The information is also available in Anacom's Internet website in:

Evaluation of Internet Access Service

Dial-Up

June/July 2005

Contents

I EXECUTIVE SUMMARY

I.I GENERAL FRAMEWORK

The ICP-Autoridade Nacional de Comunicações (ANACOM) has for the first time conducted a study to gauge the quality of internet access services in Portugal from the user standpoint.

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

The FCCN (*Fundação para a Computação Científica Nacional*), APRITEL (*Associação dos Operadores de Telecomunicações*) and IC (*Instituto do Consumidor*) were also involved in this study and their suggestions and critical opinions were considered when determining the study methodology.

Subject to analysis in this first phase were the narrowband (dial-up) offers for the residential market segment supplied by the ISPs Telepac/SAPO, Clixgest/Novis, OniTelecom and Media Capital/IOL. These are Portugal's four biggest ISPs supplying such access, accounting for more than 90% of the market.

The indicators used to evaluate internet access service are divided into two basic types:

- **Reliability/Availability** – the time and success percentage for making a dial-up connection were measured and the service support systems (DNS and DHCP) verified;
- **Performance** – the information (HTTP and FTP) transmission/reception capacities were evaluated.

To carry out this project a panel of internet users was set up, representative in terms of time and geographic spread of the results, based on which the necessary measurements were conducted.

Measurements were made using a computer programme (software agent) developed for this purpose, installed in the personal computers of the user panel members. The software agent is automatically activated during preset time periods; it functions by connecting to the ISP, service provider in each panel computer, accessing the data centres of the operators under study and two international ones, and conducting the tests deemed necessary.

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

The measurements were used to extrapolate general data for each of the indicators, applying weighting and quality control processes.

Measurements were conducted from 14/06/2005 to 17/07/2005.

Various factors can affect internet navigation vis-à-vis the bitrate of information transmission/reception, specifically processing delays introduced in the access equipment itself, such as the use of anti-virus and personal firewalls; machine capacity, kinds of navigation software (browser versions, etc.); factors inherent to the operator network (caching, size of peering circuits, access technology, etc.); and sites visited, which are supported on platforms with their own performance limits.

Given these constraints, an effort was made to eliminate factors exogenous to operators, or, at best, to assess such entities under equal conditions (all results are namely influenced by protocol headers and anti-virus delays and personal firewalls) so that, while perfect information cannot be obtained, at least reliable conclusions may be drawn regarding the operators' performance. This, for example, is the reason behind the homogenisation (as much as possible) of access equipment, the removal of caching mechanisms (which mar the real results of transmission/reception speeds) and the creation of specific FTPs and sites to conduct the tests.

I.II   MAIN CONCLUSIONS

Regarding the Reliability/Availability indicators, the ISPs under study obtained success rates of above 98% for making dial-up internet connections. It is noteworthy that more than 92% of connections were made on the first attempt.
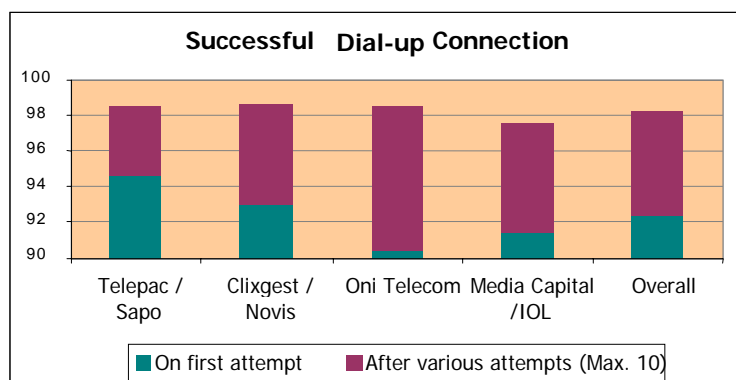
The average time needed to make such an internet connection was approximately 32 seconds.
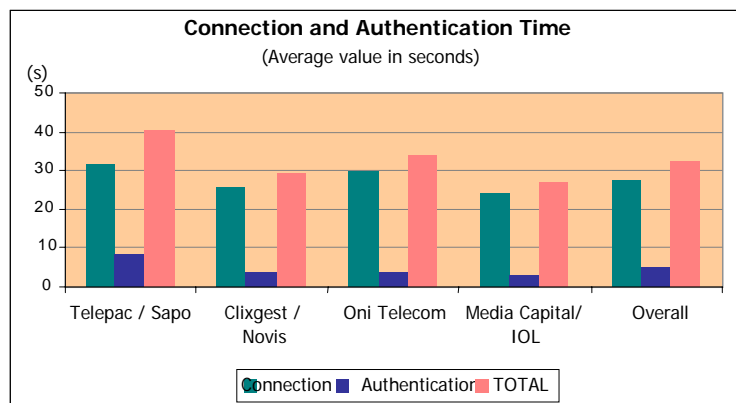
The aim of the Performance indicators evaluated in this study is to measure parameters in a situation of accessing any area on the internet. Such is the case of the indicator for the Speed Downloading Total Pages from a website (HTTP).

According to the results obtained for the Average Speed Downloading Total Pages, the operators are very close to each other. For the national target ISPs, OniTelecom presents the lowest value (39 kbps), while the figures for the remaining ISPs are close to 41 kbps. When the targets are the international ISPs, the values

obtained for this indicator vary between the 38 kbps of Telepac/Sapo and Clixgest/Novis, and the nearly 36 kbps of OniTelecom.

The download speeds for the international target ISPs are lower than those obtained for the national target ISPs, which indicates that the international segments are a constraint for all the operators.

Speed Downloading Total Pages
National ISPs vs. International ISPs
(Average value in kbps)
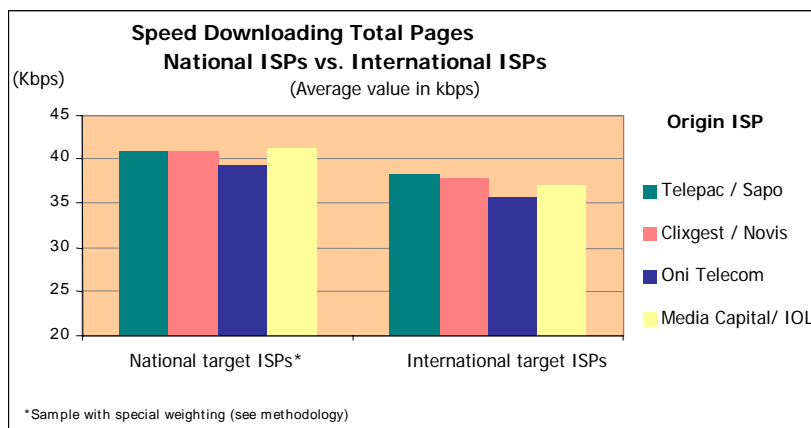
The performance indicators were also examined by means of FTP tests. As with the HTTP tests, average download speed is slightly less when the international target ISPs are measured. The highest average download speed for the two destinations (own and international) was obtained by the ISP Clixgest/Novis, though the differences between operators are relatively insignificant.

Download Speed
(Average value in kbps)
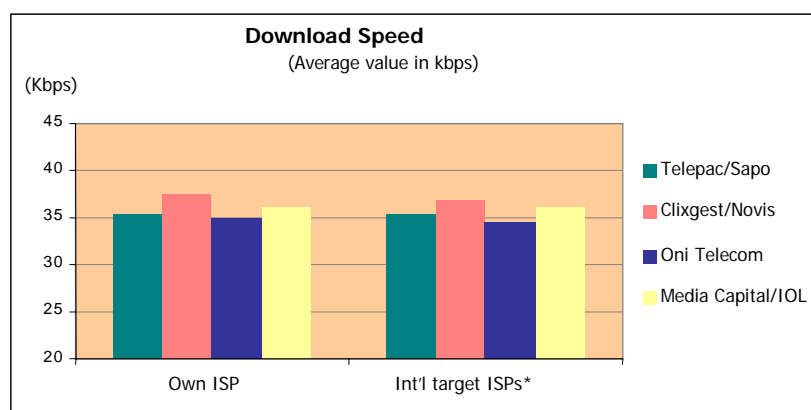
Comparison of the FTP and HTTP download speeds shows that the values obtained in FTP are lower. Given that the FTP protocol transports useful information more efficiently and does not use information compression, the FTP measurements should be closer to real access bitrate than the HTTP ones. HTTP's better performance can be explained by a number of mechanisms that increase the efficiency of this protocol, such

as, for example, the use of compression carried out by the operators.

In the test situation where a binary file was sent to the data centres of the operators under review (own ISP), very similar average upload speeds were obtained.

Upload Speed
(Average value in kbps)
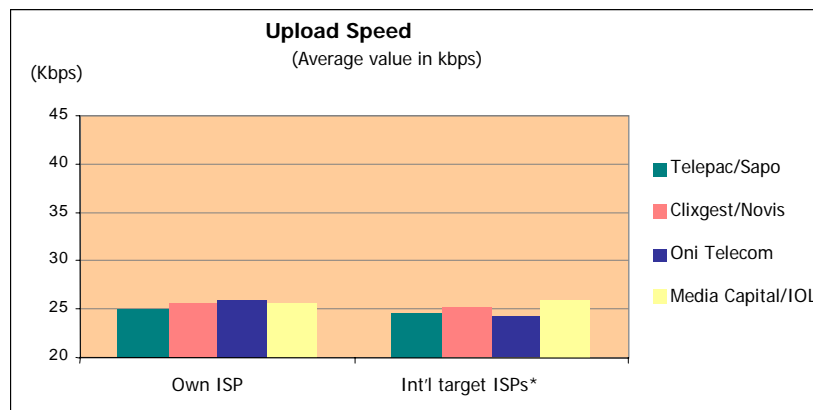
The upload speed is generally shown to be less when the connections are to international target ISPs. The operator Media Capital/IOL is the exception to the rule; its average speed for the group of international target ISPs is more than the average speed of connection with itself. This ISP was the one that obtained the highest average value (25.94 kbps) for the group of international target ISPs.

Another test conducted was the Ping Test, which enabled measurement of line latency, i.e., the instantaneousness of communication, which is especially significant when interactive applications are used (online games, for example).

Ping Time
(Avg. value in ms)
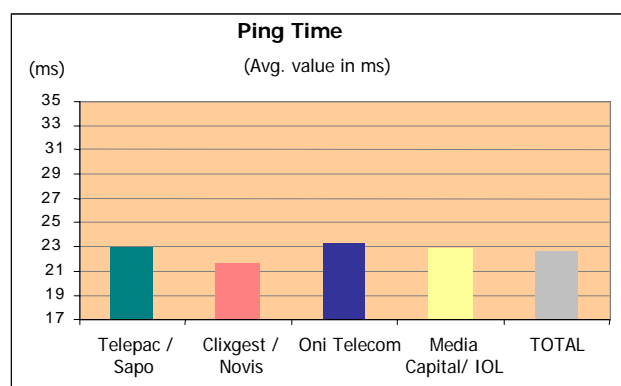
The Clixgest/Novis ISP had the best result for average ping time, obtaining the lowest value (about 217 ms). None of the other ISPs obtained an average time below the overall average time for the entire sample (227.2

ms).

The conducted tests also enabled observation that in some situations the traffic between origin ISPs and national target ISPs was routed via international routes.

1   INTRODUCTION

The ICP-Autoridade Nacional de Comunicações (ANACOM) has for the first time conducted a study to gauge the quality of internet access services in Portugal from the user standpoint.

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

The FCCN (*Fundação para a Computação Científica Nacional*) APRITEL (*Associação dos Operadores de Telecomunicações*) and IC (*Instituto do Consumidor*) were also involved in this study and their suggestions and critical opinions were considered when determining the study methodology.

Internet access service is understood to be the capacity to connect to the internet network with a given pace for transmitting and receiving information. This service is normally supplied by an ISP which, beyond the basic services of connection, transmission and reception of information (access to websites, email, etc.), may also offer additional services (mailboxes, site storage space, etc.). This study only aims to examine the basic services (connectivity and information transport – sending and receiving datagrammes).

In this first phase the narrowband (dial-up) offers provided by Portuguese ISPs for the residential market segment were subject to analysis. The option for this market segment is due to recognition that it is the one that most needs to be accompanied by the regulator to safeguard its interests.

Table 1 – Operators examined, for analogue dial-up technology

Technology		Bitrate	ISP
Narrowband	Analogue Dial-up	56 kbps	Telepac/Sapo
			Clixgest/Novis
			OniTelecom
			Media Capital/IOL

The four biggest Portuguese ISPs supplying the residential market were subject to analysis, accounting for more than 90% of the market.

The option to not include basic digital ISDN accesses in the study is due to the fact that the number of installed accesses with this technology is relatively insignificant when compared to the number of analogue accesses (basic ISDN accesses account for only about 4% of total installed accesses).

The indicators used to evaluate internet access service are divided into two basic types:

- **Reliability/Availability**

  Measures network availability (service accessibility) and the reliability of same (maintenance of availability);

- **Performance** – the information (HTTP and FTP) transmission/reception capacities were evaluated.

  Measures the provision of access, specifically the capacity to transmit/receive information (HTTP and FTP).

For the reliability/availability indicators the time and success percentage for making a dial-up connection were measured and the service support systems (DNS and DHCP) were verified.

For the performance indicators the aim was to measure parameters in a situation of access to a common webpage housed in the data centres of the various ISPs under review, in the data centres of the ISPs TV Cabo and Cabovisão, and in two international data centres (located in the United States of America).

To conduct the study a panel of internet users was set up, representative in terms of time and geographic spread of the results, based on which the necessary measurements were carred out – the sample units of this study. The software agent developed for this study was installed in the panel members' computers, whose minimum characteristics were determined beforehand so as not to constitute a factor limiting internet access.

