the measurement, a set of controls are performed (firewall test, test for duplex mismatch detection, etc.). Measurements are done separately in the uplink and downlink directions; a typical measurement lasts 10 seconds in each direction. After the measurement is completed, the basic results are shown on screen: test server location, download and upload speed, latency (RTT), retransmission rate (packet loss rate) and jitter.



I agree to the [data policy](#)

BEGIN ▶

 Please close other applications running on your computer, so that the measurement result is not affected by other traffic sharing the capacity of your connection. For a more accurate measurement, please check that your computer has a wired connection to your modem/router (in order to avoid wireless effects). Additionally, if you perform the measurement as a registered user, please keep your profile information (Internet service provider name, address information) up-to-date, so that your measurement results are registered correctly.



RESULTS DETAILS ADVANCED

	Test Server	Athens, GR
	Download	91.62 Mb/s
	Upload	91.16 Mb/s
	Latency	9.25 msec
	Retransmission	0.01%
	Jitter	36 msec

I agree to the [data policy](#)

AGAIN ↺

3.2 Qualitative features of the connection

- **Download and upload speed.** These measurements provide an accurate (as possible) assessment of available bandwidth in the computer where the measurement is being conducted. It should be noted that for these values as well as the others described here, the measurement is based on user-server communication. The assessment therefore relates to the entire “path” between them, not only the user’s physical connection to the network. Fast speeds usually mean high speed downloads for the user. Since measurement is conducted using the TCP protocol, other factors which affect this specific protocol also tend to be visible from this measurement. In most cases, the slowest connection on a path determines the maximum speed that can be achieved.
- **Round Trip Time (RTT).** Defined as the time needed for a standard packet to go from user to server, and for the acknowledgement of its receipt by the server to arrive back to the user.

Clearly, since the measurement comprises both directions, the RTT refers both to the uplink and downlink of a connection.”

The RTT is a great indicator of network quality, the significance of which is similar to that of upload/download speed. Lengthy RTTs may mean greater delays in interactive on-line games or other applications sensitive to this feature, such as VoIP telephony programmes (Skype, Viber, Facebook Messenger, etc.). In order to calculate RTT as accurately as possible, dozens of uploads/responses are sent in both directions, from which an average is subsequently taken.

- **Packet Loss.** In the vast majority of cases, packet loss means network congestion at some point of the path from user to server. It should be noted that even values of around 1% are an indication of a serious network malfunction.
- **Jitter.** This feature shows the range of values around which RTT (see above) fluctuates. For example, a variation of around 3 milliseconds indicates the gap between the highest and the lowest value for packet upload/response time recorded during the measurement process. Jitter may often reveal possible network connection problems. However it should be taken into account that it is based on the extreme values from a large number of measurements and is consequently not always a reliable qualitative criterion.

3.3 Details

After completion of a measurement, the user can see a more detailed report of the measurements, by clicking on “DETAILS”. The report includes values of TCP parameters (receive window, number of duplicate ACKs, RTO, etc.) as well as useful diagnostics, such as whether network congestion was detected.

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I agree to the [data policy](#)

RESULTS DETAILS ADVANCED

Server: n dt-iupui-mlab1-ath03.measurement-lab.org

TCP receive window: 382976 current, 481280 maximum
0.01 % of packets lost during test
Round trip time: 2 msec (minimum), 78 msec (maximum), 9 msec (average)
Jitter: 76 msec
0.21 seconds spend waiting following a time out
Current TCP RTO (Retransmission timeout) value: 207
1016 selective acknowledgement packets received

No duplex mismatch condition was detected.
The test did not detect a cable fault.
No network congestion was detected.

97.39 % of the time was not spent in a receiver limited or sender limited state.
0.00 % of the time the connection is limited by the client machine's receive buffer.
Optimal receive buffer: - bytes
Bottleneck link: -
1010 number of duplicate ACKs received

Finally, by clicking on “ADVANCED”, the user can see the values of the Web100 parameters recorded during the measurement.

3.4 Error messages

The system includes several controls in order to avoid recording measurements with non-verified user data. For example, it does not record measurements performed from mobile networks, from networks of fixed providers who have not registered their IP ranges with EETT, or from networks outside Greece.

