World Academy of Science, Engineering and Technology
International Journal of Electronics and Communication Engineering
Vol:13, No:4, 2019

Availability Strategy of Medical Information for Telemedicine Services

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***Abstract*—**The telemedicine services require correct computing resource management to guarantee productivity and efficiency for medical and non-medical staff. The aim of this study was to examine web management strategies to ensure the availability of resources and services in telemedicine so as to provide medical information management with an accessible strategy. In addition, to evaluate the quality-of-service parameters, the followings were measured: delays, throughput, jitter, latency, available bandwidth, percent of access and denial of services based of web management performance map with profiles permissions and database management. Through 24 different test scenarios, the results show 100% in availability of medical information, in relation to access of medical staff to web services, and quality of service (QoS) of 99% because of network delay and performance of computer network. The findings of this study suggest that the proposed strategy of web management is an ideal solution to guarantee the availability, reliability, and accessibility of medical information. Finally, this strategy offers seven user profile used at telemedicine center of Bogota-Colombia keeping QoS parameters suitable to telemedicine services.

***Keywords*—**Availability, medical information, QoS, strategy, telemedicine.

I. Introduction

IN the sector of information and communication technology (ICT), the information systems are tools used for the organized storage of all data, with the purpose of providing a service to users.

Currently, there are studies focused on the management of information systems, where operation and organization methods are established for them, in accordance with the inherent characteristics from the data (size, volume, formats). Said studies evaluate file systems to improve the conditions of access speed [1], reference mechanisms for precise searches in virtual libraries [2] and web storage systems for multimedia files [3]. It is important to emphasize that each study defines parameters for the measurement of quality, adapted to the context they are developed in, based on references that specify the ways to select them and monitoring their timely fulfillment [4].

Accordingly, the rightful implementation of an information system requires a management task in accordance with the context it will be implemented in. An information system that offers services in the health area, works with medical information, which has characteristics that categorize it as sensible, semiprivate and classified information [5].

The concept of medical information is defined as any useful data for the development of procedures inside an organization, dedicated specifically to the provision of health services. This definition involves: A patient's medical record (personal information, family background, psychosocial health, diagnostic imaging, timeline of medical events), medical procedure handbooks and clinical reports on the population level.

In Colombia, specifically, the organizations dedicated to the provision of health services in the public sector, do not have the virtual systems focused on the user for the management of medical information, in other words, the data are stored and only offered to the users that own it in a physical form. In this vein, there is a need to innovate by implementing an information system that provides data availability, accessibility and reliability, with the purpose of guaranteeing a reliable operation for the users from a health system.

This study evaluates the necessary requirements and conditions for the design and implementation of an information system focused on web health services. The considerations made are based on the need to guarantee high availability, controlled access and traceability of the medical information. The fulfillment of the established conditions is verified through the measurement of predefined parameters to determine the QoS.

II. Procedure

A. Determination of QoS Variables and Parameters

The first stage for the development of this study involved the selection of measurable variables for the setting of the QoS. This selection process was conducted through a comparative analysis using a matrix that relates 20 scientific articles with characteristics similar to those from the following study.

Once the review and selection of the articles was conducted, we extracted the QoS variables and parameters used in each of them. The purpose of this process was to evaluate how often each variable is used in similar measurement processes. The idea was to subsequently define the parameters that have a greater importance and whose applicability can best adapt to the following study.

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The frequency of use for the extracted variables is analyzed in graphs and the QoS parameters selected for this study are finally listed and mathematically interpreted.

B. Establishment of Technical Requirements

The second stage of development from the study is conducted through the review and identification of available resources and necessary recourses for the implementation of the proposed management strategy. In this vein, the considerations regarding the available resources are made in accordance with tests used in this study and the implementation of the management strategy.

The work scenario is a double server system located in the 'Calle 100' location from the Universidad Militar Nueva Granada in Bogotá, Colombia with public IP address: 190.60.233.52 and private IP address: 190.60.233.52.

After the evaluation of available resources in the work scenario, the required resources are defined for the development and implementation of the management strategy. This process is conducted through a report of technical requirements, which specify monitoring software tools, manager system for the database and necessary traffic simulation tools. These resources are selected with the purpose of enabling the system for the creation and measurement of test scenarios consistent with the previously selected QoS parameters.

C. Design, Implementation and Evaluation of the Strategy

The third development stage from the study is conducted through the evaluation of the system performance, after it has adopted the defined management conditions to guarantee the availability, accessibility and reliability of the information. For an optimal evaluation that offers significant results, different test scenarios are defined, where the relevant parameters and minimum acceptable values are specified to validate the correct functioning of the system.

The first test scenario consists in the evaluation of the performance from the web server under conditions of low traffic levels. For this we used 'ping' type test messages. Some tests were conducted internal computer from network, other tests from an external computer toward to the web server ending in repository server. In this scenario, measurements for connectivity tests conducted for ten continuous minutes are collected, which were duly monitored using the 'Wireshark' software tool. The obtained measurements are tabulated and placed in graphs in a linear form. Afterwards, the data are totalized through the statistical treatment of the arithmetic mean or average (1), to finally be documented in defined test formats.

$$Arithmetic\ Mean = \frac{\sum_{i=1}^{n} Xi}{n} \quad (1)$$

where n is Total number of data; x is value of individual data.

The second test scenario consists on the evaluation of the performance from the web server under conditions with high levels of traffic and saturation. We used the 'HTTP Request' type of request messages. Tests were conducted from an internal network computer and an external network computer. In each test the number of simultaneous request is progressively increased, with the purpose of demonstrating the allowed limit before the system gets saturated. The high traffic levels are duly simulated using the 'ApacheJMeter' tool. The measurements are extracted with the 'Wireshark' tool and once they are obtained, they are respectively tabulated and placed in graphs in a linear form. Afterwards, the data are totalized through the statistical treatment of arithmetic mean or average (1), to finally be documented in defined test formats.

The third test scenario consists of the evaluation of accessibility through the implementation of a profile and permits architecture, which is implemented on the database related to the system. The proposed architecture involves seven different profiles (patient, nurse, general doctor, specialist doctor, administrator, technic and government) that contemplate the possible users of an information system focused on health. The accessibility definition for each profile is conducted in accordance with the privacy and use principles for medical information [6], [7]. Additionally, information corresponding to the necessary services in the system (Triage, System configuration and Authorization for configurations) is created. The creation of the data is simulated, in other words, the data are fictional, since we are only trying to regulate the access for the created profiles. The profiles and permit assignment are conducted through the 'PhpMyAdmin' database management tool. Once the architecture is implemented, access tests are conducted for each of the defined profiles. In each test, one hundred logic data are obtained (effective access/denied access), which are quantified through the statistical treatment of event probability (2), to be finally placed in graphs in a linear form and documented in defined test formats.

$$Probability\ of\ event = \frac{Favorables\ cases}{Posible\ cases} \quad (2)$$

III. Results

A. Determination of QoS Variables and Parameters

After the extraction of important variables, the relevant QoS parameters are specified and then all the processes that are part of the development of the present study are quantified based on Table I.

TABLE I
SELECTED QOS PARAMETERS

Parameter	Definition	Mathematical Relationship
Delay	Time from origin to destination	Dl
Latency	Sum of temporary delays	$Lt = \sum Dl\ 1 + Dl\ 2 + \cdots Dl\ n$
Jitter	Temporal variability of the delay	Jt =|Dl - Lt|
Bandwidth Available	Volume of possible data in a specific time	BW
Bandwidth Variation	Temporary variability of the bandwidth	VBW= (VBW – BW)\ 2
Efficiency	Percentage of bandwidth optimization	Ef=BW theorist \ BW experimental
Throughput	Effective transfer rate	Th= Bit Rate\ Transmission Time

B. Establishment of Technical Requirements

In the work scenario, the following hardware resources are available: Oracle Linux base operative system version 5, four processing cores, eight Gigabytes RAM memory and internal memory storage of one Terabyte.

After considering the available resources and the parameters selected as relevant, the following tools: Wireshark, ApacheJMeter, PhpMyAdmin and Matlab2017, were selected as necessary resources for the development of this study. The selection of each tool was made through the consideration of characteristics, which were compared to another alternative tool for the performance of the same function.

TABLE II
TECHNICAL REQUIREMENTS

Selected Tool	Function	Alternative Tool
Wireshark	Traffic and protocol analyzer	Pandora FMS
ApacheJMeter	Simulator for load tests	Funkload
PhpMyAdmin	Management system for databases	MariaDB
Matlab 2017	Mathematical software with graphing function	Microsoft office Excel 2016

It is worth mentioning, that additional software resources are installed to support the software tools and implemented hardware. These additional specifications are mentioned in the technical requirements report that was made.

C. Design, Implementation and Evaluation of the Strategy

To conduct the tests defined for the first scenario, we collected six hundred measurements in each one and we verified that the measured levels were acceptable. For each conducted test, certain specific parameters are considered. The data were collected in create format that following columns are specified: size of the package, IP destination address, sequence number, life cycle, general time, delay, latency, jitter, available bandwidth, variation bandwidth, efficiency, instantaneous throughput, general throughput, total bits and total capture time (as shown in Fig. 1).

