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# **Evaluation of the Internet Access Service**

## ***Broadband: ADSL and Cable***

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September / October 2005

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# I EXECUTIVE SUMMARY

## I.I GENERAL FRAMEWORK

For the first time, ICP - Autoridade Nacional de Comunicações (ANACOM) made a study on the quality of the Internet access services in Portugal, from a user's standpoint.

The study was prepared and made in partnership with CONVEX – Consultoria e Integração de Sistemas, Lda. and MARKTEST – Marketing, Organização, Formação, Lda.

FCCN – Foundation for National Scientific Computation, APRITEL – Telecommunications Operators Association and IC – Institute of the Consumer, were also involved in this study and their suggestions and critical opinions were considered in the definition of the study's methodology.

A first phase of the study analyzed the narrowband (Dial-Up) offers to the home market by ISPs Telepac/Sapo, Clixgest/Novis, OniTelecom and Media Capital/IOL. These are the 4 major Portuguese ISPs providing this kind of service and share over 90% of the market.

The second phase of the project, analyzed in this report, focused on broadband (ADSL and Cable) offers to the home market by ISPs Telepac/Sapo, Clixgest/Novis, OniTelecom, TV Cabo and Cabovisão. These operators make up over 90% of the offer available in the Portuguese market for this kind of access. Both in Cable and in ADSL, the operators studied herein have the largest market shares, with over 90% of the active accesses in the corresponding technologies.

This study analysed the offers with the largest number of home clients per operator. The analysed offers are shown on the following table:

Table 1 – Analyzed commercial offer per ISP

ISP	Maximum Download speed	Maximum Upload speed
Telepac / Sapo	2 Mbps	128 kbps
Clixgest / Novis	2 Mbps	256 kbps
TV Cabo	2 Mbps	128 kbps
OniTelecom	512 kbps	128 kbps
Cabovisão	512 kbps	128 kbps

Efficiency Indicators were used to evaluate ADSL and Cable broadband Internet access service's Data upload and download abilities (HTTP e FTP).

The making of this project implied the setting of an Internet user test panel, targeted at representing the dispersion of results both in geography and in time, and from which the required measurements and tests were made.

A computer application (software agent) developed for this purpose and installed on the personal computers of the test panel's members made the measurements. The software agent is automatically activated on predetermined time periods. Its function is to connect to the ISP, service provider in each computer of the panel, to access the data centres of the operators under analysis and the two international ones, and to operate the required tests.

The software agent depends on a central platform that, besides controlling the agents, is responsible for the storing and processing of all information.

From the measurements done, general data for each indicator was extrapolated using weighting and quality control processes.

Measurements, in the scope of Broadband, were performed between 23/09/2006 and 23/10/2005.

Several factors can influence data upload/download speed in Internet browsing, namely processing delays installed in the access equipment, such as personal firewalls and anti-virus; the machines' capacities, types of used browsers (versions, etc.); the operator's network (caching, the sizing of peering lines, access technology, etc.) and visited sites based on platforms with their own performance limitations.

In face of these constraints, the research attempted to eliminate all factors not controlled by the operators or, at least, to evaluate these entities under the exact same conditions (namely, all results were affected by protocol headers and by anti-virus and personal firewalls delays) so that, even if it was not possible to obtain a perfect information, at least it was possible to reach reliable conclusions regarding the operators' performance. Resulting from this was, for example, the use of (as much as possible) the same access equipment, the elimination of caching mechanisms (which can bias the upload/download speeds' real results) and the creation of specific websites and FTPs in order to perform the tests.

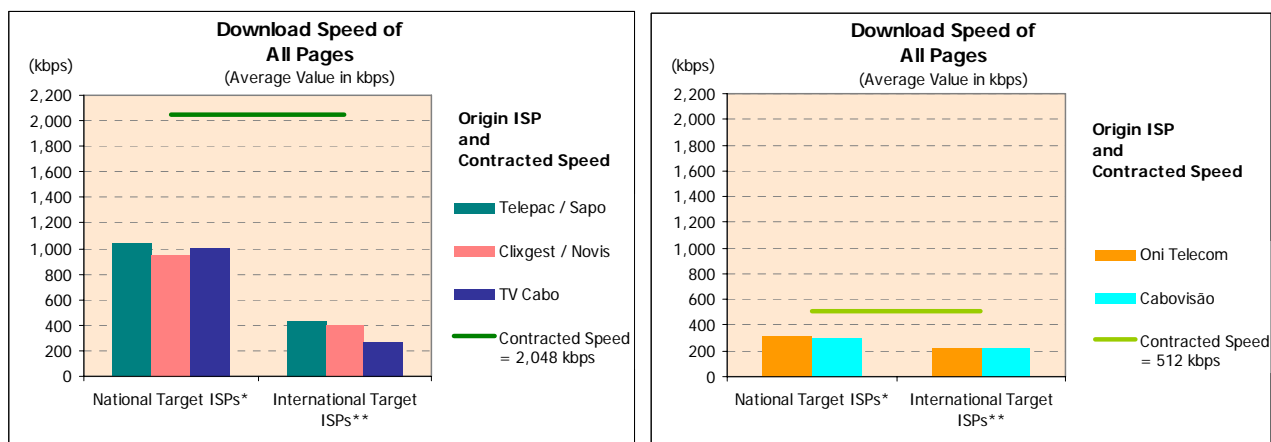
## I.II MAIN CONCLUSIONS

The purpose of the efficiency Indicators evaluated in this study is to measure parameters in a situation of access to any given Internet area. The analysis of these indicators, namely of the Download Speeds (HTTP and FTP) and Upload Speeds, should be made with some caution since the results obtained are only directly comparable regarding commercial offers with the same contracted speeds.

Thus, for each situation we have two groups of ISPs:

- ❖ Contracted download speed (HTTP and FTP):
  - 2 Mbps (2,048 kbps) – Telepac/Sapo, Clixgest/Novis and TV Cabo;
  - 512 kbps – Cabovisão and OniTelecom.
- ❖ Contracted upload speed (FTP):
  - 256 kbps – Clixgest/Novis;
  - 128 kbps – Telepac/Sapo, TV Cabo, Cabovisão and OniTelecom.

Results for the “Download Speed of All Pages” (HTTP) show that the average speed was slower than the contracted one. This occurred with all operators but was specially the case with higher (2,048 kbps) contracted speed offers.



\* Group with special weighting (see methodology)

\*\* Group made up of international ISPs

Figure 1 – User’s perception of HTTP download: Average download speed.

International target ISPs' average download speeds were also shown to be considerably slower, indicating that the international lines act as bottlenecks to all operators.

Results for operators with the fastest contracted speeds – Telepac/Sapo, Clixgest/Novis and TV Cabo – were quite similar, ranging from Telepac/Sapo's 1,043 kbps to Clixgest/Novis' 944 kbps when targeted ISPs were national. Also for this group of operators, but for international target ISPs, results varied between Telepac/Sapo's 433 kbps and TV Cabo's 271 kbps.

The group of ISPs with the slowest contracted download speed - Cabovisão and OniTelecom – had very similar average download speeds, near to 313 kbps for national target ISPs, and 225 kbps for international target ISPs.

Although the average values for each group of operators are relatively similar, the results are quite different when analysed by speed intervals.

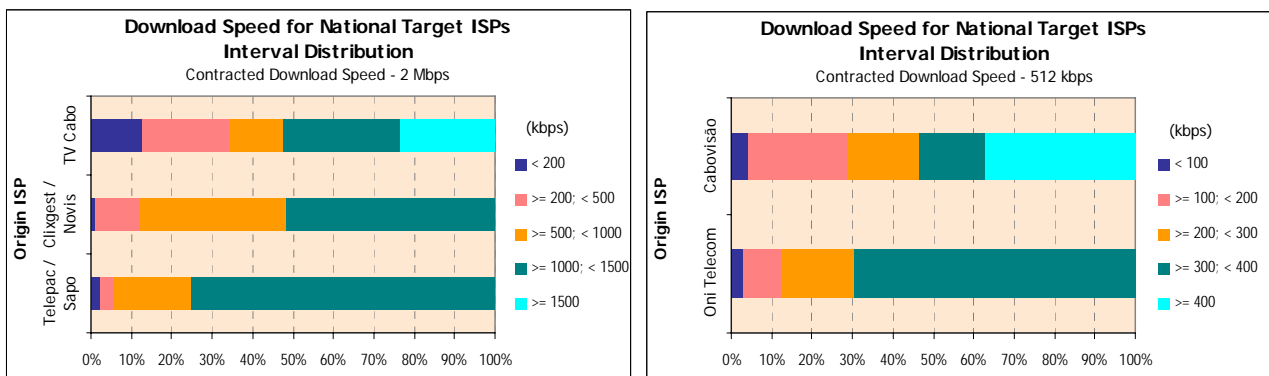


Figure 2 – Download speed interval distribution (HTTP), for national target ISPs.

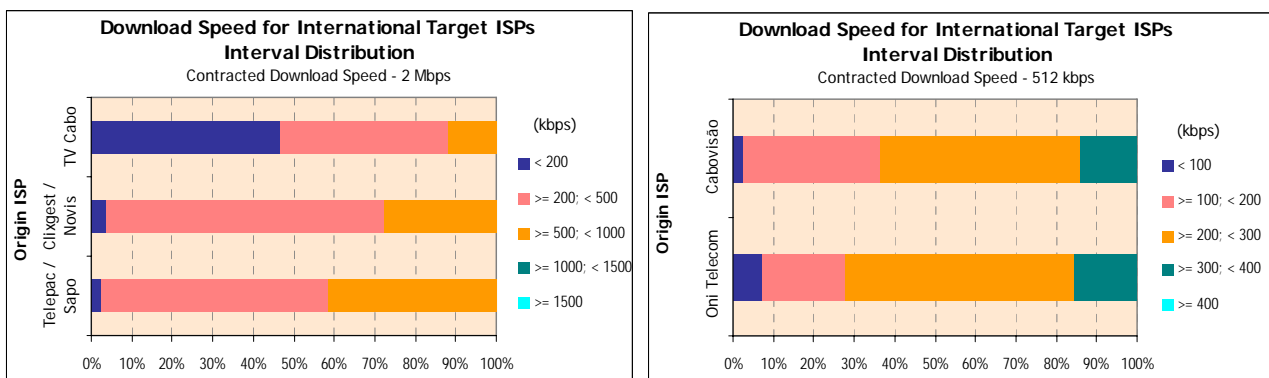


Figure 3 – Download speed interval distribution (HTTP), for international target ISPs.

In the group of ISPs with a 2 Mbps download speed offer, for national target ISPs, ISP TV Cabo was the only one reaching speeds within the highest interval – speeds equal or above 1,500 kbps (the speeds for 23.4% of the measurements fell within this interval). However, this was also the ISP with a higher number of measurements with speeds below 500 kbps (34.5%), while operators Clixgest/Novis and Telepac/Sapo only had 11.9% and 5.9% of measurements in this interval, respectively.

When the targets were international, none of the operators registered speeds above 1,000 kbps. 11.9% of TV Cabo's measurements, 27.6% of Clixgest/Novis' and 41.7% of Telepac/Sapo's fell in the 500 to 1000 kbps interval. On the lowest interval – download speeds below 200 kbps – differences between operators were even stronger. 46.6% of TV Cabo's measurements were in this interval, while the other two operators' ratios were very low – of 3.8% for Clixgest/Novis and 2.7% for Telepac/Sapo.

In the group of ISPs with a 512 kbps download speed offer, the scenario was identical. In the case with national target ISPs, only the cable operator (Cabovisão) had measurements (37.3%) in the highest interval (speeds over 400 kbps). However, it was also the one with more measurements with worst results. Cabovisão had 28.8% of the measurements with speeds below 200 kbps while OniTelecom only had 12.1% below this speed. For international target ISPs, the results are quite balanced between the two operators.

The variation in the HTTP download speed indicator between week days and the weekend and along the hours of the day was also studied.

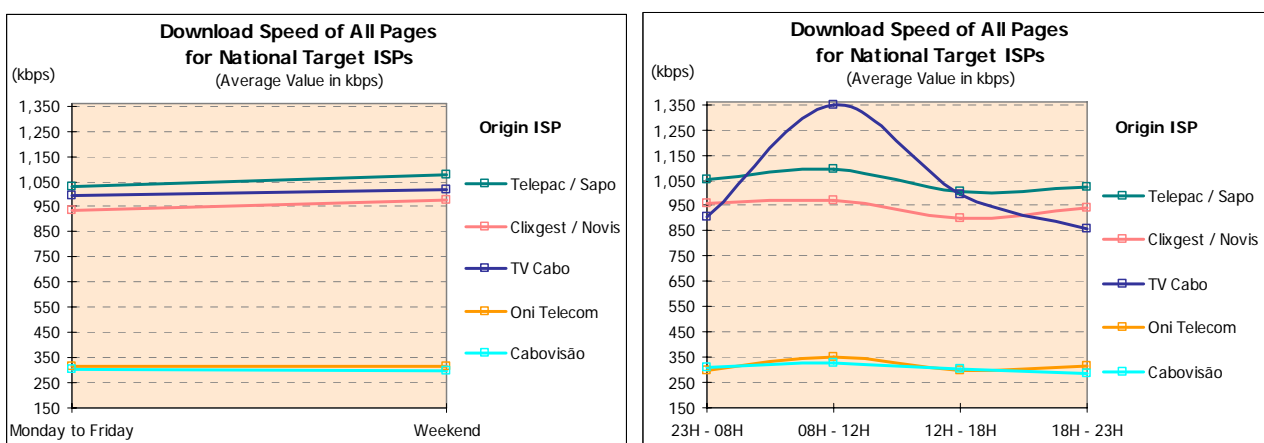


Figure 4 – Average download speed variation (HTTP) by day of the week and hours, for national target ISPs.



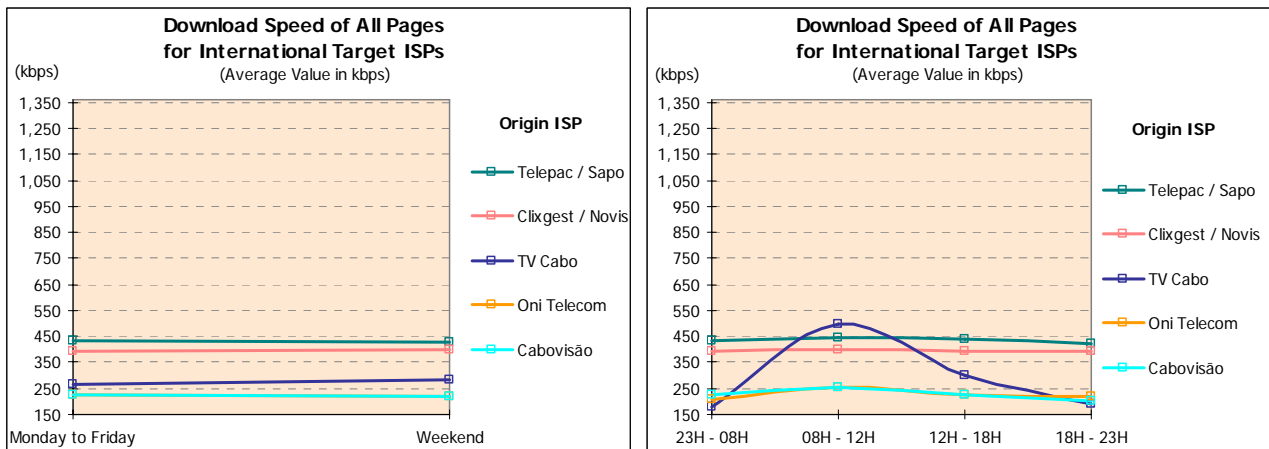
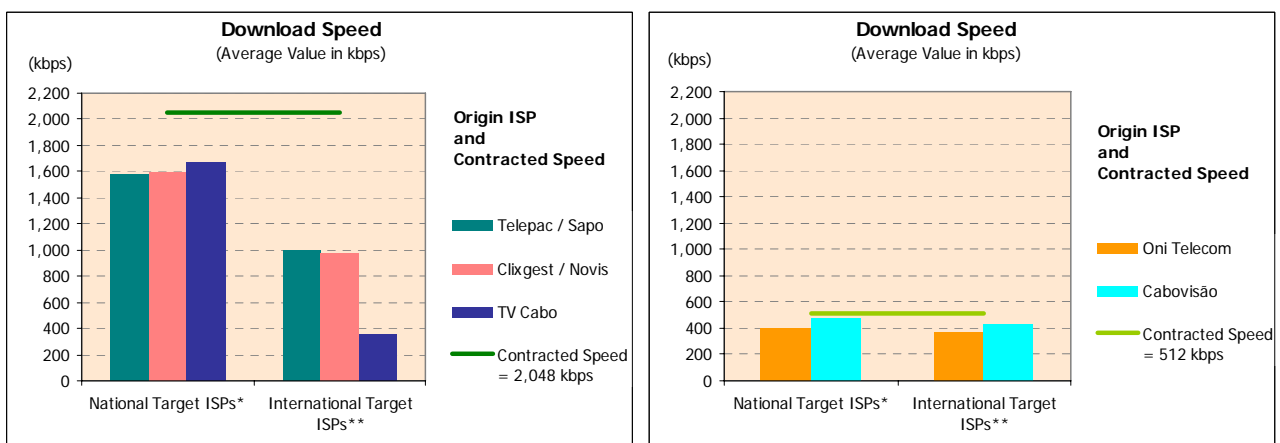


Figure 5 – Average download speed variation (HTTP) by day of the week and hours, for international target ISPs.

The several studied operators do not show important variations in this indicator between week days and the weekend. However, an analysis along the hours of the day shows some speed variation, even quite significant in the case of operator TV Cabo, both for national and for international target ISPs.

Efficiency indicators were also studied by means of FTP download tests.

The FTP protocol is more efficient in transporting useful data and does not use data compression. Therefore, FTP measurements are closer to the real access throughput than HTTP ones.



\* Measurements to the same ISP

\*\* Group made up of international ISPs

Figure 6 – User's perception of FTP download: Average download speed.

These FTP test results for national target ISPs only included measurements to the same ISP, since guaranteeing result comparability is fundamental, because not all operators possessed FTP servers for the making of crossed tests (the case with operators Telepac/Sapo and TV Cabo). However, crossed tests were

made for the remaining operators, the results of which are also part of this report.

Average FTP download speed values are higher than those of HTTP's.

For the 2 Mbps download speed offer, in the analysis for national target ISPs, TV Cabo was the operator with the highest average speed (1,668 kbps), closely followed by the other two operators (1,583 kbps for Telepac/Sapo and 1,596 kbps for Clixgest/Novis). Regarding the group of ISPs with a 512 kbps contracted speed, the highest average speed was 477 kbps, by ISP Cabovisão, while OniTelecom did not go beyond a 399 kbps average speed.

As with the HTTP tests, average download speed is lower in the case with measurements for international target ISPs. In the group of ISPs with the highest contracted speeds, Telepac/Sapo and Clixgest/Novis reached very similar values (respectively 995 kbps and 976 kbps), while TV Cabo's values were much lower, not exceeding an average 360 kbps download speed. In the group of ISPs with the lowest contracted speed, ISP Cabovisão's average speed was the fastest (431 kbps). OniTelecom settled for 368 kbps.

Regarding the interval distribution of download speeds, ISPs' results also differed, in much the same way as with the HTTP test.

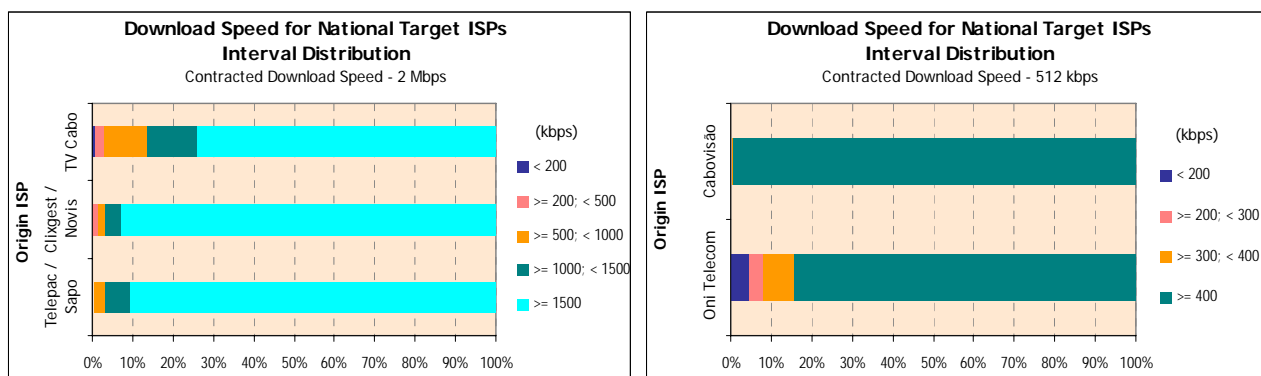


Figure 7 – Download speed interval distribution (FTP), for national target ISPs.

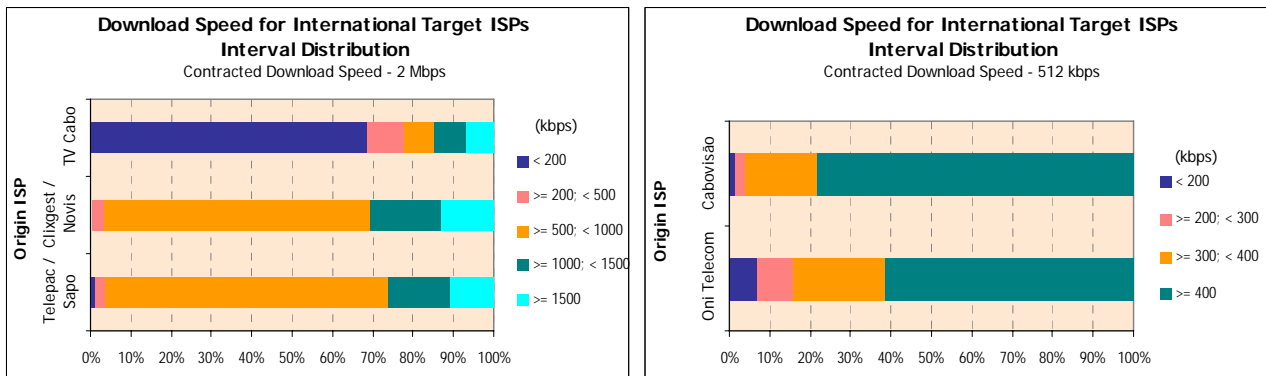


Figure 8 – Download speed interval distribution (FTP), for international target ISPs.

In the group of ISPs with a 2 Mbps download speed offer, the data centres of ISPs Clixgest/Novis and Telepac/Sapo had over 90% of measurements in the highest interval (speeds above 1,500 kbps), while 74% of measurements for ISP TV Cabo fell in this interval.

In the ISPs with a 512 kbps download speed offer, highlight goes to Cabovisão, with over 99% of measurements for national target ISPs with speeds equal or above 400 kbps (84% in the case with OniTelecom).

Regarding the measurements to international target ISPs, in the group of ISPs with a 2 Mbps download speed offer, TV Cabo registered the highest number of measurements, around 69%, in the lowest speed interval (below 200 kbps), while Clixgest/Novis and Telepac/Sapo had residual values of 0.5% and 1% in this interval, respectively. Most measurements for these two operators, Telepac/Sapo and Clixgest/Novis (70% and 66%, respectively) fell in the 500 to 1,000 kbps interval.

For the group of ISPs with a 512 kbps download speed offer, Cabovisão had better results than ISP OniTelecom, for international target ISPs, since it had a lower percentage of measurements with speeds in the lower interval, of less than 200 kbps (1.3% against 6.9%) and a higher percentage of measurements in the highest interval, equal or above 400 kbps (78.3% against 61.5%).

This indicator does not vary significantly with ISPs Telepac/Sapo, Clixgest/Novis, OniTelecom and Cabovisão regarding the day of the week, the hour of the day or the location of target ISPs. The results were different with ISP TV Cabo, which had different behaviours for each type of target ISPs. For national ISPs, it showed variations of low significance, regardless of the day of the week or hour of the day. For international ISPs, important differences occurred in the download speed, mainly along the hours of the day.

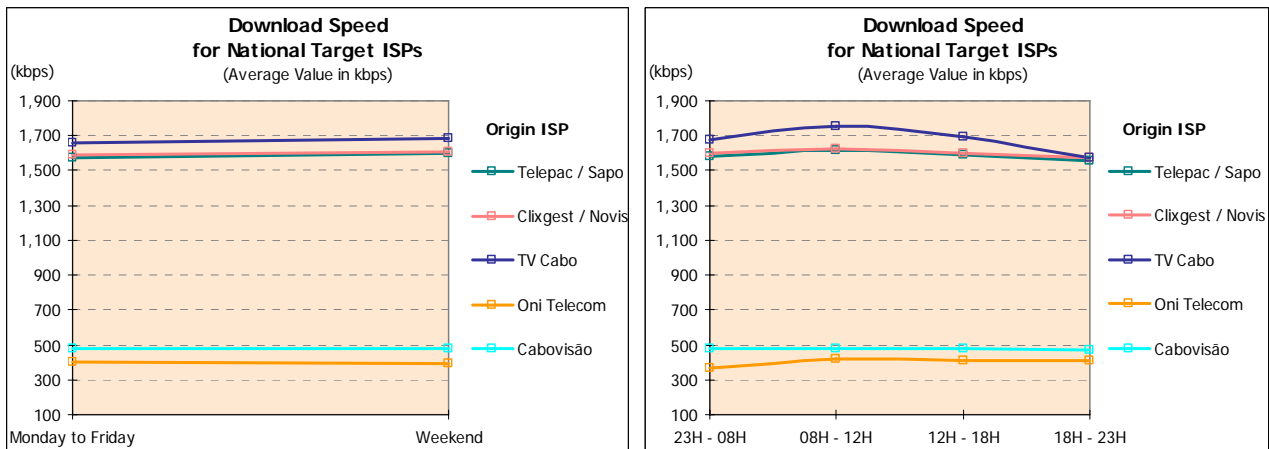


Figure 9 – Average download speed variation (FTP) by day of the week and hours, for national target ISPs.

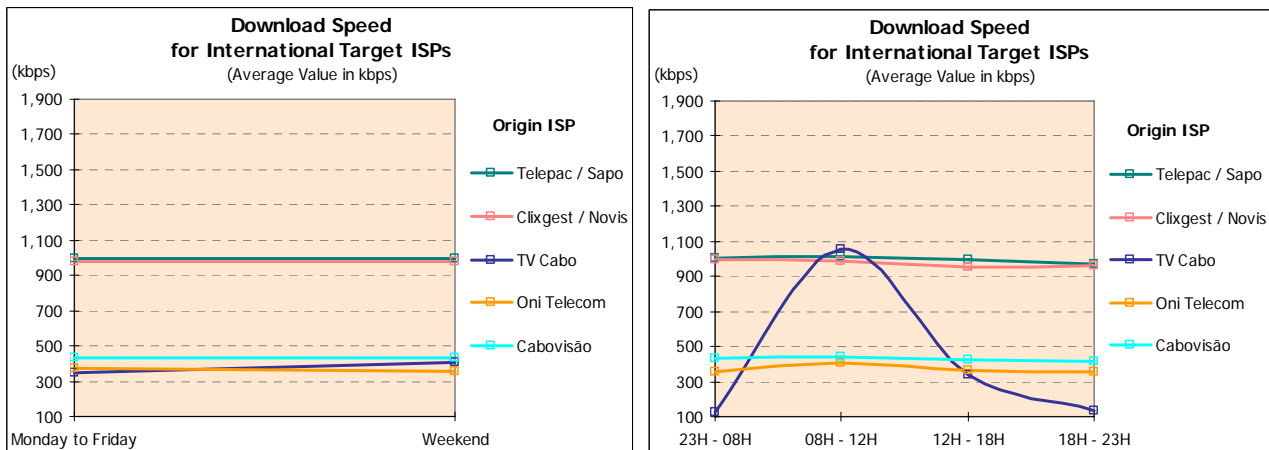
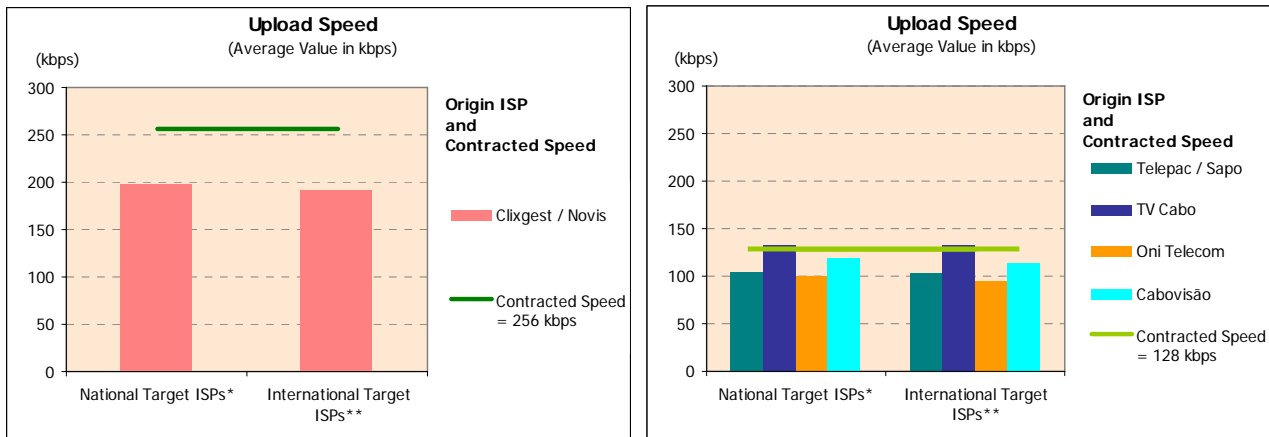


Figure 10 - Average download speed variation (FTP) by day of the week and hours, for international target ISPs.

The “average upload speed” (FTP) indicator analyses the behaviour of Internet access when sending files to the data centres of the studied operators.

The results are only directly comparable when the analyzed offers have the same contracted speed. Among the analysed ISPs, only Clixgest/Novis has a 256 kbps upload offer and therefore this operator’s results cannot directly compare to the remaining ones.

This ISP’s average upload speeds for its own data centre and for the data centres of the international ISPs were of around 200 kbps, thus below the contracted speed (256 kbps).