If a registered user tries to make a measurement from a non-identified IP address, the following message will appear:

Your IP address [x.x.x.x] is not registered by your ISP in the HYPERION database. Your measurement results shall not be stored. In case you are a subscriber of a Greek ISP, please report the problem to your ISP or to EETT.

In this case, if a user makes this measurement from a fixed connection, the correspondent ISP should inform EETT about the IP ranges used by its customers, and the offered nominal speeds. Measurements would subsequently be stored. However, if the user makes this measurement from a mobile connection, it would not be stored.

In the case of users outside Greece attempting to register, the following error message appears:

Your IP address is not registered by your ISP in the HYPERION database. Unfortunately you cannot register, but you can still perform measurements anonymously. In case you are a subscriber of a Greek ISP, please report the problem to your ISP or to EETT.

Furthermore, before each measurement by a registered user, a check is performed on whether the user's IP address corresponds to the ISP stated in the user's account. If there is no agreement, the following error message appears:

It seems that your current IP address belongs to an ISP different from the one of your selected connection. If you wish to register your measurements, select the correct connection from the list or set the correct ISP in the Settings of this connection.

Usually, this problem appears when a user has created different connections (e.g. home, office) and does not choose the correct one before running a measurement. Additionally, when users have changed ISP and have not updated their account information. To solve these problems, users just have to choose the correct connection, or update their account information prior to the measurement.