Package size (Bytes)	Destination IP	Sequence number	Time to live	Time (ms)	Delay (ms)	Latency (ms)	Jitter (ms)	BW Available (Mbps)	BW Variation (Mbps)	Performance %	Instant Throughput (bps)
64	160.60.233.52	1	62	0,622	0,311	0,311	0,000	1,6463	1,646	81,4	0,002
64	160.60.233.52	2	62	0,756	0,378	0,500	0,122	1,3545	0,146	66,9	0,003
64	160.60.233.52	3	62	0,677	0,339	0,613	0,274	1,5126	0,683	74,7	0,004
64	160.60.233.52	4	62	0,383	0,192	0,661	0,469	2,6736	0,995	132,1	0,010
64	160.60.233.52	5	62	3,350	1,675	0,996	0,679	0,3057	0,345	15,1	0,001
64	160.60.233.52	6	62	0,544	0,272	1,041	0,769	1,8824	0,769	93	0,011
64	160.60.233.52	7	62	2,650	1,325	1,230	0,095	0,3864	0,191	19,1	0,003
64	160.60.233.52	8	62	0,540	0,270	1,264	0,994	1,8963	0,853	93,7	0,015
64	160.60.233.52	9	62	10,700	5,350	1,859	3,491	0,0957	0,378	4,7	0,001
64	160.60.233.52	10	62	1,360	0,680	1,927	1,247	0,7529	0,187	37,2	0,007
64	160.60.233.52	11	62	0,436	0,218	1,946	1,728	2,3486	1,081	116	0,025
64	160.60.233.52	12	62	0,699	0,350	1,975	1,626	1,4649	0,192	72,4	0,017
Results											
Total bits = 307200				Total time (s) = 0,690				Overall Throughput (bps) = 445343,9			

Fig. 1 Random sample of data (that has not been averaged)

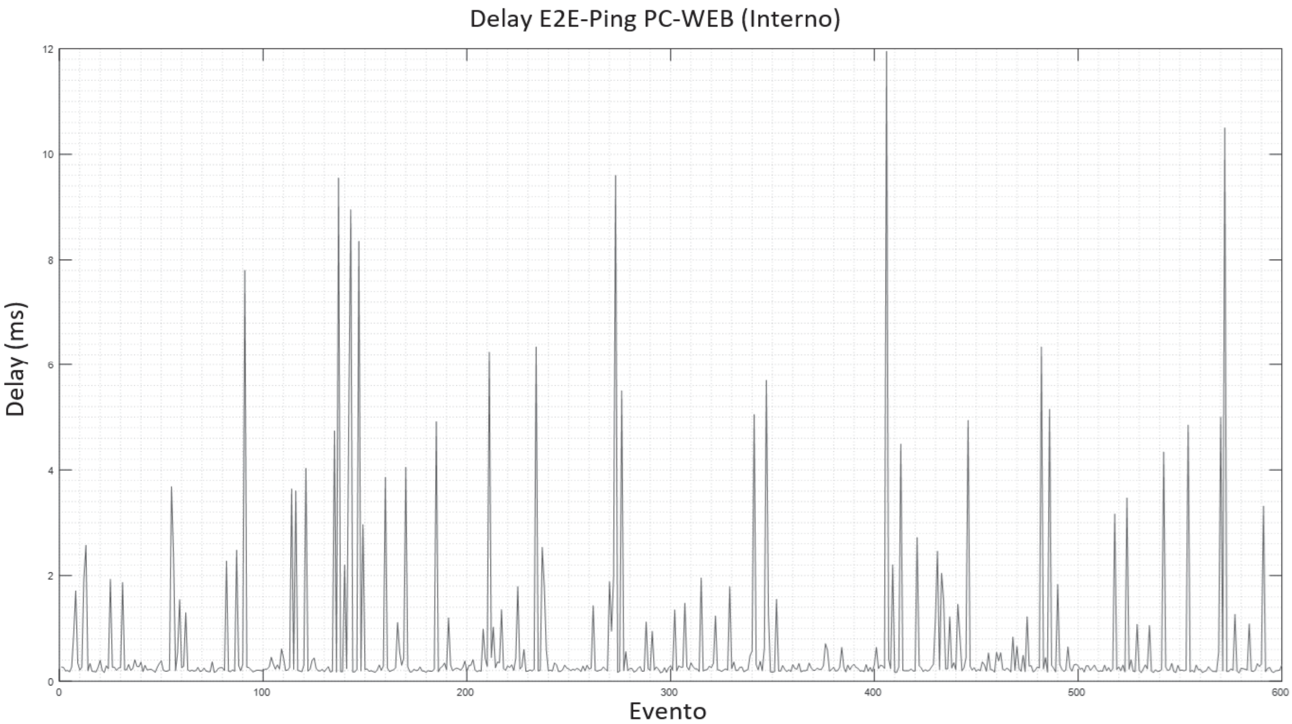

Fig. 2 Graphic behavior of the delay parameter in the internal access test

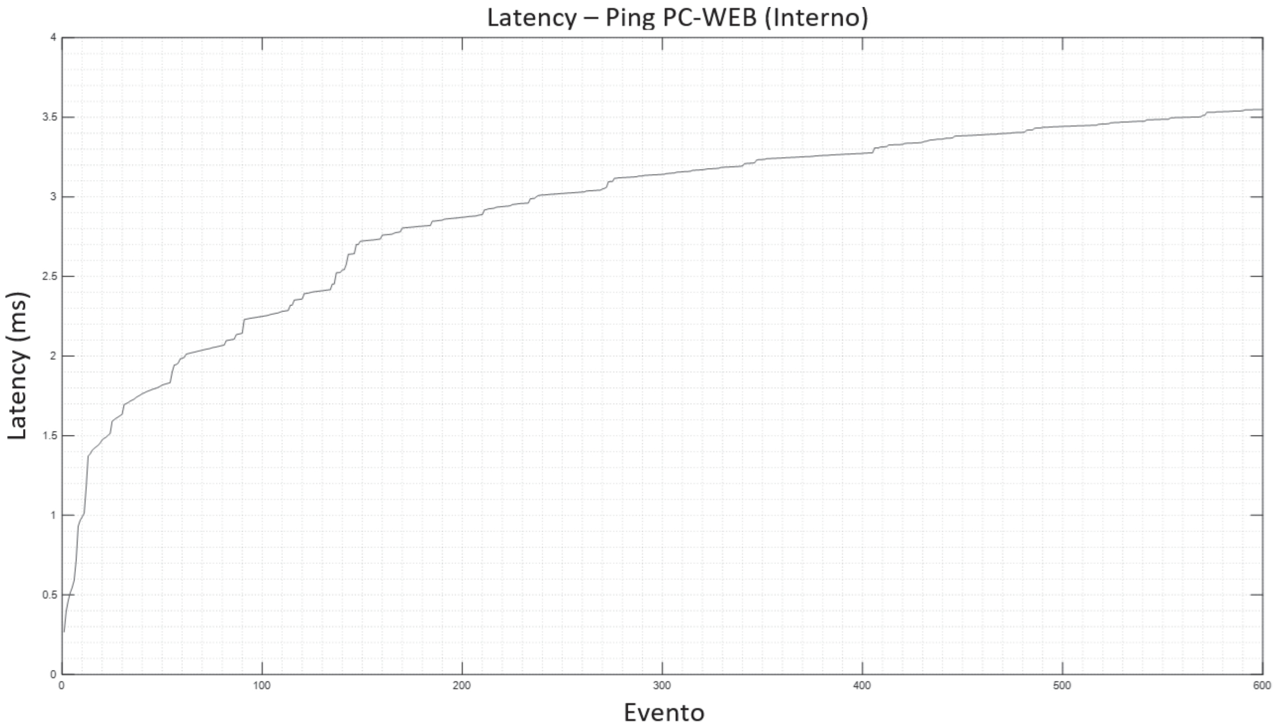

Fig. 3 Graphic behavior of the latency parameter in the internal access test

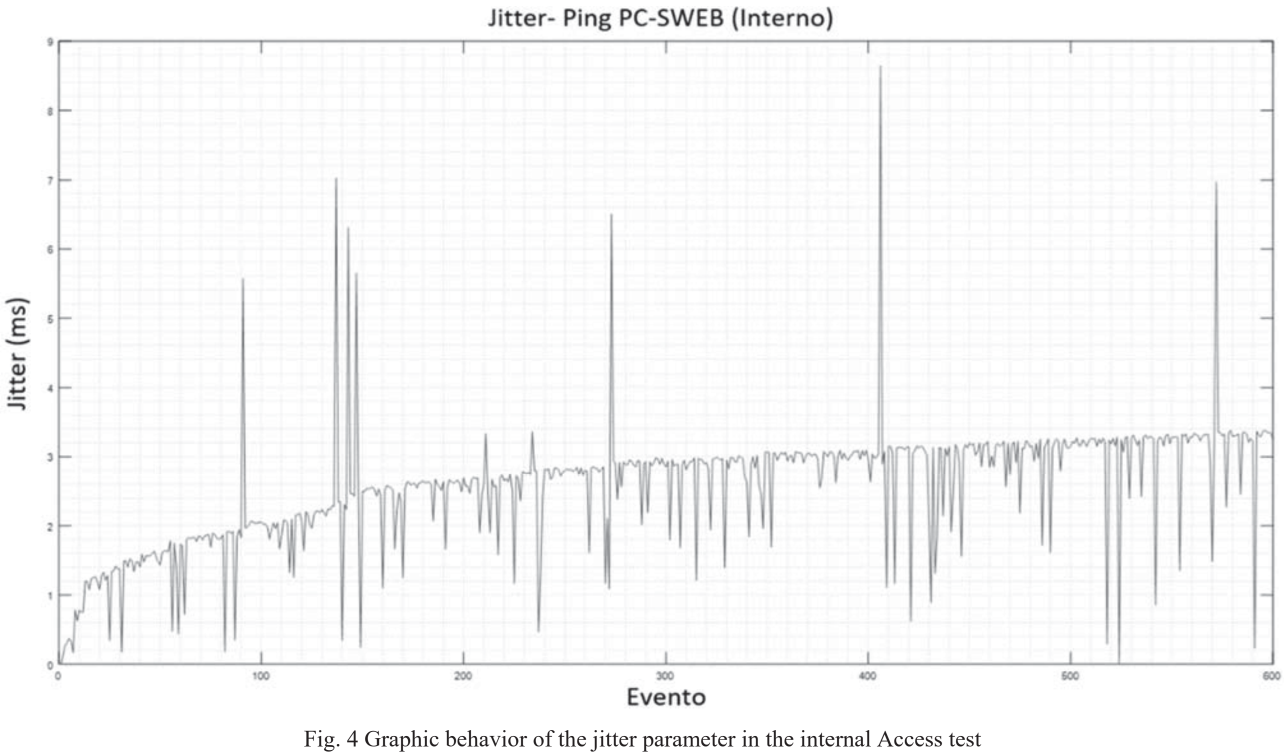

Fig. 4 Graphic behavior of the jitter parameter in the internal Access test

Afterwards, the collected data for each parameter are duly graphed through the 'MATLAB2017' software tool. Linear graphs are used to demonstrate the behavior of each variable during the test. Finally, the results are averaged and documented in an independent test format. Hereunder, the results obtained in each test are shown:

1) Tests from an Internal Network Computer

The behavior of the following variables is verified: delay (should remain under 5 milliseconds) (as shown in Fig. 2), jitter (should remain under 100 ms) (as shown in Fig. 3) and latency (should remain under 65 ms) (as shown in Fig. 4). In the graphic behavior from the evaluated parameters, a vertical range is defined for the data, and the behavior is observed for each one during the test. It confirms that most of the data do not exceed the established thresholds, despite the presence of peaks or atypical data in the readings from the delay and jitter parameters. On the other hand, the latency parameter presents an inverted exponential growth, which implies an increase that becomes less significant, looking for a stability point that in this case is near 35 ms, in other words, an acceptable value. Obtaining the average values (as shown in Fig. 5) allows us to validate the obtained information through the graphic analysis, which confirms that the considered parameters behave optimally.

2) Tests from an External Network Computer

The behavior of the following variables is verified: Delay (should remain under 5 milliseconds) (as shown in Fig. 6), jitter (should remain under 100 ms) (as shown in Fig. 7), and latency (should remain under 65 ms) (as shown in Fig. 8).

In the graphic behavior of the evaluated parameters a vertical range is defined for the data, and the behavior of each one is observed throughout the test. It confirms that most of the data do not exceed the established thresholds, despite the presence of peaks or atypical data in the readings from the delay and jitter parameters. On the other hand, the latency parameter presents an inverse exponential growth, which implies an increase that becomes less significant, looking for a stability point that in this case is near 45 ms, in other words, an acceptable value.

Obtaining the average values (as shown in Fig. 9) allows us to validate the obtained information through the graphic analysis, which confirms that the considered parameters behave optimally.

3) Tests from the Web Server to the Repository Server

The behavior of the following variables is verified: Throughput (should remain equal or greater than 1 bps) (as shown in Fig. 10), and efficiency (should remain equal or greater than 99%).

4) Tests from the Web Server

The behavior of the following variables is verified: bandwidth (should remain equal or greater than 2Mbps) (as shown in Fig. 12) and bandwidth variation (should remain equal or under 1Mbps) (as shown in Fig. 13).

Delay (ms)	0,630
Latency (ms)	3,481
Jitter (ms)	3,098
Bandwidth Available (Mbps)	2,100
Bandwidth Variation (Mbps)	0,746
Efficiency (%)	104%
Instant throughput (bps)	1,107
General throughput (bps)	396545.715