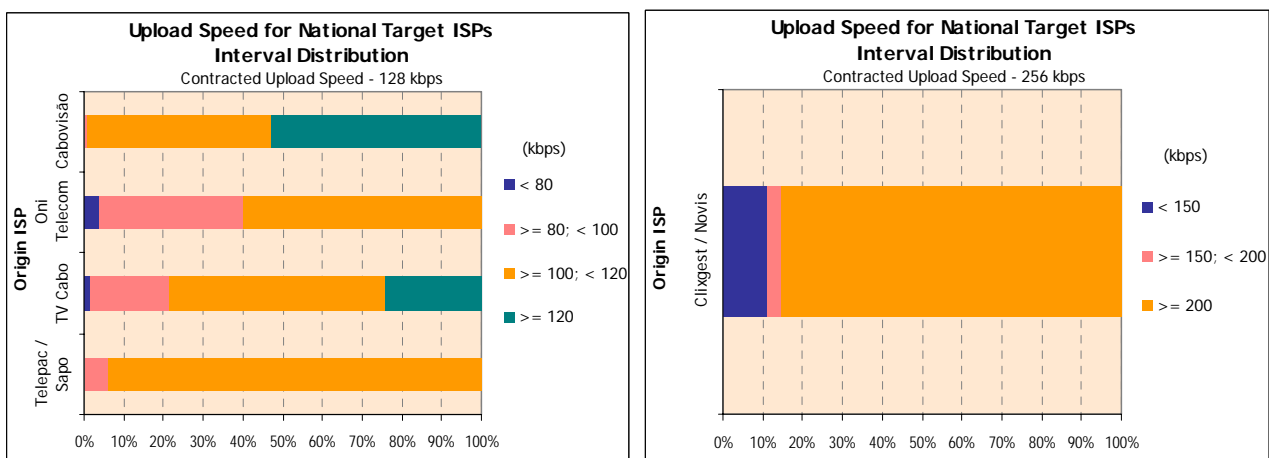


\* Measurements to the same ISP  
 \*\* Group made up of international ISPs

Figure 11 – User’s perception of FTP upload: Average upload speed.

In the case with the remaining operators, offering upload speeds of 128 kbps, each operator’s results, for its own data centre and for the international data centres, show that TV Cabo has the fastest average speeds (about 134 kbps and 129 kbps, respectively), even exceeding the contracted speed (128 kbps). The speeds registered by these ISPs, both for national and for international target ISPs, were around 100 kbps, 95 kbps and 115 kbps, for Telepac/Sapo, OniTelecom and Cabovisão, in this order.

Regarding the analysis by speed intervals, in the group of ISPs with a 128 kbps upload speed offer ISPs Cabovisão and TV Cabo were the only ones with speeds in the highest interval (speeds equal or above 120 kbps).



Figures 12 – Upload speed interval distribution (FTP), for national target ISPs.

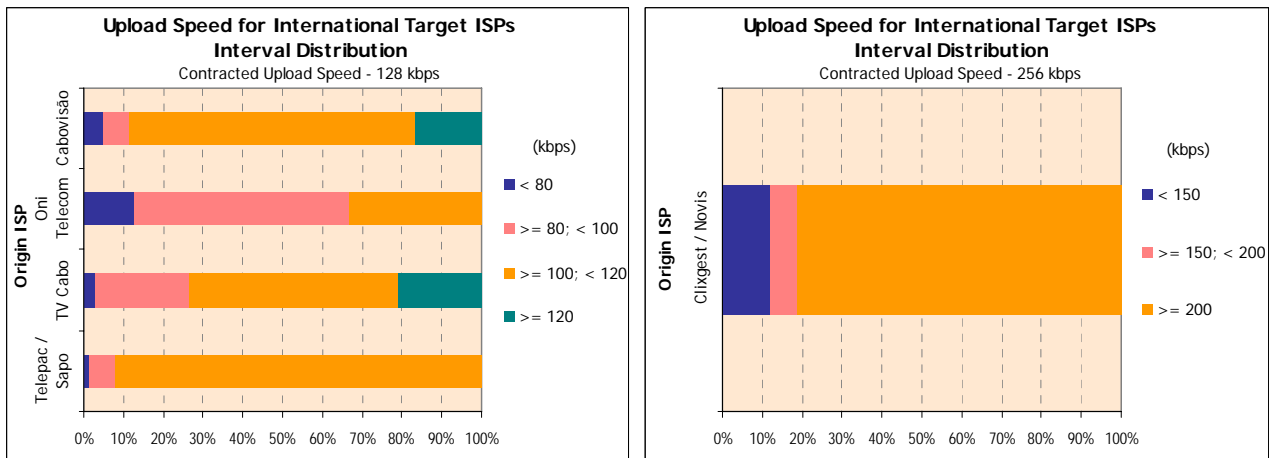


Figure 13 – Upload speed interval distribution (FTP), for international target ISPs.

In measurements for national target ISPs, highlight goes to Cabovisão, which percentage of measurements in this interval is about 53%, whereas TV Cabo's is around 24%. In the case with international target ISPs, these relative positions are reversed: TV Cabo had the best result, with about 21% of the measurements, against Cabovisão's 17%.

Regarding the lower speed intervals (speeds below 100 kbps) highlight goes, on the negative side, to OniTelecom, which stands for 40% of the measurements in these intervals, for national target ISPs, and around 67%, for international target ISPs.

Regarding ISP Clixgest/Novis (a 256 kbps contracted speed), most measurements had values above 200 kbps, about 85% for national target ISPs and 81% for international target ISPs.

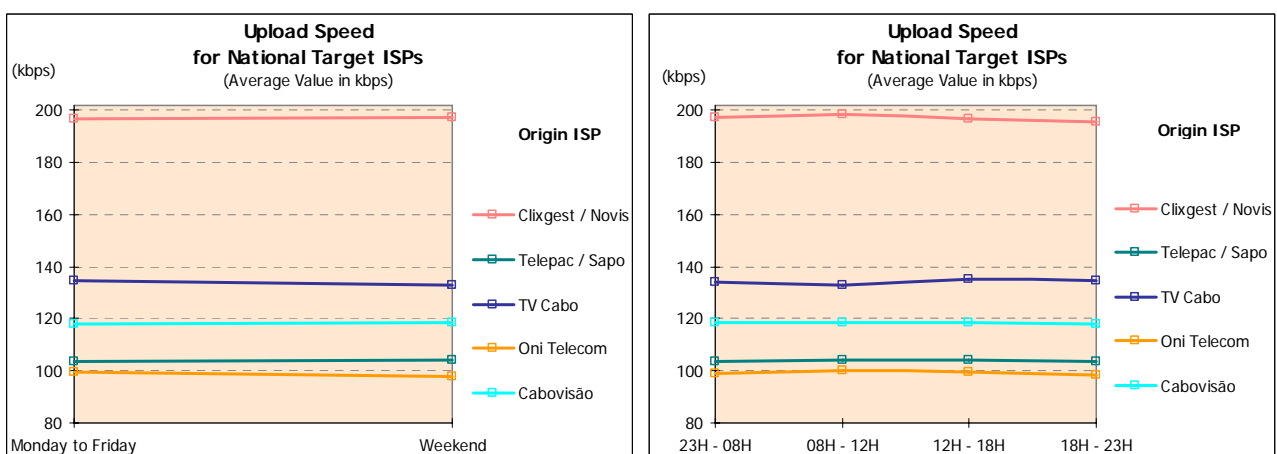


Figure 14 – Average upload speed variation (FTP) by day of the week and hours, for national target ISPs.

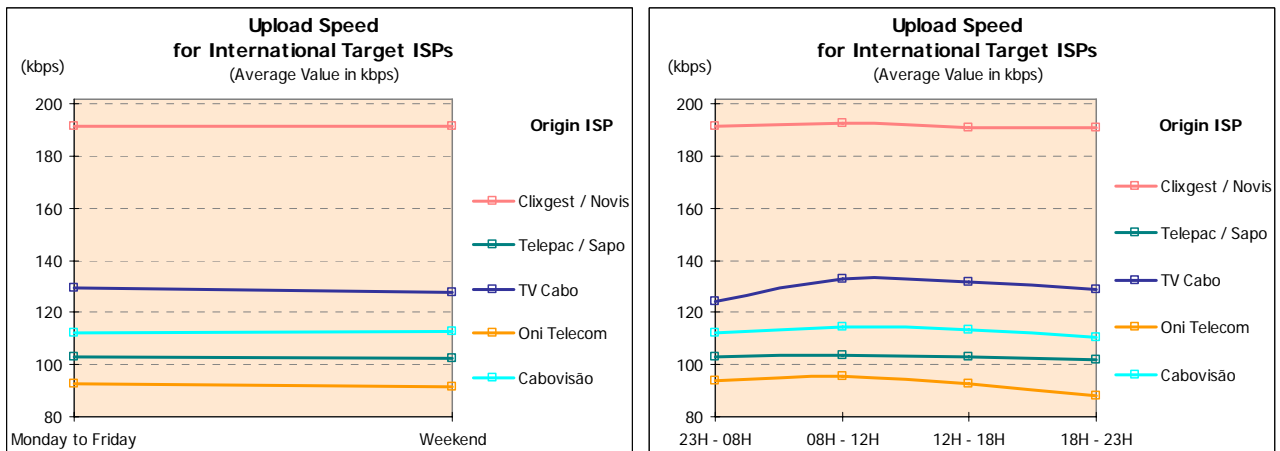


Figure 15 – Average upload speed variation (FTP) by day of the week and hours, for international target ISPs.

Regarding the variation in the FTP upload speed indicator, none of the analysed ISPs showed important variations by day of the week, hour of the day or location of the target ISP.

Another test made was the Ping one, which measured the line's latency, i.e., the communication's instantaneity, which is particularly relevant when using interactive applications (online games, for example). The analysed indicator was the Ping Time.

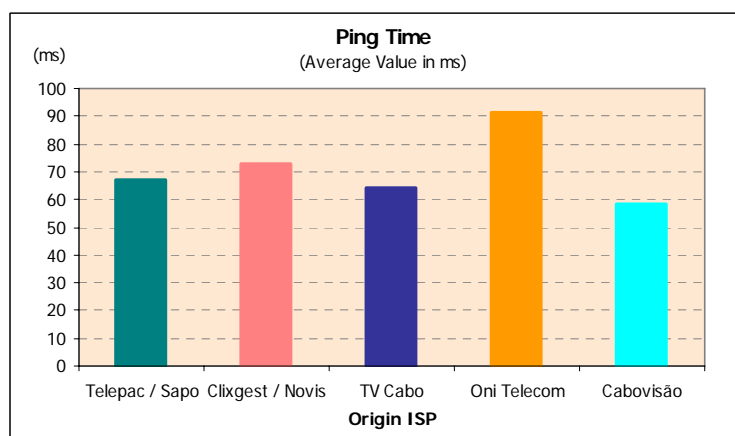


Figure 16 – Average ping time

ISP Cabovisão had the best result for the average ping time, with the lowest value (around 58 ms). The highest average value (around 91 ms) was registered by ISP OniTelecom.

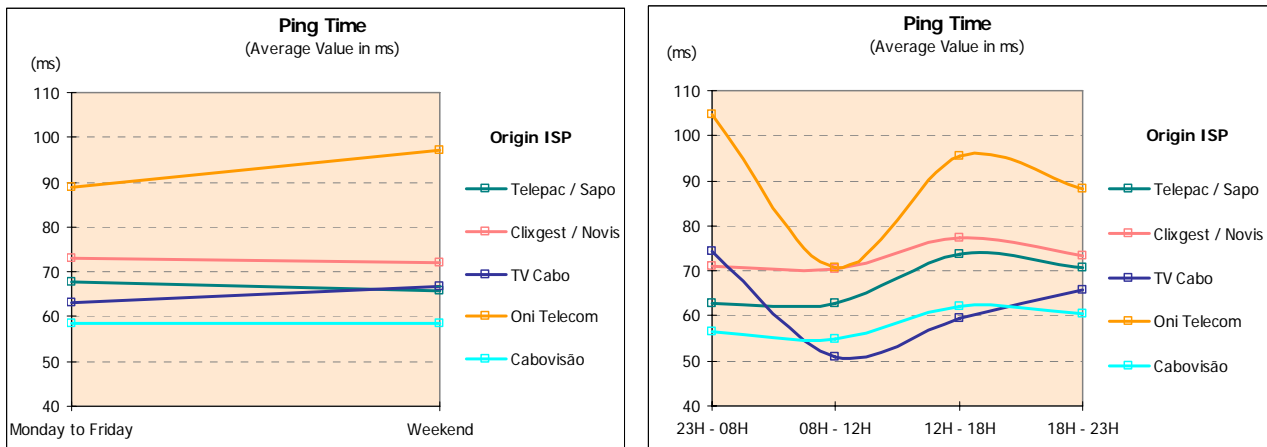


Figure 17 – Ping time variation by day of the week and hours.

When analysing the variation in this indicator by days of the week, operators OniTelecom and TV Cabo show slight degradations on the weekend. For the remaining operators, the indicator remains practically unchanged.

Regarding the hourly variation, the worse values for operators OniTelecom and TV Cabo occurred during dawn (23h00 to 08h00 period), while, for the remaining operators, they occurred in the afternoon period (from 12h00 to 18h00).

The tests also showed that, in some situations, traffic among national origin and national target ISPs was carried through international routes.



## 1 INTRODUCTION

For the first time, ICP - Autoridade Nacional de Comunicações (ANACOM) made a study on the quality of the Internet access services in Portugal, from a user's standpoint.

The study was prepared and made in partnership with CONVEX – Consultoria e Integração de Sistemas, Lda. and MARKTEST – Marketing, Organização, Formação, Lda.

FCCN - Foundation for National Scientific Computation, APRITEL - Telecommunications Operators Association and IC - Institute of the Consumer, were also involved in this study and their suggestions and critical opinions were considered in the definition of the study's methodology.

An Internet access service is defined as the ability to connect to the Internet network using a certain data upload and download speed. Normally this service is provided by an ISP that, besides basic services of data connection, transmission and reception (access to websites, e-mail, etc.), may also offer additional services (mail boxes, site hosting, etc.). This study intended to analyse only the basic services (connectivity and data transport – datagram sending and receiving).

A first phase of the study analyzed the narrowband (Dial-Up) offers to the home market by Portuguese ISPs.

This second phase of the project analyzed the broadband (ADSL and Cable) offers provided by Portuguese ISPs, also to the home market.

The option for this market segment stems from the recognition that it is the one mostly in need of the regulator's follow-up in order to safeguard its interests.

The study analysed the 5 major (3 biggest ADSL and 2 biggest Cable) Portuguese ISPs with offers to the home market, standing for 90% of the market.

The decision on which commercial offer to analyse per operator took into account its weight on each ISP's home portfolio – the option went for the offer with the highest number of clients.

Table 2 – Analyzed operators for Broadband technologies

Technology		Throughput	ISP
Broadband	ADSL	2 Mbps <i>Download</i> 128 kbps <i>Upload</i>	Telepac/Sapo
		2 Mbps <i>Download</i> 256 kbps <i>Upload</i>	Clixgest/Novis
		512 kbps <i>Download</i> 128 kbps <i>Upload</i>	OniTelecom
	Cabo Cable	2 Mbps <i>Download</i> 128 kbps <i>Upload</i>	TV Cabo
		512 kbps <i>Download</i> 128 kbps <i>Upload</i>	Cabovisão

The indicators used to evaluate the Internet access service are Efficiency Indicators, through which data upload and download abilities (HTTP and FTP) are evaluated. The aim was to measure parameters in a situation of access to a common web page, located on the data centres of the several ISPs under analysis and on two international data centres (located in the United States of America).

For the making of this project, an Internet user test panel was specifically set up targeted at representing the dispersion of results both in geography and in time. It was used to make the required measurements – the sample units of this study. Every computer used by the members of the panel, where the software agent specially created for this study was installed, had the previously defined minimum requirements, so that they would not become an Internet access limitative factor.

The studies “Bareme-Internet” and “NetPanel”, already made by partner MARKTEST, were used to set-up this panel’s sample. These are reference studies for the Portuguese market, allowing, among other things, to characterize the Portuguese Homes (Mainland Portugal) regarding the Internet and to know the behaviour of Portuguese Internet users when browsing at home.

Measurements were made by a computer application (software agent) developed for this purpose and installed on the personal computers of the members of the test panel set up for this study. The software agent is automatically activated, on predetermined time periods, and its function is to log in to the ISP, service provider for each computer of the panel, to access the data centres of the analysed operators and of the two international ones, and to operate the required tests.

The software agent depends on a central platform responsible for controlling the agents and for storing and processing all the information.

It was essential to this study that all operators were under the exact same circumstances, i.e., that the number of measurements performed from each ISP under analysis was the same as from the remaining ones. As the sample (in fact) used had some unbalances among operators, the collected data was subject to a weighting scheme.

On HTTP tests, and only concerning the download speed for sites hosted by national ISPs, the option was to add another factor to the weighting scheme already in place. Since all HTTP tests try to recreate a browsing experience identical to reality, destination ISPs were weighted taking into account the weight that these have in Internet browsing at home.

Several factors can influence data upload/download throughput for Internet browsing, namely processing delays introduced in the access equipment, such as the use of personal firewalls and anti-virus; the machines' capacities, types of browsers (browser versions, etc.); factors inherent to the operator's network (caching, sizing of peering lines, access technology, etc.) and visited sites based on platforms with their own performance limitations.

In face of these constraints, the research attempted to eliminate all factors not controlled by the operators or, at least, to evaluate these entities under the exact same conditions (namely, all results were affected by protocol headers and by anti-virus and personal firewalls delays) so that, even if it was not possible to reach a perfect information, at least it was possible to reach reliable conclusions regarding the operators' performance. Resulting from this was, for example, the use of (as much as possible) the same access equipment, the elimination of caching mechanisms (which can bias the upload/download speeds' real results) and the creation of specific websites and FTPs in order to perform the tests.

## 2 METHODOLOGY

### 2.1 UNIVERSE, SAMPLE AND RESULTS

#### 2.1.1 UNIVERSE

This study's universe was made up of Mainland Portugal's homes with at least one resident accessing the Internet from home and using a broadband offer by at least one of the following ISPs (Internet Service Providers): Telepac/Sapo, Clixgest/Novis, TV Cabo, OniTelecom and Cabovisão.

#### 2.1.2 SAMPLE

##### 2.1.2.1 SAMPLE DEFINITION

For a study with these characteristics, a panel of 100 homes under the above mentioned conditions (2.1.1 Universe) was considered large enough, considering that in each of the panel's homes several measurements would be made, thus minimizing error. This study does not consider people's behaviour, but rather the several situations in which a connection occurs, taking into account the region where the connection is established and the hour at which that happens.

A non-proportional sample of 100 homes was defined for this study, all equally distributed by ISP used in the setting of broadband connections, as shown on the matrix of the following table:

Table 3 – Sample by ISP

<b>ISP</b>	<b>No. of Homes</b>
Telepac / Sapo	20
Clixgest / Novis	20
TV Cabo	20
OniTelecom	20
Cabovisão	20
<b>TOTAL</b>	<b>100</b>

A proportional dispersion of the sample within the Region variable was also proposed, as shown on the matrix of the following table:

Table 4 – Sample by Region

Region	No. of Homes
Greatest Lisbon	35
Greatest Porto	20
Coastline	33
Inland	12
<b>TOTAL</b>	<b>100</b>

The Region variable is made up of the following aggregations:

- **Greatest Lisbon** (includes the communes of Almada, Amadora, Cascais, Lisbon, Loures, Odivelas, Oeiras and Sintra);
- **Greatest Porto** (includes the communes of Gaia, Gondomar, Maia, Matosinhos, Porto, and Santa Maria da Feira);
- **Coastline** (includes the communes of the Aveiro District, excluding the communes of Arouca, Castelo de Paiva, Sever do Vouga and Vale de Cambra; communes of the Braga District: Barcelos, Braga, Esposende, Guimarães, Vila Nova de Famalicão and Vizela; communes of the Coimbra District: Cantanhede, Coimbra, Condeixa-a-Nova, Figueira da Foz, Mira, Montemor-o-Velho and Soure; communes of the Porto District: Póvoa do Varzim, Santo Tirso, Trofa, Valongo and Vila do Conde; communes of the Viana do Castelo District: Caminha and Viana do Castelo; the communes of the Leiria District, excluding Alvaiázere, Ansião, Castanheira de Pêra, Figueiró dos Vinhos and Pedrogão Grande; the communes of the Lisbon District, excluding Amadora, Cascais, Lisbon, Loures, Odivelas, Oeiras and Sintra; the communes of the Santarém District, excluding Almeirim, Alpiarça Benavente, Chamusca, Coruche, Ferreira do Zêzere, Mação, Salvaterra de Magos and Sardoal; communes of the Setúbal District: Barreiro, Moita, Montijo, Seixal, Sesimbra and Setúbal and all the communes of the Faro District);
- **Inland** (includes all the remaining communes of Mainland Portugal).

The following final sample used to collect information:

Table 5 – Non-proportional sample by ISP and by Region

ISP	No. of Homes	Region	No. of Homes
Telepac/Sapo	32	Greatest Lisbon	45
Clixgest/Novis	22	Greatest Porto	30
TV Cabo	21	Coastline	40
OniTelecom	29	Inland	14
Cabovisão	25	<b>TOTAL</b>	<b>129</b>
<b>TOTAL</b>	<b>129</b>		

After the data was collected, results from 7 homes were eliminated from the sample, as they were considered outliers, as described in section 2.1.4.2 (Quality Control of Results) of this document.

#### 2.1.2.2 SAMPLE SELECTION METHOD

The recruited homes were selected according to the ISP used and the Region where they are located, by using:

- Existing Data Bases;
- Direct recruitment made by telephone.

Homes with residents working at ICP - ANACOM or at an ISP, even if the latter was not analysed in this study, were not accepted to this study's sample.

The cooperation of the individual responsible for the maintenance of the computers in each of the homes was requested. In homes with more than one individual with this function, the one revealing greater knowledge and interest for these areas was chosen.

In each home, only one machine (personal computer) would be selected to perform the tests and it fulfilled the requirements detailed in section 2.2.3 (Software Agent Specifications).

Each home was recruited for the time of the survey. Whenever there were withdrawals or deficiencies in the cooperation, another home with the same characteristics defined in the sample matrix would be recruited.

## 2.1.3 DATA COLLECTION

### 2.1.3.1 COLLECTION PERIOD

Data collection for this second phase took place between 23/09/2005 and 23/10/2005.

### 2.1.3.2 PROCEEDINGS

Each member of the test panel was asked to install in the selected machine a computer programme - software agent – responsible for performing the Internet access tests.

Whenever a measurement had to be made, the member of the test panel would be reached by telephone or e-mail and notified of the need to leave both the PC and the modem on so that the tests could be started.

At the sample points (homes), measurements were performed every day of the week and at different time periods. The distribution of time periods was made based on the audience curves provided by MARKTEST's NetPanel study.

The strongest differences in the curves were registered between week days and the weekend, and thus the following time distribution was made for the measurements:

Table 6 –Time distribution of measurements

<b>Time Periods</b>	<b>Days</b>	<b>Week Days</b>	<b>Weekends</b>
From 08h00 to 10h00		✓	✓
From 10h00 to 12h00		✓	✓
From 12h00 to 16h00		✓	✓
From 16h00 to 18h00		✓	✓
From 18h00 to 20h00		✓	-
From 18h00 to 21h00		-	✓
From 20h00 to 21h00		✓	-
From 21h00 to 23h00		✓	✓
From 23h00 to 01h00		✓	✓
From 01h00 to 04h00		✓	✓
From 04h00 to 08h00		✓	✓
<b>TOTAL</b>		<b>10</b>	<b>9</b>

Each of the machines selected for the test (or each of the panel's homes) made 10 measurements on each week day and 9 measurements on each weekend day, throughout the collection period (in each home and on each week, a measurement was made on a different week day), on each machine selected for the test. From this would result a total of 6,800 measurement sets<sup>1</sup>, taking into account a theoretic value of 100 homes on the sample.

During this period of time, the software ran automatically (without the user's intervention), on the time intervals considered adequate and when the machine was not in use. The software would detect if the machine was being used and, in that case, would send a pop-up alerting the test panel user to free the machine due to the need to perform a measurement. Exceptions occurred when the test panel member was asked to activate the application.

## 2.1.4 DATA PROCESSING

### 2.1.4.1 WEIGHTING

It was considered essential for this study that all operators would be analysed under equal circumstances, i.e., 1,360 measurement sets should be made from each analysed ISP.

The weighting was made using the Rim-Weighting process and included the following variables and crossings:

Table 7 – Variables and crossings used in data weighting

Tests	HTTP	FTP Download	FTP Upload	Ping	Traceroute
Origin ISPs (ISPs)	✓	✓	✓	✓	✓
Time Bands (TB)	✓	✓	✓	✓	✓
Week Days	✓	✓	✓	✓	✓
Regions	✓	✓	✓	✓	✓
Target ISPs (Targets)	✓	✓	✓	✓	✓
Target ISPs (Targets) + ISPs	✓	✓	✓	✓	✓
Week Days + Time Bands	✓	✓	✓	✓	✓
Week D. + TB + ISPs	✓	-	-	✓	✓
Week D. + TB + Targets	✓	-	-	✓	✓
Week D. + TB + ISPs + Targets	✓	✓	✓	✓	✓
Week D. + TB + Regions	✓	✓	✓	✓	✓
Week D. + TB + Regions + Targets	✓	-	-	✓	✓

<sup>1</sup> 1,360 measurement sets for each analyzed ISP, which totals 6,800 measurement sets for the 5 analyzed ISPs. Considering the making of crossed tests between origin and target ISPs, the numbers of measurements are multiple of the first one. For example, considering the crossings between 5 origin ISPs and 7 target ISPs the number of measurements totals 47,600.



This is an interactive process that weights the observations in such a way that their sum reaches the desired proportion for each pre-defined cell. It is then said that the weighting system has reached its optimal.

On HTTP tests, and only regarding the table with the download speed in a normal browsing experience, for sites hosted by national ISPs the option was do add another factor to the weighting already made. Since all HTTP tests try to recreate a browsing experience identical to reality, destination ISPs were weighted taking into account their weight in home Internet browsing. For this purpose, results from MARKTEST's NetPanel study were used.

An analysis to the browsing habits of Portuguese people shows that the most accessed websites are not proportionally hosted by the several Portuguese ISPs and thus the research tried to identify this proportion.

A top 1000 site list (based on Unique Users<sup>2</sup>) was extracted from a NetPanel's ranking for the month of June, and the ISPs hosting each of these sites were found.

After classifying the sites by target ISP (the hosts of the websites), and taking into account the number of pages consumed at the NetPanel, each was given a weight.

This analysis was also made for the first phase (dial-up) of this study, but the criterion and weights were kept for this second phase, since it was concluded that the possible differences existing in more recent time periods are not relevant enough to cause changes to the proportions found.

Table 8 – "Weight" of each ISP

ISP	%
Telepac / Sapo	53.3
Clixgest / Novis	29.8
OniTelecom	9.6
TV Cabo	6.1
Cabovisão	1.2
<b>TOTAL</b>	<b>100</b>

---

<sup>2</sup> "Unique User": estimated number of different individuals that accessed a site on the Internet, during the period chosen for analysis. No duplication of individuals occurs.

Target ISPs in this study (shown on Table 8) are representative of the national traffic since, according to NetPanel's data, they make up around 81% of the traffic to sites hosted by national ISPs.

Since sites hosted by International ISPs were not included in this analysis, the results of the measurements made for the international target ISPs were not subject to this kind of weighting.

#### 2.1.4.2 QUALITY CONTROL OF RESULTS

Quality control of the processed data includes the identification of outliers that are not necessarily undesirable, in spite of being odd regarding the majority of results obtained on a certain sample. It is fundamental to identify them and place them on possible error lists, for later analysis. Should they clearly distort results and not be relevant, they are erased.

On a first analysis of the results obtained by home, 7 homes were erased from the sample, since the values obtained were clearly considered outliers. The following table shows the number of homes excluded from the sample, by ISP and exclusion motive.

Table 9 – Homes excluded from the sample, by ISP and Exclusion Motive

ISP	Number of Homes	Exclusion Motive
Telepac/Sapo	3	Global results <b>strongly below</b> what was foreseen regarding the contracted speed
Clixgest/Novis	2	Global results <b>strongly above</b> what was foreseen regarding the contracted speed
TV Cabo	2	Global results <b>strongly below</b> what was foreseen regarding the contracted speed
OniTelecom	0	
Cabovisão	0	
<b>TOTAL</b>	<b>7</b>	

These homes' results seem to reveal that the speeds they were given were not the contracted ones. In order to eliminate any doubts regarding the contracted speed, all members of the test panel were asked to send over the invoices from their ISPs, whenever these were clear regarding the speed contracted with the operator. Should the invoice not be clear enough, the operator was contacted by phone to verify the speed that had been given to each home.

In the case with the two ISP Clixgest/Novis' client homes, all measurements registered speeds above 2 Mbps, and over 60% of them showed speeds above 3 Mbps, which seems to show that they had 4 Mbps maximum

speeds, contrarily to what is stated on the operator's invoices.

For client homes of ISP Telepac/Sapo, all measurements seem to show that these homes did not migrate from their previous 512 Kbps speed, which is contrary to the information provided by their own operator.

For client homes of TV Cabo, all measurements registered speeds above 640 kbps which, as with the previous case, seem to show that these homes did not migrate from their previous 512 Kbps speed, which is contrary to what the operator had announced. When these tests were made, the operator had announced that it had already made automatic migrations for all its clients

Regarding the analysis of the test sets to the homes included in this study, it started with an outlier analysis based on a method called *box plots with fences*, which identifies the extremes values that may be eliminated after being analysed.

Since the dispersion of results is very high for some operators, it was considered that the large number of extreme values identified using the above-mentioned method were not isolated situations, and therefore they were kept in the data series. Only tests with very extreme results were excluded.

### 2.1.5 PRECISION OF THE RESULTS

Precision errors of the global results are always inferior to 3%, for a 95% confidence level.

Tables showing precision errors of the analyzed variables are part of an annex to this study.

## 2.2 TECHNICAL ARCHITECTURE, OPERATING MODE AND COMPONENT DETAIL

### 2.2.1 GLOBAL OPERATING MODEL

Evaluation of the Internet access quality was made by collecting indicators, by a software agent, during the access to a standard web page hosted at the several ISPs' data centres.

The software agent was previously installed on the computers of a user test panel targeted at representing the dispersion of results both in geography and in time, and which was automatically activated on the predefined time periods. On isolated occasions the agent was activated by the panel member, as a way to overcome possible failures or to make further measurements.

The function of the agent was to connect to the service provider operator, access the data centres of the analysed operators and of two international ones, and make the necessary tests.

The software agent is not autonomous and depends on a central platform that is responsible for the tests' control and for the storing and processing of all collected data.

Only at the end of each test would the collected data be sent to the central platform, in order to avoid interferences in the results. The data would be locally registered and, at the end of each test, the agent would connect to the central platform's collection server and send the data. Data was sent encrypted in order to guarantee safety and integrity. This method is already used by MARKTEST on the NetPanel study using the NOL application.

Communication between the agent and the data collection server was assured by web services. Data was stored at a relational DBMS (database management system).

An additional website was created for every test panel member to adjust the test calendar, depending on their availability. This website also made it possible to refer to the calendar of the already made tests and to send and receive messages.

## 2.2.2 MEASURED PARAMETERS

**Efficiency Indicators** were used for this phase of the study, in order to evaluate the data upload and download abilities (HTTP and FTP) and to measure parameters on a situation of access to any given Internet area.

**User's perception of download – http:// (kbps):** Access by the client's PC to the standard website located on the operators' data centres.

In order to make this measurement and allow HTTP access to the site, the Windows' Wininet layer was used, thus emulating the behaviour of a browser. For each of the five pages of the standard website, it was firstly made a request for the HTML file and, later and simultaneously, a request for the several images related to that file.

