CERTBERUS

Client Application for Windows

Abstract

Innovative secure environment for online exams.

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INTRODUCTION

The coronavirus pandemic has forced students and educators across all levels of education to rapidly adapt to online learning. The impact of this — and the developments required to make it work — could permanently change how education is delivered.

In this new framework that is starting to emerge the requirements of the new era, leads us to develop special software environments so that we will be able to provide high quality services.

Certberus™ application (from this point also named as 'client application'), is the basis to create a secure and inviolable online examination environment. It is an application that runs on candidate's computer and in addition to providing the safe environment of the exam, it also performs the following functions:

- Allows user to centrally login with his/her credentials.
- Provides easy selection of exam platform. Application is compatible with several exam platforms and can cover lists of exam providers.
- **Certberus™** is a multilingual application. Currently supports Greek and English but it will include several other languages in the future.
- Performs in depth computer checks to ensure that candidate's computer is fully compatible and conforms to the requirements of the exam.
- On Boarding is a special group of steps that allows candidate to conform with the NDA (Non Disclosure Agreement) or on the Exam Rules.
- Performs an extensive check on the applications that may be running in candidate's computer and automatically terminates those that are not allowed.
- Provides an integrated system of proctoring by sharing candidate's computer camera and microphone with the invigilator. Automatically all sessions are recorded for further reference.
- Finally locks the computer to the exam window and lets candidate to get started with the exam.

All the above will be covered in detail later in this document.

INSTALLATION

There is no need to run a setup file. Client application is being downloaded from internet and runs as it is by double clicking on its icon. Windows may ask you to confirm:

Click on *Run* button to continue.

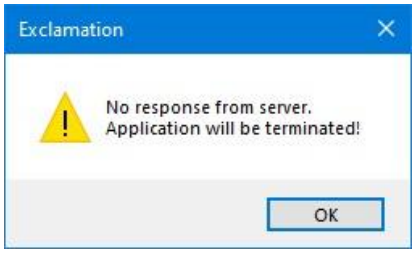
Note:
Normally all the companion software needed to run the client application is being included already. In some windows 7 systems that are not updated, the .Net framework may be needed. In such cases our application will detect the missing Windows libraries and will try to install them automatically. If for any reason this can't be done, you must install the missing libraries manually.

THE CLIENT APPLICATION IN DEPTH

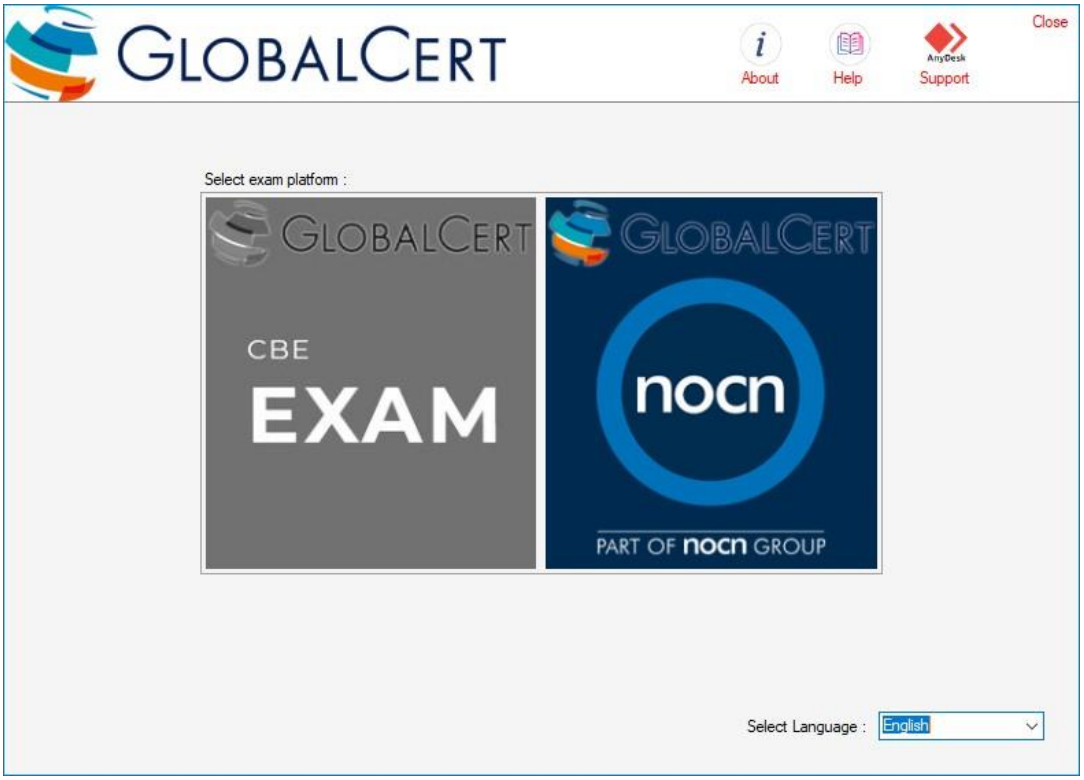
By starting the client application, internet connection test will take place and you will get the following on your screen:

In case of no internet connectivity or in very slow connections, you 'll get the message:

If for some reason the client application can't communicate with our servers (even if a network connection is active) an error will appear on screen. At this point there is no way to continue and the only choice is abort and exit the application by pressing *OK* button.



If your internet connection is stable enough and the connection speeds are between the desired limits the user will get the *Platform Selection* screen:



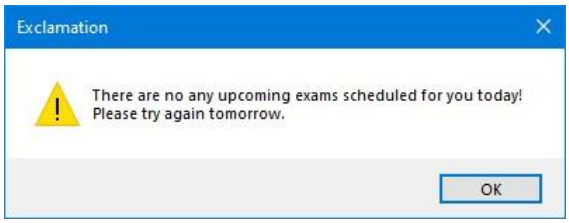
For **Certberus**™ a platform is the equivalent of an Exam Provider. A Platform has its own servers to provide exam sheets with questions and it is controlled by specific group of system admin, proctors and technicians.
In this screen you can also choose the application language. Currently Greek and English languages are supported.

THE LOGIN PROCESS

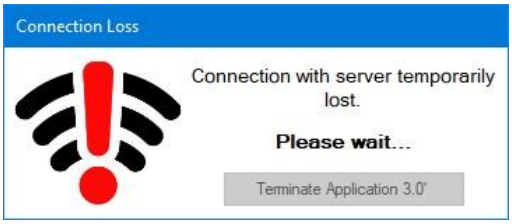
Certberus™ provides a central login for the entire exam process. Candidate's credentials are verified by our server. The whole communication is a highly secured process with two levels of security. On first level all data transferred to server are encrypted with a 256bit key (2^{256} = 1.15 *10^{77} possible combinations). On second level, a special secret key is added in every packet transferred from or to **Certberus**™. With this key, server is 'confident' that the received data package came from our client application and not from any other source.

All unsuccessful login attempts are logged in our server, for further investigation if this needed. In case of connection loss client application saves locally all logged events and sends them to our server when internet connection comes active again. This process is totally asynchronous and doesn't affect the performance of the client application.

If the candidate runs the client application in a date that there are no upcoming exams scheduled for him/her, he/she will get the following error:



An error message also comes up while a connection loss is detected, no matter the phase that the client application is:

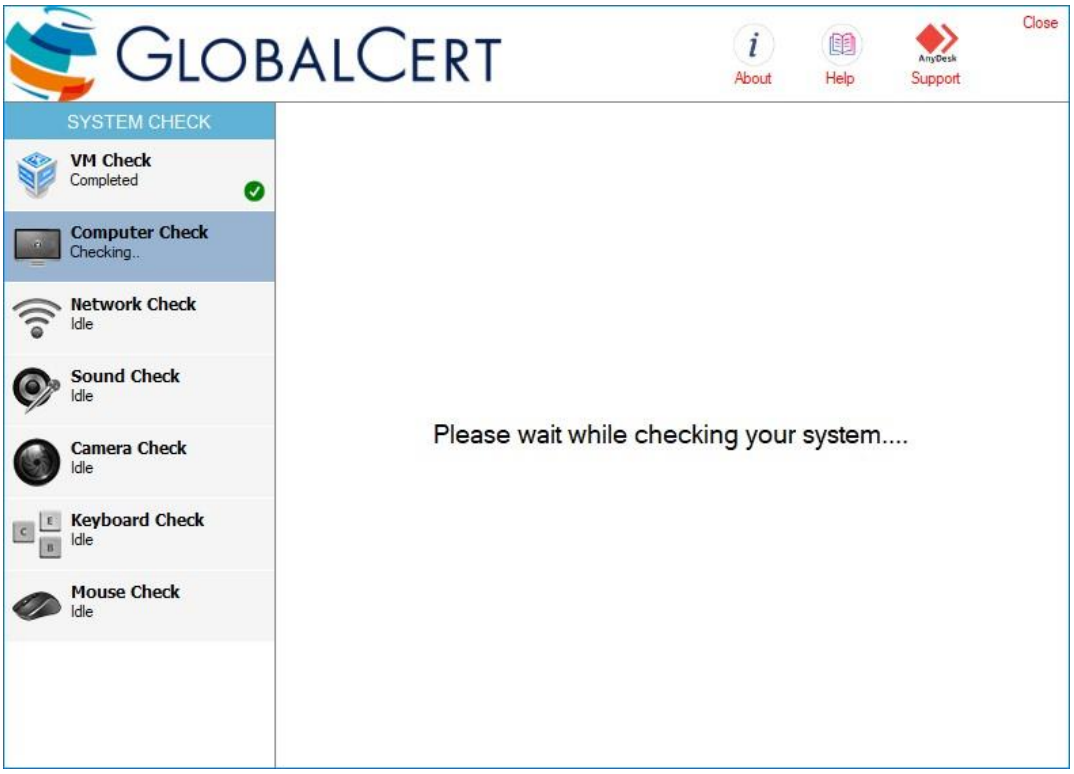


The user has two options. Either can leave the message on screen until closed automatically once the connection becomes active, or press the button (that shows a reverse countdown) to exit application.