Fig. 5 Average values from the QoS parameters in the internal Access test

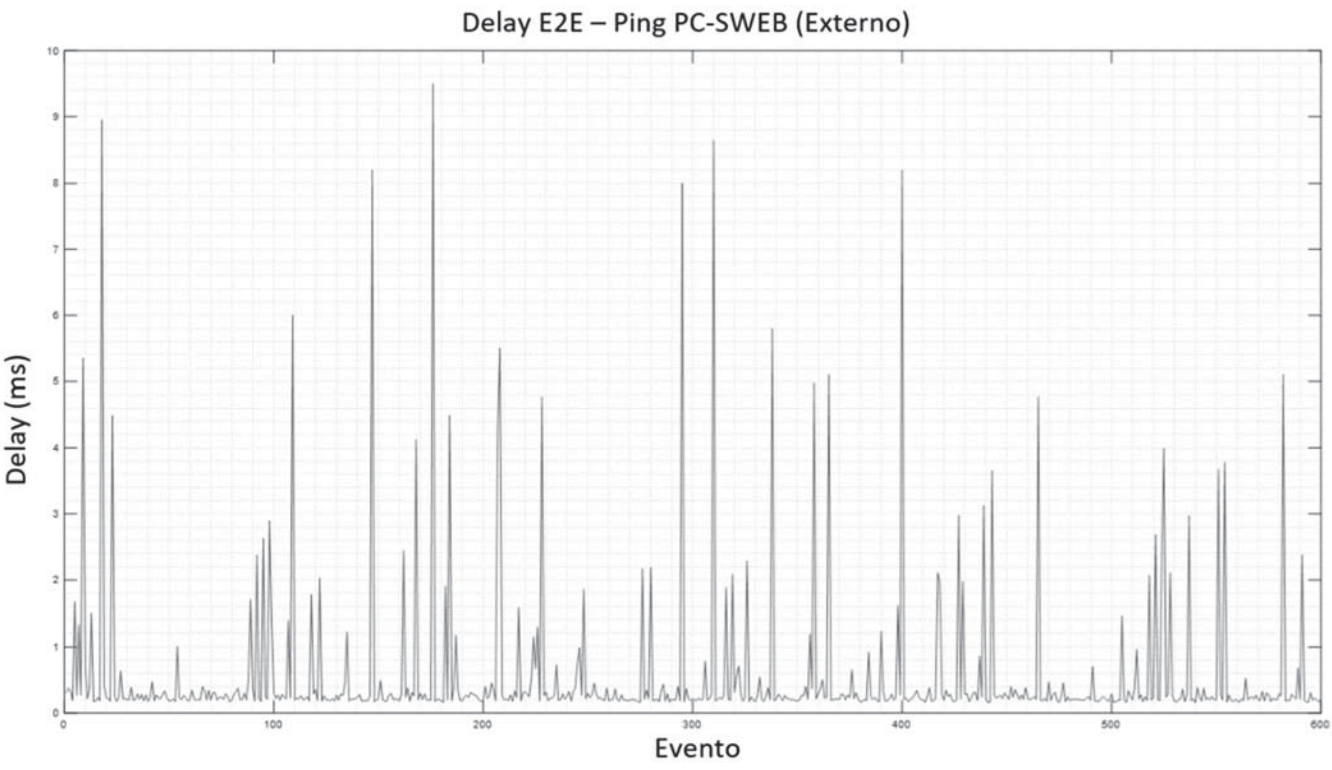

Fig. 6 Graphic behavior from the delay parameter in the external access test

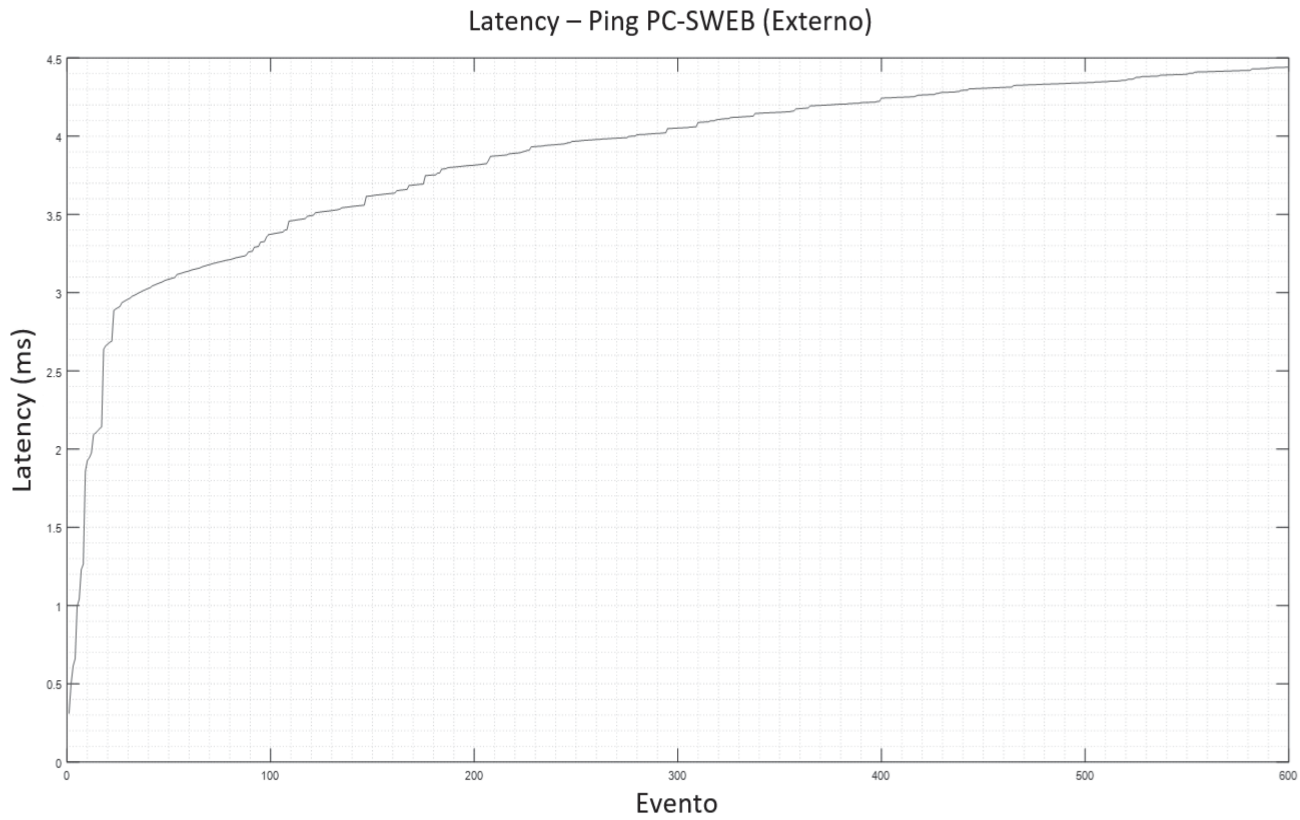

Fig. 7 Graphic behavior of the latency parameter in the external access test

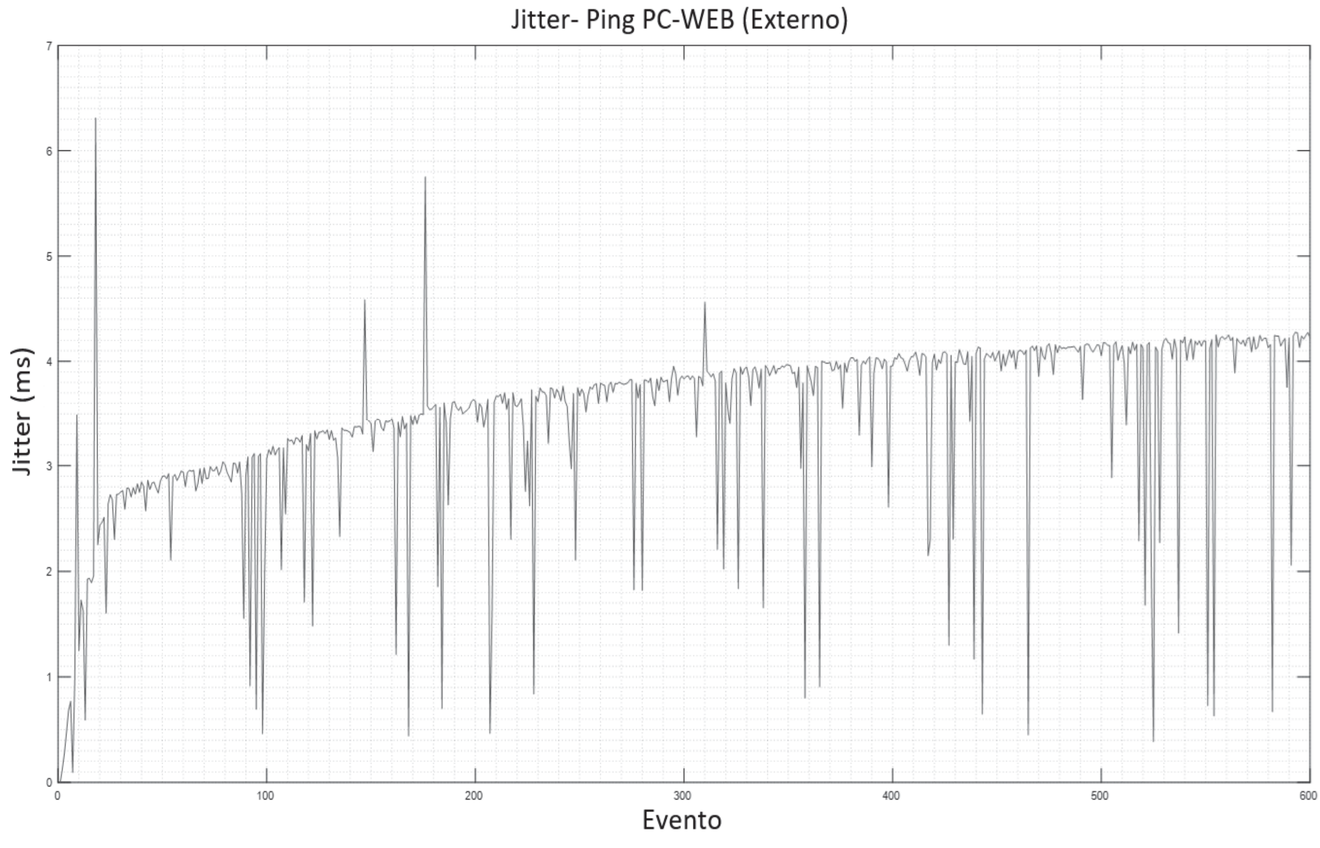

Fig. 8 Graphic behavior of the jitter parameter in the external access test

Delay (ms)	0,478
Latency (ms)	4,384
Jitter (ms)	3,917
Bandwidth Available (Mbps)	2,166
Bandwidth Variation (Mbps)	0,754
Efficiency (%)	107%
Instant throughput (bps)	1,136
General throughput (bps)	445343,895

Fig. 9 Average values in the external access test

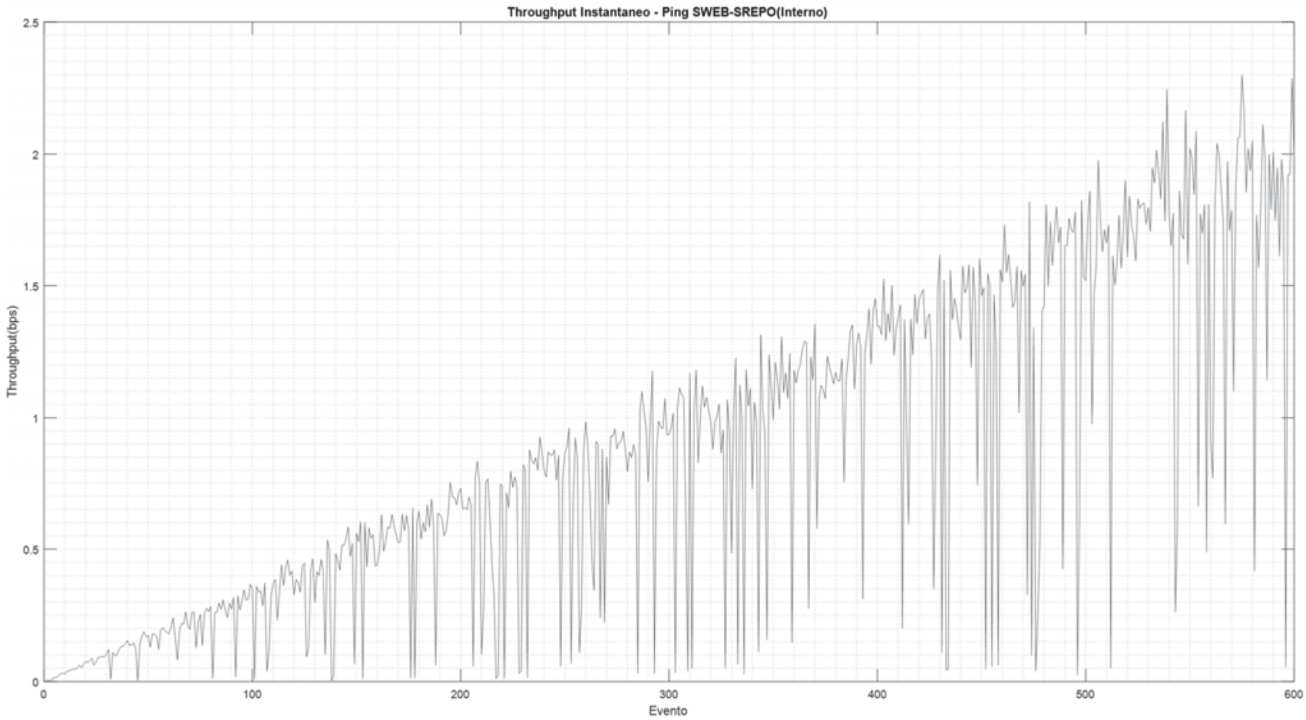

Fig.10 Graphic behavior of the throughput parameter in the connectivity test with the repository server

Delay (ms)	0,508
Latency (ms)	2,317
Jitter (ms)	2,171
Bandwidth Available (Mbps)	2,992
Bandwidth Variation (Mbps)	1,052
Efficiency (%)	148%
Instant throughput (bps)	0,875
General throughput (bps)	504215,749

Fig. 11 Average values in the connectivity test with the repository server

The graphic behaviors from the evaluated variables demonstrate a tendency to stability. However, there are measurements that move away from other recorded data. These instability records, as growths of almost one additional megabyte, are justified by the hardware limitations of the system. However, the declines from the readings don't exceed the established quality thresholds, as evidenced with the collection of the average values (as shown in Fig. 14).

To conduct the defined tests for the second scenario, six hundred data was collected for each of the evaluated cases. It is important to mention that the progressive increase of simultaneous users is applied in each of the tests, with the purpose of determining the saturation point of the system.

When conducting the evaluation in real time of how many simultaneous users are accepted by the system, a standard value of one hundred users is established as the test number. After the measurements are conducted again, with the load of one hundred internal users, one hundred external users in a simultaneous way.

Hereunder, the results obtained and the graphic behavior for the delay, efficiency and throughput parameters are shown.

5) Tests from the Internal Network Computer with One Hundred Simultaneous Requests

In this test the same operation and performance conditions are evaluated, based on the behavior of the delay (as shown in Fig. 15) and throughput (as shown in Fig. 16) variables.