**User's perception of download – ftp:// (kbps):** Access by the client's PC, via FTP, to a (binary) file at the operators' data centres.

For testing purposes, a 1MB (binary) file was used, placed at the data centres of the analysed operators and at the two international data centres.

**User's perception of upload – ftp:// (kbps):** Upload of a binary file, via FTP, to the operators' data centres.

A 0.5 MB binary file was used in the tests.

Crossed FTP tests were made when the operators had FTP servers allowing them, both when downloading and when uploading data. Only operators Telepac/Sapo and TV Cabo did not allow these crossed tests. This situation is seen on the tables presenting the results of FTP download and upload crossed tests.

Download and upload were not tested simultaneously, in order to avoid degradation of the transfer rates. This happens because some upstream traffic, namely *acknowledges* (ACKs), is generated during a download. Although it is in small quantity, this traffic must be sent with the minimum possible delay so that the TCP/IP mechanisms keep the maximum speed supported by the channel. Should additional upstream traffic be generated during a download, there is the risk of delaying the sending of ACKs. Consequently, the uploading machine will conclude that the upload is faster than possibly registered by the receiver. In response to this situation, it will slow down the upload. This situation is further accentuated in asymmetric connections (e.g. Dial-Up, Cable and ADSL), since the upstream bandwidth is larger than for downstream.

**Ping (ms): Ping (ms):** ICMP ECHO to the standard page (measurement of the latency between the user and the standard page's site).

### 2.2.3 SOFTWARE AGENT SPECIFICATIONS

A software agent in C++ programming language guaranteeing platform evolution was created for this study. The operating architecture is Client/Server, and the agent is placed on the client's side.

The application was developed in a way as to be sent to each test panel member, incorporating a unique panel member identification code. A setup was created for the automatic installation of the application. The application was distributed to the panel members by e-mail and/or by download from the web area created for that purpose on the central platform.

At the moment of installation, a unique machine identification code was generated. The combination of the unique identification codes of the test panel member and of the machine leads to detecting undesired installation of the application on multiple computers and the consequent tampering of the collected data.

During the periods that were defined for data collection, the elements of the Broadband test panel were instructed and contacted to keep their computers on so that the software agent could establish a connection to the Internet and perform the necessary tests.

The software agent was responsible for the operation of the Efficiency Indicators tests:

- User's perception of download (http://);
- User perception of download (ftp://);
- User perception of upload (ftp://);
- Ping;
- Traceroute.

Whenever a measurement was not made due to non compliance with all the requirements imposed on test panel members, the panel member would be notified of the date of the new measurement to be made.

The data collected by the software agent would be sent to the central platform at the end of each test. This data was tagged with its origin, collection date and hour.

In order to assure that the time of all measurements had the same referential, the software agents installed at the panel members' PCs synchronized the internal watches of the application with the NTP servers provided by FCCN, at the beginning of each measurement.

The application developed for data collection is not intrusive to the operating system or the applications at the PCs of test panel members, and they run and work in a transparent way.

When the software agent is installed on a machine, it acts in the following way:

- When a connection to the Internet is established, every half hour it accesses a web service to verify when the next test is scheduled and if there are messages for and from the test panel member.
- If the connection is not previously established, every 3 hours it tries to establish a connection and performs the previously described process;
- If the established connection fails, a new connection is attempted after 15 minutes.

Regarding the performed tests, the proceedings were as follows:

- During the recruitment period, all test panel members were sent an application that provided the evaluation of the characteristics of the machines to use on the tests, and all those which did not fulfil the requirements (Intel® Pentium® processor II or higher, 128MB RAM (physical memory) or higher and 1 GB or higher hard disk) were discarded.
- Some days before the data collection started, the test panel member was warned of the study's starting date.
- When the tests were made, the software agent blocked all applications that might be running and produced a report to evaluate the machine's requirements. This report was later evaluated. All tests that took place under an unfavourable situation were eliminated.
- When the software agent tried to start the tests and there was a constraint, the attempt was aborted and a new test was started 5 minutes later, up to a maximum of 10 attempts or until the end of the time period foreseen for the tests.
- When the tests were not successful, the test panel member was alerted and, in situations where there was not enough cooperation to allow the tests to be successful, the home was removed from the test panel and replaced with another one with the same features regarding the selection variables.

The software agent that was developed avoids caching mechanisms at the PC level and was created for NT5+ (Windows NT, Windows 2000, Windows XP and Windows 2003) operating systems. Confirmation was made that the machines of the test panel had one of these systems installed.

The software agent installed at the PCs of the panel members has the capacity to access the standard page and to browse the dimensions described in the applying section, in order to simulate a browsing experience equal to reality (to perform a sequence of *gets*).

## 2.2.4 CENTRAL PLATFORM SPECIFICATIONS

The Central Platform developed for this study is based on 4 servers:

- **Collection Server** – it has a specific built in software, named “Task Coordinator”, and is responsible for the coordination of all data collection. Software agents are not autonomous and depend on this server to perform any task.
- **Database Server** – stores the tests’ schedule and configuration, for each machine in the test panel, and stores the results of the tests. It also holds the register of test panel members, namely contact data, regional characterization, characterization of the machine to use for the test (operating system, processor characteristics, RAM, etc.) and data on the ISP to which each machine is connected.
- **Back Office Server** – the platforms developed for the test panel management and for the production of results are hosted on this server.
- **Web Server** – this server gives the test panel member the possibility to change the task schedule within the time limits defined for the study – and to send and receive messages.

The architecture of the central platform is shown on Figure 18.

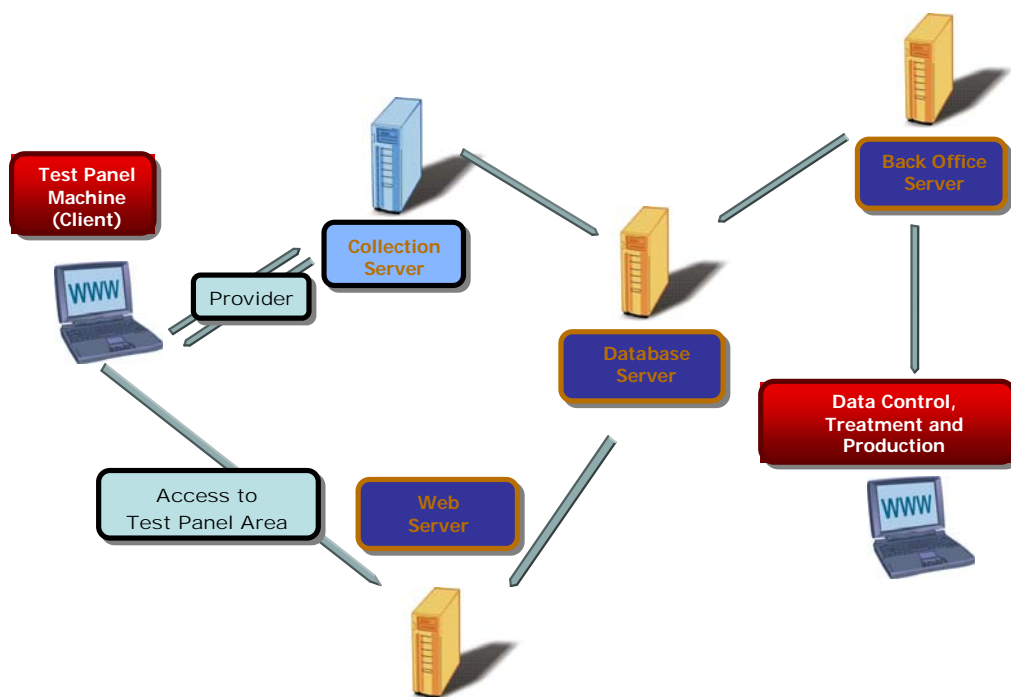


Figure 18 – System Architecture



The software agent is not autonomous and totally depends on the central system. It communicates with the collection server, which in turn uploads to it the configurations of each test (the agent does not store configurations).

Before starting any task, the agent first accesses the collection server in order to verify if the latter has any tests to perform. After that, it requests authorization to perform the test and the corresponding tasks (measurements). The task coordinator does not assign the tasks sequentially, so that it does not overload the FTPs/sites involved in these measurements.

For each task, the task coordinator gives detailed specifications for the making of the measurements – sites/servers/FTPs to use.

At any moment it is possible to make the adjustments considered necessary.

When all measurements of each test are finished, the task terminator determines that the test was successfully performed and informs the agent that the test being performed has ended.

The collection server is responsible for the deactivation of the agents, when all tests are ended or when the decision is made to deactivate a machine in the panel.

All communication between the software agent and the collection server is encrypted.

The Database server is the core of the central platform, and interacts with the remaining servers. It stores and provides all information needed for the making of the study, namely:

- test scheduling and configuration, for each machine on the test panel.
- results of the tests;
- register of the test panel members' data, such as contact data, regional characterization, characterization of the machine to be used in the test (operating system, processor characteristics, RAM, etc.) and data on the ISP to which each machine is connected.

### 2.2.5 STANDARD WEB PAGE

The standard web page is made up of an initial web page and secondary pages on separate pages. It is placed at a web server on the data centres of each analysed operator and also in two international (United States) data centres, and the access speed is sized in such a way that it does not become a bottleneck in

connection with this study.

The page complies with the standards in force at W3C. The home page is based on a mix of images and text. Several (four) links are associated to this dimension, giving access to further data, and each of these sections is on separate web pages, each one of them with text and images.

The size of the several pages is as follows:

<b>Size (bytes)</b>	<b>File</b>
3,181	/pagina1.htm
43	/images/imagen.gif
16,793	/images/imagen2.jpg
31,615	/images/imagen3.jpg
79,931	/images/imagen4.jpg
4,304	/pagina2.htm
24,313	/images/imagen5.jpg
2,885	/pagina3.htm
67,131	/images/imagen6.jpg
17,769	/images/imagen7.jpg
17.198	/images/imagen8.jpg
4,080	/pagina4.htm
24,618	/images/imagen9.jpg
3,785	/pagina5.htm
37,895	/images/imagen10.jpg

The software agent accesses the standard page and browses the above described dimensions, in order to simulate a browsing experience identical to the real one, as if by a typical Internet user (perform a sequence of *gets*).

#### 2.2.6 STANDARD FTP FILE

A (binary) file of the following sizes was used:

- 1 MB for the download
- 0.5 MB for the upload

On each situation, the file was automatically generated.

### 3 RESULTS

#### 3.1 NETWORK EFFICIENCY INDICATORS

##### 3.1.1 USER'S PERCEPTION OF HTTP DOWNLOAD

###### 3.1.1.1 NATIONAL TARGET ISPS

###### 3.1.1.1.1 AVERAGE DOWNLOAD SPEED

Download Speed of All Pages (Average Value in kbps)						
Measurements for National Target ISPs* (kbps)						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	1,031.41	933.98	994.68	313.15	306.05
	Weekend	1,076.48	975.31	1,020.18	313.99	299.26
<b>Hours</b>	23H - 08H	1,052.35	960.40	906.47	298.46	306.45
	08H - 12H	1,093.28	973.32	1,348.93	349.23	324.92
	12H - 18H	1,006.94	902.10	992.46	300.22	306.28
	18H - 23H	1,023.40	938.42	856.94	313.11	285.09
<b>TOTAL</b>		<b>1,043.34</b>	<b>944.92</b>	<b>1,001.43</b>	<b>313.37</b>	<b>304.25</b>
<b>BASE</b> (N° of measurements for Nat. Targ. ISPs)		6,800	6,800	6,800	6,800	6,800

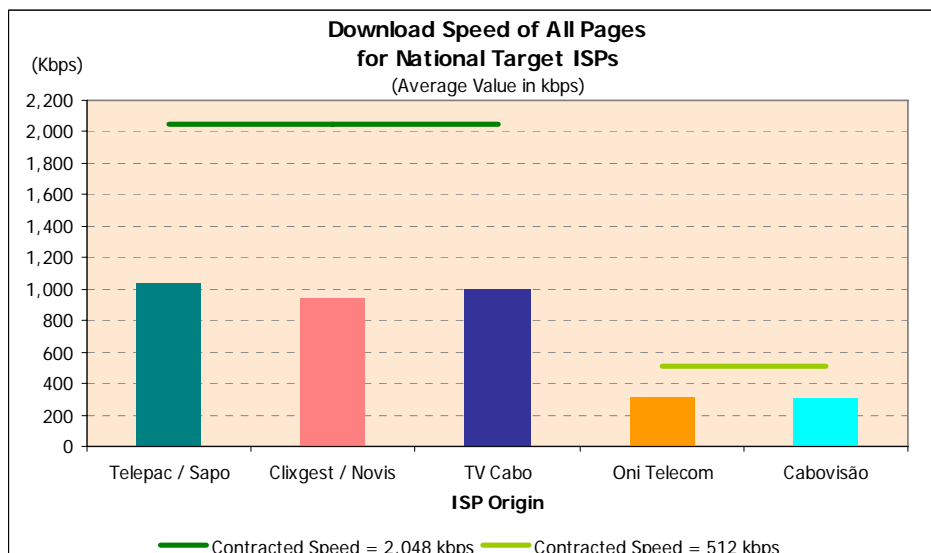
\* This table had special weighting (see methodology)

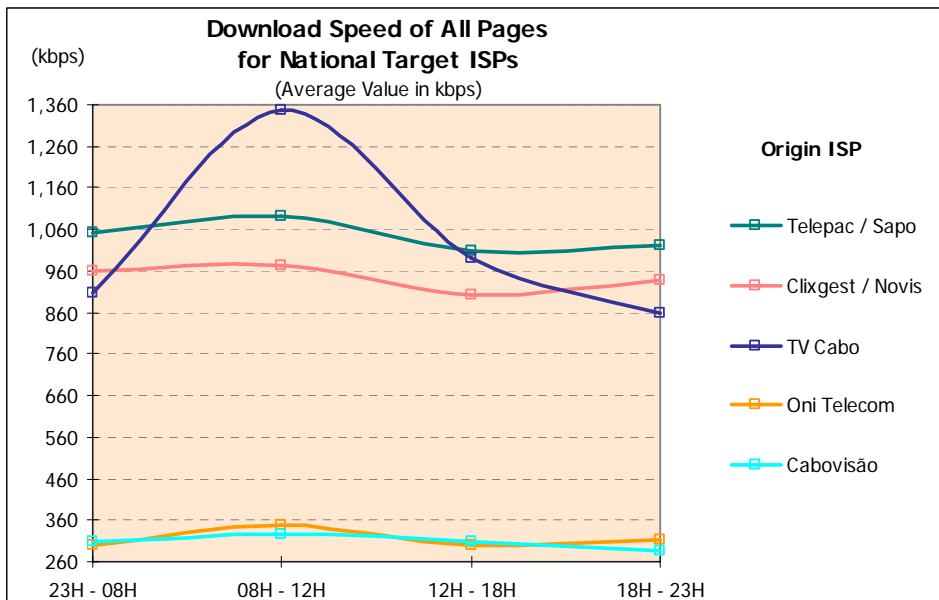
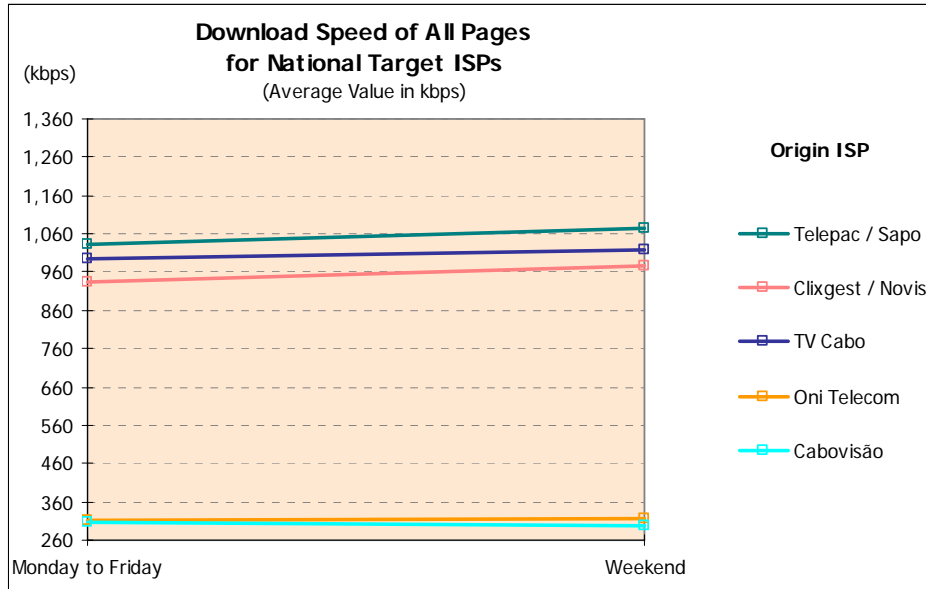
Download Speed of All Pages: Loading speed of a full micro site (5 pages and their images) (kbps)

#### Explanatory Notes for Reading the Table (ENRT):

In 6,800 measurements of ISP Cabovisão for national target ISPs the average download speed of all pages equals 304.25 kbps;

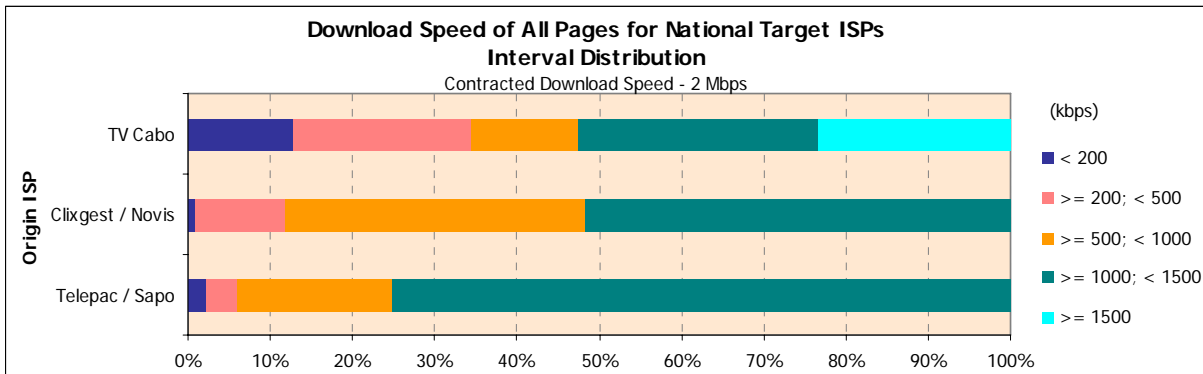
When grouped by weekly period, the average download speed of those 6,800 measurements regarding ISP Cabovisão is 306.05 kbps, for measurements made from Monday to Friday, and 299.26 kbps, for weekends.



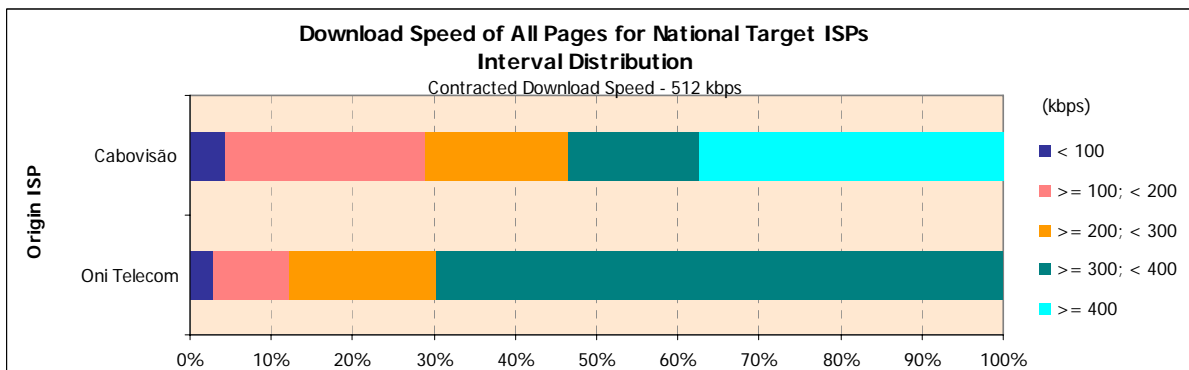


3.1.1.1.2 DOWNLOAD SPEED – INTERVAL DISTRIBUTION

Download Speed of All Pages for National Target ISPs Interval Distribution		Origin ISP					
		Contracted Download Speed - 2 Mbps					
		Telepac / Sapo		Clixgest / Novis		TV Cabo	
		n	%	n	%	n	%
Download Speed of All Pages (kbps)	< 200	155	2.3%	62	0.9%	871	12.8%
	>= 200; < 500	243	3.6%	747	11.0%	1,473	21.7%
	>= 500; < 1000	1,298	19.1%	2,478	36.4%	889	13.1%
	>= 1000; < 1500	5,104	75.1%	3,513	51.7%	1,978	29.1%
	>= 1500	0	0.0%	0	0.0%	1,589	23.4%
BASE (N° of measurements)		6,800		6,800		6,800	



Download Speed of All Pages for National Target ISPs Interval Distribution		Origin ISP			
		Contracted Download Speed - 512 kbps			
		Oni Telecom		Cabovisão	
		n	%	n	%
Download Speed of All Pages (kbps)	< 100	194	2.9%	295	4.3%
	>= 100; < 200	629	9.2%	1,667	24.5%
	>= 200; < 300	1,229	18.1%	1,204	17.7%
	>= 300; < 400	4,747	69.8%	1,098	16.1%
	>= 400	0	0.0%	2,536	37.3%
BASE (N° of measurements)		6,800		6,800	



### 3.1.1.2 INTERNATIONAL TARGET ISPS

#### 3.1.1.2.1 AVERAGE DOWNLOAD SPEED

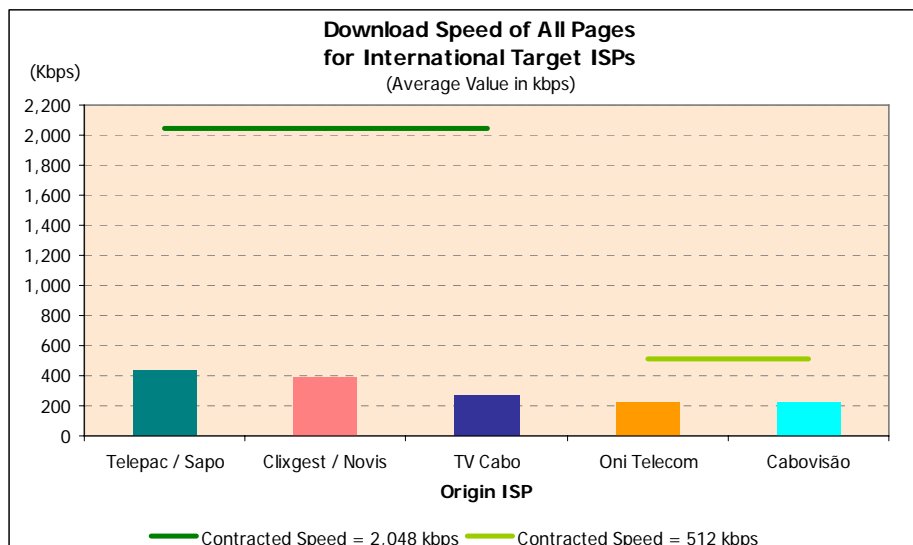
Download Speed of All Pages (Average Value in kbps)						
Measurements for International Target ISPs (kbps)						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	434.83	392.49	267.69	227.58	226.26
	Weekend	429.38	398.85	280.74	217.59	221.22
<b>Hours</b>	23H - 08H	432.84	393.77	178.95	210.26	226.89
	08H - 12H	443.84	399.59	494.52	252.49	253.57
	12H - 18H	441.13	390.81	298.99	227.24	226.91
	18H - 23H	420.57	393.12	187.93	219.16	200.17
<b>TOTAL</b>		<b>433.38</b>	<b>394.18</b>	<b>271.14</b>	<b>224.94</b>	<b>224.92</b>
<b>BASE</b> (Nº of measurements for Intern. Target ISPs)		2,720	2,720	2,720	2,720	2,720

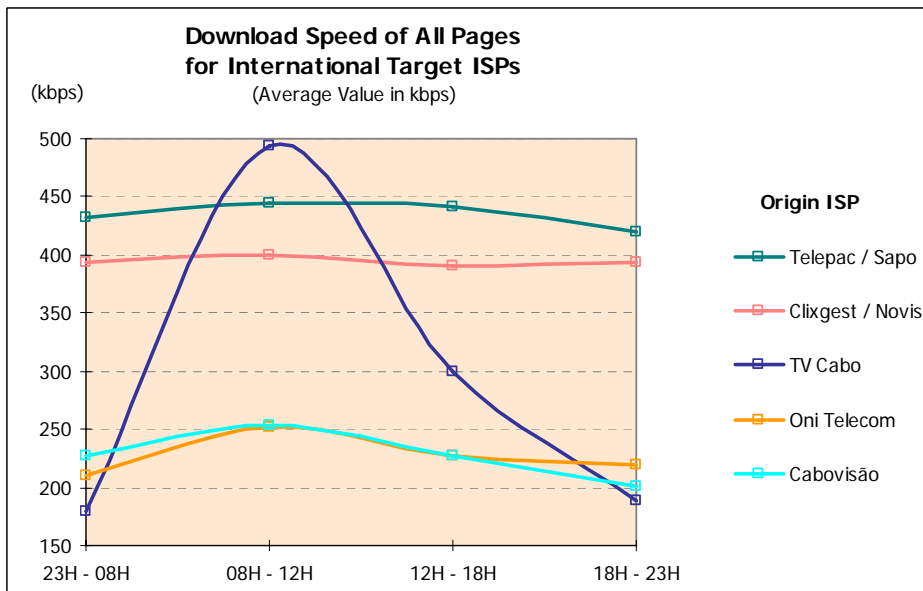
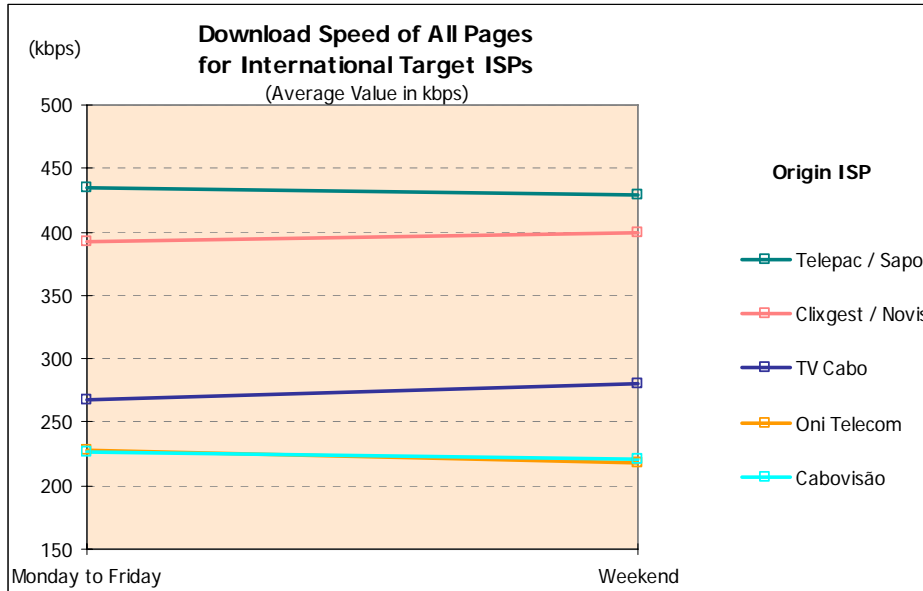
Download Speed of All Pages: Loading speed of a full micro site (5 pages and their images) (kbps)

#### Explanatory Notes for Reading the Table (ENRT):

In 2,720 measurements of ISP TV Cabo for international target ISPs the average download speed of all pages equals 271.14 kbps;

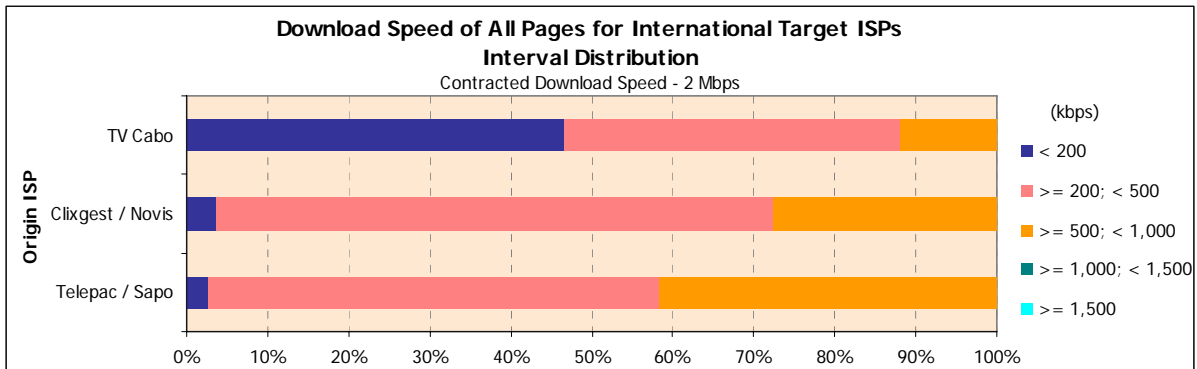
When grouped by weekly period, the average download speed of those 2,720 measurements regarding ISP TV Cabo is 267.69 kbps, for measurements made from Monday to Friday, and 280.74 kbps, for weekends.