SYSTEM CHECK PHASE

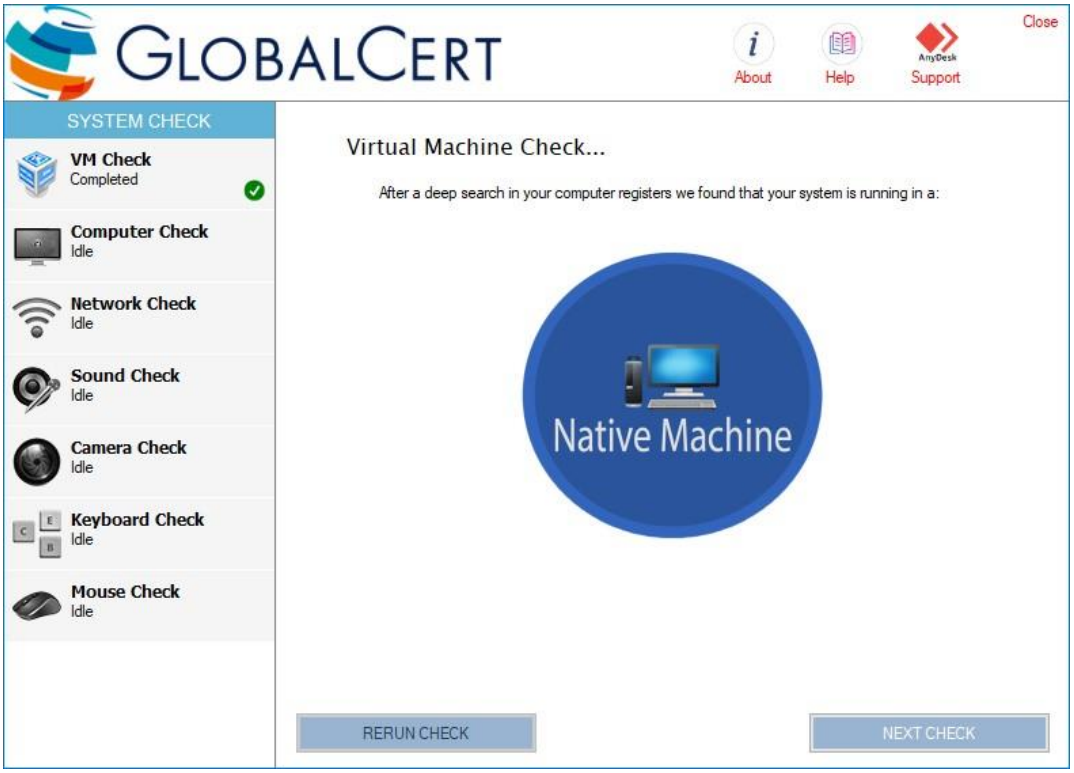
System Check is a crucial process to achieve a stable and secure environment for the candidate. **Certberus™** must ensure that all computer subsystems like (memory, disk storage, screen, cpu, video, audio etc) work perfectly.

All these individual system tests are done in *System Check* application phase, one by one:

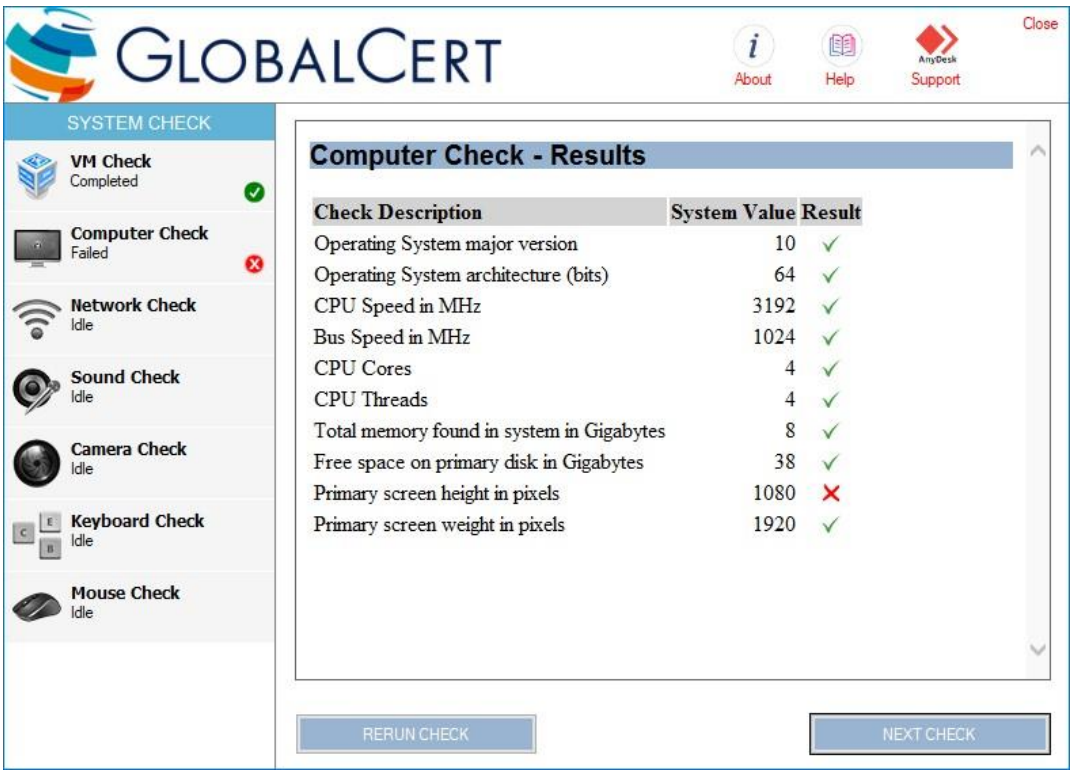


System Check reports its findings to our server in real time. This is useful for our customer support service team to know all the details of your system so the can easily find effective solutions to those candidates who may face problems.

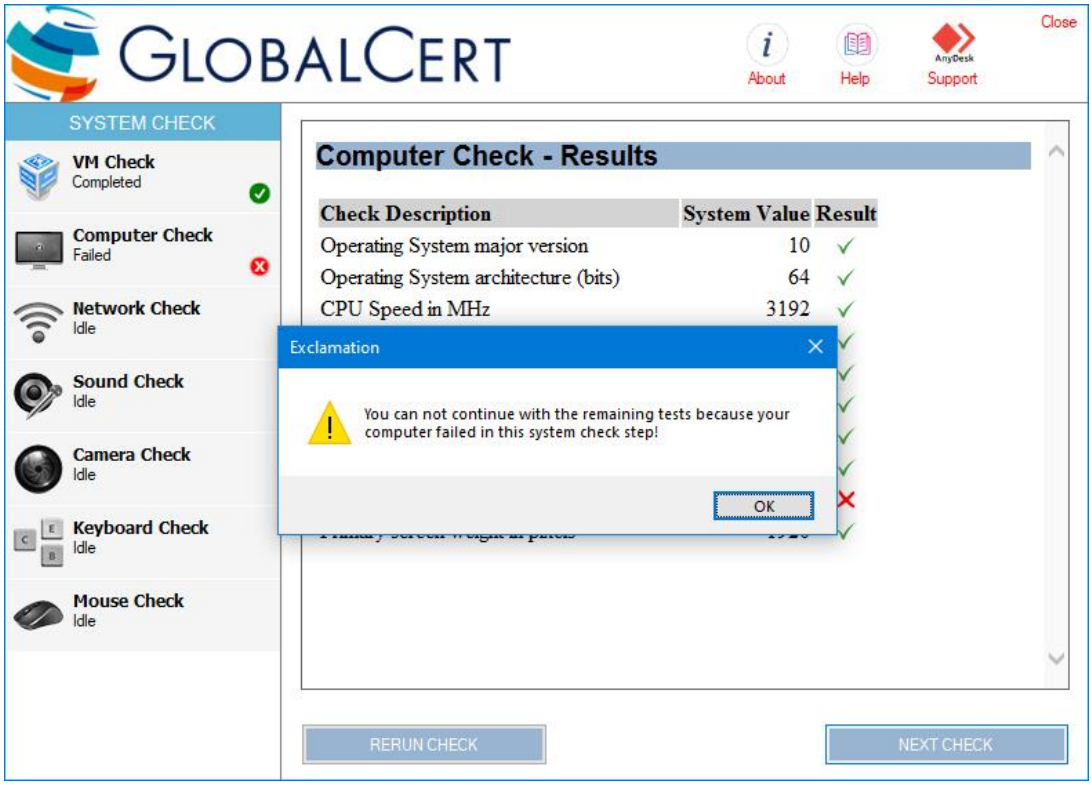
The first System Check step *is Virtual Machine Environment* check. **Certberus™** not allowed to run in Virtual Machines. If this check fails the application will be terminated after showing a relevant message to user.