The "Bareme-Internet" and "NetPanel" studies previously conducted by the MARKTEST partner were used to design the panel sample. They are reference studies for the Portuguese market and enable Portuguese households (mainland Portugal) to be characterised with respect to the internet, among other things, besides helping learn about the behaviour of Portuguese internet users when surfing the net from their homes.

Measurements were made using a computer programme (software agent) developed for this purpose, installed in the personal computers of the members of the user panel set up for this study. The software agent is automatically activated during preset time periods; it functions by connecting to the ISP, service provider in each panel computer, accessing the data centres of the operators under study and the two international ones, and conducting the tests deemed necessary.

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

It was held to be an essential requirement for this study that all the operators should be considered under equal circumstances, i.e., that the same number of measurements should be made from each ISP under

study. As there was some imbalance between operators in the sample used (in practice), the collected data was subject to a weighting process.

In the HTTP tests, and only with respect to the download speed for sites housed in national ISPs, a decision was made to add another factor to the weighting already practiced: given that the HTTP tests seek to recreate a navigation experience identical to reality, the destination ISPs were weighted taking into account the influence they have in navigation conducted from home.

Various factors can affect internet navigation vis-à-vis the bitrate of information transmission/reception, specifically processing delays introduced in the access equipment itself, such as the use of anti-virus and personal firewalls; machine capacity, kinds of navigation software (browser versions, etc.); factors inherent to the operator network (caching, size of peering circuits, access technology, etc.); and sites visited, which are supported on platforms with their own performance limits.

Given these constraints, an effort was made to eliminate factors exogenous to operators, or, at best, to evaluate such entities under equal conditions (all results are namely influenced by protocol headers and anti-virus delays and personal firewalls) so that, while perfect information cannot be obtained, at least reliable conclusions may be drawn regarding the operators' performance. This, for example, is the reason behind the homogenisation (as much as possible) of access equipment, the removal of caching mechanisms (which mar the real results of transmission/reception speeds) and the creation of specific FTPs and sites to conduct the tests.

2 METHODOLOGY

2.1 FIELD, SAMPLE AND OBTAINING RESULTS

2.1.1 FIELD

The basic study field is the homes of mainland Portugal where at least one individual resides who accesses the internet from home, using as an ISP (internet service provider) at least one of the following operators: Media Capital/IOL, Clixgest/Novis, Telepac/Sapo, and OniTelecom, in the offer for dial-up connection.

2.1.2 SAMPLE

2.1.2.1 DEFINITION OF SAMPLE

For a study of this nature, a panel with 100 homes with the conditions defined in the point above (2.1.1 Field) was deemed sufficient for this study, given that for each panel home various measurements would be made, thus minimising errors in the presented results. Note that for this study the individuals' behaviour does not matter, rather the various situations in which a connection is running, taking into account the region where the connection is made and the day and time it occurs.

A non-proportional sample of 100 homes was defined for this study, distributed equitatively by ISP used to make dial-up connections, as indicated in the following table:

Table 2 – Sample by ISP

ISP	No. of Homes
Telepac / Sapo	25
Clixgest / Novis	25
OniTelecom	25
Media Capital/IOL	25
TOTAL	100

A proportional sample spread by the Region variable was also proposed, as per the following table:

Table 3 – Sample by Region

Region	No. of Homes
Greater Lisbon	20
Greater Oporto	13

Region	No. of Homes
Coast	37
Interior	30
TOTAL	**100**

The Region variable comprises the following aggregations:

- **Greater Lisbon** (includes counties of Almada, Amadora, Cascais, Lisbon, Loures, Odivelas, Oeiras and Sintra);

- **Greater Oporto** (includes counties of Gaia, Gondomar, Maia, Matosinhos, Oporto and Santa Maria da Feira);

- **Coast** (includes counties of the District of Aveiro, except for the counties of Arouca, Castelo de Paiva, Sever do Vouga and Vale de Cambra; counties of the District of Braga: Barcelos, Braga, Esposende, Guimarães, Vila Nova de Famalicão and Vizela; counties of the District of Coimbra: Cantanhede, Coimbra, Condeixa-a-Nova, Figueira da Foz, Mira, Montemor-o-Velho and Soure; counties of the District of Oporto: Póvoa do Varzim, Santo Tirso, Trofa, Valongo and Vila do Conde; counties of the District of Viana do Castelo: Caminha and Viana do Castelo; the counties of the District of Leiria, except for Alvaiázere, Ansião, Castanheira de Pêra, Figueiró dos Vinhos and Pedrógão Grande; the counties of the District of Lisbon, except for Amadora, Cascais, Lisbon, Loures, Odivelas, Oeiras and Sintra; the counties of the District of Santarém, except for Almeirim, Alpiarça Benavente, Chamusca, Coruche, Ferreira do Zêzere, Mação, Salvaterra de Magos and Sardoal; counties of the District of Setúbal: Barreiro, Moita, Montijo, Seixal, Sesimbra and Setúbal and all counties of the District of Faro);

- **Interior** (includes all remaining counties in mainland Portugal).

The final collected sample was as follows:

Table 4 – Non-proportional sample by ISP and by Region

ISP	No. of Homes	Region	No. of Homes
Telepac / Sapo	25	Greater Lisbon	33
Clixgest / Novis	31	Greater Oporto	13
OniTelecom	32	Coast	39
Media Capital/IOL	28	Interior	31
TOTAL	**116**	**TOTAL**	**116**

2.1.2.2 METHOD OF SAMPLE SELECTION

The homes recruited were chosen according to ISP used and Region where located, by means of:

- Existing databases;

- Direct recruitment carried out by telephone.

Homes where people who work for ICP-ANACOM or any ISP live were not accepted in the study sample, even when the latter was not analysed in the study.

The individual responsible for maintaining the home's existing computer systems was asked to collaborate. If more than one person in the home carried out such duties, the one who showed more knowledge and interest for those areas was chosen. That individual is designated as the panellist for effects of this document.

Only one machine (personal computer) was chosen to conduct the tests in each home, said machine complying with the requirements set out in point 2.2.3 (Specification of the Software Agent) of this document.

Each home was recruited for the period of the study duration. Whenever deficiencies or withdrawals of collaboration were detected another home was recruited with the same characteristics defined in the sample matrix.

2.1.3 INFORMATION COLLECTION

2.1.3.1 COLLECTION PERIOD

The information was collected between 14/06/2005 and 17/07/2005.

2.1.3.2 PROCEDURES

Each panellist was asked to instal in the selected machine a computer programme – software agent – responsible for conducting the internet access tests.

Whenever it was necessary to conduct a measurement the panellist was contacted by telephone or email, advising that during the established period it would be necessary to leave the PC and modem connected so that the tests could begin.

In the sample points (homes) measurements were made every day of the week and at different time periods.

The distribution of periods was determined based on the audience curves provided MARKTEST'S NetPanel study.

The most notable differences in the curves are between working days and weekends; for this reason the following time distribution was used for the measurements:

Table 5 – Time distribution of measurements

Days Time Periods	Working Days	Weekends
From 8 a.m. to 10 a.m.	✔	✔
From 10 a.m. to 12 noon	✔	✔
From 12 noon to 4 p.m.	✔	✔
From 4 p.m. to 6 p.m.	✔	✔
From 6 p.m. to 8 p.m.	✔	-
From 6 p.m. to 9 p.m.	-	✔
From 8 p.m. to 9 p.m.	✔	-
From 9 p.m. to 11 p.m.	✔	✔
From 11 p.m. to 1 a.m.	✔	✔
From 1 a.m. to 4 a.m.	✔	✔
From 4 a.m. to 8 a.m.	✔	✔
TOTAL	**10**	**9**

In each machine chosen for the test (which is also equivalent to a panel home), 10 measurements were made on each working day and 9 measurements on each weekend day over the course of the collection period (in each home and in each week one measurement was made on a different week day), resulting in a total of 6,800 batteries of measurements[1].

During this time period the programme ran automatically (without user intervention) in the time intervals deemed necessary and when the machine was not being used at the time. The programme detected whether the machine was being used, and if so a pop-up advised the panellist to free up the machine due to the need to conduct a measurement. Only in certain occasional cases were panellists asked to activate the application by themselves.

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[1] 1,700 measurement batteries for each ISP studied, which for the four ISPs studied gives a total of 6,800 measurement batteries. Considering the carrying out of tests crossed between origin ISPs and target ISPs, multiple measurement numbers are obtained from the previous numbers. For example if the crosses between 4 origin ISPs and 8 target ISPs are considered, then the number of measurements totals 54,400.

2.1.4 INFORMATION PROCESSING

2.1.4.1 WEIGHTING

It was deemed to be an essential requirement of this study that all the operators under review be considered according to equal circumstances, i.e., for each ISP under study 1,700 measurement batteries were conducted. As there were some imbalances between operators in the sample used (in practice), the collected data was subject to a weighting process.

The weighting was carried out by means of the Rim-Weighting process, and included the following variables:

- ISPs;
- Bands;
- Days of the Week;
- Regions;
- Days of the Week * Bands;
- Targets (Target ISPs).

This is an iterative process which assigns a weighting for each observation, so that their sum for each preset cell reaches the desired proportion. The weighting system in that case is said to have reached the optimal.

In the HTTP tests, and only in the context reflecting the download speed obtained during the experience of normal navigation to sites housed in national ISPs, a decision was made to add another factor to the weighting already practiced. Given that the HTTP tests seek to recreate a navigation experience identical to reality, the destination ISPs were weighted taking into account the influence they have in navigation conducted from home. To that end results from MARKTEST's NetPanel study were used.

The analysis of Portuguese navigation habits showed that the most accessed sites are not proportionally housed in the various Portuguese ISPs; for this reason an effort was made to identify that proportion.

Using a NetPanel ranking for the month of June, the top 1,000 sites (based on Single Users[2]) were extracted

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[2] "Single User": estimated number of different individuals who access an internet site during the period chosen for analysis. There is no

and the ISP in which each of those sites was housed was determined.

After the sites were classified by target ISP (with the housed website), the weights for each one were determined taking into account the number of pages consumed in NetPanel. The weights found were:

Table 6 – "Weight" of each ISP

ISP	%
Telepac / Sapo	53,3
Clixgest / Novis + IOL	29,8
OniTelecom	9,6
TV Cabo	6,1
Cabovisão	1,2
TOTAL	100

The target ISPs included in this study (indicated in Table 6) are representative of the national traffic conducted, given that according to NetPanel data they represent nearly 81% of traffic to sites housed in national ISPs.

The Clixgest/Novis and Media Capital/IOL operators were considered together, as they share the same platforms.

As the sites housed in international ISPs were not included in this analysis, the results of the measurements made for the international target ISPs were not subject to this type of weighting.

2.1.4.2 CONTROL OF QUALITY OF RESULTS

Control of the quality of the processed information requires identification of the outliers, which are not necessarily undesirable elements even though they cause surprise regarding most of the results obtained in a given sample. It is vital to identify them and place them on lists describing eventual mistakes, for later analysis. If they clearly distort the results and are not by themselves of relevant significance, then they are eliminated.

The method used to analyse outliers was the one designated as box plots with fences, via which the extreme values are identified so that they can be eliminated after being examined.

The extreme values identified by means of the said mehod were subject to careful examination, leading to the conclusion that they corresponded to non-time-specific situations, so they were kept in the set of data. Another

duplication of individuals.

reason not to eliminate them was due to the fact that it was noted that their removal might favour an operator, which would distort the results.

2.1.5 PRECISION OF RESULTS

The precision errors for the results obtained are always less than 2%, for a 95% confidence level.

Tables with the precision errors obtained for the analysed variables are presented in the annex.

2.2 TECHNICAL ARCHITECTURE, MODE OF OPERATION AND DETAILS OF COMPONENTS

2.2.1 OVERALL OPERATION MODEL

The quality of internet access was evaluated by using a software agent to collect indicators during the access to a standard webpage located in the data centres of the various ISPs.

The software agent was installed beforehand in the computers of a users panel, respresentative in terms of time and geographic spread of the results, and was automatically activated during preset time periods. In certain specific situations the agent was activated by the panellist, so as to deal with eventual problems or allow additional measurements to be conducted.

The agent's function was to make the connection to the operator providing the service, access the data centres of the operators under study, the operators TV Cabo and Cabovisão, and the two international ones, and to carry out the tests deemed necessary.

The software agent is not autonomous and depends on a central platform, which is responsible for controlling the tests, and storing and processing all the collected information.

The collected information was sent to the central platform at the end of each test, to prevent interference with the results. The information was first registered locally; when each test was completed the agent made a connection to central platform collection server and forwarded the information. The data was sent encrypted to ensure security and integrity. This method has been used by MARKTEST in the NetPanel study, with the NOL application.

Communication between the agent and the data collection server was assured by web services. The data was stored in a relational SGBD.

An additional website was created to allow each panellist to adjust the testing calendar as per their availability. On this website it was also possible to consult the calendar of tests already conducted, and to send and receive messages.

2.2.2 PARAMETERS MEASURED

The indicators used to evaluate internet access service are divided into two fundamental types:

- Reliability/Availability

- Performance

2.2.2.1 RELIABILITY/AVAILABILITY INDICATORS

For the reliability/availability indicators the time and percentage of success in making dial-up connections were measured and the service support systems (DNS and DHCP) verified.

<u>Indicators</u>:

- Availability of Dial-up Connection (DNS link and connection)

- Time Making a Dial-up Connection (connection time and authentication time)

The analysis of the Availability of Dial-up Connection was divided into two stages:

1. Connection to the provider, until the moment when communicatioon is established;

2. Authentication on the provider's server (verification of username and password)

2.2.2.2 PERFORMANCE INDICATORS

User perception in reception – http:// (kbps): Access by the customer's PC to the standard website placed in the operators' data centres.

To conduct this measurement and allow HTTP access to the site, the Wininet layer of Windows was used, thus emulating the behaviour of a browser. For each of the standard website's five pages an HTML file was first requested; next and and at the same time the various images associated to that file were requested.