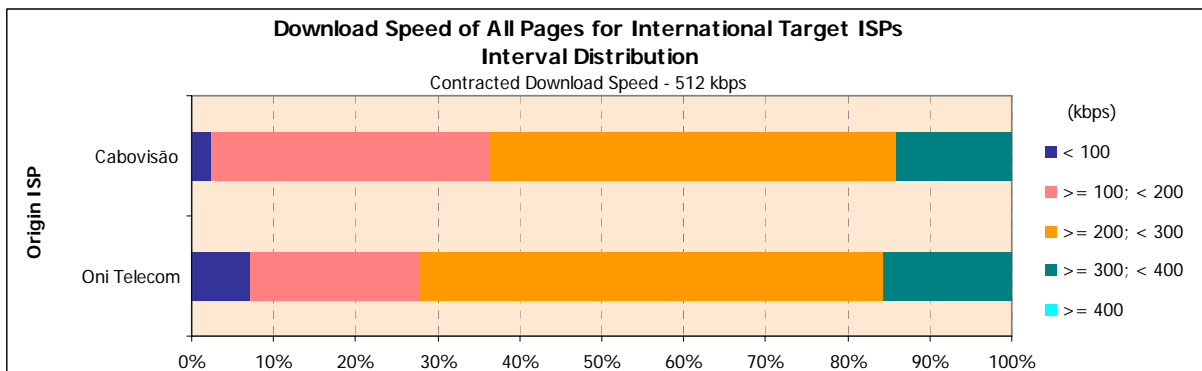


3.1.1.2.2 DOWNLOAD SPEED – INTERVAL DISTRIBUTION

Download Speed of All Pages for International Target ISPs Interval Distribution		Origin ISP					
		Contracted Download Speed - 2 Mbps					
		Telepac / Sapo		Clixgest / Novis		TV Cabo	
		n	%	n	%	n	%
Download Speed of All Pages (kbps)	< 200	72	2.7%	102	3.8%	1,268	46.6%
	>= 200; < 500	1,514	55.7%	1,866	68.6%	1,128	41.5%
	>= 500; < 1000	1,134	41.7%	752	27.6%	324	11.9%
	>= 1000; < 1500	0	0.0%	0	0.0%	0	0.0%
	>= 1500	0	0.0%	0	0.0%	0	0.0%
BASE (Nº of measurements)		2,720		2,720		2,720	



Download Speed of All Pages for International Target ISPs Interval Distribution		Origin ISP			
		Contracted Download Speed - 512 kbps			
		Oni Telecom		Cabovisão	
		n	%	n	%
Download Speed of All Pages (kbps)	< 100	195	7.2%	67	2.5%
	>= 100; < 200	563	20.7%	923	33.9%
	>= 200; < 300	1,535	56.4%	1,351	49.7%
	>= 300; < 400	427	15.7%	379	13.9%
	>= 400	0	0.0%	0	0.0%
BASE (Nº of measurements)		2,720		2,720	





### 3.1.1.3 NATIONAL AND INTERNATIONAL TARGET ISPs

#### 3.1.1.3.1 AVERAGE DOWNLOAD SPEED

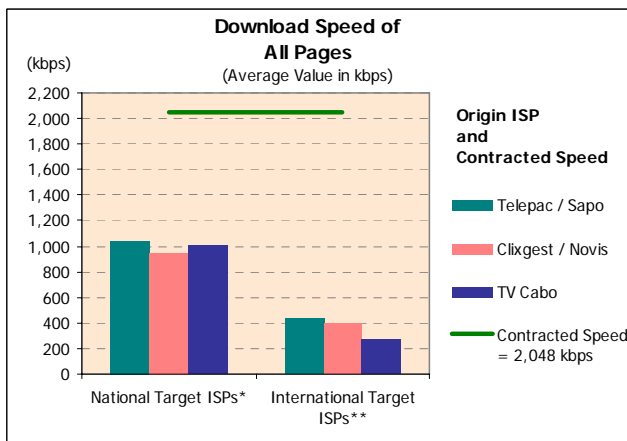
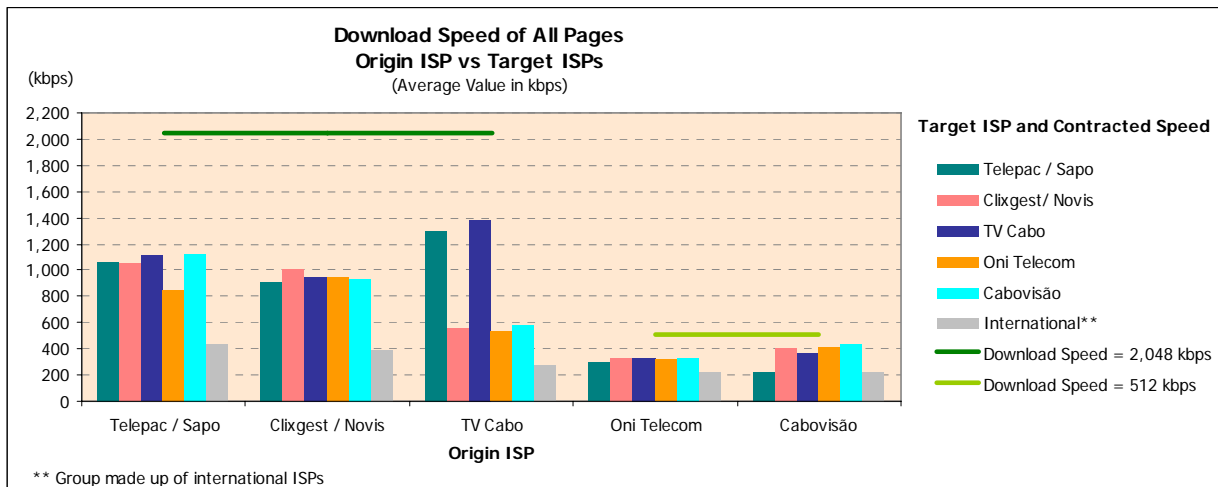
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapó	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
Target ISP	Telepac / Sapó	1,064.63	907.61	1,303.26	301.51	222.25
	Clixgest/ Novis	1,049.98	1,010.96	550.99	328.67	397.69
	TV Cabo	1,110.09	943.30	1,386.93	330.39	367.48
	Oni Telecom	852.20	949.92	534.67	318.38	412.51
	Cabovisão	1,126.63	929.41	574.11	333.40	436.59
BASE (Nº of measurements)		9,520	9,520	9,520	9,520	9,520

\* This table was not subject to the special weighting described in methodology  
 \*\* Group made up of international ISPs

Download Speed of All Pages: Loading speed of a full micro site (5 pages and their images) (kbps)

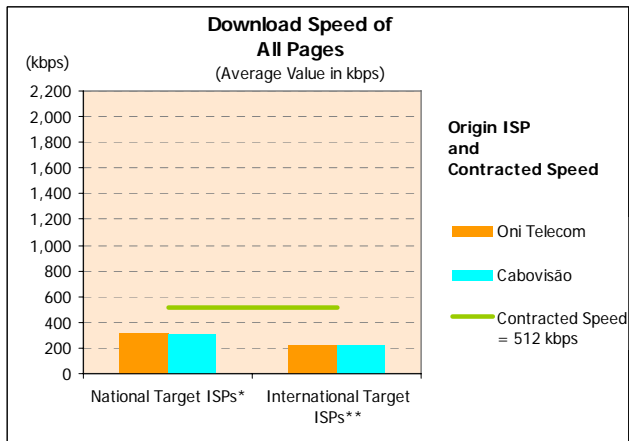
#### ENRT:

As a Target ISP, operator Cabovisão obtained a 929.41 kbps average download speed of all pages when connecting through ISP Clixgest / Novis and 436.59 kbps when connecting through itself.



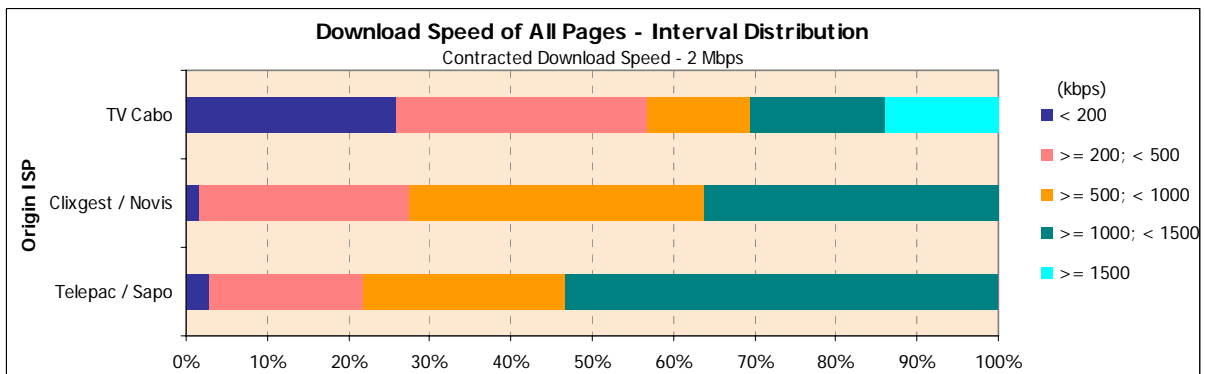
\* Group with special weighting (see methodology)

\*\* Group made up of international ISPs

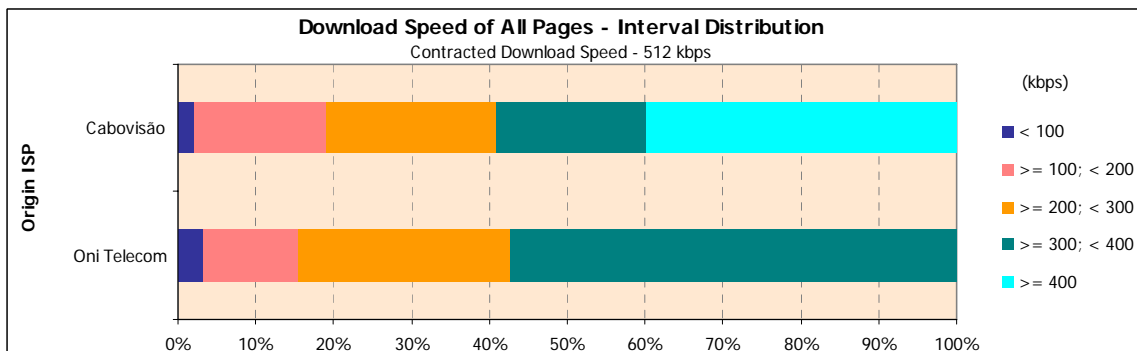


3.1.1.3.2 DOWNLOAD SPEED – INTERVAL DISTRIBUTION

Download Speed of All Pages		Origin ISP					
Interval Distribution		Contracted Download Speed - 2 Mbps					
Download Speed of All Pages (kbps)		Telepac / Sapo		Clixgest / Novis		TV Cabo	
		n	%	n	%	n	%
		< 200	269	2.8%	163	1.7%	2,465
>= 200; < 500	1,796	18.9%	2,457	25.8%	2,948	31.0%	
>= 500; < 1000	2,375	24.9%	3,438	36.1%	1,198	12.6%	
>= 1000; < 1500	5,080	53.4%	3,462	36.4%	1,586	16.7%	
>= 1500	0	0.0%	0	0.0%	1,323	13.9%	
BASE (Nº of measurements)		9,520		9,520		9,520	



Download Speed of All Pages		Origin ISP			
Interval Distribution		Contracted Download Speed - 512 kbps			
Download Speed of All Pages (kbps)		Oni Telecom		Cabovisão	
		n	%	n	%
		< 100	315	3.3%	203
>= 100; < 200	1,150	12.1%	1,616	17.0%	
>= 200; < 300	2,602	27.3%	2,069	21.7%	
>= 300; < 400	5,453	57.3%	1,846	19.4%	
>= 400	0	0.0%	3,787	39.8%	
BASE (Nº of measurements)		9,520		9,520	



### 3.1.2 USER'S PERCEPTION OF FTP DOWNLOAD

#### 3.1.2.1 NATIONAL TARGET ISPs

##### 3.1.2.1.1 AVERAGE DOWNLOAD SPEED

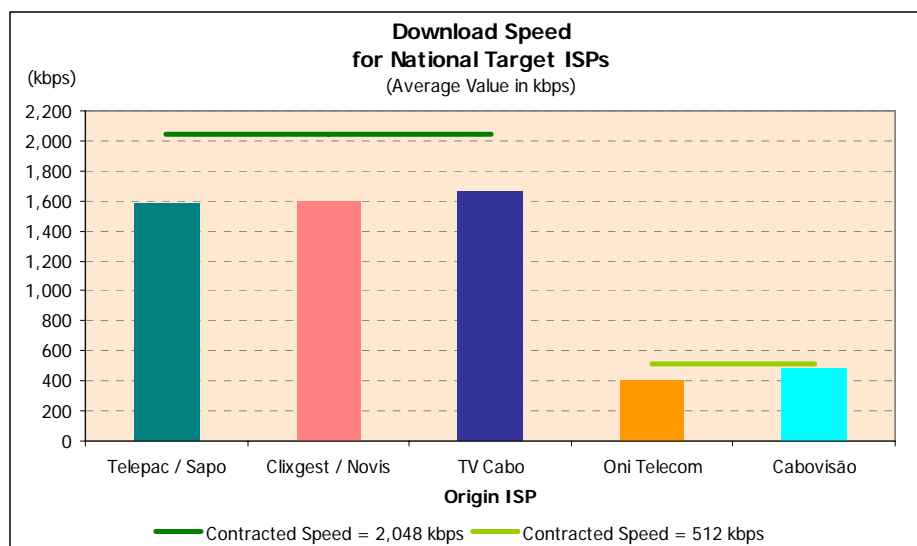
Download Speed (Average Value in kbps)						
Measurements for National Target ISPs						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	1,576.98	1,591.55	1,661.60	400.40	476.87
	Weekend	1,598.92	1,608.80	1,686.34	396.10	475.70
<b>Hours</b>	23H - 08H	1,579.98	1,599.26	1,676.79	369.80	477.35
	08H - 12H	1,611.58	1,623.74	1,756.19	417.92	478.32
	12H - 18H	1,592.65	1,595.69	1,693.16	414.25	476.64
	18H - 23H	1,557.42	1,572.60	1,575.29	407.04	474.34
<b>TOTAL</b>		<b>1,582.79</b>	<b>1,596.11</b>	<b>1,668.15</b>	<b>399.26</b>	<b>476.56</b>
<b>BASE</b> (Nº of measurements to ISP itself)		1,360	1,360	1,360	1,360	1,360

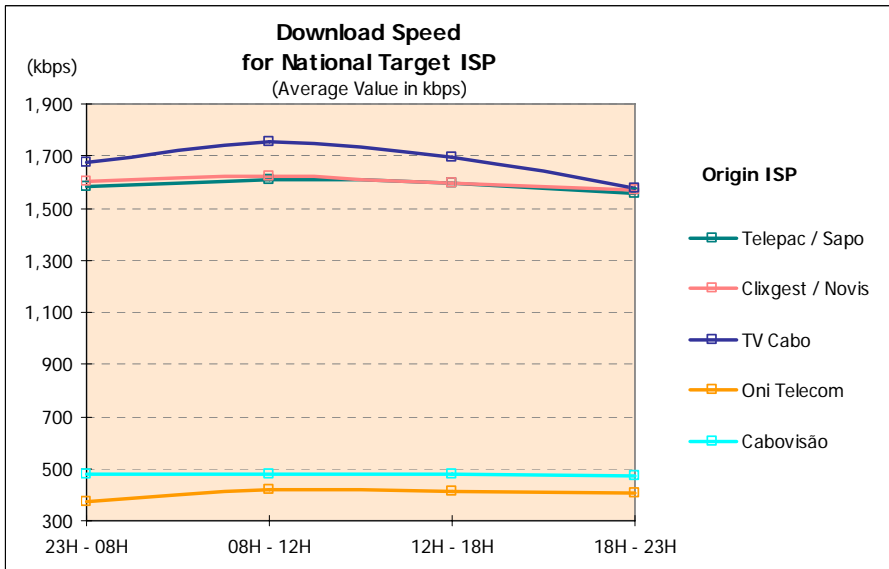
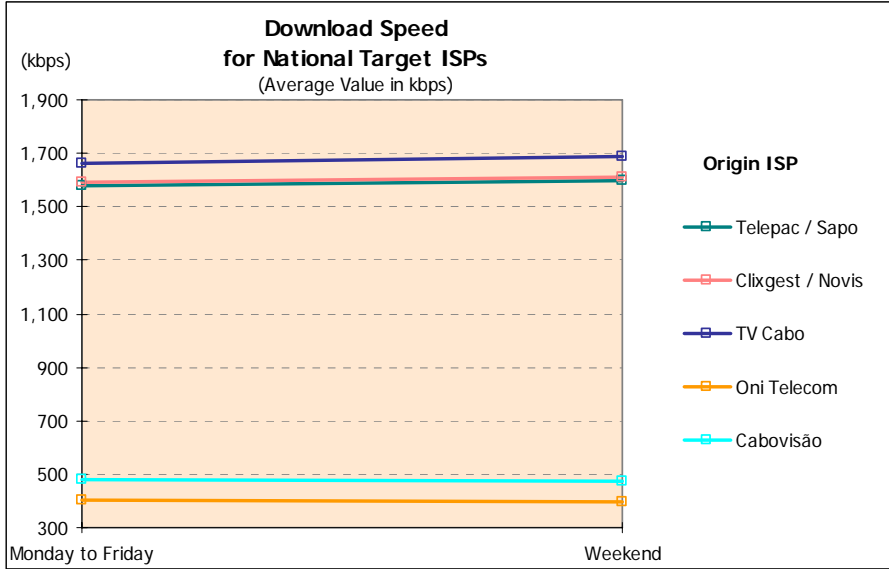
Download Speed: FTP download speed of a 1 Mb file (kbps)

#### Explanatory Notes for Reading the Table (ENRT):

In 1,360 measurements of ISP Telepac/Sapo to itself as Target ISP the average download speed of all pages equals 1,582.79 kbps;

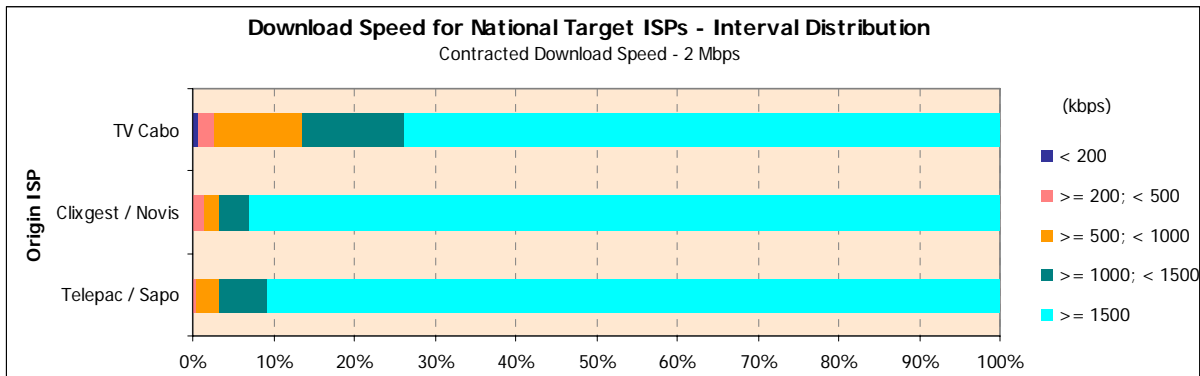
When grouped by weekly period, the average download speed of those 1,360 measurements regarding ISP Telepac/Sapo is 1,576.98 kbps, for measurements made from Monday to Friday, and 1,598.92 kbps, for weekends.



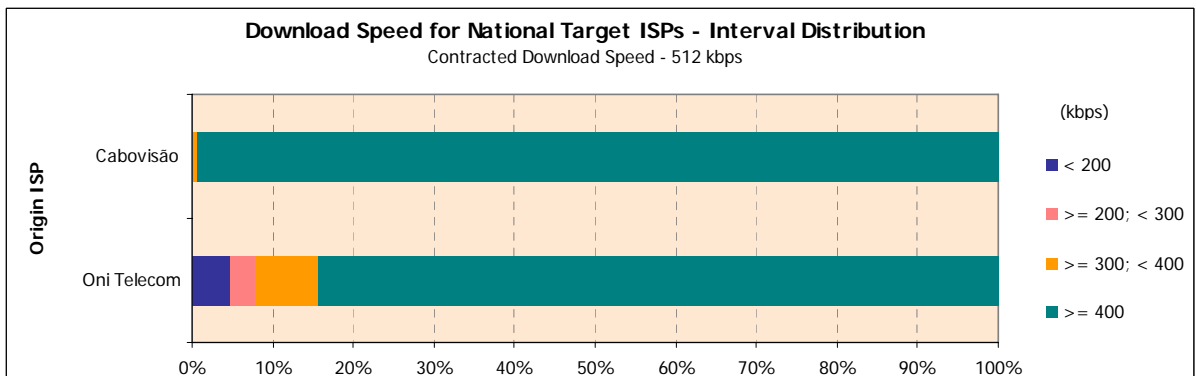


3.1.2.1.2 DOWNLOAD SPEED – INTERVAL DISTRIBUTION

Download Speed for National Target ISPs		Origin ISP					
Interval Distribution		Contracted Download Speed - 2 Mbps					
Download Speed (kbps)		Telepac / Sapo		Clixgest / Novis		TV Cabo	
		n	%	n	%	n	%
		< 200	0	0.0%	1	0.1%	9
>= 200; < 500	6	0.4%	18	1.4%	28	2.1%	
>= 500; < 1000	39	2.9%	26	1.9%	149	11.0%	
>= 1000; < 1500	82	6.0%	51	3.7%	169	12.4%	
>= 1500	1,233	90.7%	1,264	92.9%	1,005	73.9%	
<b>BASE (Nº of measurements to the same ISP)</b>		1,360		1,360		1,360	



Download Speed for National Target ISPs		Origin ISP			
Interval Distribution		Contracted Download Speed - 512 kbps			
Download Speed (kbps)		Oni Telecom		Cabovisão	
		n	%	n	%
		< 200	65	4.8%	0
>= 200; < 300	41	3.0%	3	0.2%	
>= 300; < 400	106	7.8%	6	0.5%	
>= 400	1,148	84.4%	1,351	99.3%	
<b>BASE (Nº of measurements to the same ISP)</b>		1,360		1,360	



### 3.1.2.2 INTERNATIONAL TARGET ISPS

#### 3.1.2.2.1 AVERAGE DOWNLOAD SPEED

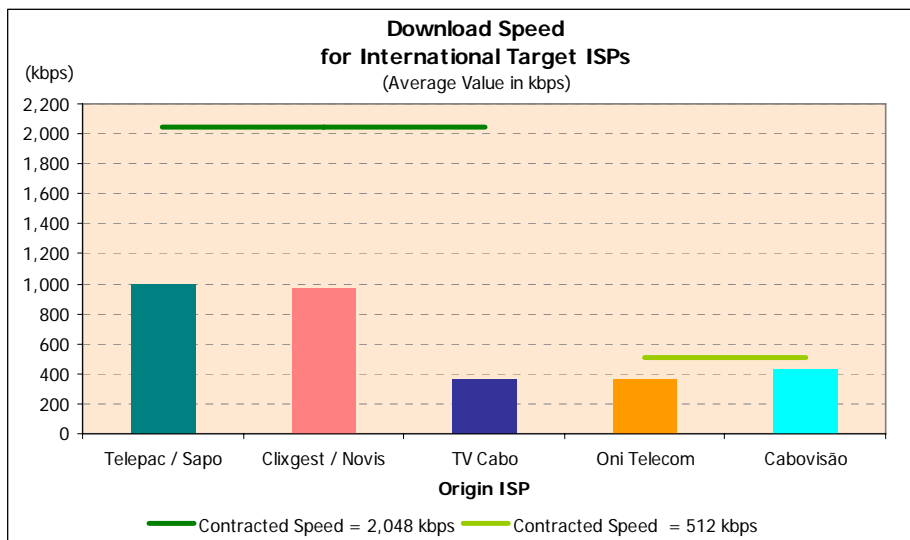
<b>Download Speed</b> (Average Value in kbps)						
Measurements for International Target ISPs						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	994.66	975.63	343.72	372.66	430.72
	Weekend	995.01	978.46	408.54	353.85	433.33
<b>Hours</b>	23H - 08H	1,000.47	998.14	123.46	353.12	436.35
	08H - 12H	1,011.28	984.88	1,052.47	406.38	444.74
	12H - 18H	999.37	949.62	336.04	362.28	428.13
	18H - 23H	972.86	965.79	132.01	359.24	418.54
<b>TOTAL</b>		<b>994.75</b>	<b>976.38</b>	<b>360.88</b>	<b>367.68</b>	<b>431.41</b>
<b>BASE</b> (N° of measurements for Intern. Targ. ISPs)		2,720	2,720	2,720	2,720	2,720

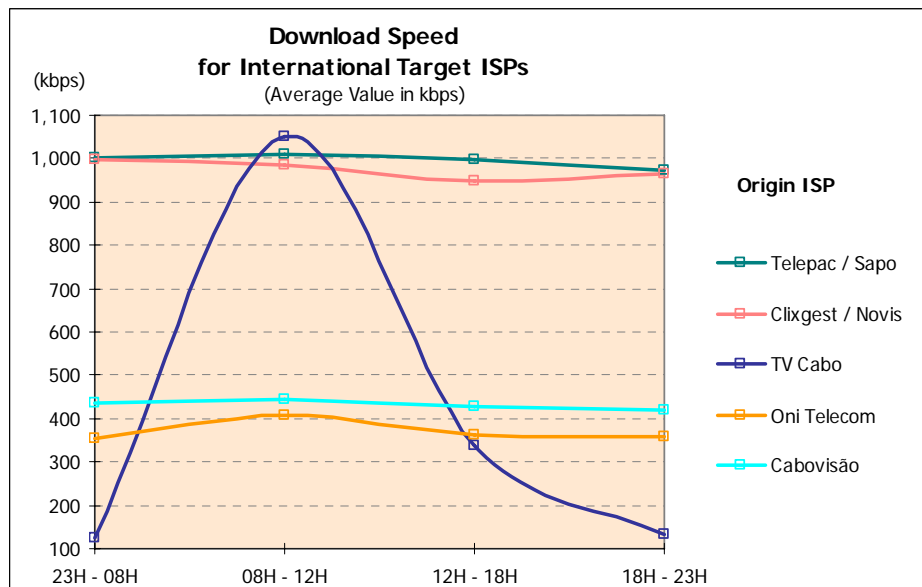
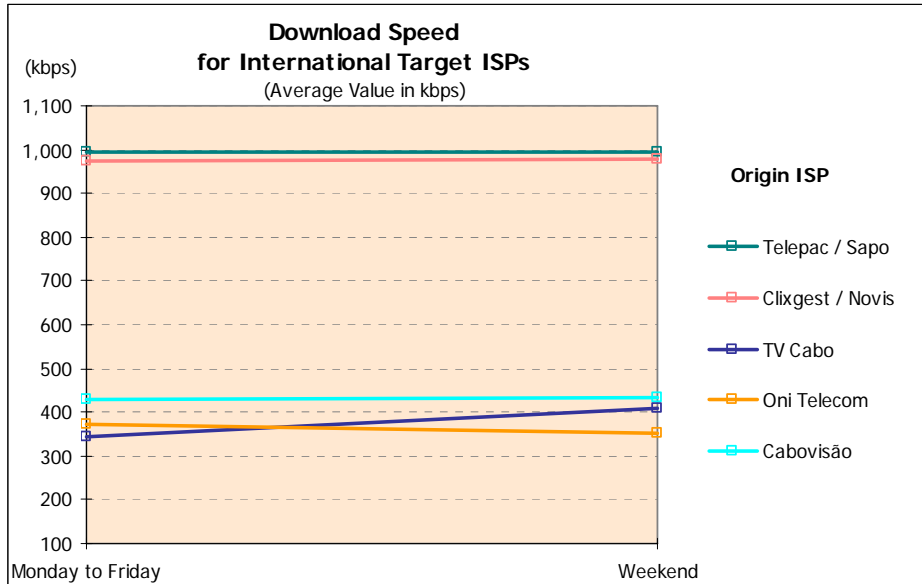
Download Speed: FTP download speed of a 1 Mb file (kbps)

#### Explanatory Notes for Reading the Table (ENRT):

In 2,720 measurements of ISP OniTelecom to international target ISPs the average download speed of all pages equals 367.68 kbps;

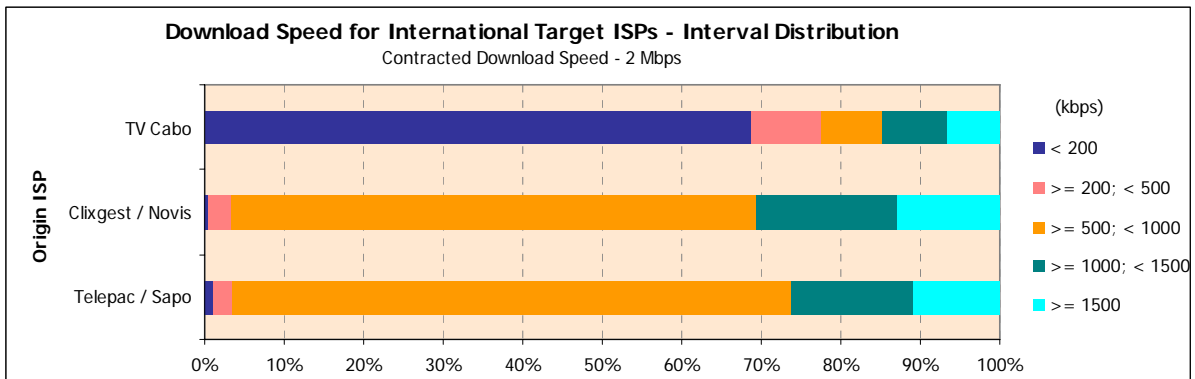
When grouped by weekly period, the average download speed of those 2,720 measurements regarding ISP OniTelecom is 372.66 kbps, for measurements made from Monday to Friday, and 353.85 kbps, for weekends.