The second in *System Check* list of steps, is the *Computer Check*. In this step all computer subsystems are checked in depth to confirm that all are working as intended. When the check is completed a short summary shown on screen:



Certberus™ draws a red X next to the parameter that didn't comply with the predefined specifications. The user can run this check from the beginning by pressing the *RERUN CHECK* button, hoping that the failed parameter will pass this time. In any case if there is a failed parameter in a System Check step the process can't continue even if user clicks on *NEXT CHECK* button. In such case an error pop's up:

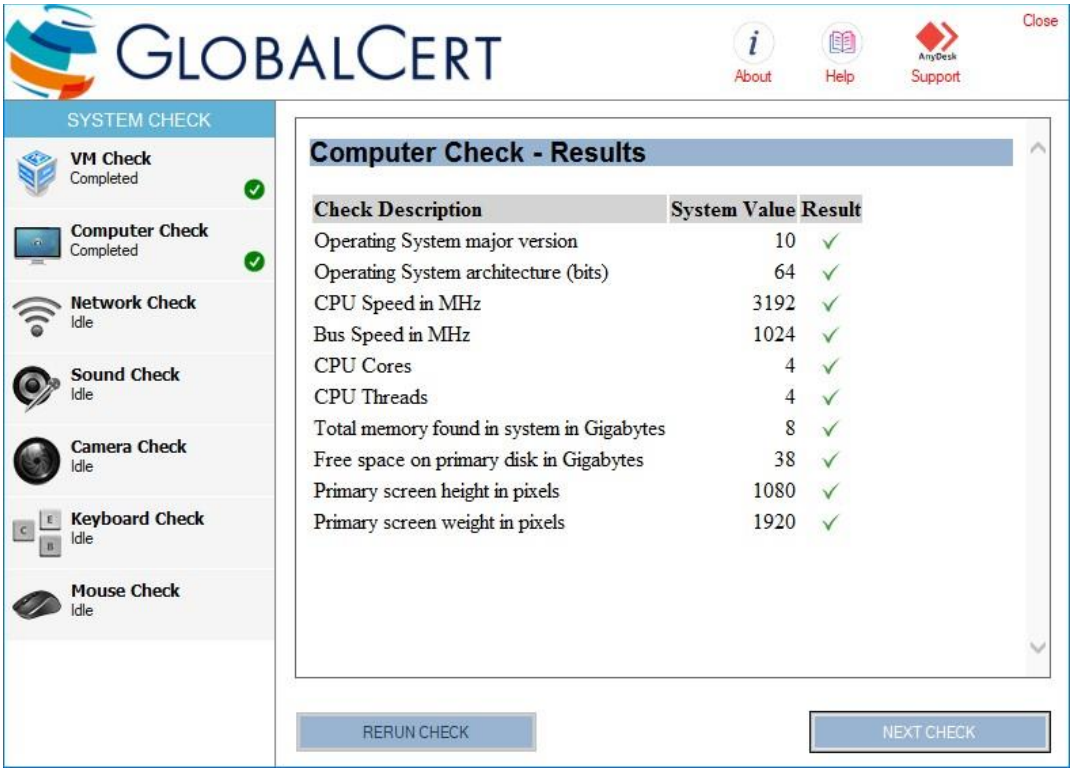


All parameters, settings and acceptable values are defined and stored in our server. This means that we are able to change them in real time and **Certberus™** will update itself automatically, **without** the need for you to download the app once again.

When a failed parameter is detected, during the System Check process, application must be terminated and run again from the beginning. There is no way to bypass a failed System Check. In some situations, and only if the failed parameter is not crucial, the candidate may ask from our customer support service to disable the comparison check for this parameter.

This can be achieved real time remotely and the only need is the user to click on RERUN CHECK button. The client application will not consider about the failed parameter and the Computer Check step will be completed successfully. This applies throughout the entire application.

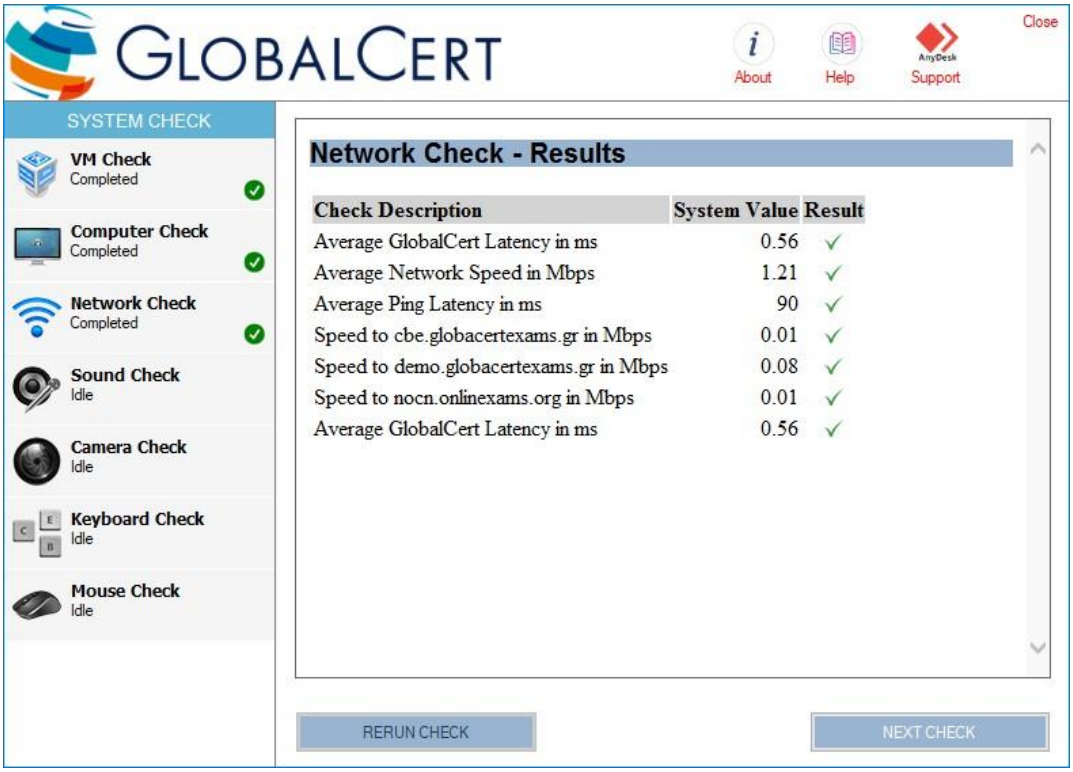
An innovative Monitoring System[1] is running in our servers allowing us to have almost full control on each client application either individually or as a group.



User may proceed to next System Check step by pressing the *NEXT CHECK* button.

1. *Certberus Monitoring System is a web frontend that let us to control how the Client Application will act, giving to our customer support team the ability to be more effectual to problem solving. It also provides an intergraded proctoring system with real time chat with candidate, audio and video recording from candidate's camera and also real time logging.*

Unlike the initial *Internet Connection* check that the client application runs on startup, the *Network Check* step performs an extensive and in depth check of your computer's Networking subsystem, and or the connectivity state.



In this System Check step **Certberus**™ tries to ensure that the connection to our servers is optimal and stable, in order to confirm no problems will appear while the candidate is taking the exam.

The most significant parameters in this System Check step are *Latency* and *Speed*.

In general terms, latency is the time delay between a user's action and the response received. In an online setting, latency would be the time delay between an action from a user who is interacting with a website (e.g. clicking on a link) or a software application (like **Certberus**™) and the response (complete loading of web page or receiving data sent from server).

Although data on the Internet can travel very quickly (at the speed of light for fiber optic cables), latency can't be completely eliminated due to reasons such as distance and networking routing. In a worst-case scenario, latency can become so high that packets end up being lost -- thus, keeping Internet latency to a minimum is important. Lower network latency increases **Certberus**™ performance and user satisfaction.

Network Latency, throughput, and bandwidth can all affect the performance of the system. Although they are highly-related, they are distinct terms. Bandwidth refers to the maximum amount of data that can pass through in a given amount of time.

In this step **Certberus**™ looks for the minimum acceptable values in those two parameters.