User perception in reception – ftp:// (kbps): Access from the customer's PC, via FTP, to a (binary) file placed in the operators' data centres.

To conduct the tests a 128 KB (binary) file was used, placed in the data centres of the operators under study and in the two international data centres. This file comprises a random sequence of bytes, so that the compression rate tends to zero.

Perception of user in transmission – ftp:// (kbps): Upload of a binary file via FTP to the data centre of the ISP used by each panel element and also to the two international data centres (thus simulating the sending of an email).

No cross tests of FTP were conducted (except for the international data centres), because some of the FTP servers used in the tested national operators did not permit same.

The download and upload tests were not conducted simultaneously, to prevent degradation of the transfer rates. This is because some upstream traffic is generated during a download, specifically acknowledgments (ACKs). Although the quantity of such traffic is small, it has to be sent with the least delay possible, so that the TCP/IP mechanisms can maintain communication at the maximum speed allowed by the channel. When additional upstream traffic is generated during a download there is a risk that the sending of ACKs may be delayed. The emitting machine will consequently conclude that the sending is subject to a higher speed than the receiver is able to register. In response to this situation it will start sending more slowly. This problem is more accentuated in asymmetric connections (dial-up, cable and ADSL, for example), given that upstream has less bandwidth than downstream.

To conduct the tests a 128 KB (binary) file was used.

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

2.2.3 SPECIFICATION OF THE SOFTWARE AGENT

A software agent was created for this study using the C++ programming language, which guarantees evolution of the platform. The operational architecture is that of Customer/Server, with the agent placed on the customer's side.

The application was produced so as to be sent to each panel member with a unique identification code for the incorporated panellists. A set-up was created to automatically install the application. The application was distributed to the panellists by email and/or by download from the web area of each panel member, which had been set up 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 panellist and the machine enabled any undue installation of the application in multiple computers to be detected, along with the consequent adulteration of the information gathered.

During the periods set for collecting information, the members of the dial-up panel were instructed and contacted to keep their computers connected, so that the software agent could make the internet connection and carry out the necessary tests.

The functions carried out by the application are described as follows:

- Execution of the tests for the Reliability/Availability Indicators:

  - Availability of dial-up connection;

  - Latency in the process of establishing a dial-up connection/authentication;

  - Verification of systems.

- Execution of the tests for the Performance Indicators:

  - User perception in reception (http://);

  - User perception in reception (ftp://);

  - User perception in transmission (ftp://);

  - Ping;

  - TraceRoute.

Whenever any measurement was not conducted, as the requirements imposed on the panel members were not met, the panellist was advised of the date the new measurement would be made.

The information collected by the software agent was sent to the central platform at the end of each test. This information is identified by its origin, date and collection time.

So that the time of all measurements has the same reference, at the beginning of each of them the software agents installed in the panellists' PCs synchronise the application's internal clocks with the NTP servers provided by the FCCN. This synchronisation ensures that the measurments carried out by the agents can be compared with respect to time and with a high degree of reliability.

The application produced to collect data is not intrusive with the operative system or with the PC applications of the panel member, and carries out its work transparently.

When the software agent is installed in a machine, it behaves as follows:

- When an internet connection is made, it accesses a web service every half hour to check when the next text is scheduled and whether there are any messages for the panellist;

- If the connection is not established beforehand, it tries every three hours to make a connection and carries out the process described above;

- If the established connection is interrupted, then a new connection is attempted 15 minutes later.

Regarding the conducted tests, the procedures were as follows:

- During the recruitment period all the panelists were sent an application to assess the characteristics of the machines to be used in the tests. All those that did not meet the requirements (Intel® Pentium® processor II or above, 128MB RAM (physical memory) or more and 1 GB of hard disk or more) were rejected.

- A few days before the information began to be collected the panellist was advised of the date the study would begin.

- When the tests were being conducted the software agent blocked all applications that could be running and produced a report to assess the machine's requirements. This report was subsequently evaluated. All the tests that took place in unfavourable conditions were eliminated.

- When the software agent tried to begin the tests and any sort of hindrance was detected, the attempt was aborted and a new test begun five minutes later, up to a maximum of ten attempts or until the end of the time period envisaged for the tests.

- When the tests were not successful, the panellist was advised and in situations where there was insufficient collaboration to ensure successful tests the home in question was removed from the panel and replaced by another with similar characteristics vis-à-vis the selection variables.

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

The software agent installed in the panel members' PCs is able to access the standard page and to navigate

per the dimensions described in the point referred, so as to simulate a navigation experience identical to reality (carry out a sequence of gets).

2.2.4 CENTRAL PLATFORM SPECIFICATION

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

- **Collection Server** – has specific software incorporated, designated as "Task Co-ordinator", and is responsible for all information gathering co-ordination. The software agents are not autonomous and depend on this server to carry out any task.

- **Database Server** – stores the test scheduling and configuration for each panel machine, and stores the results of the conducted tests. Also contains the registry of panellist characteristics, specifically for contacts, regional characterisation, characterisation of machine used in the test (operating system, processor features, RAM, etc.) and information on the ISP to which the machine is connected.

- **Back Office Server** – this server houses the platforms developed to manage the panel and to produce results.

- **Web Server** – This server enables panellists, by means of a reserved web area, to change the scheduling of tasks, within the time limits determined for the study. It also allows messages to be sent and received.

The central platform's architecture is depicted in Figure 1.
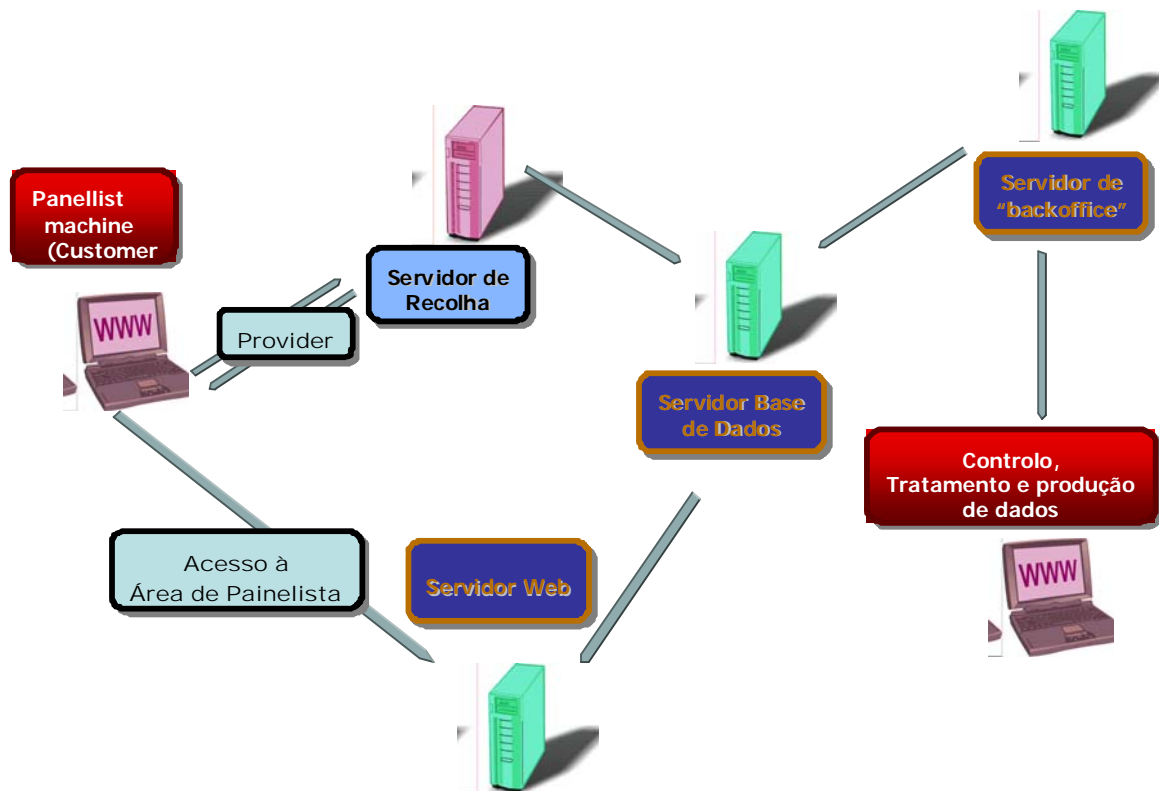
Figure 1 – Sysem architecture.

The software agent is not autonomous and depends entirely on the central system. It communicates with the collection server which transmits to it the configurations for each test/measurement (the agent does not store configurations).

Before beginning any task the agent first accesses the collection server to confirm whether any tests are to be done. Next it asks permission to carry out the test and respective tasks (measurements). The task co-ordinator does not assign tasks sequentially, so as not to overload the sites/FTPs involved in the measurements. Each site/FTP customer is not accessed by more than five machines at the same time.

In each assigned task the task co-ordinator delivers to the agent detailed specifications for conducting the measurements – sites/servers/FTPs to use.

It is possible at any time to make the adjustments deemed necessary.

When the measurements for each test have been completed, the task co-ordinator determines whether the test was conducted successfully and informs the agent that the ongoing test is finished. The agent will then verify the conditions for conducting the next test.

The collection server is responsible for deactivating the agents when they complete all the tests or when the decision is made to deactivate a panel machine.

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

The Database server is the core of the central platform, interacting with all the other servers. It stores and provides all the information needed to carry out the study, specifically:

- test scheduling and configuration, for each panel machine;

- results of the conducted tests;

- registry of the panellists' characteristics, such as contact data, regional characterisation, characterisation of the machine to use in the test (operating system, processor features, RAM, etc.) and information on the ISP linked to each machine.

2.2.5 STANDARD WEB PAGE

The standard web page comprises an initial page and secondary pages implemented in separate pages and placed on a web server in the data centres of each operator under study, the operators TV Cabo and Cabovisão and also in the two international data centres (United States), with access bitrate dimensioned so as not be a bottleneck for this study.

The page is in line with current W3C standards. The Home Page contains a mixture of images and text. Several links (four) are associated to this dimension from the home page, allowing access to more information; each one of these sections is implemented in separate pages, each with text and images.

The sizes of the various pages are as follows:

Size (bytes)	File
3.181	/pagina1.htm
43	/images/imagem.gif
16.793	/images/imagem2.jpg
31.615	/images/imagem3.jpg
79.931	/images/imagem4.jpg
4.304	/pagina2.htm
24.313	/images/imagem5.jpg
2.885	/pagina3.htm
67.131	/images/imagem6.jpg
17.769	/images/imagem7.jpg

Size (bytes)	File
17.198	/images/imagem8.jpg
4.080	/pagina4.htm
24.618	/images/imagem9.jpg
3.785	/pagina5.htm
37.895	/images/imagem10.jpg

The software agent accesses the standard page and navigates through the above dimensions in order to simulate a navigation experience identical to a real one carried out by a typical internet user (effect a series of gets).

2.2.6 STANDARD FTP FILE

This is a randomly generated 128 KB binary file.

3 RESULTS

3.1 NETWORK AVAILABILITY INDICATORS

3.1.1 SUCCESSFUL DIAL-UP CONNECTION ON FIRST ATTEMPT

	ISP								TOTAL	
	Telepac / Sapo		Clixgest / Novis		Oni Telecom		Media Capital /IOL			
	n	%	n	%	n	%	n	%	n	%
Dial-up connection successful on first attempt	1.609	94,6%	1.581	93,0%	1.538	90,4%	1.555	91,5%	6.282	92,4%
Problem with dial-up connection	91	5,4%	119	7,0%	162	9,6%	145	8,5%	518	7,6%
BASE (No. of	1.700	100%	1.700	100%	1.700	100%	1.700	100%	6.800	100%

Dial-up Connection (Total): establishment of a dial-up link/connection (includes the connection and DNS link)

Explanatory Note for Reading the Table (ENRT):

For the ISP OniTelecom, in 90.4% of measurements (1538 out of the total of 1,700 measurements for this operator) the dial-up connection was successfully made on the first attempt and the remaining 9.6% (162) involved measurements where there was at least one problem making it impossible to make the connection on the first attempt.