The graphic behavior of the variables demonstrates a similar behavior to the one presented in the tests without load conditions. However, the redefined graph ranges show a considerable increase in the delay value and a decrease of negative peaks in the throughput variable. Through the collection of average values (as shown in Fig. 17), an approach to the limit considered as acceptable is evidenced, which implies that the system functions correctly with its limit of one hundred simultaneous internal users.

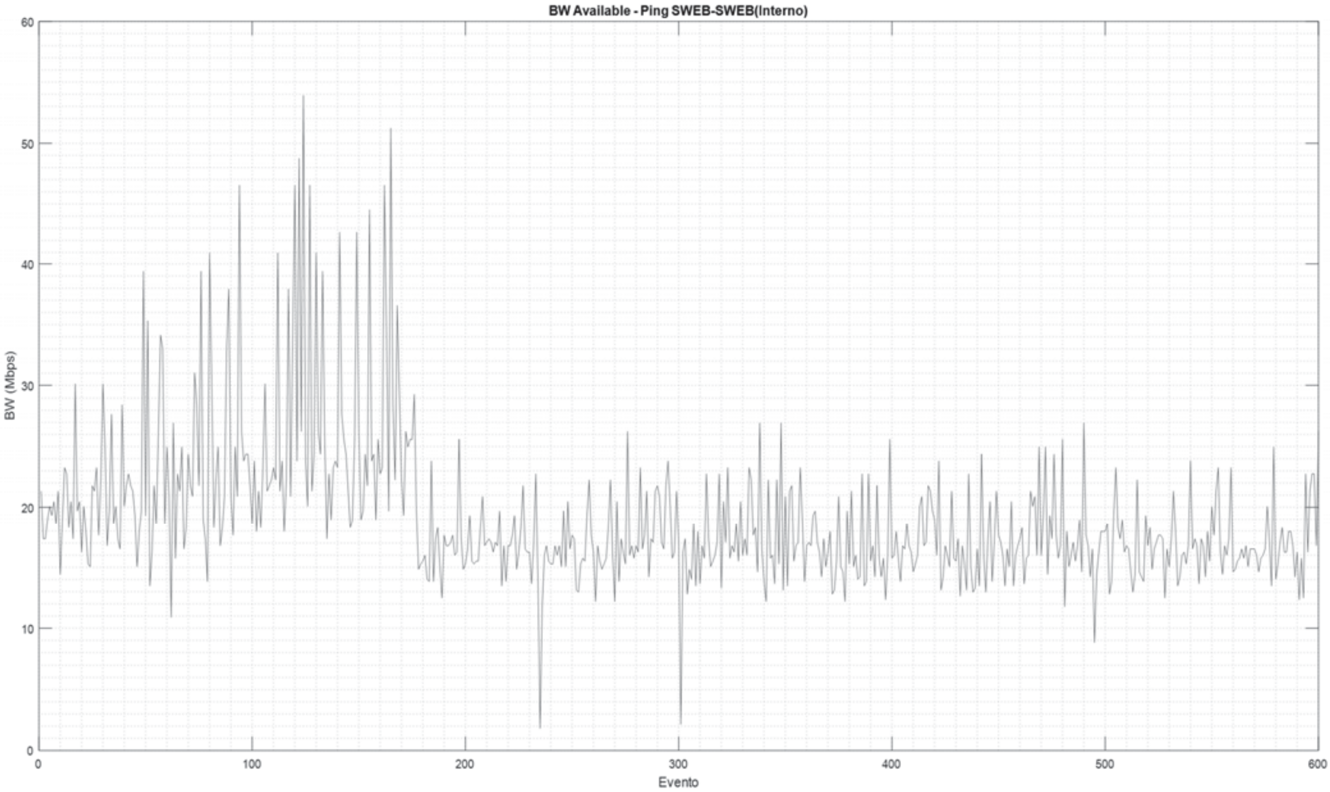

Fig. 12 Graphic behavior of the bandwidth parameter in the web server performance test

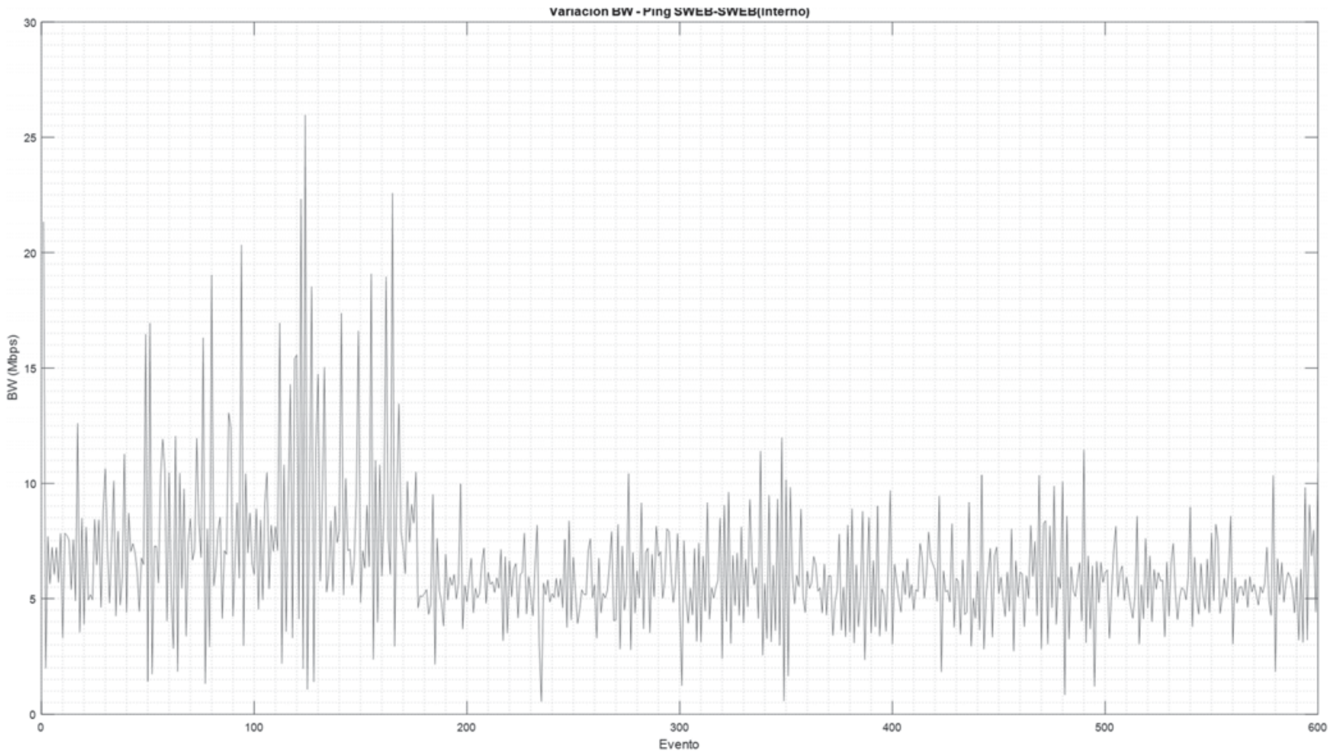

Fig. 13 Graphic behavior of the bandwidth variation parameter in the web server performance test

Delay (ms)	0,029
Latency (ms)	0,156
Jitter (ms)	0,128
Bandwidth Available (Mbps)	19,194
Bandwidth Variation (Mbps)	6,431
Efficiency (%)	948,3
Instant throughput (bps)	5,238
General throughput (bps)	8763371,84

Fig. 14 Average values in the web server performance test

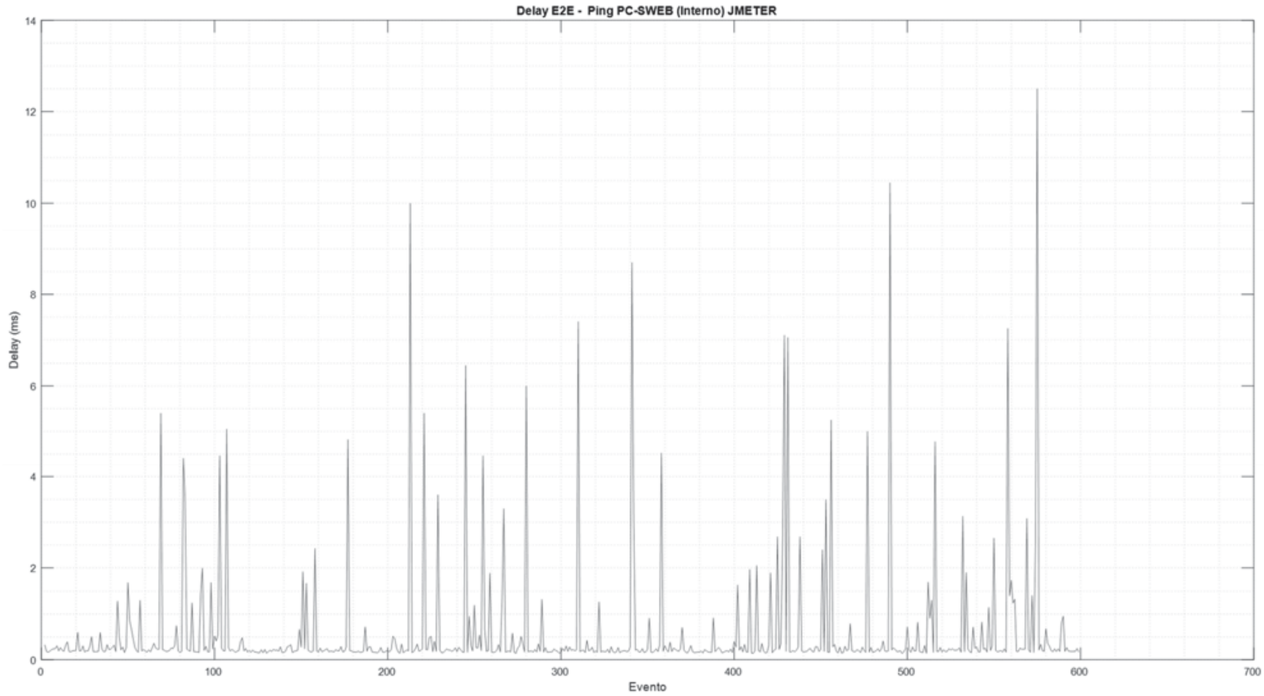

Fig. 15 Graphic behavior of the delay variable in the internal access test with load