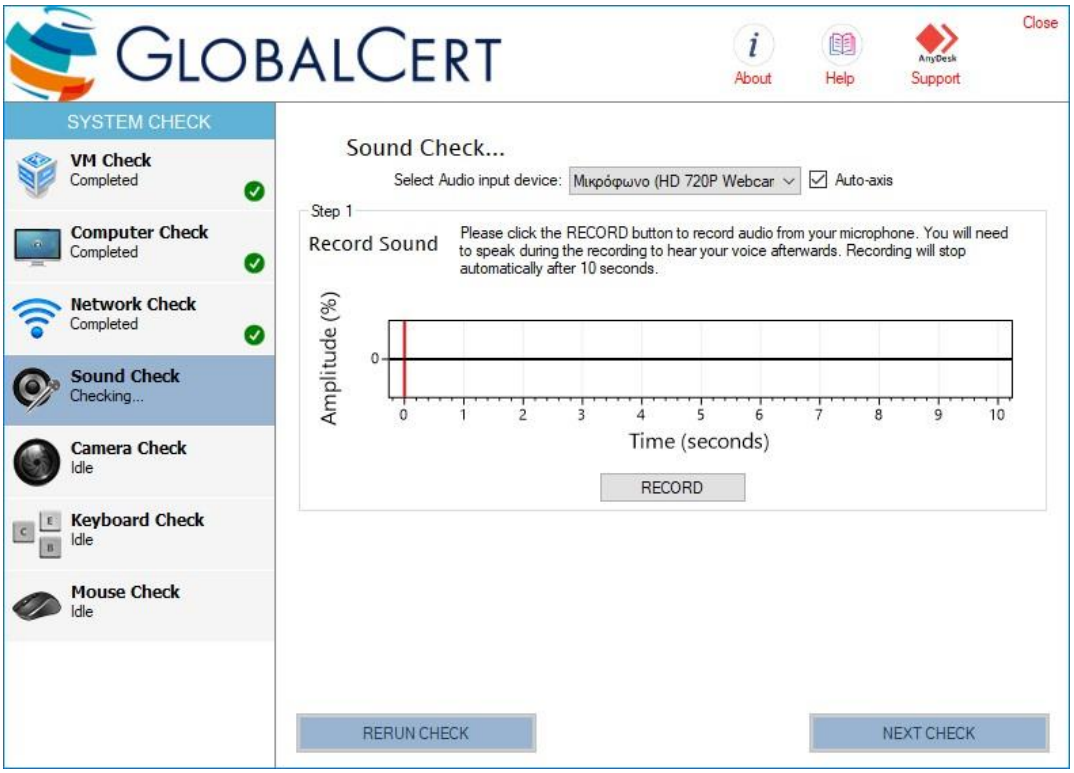
Fiber Optic cables are the most responsive, allowing data transmission at the speed of light, but copper wires are slower. Wireless transmissions also exhibit higher latency compared to wired transmissions.

WiFi connections, when access points are behind thick or heavy armed cement walls, usually cause connection problems. Instability, very low speeds and extremely high latencies. Please avoid using WiFi networks, mostly when there is long distance with obstacles between your computer and the internet access point (router).

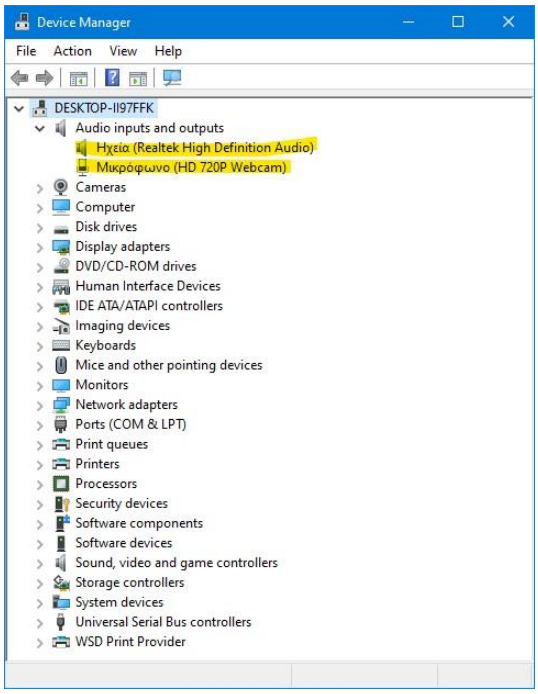
A cabled network connection is always a good idea.

Even if the *VM, Computer and Network* checks are automated, the *Sound Check* needs some user intervention although. The *Sound Check* step is divided into three (3) sub steps that appears progressively as the user goes.

In the first sub step the user must record his/her voice, so he/she is able to confirm that the computer audio subsystem is working properly in the next sub step. To do this, after selecting the main audio input device from the combo box on top of step 1, please click to the *RECORD* button.



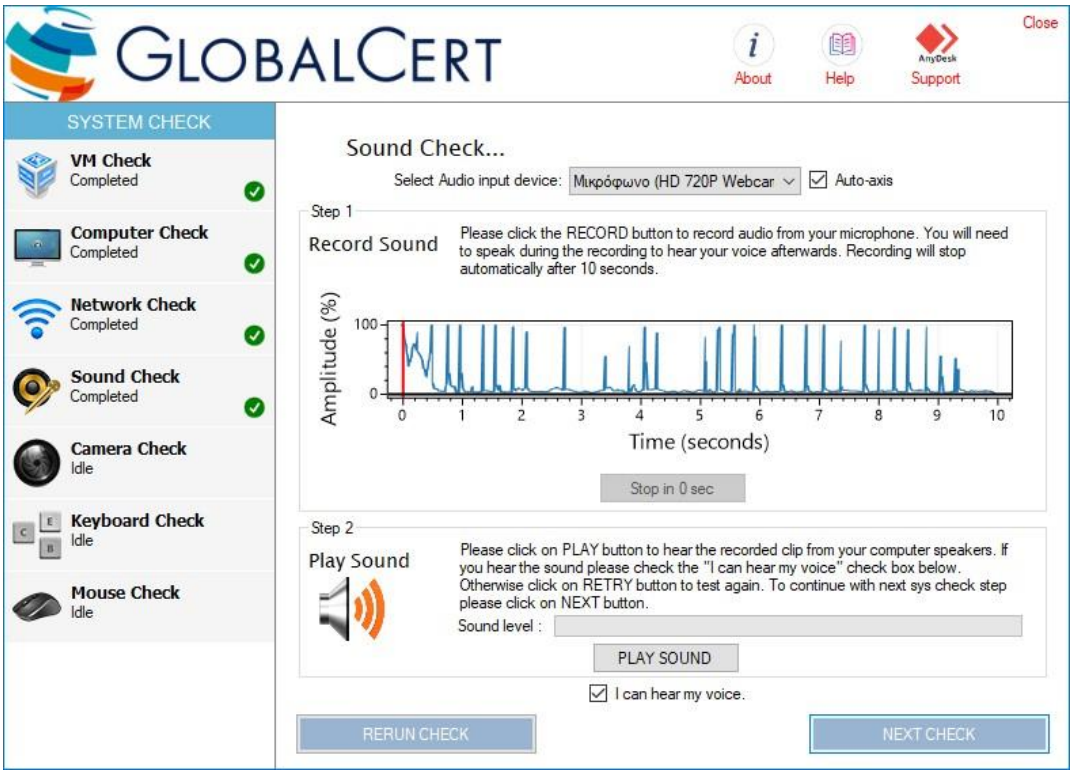
If **Certberus**™ can't show the screen in the picture above, but remains to an empty screen that only shows the message "Please wait while checking your system…", exit the application by pressing the *Close* word, written in red, on the upper right corner of the application's main window.



Check your microphone, your speakers and the audio settings of your computer's operating system. Please also check the Windows Device Manager to ensure that the audio device is up and running.

Please keep in mind that Windows Devices and other related tools are very useful while troubleshooting computer's operation abnormalities.

While **Certberus**™ recording sounds from your computer's microphone - a graph is shown on screen. Each peak in the graph indicates sound peaks captured from microphone. This is a good overall indication that sounds are recorded. A flat or almost smooth line in graph indicates that probably no sound captured from your microphone or the captured sound level is very low.



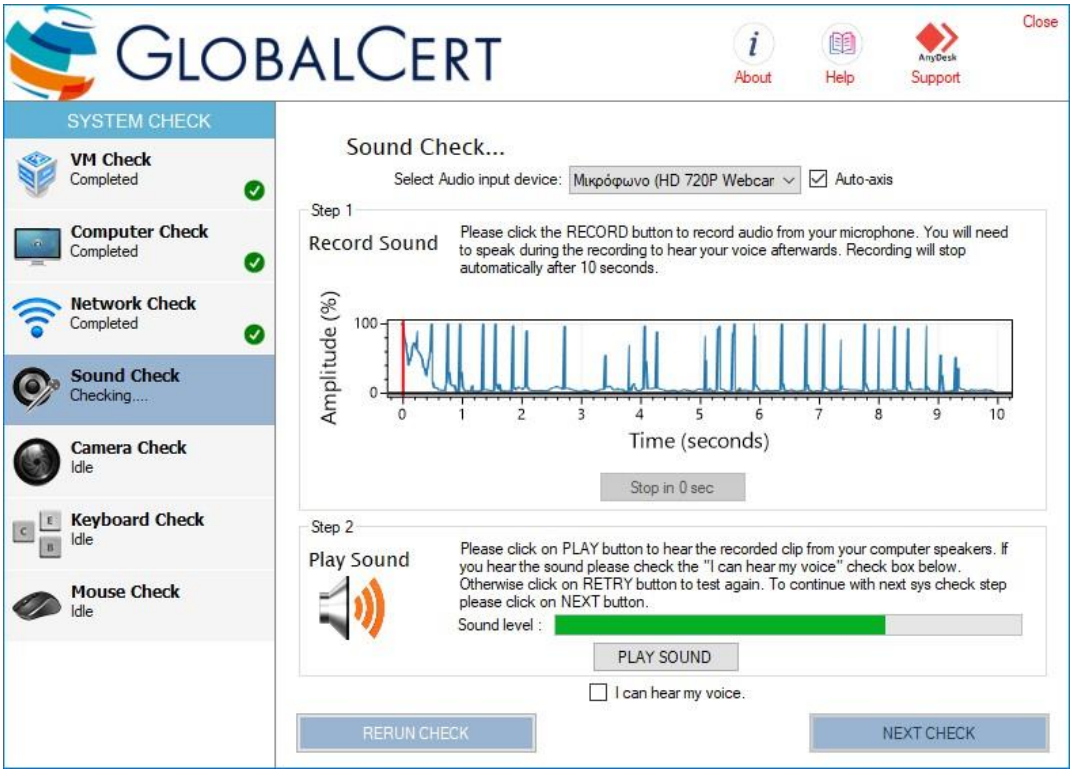
Sound recording phase lasts for only 10 sec and can't be interrupted. While recording the RECORD button turns into a reverse counter indicator that shows the remaining seconds of recording.