Dial-up Connection Successful on First Attempt
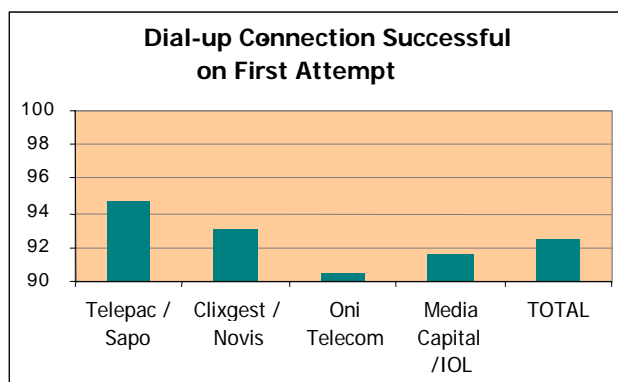
3.1.2 SUCCESSFUL DIAL-UP CONNECTION

	ISP								TOTAL	
	Telepac / Sapo		Clixgest / Novis		Oni Telecom		Media Capital /IOL			
	n	%	n	%	n	%	n	%	n	%
Successful internet connection	1.674	98,5%	1.676	98,6%	1.674	98,5%	1.658	97,5%	6.682	98,3%
Internet connection not established	26	1,5%	24	1,4%	26	1,5%	42	2,5%	118	1,7%
BASE (No. of	1.700	100%	1.700	100%	1.700	100%	1.700	100%	6.800	100%

Internet Connection: successful establishment of link/connection

ENRT:

For the ISP Telepac/Sapo, in 98.5% of measurements (1674 out of the total of 1,700 measurements made for this operator) it was possible to connect to the internet on the first attempt (first dial-up connection) or after successive attempts, and the remaining 1.5% (26) involved measurements where the internet link was not established, even after several attempts.
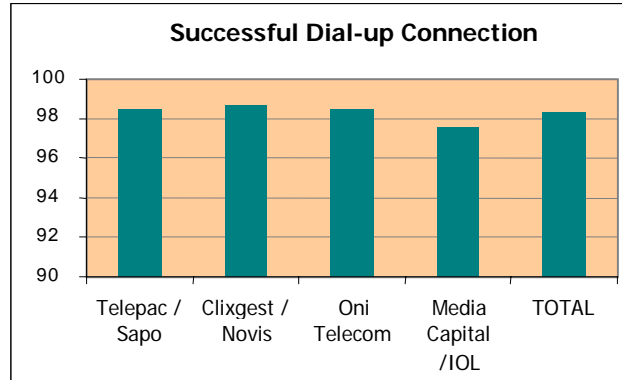
3.1.3 ANOMALIES

	ISP								TOTAL	
	Telepac / Sapo		Clixgest / Novis		Oni Telecom		Media Capital /IOL			
	n	%	n	%	n	%	n	%	n	%
Problem in	87	94,8%	97	81,9%	156	95,8%	138	95,4%	478	92,3%
Problem in DNS Link	9	10,1%	22	18,1%	7	4,2%	7	4,6%	44	8,5%
BASE (No. of measurements where a problem occurred)	91		119		162		145		518	

Dial-up Connection: establishment of a dial-up link/connection

DNS Link: verification of the internet service support systems

ENRT:

Regarding the set of measurements where there was at least one problem in the dial-up connection (518), in 92.3% (478) there was at least one problem in the initial connection phase and in 8.5% (44) of those same measurements there was at least one problem in the DNS link.
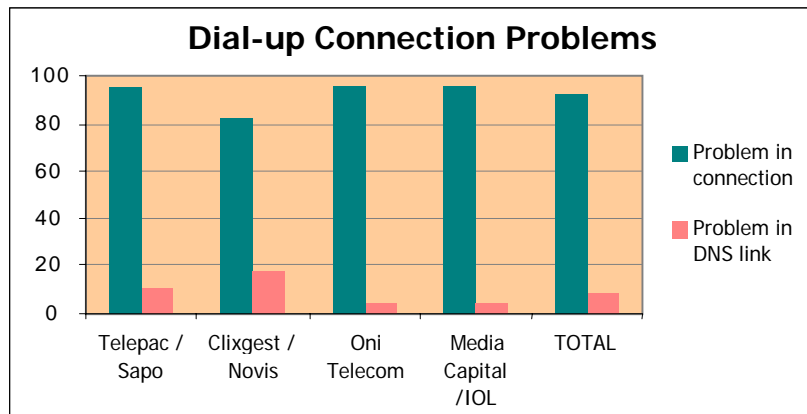
3.2 NETWORK PERFORMANCE INDICATORS

3.2.1 USER PERCEPTION IN HTTP RECEPTION (DOWNLOAD)

3.2.1.1 NATIONAL TARGET ISPs

Speed Downloading Total Pages (Average Value in kbps) Measurements for national target ISPs*		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly period	Mon. to Fri.	40,57	40,87	39,05	41,18	40,42
	Weekend	42,12	41,74	39,57	41,42	41,21
Time Period	23H - 08H	41,77	41,61	39,61	42,03	41,25
	08H - 12H	40,94	40,94	39,57	41,30	40,69
	12H - 18H	39,41	41,08	37,90	40,21	39,65
	18H - 23H	41,29	40,69	39,39	41,10	40,61
TOTAL		**40,98**	**41,10**	**39,19**	**41,24**	**40,63**
BASE (No. of measurements p/national		8.500	8.500	8.500	8.500	34.000

* This table has special weighting (see methodology)

Speed Downloading Total Pages: Speed achieved when loading the entire microsite
(5 páges and respective images) (kbps)

ENRT:

In 8,500 measurements referring to the ISP Media Capital/ IOL, for the set of national target ISPs the average speed downloading total pages equals 41.24 kbps;

Regarding those 8,500 measurements, grouped (or ventilated) according to the weekly period in which they were conducted, average download speed is 41.18 kbps for measurements made during the weekly period from Monday to Friday and 41.42 41,42 kbps for the weekend period.

3.2.1.2 INTERNATIONAL TARGET ISPs

Speed Downloading Total Pages (Average Value in kbps) Measurements for international target ISPs		ISP				(kbps) TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	37,99	37,64	35,63	37,02	37,07
	Weekend	39,36	38,60	35,97	36,95	37,72
Time Period	23H - 08H	38,89	38,34	35,58	37,49	37,57
	08H - 12H	38,86	38,12	36,07	37,12	37,54
	12H - 18H	37,03	37,60	35,28	36,48	36,60
	18H - 23H	38,35	37,45	35,95	36,75	37,12
TOTAL		**38,35**	**37,89**	**35,72**	**37,00**	**37,24**
BASE(No. of		3.400	3.400	3.400	3.400	13.600

Speed Downloading Total Pages: speed achieved in loading the entire microsite (5 pages and respective images) (kbps)

ENRT:

In 3,400 measurements for international target ISPs involving the ISP Media Capital/ IOL, average speed downloading total pages equals 37 kbps;

Regarding those 3,400 measurements, grouped (or ventilated) according to the weekly period in which they were made, average download speed is 37.02 kbps for measurements made during the weekly period from Monday to Friday and 36.95 kbps for the weekend period.

3.2.1.3   NATIONAL AND INTERNATIONAL TARGET ISPS

Speed Downloading Total Pages from the Origin ISP to Target ISPs (Average Value in kbps)		Target ISP					(kbps)
		Telepac / Sapo	Clixgest / Novis	Oni / Telecom	TV Cabo	Cabovisão	Internat.*
ISP	Telepac / Sapo	40,82	41,36	40,51	41,23	41,10	38,35
	Clixgest / Novis	40,91	41,55	40,82	41,07	41,19	37,89
	Oni / Telecom	38,92	39,37	39,95	39,28	39,63	35,72
	Media Capital/IOL	40,95	41,91	41,09	40,75	41,58	37,00
BASE(No. of		6.800	6.800	6.800	6.800	6.800	13.600

* Group formed by the international ISPs

Speed Downloading Total Pages: speed achieved in loading the entire microsite (5 pages and respective images) (kbps)

ENRT:

As a target ISP the operator Telepac/Sapo obtained an average speed downloading total pages of 40.91 kbps in the connection via the ISP Clixgest/Novis and 40.82 kbps via the connection with itself

3.2.2 USER PERCEPTION IN FTP RECEPTION (DOWNLOAD)

3.2.2.1 NATIONAL TARGET ISPs

Download Speed (Average Value in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	35,32	37,36	35,06	36,01	35,94
	Weekend	35,85	38,15	34,58	36,15	36,18
Time Period	23H - 08H	35,87	37,83	35,22	37,12	36,51
	08H - 12H	35,62	37,75	35,06	35,67	36,03
	12H - 18H	34,98	37,14	34,79	34,60	35,38
	18H - 23H	35,23	37,44	34,63	36,22	35,88
TOTAL		**35,46**	**37,56**	**34,93**	**36,05**	**36,00**
BASE (No. of measurements p/national ISPs)		1.700	1.700	1.700	1.700	6.800

Download Speed: speed achieved downloading a 128 KB file by FTP (kbps)

Explanatory Notes for Reading Table (ENRT):

In 1,700 measurements for national target ISPs involving the ISP Telepac/Sapo, average download speed equals 34.46 kbps

Regarding those 1,700 measurements, for national target ISPs grouped (or ventilated) according to the weekly period in which they were made, average download speed is 35.32 kbps for measurements made during the weekly period from Monday to Friday and 35.85 kbps for the weekend period
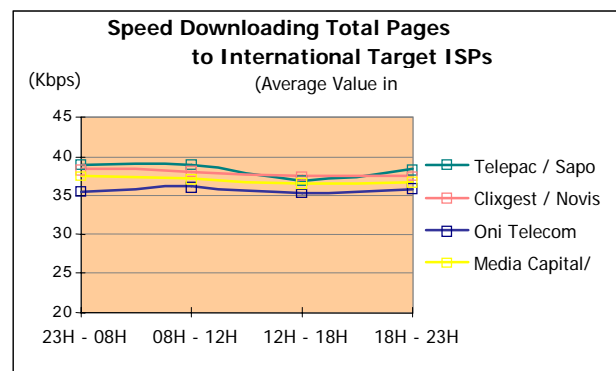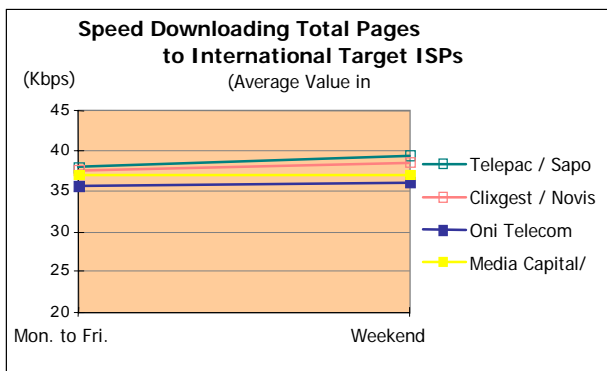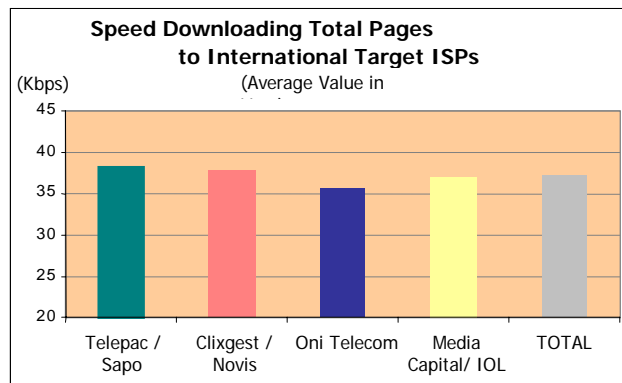

Download Speed to National Target ISPs (Average Value in

Download Speed to National Target ISPs (Average Value in

Download Speed to National Target ISPs (Average Value in

3.2.2.2   INTERNATIONAL TARGET ISPs

Download Speed (Average Value in kbps) Measurements for international target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	35,13	36,58	34,65	36,24	35,65
	Weekend	35,75	37,57	34,55	35,90	35,94
Time Period	23H - 08H	35,82	36,93	34,94	36,76	36,11
	08H - 12H	35,11	36,99	34,90	36,05	35,76
	12H - 18H	34,73	36,62	34,12	35,54	35,25
	18H - 23H	35,27	36,79	34,45	36,00	35,63
TOTAL		**35,30**	**36,84**	**34,62**	**36,15**	**35,73**
BASE (No. of measurements p/int'l ISPs)		3.400	3.400	3.400	3.400	13.600

Download Speed: speed achieved downloading a 128 KB file by FTP (kbps)

Explanatory Notes for Reading Table (ENRT):

In 3,400 measurements for international target ISPs involving the ISP Telepac/Sapo, average download speed equals 35.3 kbps

Regarding those 3,400 measurements, for international target ISPs grouped (or ventilated) according to the weekly period in which they were made, average download speed is 35.13 kbps for the measurements made during the weekly Period from Monday to Friday and 35.75 kbps for the weekend period
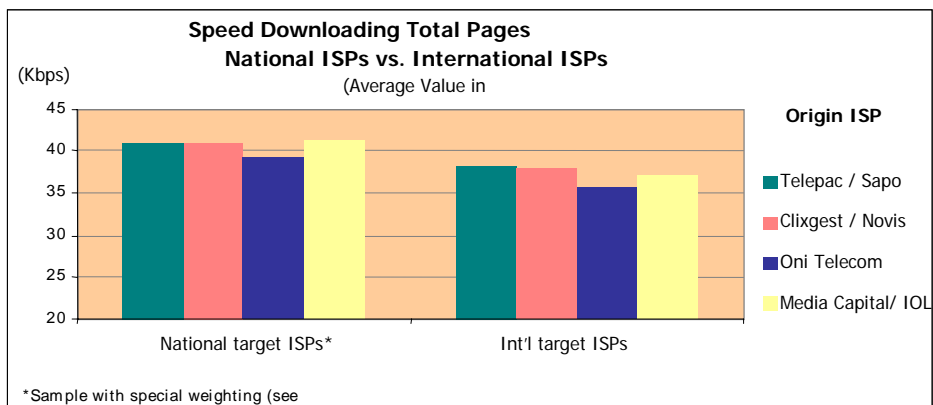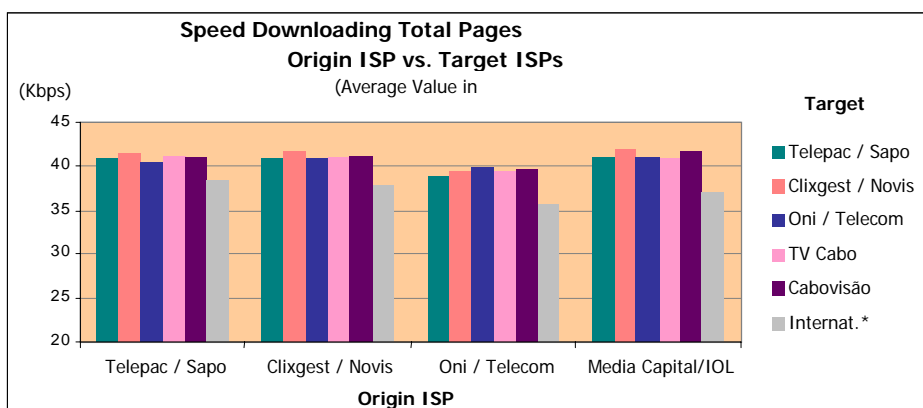
3.2.2.3   NATIONAL AND INTERNATIONAL TARGET ISPS