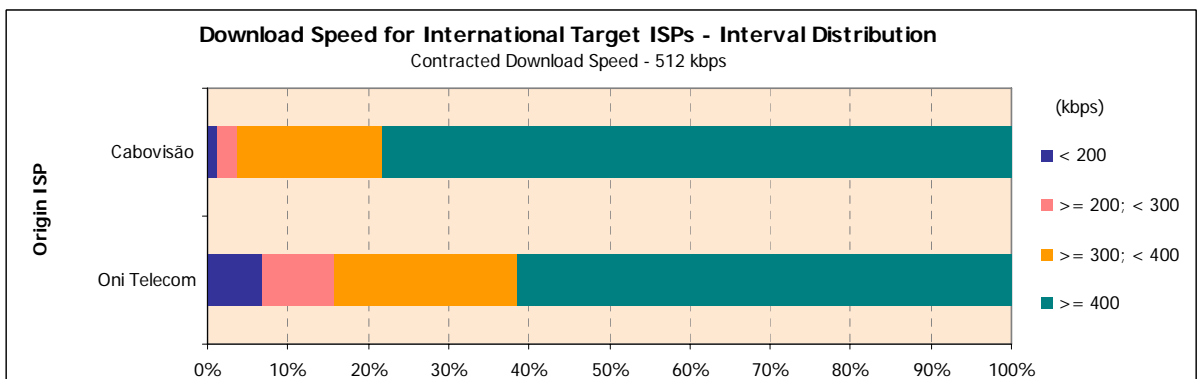


3.1.2.2.2 DOWNLOAD SPEED – INTERVAL DISTRIBUTION

Download Speed for International Target ISPs							
Interval Distribution (kbps)							
Download Speed (kbps)	Interval	Origin ISP					
		Contracted Download Speed - 2 Mbps					
		Telepac / Sapo		Clixgest / Novis		TV Cabo	
		n	%	n	%	n	%
Download Speed (kbps)	< 200	27	1.0%	13	0.5%	1,871	68.8%
	>= 200; < 500	72	2.6%	79	2.9%	238	8.8%
	>= 500; < 1000	1,905	70.0%	1,795	66.0%	208	7.6%
	>= 1000; < 1500	421	15.5%	482	17.7%	220	8.1%
	>= 1500	295	10.9%	351	12.9%	183	6.7%
BASE (Nº of measurements)		2,720		2,720		2,720	



Download Speed for International Target ISPs					
Interval Distribution (kbps)					
Download Speed (kbps)	Interval	Origin ISP			
		Contracted Download Speed - 512 kbps			
		Oni Telecom		Cabovisão	
		n	%	n	%
Download Speed (kbps)	< 200	188	6.9%	35	1.3%
	>= 200; < 300	239	8.8%	68	2.5%
	>= 300; < 400	621	22.8%	487	17.9%
	>= 400	1,672	61.5%	2,131	78.3%
BASE (Nº of measurements)		2,720		2,720	





### 3.1.2.3 NATIONAL AND INTERNATIONAL TARGET ISPs

#### 3.1.2.3.1 AVERAGE DOWNLOAD SPEED

		Origin ISP					(kbps)
		Contracted Download Speed					
		2 Mbps			512 kbps		
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão	
Target ISP	Telepac / Sapo	1,582.79	**	**	**	**	
	Clixgest/ Novis	1,626.19	1,596.11	725.31	402.31	470.03	
	TV Cabo	**	**	1,668.15	**	**	
	Oni Telecom	1,326.58	1,560.20	723.10	399.26	475.25	
	Cabovisão	1,624.63	1,534.08	694.68	397.12	476.56	
International*		994.75	976.38	360.88	367.68	431.41	
BASE (Nº of measurements)		8,160	6,800	8,160	6,800	6,800	

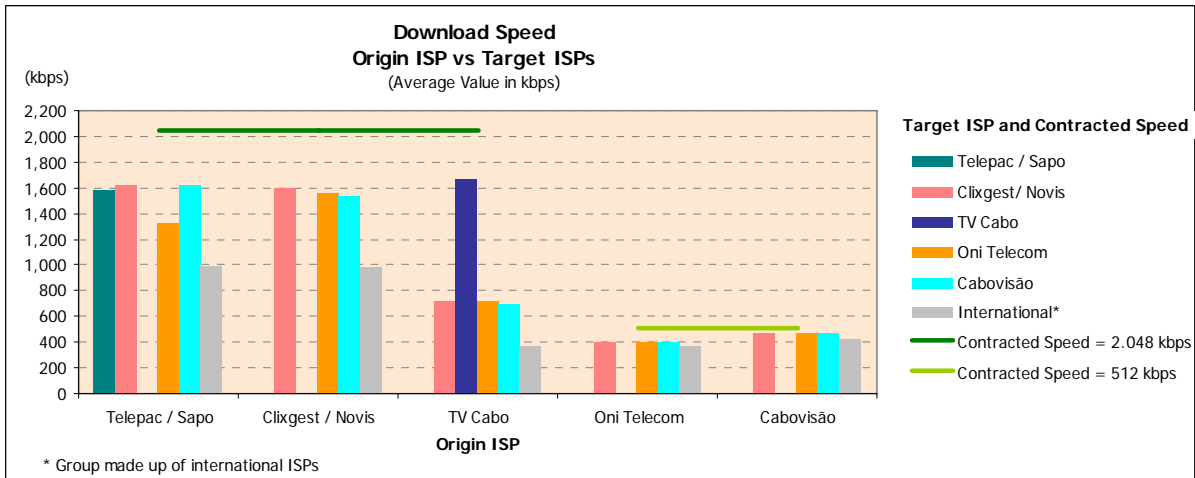
\* Group made up of international ISPs

\*\* The Target ISP did not allow the making of this test

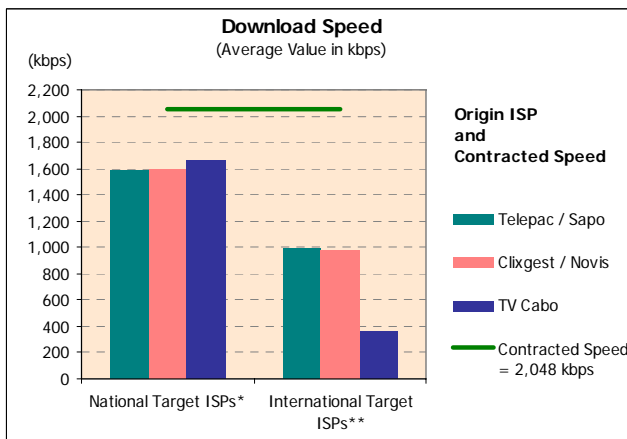
Download Speed : FTP download speed of a 1 Mb file (in kbps) (kbps)

#### ENRT:

As a Target ISP, operator OniTelecom obtained a 475.25 kbps average download speed of all pages when connecting through ISP Cabovisão and 399.26 kbps, when connecting through itself.

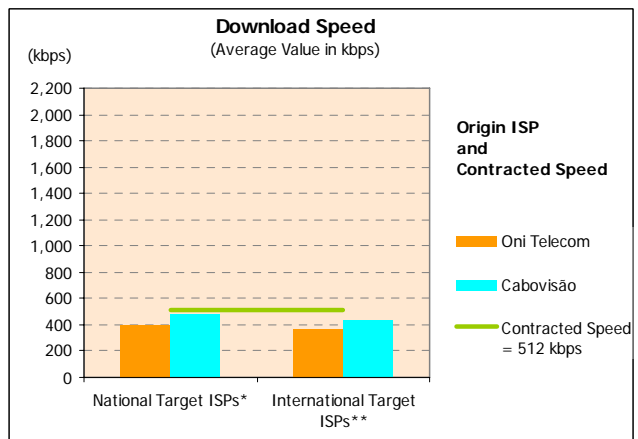


\* Group made up of international ISPs



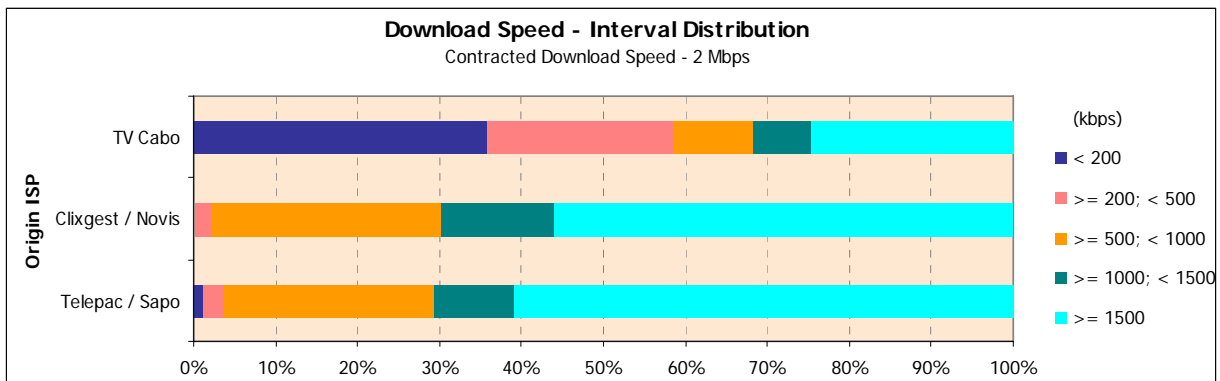
\* Measurements to the same ISP

\*\* Group made up of international ISPs

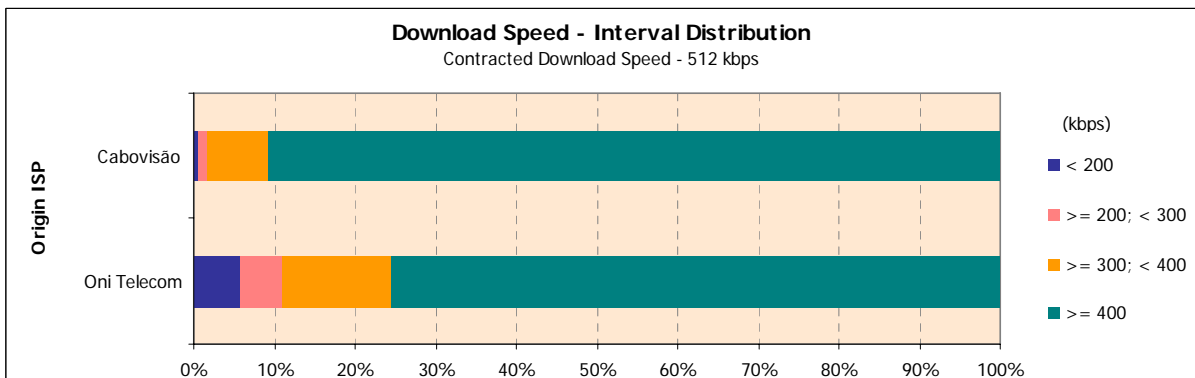


3.1.2.3.2 DOWNLOAD SPEED – INTERVAL DISTRIBUTION

Download Speed Interval Distribution		Origin ISP					
		Contracted Download Speed - 2 Mbps					
		Telepac / Sapo		Clixgest / Novis		TV Cabo	
		n	%	n	%	n	%
Download Speed (kbps)	< 200	99	1.2%	19	0.3%	2,929	35.9%
	>= 200; < 500	208	2.5%	141	2.1%	1,837	22.5%
	>= 500; < 1000	2,086	25.6%	1,891	27.8%	816	10.0%
	>= 1000; < 1500	803	9.8%	938	13.8%	566	6.9%
	>= 1500	4,963	60.8%	3,812	56.1%	2,012	24.7%
<b>BASE</b>		8,160		6,800		8,160	



Download Speed Interval Distribution		Origin ISP			
		Contracted Download Speed - 512 kbps			
		Oni Telecom		Cabovisão	
		n	%	n	%
Download Speed (kbps)	< 200	387	5.7%	39	0.6%
	>= 200; < 300	351	5.2%	74	1.1%
	>= 300; < 400	930	13.7%	518	7.6%
	>= 400	5,133	75.5%	6,168	90.7%
<b>BASE</b>		6,800		6,800	



### 3.1.3 USER'S PERCEPTION OF FTP UPLOAD

#### 3.1.3.1 NATIONAL TARGET ISPs

##### 3.1.3.1.1 AVERAGE UPLOAD SPEED

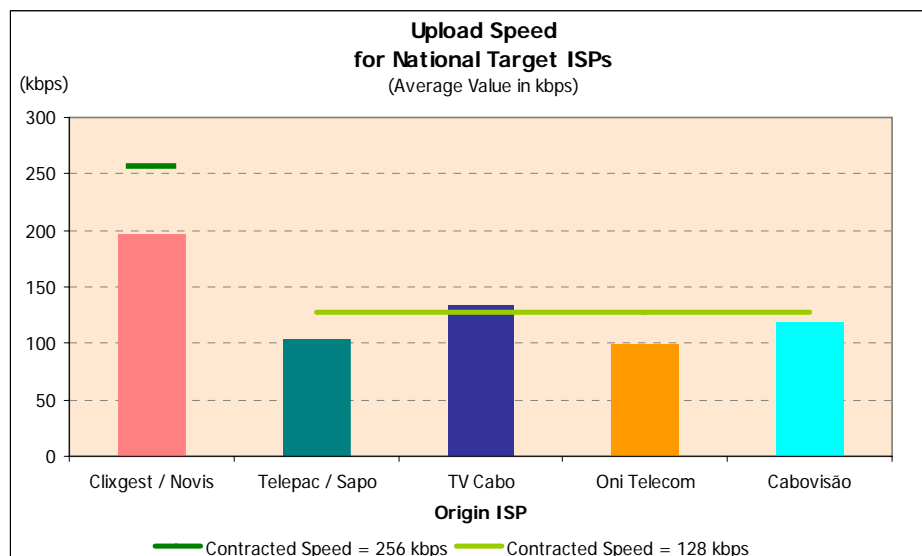
Upload Speed (Average Value in kbps) Measurements for National Target ISPs		Origin ISP					(kbps)
		Contracted Upload Speed					
		256 kbps	128 kbps				
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão	
Weekly Period	Monday to Friday	196.99	103.83	134.72	99.56	118.17	
	Weekend	197.33	103.91	132.88	97.70	118.51	
Hours	23H - 08H	197.65	103.69	134.23	98.89	118.30	
	08H - 12H	198.60	104.11	133.08	99.89	118.57	
	12H - 18H	196.76	104.01	135.08	99.60	118.33	
	18H - 23H	195.55	103.74	134.46	98.27	117.92	
<b>TOTAL</b>		<b>197.08</b>	<b>103.85</b>	<b>134.23</b>	<b>99.07</b>	<b>118.26</b>	
<b>BASE</b> (Nº of measurements to ISP itself)		1,360	1,360	1,360	1,360	1,360	

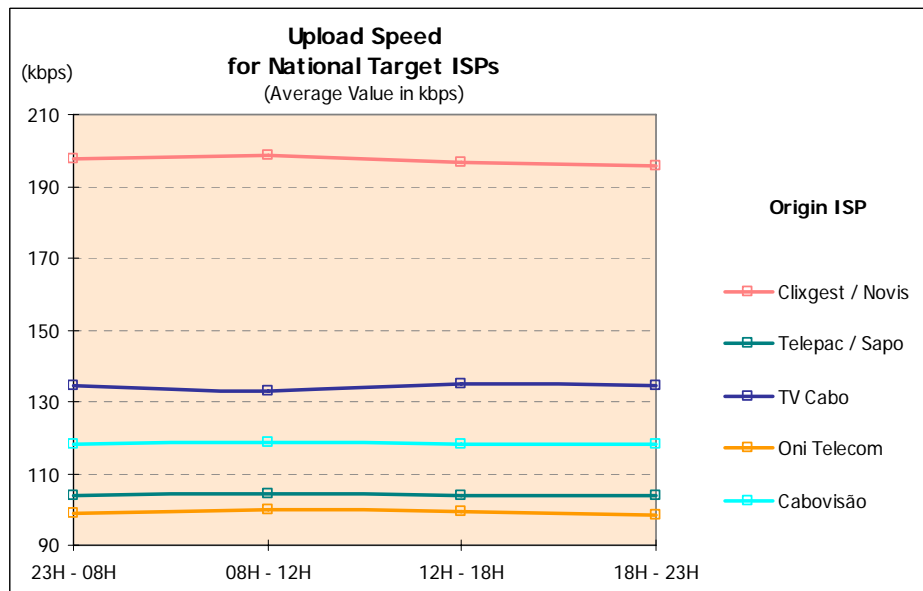
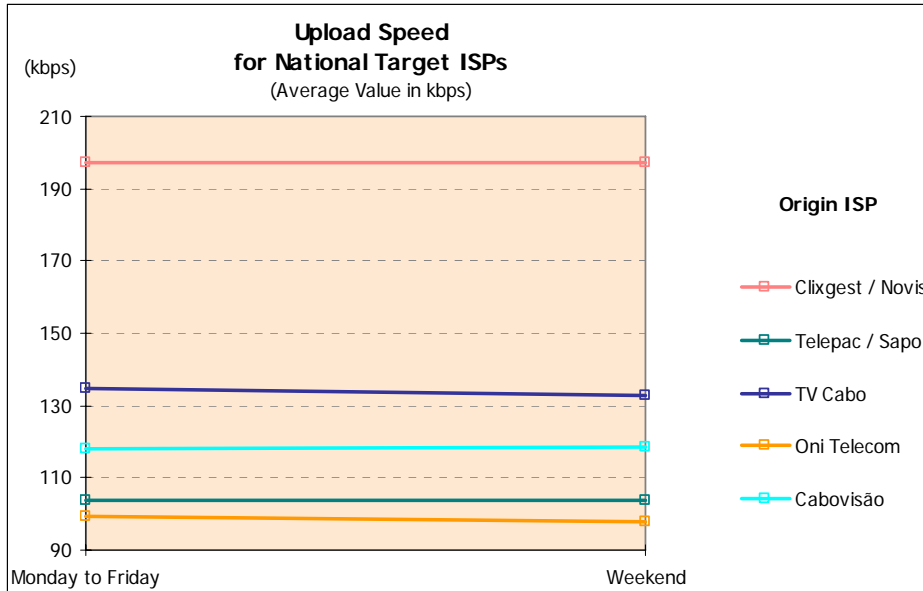
Upload Speed: FTP upload speed of a 0.5 Mb file (kbps)

#### Explanatory Notes for Reading the Table (ENRT):

In 1,360 measurements of ISP TV Cabo to itself as Target ISP the average upload speed of all pages equals 134.23 kbps;

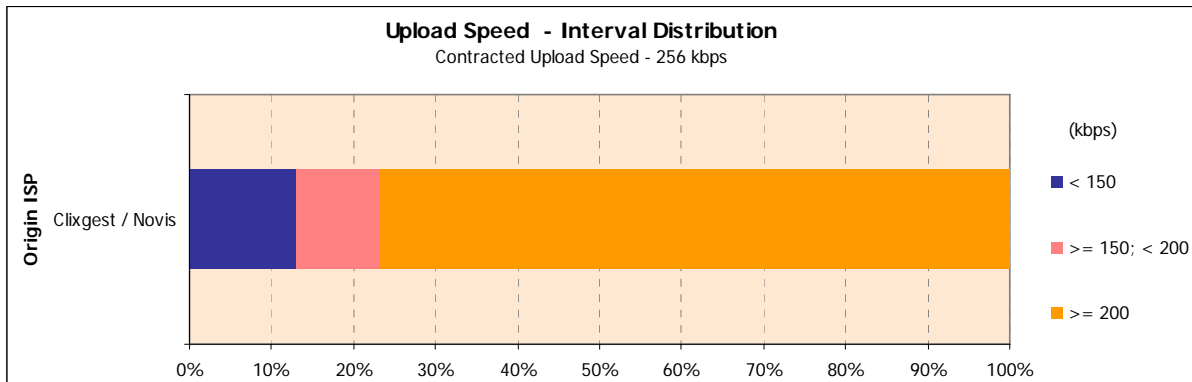
When grouped by weekly period, the average upload speed of those 1,360 measurements regarding ISP TV Cabo is 134.72 kbps, for measurements made from Monday to Friday, and 132.88 kbps, for weekends.



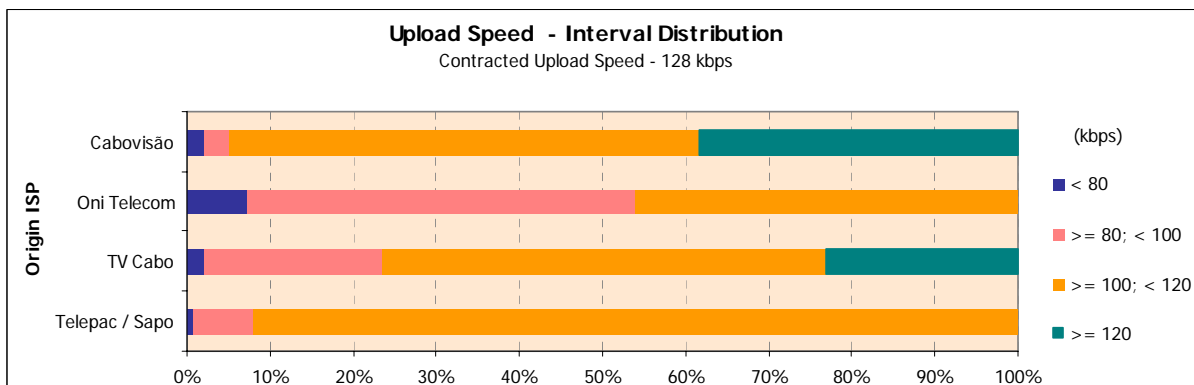


3.1.3.1.2 UPLOAD SPEED – INTERVAL DISTRIBUTION

Upload Speed for National Target ISPs			
Interval Distribution			
Upload Speed (kbps)	Origin ISP		
	Contracted Upload Speed - 256 kbps		
	Clixgest/Novis		
		n	%
< 150		153	11.2%
>= 150; < 200		46	3.4%
>= 200		1,161	85.4%
BASE (Nº of measurements to the same ISP)		1,360	



Upload Speed for National Target ISPs									
Interval Distribution									
Upload Speed (kbps)	Origin ISP								
	Contracted Upload Speed - 128 kbps								
	Telepac/Sapo		TV Cabo		Oni Telecom		Cabovisão		
	n	%	n	%	n	%	n	%	
< 80	4	0.3%	18	1.3%	50	3.7%	3	0.2%	
>= 80; < 100	80	5.9%	275	20.2%	493	36.2%	6	0.5%	
>= 100; < 120	1,277	93.9%	737	54.2%	817	60.1%	635	46.7%	
>= 120	0	0.0%	330	24.3%	0	0.0%	716	52.7%	
BASE (Nº of measurements to the same ISP)		1,360		1,360		1,360		1,360	



### 3.1.3.2 INTERNATIONAL TARGET ISPS

#### 3.1.3.2.1 AVERAGE UPLOAD SPEED

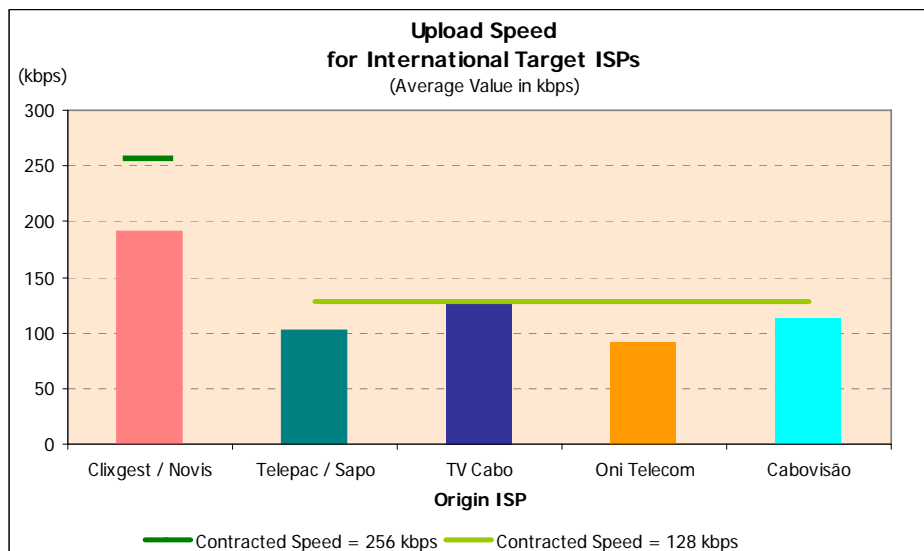
<b>Upload Speed</b> (Average Value in kbps)		<b>Origin ISP</b>					(kbps)
Measurements for International Target ISPs		<b>Contracted Upload Speed</b>					
		256 kbps	128 kbps				
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão	
<b>Weekly Period</b>	Monday to Friday	191.47	102.92	129.32	92.57	112.11	
	Weekend	191.71	102.43	127.74	91.57	112.97	
<b>Hours</b>	23H - 08H	191.82	102.75	124.56	94.08	112.10	
	08H - 12H	192.56	103.37	132.97	95.47	114.63	
	12H - 18H	190.86	103.17	131.70	92.53	113.23	
	18H - 23H	190.97	102.12	128.64	87.84	110.24	
<b>TOTAL</b>		<b>191.54</b>	<b>102.79</b>	<b>128.90</b>	<b>92.30</b>	<b>112.33</b>	
<b>BASE</b> (N° measurements for Internat. Targ. ISPs)		2,720	2,720	2,720	2,720	2,720	

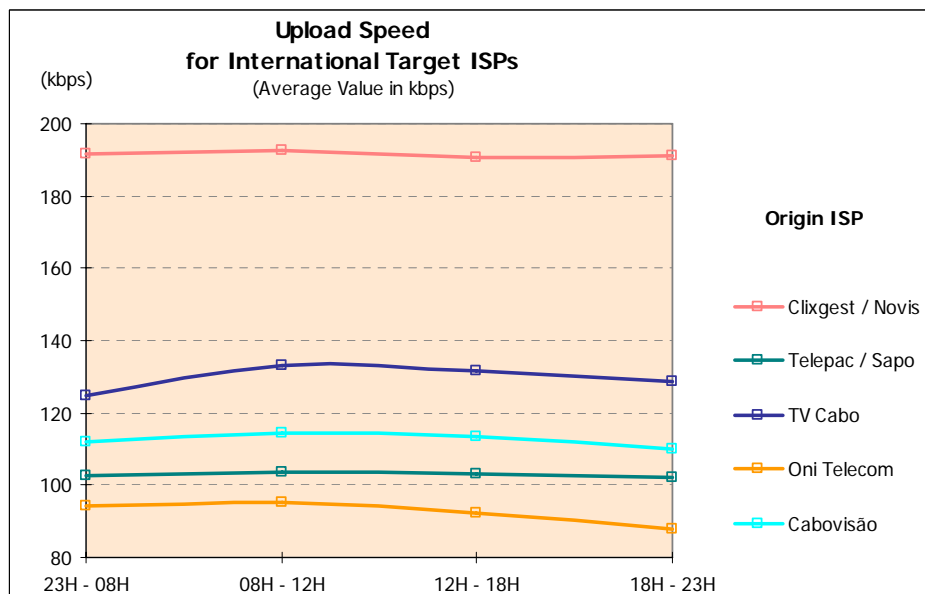
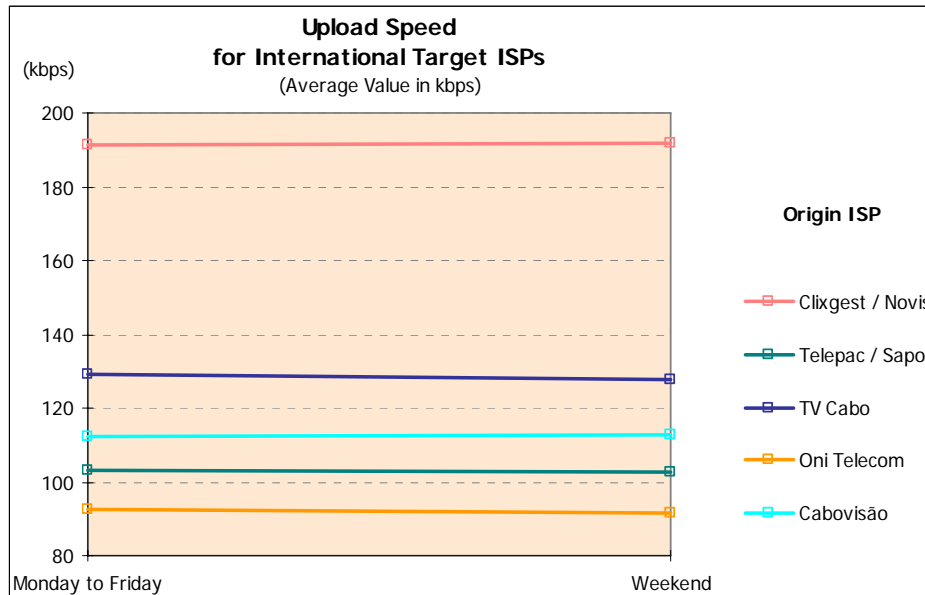
Upload Speed: FTP upload speed of a 0.5 Mb file (kbps)

#### Explanatory Notes for Reading the Table (ENRT):

In 2,720 measurements of ISP TV Telepac/Sapo to international target ISPs the average upload speed of all pages equals 102.79 kbps;

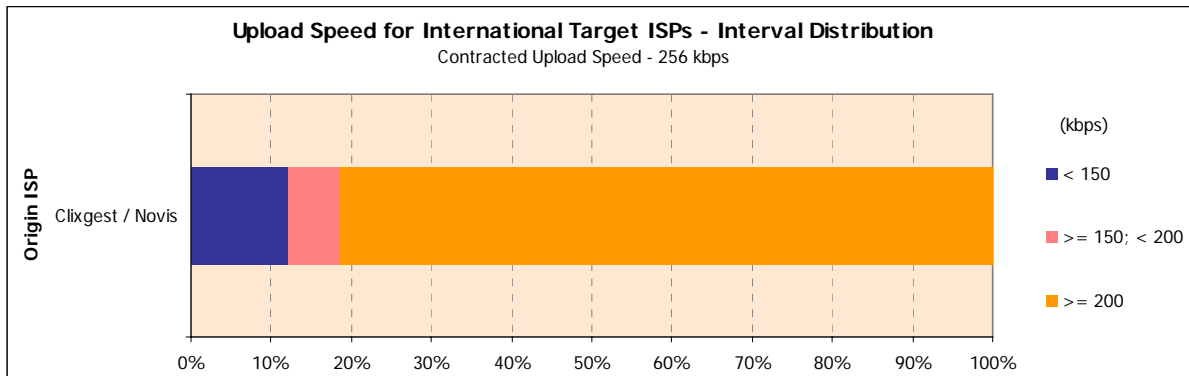
When grouped by weekly period, the average upload speed of those 2,720 measurements regarding ISP Telepac/Sapo is 102.92 kbps, for measurements made from Monday to Friday, and 102.43 kbps, for weekends.