The first sub step in *Sound Check* is completed after a successful recording. If for some reason the recording didn't complete or completed with an error message, please rerun the check by pressing the *RERUN CHECK* button. If an error message appears after every recording trial, exit the application using the red Close word on the upper right corner of **Certberus**™ main window.

All internal errors in client application are logged to server for further use to improve our product in future versions. There is no way to block **Certberus**™ from reporting errors to our server.

The second sub step in *Sound Check* is about testing your computer's sound output. The user clicks on *PLAY SOUND* button and the client application plays the previously recorded sample.

A green bar plays the role of VU meter to show you the levels of the sound played. If the user can hear his/her voice in the recorded sample, the audio output system (speakers) works fine. In any other case the test failed and the user either can rerun the *Sound Check* from the beginning or close the application and check his/her computer audio settings. The he/she can run the client application again and perform once more the *System Check*.

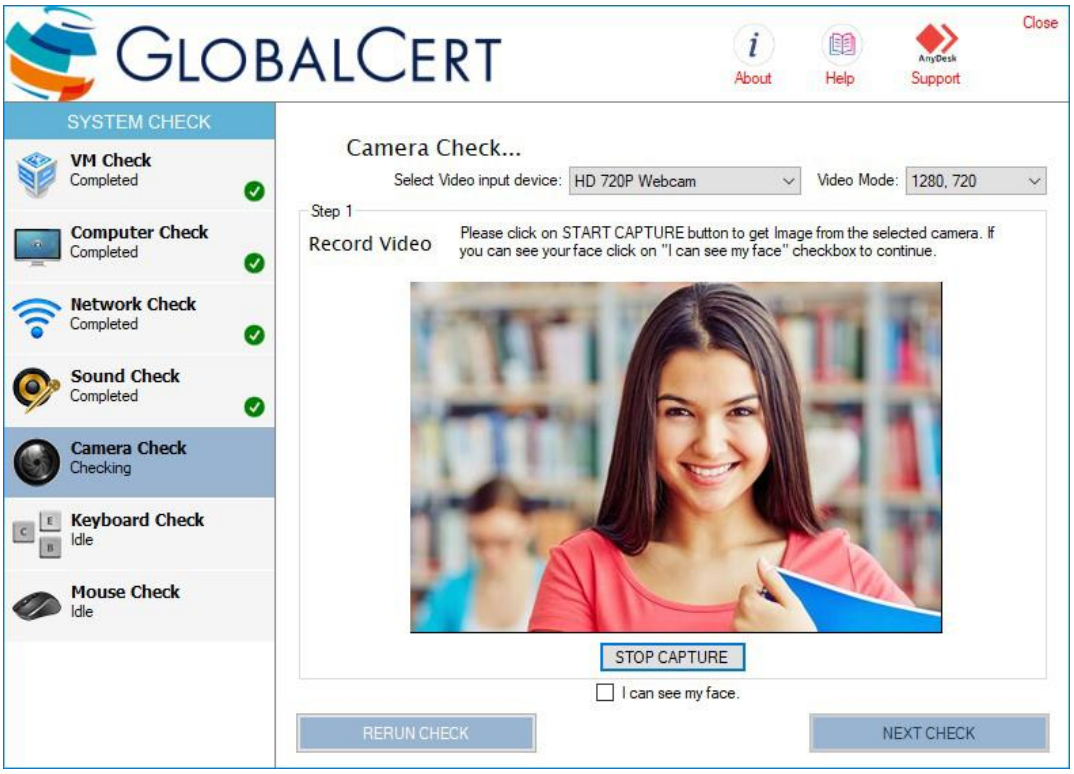


Keep in mind that the sound sample is being sent to our server as we did with any other data that **Certberus™** collects. You can find a list with the kind of data that **Certberus™** collects from your computer at the end of this booklet.

All data are kept in our servers for limited time and only for support reasons, before and during the exam. When exam is finished all data are deleted. This is a prerequisite that every candidate accepts before proceeds with online exams during the On Boarding session.

The *Camera Check* step needs a user intervention also. The user must click on CAPTURE button to let **Certberus™** capture real time video from camera. This video will not recorded! The main reason we capture video in this phase is only for testing camera. The camera must support real time video not only still images.

The user can stop real time video capturing by pressing the *STOP CAPTURE* button below the video preview area.



Certberus™ gives the ability to user to select the main video input device connected to his/her computer and the desired resolution also. This can be done from the two combo boxes on top of the *Camera Check* screen.

If for some reason no real time video is shown in video preview area, please rerun the check by pressing the *RERUN CHECK* button. If an error message appears after every trial, exit the application using the red Close word on the upper right corner of **Certberus™** main window.

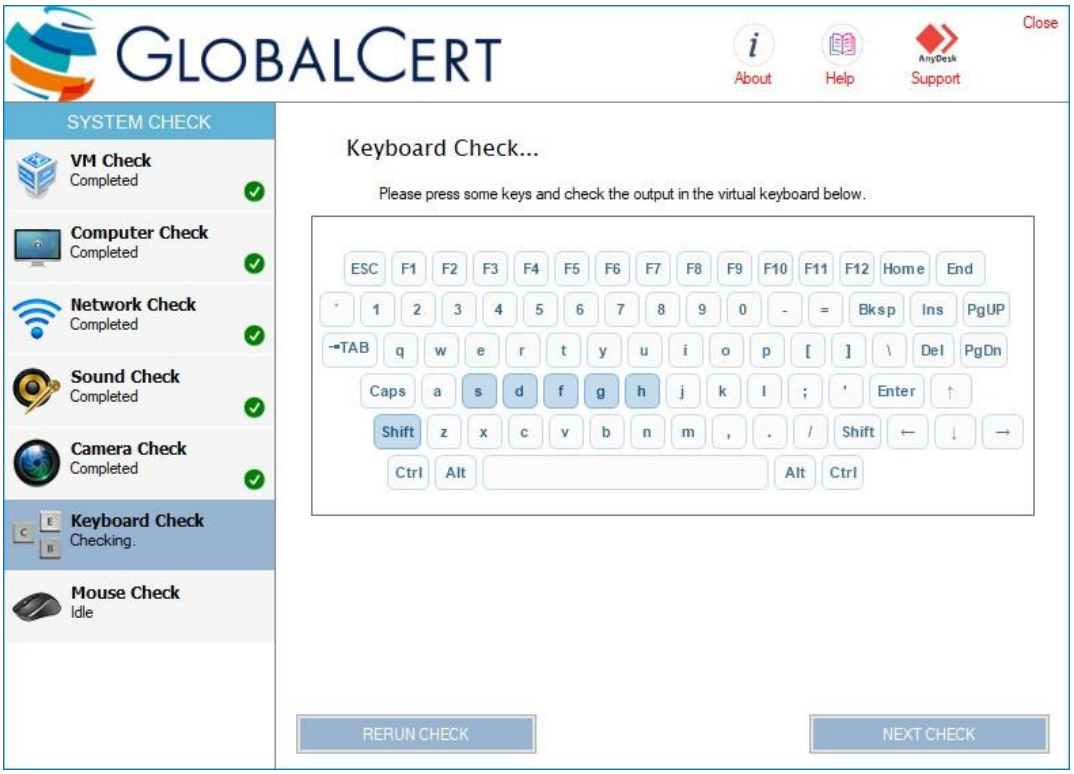
All internal errors in client application are logged to server for further use to improve our product in future versions. There is no way to block **Certberus™** from reporting errors to our server.

If the user sees his/her face into the real time video preview he/she can click on “I can see my face” check box and the real time video capture is stopped and a still image is showing instead.

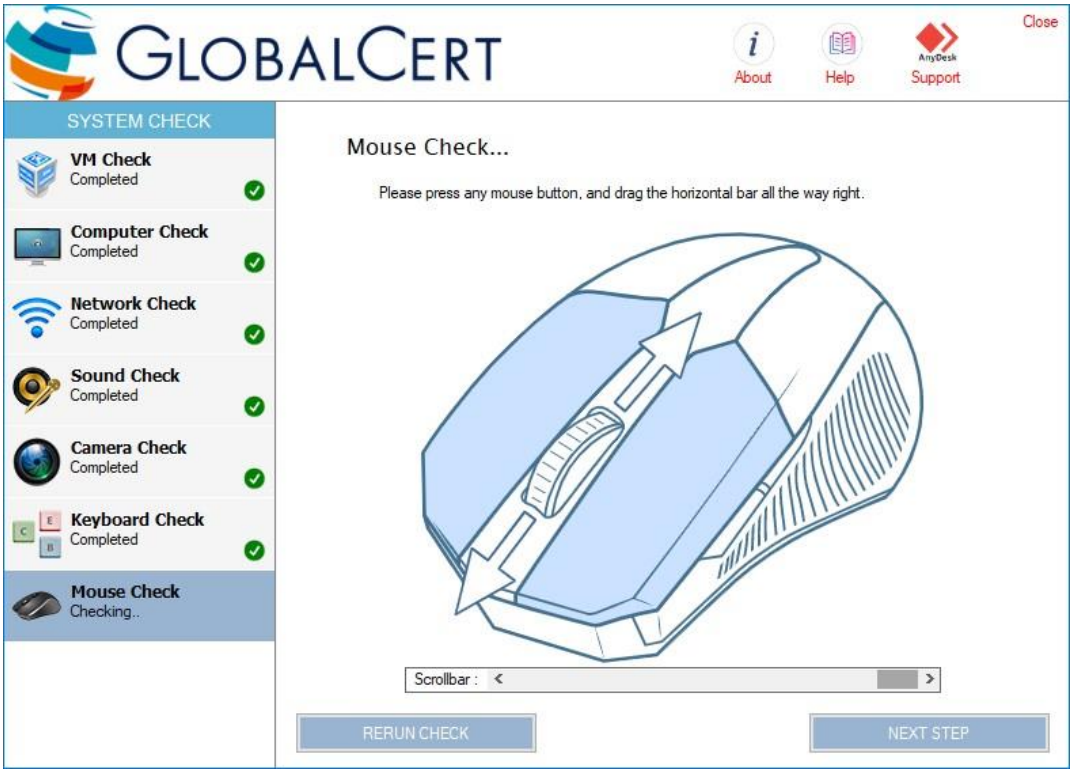
This still image will be sent to server after the user clicks on *NEXT CHECK* button. The same that applies to any other data applies and for this image. The general data collection policy that **Certberus™** follow, is something that the final user accepts unconditionally.