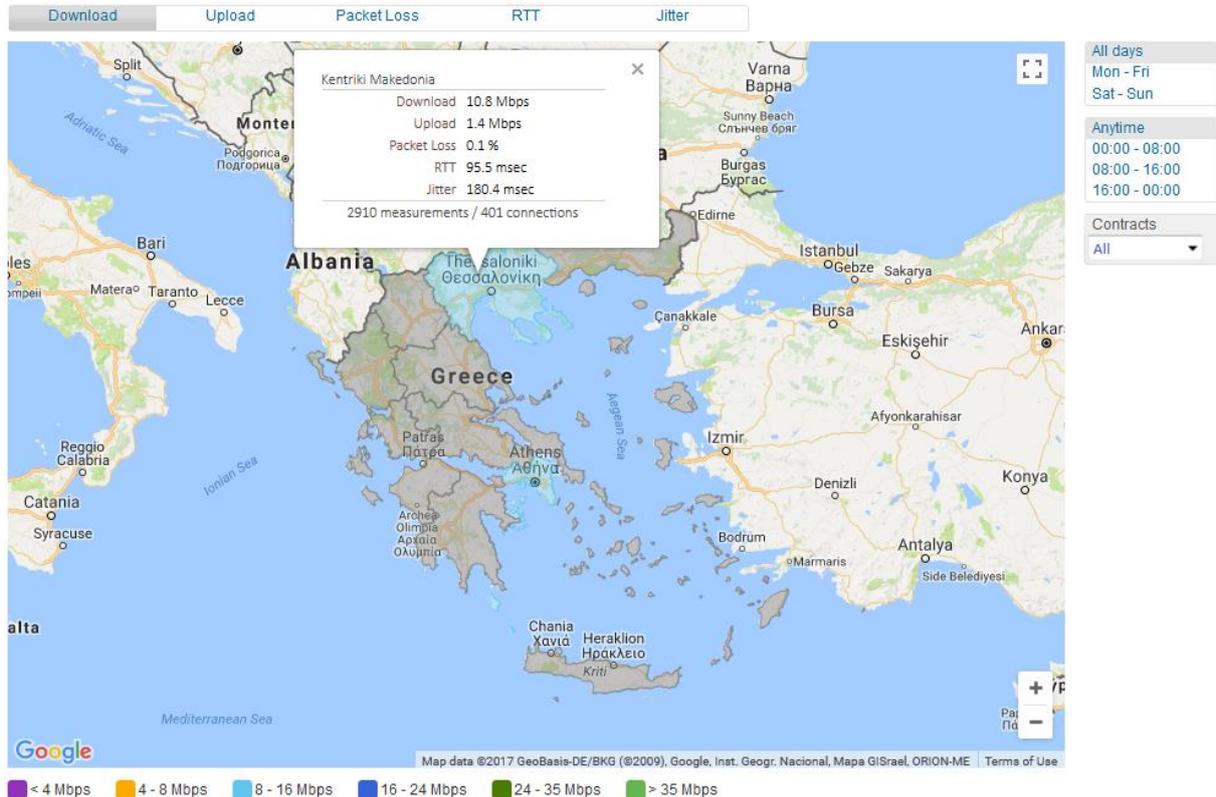
4 Measurement results and statistics

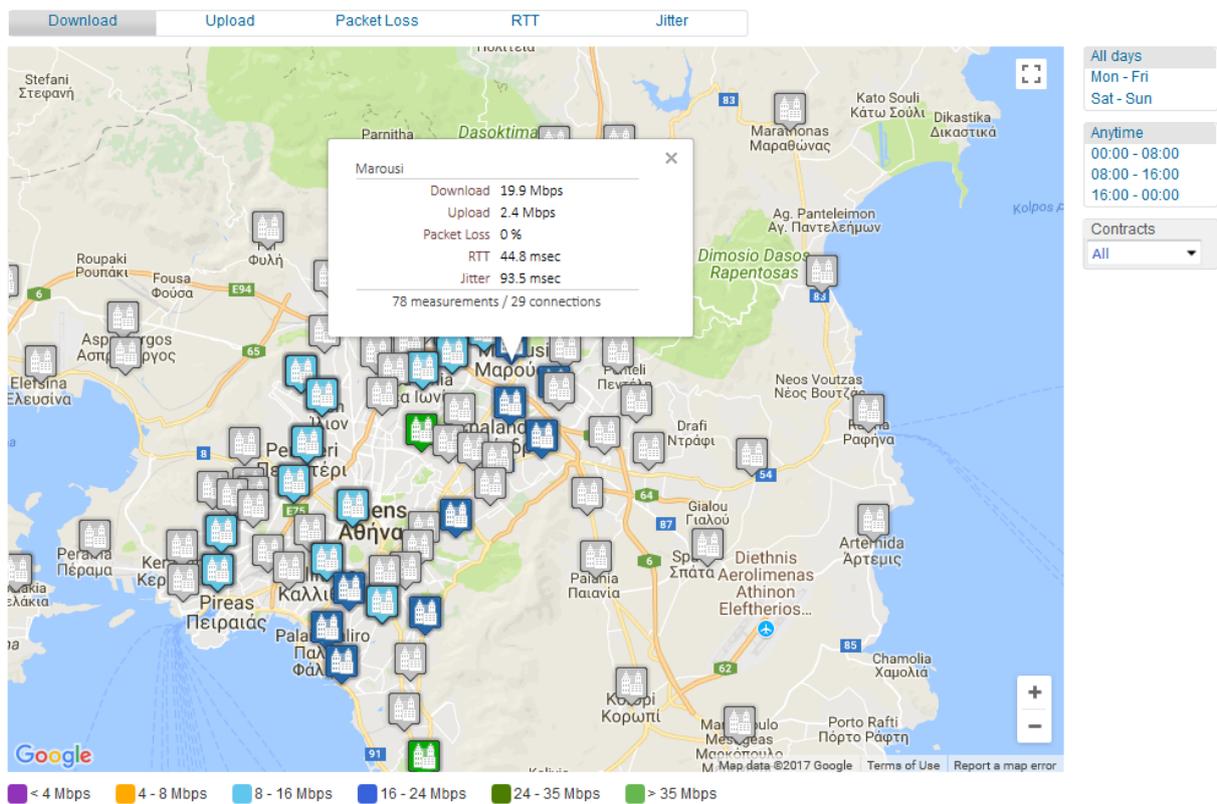
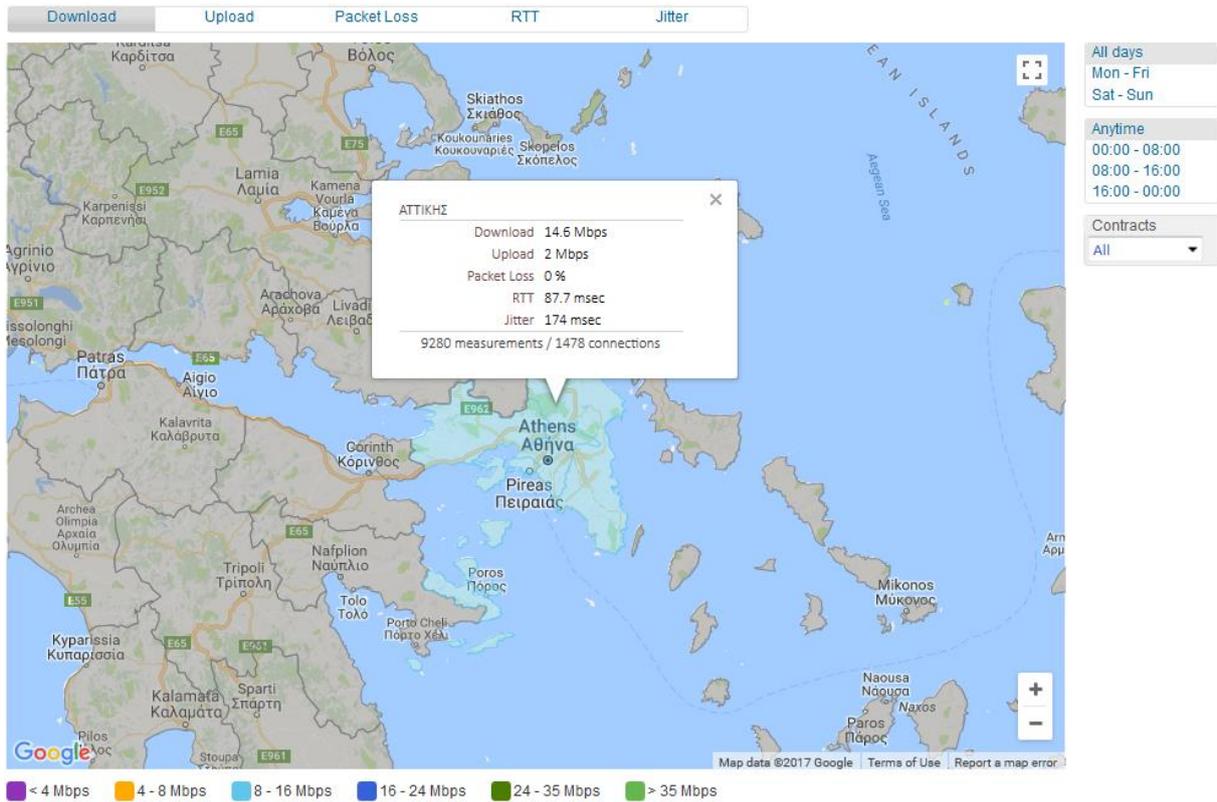
Measurement results are available in three different formats. The user may consult them and store them locally:

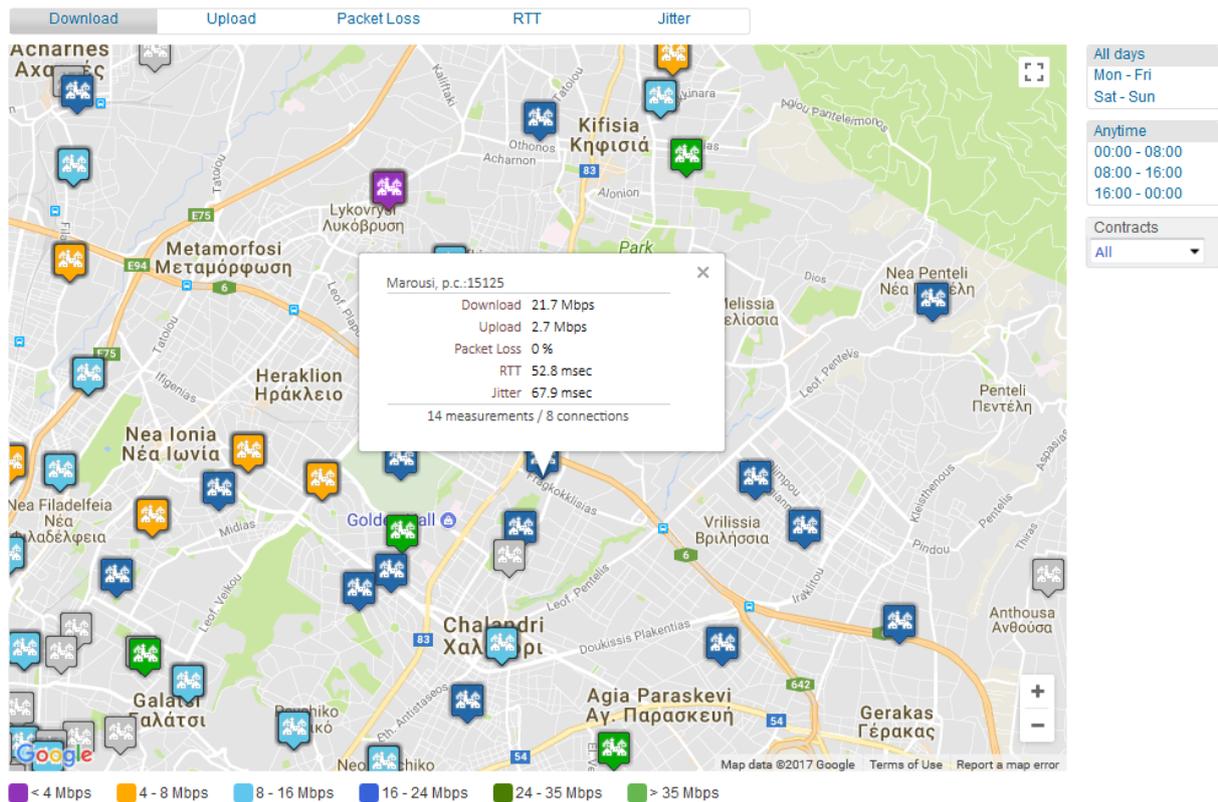
- With the statistical data projected on a map of Greece
- As graphs relating to time
- As a simple list with the details of each measurement