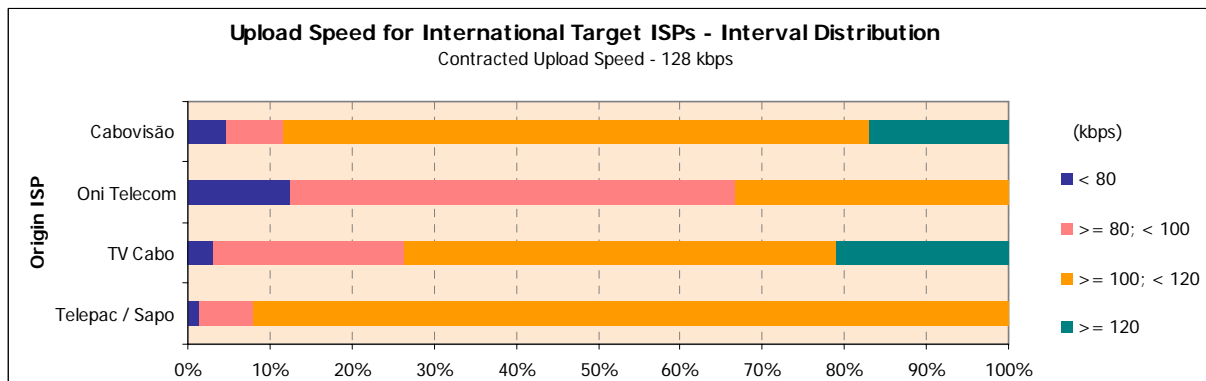


3.1.3.2.2 UPLOAD SPEED – INTERVAL DISTRIBUTION

Upload Speed for International Target ISPs				
Interval Distribution				
Upload Speed (kbps)	Origin ISP			
	Contracted Upload Speed - 256 kbps			
	Clixgest/Novis			
		n	%	
Upload Speed (kbps)	< 150	330	12.1%	
	>= 150; < 200	178	6.5%	
	>= 200	2,212	81.3%	
BASE (Nº of measurements)		2,720		



Upload Speed for International Target ISPs										
Interval Distribution										
Upload Speed (kbps)	Origin ISP									
	Contracted Upload Speed - 128 kbps									
	Telepac/Sapo		TV Cabo		Oni Telecom		Cabovisão			
	n	%	n	%	n	%	n	%	n	%
< 80	37	1.3%	86	3.2%	341	12.5%	128	4.7%		
>= 80; < 100	180	6.6%	631	23.2%	1,475	54.2%	190	7.0%		
>= 100; < 120	2,504	92.1%	1,430	52.6%	904	33.3%	1,941	71.4%		
>= 120	0	0.0%	573	21.1%	0	0.0%	461	17.0%		
BASE (Nº of measurements)		2,720		2,720		2,720		2,720		





### 3.1.3.3 NATIONAL AND INTERNATIONAL TARGET ISPs

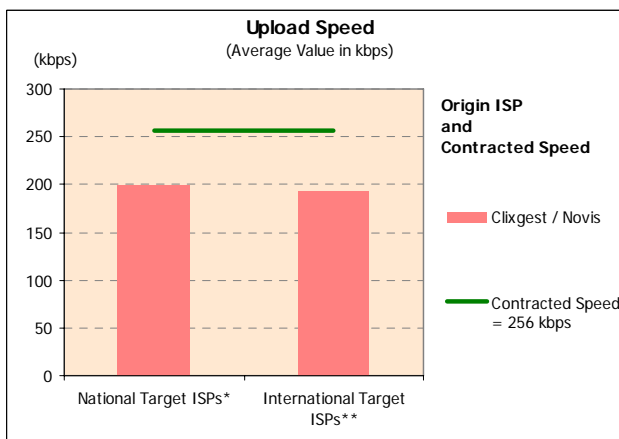
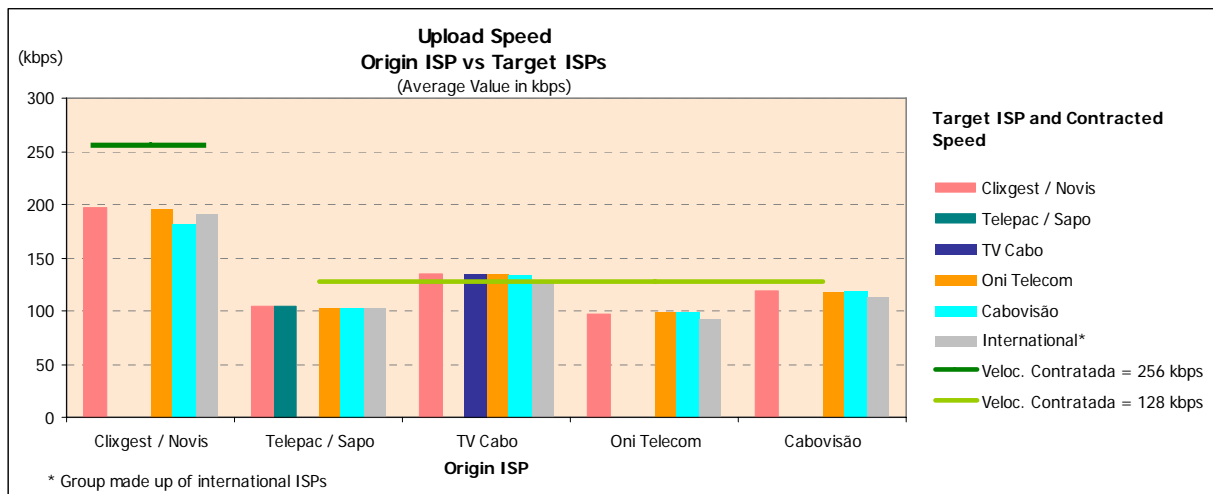
#### 3.1.3.3.1 AVERAGE UPLOAD SPEED

Origin ISP		Contracted Upload Speed					(kbps)
		256 kbps		128 kbps			
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão	
Target ISP	Clixgest / Novis	197.08	103.93	134.83	97.08	118.12	
	Telepac / Sapo	**	103.85	**	**	**	
	TV Cabo	**	**	134.23	**	**	
	Oni Telecom	196.25	103.32	134.64	99.07	118.10	
	Cabovisão	181.67	102.86	133.77	98.98	118.26	
	International*	191.54	102.79	128.90	92.30	112.33	
<b>BASE (Nº of measurements)</b>		<b>6,800</b>	<b>8,160</b>	<b>8,160</b>	<b>6,800</b>	<b>6,800</b>	

\* Group made up of international ISPs  
 \*\* The Target ISP did not allow the making of this test  
 Upload Speed: FTP upload speed of a 0.5 Mb file (kbps)

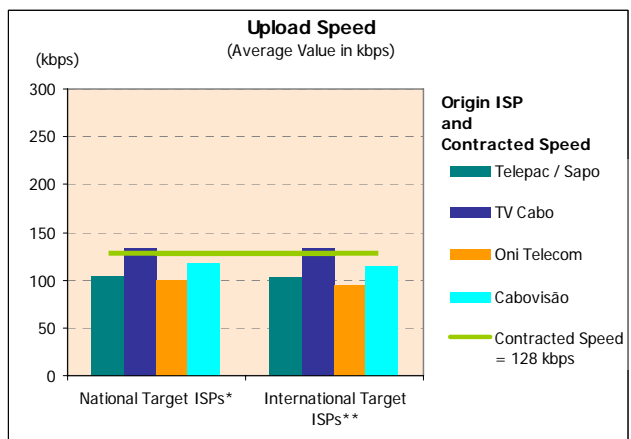
#### ENRT:

As a Target ISP, operator Cabovisão obtained a 98.98 kbps average upload speed when connecting through ISP OniTelecom and 118.26 kbps, when connecting through itself.



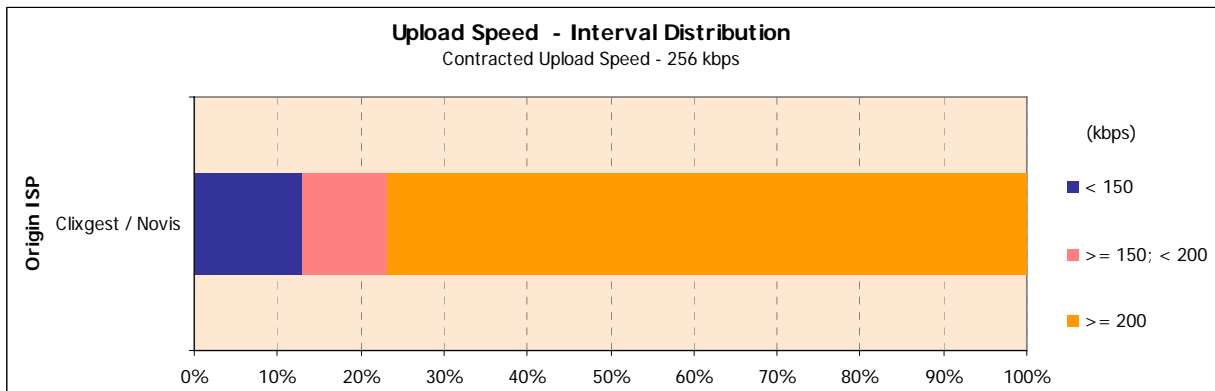
\* Measurements to the same ISP

\*\* Group made up of international ISPs

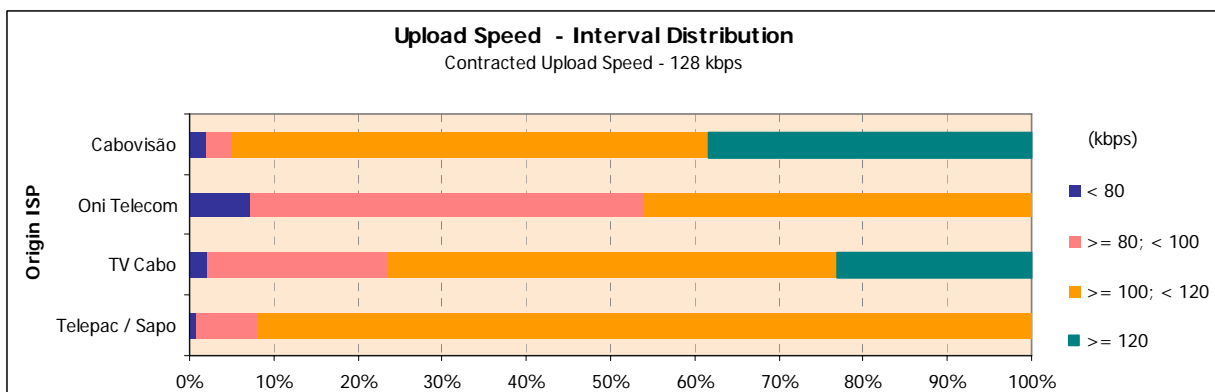


3.1.3.3.2 UPLOAD SPEED – INTERVAL DISTRIBUTION

Upload Speed Interval Distribution			
Upload Speed (kbps)		Origin ISP	
		Contracted Upload Speed - 256 kbps	
		Clixgest/Novis	
		n	%
< 150		883	13.0%
>= 150; < 200		696	10.2%
>= 200		5,221	76.8%
<b>BASE</b>		<b>6,800</b>	



Upload Speed Interval Distribution (kbps)									
Upload Speed (kbps)		Origin ISP							
		Contracted Upload Speed - 128 kbps							
		Telepac/Sapo		TV Cabo		Oni Telecom		Cabovisão	
		n	%	n	%	n	%	n	%
< 80		67	0.8%	167	2.0%	494	7.3%	137	2.0%
>= 80; < 100		586	7.2%	1,758	21.5%	3,173	46.7%	210	3.1%
>= 100; < 120		7,507	92.0%	4,343	53.2%	3,132	46.1%	3,847	56.6%
>= 120		0	0.0%	1,892	23.2%	0	0.0%	2,605	38.3%
<b>BASE</b>		<b>8,160</b>		<b>8,160</b>		<b>6,800</b>		<b>6,800</b>	



### 3.1.4 PING TEST

#### 3.1.4.1 PING TIME

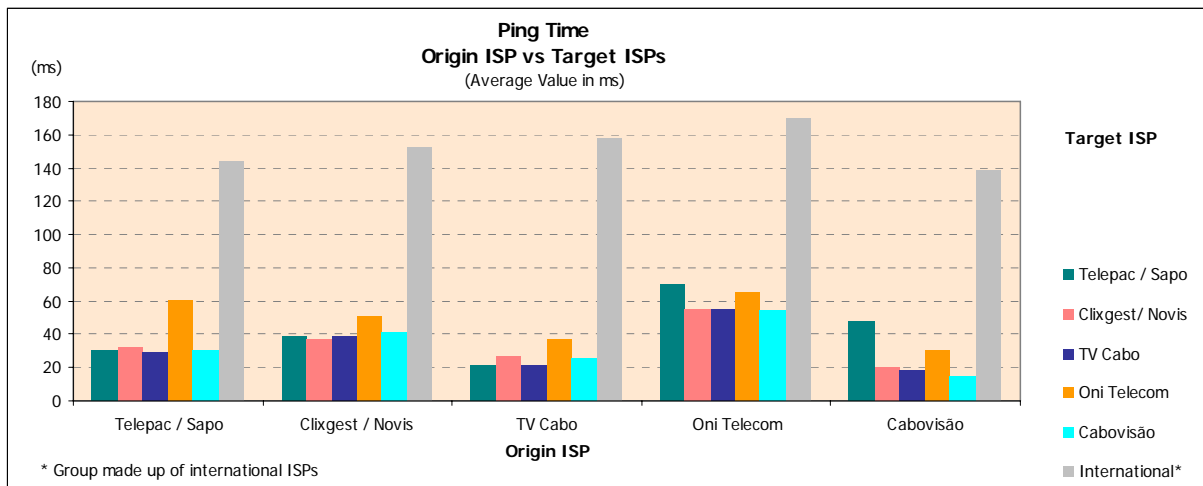
Ping Time from the Origin ISP to Target ISPs (Average Value in ms) (ms)						
	Origin ISP	Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
Target ISP	Telepac / Sapo	30.71	38.35	21.35	69.79	48.07
	Clixgest/ Novis	32.07	36.74	26.93	55.18	20.48
	TV Cabo	29.39	38.80	20.74	54.77	18.75
	Oni Telecom	60.83	50.56	36.95	65.14	30.27
	Cabovisão	30.10	41.06	25.43	54.26	14.60
	International*	143.89	152.16	158.37	169.53	138.46
<b>BASE</b> (N° of measurements)		9,520	9,520	9,520	9,520	9,520

\* Group made up of international ISPs

Ping Time: ICMP ECHO time to the standard site/page (latency between the user and the standard page's site) (ms)

#### ENRT:

As a Target ISP, operator TV Cabo obtained a 29.39 ms average ping time when connecting through ISP Telepac / Sapo and 24.74 ms when connecting to itself.



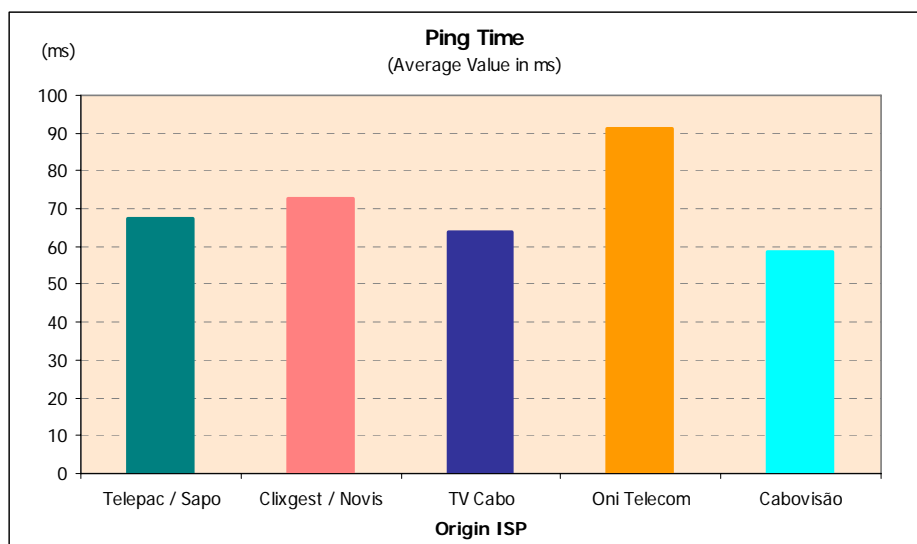
Ping Time (Average Value in ms)		Origin ISP					(ms)
		Contracted Download Speed					
		2 Mbps			512 kbps		
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão	
<b>Weekly Period</b>	Monday to Friday	67.87	73.17	63.07	89.01	58.43	
	Weekend	65.59	71.88	66.66	97.17	58.46	
<b>Hours</b>	23H - 08H	62.94	70.95	74.20	104.82	56.55	
	08H - 12H	62.68	70.42	50.93	70.61	54.78	
	12H - 18H	73.83	77.41	59.64	95.36	62.15	
	18H - 23H	70.61	73.32	65.63	88.15	60.50	
<b>TOTAL</b>		<b>67.27</b>	<b>72.83</b>	<b>64.02</b>	<b>91.17</b>	<b>58.44</b>	
<b>BASE</b> (N° of measurements)		9,520	9,520	9,520	9,520	9,520	

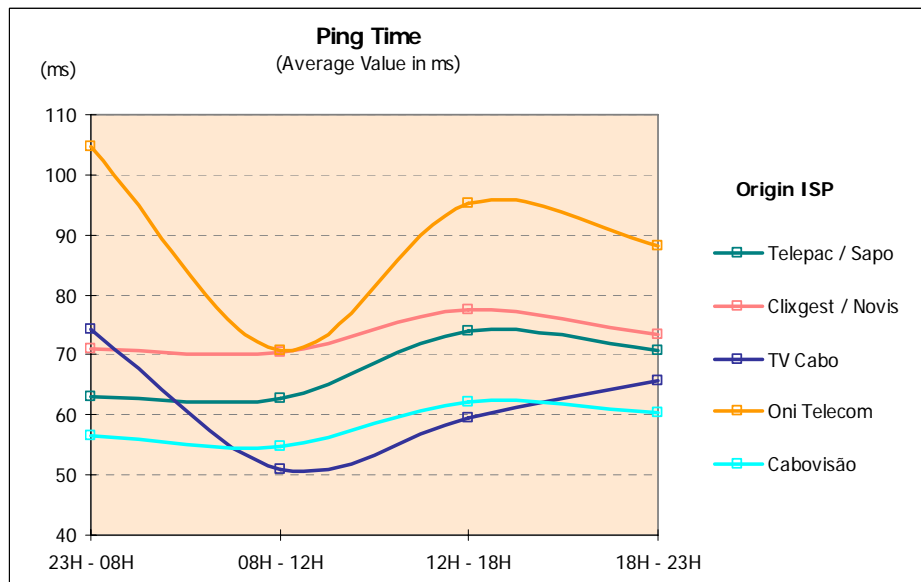
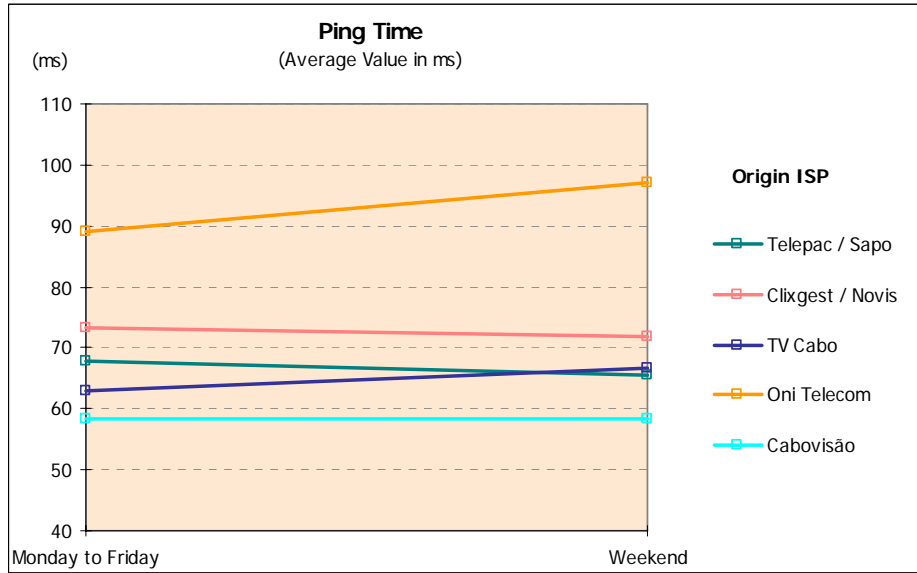
Ping Time: ICMP ECHO time to the standard site/page (latency between the user and the standard page's site) (ms)

**Explanatory Notes for Reading the Table (ENRT):**

In 9,520 measurements of ISP OniTelecom, the average Ping time equals 91.17 ms;

When grouped by weekly period, the average ping time of those 9,520 measurements regarding ISP OniTelecom is of 89.01 ms, for measurements made from Monday to Friday, and 97.17 ms, for weekends.





## 3.2 ADDITIONAL INFORMATION

### 3.2.1 TRACEROUTE

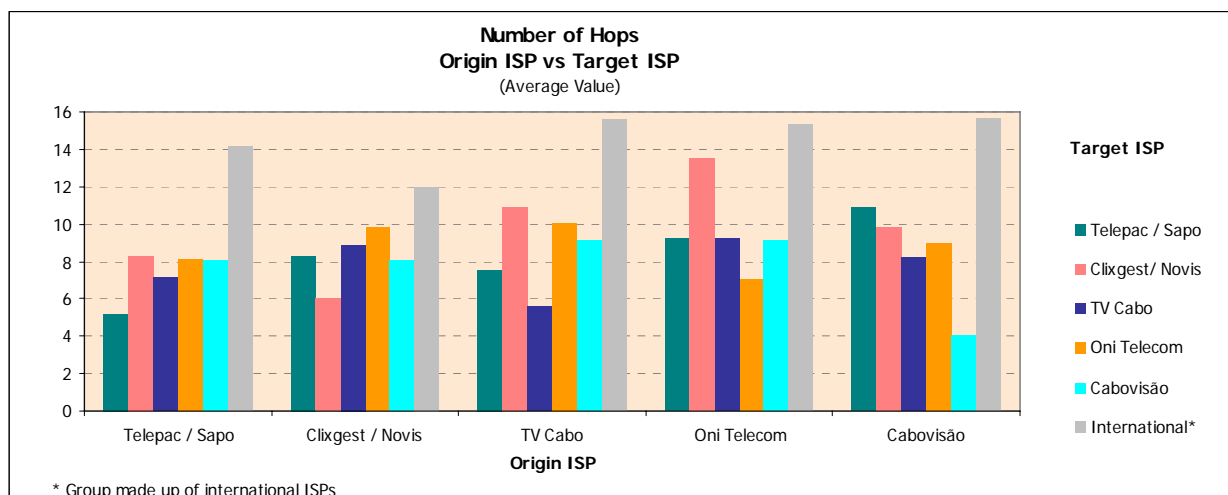
Number of Hops from Origin ISP to Target ISPs (Average Value)						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
Target ISP		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
	Telepac / Sapo	5.16	8.30	7.58	9.22	10.92
	Clixgest/ Novis	8.30	6.03	10.88	13.45	9.81
	TV Cabo	7.16	8.85	5.58	9.19	8.18
	Oni Telecom	8.16	9.81	10.09	7.03	8.93
	Cabovisão	8.02	8.04	9.10	9.12	4.04
	International*	14.18	11.94	15.62	15.32	15.63
<b>BASE (N° of measurements)</b>		9,520	9,520	9,520	9,520	9,520

\*\* Group made up of international ISPs

No. of Hops (leaps): Number of intermediary machines used between the user's machine and the destination server

#### ENRT:

As a Target ISP, operator OniTelecom reached 9.81 average hops when connecting through ISP Clixgest / Novis and 7.03 kbps when connecting through itself.



### Type of Route Used for National Target ISPs

		National Target ISP										TOTAL			
		Telepac / Sapo		Clixgest / Novis		Oni Telecom		TV Cabo		Cabovisão		National Target ISPs			
		n	%	n	%	n	%	n	%	n	%	n	%		
Telepac / Sapo	Exclus. National Routes	1,360	100.0%	1,358	99.9%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,798	100.0%
	International Routes	0	0.0%	2	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.0%
		1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,800	100.0%
Clixgest / Novis	Exclus. National Routes	1,345	98.9%	1,360	100.0%	1,360	100.0%	1,354	99.5%	1,360	100.0%	1,360	100.0%	6,778	99.7%
	International Routes	15	1.1%	0	0.0%	0	0.0%	6	0.5%	0	0.0%	0	0.0%	22	0.3%
		1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,800	100.0%
Oni Telecom	Exclus. National Routes	1,360	100.0%	1,342	98.7%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,782	99.7%
	International Routes	0	0.0%	18	1.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	18	0.3%
		1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,800	100.0%
TV Cabo	Exclus. National Routes	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,800	100.0%
	International Routes	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,800	100.0%
Cabovisão	Exclus. National Routes	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,327	97.6%	1,360	100.0%	1,360	100.0%	6,767	99.5%
	International Routes	0	0.0%	0	0.0%	0	0.0%	33	2.4%	0	0.0%	0	0.0%	33	0.5%
		1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	1,360	100.0%	6,800	100.0%
ISPs TOTAL		6,785	99.8%	6,780	99.7%	6,800	100.0%	6,761	99.4%	6,800	100.0%	33,926	99.8%		
		15	0.2%	20	0.3%	0	0.0%	39	0.6%	0	0.0%	74	0.2%		
		6,800	100.0%	6,800	100.0%	6,800	100.0%	6,800	100.0%	6,800	100.0%	34,000	100.0%		

Exclusively National Route: When intermediary machines used on the path have IP addresses belonging to ranges granted to national operators

International Route: When there is at least one machine on the path which IP address is not inside the ranges granted to national operators

#### Explanatory Notes for Reading the Table (ENRT):

100% of the 1,360 measurements for Target ISP Telepac/Sapo corresponded to exclusively international routes when connecting through itself.

99.8% of the 6,800 measurements for Target ISP Telepac/Sapo corresponded to exclusively national routes and 0.2% to international routes.

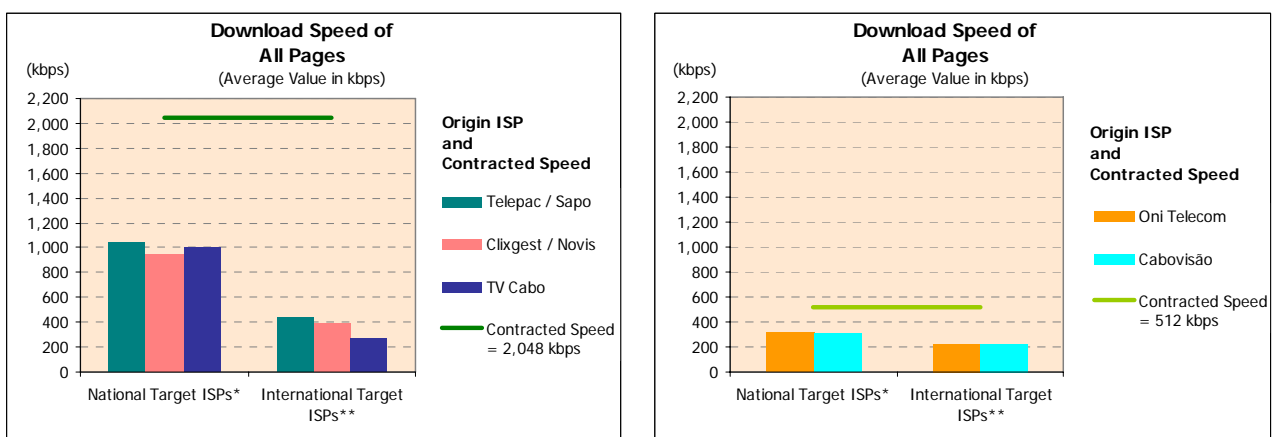
## 4 CONCLUSIONS

The Efficiency Indicators evaluated in this study intend to measure parameters regarding access to any given Internet area. Analysis of these indicators, namely Download Speeds (HTTP and FTP) and Upload Speeds, must be made with some caution, since the results are only directly comparable for commercial offers with the same contracted speeds.

Thus, we have two groups of ISPs for each situation:

- ❖ Contracted download speed (HTTP e FTP):
  - 2 Mbps (2,048 kbps) – Telepac/Sapo, Clixgest/Novis and TV Cabo;
  - 512 kbps – Cabovisão and OniTelecom.
- ❖ Contracted upload speed (FTP):
  - 256 kbps – Clixgest/Novis;
  - 128 kbps – Telepac/Sapo, TV Cabo, Cabovisão and OniTelecom.

Results for the indicator “Download Speed of All Pages” (HTTP) show that the average speed did not reach the contracted speed. This happens with all operators but is more noticeable for higher contracted speed offers (2,048 kbps).



\* Group with special weighting (see methodology)  
 \*\* Group made up of international ISPs

Figure 19 – User perception of HTTP download: Average download speed.



Average download speeds for international target ISPs are also quite lower, which leads to suspect that the international routes work as bottlenecks to all operators.

Results for highest contracted speed operators – Telepac/Sapo, Clixgest/Novis and TV Cabo – are close among themselves, from Telepac/Sapo’s 1,043 kbps to Clixgest/Novis’ 944 kbps, for national target ISPs. Also for this group of operators, but for international target ISP’s, results vary between Telepac/Sapo’s 433 kbps and TV Cabo’s 271 kbps.

The group of ISPs with the lowest contracted speeds – Cabovisão and OniTelecom – has very similar results, close to 313 kbps for national target ISPs and 225 kbps for international target ISPs.

Although the average values for each group of operators are relatively close to each other, the results are quite different when an analysis by speed intervals is done.

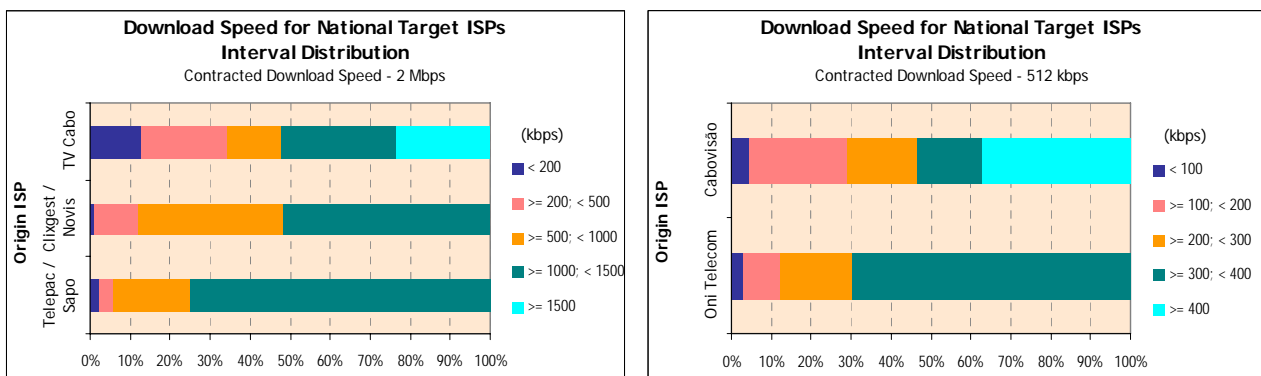


Figure 20 – Download speed interval distribution (HTTP), for national target ISPs.

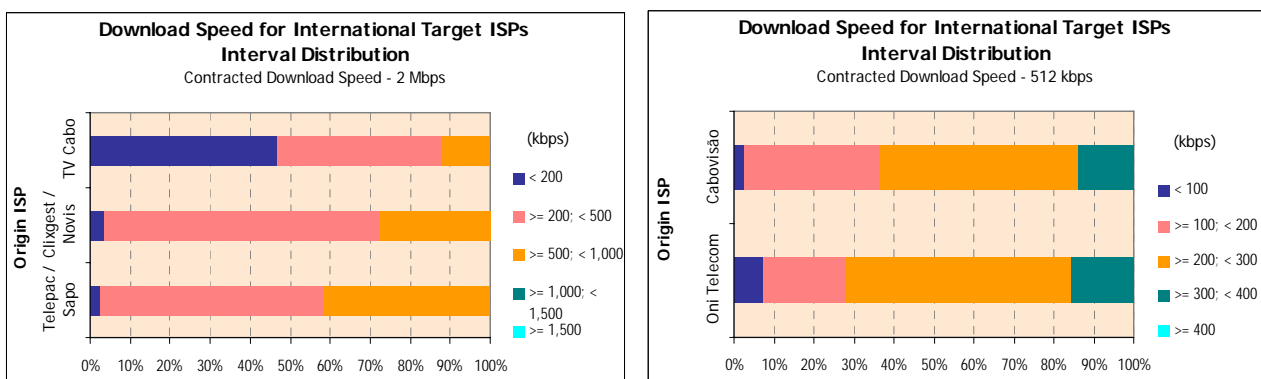


Figure 21 – Download speed interval distribution (HTTP), for international target ISPs.

In the group of ISPs with a 2 Mbps download speed offer, for national target ISPs, ISP TV CABO was the only one with speeds in the highest interval – speeds of or above 1500 kbps (23.4% of the measurements made registered speeds in this interval). However, this is also the ISP with a higher number of measurements with speeds under 500 kbps (34.5%), while operators Clixgest/Novis and Telepac/Sapo only had 11.9% and 5.9% of the measurements in that interval.

When the targets are international, none of the operators registered speeds above 1,000 kbps. TV Cabo registered 11.9% of measurements in the 500 to 1,000 kbps interval; Clixgest/Novis 27.6%, and Telepac/Sapo 41.7%. In the lowest interval – download speeds below 200 kbps – differences between operators are even stronger. TV Cabo had 46.6% of measurements in this interval, while the other two operators had very low percentages, 3.8% for Clixgest/Novis and 2.7% for Telepac/Sapo.