Keyboard and *Mouse Check* steps are the last steps to complete the *System Check* process. Both need user intervention.

To complete keyboard Check start pressing any keys from your computer's keyboard. These keys are marked with orange color while being pressed and with cyan color when released.



To complete *Mouse Check* step, please press any mouse key or scroll the mouse scroller. To ensure that your mouse is working properly and supports click and drag events, please drag the scroll bar all the way right.



Buttons pressed are lighted with cyan color.

The *System Check* procedure completed successfully. The client application automatically stores this information which means that your computer is considered as checked, and capable to provide you a stable and secure environment for your exam.

If you exit the application at this point, and run the application again, the *System Check* procedure won't be activated again.

A successfully completed *System Check* is considered valid for a specified period of time. This time period is set by the Cerberus Monitoring web application, and is subject to change without notice.

Often a successfully completed *System Check* procedure is valid for 10 hours (default for GlobalCERT's exams only – this may vary between other platforms). This means that if you run the client application at 8 am on the day of the exam and the *System Check* completes successfully, this will be valid even if the exam is scheduled for 4 pm, without having the client application running all these hours.

This is very handy and lets you complete the two preliminary sessions (*System Check* and *On Boarding*) hours before the time of the actual exam.

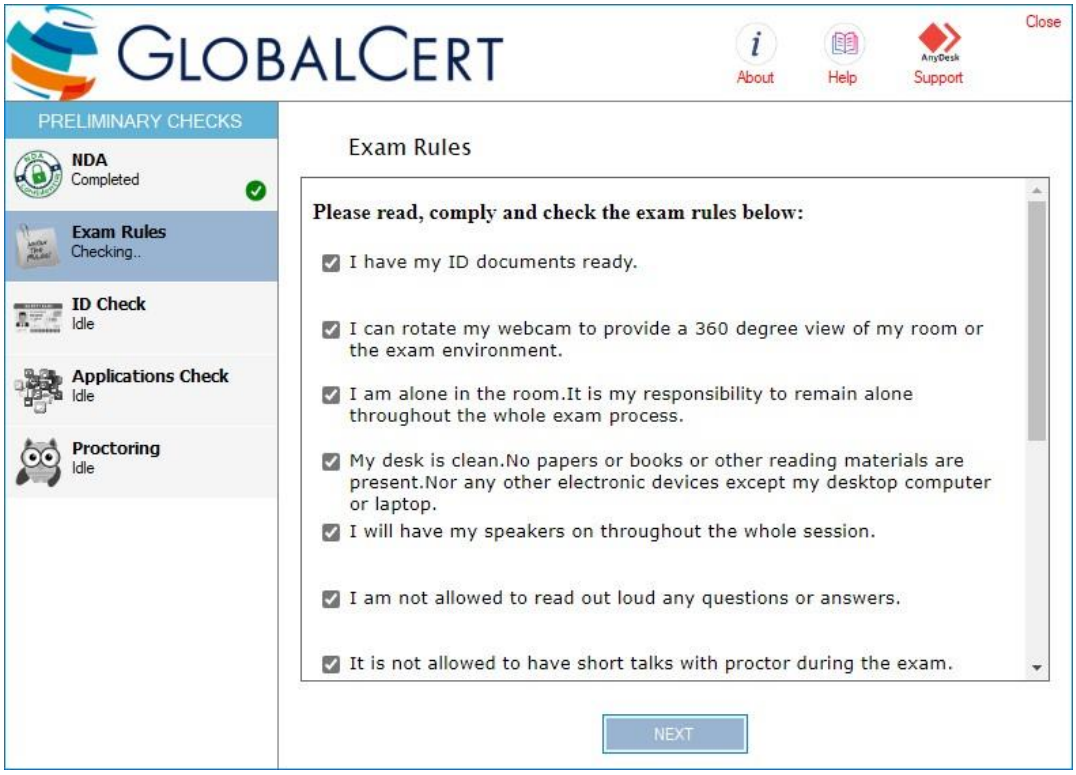
This feature applies only for the same computer and the same network of course. You **can't** transfer **Certberus™** from one computer to another.

Certberus™ is equipped with a clever system against cheating. Do not forget that all actions and events are logged in our servers and our proctors are informed for any suspicious or abnormal operations you may do with our client application. This may drive you to an exam failure.

ON BOARDING PHASE

The first step in *OnBoarding* phase is the acceptance of a Non Disclosure Agreement (NDA). It is a mandatory user accepts the NDA by clicking the “I consent” check box laid on bottom of the screen:

The second step, is about the Exam Rules acceptance. User must accept all the rules one by one. There is no way to continue if not all check boxes are checked. This event is being logged in our server as a proof that user read and accepted all the rules.

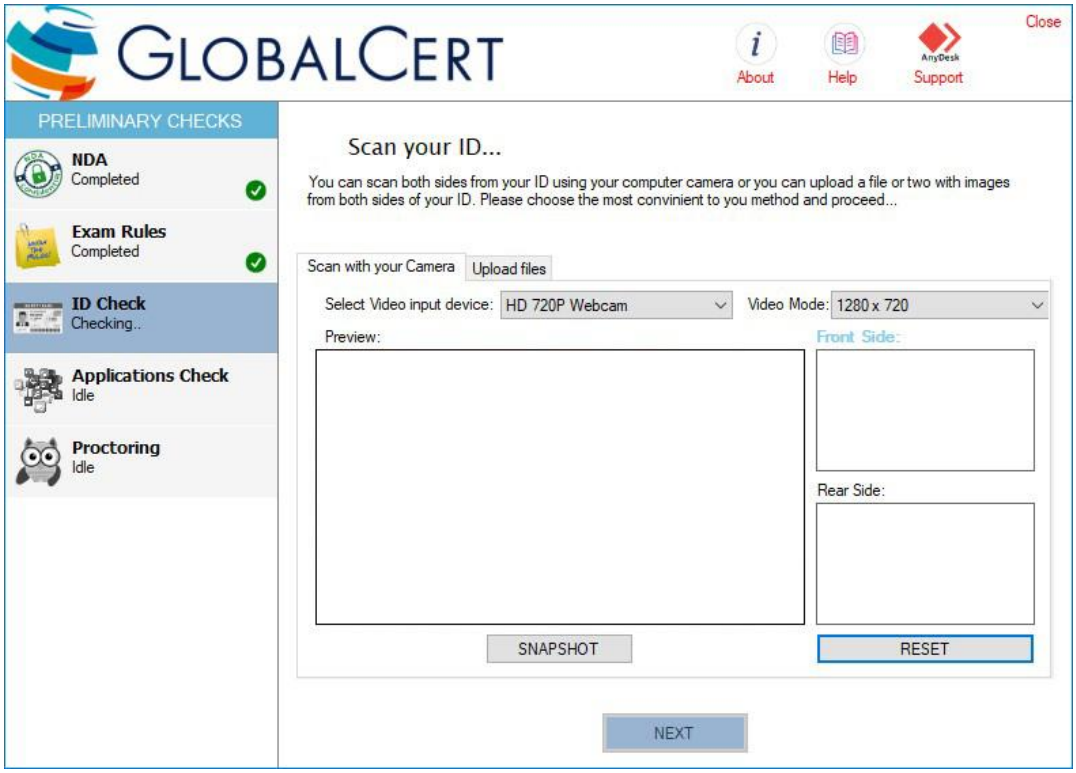


All exam rules are predefined and stored to our server and may be changed without further notice.

EXAM RULES LISTING (sample):

- [ ] I have my ID documents ready.
- [ ] I can rotate my webcam to provide a 360 degree view of my room or the exam environment.
- [ ] I am alone in the room. It is my responsibility to remain alone throughout the whole exam process.
- [ ] My desk is clean. No papers or books or other reading materials are present. Nor any other electronic devices except my desktop computer or laptop (never both).
- [ ] I will have my speakers on throughout the whole session.
- [ ] I am not allowed to read out loud any questions or answers.
- [ ] It is not allowed to have short talks with proctor during the exam.
- [ ] My mobile phone will be deactivated and it will be at least two meters away from me.
- [ ] I will silently conform to proctor's instructions.
- [ ] This application will automatically close any other application that may be running in your computer. Please consider to save your data before proceed with exam.
- [ ] If there are any interruptions in communication, once the communication is restored my test will continue from the last action without losing any data or time.
- [ ] I've already completed at least one demo exam before proceed with final exam.
- [ ] I consent to all GDPR regulations and restrictions, allowing **GlobalCERT** ™ to keep my personal data.