Speed Downloading from Origin ISP to Target ISPs (Average Value in kbps)		Own ISP	Int'l Target ISPs*
			(kbps)
Origin ISP	Telepac/Sapo	35,46	35,30
	Clixgest/Novis	37,56	36,84
	Oni Telecom	34,93	34,62
	Media Capital/IOL	36,05	36,15

* Group formed by the international ISPs
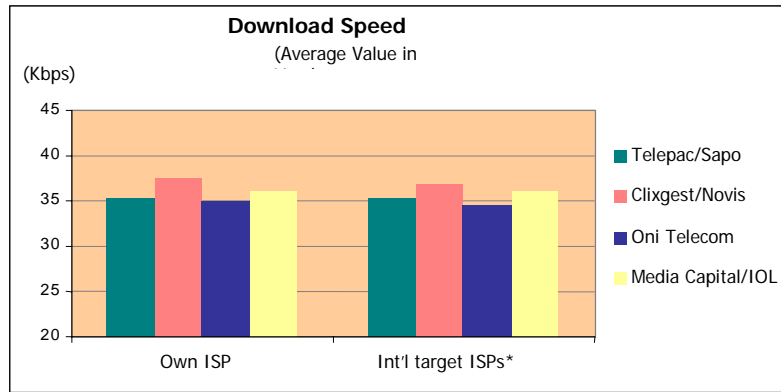
3.2.3 USER PERCEPTION IN SENDING FTP (UPLOAD)

3.2.3.1 NATIONAL TARGET ISPs

Upload Speed (Average Value in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	25,07	25,75	25,93	25,54	25,57
	Weekend	24,73	25,76	25,96	26,21	25,67
Time Period	23H - 08H	24,98	25,97	26,01	26,52	25,87
	08H - 12H	25,11	25,65	25,90	24,86	25,38
	12H - 18H	24,87	25,75	25,78	25,00	25,35
	18H - 23H	24,98	25,59	26,00	26,01	25,64
TOTAL		**24,98**	**25,75**	**25,94**	**25,72**	**25,60**
BASE (No. of measurements p/national		1.700	1.700	1.700	1.700	6.800

Upload Speed: speed achieved in uploading a 28 KB file by FTP (kbps)

Explanatory Notes for Reading Table (ENRT):

In 1,700 measurements for national target ISPs involving the ISP Telepac/Sapo, average upload speed equals 24.98 kbps

Regarding those 1,700 measurements, for the national target ISPs grouped (or ventilated) according the weekly period they were made, average upload speed is 25.07 kbps for measurements made during the period from Monday to Friday and 24.73 kbps for the weekend period

3.2.3.2 INTERNATIONAL TARGET ISPs

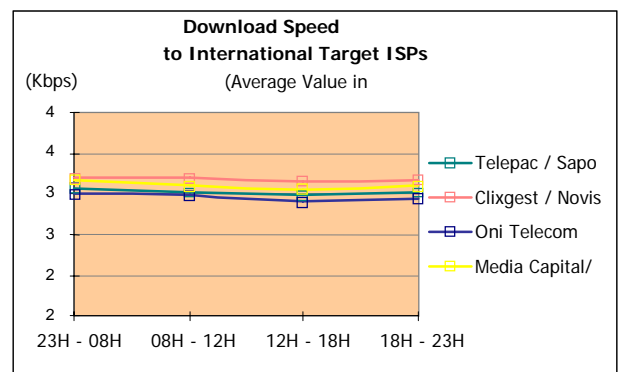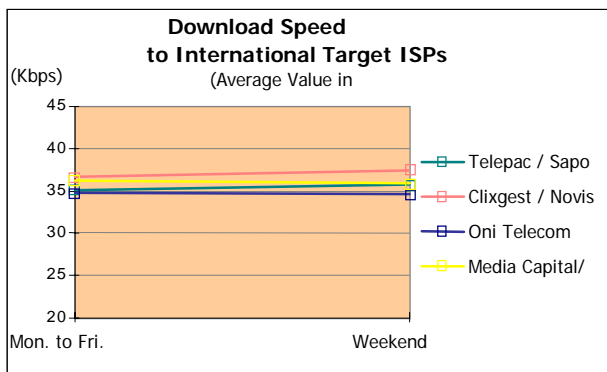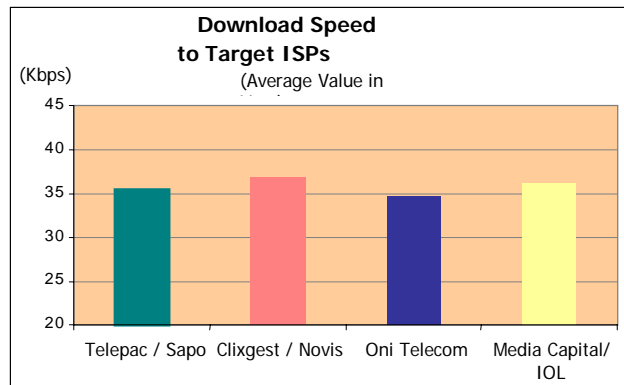**Upload Speed (Average Value in kbps)**
Measurements for international target ISPs   (kbps)

		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly	Mon. to Fri.	24,71	25,25	24,34	25,90	25,05
Period	Weekend	24,60	25,37	24,23	26,05	25,06
Time	23H - 08H	24,79	25,55	24,36	26,31	25,25
Period	08H - 12H	24,81	25,28	24,58	26,11	25,19
	12H - 18H	24,56	25,10	23,98	25,68	24,83
	18H - 23H	24,55	25,13	24,30	25,60	24,90
TOTAL		**24,68**	**25,28**	**24,31**	**25,94**	**25,05**
BASE (No. of measurements p/int'l		3.400	3.400	3.400	3.400	13.600

Upload Speed: speed achieved in uploading a 128 KB file by FTP (kbps)

Explanatory Notes for Reading Table (ENRT):

In 3,400 measurements for international target ISPs involving the ISP Telepac/Sapo, the average upload speed equals 24.68
Regarding those 3,400 measurements, for international target ISPs grouped (or ventilated) according to the weekly period in which they were made, the average upload speed is 24.71 kbps for those made during the weekly period from Monday to Friday and 24.6 kbps for the weekend period

Upload Speed to International Target ISPs (Average Value in (Kbps))

Upload Speed to International Target ISPs (Average Value in (Kbps))

Upload Speed to International Target ISPs (Average Value in (Kbps))
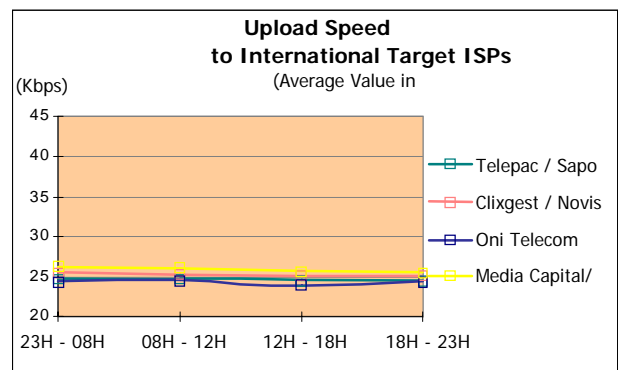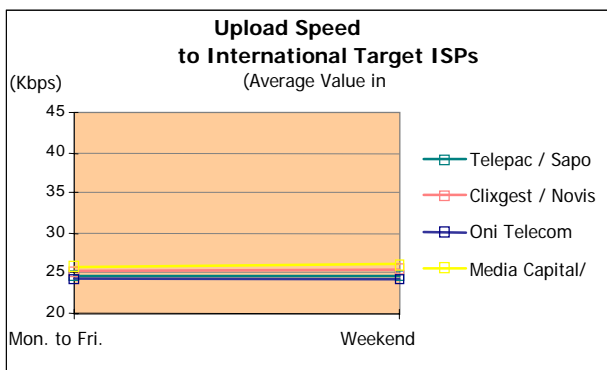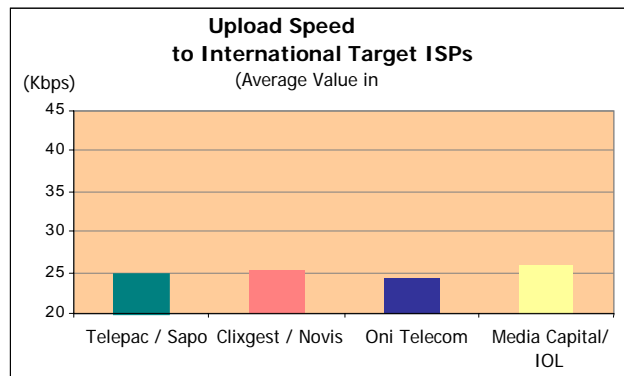
3.2.3.3 NATIONAL AND INTERNATIONAL TARGET ISPS

Upload Speed from the Origin ISP to the Target ISPs (Average Value in kbps)		Own ISP	Int'l Target ISPs*
			(kbps)
Origin ISP	Telepac/Sapo	24,98	24,68
	Clixgest/Novis	25,75	25,28
	Oni Telecom	25,94	24,31
	Media Capital/IOL	25,72	25,94

* Group formed by the international ISPs
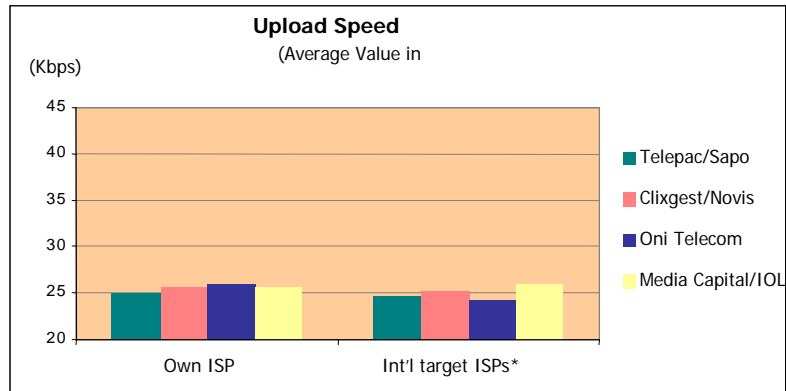
3.2.4 PING TEST

Ping Time from Origin ISP to Target ISP	(Average Value in ms)							(ms)
		Target ISP						TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	TV Cabo	Cabovisão	Intern. *	
ISP	Telepac / Sapo	195,26	197,81	208,86	198,84	194,43	218,00	312,38	229,74
	Clixgest / Novis	179,17	178,39	225,13	179,43	188,49	177,66	303,06	216,80
	Oni Telecom	192,98	227,18	192,74	189,48	199,68	186,03	340,74	233,70
	Media Capital/ IOL	196,53	195,66	205,48	195,57	208,66	195,11	315,77	228,57
BASE (no. of		6.800	6.800	6.800	6.800	6.800	6.800	13.600	54.400

* Group formed by the international ISPs
Ping Time: ICMP ECHO time to the standard page/site (latency time between the user and the standard page site (ms)

ENRT:

As Target ISP the operator Telepac/Sapo obtained an average ping time of 179.17 ms in the connection via the ISP Clixgest/Novis and 195.26 ms via the connection with itself. The average ping time in total connections of the operator Telepac/Sapo equals 229.74 ms.

Ping Time
Origin ISPs vs. National Target ISPs
(Average Value in ms)

Ping Time
Int'l Target ISP vs. Origin ISP
(Average Value in

Ping Time	(Average Value in ms)	ISP				TOTAL (ms)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	231,26	217,60	236,38	229,90	228,79
	Weekend	225,54	214,57	226,23	224,86	222,80
Time Period	23H - 08H	225,33	216,34	234,95	228,91	226,38
	08H - 12H	226,60	213,08	225,49	224,30	222,37
	12H - 18H	238,12	219,33	240,03	230,72	232,05
	18H - 23H	230,77	218,17	233,69	229,76	228,10
TOTAL		229,74	216,80	233,70	228,57	227,20
BASE (No. of		13.600	13.600	13.600	13.600	54.400

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

Explanatory Notes for Reading the Table (ENRT)

In 13,600 measurements referring to the ISP Oni Telecom, the average ping time equals 233.7 ms.