4.1 Map

The statistical map is the main way of displaying the results of the measurements statistical analysis by region. Registered users can see on the map the measurements conducted in their region. Otherwise, when first pulled up the map shows the whole of Greece. Depending on zoom level, the numerical data is grouped by broader or narrower region. Specifically, resolution levels on an ascending scale range from administrative regions and prefectures to municipalities and neighborhoods (based on postcodes).







The polygons lie symmetrically around the centre of the region they represent. The colours represent the range of values within which the result of the measurement falls for that specific region. Clicking on a polygon produces a pop-up showing the average value for the metrics of the tool selected. The following metrics are projected on the map for the NDT tool:

- Download speed (downstream)
- Upload speed (upstream)
- Round Trip Time (RTT)
- Packet loss
- Jitter

The range of values for each of the indicators can be split into various intervals, as indicated in the note below the map. The colour of the corresponding polygon is determined by the interval to which each statistical value belongs.

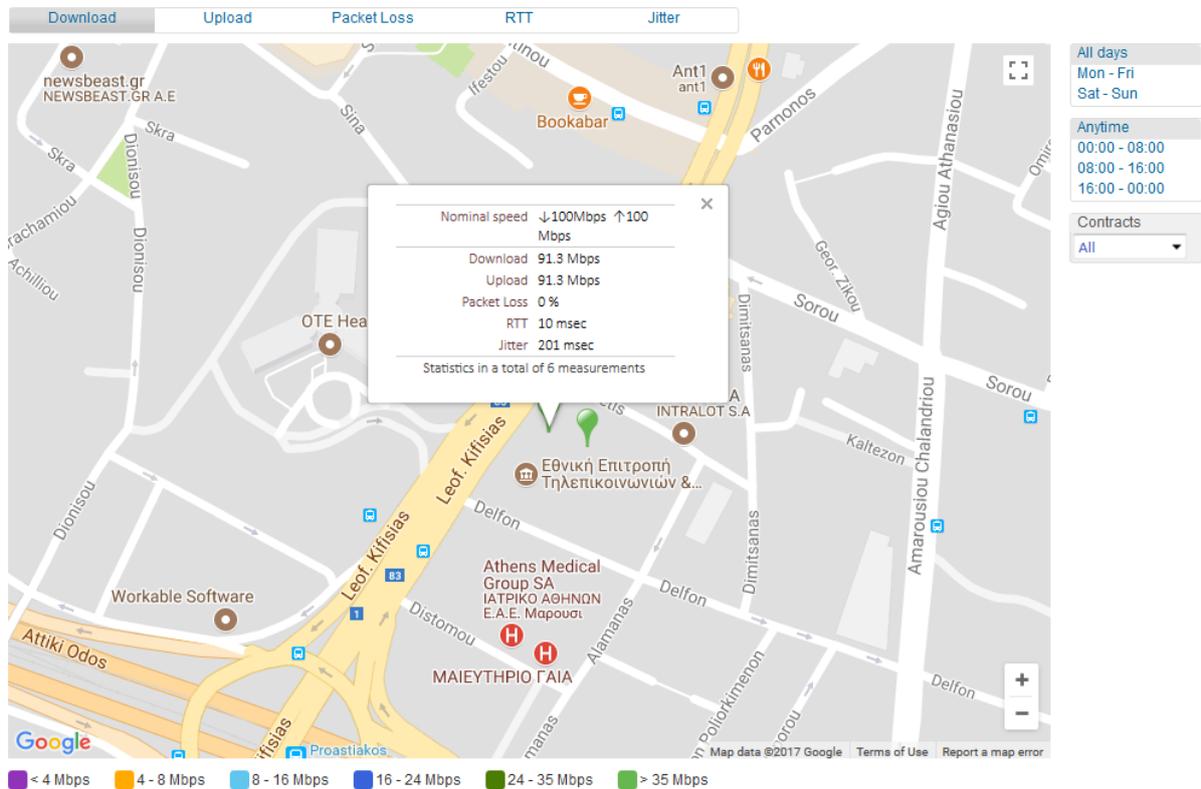
The available options, such as upload and download speed, are shown in tabs above the map. By clicking on one of the polygons on the map, a pop-up appears, showing the mean value of all the metrics for the selected tool for that area.