In the group of ISPs with a 512 kbps download speed offer, the scenario was identical. In the case with national target ISPs, only the cable operator (Cabovisão) had measurements (37.3%) in the highest interval (speeds over 400 kbps). However, it was also the one with more measurements with worst results. Cabovisão had 28.8% of the measurements with speeds below 200 kbps while OniTelecom only had 12.1% below this speed. For international target ISPs, the results are quite balanced between the two operators.

The variation in the HTTP download speed indicator between week days and the weekend and along the hours of the day was also analysed.

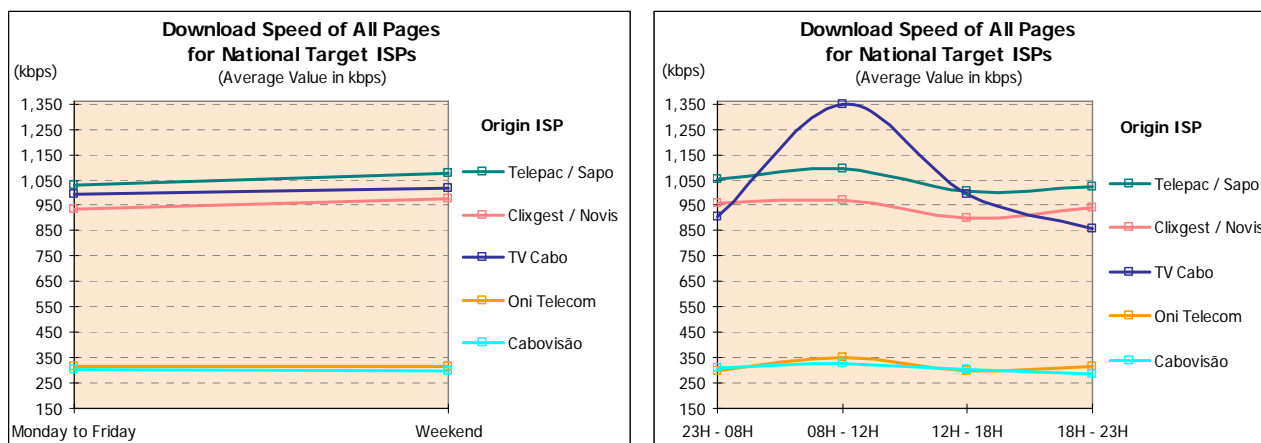


Figure 22 – Average download speed variation (HTTP) by day of the week and hours, for national target ISPs.

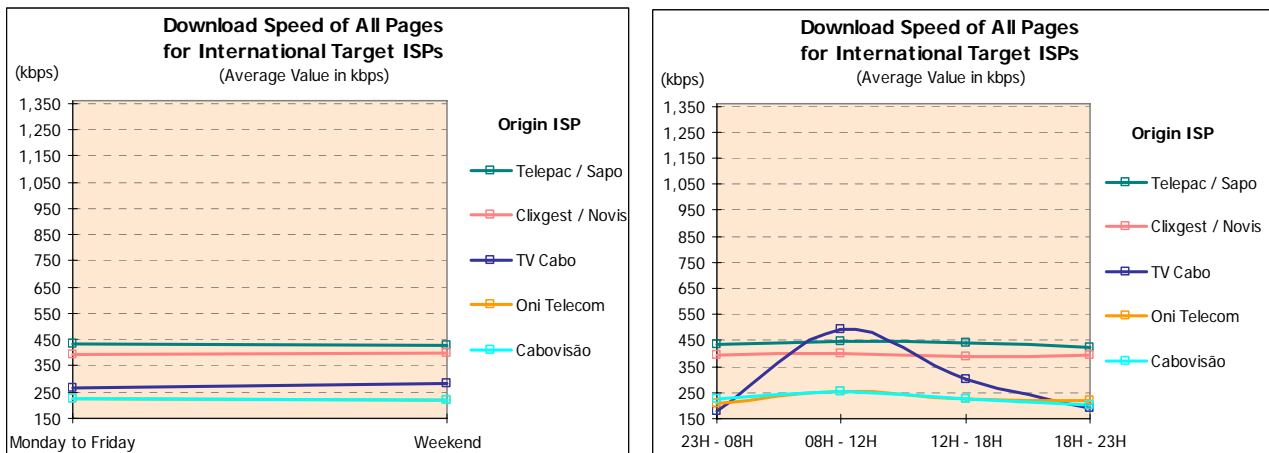
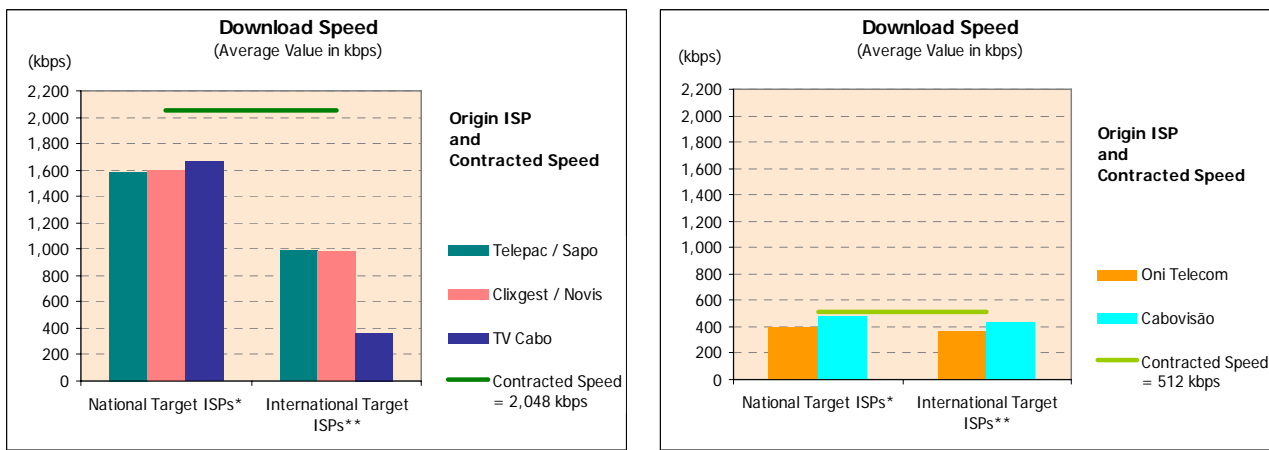


Figure 23 – Average download speed variation (HTTP), by day of the week and hours, for international target ISPs.

The several analysed operators do not show important variations in this indicator between week days and the weekend. However, an analysis along the hours of the day shows some speed variation, even quite significant in the case with operator TV Cabo, both for national and for international target ISPs.

Efficiency indicators were also studied using FTP download tests.

FTP protocol is more efficient in routing useful data and does not use data compression, and therefore FTP measurements are closer to the real access throughput than the HTTP ones.



\* Measurements for the same ISP

\*\* Group made up of international ISPs

Figure 24 – User's perception of FTP download: Average download speed.

These FTP test results for national target ISPs only included measurements to the same ISP, since guaranteeing result comparability is fundamental, because not all operators possessed FTP servers for the

making of crossed tests (the case with operators Telepac/Sapo and TV Cabo). However, crossed tests were made for the remaining operators, the results of which are also part of this report.

Average FTP download speed values are higher than those registered in HTTP.

For the 2 Mbps download speed offer, in the analysis for national target ISPs, TV Cabo was the operator with the highest average speed (1,668 kbps), closely followed by the other two operators (1,583 kbps for Telepac/Sapo and 1,596 kbps for Clixgest/Novis). Regarding the group of ISPs with a 512 kbps contracted speed offer, the highest average speed was 477 kbps, by ISP Cabovisão, while OniTelecom did not go beyond a 399 kbps average speed.

As with the HTTP tests, average download speed is lower in the case with measurements for international target ISPs. In the group of ISPs with the highest contracted speeds, Telepac/Sapo and Clixgest/Novis reached very similar values (respectively 995 kbps and 976 kbps), while TV Cabo's values were much lower, not exceeding an average 360 kbps download speed. In the group of ISPs with the lowest contracted speed, ISP Cabovisão's average speed was the fastest (431 kbps). OniTelecom settled for 368 kbps.

Regarding download speed interval distribution, as with the HTTP test, ISPs also reached different results.

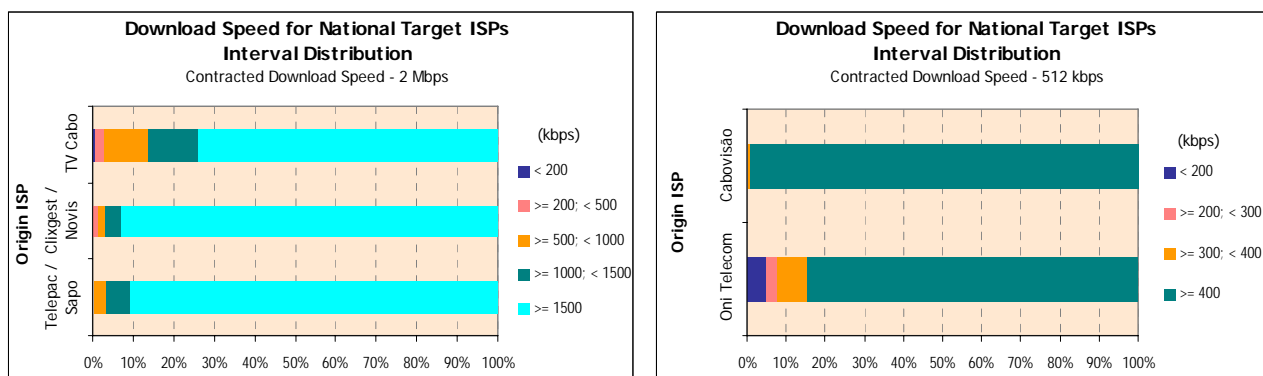


Figure 25 – Average download speed interval distribution (FTP), for national Target ISPs.

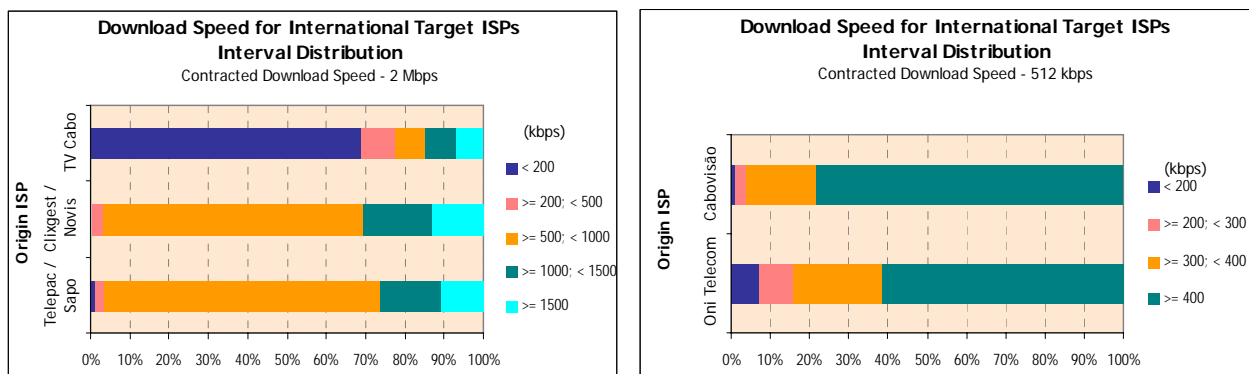


Figure 26 – Average download speed interval distribution (FTP), for international Target ISPs.

In the group of ISPs with a 2 Mbps download speed offer, the data centres of ISPs Clixgest/Novis and Telepac/Sapo had over 90% of measurements in the highest interval (speeds above 1,500 kbps), while 74% of measurements for ISP TV Cabo fell in this interval.

In the ISPs with a 512 kbps download speed offer, highlight goes to Cabovisão, with over 99% of measurements for national target ISPs with speeds equal or above 400 kbps (84% in the case with OniTelecom).

Regarding the measurements to international target ISPs, in the group of ISPs with a 2 Mbps download speed offer, TV Cabo registered the highest number of measurements, around 69%, in the lowest speed interval (below 200 kbps), while Clixgest/Novis and Telepac/Sapo had residual values of 0.5% and 1% in this interval, respectively. Most measurements for these two operators, Telepac/Sapo and Clixgest/Novis (70% and 66%, respectively) fell in the 500 to 1,000 kbps interval.

For the group of ISPs with a 512 kbps download speed offer, Cabovisão had better results than ISP OniTelecom, for international target ISPs, since it had a lower percentage of measurements with speeds in the lower interval, of less than 200 kbps (1.3% against 6.9%) and a higher percentage of measurements in the highest interval, equal or above 400 kbps (78.3% against 61.5%).

This indicator does not vary significantly with ISPs Telepac/Sapo, Clixgest/Novis, OniTelecom and Cabovisão regarding the day of the week, the hour of the day or the location of target ISPs. The results were different with ISP TV Cabo, which had different behaviours for each type of target ISPs. For national ISPs, it showed variations of low significance, regardless of the day of the week or hour of the day. For international ISPs, important differences occurred in the download speed, mainly along the hours of the day.

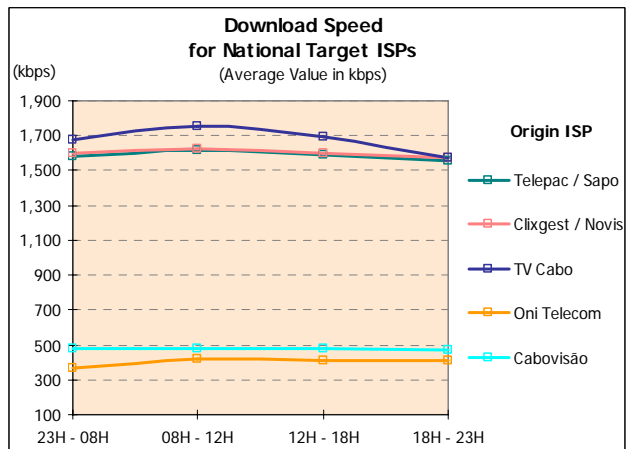
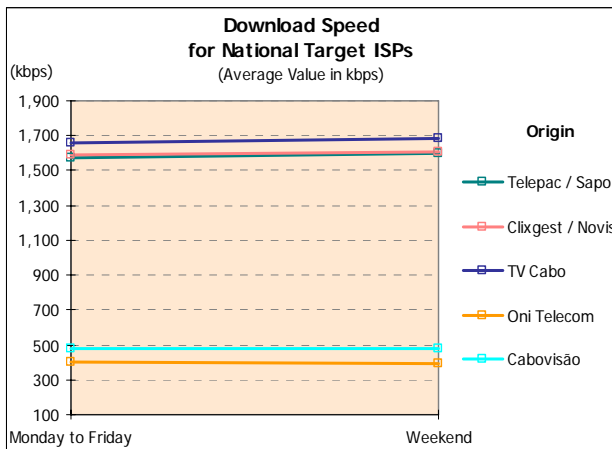


Figure 27 – Average download speed variation (FTP) by day of the week and hours, for national Target ISPs.

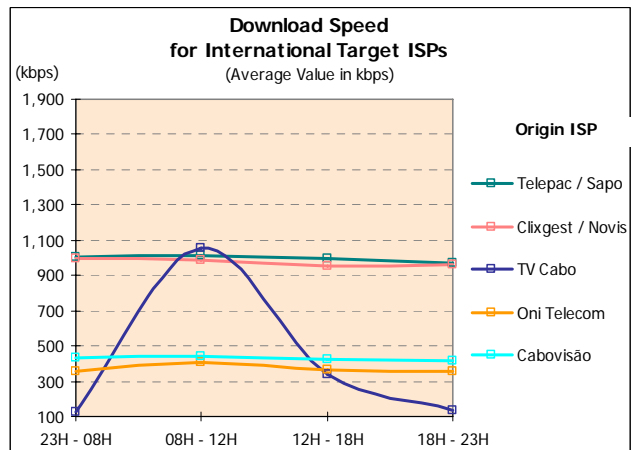
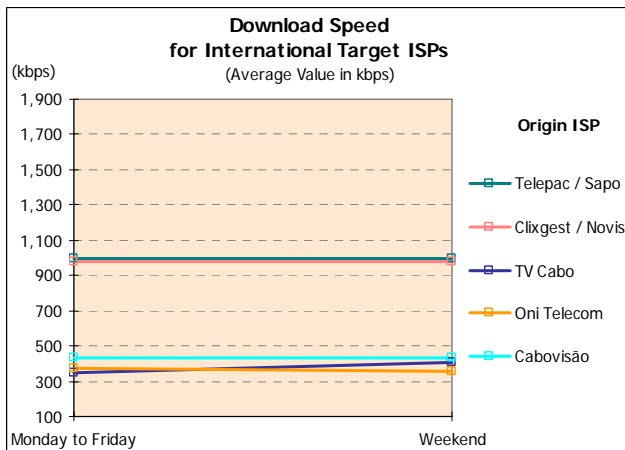
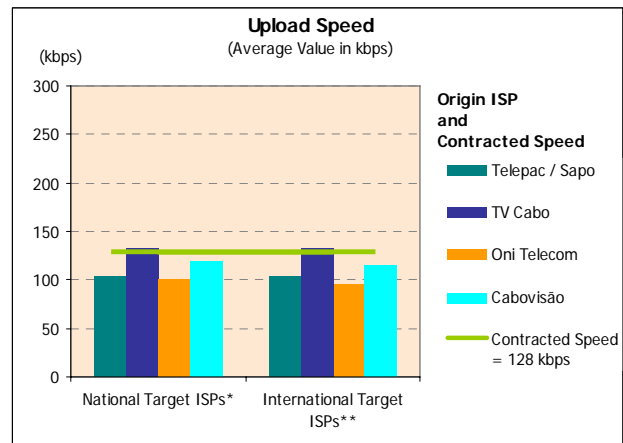
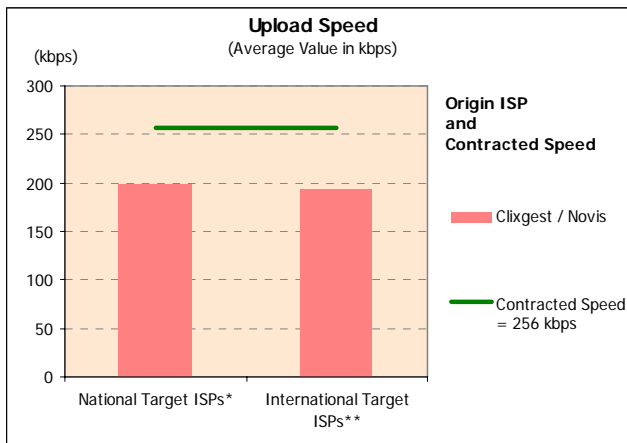


Figure 28 – Average download speed variation (FTP) by day of the week and hours, for international Target ISPs.

The “average upload speed” (FTP) indicator analyses the behaviour of Internet access when sending files to the data centres of the studied operators.

The results are only directly comparable when the analyzed offers have the same contracted speed. Among the analysed ISPs, only Clixgest/Novis has a 256 kbps upload offer and therefore this operator's results cannot directly compare to the remaining ones.

This ISP's average upload speeds for its own data centre and for the data centres of the international ISPs were of around 200 kbps, thus below the contracted speed (256 kbps).



\* Measurements to the same ISP  
 \*\* Group made up of international ISPs

Figure 29 – User’s perception of FTP upload: Average upload speed.

In the case with the remaining operators, offering upload speeds of 128 kbps, each operator’s results, for its own data centre and for the international data centres, show that TV Cabo has the fastest average speeds (about 134 kbps and 129 kbps, respectively), even exceeding the contracted speed (128 kbps). The speeds registered by these ISPs, both for national and for international target ISPs, were around 100 kbps, 95 kbps and 115 kbps, for Telepac/Sapo, OniTelecom and Cabovisão, in this order.

Regarding the analysis by speed intervals, in the group of ISPs with a 128 kbps upload speed offer ISPs Cabovisão and TV Cabo were the only ones with speeds in the highest interval (speeds equal or above 120 kbps).

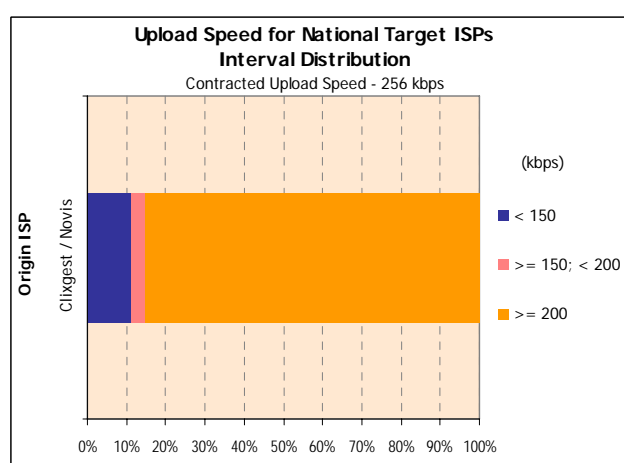
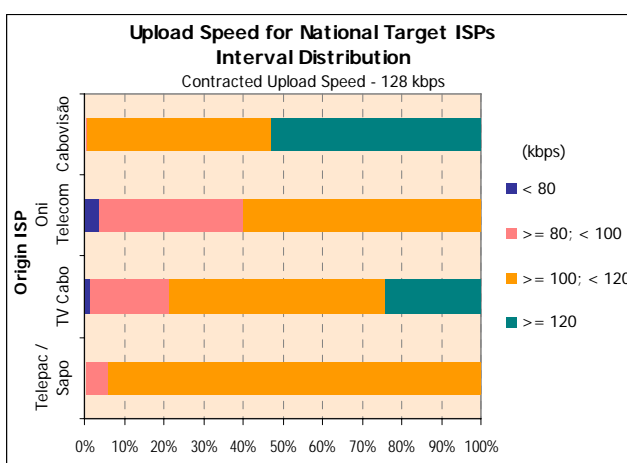


Figure 30 – Upload speed interval distribution (FTP), for national target ISPs.

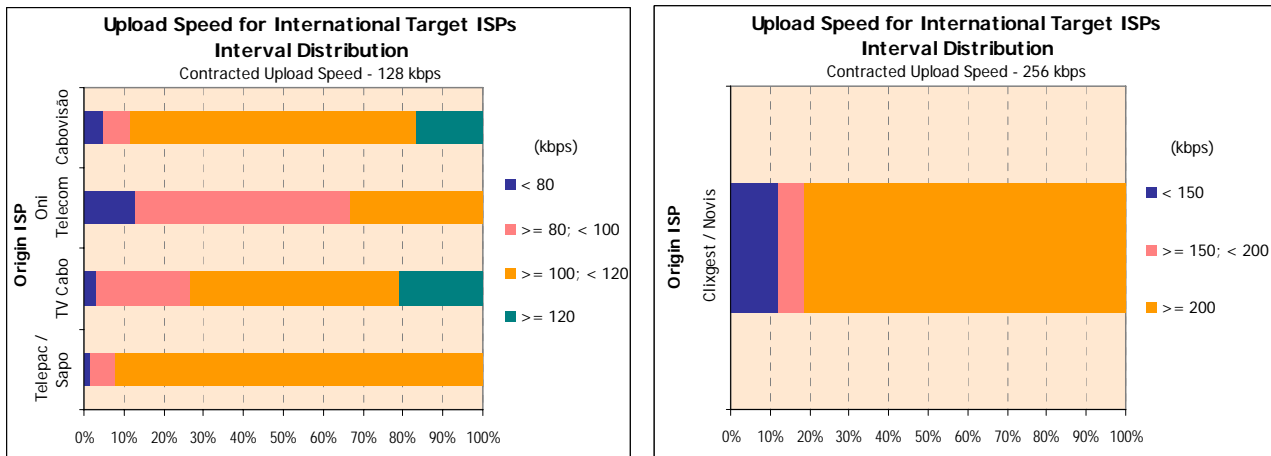


Figure 31 – Upload speed interval distribution (FTP), for international target ISPs.

In measurements for national target ISPs, highlight goes to Cabovisão, which percentage of measurements in this interval is about 53%, whereas TV Cabo's is around 24%. In the case with international target ISPs, these relative positions are reversed: TV Cabo had the best result, with about 21% of the measurements, against Cabovisão's 17%.

Regarding the lower speed intervals (speeds below 100 kbps) highlight goes, on the negative side, to OniTelecom, which stands for 40% of the measurements in these intervals, for national target ISPs, and around 67%, for international target ISPs.

Regarding ISP Clixgest/Novis (a 256 kbps contracted speed), most measurements had values above 200 kbps, about 85% for national target ISPs and 81% for international target ISPs.

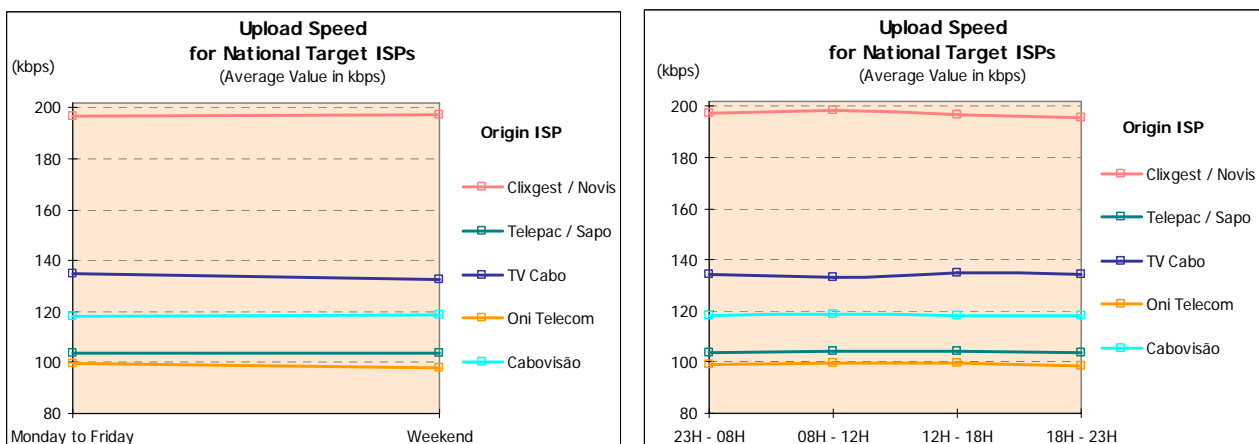


Figure 32 – Average upload speed variation (FTP) by day of the week and hours, for national target ISPs.



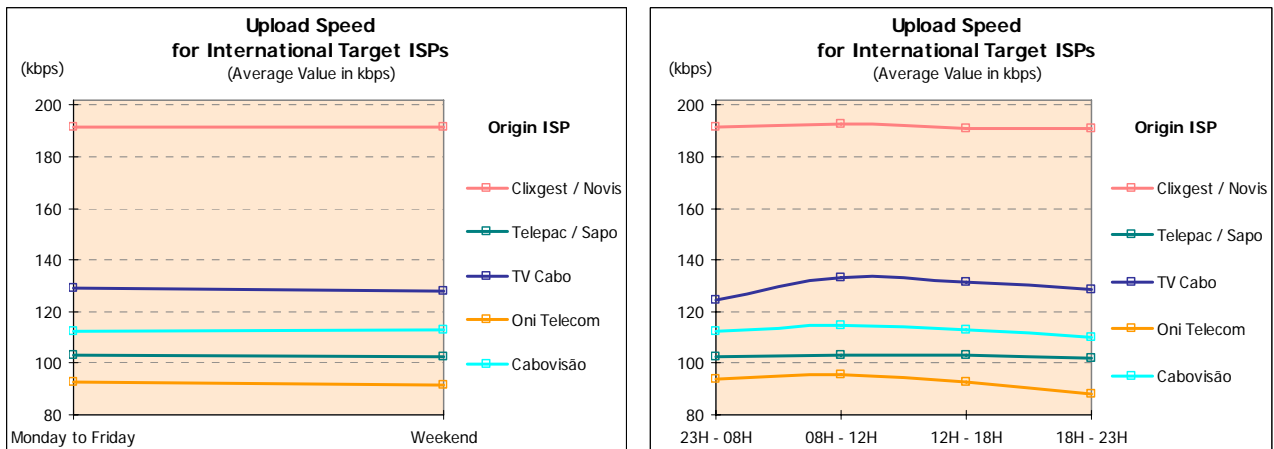


Figure 33 – Average upload speed variation (FTP) by day of the week and hours, for international target ISPs.

Regarding the variation in the FTP upload speed indicator, none of the analysed ISPs showed important variations by day of the week, hour of the day or location of the target ISP.

Another test made was the Ping one, which measured the line's latency, i.e., the communication's instantaneity, which is particularly relevant when using interactive applications (online games, for example). The analysed indicator was the Ping Time.

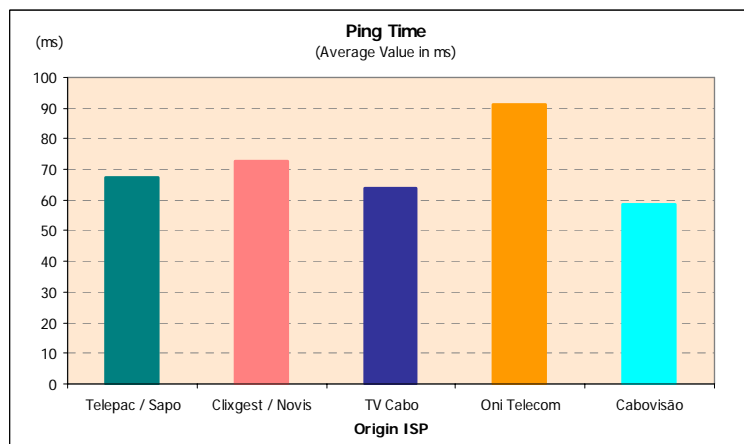


Figure 1 – Average ping time

ISP Cabovisão had the best result for the average ping time, with the lowest value (around 58 ms). The highest average value (around 91 ms) was registered by ISP OniTelecom.

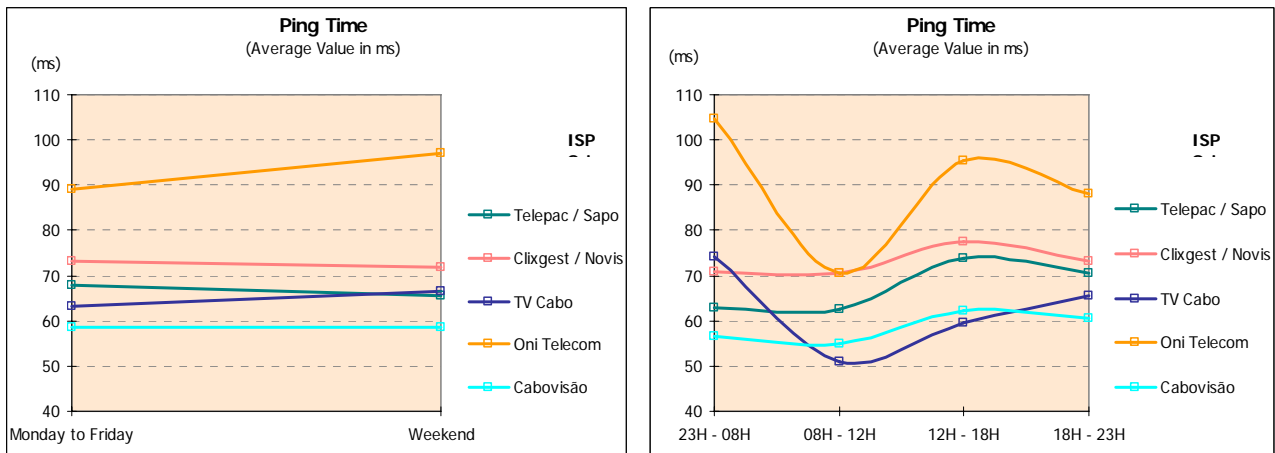


Figure 36 – Ping time variation by day of the week and hours.