Regarding those 13,600 measurements, grouped (or ventilated) according to the weekly period in which they were condu
average ping time is 236.38 ms for measurements made during the weekly period from Monday to Friday
and 226.23 ms for the weekend period.
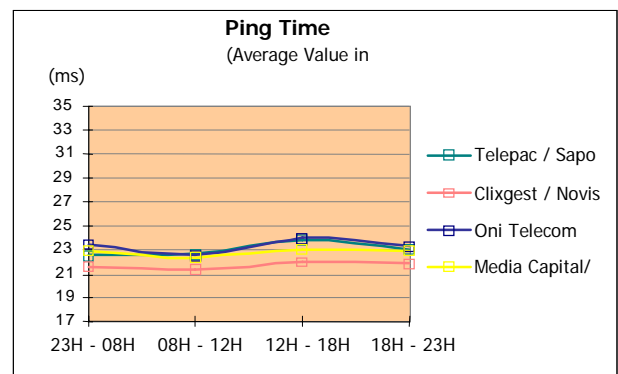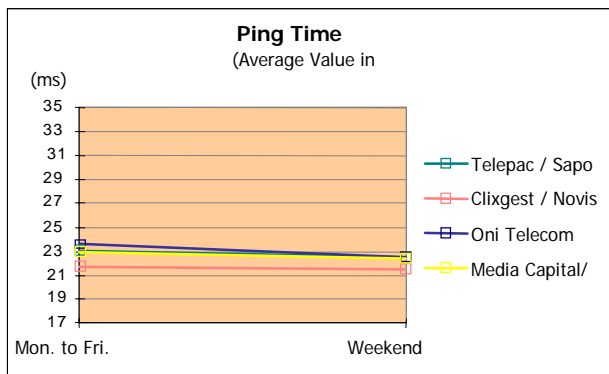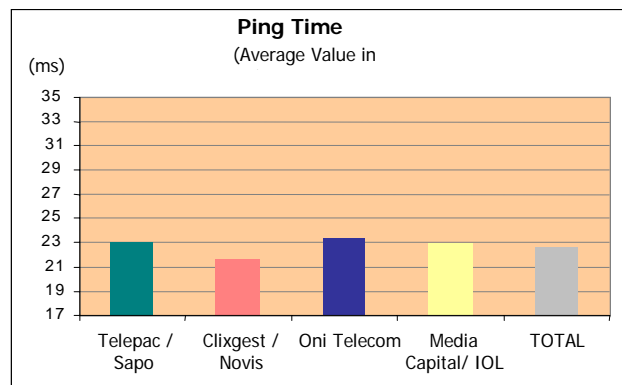
3.3   ADDITIONAL INFORMATION

3.3.1   TIME SPENT MAKING A CONNECTION

3.3.1.1   TOTAL DIAL-UP TIME

Total Dial-up Time (Average Value in seconds)		ISP				TOTAL (s)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	40,34	29,52	33,58	26,71	32,54
	Weekend	39,50	28,81	33,69	26,96	32,24
Time Period	23H - 08H	39,93	29,35	33,61	26,40	32,32
	08H - 12H	39,68	29,37	33,55	26,96	32,39
	12H - 18H	40,68	29,38	33,83	27,16	32,76
	18H - 23H	40,24	29,25	33,48	26,78	32,44
TOTAL		**40,12**	**29,33**	**33,61**	**26,78**	**32,46**
BASE (No. of		1.700	1.700	1.700	1.700	6.800

Total Dial-up Time: total time spent to make a dial-up connection (includes the connection and authentication phases) (seconds)

Explanatory Notes for Reading the Table (ENRT)

In 1,700 measurements referring to the ISP Clixgest/Novis, the average time to make a dial-up connection equals 29.33 seconds.

Regarding those 1,700 measurements, grouped (or ventilated) according to the weekly period in which they were made, the average time to make a dial-up connection is de 29.52 seconds for measurements made during the weekly period from Monday to Friday and 28.81 seconds for the weekend period.

Total Dial-up Time (Average, minimum and maximum value in seconds) (s)		Min	Avg.	Max
ISP	Telepac / Sapo	26,35	40,12	83,49
	Clixgest / Novis	15,95	29,33	103,80
	Oni Telecom	22,85	33,61	69,48
	Media Capital/ IOL	16,03	26,78	89,04
OVERALL		**15,95**	**32,46**	**103,80**

Total Dial-up Time: total time spent to make a dial-up connection (includes the connection and authentication phases) (seconds)

ENRT:

For the total of sample measurements, the total time to make a dial-up connection recorded a minimum value of 15.95 seconds and a maximum value of 103.80 seconds and obtained an average value equalling 32.46 seconds.

For the set of measurements of the ISP Media Capital/IOL, the total time to make a dial-up connection recorded a minimum value of 16.03 seconds and a maxim value of 89.04 seconds and obtained an average value equalling 26.78 seconds.

Total Dial-up Time (in seconds)
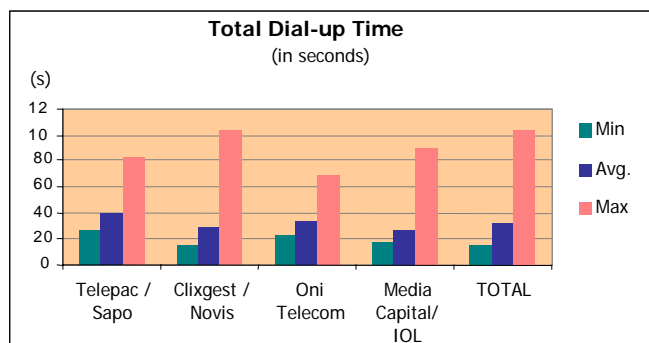
3.3.1.2   CONNECTION AND AUTHENTICATION TIME

Connection and Authentication Time	(Average Value in seconds)	ISP				TOTAL (s)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Time	Connecti	31,49	25,53	29,48	23,73	27,56
	Authentication	8,63	3,81	4,12	3,05	4,90
	TOTAL	**40,12**	**29,33**	**33,61**	**26,78**	**32,46**

Connection Time: Time spent to make a dial-up connection, until completion of the speed negotiation phase (seconds)

Authentication Time: authentication time (for dial-up connection) on ISP servers (seconds)

ENRT:

For total sample measurements the average time obtained in the connection phase to make the dial-up connection is 27.56 seconds and the average time obtained in the authentication phase is 4.9 seconds; the average total dial-up connection time equals 32.46 seconds.

For the set of measurements of the ISP Oni Telecom, the average time obtained in the connection phase when making the dial-up connection is 29.48 seconds and the average time obtained in the authentication phase is 4.12 seconds; the average total dial-up connection times equals 33.61 seconds.

Connection and Authentication Time
(Average Value in seconds)

3.3.2 TRACEROUTE
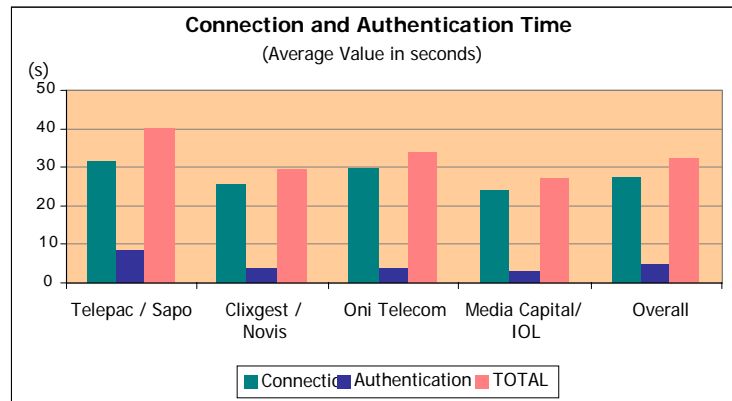
No. of Hops – Origin ISP vs. Target ISP
(Average Value)
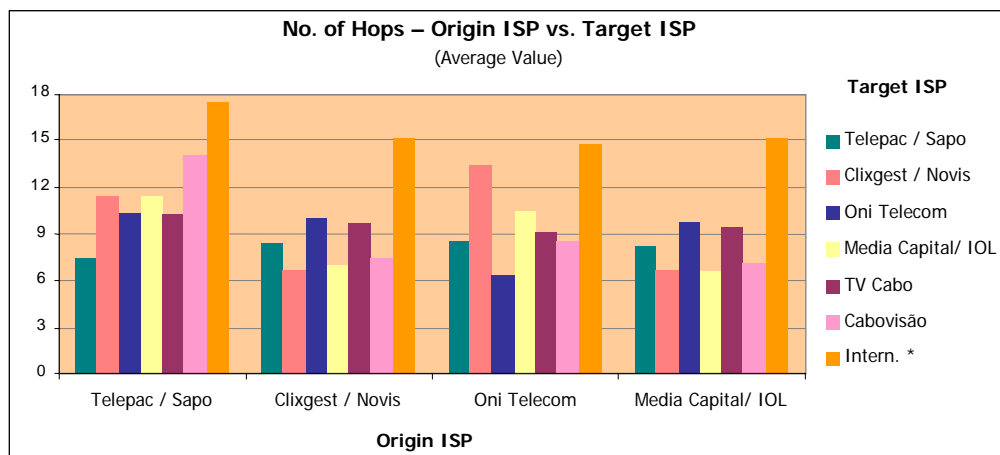
Type of Routes Used to Each National Target ISP

| | | National Target | | | | | | | | | | | | TOTAL | |
| | | Telepac / Sapo | | Clixgest / Novis | | Oni Telecom | | Media Capital/IOL | | TV Cabo | | Cabovisão | | | |
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Telepac / Sapo	Exclus. National Routes	1.700	100,0%	1.699	99,9%	1.700	100,0%	1.698	99,9%	1.700	100,0%	1.503	88,4%	10.000	98,0%
	International Routes	0	0,0%	1	0,1%	0	0,0%	2	0,1%	0	0,0%	197	11,6%	200	2,0%
		1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	10.200	100,0%
Clixgest / Novis	Exclus. National Routes	1.693	99,6%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	10.193	99,9%
	International Routes	7	0,4%	0	0,0%	0	0,0%	0	0,0%	0	0,0%	0	0,0%	7	0,1%
		1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	10.200	100,0%
Oni Telecom	Exclus. National Routes	1.700	100,0%	0	0,0%	1.700	100,0%	0	0,0%	1.700	100,0%	1.700	100,0%	6.800	66,7%
	International Routes	0	0,0%	1.700	100,0%	0	0,0%	1.700	100,0%	0	0,0%	0	0,0%	3.400	33,3%
		1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	10.200	100,0%
Media Capital/IOL	Exclus. National Routes	1.695	99,7%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	10.195	99,9%
	International Routes	5	0,3%	0	0,0%	0	0,0%	0	0,0%	0	0,0%	0	0,0%	5	0,1%
		1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	1.700	100,0%	10.200	100,0%
TOTAL	Exclus. National Routes	6.788	99,8%	5.099	75,0%	6.800	100,0%	5.098	75,0%	6.800	100,0%	6.603	97,1%	37.188	91,1%
	International Routes	12	0,2%	1.701	25,0%	0	0,0%	1.702	25,0%	0	0,0%	197	2,9%	3.612	8,9%
		6.800	100,0%	6.800	100,0%	6.800	100,0%	6.800	100,0%	6.800	100,0%	6.800	100,0%	40.800	100,0%

Exclusively National Route: situation where the intermediate machines used in the path have ISP addresses belonging to ranges allocated to national operators.

International Route: situation where there is at least one machine on the path whose ISP address is not within the ranges allocated to national operators.

4 CONCLUSIONS

Regarding the Reliability/Availability indicators, the ISPs under study obtained success rates of more than 98% for making dial-up internet connections, with more than 92% of connections being made on the first attempt.
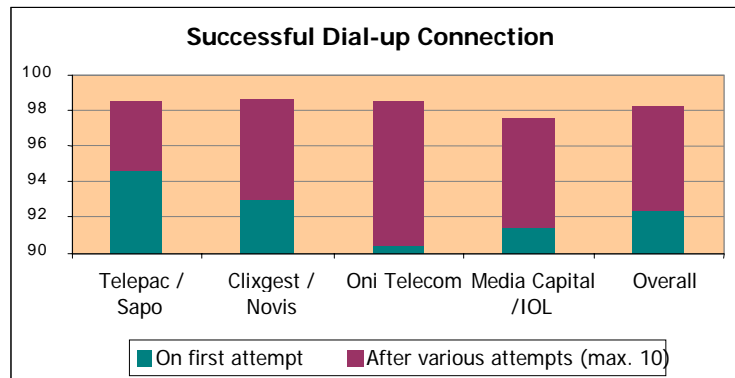
The average time to make such an internet connection was approximately 32 seconds.
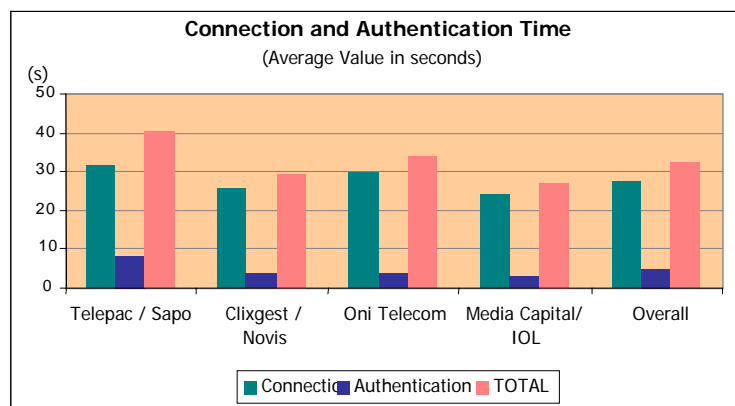
The aim of the Performance Indicators evaluated in this study is to measure parameters in a situation of access to any area on the internet. Such is the case of the Speed Downloading Total Pages from a website (HTTP).

According to the results obtained for Average Speed Downloading Total Pages, the operators are very close to each other. OniTelecom had the lowest value (39 kbps) among the national target ISPs, while the remaining ISPs had values approaching 41 kbps. When the targets are international ISPs, the values obtained for this indicator vary between the 38 kbps of Telepac/Sapo and Clixgest/Novis, and the nearly 36 kbps of OniTelecom.