All the connections in the area from all providers (ISPs) are taken into account when calculating the values.

Google Maps API was used to create the map, hence as with any application of this type, the mouse can be used to zoom and shift the map. The visitor can use the mouse and/or the zoom control slider to do this. He may also select from the various map layers in the top-right hand corner.

At higher resolutions, measurements are grouped into collated statistics by connection rather than by region. Besides the metrics measured, each pop-up also includes indications regarding:

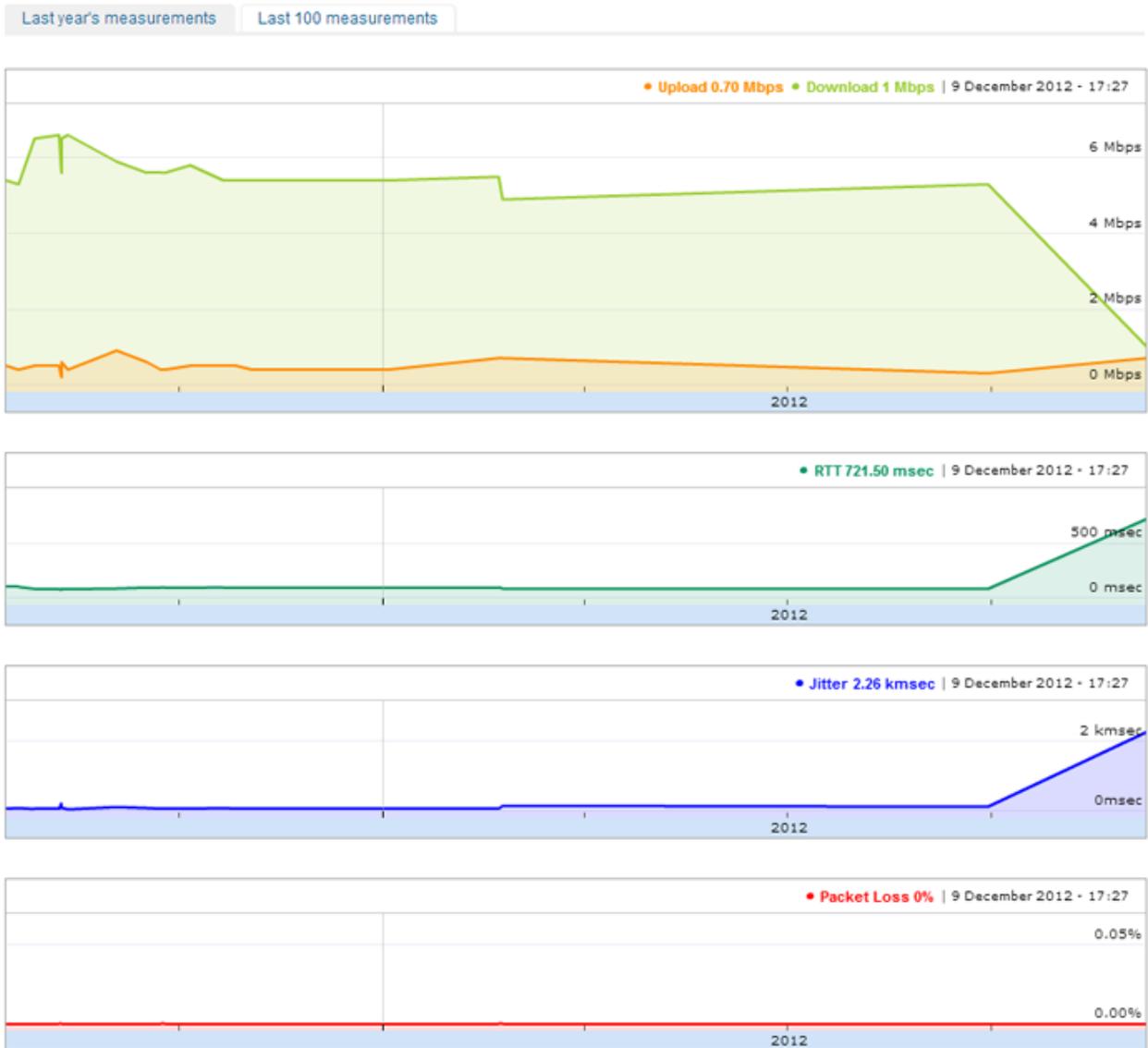
- The nominal speed of the packet purchased by the user
- The number of measurements conducted