When analysing the variation in this indicator by days of the week, operators OniTelecom and TV Cabo show slight degradations on the weekend. For the remaining operators, the indicator remains practically unchanged.

Regarding the hourly variation, the worse values for operators OniTelecom and TV Cabo occurred during dawn (23h00 to 08h00 period), while, for the remaining operators, they occurred in the afternoon period (from 12h00 to 18h00).

The tests also showed that, in some situations, traffic among national origin and national target ISPs was carried through international routes.

# Annex 1

## Annex 1 – Results' minimum, average and maximum values, standard deviation and precision errors

### 1 User's perception of HTTP download

#### 1.1 Average values, standard deviation and precision errors

##### 1.1.1 National Target ISPs

<b>Download Speed of All Pages (Average Value in kbps)</b>						
Measurements for National Target ISPs*						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	1,031.41	933.98	994.68	313.15	306.05
	Weekend	1,076.48	975.31	1,020.18	313.99	299.26
<b>Hours</b>	23H - 08H	1,052.35	960.40	906.47	298.46	306.45
	08H - 12H	1,093.28	973.32	1,348.93	349.23	324.92
	12H - 18H	1,006.94	902.10	992.46	300.22	306.28
	18H - 23H	1,023.40	938.42	856.94	313.11	285.09
<b>TOTAL</b>		<b>1,043.34</b>	<b>944.92</b>	<b>1,001.43</b>	<b>313.37</b>	<b>304.25</b>
<b>BASE</b> (N° of measurements for Nat. Targ. ISPs)		6,800	6,800	6,800	6,800	6,800

\* This table had special weighting (see methodology)

<b>Download Speed of All Pages (Standard Deviation in kbps)</b>						
Measurements for National Target ISPs*						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	259.30	295.81	677.41	84.01	128.33
	Weekend	212.00	267.68	688.87	77.51	127.34
<b>Hours</b>	23H - 08H	240.79	287.75	682.07	95.66	128.87
	08H - 12H	189.50	268.51	576.83	50.53	121.47
	12H - 18H	291.37	303.29	655.74	80.06	127.09
	18H - 23H	254.16	291.13	679.65	78.94	130.10
<b>TOTAL</b>		<b>248.44</b>	<b>289.18</b>	<b>680.50</b>	<b>82.34</b>	<b>128.09</b>
<b>BASE</b> (N° of measurements for Nat. Targ. ISPs)		6,800	6,800	6,800	6,800	6,800

\* This table had special weighting (see methodology)

<b>Download Speed of All Pages (Precision Error in kbps)</b>						
Measurements for National Target ISPs* (kbps)						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	3.67	4.18	9.58	1.19	1.81
	Weekend	5.00	6.31	16.24	1.83	3.00
<b>Hours</b>	23H - 08H	5.25	6.28	14.88	2.09	2.81
	08H - 12H	5.06	7.18	15.42	1.35	3.25
	12H - 18H	7.79	8.11	17.53	2.14	3.40
	18H - 23H	5.83	6.68	15.59	1.81	2.98
<b>TOTAL</b>		<b>3.01</b>	<b>3.51</b>	<b>8.25</b>	<b>1.00</b>	<b>1.55</b>
<b>BASE</b> (Nº of measurements for Nat. Targ. ISPs)		6,800	6,800	6,800	6,800	6,800

\* This table had special weighting (see methodology)

### 1.1.2 International Target ISPs

<b>Download Speed of All Pages (Average Value in kbps)</b>						
Measurements for International Target ISPs (kbps)						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	434.83	392.49	267.69	227.58	226.26
	Weekend	429.38	398.85	280.74	217.59	221.22
<b>Hours</b>	23H - 08H	432.84	393.77	178.95	210.26	226.89
	08H - 12H	443.84	399.59	494.52	252.49	253.57
	12H - 18H	441.13	390.81	298.99	227.24	226.91
	18H - 23H	420.57	393.12	187.93	219.16	200.17
<b>TOTAL</b>		<b>433.38</b>	<b>394.18</b>	<b>271.14</b>	<b>224.94</b>	<b>224.92</b>
<b>BASE</b> (Nº of measurements for Intern. Target ISPs)		2,720	2,720	2,720	2,720	2,720

<b>Download Speed of All Pages (Standard Deviation in kbps)</b>						
Measurements for International Target ISPs (kbps)						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly period</b>	Monday to Friday	130.65	139.84	178.18	69.72	68.36
	Weekend	137.89	135.83	189.91	67.41	69.61
<b>Hours</b>	23H - 08H	134.48	141.07	109.91	79.18	69.78
	08H - 12H	123.80	131.68	160.60	52.09	59.24
	12H - 18H	127.44	137.45	157.42	66.17	68.19
	18H - 23H	139.51	142.45	116.52	64.70	65.57
<b>TOTAL</b>		<b>132.60</b>	<b>138.79</b>	<b>181.42</b>	<b>69.24</b>	<b>68.72</b>
<b>BASE</b> (Nº of measurements for Intern. Targ. ISPs)		2,720	2,720	2,720	2,720	2,720

Download Speed of All Pages (Precision Error in kbps)						
Measurements for International Target ISPs						
		Origin ISP				
		Contracted Download Speed				
		2 Mbps			512 kbps	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	2.92	3.13	3.98	1.56	1.53
	Weekend	5.14	5.06	7.08	2.51	2.59
<b>Hours</b>	23H - 08H	4.64	4.87	3.79	2.73	2.41
	08H - 12H	5.23	5.56	6.79	2.20	2.50
	12H - 18H	5.39	5.81	6.65	2.80	2.88
	18H - 23H	5.06	5.17	4.23	2.35	2.38
<b>TOTAL</b>		<b>2.54</b>	<b>2.66</b>	<b>3.48</b>	<b>1.33</b>	<b>1.32</b>
<b>BASE (N° of measurements for Intern. Targ. ISPs)</b>		2,720	2,720	2,720	2,720	2,720

## 1.2 Minimum, average and maximum values

Download Speed of All Pages from the Origin ISP to Target ISPs *										
(Average, Minimum and Maximum Value in kbps)										
		Origin ISP								
		Contracted Download Speed - 2 Mbps								
		Telepac / Sapo			Clixgest / Novis			TV Cabo		
		Average	Min	Max	Average	Min	Max	Average	Min	Max
<b>Target ISP</b>	Telepac / Sapo	1,064.63	17.70	1,351.05	907.61	23.15	1,370.21	1,303.26	10.53	2,888.91
	Clixgest / Novis	1,049.98	6.04	1,348.82	1,010.96	6.73	1,388.23	550.99	8.73	2,627.39
	TV Cabo	1,110.09	97.34	1,374.94	943.30	25.15	1,381.97	1,386.93	52.34	3,054.95
	OniTelecom	852.20	20.54	1,344.04	949.92	69.36	1,386.17	534.67	13.02	2,840.94
	Cabovisão	1,126.63	89.22	1,365.21	929.41	48.83	1,346.19	574.11	12.53	2,959.12
	International**	433.38	14.71	711.22	394.18	11.14	731.78	271.14	7.33	964.03
<b>BASE (N° of measurements)</b>		9,520			9,520			9,520		

\* This table was not subject to the special weighting described in methodology  
\*\* Group made up of international ISPs

Download Speed of All Pages from the Origin ISP to Target ISPs *							
(Average, Minimum and Maximum Value in kbps)							
		Origin ISP					
		Contracted Download Speed - 512 kbps					
		Oni Telecom			Cabovisão		
		Average	Min	Max	Average	Min	Max
<b>Target ISP</b>	Telepac / Sapo	301.51	17.79	395.68	222.25	12.34	465.81
	Clixgest/ Novis	328.67	10.94	395.45	397.69	10.01	531.99
	TV Cabo	330.39	52.35	397.29	367.48	9.18	493.64
	Oni Telecom	318.38	49.81	398.57	412.51	19.09	504.46
	Cabovisão	333.40	65.76	396.28	436.59	74.53	574.33
	International**	224.94	10.45	325.04	224.92	10.77	380.56
<b>BASE (N° of measurements)</b>		9,520			9,520		

\* This table was not subject to the special weighting described in methodology  
\*\* Group made up of international ISPs

## 2 User's perception of FTP download

### 2.1 Average values, standard deviation and precision errors

#### 2.1.1 National Target ISPs

<b>Download Speed (Average Value in kbps)</b>						
Measurements for National Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	1,576.98	1,591.55	1,661.60	400.40	476.87
	Weekend	1,598.92	1,608.80	1,686.34	396.10	475.70
<b>Hours</b>	23H - 08H	1,579.98	1,599.26	1,676.79	369.80	477.35
	08H - 12H	1,611.58	1,623.74	1,756.19	417.92	478.32
	12H - 18H	1,592.65	1,595.69	1,693.16	414.25	476.64
	18H - 23H	1,557.42	1,572.60	1,575.29	407.04	474.34
<b>TOTAL</b>		<b>1,582.79</b>	<b>1,596.11</b>	<b>1,668.15</b>	<b>399.26</b>	<b>476.56</b>
<b>BASE (N° of measurements to ISP itself)</b>		1,360	1,360	1,360	1,360	1,360

<b>Download Speed (Standard Deviation in kbps)</b>						
Measurements for National Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	218.75	209.77	580.00	70.14	15.19
	Weekend	164.13	175.05	612.69	70.23	17.16
<b>Hours</b>	23H - 08H	205.12	198.18	578.89	102.46	10.48
	08H - 12H	136.37	156.39	577.47	35.38	6.67
	12H - 18H	181.27	189.90	582.96	30.76	17.94
	18H - 23H	257.40	236.90	601.38	54.60	22.12
<b>TOTAL</b>		<b>205.88</b>	<b>201.25</b>	<b>588.70</b>	<b>70.16</b>	<b>15.74</b>
<b>BASE (No. of measurements to ISP itself)</b>		1,360	1,360	1,360	1,360	1,360

<b>Total Download Speed (Precision Error in kbps)</b>						
Measurements for National Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	6.92	6.63	18.34	2.22	0.48
	Weekend	8.65	9.23	32.29	3.70	0.90
<b>Hours</b>	23H - 08H	10.01	9.67	28.25	5.00	0.51
	08H - 12H	8.15	9.35	34.51	2.11	0.40
	12H - 18H	10.83	11.35	34.84	1.84	1.07
	18H - 23H	13.20	12.15	30.85	2.80	1.13
<b>TOTAL</b>		<b>5.58</b>	<b>5.46</b>	<b>15.96</b>	<b>1.90</b>	<b>0.43</b>
<b>BASE (No. of measurements to ISP itself)</b>		1,360	1,360	1,360	1,360	1,360

## 2.1.2 International Target ISPs

<b>Download Speed (Average Value in kbps)</b>						
Measurements for International Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	994.66	975.63	343.72	372.66	430.72
	Weekend	995.01	978.46	408.54	353.85	433.33
<b>Hours</b>	23H - 08H	1,000.47	998.14	123.46	353.12	436.35
	08H - 12H	1,011.28	984.88	1,052.47	406.38	444.74
	12H - 18H	999.37	949.62	336.04	362.28	428.13
	18H - 23H	972.86	965.79	132.01	359.24	418.54
<b>TOTAL</b>		<b>994.75</b>	<b>976.38</b>	<b>360.88</b>	<b>367.68</b>	<b>431.41</b>
<b>BASE</b> (N° of measurements for Intern. Targ. ISPs)		2,720	2,720	2,720	2,720	2,720

<b>Download Speed (Standard Deviation in kbps)</b>						
Measurements for International Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly period</b>	Monday to Friday	281.92	335.73	529.64	80.53	57.77
	Weekend	318.37	312.88	593.65	89.17	55.59
<b>Hours</b>	23H - 08H	276.08	324.52	252.75	100.84	44.35
	08H - 12H	271.89	328.59	649.31	29.36	33.47
	12H - 18H	276.79	329.45	457.91	81.28	64.39
	18H - 23H	330.89	335.43	268.07	81.75	73.06
<b>TOTAL</b>		<b>291.95</b>	<b>329.78</b>	<b>547.95</b>	<b>83.30</b>	<b>57.20</b>
<b>BASE</b> (No. of measurements for Intern. Target ISPs)		2,720	2,720	2,720	2,720	2,720

<b>Download Speed (Precision Error in kbps)</b>						
Measurements for International Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Download Speed</b>				
		<b>2 Mbps</b>			<b>512 kbps</b>	
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	6.30	7.51	11.84	1.80	1.29
	Weekend	11.87	11.66	22.12	3.32	2.07
<b>Hours</b>	23H - 08H	9.53	11.20	8.72	3.48	1.53
	08H - 12H	11.49	13.89	27.44	1.24	1.41
	12H - 18H	11.70	13.92	19.35	3.43	2.72
	18H - 23H	12.00	12.17	9.72	2.97	2.65
<b>TOTAL</b>		<b>5.60</b>	<b>6.32</b>	<b>10.51</b>	<b>1.60</b>	<b>1.10</b>
<b>BASE</b> (No. of measurements for Intern. Target ISPs)		2,720	2,720	2,720	2,720	2,720



## 2.2 Minimum, average and maximum values

Download Speed from the Origin ISP to Target ISPs										
(Average, Minimum and Maximum Value in kbps)										
(kbps)										
		Origin ISP								
		Contracted Download Speed - 2 Mbps								
		Telepac / Sapo			Clixgest / Novis			TV Cabo		
		Average	Min	Max	Average	Min	Max	Average	Min	Max
Target ISP	Telepac / Sapo	1,582.79	240.84	1,728.60	**	**	**	**	**	**
	Clixgest / Novis	1,626.19	178.37	1,732.58	1,596.11	150.06	1,810.75	725.31	21.30	3,846.19
	TV Cabo	**	**	**	**	**	**	1,668.15	102.53	3,495.63
	OniTelecom	1,326.58	52.98	1,729.66	1,560.20	172.54	1,788.57	723.10	14.07	3,848.36
	Cabovisão	1,624.63	54.11	1,721.62	1,534.08	141.13	1,793.19	694.68	15.18	3,827.68
	International*	994.75	46.98	1,617.15	976.38	48.35	1,625.85	360.88	9.56	3,018.53
<b>BASE (Nº of measurements)</b>		8,160			6,800			8,160		
* Group made up of international ISPs										
** The Target ISP did not provide conditions for the making of this test										

Download Speed from the Origin ISP to Target ISPs							
(Average, Minimum and Maximum Value in kbps)							
(kbps)							
		Origin ISP					
		Contracted Download Speed - 512 kbps					
		Oni Telecom			Cabovisão		
		Average	Min	Max	Average	Min	Max
Target ISP	Telepac / Sapo	**	**	**	**	**	**
	Clixgest/ Novis	402.31	53.50	436.81	470.03	90.47	615.53
	TV Cabo	**	**	**	**	**	**
	Oni Telecom	399.26	34.33	438.67	475.25	117.02	619.06
	Cabovisão	397.12	43.85	435.67	476.56	251.81	576.06
	International*	367.68	24.05	431.09	431.41	19.36	580.84
<b>BASE (Nº of measurements)</b>		6,800			6,800		
* Group made up of international ISPs							
** The Target ISP did not provide conditions for the making of this test							

### 3 User's perception of FTP upload

#### 3.1 Average values, standard deviation, precision errors

##### 3.1.1 National Target ISPs

Upload Speed (Average Value in kbps)						
Measurements for National Target ISPs						
		Origin ISP				
		Contracted Upload Speed				
		256 kbps	128 kbps			
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão
Weekly Period	Monday to Friday	196.99	103.83	134.72	99.56	118.17
	Weekend	197.33	103.91	132.88	97.70	118.51
Hours	23H - 08H	197.65	103.69	134.23	98.89	118.30
	08H - 12H	198.60	104.11	133.08	99.89	118.57
	12H - 18H	196.76	104.01	135.08	99.60	118.33
	18H - 23H	195.55	103.74	134.46	98.27	117.92
<b>TOTAL</b>		<b>197.08</b>	<b>103.85</b>	<b>134.23</b>	<b>99.07</b>	<b>118.26</b>
BASE (N° of measurements to ISP itself)		1,360	1,360	1,360	1,360	1,360

Upload Speed (Standard Deviation in kbps)						
Measurements for National Target ISPs						
		Origin ISP				
		Contracted Upload Speed				
		256 kbps	128 kbps			
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão
Weekly Period	Monday to Friday	32.53	2.84	52.88	8.60	4.89
	Weekend	32.93	4.10	53.57	11.11	2.91
Hours	23H - 08H	31.86	4.28	52.25	9.15	3.68
	08H - 12H	30.65	1.86	53.67	7.52	4.60
	12H - 18H	32.92	2.18	53.55	8.90	4.46
	18H - 23H	34.66	3.28	53.30	10.98	5.07
<b>TOTAL</b>		<b>32.63</b>	<b>3.22</b>	<b>53.05</b>	<b>9.36</b>	<b>4.45</b>
BASE (No. of measurements to ISP itself)		1,360	1,360	1,360	1,360	1,360

Upload Speed (Error Precision in kbps)						
Measurements for National Target ISPs						
		Origin ISP				
		Contracted Upload Speed				
		256 kbps	128 kbps			
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão
Weekly Period	Monday to Friday	1.03	0.09	1.67	0.27	0.15
	Weekend	1.74	0.22	2.82	0.59	0.15
Hours	23H - 08H	1.55	0.21	2.55	0.45	0.18
	08H - 12H	1.83	0.11	3.21	0.45	0.27
	12H - 18H	1.97	0.13	3.20	0.53	0.27
	18H - 23H	1.78	0.17	2.73	0.56	0.26
<b>TOTAL</b>		<b>0.88</b>	<b>0.09</b>	<b>1.44</b>	<b>0.25</b>	<b>0.12</b>
BASE (No. of measurements to ISP itself)		1,360	1,360	1,360	1,360	1,360

### 3.1.2 International Target ISPs

<b>Upload Speed</b> (Average Value in kbps)						
Measurements for International Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Upload Speed</b>				
		<b>256 kbps</b>	<b>128 kbps</b>			
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	191.47	102.92	129.32	92.57	112.11
	Weekend	191.71	102.43	127.74	91.57	112.97
<b>Hours</b>	23H - 08H	191.82	102.75	124.56	94.08	112.10
	08H - 12H	192.56	103.37	132.97	95.47	114.63
	12H - 18H	190.86	103.17	131.70	92.53	113.23
	18H - 23H	190.97	102.12	128.64	87.84	110.24
<b>TOTAL</b>		<b>191.54</b>	<b>102.79</b>	<b>128.90</b>	<b>92.30</b>	<b>112.33</b>
<b>BASE</b> (Nº measurements for Internat. Targ. ISPs)		2,720	2,720	2,720	2,720	2,720

<b>Upload Speed</b> (Standard Deviation in kbps)						
Measurements for International Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Upload Speed</b>				
		<b>256 kbps</b>	<b>128 kbps</b>			
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	31.79	5.32	49.03	13.75	14.10
	Weekend	32.87	8.57	50.34	15.46	12.13
<b>Hours</b>	23H - 08H	31.51	6.54	46.54	12.26	13.68
	08H - 12H	31.14	3.31	50.07	10.38	10.12
	12H - 18H	33.18	5.01	51.22	13.07	12.56
	18H - 23H	32.57	8.34	50.22	17.97	16.01
<b>TOTAL</b>		<b>32.07</b>	<b>6.34</b>	<b>49.38</b>	<b>14.23</b>	<b>13.61</b>
<b>BASE</b> (No of measurements for Intern. Targ. ISPs)		2,720	2,720	2,720	2,720	2,720

<b>Upload Speed</b> (Precision Error in kbps)						
Measurements for International Target ISPs						
		<b>Origin ISP</b>				
		<b>Contracted Upload Speed</b>				
		<b>256 kbps</b>	<b>128 kbps</b>			
		Clixgest / Novis	Telepac / Sapo	TV Cabo	Oni Telecom	Cabovisão
<b>Weekly Period</b>	Monday to Friday	0.71	0.12	1.10	0.31	0.32
	Weekend	1.22	0.32	1.88	0.58	0.45
<b>Hours</b>	23H - 08H	1.09	0.23	1.61	0.42	0.47
	08H - 12H	1.32	0.14	2.12	0.44	0.43
	12H - 18H	1.40	0.21	2.16	0.55	0.53
	18H - 23H	1.18	0.30	1.82	0.65	0.58
<b>TOTAL</b>		<b>0.61</b>	<b>0.12</b>	<b>0.95</b>	<b>0.27</b>	<b>0.26</b>
<b>BASE</b> (No of measurements for Intern. Targ. ISPs)		2,720	2,720	2,720	2,720	2,720

### 3.2 Minimum, average and maximum values

Upload Speed from the Origin ISP to Target ISPs (Average, Minimum and Maximum Value in kbps)										
(kbps)										
Origin ISP										
Contracted Upload Speed - 256 kbps										
Contracted Upload Speed - 128 kbps										
Clixgest / Novis										
Telepac / Sapo										
TV Cabo										
Target ISP		Average	Min	Max	Average	Min	Max	Average	Min	Max
Target ISP	Clixgest / Novis	197.08	13.80	212.59	103.93	54.43	105.37	134.83	9.14	240.83
	Telepac / Sapo	**	**	**	103.85	22.54	106.74	**	**	**
	TV Cabo	**	**	**	**	**	**	134.23	9.02	241.42
	OniTelecom	196.25	68.97	212.67	103.32	13.86	105.47	134.64	11.75	240.57
	Cabovisão	181.67	65.91	212.55	102.86	32.62	105.31	133.77	6.90	240.92
	International*	191.54	49.40	207.70	102.79	19.64	104.96	128.90	12.72	236.12
<b>BASE (N° of measurements)</b>		6,800			8,160			8,160		
* Group made up of international ISPs										
** The Target ISP did not provide the conditions for the making the making of this test										

Upload Speed from the Origin ISP to Target ISPs (Average, Minimum and Maximum Value in kbps)										
(kbps)										
Origin ISP										
Contracted Upload Speed - 128 kbps										
Oni Telecom										
Cabovisão										
Target ISP		Average	Min	Max	Average	Min	Max	Average	Min	Max
Target ISP	Clixgest / Novis	97.08	15.02	106.91	118.12	38.75	153.99			
	Telepac / Sapo	**	**	**	**	**	**			
	TV Cabo	**	**	**	**	**	**			
	Oni Telecom	99.07	32.32	106.87	118.10	43.55	150.18			
	Cabovisão	98.98	34.69	106.86	118.26	51.76	146.56			
	International*	92.30	15.84	106.04	112.33	2.95	153.04			
<b>BASE (N° of measurements)</b>		6,800			6,800					
** Group made up of international ISPs										
** The Target ISP did not provide the conditions for the making the making of this test										

## 4 Ping Test

### 4.1 Average values, standard deviation and precision errors

Ping Time (Average Value in ms)		Origin ISP					(ms)
		Contracted Download Speed					
		2 Mbps			512 kbps		
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão	
Weekly Period	Monday to Friday	67.87	73.17	63.07	89.01	58.43	
	Weekend	65.59	71.88	66.66	97.17	58.46	
Hours	23H - 08H	62.94	70.95	74.20	104.82	56.55	
	08H - 12H	62.68	70.42	50.93	70.61	54.78	
	12H - 18H	73.83	77.41	59.64	95.36	62.15	
	18H - 23H	70.61	73.32	65.63	88.15	60.50	
<b>TOTAL</b>		<b>67.27</b>	<b>72.83</b>	<b>64.02</b>	<b>91.17</b>	<b>58.44</b>	
BASE (Nº of measurements)		9,520	9,520	9,520	9,520	9,520	

Ping Time (Standard Deviation in ms)		Origin ISP					(ms)
		Contracted Download Speed					
		2 Mbps			512 kbps		
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão	
Weekly Period	Monday to Friday	58.46	55.05	79.86	65.42	55.53	
	Weekend	71.68	54.19	99.53	71.48	57.23	
Hours	23H - 08H	52.62	54.11	114.79	76.04	55.01	
	08H - 12H	51.09	53.66	52.40	51.55	53.39	
	12H - 18H	63.26	57.25	58.79	65.50	58.39	
	18H - 23H	76.52	54.44	82.39	64.04	56.89	
<b>TOTAL</b>		<b>62.24</b>	<b>54.83</b>	<b>85.51</b>	<b>67.17</b>	<b>55.99</b>	
BASE (No. of measurements)		9,520	9,520	9,520	9,520	9,520	

Ping Time (Precision Error in ms)		Origin ISP					(ms)
		Contracted Download Speed					
		2 Mbps			512 kbps		
		Telepac / Sapo	Clixgest / Novis	TV Cabo	Oni Telecom	Cabovisão	
Weekly Period	Monday to Friday	0.70	0.66	0.95	0.78	0.66	
	Weekend	1.43	1.08	1.98	1.42	1.14	
Hours	23H - 08H	0.97	1.00	2.12	1.40	1.01	
	08H - 12H	1.15	1.21	1.18	1.16	1.21	
	12H - 18H	1.43	1.29	1.33	1.48	1.32	
	18H - 23H	1.48	1.06	1.60	1.24	1.10	
<b>TOTAL</b>		<b>0.64</b>	<b>0.56</b>	<b>0.88</b>	<b>0.69</b>	<b>0.57</b>	
BASE (No. of measurements)		9,520	9,520	9,520	9,520	9,520	

## 4.2 Minimum, average and maximum values

Ping Time from the Origin ISP to Target ISPs (Average, Minimum and Maximum Value in ms)										
(ms)										
		Origin ISP								
		Contracted Download Speed - 2 Mbps								
		Telepac / Sapo			Clixgest / Novis			TV Cabo		
		Average	Min	Max	Average	Min	Max	Average	Min	Max
Target ISP	Telepac / Sapo	30.71	15.87	536.91	38.35	15.37	224.19	21.35	6.92	532.71
	Clixgest / Novis	32.07	17.81	546.57	36.74	15.31	182.27	26.93	8.24	783.49
	TV Cabo	29.39	15.98	504.92	38.80	14.29	265.10	20.74	6.65	606.55
	OniTelecom	60.83	17.93	609.13	50.56	14.70	284.89	36.95	7.76	622.57
	Cabovisão	30.10	17.64	159.34	41.06	18.74	234.67	25.43	7.92	617.39
	International*	143.89	120.95	960.36	152.16	120.65	303.50	158.37	110.35	988.10
<b>BASE (N° of measurements)</b>		9,520			9,520			9,520		

\* Group made up of international ISPs

Ping Time from the Origin ISP to Target ISPs (Average, Minimum and Maximum Value in ms)										
(ms)										
		Origin ISP								
		Contracted Download Speed - 512 kbps								
		Oni Telecom			Cabovisão					
		Average	Min	Max	Average	Min	Max			
Target ISP	Telepac / Sapo	69.79	23.02	459.03	48.07	7.75	436.82			
	Clixgest/ Novis	55.18	22.05	214.74	20.48	12.46	222.90			
	TV Cabo	54.77	21.11	239.38	18.75	7.49	164.72			
	OniTelecom	65.14	20.52	354.83	30.27	7.94	295.57			
	Cabovisão	54.26	22.31	198.13	14.60	5.26	147.70			
	International*	169.53	130.41	514.79	138.46	8.67	333.90			
<b>BASE (N° of measurements)</b>		9,520			9,520					

\* Group made up of international ISPs

# Annex 2

## Annex 2 – Glossary

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### Main Concepts

<b>Download Speed</b>	FTP download speed of a 1 Mb file (in kbps)
<b>Upload Speed</b>	FTP upload speed of a 0.5 Mb file (in kbps)
<b>Download Speed of All Pages</b>	Loading speed of a full micro site (5 pages and their images) (in kbps)
<b>Ping Time</b>	ICMP ECHO time to the standard site/page (latency between the user and the standard page's site)
<b>No. of Hops (leaps)</b>	Number of intermediary machines used between the user's machine and the destination server
<b>International Route</b>	When there is at least one machine on the path which IP address is not inside the ranges granted to national operators.
<b>Exclusively National Route</b>	When intermediary machines used on the path have IP addresses belonging to ranges granted to national operators.
<b>Traceroute</b>	Trace route (path or route) to the standard page.
<b>Web Caching</b>	System providing storage of much requested (but seldom changed) pages, images and other web objects. Thus, if the same information is requested more than once after the first request, the Web Cache system returns the locally stored data instead of the real information, thus decreasing traffic on the Internet and the request's response time.
<b>Data Centre</b>	Physical facility used to host large amounts of electronic equipment, usually computers, servers and communication equipment. As the name shows, "Data Centres" are usually used by organizations to manipulate all data necessary to their operation. For example, a Bank may have a Data Centre keeping the data concerning their clients' accounts and processing all operations that involve this critical information. In the case with Telecommunications Operators, Data Centres are physical spaces with great computing, hosting and communication capacities, and from which several specific services are usually offered to final clients, as, for example, the hosting of Websites or servers.



## Strategic Concepts

<b>Sample Average</b>	The middle of the gravity centre of the distribution formed by the values of the statistical variable.
<b>Standard Deviation</b>	The quadratic average of the deviations to the average.
<b>Precision Error (or Average Precision Error)</b>	Since the average varies in samples extracted from the same universe, the quantification of its variability is named sample error estimate or precision error/average precision error.

## Acronyms

<b>ISP</b>	Internet Service Providers
<b>HTTP</b>	Hypertext Transfer Protocol
<b>FTP</b>	File Transfer Protocol
<b>ICMP</b>	Internet Control Message Protocol
<b>NTP</b>	Network Time Protocol
<b>bit</b>	the smallest data unit on a machine
<b>bps</b>	bits per second – number of bits transmitted over 1 second (transmission speed unit)
<b>kb</b>	kilo-bit – set of 1,024 bits
<b>kbps</b>	kilo-bits per second – number of kilo-bits transmitted over 1 second
<b>Mb</b>	Mega-bit – set of 1,048,576 bits (or 1,024 kilo-bits)
<b>Mbps</b>	Mega-bits per second - number of mega-bits transmitted over 1 second
<b>B</b>	Byte - set of eight bits (unit for the storing of information in a machine)
<b>KB</b>	Kilo-byte – set of 1,024 bytes
<b>MB</b>	Mega-byte – set of 1,048,576 bytes (or 1,024 kilo-bytes)
<b>ms</b>	one thousandth of a second
<b>s</b>	Seconds
<b>n</b>	number of sample units (measurements, in this study)