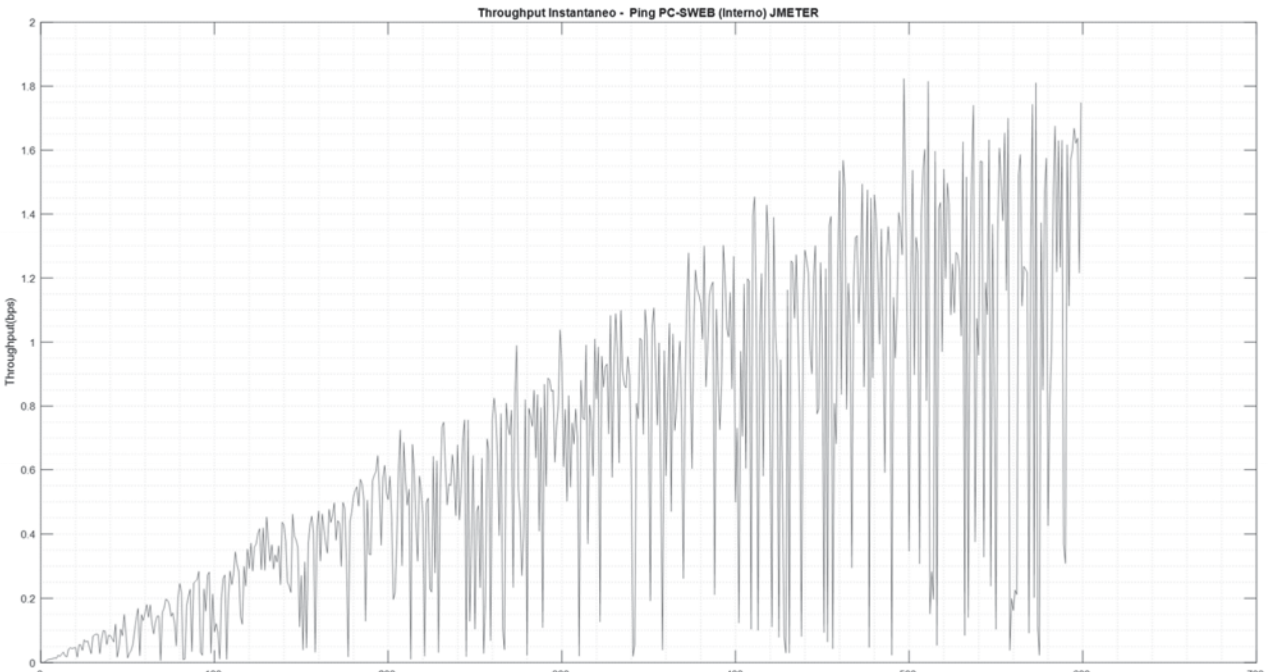

Fig. 16 Graphic behavior of the throughput variable in the internal access test with load

Delay E2E (ms)	0,728
Latency (ms)	2,531
Jitter (ms)	2,256
Bandwidth Available (Mbps)	2,111
Bandwidth Variation (Mbps)	0,776
Efficiency (%)	104%
Instant throughput (bps)	1,100
General throughput (bps)	440831,394

Fig. 17 Average values for the QoS parameters in the internal access test with load

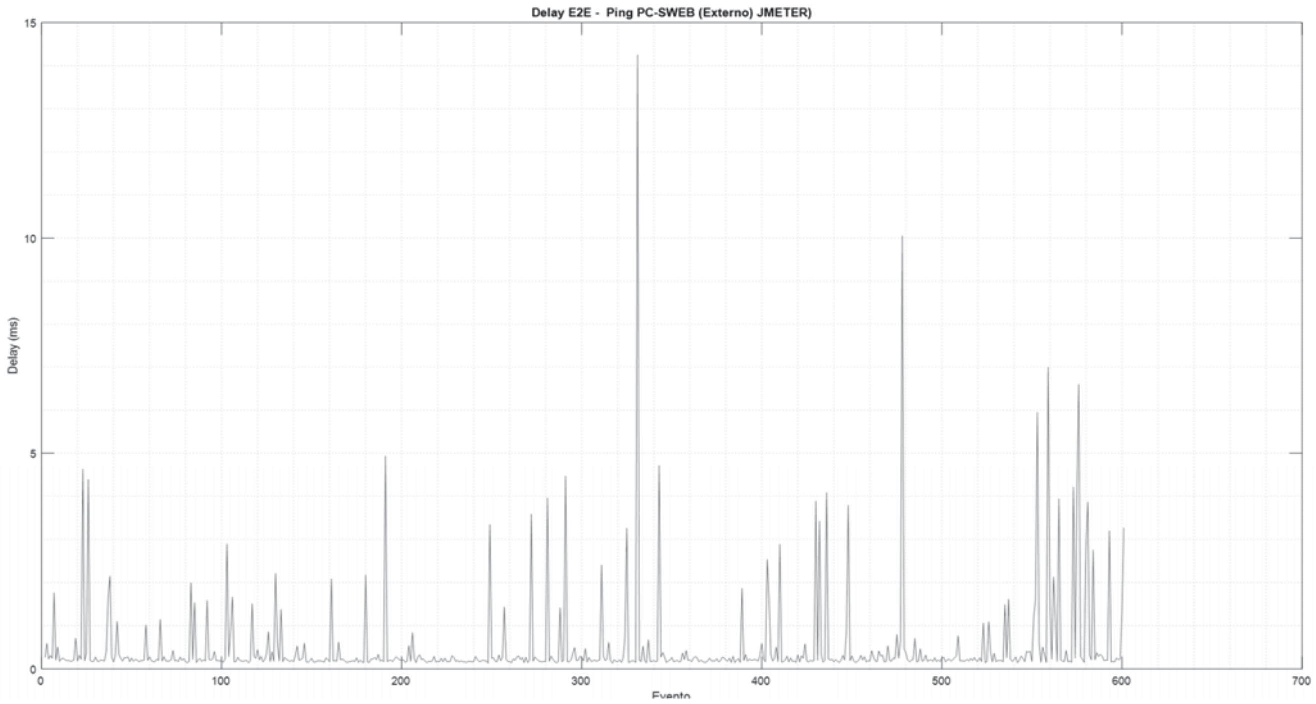

Fig. 18 Graphic behavior of the delay variable in the external access test with load

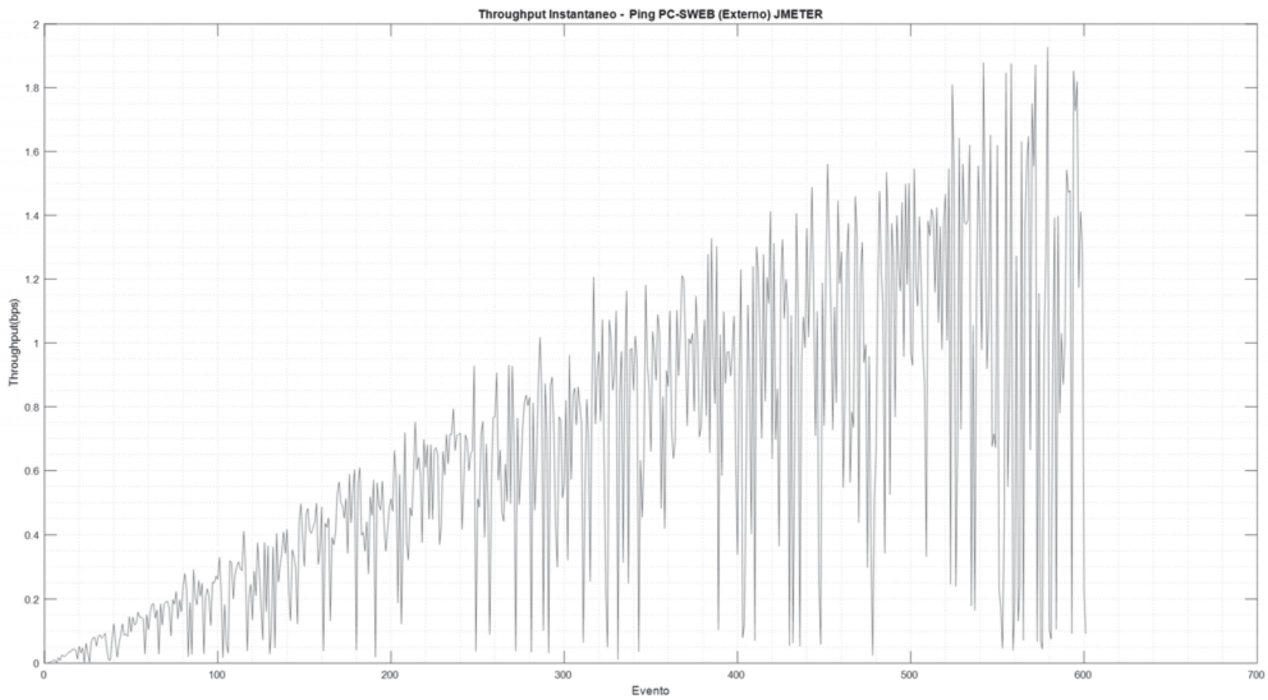

Fig. 19 Graphic behavior of the throughput variable in the external access test with load