4.2 Graphs

HYPERION keeps record of measurements, in condition that users are registered with the system. These measurements are used to export statistical data, while the user has also the possibility, via the available graphs, to view the records of the performed measurements.

Measurements results are presented as a function of time, on a daily basis. In case that multiple measurements have occurred per day, then the average value is calculated.



4.3 List of measurements

The details regarding the user's current measurement are displayed once it has been completed by the chosen tool. The user's record, however, which contains all previous recorded measurements, can be called up by clicking on the [Details](#) tab.

Detailed list of your measurements

NDT

	Date/Time	Download (Mbps)	Upload (Mbps)	RTT (msec)	Packet Loss	Jitter
1	4/4/2015 - 16:46:00	3.501	0.478	149.4	0.00%	146
2	4/4/2015 - 16:47:00	3.501	0.471	149.4	0.00%	147
3	4/4/2015 - 16:48:00	3.496	0.476	149.4	0.00%	147
4	4/4/2015 - 16:50:00	3.496	0.476	149.3	0.00%	146
5	4/4/2015 - 17:03:00	3.503	0.509	149.3	0.00%	145
6	4/4/2015 - 17:04:00	3.501	0.472	149.3	0.00%	146
7	4/4/2015 - 17:05:00	3.501	0.476	149.2	0.00%	149
8	16/5/2015 - 12:01:00	1.240	0.644	103.5	0.73%	164
9	16/5/2015 - 12:02:00	1.124	0.615	65.9	1.63%	265

Export data as CSV file

Each measurement is characterised by the date and time at which it was conducted. This is only recorded for users registered with the system. The [Export data as CSV file](#) tab allows this data to be recorded locally. The file can be opened using a spreadsheet application (e.g. Microsoft Office Excel).

5 Terms of use

5.1 General terms

- Measurements of the qualitative features of broadband connections are conducted with measurement tools, using the M-Lab measurement system.
- The M-Lab's measurement tools process and store data as defined on the following webpage: <https://www.measurementlab.net/privacy/>
- EETT may use the results of measurements conducted by users to draw and publish conclusions and instructions relating to the broadband services provided to consumers.
- The HYPERION system incorporates the M-Lab's measurement tools, the use of which is subject to the "Acceptable Use Policy (AUP)" terms to be found on the following website: <https://www.measurementlab.net/aup/>
- The HYPERION system and the measurement tools are provided without guarantee.
- By registering with the system, the user has access to additional possibilities, more particularly:
 - Geographical projection of the qualitative features measurements for his broadband connection on a map of the country.
 - Individualised statistical graphs showing the measurements for the user's broadband connection on the time axis.
 - Receiving records of the measurements in CSV format (Comma Separated Values).