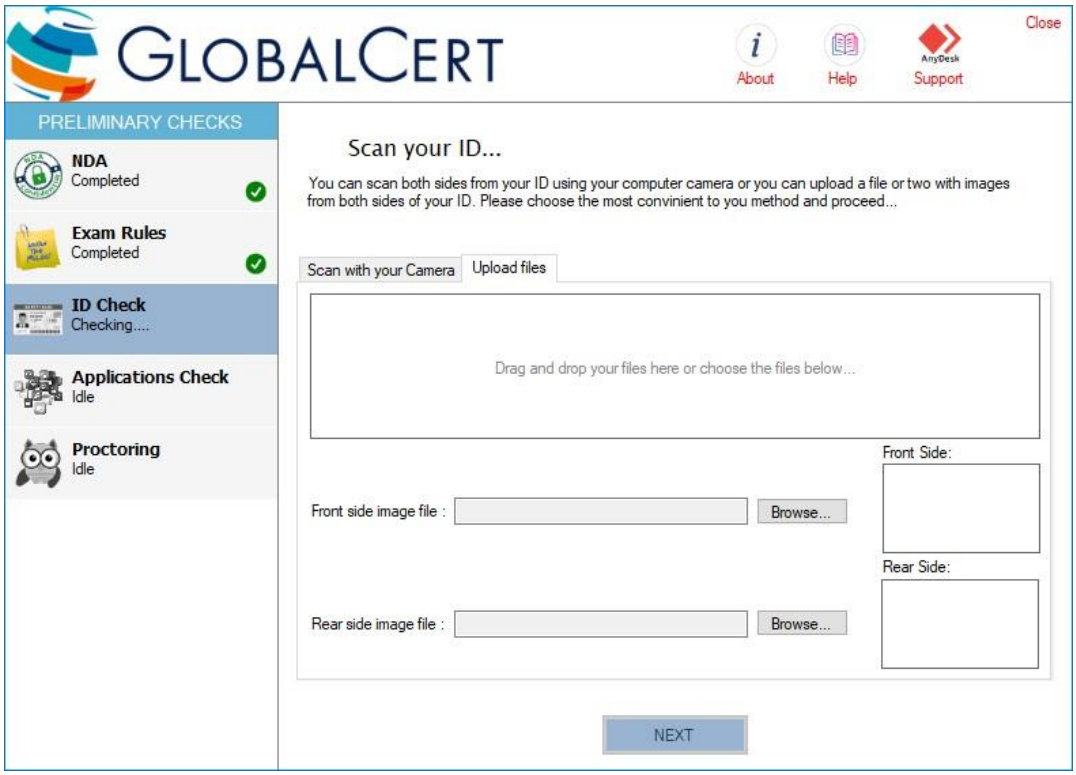
Next step in *OnBoarding* phase is your ID document submission. It is mandatory to upload to our servers your original ID card so that proctor be able to identify you before starting the exam process. To make this easy for you, **Certberus™** provides a very friendly User Interface:



After selecting the camera input device and the video mode from the related combo boxes, you can bring your ID card / password in front of your camera to take a snapshot of the front side. Please notice that initially the title Front Side over the rectangle at the right-hand side is depicted in cyan. This means that if you press the *SNAPSHOT* button, the picture taken will be placed on that rectangle, picturing the front side of your ID card.

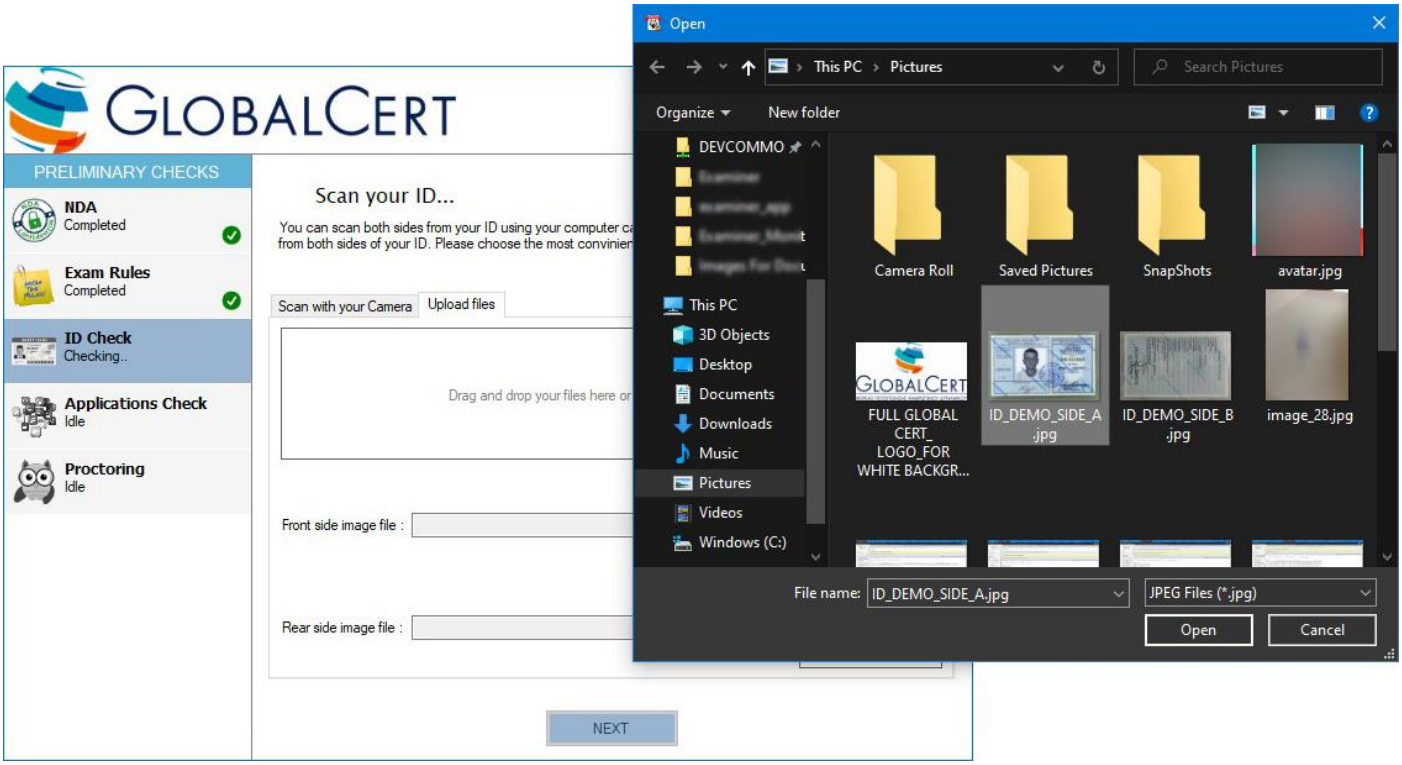
Please do the same process for the rear side of your ID card. Once both sides are pictured in the related rectangles press the *NEXT* button to continue.

Another method to upload your ID card is by clicking the Upload Files tab. Through this Interface, user can upload any pdf or picture files (jpg, png, tif, gif etc) from his/her computer.

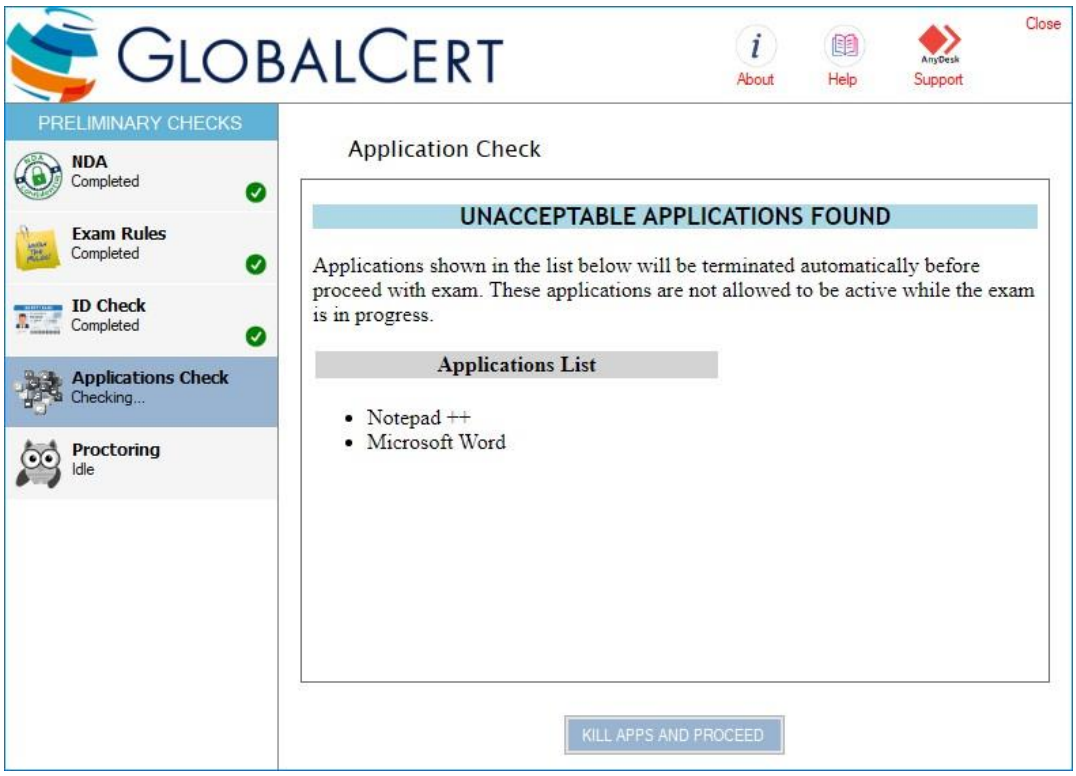


The first way to upload your ID files is by selecting them via the Windows Explorer window and drag and drop them onto the white area labeled “Drag and drop your files here or choose from the files below”. If you do so, your ID image files will be shown in the corresponding rectangles. You can select up to two files. Selecting more than two files will lead to an error notification.