The download speeds for international target ISPs are lower than those obtained for national target ISPs, which indicates that the international segments are a constraint for all the operators.
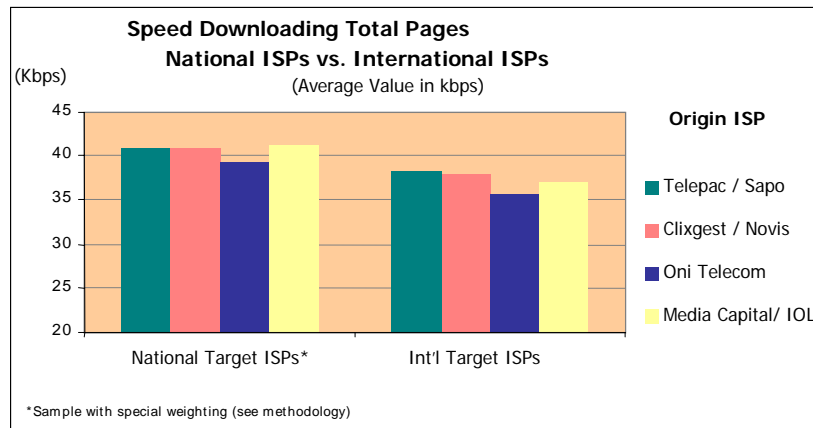
Performance indicators were also analysed by means of FTP tests. As with the HTTP tests, average download speed is slightly lower when the measurements are for international target ISPs. The highest average download speed for the two destinations (own and international) was obtained by the ISP Clixgest/Novis, though the differences between operators are relatively insignificant.
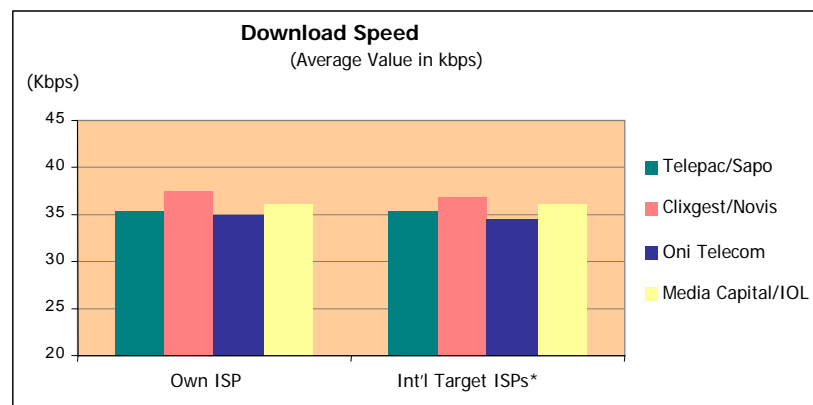
Comparison of the FTP and HTTP download speeds shows that the values obtained in FTP are lower. Given that the FTP protocol is more efficient for transporting useful information and does not use information compression, the measurements obtained in FTP should be closer to the real access bitrate than the ones for HTTP. HTTP's better performance can be explained by a number of mechanisms increasing the efficiency of this protocol, such as the use of compression carried out by the operators, for example.

Very similar average upload speeds were obtained in the test situation of sending a binary file to the data

centres of the operators under study (own ISP).

Upload Speed
(Average Value in kbps)
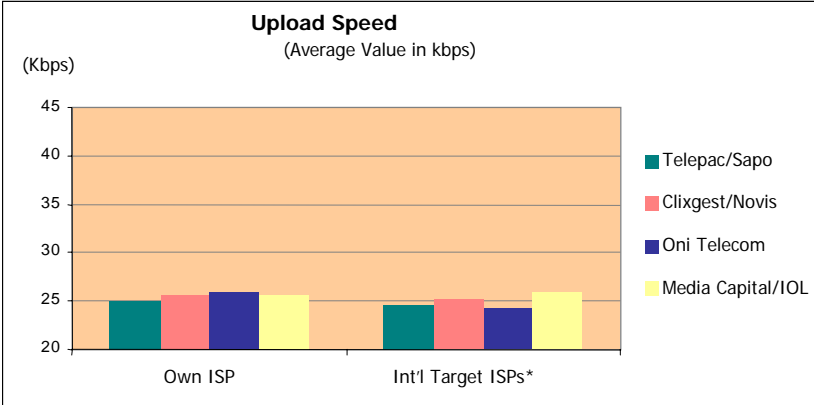
Upload speed is generally lower for connections to international target ISPs. The operator Media Capital/IOL is the exception to the rule; its average speed to the set of international target ISPs is higher than the average speed connecting with itself. This ISP was the one that obtained the highest average value (25.94 kbps) for the set of international target ISPs.

The conducted tests also included the Ping Test, which measured line latency, i.e., the instantaneousness of communication, which is especially significant when interactive applications are used (online games, for example).

Ping Time
(Average Value in
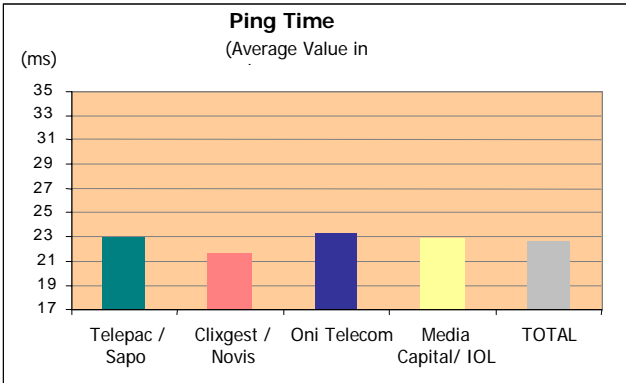
The ISP Clixgest/Novis presented the best result for average ping time, obtaining the lowest value (about 217 ms). None of the other ISPs obtained an average time below the overall average for the total sample (227.2 ms).

The conducted tests also showed that in some situations the traffic between origin ISPs and national target

ISPs was routed via international routes.

Annex 1

Annex 1 – Minimum, average and maximum values, standard deviation and precision errors of results

1 User perception in HTTP reception (download)

1.1 Average values, standard deviation and precision errors

1.1.1 National Target ISPs

Speed Downloading Total Pages Measurements for national target ISPs*		(Average Value in kbps)				(kbps)
		ISP				**TOTAL**
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	40,57	40,87	39,05	41,18	40,42
	Weekend	42,12	41,74	39,57	41,42	41,21
Time Period	23H - 08H	41,77	41,61	39,61	42,03	41,25
	08H - 12H	40,94	40,94	39,57	41,30	40,69
	12H - 18H	39,41	41,08	37,90	40,21	39,65
	18H - 23H	41,29	40,69	39,39	41,10	40,61
TOTAL		**40,98**	**41,10**	**39,19**	**41,24**	**40,63**
BASE (No. of measurements p/national target ISPs)		8.500	8.500	8.500	8.500	34.000

* This table was subject to special weighting (see methodology)

Speed Downloading Total Pages Measurements for national target ISPs *		(Standard Deviation in kbps)				(kbps)
		ISP				**TOTAL**
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	7,23	8,30	6,90	7,59	7,57
	Weekend	6,46	8,42	6,70	7,91	7,48
Time Period	23H - 08H	6,63	8,25	6,66	7,12	7,26
	08H - 12H	7,42	8,88	6,69	7,94	7,80
	12H - 18H	7,53	7,80	7,35	8,16	7,80
	18H - 23H	6,71	8,40	6,67	7,60	7,42
TOTAL		**7,06**	**8,34**	**6,85**	**7,68**	**7,55**
BASE (No. of measurements p/national target ISPs)		8.500	8.500	8.500	8.500	34.000

* This table was subject to special weighting (see methodology)

Speed Downloading Total Pages Measurements for national target ISPs *		(Precision Error in kbps)				(kbps)
		ISP				**TOTAL**
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	0,09	0,11	0,09	0,10	0,05
	Weekend	0,14	0,18	0,14	0,17	0,08
Time Period	23H - 08H	0,13	0,16	0,13	0,14	0,07
	08H - 12H	0,18	0,21	0,16	0,19	0,09
	12H - 18H	0,18	0,19	0,18	0,20	0,09
	18H - 23H	0,14	0,17	0,14	0,16	0,08
TOTAL		**0,08**	**0,09**	**0,07**	**0,08**	**0,04**
BASE (No. of measurements p/national target ISPs)		8.500	8.500	8.500	8.500	34.000

* This table was subject to special weighting (see methodology)

1.1.2 International Target ISPs

Speed Downloading Total Pages		(Average Value in kbps)				
Measurments for international target ISPs						(kbps)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	37,99	37,64	35,63	37,02	37,07
	Weekend	39,36	38,60	35,97	36,95	37,72
Time Period	23H - 08H	38,89	38,34	35,58	37,49	37,57
	08H - 12H	38,86	38,12	36,07	37,12	37,54
	12H - 18H	37,03	37,60	35,28	36,48	36,60
	18H - 23H	38,35	37,45	35,95	36,75	37,12
TOTAL		**38,35**	**37,89**	**35,72**	**37,00**	**37,24**
BASE (No. of measurements p/int'l target ISPs)		3.400	3.400	3.400	3.400	13.600

Speed Downloading Total Pages		(Standard Deviation in kbps)				
Measurements for international target ISPs						(kbps)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	7,12	9,02	7,11	8,11	7,93
	Weekend	6,08	7,95	7,03	8,77	7,64
Time Period	23H - 08H	6,37	8,60	6,99	7,91	7,62
	08H - 12H	6,69	9,17	7,01	8,34	7,93
	12H - 18H	7,63	8,99	7,36	8,69	8,23
	18H - 23H	6,88	8,43	7,05	8,35	7,76
TOTAL		**6,89**	**8,76**	**7,09**	**8,29**	**7,86**
BASE (No. of measurements p/int'l target ISPs)		3.400	3.400	3.400	3.400	13.600

Speed Downloading Total Pages		(Precision Error in kbps)				(kbps)
Measurements for international target ISPs						
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	0,14	0,18	0,14	0,16	0,08
	Weekend	0,20	0,27	0,23	0,29	0,13
Time Period	23H - 08H	0,20	0,27	0,22	0,24	0,12
	08H - 12H	0,25	0,35	0,26	0,32	0,15
	12H - 18H	0,29	0,34	0,28	0,33	0,16
	18H - 23H	0,22	0,27	0,23	0,27	0,13
TOTAL		**0,12**	**0,15**	**0,12**	**0,14**	**0,07**
BASE (No. of measurements p/int'l target ISPs)		3.400	3.400	3.400	3.400	13.600

1.2 Minimum, average and maximum values

Speed Downloading Total Pages from Origin ISP to Target ISPs *
(Average, minimum and maximum value in kbps)   **(kbps)**

		Telepac / Sapo			Clixgest / Novis		
		Avg.	Min	Max	Avg.	Min	Max
Target ISP	Telepac/Sapo	40,82	8,40	55,15	40,91	3,24	53,13
	Clixgest/Novis	41,36	8,20	55,94	41,55	4,82	53,19
	OniTelecom	40,51	10,68	55,22	40,82	3,60	53,23
	TV Cabo	41,23	7,89	55,59	41,07	3,60	53,11
	Cabovisão	41,10	13,08	55,45	41,19	3,30	52,81
	Internat.**	38,35	6,15	53,70	37,89	3,31	51,80
BASE(No. of		11.900			11.900		

* This table did not have the special weighting described in the
** Group formed by the international ISPs

Speed Downloading Total Pages from the Origin ISP to the Target ISPs*
(Average, minimum and maxim value in kbps)   **(kbps)**

		Oni Telecom			Media Capital/ IOL		
		Avg.	Min	Max	Avg.	Min	Max
Target ISP	Telepac/Sapo	38,92	9,85	51,23	40,95	5,98	52,11
	Clixgest/Novis	39,37	12,19	51,01	41,91	12,55	51,86
	OniTelecom	39,95	12,85	51,24	41,09	7,21	52,78
	TV Cabo	39,28	11,82	51,05	40,75	2,75	52,66
	Cabovisão	39,63	14,18	51,60	41,58	2,72	52,29
	Internat.**	35,72	3,32	50,12	37,00	1,99	50,66
BASE (No. of		11.900			11.900		

* This table did not have the special weighting described in the
** Group formed by the international ISPs

2 User perception in FTP reception (download)

2.1 Average values, standard deviation and precision errors

2.1.1 National Target ISPs

Download Speed (Average value in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	35,32	37,36	35,06	36,01	35,94
	Weekend	35,85	38,15	34,58	36,15	36,18
Time Period	23H - 08H	35,87	37,83	35,22	37,12	36,51
	08H - 12H	35,62	37,75	35,06	35,67	36,03
	12H - 18H	34,98	37,14	34,79	34,60	35,38
	18H - 23H	35,23	37,44	34,63	36,22	35,88
TOTAL		**35,46**	**37,56**	**34,93**	**36,05**	**36,00**
BASE (No. of measurements p/national ISPs)		1.700	1.700	1.700	1.700	6.800

Download Speed (Standard Deviation in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	5,58	6,34	5,80	6,37	6,10
	Weekend	5,34	5,54	6,05	6,24	5,94
Time Period	23H - 08H	5,24	5,74	5,54	5,37	5,57
	08H - 12H	5,52	6,46	5,56	6,83	6,20
	12H - 18H	5,51	6,57	6,19	6,61	6,31
	18H - 23H	5,80	6,03	6,19	6,51	6,23
TOTAL		**5,52**	**6,15**	**5,87**	**6,33**	**6,06**
BASE (No. of measurements p/national ISPs)		1.700	1.700	1.700	1.700	6.800

Download Speed (Precision Error in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	0,16	0,18	0,16	0,18	0,09
	Weekend	0,25	0,26	0,28	0,29	0,14
Time Period	23H - 08H	0,23	0,25	0,24	0,23	0,12
	08H - 12H	0,30	0,35	0,30	0,37	0,17
	12H - 18H	0,29	0,35	0,33	0,35	0,17
	18H - 23H	0,27	0,28	0,28	0,30	0,14
TOTAL		**0,13**	**0,15**	**0,14**	**0,15**	**0,07**
BASE (No. of measurements p/national ISPs)		1.700	1.700	1.700	1.700	6.800

2.1.2   International Target ISPs

Download Speed   (Average Value in kbps)
Measurements for international target ISPs   (kbps)

		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	35,13	36,58	34,65	36,24	35,65
	Weekend	35,75	37,57	34,55	35,90	35,94
Time Period	23H - 08H	35,82	36,93	34,94	36,76	36,11
	08H - 12H	35,11	36,99	34,90	36,05	35,76
	12H - 18H	34,73	36,62	34,12	35,54	35,25
	18H - 23H	35,27	36,79	34,45	36,00	35,63
TOTAL		**35,30**	**36,84**	**34,62**	**36,15**	**35,73**
BASE (No. of measurements for int'l ISPs)		3.400	3.400	3.400	3.400	13.600