5.2 Services for registered users

- EETT is entitled to use the results of the measurements conducted by the user, as well as any other information he publishes on HYPERION, in order to draw and publish useful conclusions, in compliance with personal data protection provisions.

- The user measurement statistics displayed on the map are the result of measurements conducted exclusively by registered users.

5.3 Terms of acceptance

- The user agrees to send to his provider the information stated on the new user registration form (e-mail, postal address of the connection, connection provider, nominal speed), in order to confirm the broadband connection data.
- The user agrees to send the telecommunications provider he declared upon registration the IP address and a connection identifier (e.g. local loop number) used in order to ensure that the measurement is conducted on the broadband connection the user recorded in the system.
- The user declares on his honour that the details entered in the system are true and accurate.

6 Frequently Asked Questions

1. [How accurate is the measurement conducted using the NDT?](#)

The NDT allows broadband subscribers to accurately measure the qualitative features of their connections and presents them in an impartial manner. It should, however, be noted that:

- Any measurement may be affected by various external factors (e.g. wired/wireless interface to the router, cross-traffic from other applications, memory and processing capabilities of user's computer, or structured cabling in the house)
- The user is wholly liable when using the tools
- EETT is not liable for any problems or faults which may arise during usage of the tools

To ensure a reliable measurement it is essential that (a) no other application is "running" on the user's computer or local network, which would generate network traffic and (b) there should be no form of temporary network problem on the path to the server.

It should be noted that if other computers are also generating traffic on the user's local network, this may negatively affect the accuracy of a measurement. The user in any case is advised to ensure that the network connection is as inactive as possible before proceeding to measure.

2. [Can a computer using a WiFi connection be used for the measurement?](#)

Using WiFi may affect the accuracy of the measurement. For the most widely used protocol, 802.11g, depending on the quality of the signal, the available WiFi bandwidth varies from 6 to 54 Mbps, and the wireless part of the connection operates in half-duplex mode. Therefore, if there are other devices connecting to the WiFi router (e.g. a smartphone), or the signal is weak, the WiFi speed could be lower than the speed of the wired interface, and as a result the overall speed would be limited by the WiFi speed. This rarely occurs in the case of a wired connection, where the bandwidth is always 100Mbps full duplex (if not more). It is therefore advisable to measure from a computer connected by cable to the domestic router.

3. **What factors negatively affect the quality of a measurement?**
Firewalls, heavy use of the computer's central server and even faults on the computer network cable, may affect measurement quality.
4. **Does the measurement include the overhead from TCP headers, IP headers etc.?**
No. The measurement uses TCP/IP as underlying protocols, but does not include this overhead in the throughput calculation. This results in lower speed, but is closer to the throughput an application would see.
5. **What is the range of variation for the overhead of a broadband connection?**
It isn't the same in all cases. It varies according to the WAN protocol used (e.g. PPP or HDLC), as well as application overhead, overhead for encryption, etc.
6. **Let's suppose, for example, that a user has bought a package with 24 Mbps downlink speed. What result would his measurement be expected to produce in the downlink?**
The user will always get less than the nominal speed he/she purchased as the nominal speed is only a theoretical limit at L2 (Data link layer). The actual speed of connection to the Internet depends on many factors, such as the distance from the local exchange or cabinet, noise levels, the degree of congestion in the provider's network, as well as the internal network at the subscriber's premises (wired/wireless connection to the router, existence of other devices in the same local network, cross-traffic from other applications).
Interested users can visit <https://www.increasebroadbandspeed.co.uk/2012/graph-ADSL-speed-versus-distance> for more details on the variation of the downlink connection speed depending on the distance from the exchange, for an ADSL line.
Nevertheless, it is very difficult to properly account for all factors that affect Internet speed and predict the expected speed without conducting any measurements.
7. **What protocol does the NDT use for its measurements?**
The NDT employs two inter-related sets of protocols: NDTP-Control and NDTP-Tests. Both of them are layered over TCP.
8. **How are Round Trip Time (RTT), packet loss and jitter calculated?**
By analyzing the measurement packets (data and acknowledgement) sent during the client user computer-server communication. The user sees the average values based on all the exchanged packets. The difference between the two extreme delay values constitutes the delay variation (jitter), whilst packets that were lost and had to be retransmitted are included in the percentage loss.