Delay E2E (ms)	0,775
Latency (ms)	3,022
Jitter (ms)	2,590
Bandwidth Available (Mbps)	1,996
Bandwidth Variation (Mbps)	0,736
Efficiency (%)	99%
Instant throughput (bps)	1,041
General throughput (bps)	499056,958

Fig. 20 Average values for the QoS parameters in the external access test with load

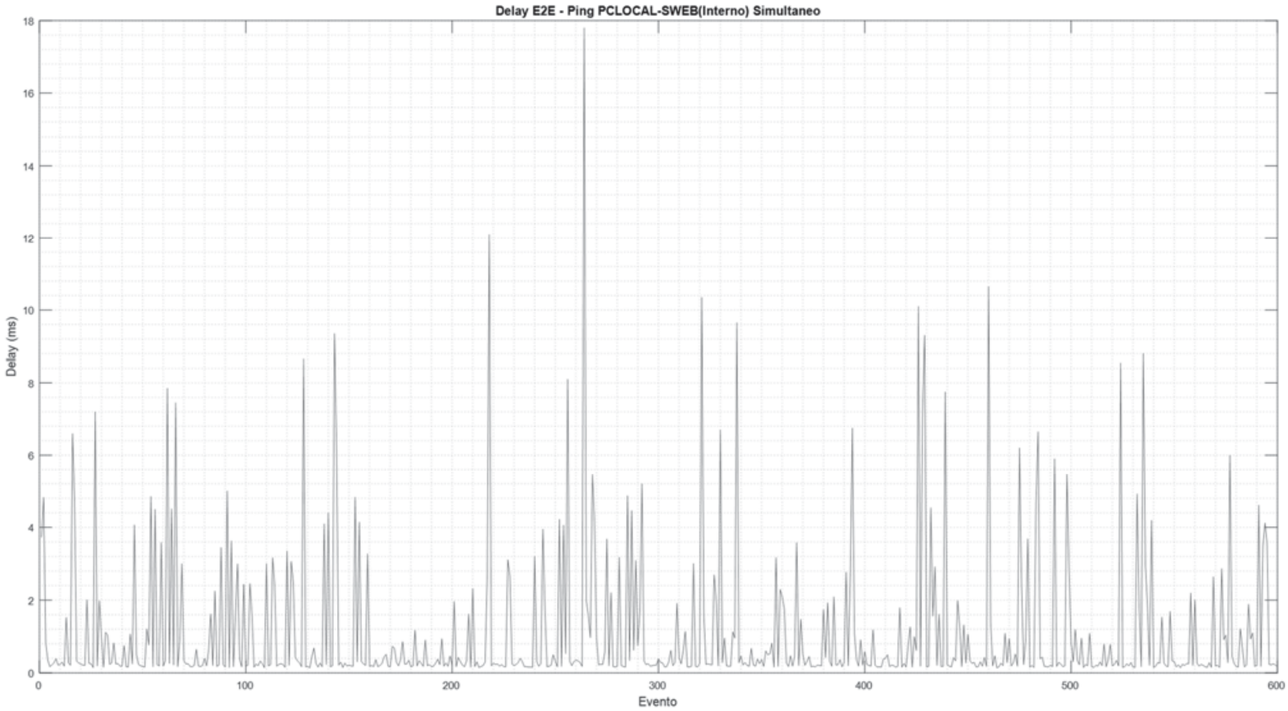

Fig. 21 Graphic behavior for the delay variable in the simultaneous access test with load

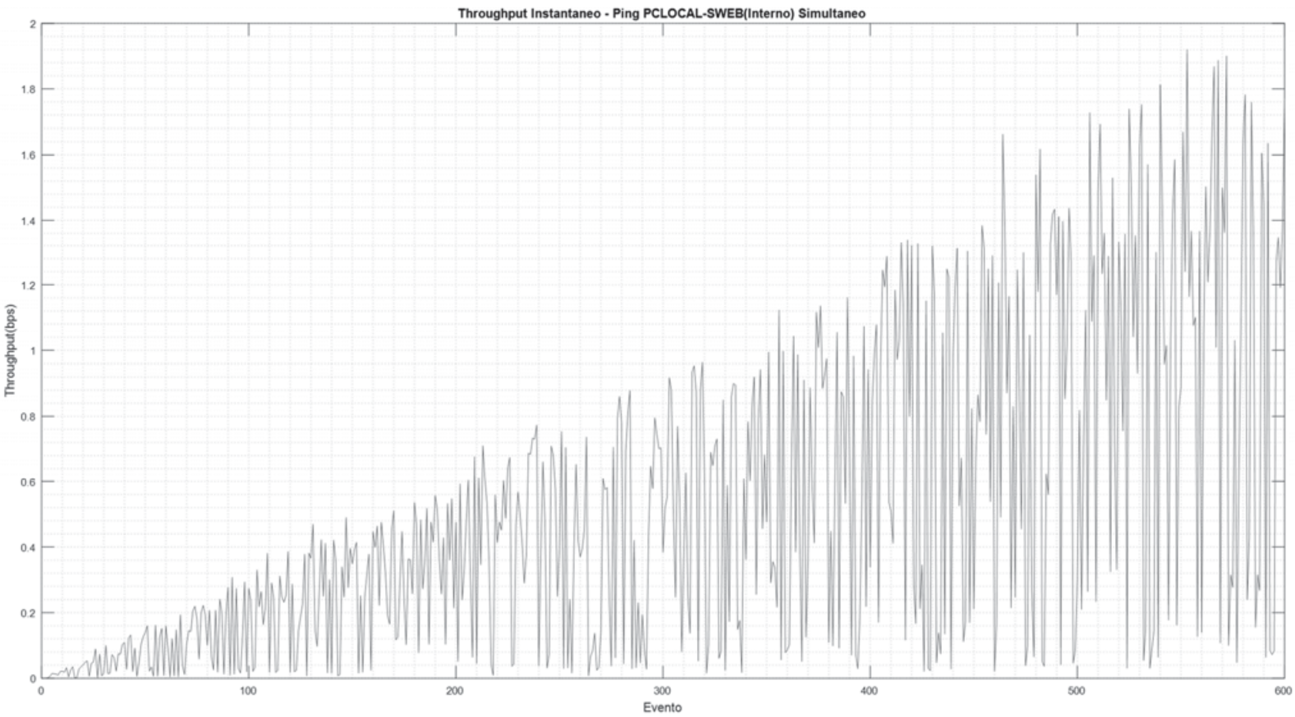

Fig. 22 Graphic behavior of the throughput variable in the simultaneous access test with load

6) Tests from the External Computer to the Network with One Hundred Simultaneous Requests

In this test, the same operation and performance conditions are evaluated, based on the behavior of the delay (as shown in Fig. 18) and throughput (as shown in Fig. 19) variables. The graphic behavior of the variables demonstrates a similar behavior to the one from the tests conducted without a load condition. However, the redefined graph ranges show a considerable decrease of the negative peaks recorded in the throughput variable. The measurements from the delay variable show an outstanding peak that significantly exceeds the acceptable threshold. Through the collection of average values (as shown in Fig. 20), an approach to the preestablished limit related to the throughput value is evidenced, which implies that the system works with an effective transmission, even in its limit of one hundred simultaneous users. However, the average value for the delay slightly exceeds the threshold defined as acceptable, thus, under the mentioned conditions, there is a slower transmission of information.

7) Tests from the Internal and External Computer with One Hundred Simultaneous Requests Each

The same operation and performance conditions are evaluated, based on the behavior of the delay (as shown in Fig. 21) and throughput (as shown in Fig. 22) variables with the application of one hundred internal and external requests, with the purpose of determining the implications this has on the system and limit its operability conditions.

The graphic behavior of the variables shows a significant increase in several data recorded for the delay, as well as a very low record of negative peaks for the throughput. This suggests that the system has exceeded the stipulated acceptable values.

Through the collection of the average values (as shown in Fig. 23), the fact that the measurements are no longer in the threshold considered as acceptable is verified. We can conclude that, even if the system continues to work without saturation indicators, it does not operate optimally for the requirements of the study.

The evaluations of the different tests from the second scenario allow us to limit the operation conditions from the used web server, with the purpose of defining the behavior and performance it has under specific conditions. Consequently, it can be asserted that the web server from the used system operated optimally for telemedicine services, with one hundred external or internal network users. Therefore, only under this condition, the availability of the information and resources can be guaranteed.

To conduct the tests defined for the third scenario, a profile architecture was previously designed for the users from a health system, as well as the characteristic services said user can access and the permits granted to each of them. First, the seven profiles are defined for the management of the access control and the individual information each of them contains (as shown in Fig. 24).

In second place, the services related to the system users are defined, additional to the information already contained in each of the profiles. The services are very specific and only related to selected proposed profiles. For this study, three specific services were proposed:

- *Triage service:* mechanism used to classify patients in the first instance, with the purpose of evaluating the severity and assign attention priority in the system.
- *System configuration service:* mechanism that enables the possibility of managing the system resources, but not the information contained in it.
- *Authorization service:* mechanism through which a designated profile enables another one to conduct a task inside the system,

Subsequently, the permits that will be assigned to each profile are defined (as shown in Fig. 25), in other words, which information will be available and which services will be accessible to each. The created profiles are independent and different in terms of permits, since they are created with that purpose: differentiate the needs of the users and control their operation within the system.