Download Speed   (Standard Deviation in kbps)
Measurements for international target ISPs   (kbps)

		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	5,85	7,25	6,07	6,91	6,59
	Weekend	5,46	5,88	6,11	6,93	6,21
Time Period	23H - 08H	5,48	7,03	5,72	6,41	6,24
	08H - 12H	5,89	7,19	5,93	7,06	6,59
	12H - 18H	5,43	7,11	6,30	7,34	6,65
	18H - 23H	6,14	6,47	6,37	6,98	6,56
TOTAL		**5,76**	**6,93**	**6,08**	**6,92**	**6,49**
BASE (No. of measurements p/int'l ISPs)		3.400	3.400	3.400	3.400	13.600

Download Speed   (Precision Error in kbps)
Measurements for international target ISPs   (kbps)

		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	0,12	0,15	0,12	0,14	0,07
	Weekend	0,18	0,20	0,20	0,23	0,10
Time Period	23H - 08H	0,17	0,22	0,18	0,20	0,10
	08H - 12H	0,22	0,27	0,22	0,27	0,12
	12H - 18H	0,21	0,27	0,24	0,28	0,13
	18H - 23H	0,20	0,21	0,21	0,23	0,11
TOTAL		**0,10**	**0,12**	**0,10**	**0,12**	**0,06**
BASE (No. of measurements p/int'l ISPs)		3.400	3.400	3.400	3.400	13.600

2.2   Minimum, average and maximum values

Download Speed from Origin ISP to Target ISPs
(Average, minimum and maximum value in Kbps)   (kbps)

		Target					
		National (Own ISP)			International		
		Avg.	Min	Max	Avg.	Min	Max
Origin ISP	Telepac/Sapo	35,46	9,45	45,22	35,30	4,04	45,90
	Clixgest/Novis	37,56	0,28	46,85	36,84	2,18	46,88
	Oni Telecom	34,93	6,25	44,50	34,62	4,88	45,57
	Media Capital/IOL	36,05	3,10	46,40	36,15	2,40	47,22

3 User perception in FTP sending (upload)

3.1 Average values, standard deviation and precision errors

3.1.1 National Target ISPs

Upload Speed (Average Value in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	25,07	25,75	25,93	25,54	25,57
	Weekend	24,73	25,76	25,96	26,21	25,67
Time Period	23H - 08H	24,98	25,97	26,01	26,52	25,87
	08H - 12H	25,11	25,65	25,90	24,86	25,38
	12H - 18H	24,87	25,75	25,78	25,00	25,35
	18H - 23H	24,98	25,59	26,00	26,01	25,64
TOTAL		**24,98**	**25,75**	**25,94**	**25,72**	**25,60**
BASE (No. of measurements p/national ISPs)		1.700	1.700	1.700	1.700	6.800

Upload Speed (Standard Deviation in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	2,88	2,79	3,40	3,68	3,22
	Weekend	3,22	2,19	3,26	2,75	2,94
Time Period	23H - 08H	3,10	2,29	3,11	2,48	2,82
	08H - 12H	2,82	2,87	3,52	4,42	3,49
	12H - 18H	2,96	2,35	3,61	3,82	3,26
	18H - 23H	2,97	3,01	3,34	3,07	3,13
TOTAL		**2,98**	**2,65**	**3,36**	**3,47**	**3,15**
BASE (No. of measurements p/national ISPs)		1.700	1.700	1.700	1.700	6.800

Upload Speed (Precision Error in kbps) Measurements for national target ISPs		ISP				TOTAL (kbps)
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	0,08	0,08	0,10	0,10	0,05
	Weekend	0,15	0,10	0,15	0,13	0,07
Time Period	23H - 08H	0,14	0,10	0,14	0,11	0,06
	08H - 12H	0,15	0,15	0,19	0,24	0,09
	12H - 18H	0,16	0,13	0,19	0,20	0,09
	18H - 23H	0,14	0,14	0,15	0,14	0,07
TOTAL		**0,07**	**0,06**	**0,08**	**0,08**	**0,04**
BASE (No. of measurements p/national ISPs)		1.700	1.700	1.700	1.700	6.800

3.1.2 International Target ISPs

Upload Speed (Average Value in kbps) Measurements for international target ISPs						(kbps)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	24,71	25,25	24,34	25,90	25,05
	Weekend	24,60	25,37	24,23	26,05	25,06
Time Period	23H - 08H	24,79	25,55	24,36	26,31	25,25
	08H - 12H	24,81	25,28	24,58	26,11	25,19
	12H - 18H	24,56	25,10	23,98	25,68	24,83
	18H - 23H	24,55	25,13	24,30	25,60	24,90
TOTAL		**24,68**	**25,28**	**24,31**	**25,94**	**25,05**
BASE (No. of measurements p/int'l ISPs)		3.400	3.400	3.400	3.400	13.600

Upload Speed (Standard Deviation in kbps) Measurements for international target ISPs						(kbps)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	3,17	3,52	4,15	3,45	3,64
	Weekend	3,12	2,89	4,09	2,82	3,34
Time Period	23H - 08H	3,16	3,08	3,91	2,64	3,31
	08H - 12H	2,96	3,55	4,05	2,91	3,45
	12H - 18H	3,22	3,47	4,43	3,68	3,78
	18H - 23H	3,24	3,42	4,19	3,82	3,72
TOTAL		**3,15**	**3,36**	**4,13**	**3,29**	**3,56**
BASE (No. of measurements p/int'l ISPs)		3.400	3.400	3.400	3.400	13.600

Upload Speed (Precision Error in kbps) Measurements for international target ISPs						(kbps)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly Period	Mon. to Fri.	0,06	0,07	0,08	0,07	0,04
	Weekend	0,10	0,10	0,14	0,09	0,06
Time Period	23H - 08H	0,10	0,10	0,12	0,08	0,05
	08H - 12H	0,11	0,13	0,15	0,11	0,07
	12H - 18H	0,12	0,13	0,17	0,14	0,07
	18H - 23H	0,11	0,11	0,14	0,12	0,06
TOTAL		**0,05**	**0,06**	**0,07**	**0,06**	**0,03**
BASE (No. of measurements p/int'l ISPs)		3.400	3.400	3.400	3.400	13.600

3.2 Minimum, average and maximum values

Upload Speed from Origin ISP to Target ISPs (Average, minimum and maximum value in kbps)							(kbps)
		Target					
		National (Own ISP)			International		
		Avg.	Min	Max	Avg.	Min	Max
Origin ISP	Telepac/Sapo	24,98	7,73	29,78	24,68	8,18	29,64
	Clixgest/Novis	25,75	2,60	28,99	25,28	0,81	28,93
	Oni Telecom	25,94	9,22	30,49	24,31	8,27	30,48
	Media Capital/IOL	25,72	7,12	30,13	25,94	3,33	29,99

4 Ping Test

4.1 Average values, standard deviation and precision errors

Ping Time	(Average Value in ms)					(ms)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly	Mon. to Fri.	231,26	217,60	236,38	229,90	228,79
Period	Weekend	225,54	214,57	226,23	224,86	222,80
Time	23H - 08H	225,33	216,34	234,95	228,91	226,38
Period	08H - 12H	226,60	213,08	225,49	224,30	222,37
	12H - 18H	238,12	219,33	240,03	230,72	232,05
	18H - 23H	230,77	218,17	233,69	229,76	228,10
TOTAL		**229,74**	**216,80**	**233,70**	**228,57**	**227,20**
BASE (No. of		13.600	13.600	13.600	13.600	54.400

Ping Time	(Standard Deviation in ms)					(ms)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly	Mon. to Fri.	78,02	82,64	109,39	79,94	88,69
Period	Weekend	67,72	80,52	99,23	72,21	80,96
Time	23H - 08H	67,89	82,16	115,15	79,75	88,25
Period	08H - 12H	70,41	78,55	98,99	74,74	81,58
	12H - 18H	80,18	83,88	103,61	78,98	87,60
	18H - 23H	82,62	83,18	105,03	77,57	87,93
TOTAL		**75,47**	**82,09**	**106,89**	**78,00**	**86,75**
BASE (No. of		13.600	13.600	13.600	13.600	54.400

Ping Time	(Precision Error in ms)					(ms)
		ISP				TOTAL
		Telepac / Sapo	Clixgest / Novis	Oni Telecom	Media Capital/ IOL	
Weekly	Mon. to Fri.	0,78	0,83	1,09	0,80	0,44
Period	Weekend	1,13	1,34	1,65	1,20	0,67
Time	23H - 08H	1,05	1,27	1,78	1,23	0,68
Period	08H - 12H	1,33	1,48	1,87	1,41	0,77
	12H - 18H	1,52	1,59	1,96	1,49	0,83
	18H - 23H	1,34	1,35	1,70	1,26	0,71
TOTAL		**0,65**	**0,70**	**0,92**	**0,67**	**0,37**
BASE (No. of		13.600	13.600	13.600	13.600	54.400

4.2 Minimum, average and maximum values

Ping Time from Origin ISP to Target ISP (Average, minimum and maximum value in ms) (ms)		Telepac / Sapo			Clixgest / Novis		
		Avg.	Min	Max	Avg.	Min	Max
Target ISP	Telepac / Sapo	195,26	117,03	600,95	179,17	104,97	779,94
	Clixgest / Novis	197,81	124,01	560,40	178,39	95,91	1247,59
	Oni Telecom	208,86	120,39	980,67	225,13	106,08	759,74
	Media Capital/IOL	198,84	124,36	695,99	179,43	102,04	796,62
	TV Cabo	194,43	120,96	624,69	188,49	101,84	783,44
	Cabovisão	218,00	116,60	1160,14	177,66	103,07	488,20
	Internat.*	312,38	138,66	1121,29	303,06	212,65	1192,06

Ping Time from Origin ISP to Target ISP (Average, minimum and maximum value in ms) (ms)		Oni Telecom			Media Capital/IOL		
		Avg.	Min	Max	Avg.	Min	Max
Target ISP	Telepac / Sapo	192,98	95,67	1151,78	196,53	100,13	997,83
	Clixgest / Novis	227,18	103,99	1028,97	195,66	103,22	1247,82
	Oni Telecom	192,74	94,11	1147,52	205,48	99,15	859,28
	Media Capital/IOL	189,48	96,50	710,54	195,57	96,52	882,20
	TV Cabo	199,68	98,89	828,26	208,66	98,62	881,10
	Cabovisão	186,03	93,31	874,85	195,11	98,90	1048,16
	Internat.*	340,74	215,71	918,35	315,77	209,74	959,91

* Group formed by the international ISPs

Annex 2

Annex 2 – Glossary

Main Concepts

Dial-up Connection	Establishment of dial-up link/connection
Dial-up Connection (Total)	Establishment of dial-up link/connection (includes the connection and the DNS link)
DNS Link	Verification of internet service support systems
Internet Connection	Successful establishment of link/connection
Support	Processes and activities provided to support software/site operationality in access and use (in seconds)
Authentication Time:	Authentication time for dial-up connection on ISP servers (in seconds)
Connection Time:	Time spent making a dial-up connection, until completion of the speed negotiation phase (in seconds)
Total Dial-up Time:	Total time spent making the dial-up connection (includes the connection and authentication phases) (in seconds)
Download Speed:	Speed achieved downloading a 128 KB file by FTP (in kbps)
Upload Speed:	Speed achieved uploading a 128 KB file by FTP (in kbps)
Speed Downloading Total Pages:	Speed achieved for complete loading from the microsite (5 pages and respective images) (in kbps)
Ping Time:	ICMP ECHO Time at the standard site/page (latency time between the user and standard page site) (in ms)
No. of hops:	Number of intermediate machines used, between the user's machine and the server at the destination
International Route:	Situation where there is at least one machine on the route whose IP address is not within the ranges allocated to national operators
Exclusively National Route:	Situation where the IP addresses of the intermediate machines used on the route belong to ranges allocated to national operators
Traceroute:	Trace route (path or route) to the standard page
Data Centre:	Physical installation used to house large quantities of electronic equipment, typically computers, servers and communications equipment. As the very name indicates, "data centres" are normally used by organisations to handle all data needed for their operations. For example, a bank may have a data centre which maintains the data on its customers' accounts and processes all operations involving that critical information. For telecommunications operators data centres are physical spaces with large capacities for computation, storage and communication are accumulated, and from which various specific services are usually supplied to end customers, such as the housing of websites or servers, for example.
Web Caching	System that enables pages, images and other oft-requested (though little changed) web

objects to be saved. If the same information is requested more than once, the Web Cache system can thus after the first request provide the information saved locally instead of the real information, therefore reducing internet traffic and the time replying to the request.

Statistical Concepts

Sample Average:	Represents the abscissa of the centre of gravity of the distribution formed by the values of the statistical variable.
Standard Deviation:	The quadratic average of deviations compared to the mean.
Precision Error (ou Standard Error of the Mean):	As the mean varies in samples taken from the same field, the quantification of their variability is designated by estimating the sampling error of the precision error(standard error of the mean.

Acronyms/Abbreviations

KB:	**K**ilo-**B**ytes (1024 bytes)
kbps:	**k**ilo-**b**its **p**er **s**econd – number of thousands of bits transmitted in the time space of one second (transmission speed unit)
ms:	**M**illi**s**econd
s:	**Second**
n:	Number of sample units (which in this study are measurements)
HTTP	Hypertext Transfer Protocol
FTP:	**F**ile **T**ransfer **P**rotocol
ISP:	**I**nternet **S**ervice **P**rovider (operators/suppliers of internet services)
IP	**I**nternet **P**rotocol
DNS:	**D**omain **N**ame **S**ystem
DHCP:	**D**ynamic **H**ost **C**onfiguration **P**rotocol
ICMP:	**I**nternet **C**ontrol **M**essage **P**rotocol
NTP	**N**etwork **T**ime **P**rotocol
RAS	**R**emote **A**ccess **S**erver