It is important to emphasize that the permits are organized in a standard way for all the profiles, in other words, through the classification of: only visualization, possibility to modify and possibility to modify with external authorization. Once the profile architecture is defined, the corresponding implementation is conducted on the database related to the web server.

For this process, the elements from the profile architecture must be related to the elements inherent to the environment defined by the used manager system of databases, 'PhpMyAdmin'. The implementation process starts with the individual creation of tables, each one related to a proposed profile or a service (as shown in Fig. 26), within each of the tables the fields corresponding to the individual information of each profile are created.

The basic and professional information fields are defined in accordance with the data established as necessary for the recording of user's information [8]. The fields for the service data, are established in accordance with the already implemented medical record policies [9].

Therefore, the fields specified for each table are: for basic profiles information: ID, Name, Last name, Age, Type of Document, Document number, Address, City, Email, Civil Status, Genre. For professional information: Years of work experience, Bachelor's degree, Attached image of the diploma or certificate, Postgraduate degrees, Attached image of the postgraduate diploma or certificate. For triage service: ID, Patient DNI, Valuation Level, TimeStamp. For system configuration service: ID, TimeStamp, Administrator ID, Technician ID, Description. Finally, for the authorization system the fields are: ID, Description, Authorizer profile, id authorizer profile, Authorized profile, ID authorized profile.

Subsequently, we create the views, in other words, automated consults, which show the specific and organized information of one or more tables from the database. Each generated view corresponds to the permits considered within the profile architecture, in other words, there is a corresponding view for each of the proposed profiles.

Delay E2E (ms)	1,106
Latency (ms)	10,275
Jitter (ms)	9,200
Bandwidth Available (Mbps)	1,739
Bandwidth Variation (Mbps)	0,677
Efficiency (%)	86%
Instant throughput (bps)	0,514
General throughput (bps)	231511,487

Fig. 23 Average values for the QoS parameters in the simultaneous access test with load

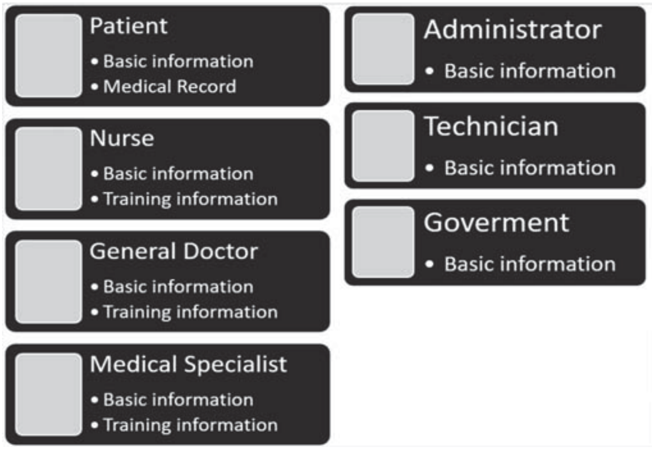

Fig. 24 Proposed profiles and information contained by each profile

Through this implementation, the profile access is limited, allowing the controlled visualization of the information and the restricted access to the services. After the creation of all the views considered within the architecture, the editing of a field for certain profiles is enabled (as shown in Fig. 28). This process is conducted through the relation of initially created views, with the enabling of the edit option for fields in specific tables. In this way the modification permits are obtained, which are also limited to certain profiles within the system.

Then, the modification permits with authorization from another profile are implemented. This process is conducted through the relation of created views to an already created field from the 'Authorization_MWS' table, in other words, only the corresponding view will be generated with the enabling of the option 'edit field', if a registered authorization for said user is verified. Said verification is conducted through the comparison of the ID value from the profile against the registered ID value in the field ID authorized profile.

Finally, once the profile architecture is implemented, the idea is to evaluate its performance through the quantification of the percentage of efficient access and service denial. These tests are conducted for each of the permits granted to each of the profiles.

It is important to consider that the availability percentage is obtained and quantified when an allowed access is evaluated. A denial percentage is obtained, when a restricted access is evaluated.

In this way, the tests for each possible access attempt are conducted, through the simulation of one hundred requests for each permit. Subsequently, the data is quantified and totalized, through the application of the 'probability of an event' statistical method, which allows us to obtain the availability and denial percentages in an independent way for each case, Table III.

It is confirmed that the obtained results maintain a minimum availability and denial percentage of 98%, thus, the architecture is considered functional and rightly implemented.

IV. Conclusion

The management strategy evaluated in this study allows us to recognize the implementation and operation requirements of a system with punctual characteristics, with the purpose of offering availability and accessibility of information, based on the needs of a system that offers health services.

Specifically, the QoS parameters used in this study offer a clear notion of the performance of the system and allow to establish a reference framework for the monitoring of the quality of a service.

On the other hand, a profile and permit architecture designed for a specific context, allows to comply with the punctual needs of a system and in the health sector case, to improve the quality of life of the patients, through a correct interaction between them and the medical personnel.

Thus, the idea of proposing a system focused on the user, through which the different actors from a health system interact, implies an innovative notion that broadens the horizon of the offering of services in telemedicine.

Likewise, a system that allows to reconsider the way in which medical information is handled in Colombia, allows to contribute to society, not only with the optimization of the resources operation and mobility of the user, but also with the promotion of the use of ICT.

Patient	Only view	Own medical record_General Doctor basic information_Medical Specialist basic information_Nurse basic information_
	Modify	Own basic information
	Modify with authorization	None
Nurse	Only view	Patient basic information_Patient medical record_General basic information_Medical Specialist basic information_Medical Specialist professional information.
	Modify	Triage_Medication
	Modify with authorization	None
General Doctor	Only view	Triage_Medication_Patient basic information_Medical Specialist basic information_Medical Specialist professional information_Nurse basic information
	Modify	Patient Medical Record
	Modify with authorization	None
Medical Specialist	Only view	Triage_Medication_Patient basic information_Nurse basic information_General doctor basic information
	Modify	Patient Medical Record
	Modify with authorization	None
Administrator	Only view	None
	Modify	System Configuration
	Modify with authorization	None
Technician	Only view	None
	Modify	None
	Modify with authorization	Registers_Sytem Configuration
Government	Only view	Statistics Data
	Modify	None
	Modify with authorization	None

Fig. 25 Permits granted to each profile

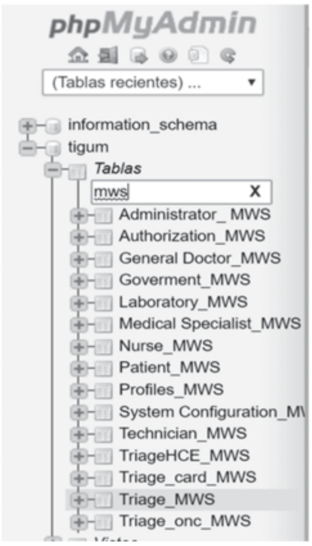

Fig. 26 Initial view of the individual tables created for profiles and services

The development of the following study highlights the importance of the deepening and innovation in the telemedicine area, with the purpose of generating mechanisms to improve the quality of the offered services. Moreover, it creates new and different solution possibilities that can be implemented on similar systems, thus allowing a progressive growth of the mapped strategy, which allows improvements and additions that turn it, in time, into a complex and very useful resource for the health sector.

TABLE III
EFFICIENCY RESULTS ON PROFILES ARCHITECTURE

Evaluated Permission	Type of evaluation	Efficiency percent
Patient_onlyview	Availability	98.05%
Patient_Modify	Availability	98.02%
Patient_Modify with authorization	Denial	100.00%
Nurse_onlyview	Availability	100.00%
Nurse _ Modify	Availability	99.02%
Nurse _ Modify with authorization	Denial	99.07%
Gdoctor_onlyview	Availability	99.01%
Gdoctor _ Modify	Availability	98.05%
Gdoctor _ Modify with authorization	Denial	100.00%
MSpecialist_only view	Availability	99.32%
MSpecialist _ Modify	Availability	98.68%
MSpecialist _ Modify with authorization	Denial	100.00%
Admin_onlyview	Denial	98.02%
Admin _ Modify	Availability	99.77%
Admin _ Modify with authorization	Denial	100.00%
Tech_onlyview	Denial	99.14%
Tech _ Modify	Denial	98.87%
Tech _ Modify with authorization	Availability	100.00%
Government_only view	Availability	98.72%
Government _ Modify	Denial	100.00%
Government _ Modify with authorization	Denial	100.00%

ID	Name	Lastname	Age	Type of document	Document number	Address	City	Email	Civil Status	Genre
1	Juan Felipe	Rozo Diaz	35	CC	1015467712	cll64·57-23	Bogota	u1401125@gmail.com	single	M
2	Javier	Pinzon Roa	32	CC	1032569888	Cll56b-34-12	Bogota	u2503321@gmail.com	Single	M
3	Eric	Tamayo Puerta	48	CC	5121512566	cll23# 68-44	Bogotá	u5206699@gmail.com	Married	M
4	Camila	Castro Torres	36	CC	1015467756	Cll68 #57-23	Bogota	u1402265@gmail.com	Single	F
5	Ernesto	Villamil Cardenas	31	CC	5163259989	cll 65#30-23	Bogota	u1402251@gmail.com	Married	M

Fig. 27 Random sample of the creation of specific fields in a table

Fig. 28 Random sample of the enabling of field editing

ACKNOWLEDGMENT

This Project has been funded by the Office of the Vice Rector for Research at Universidad Militar Nueva Granada – Project code: IMP-ING-2660.

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