The second way is by pressing each of the *Browse*… buttons depending on which side of your ID you are trying to upload. Of course, you can select only one file as long as contains both sides of your ID card.

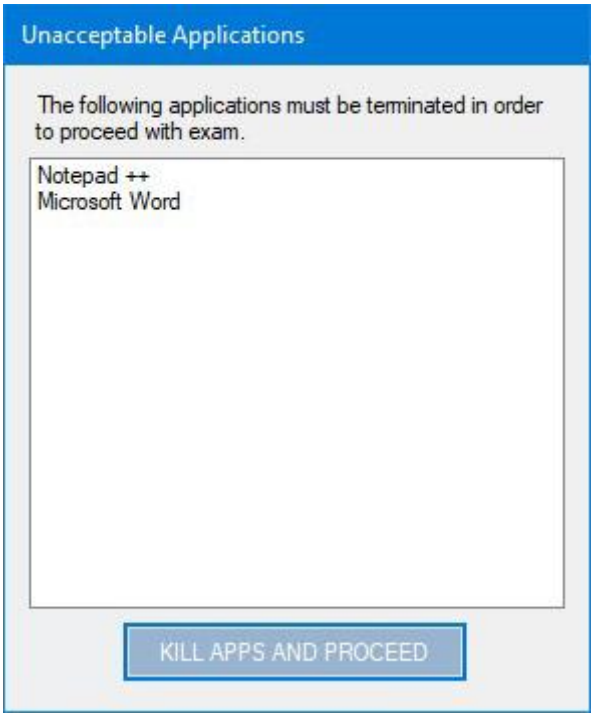


To ensure that user is not running any applications that may help him/her during the examination process, **Certberus**™ scans system task queue and if finds any apps that are not allowed, terminates them automatically.



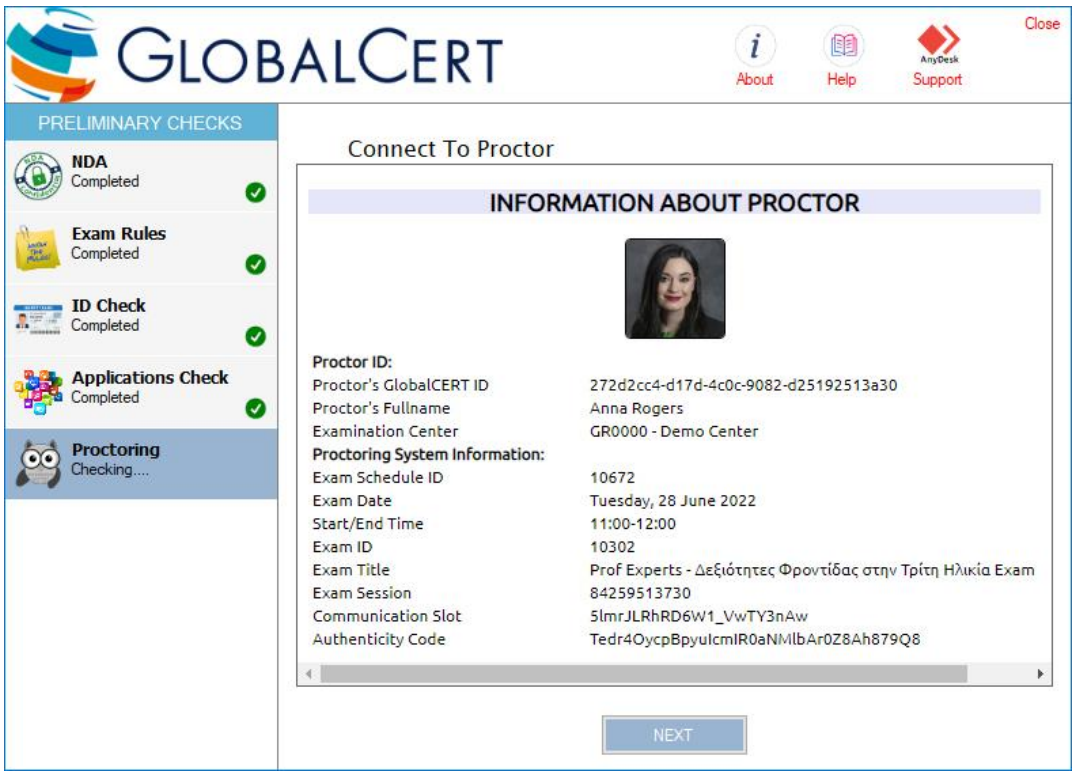
There is no way to bypass this step. It is responsibility of yours to close all other applications and save your data before running **Certberus**™. If you let **Certberus**™ to close the apps for you, unsaved data may be lost.

Note that there is no way to relaunch any unpermitted apps after this step is completed. The **Certberus**™ rescans for "malicious apps" and will list them for you to terminate.

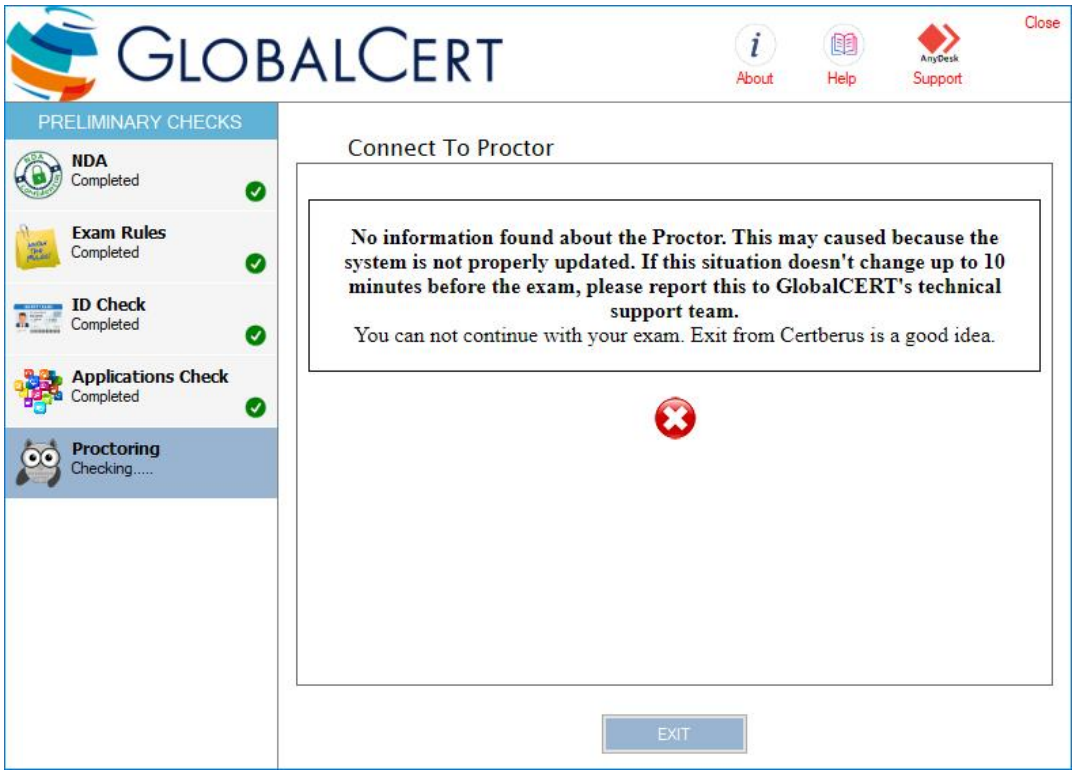


A list with "malicious apps" is stored to our server and it is being updated in short intervals without any other notice. Our client application is always updated with recently added items every time you run it.

The last step in *OnBoarding* phase is the Invigilator check. Every exam must be proctored by a person, usually defined by the exam provider. **Certberus™** application will show you all the information about exam and the Invigilator.



In case that no Invigilator is available in the system, the **Certberus™** will show an error message and will not allow you to continue. This might be due to the system not being properly updated. If this message persists until 10 minutes prior to the scheduled exam, please report this to GlobalCERT's technical support team. You cannot continue with your exam. Please exit from the Certberus



LOCKDOWN STEPS

Lockdown steps are extra precautions that prevent users from doing some tasks that may interfere the exam or drive to cheating.

Certberus™ lockdown steps include the following:

Lock Special Keystrokes : This feature disables some special keys or combination of keys from keyboard. For example, alt+TAB keystrokes, alt+F4 or PrtSc are not functional while the Exam Window is on screen. For security reasons we can't provide full list of the disabled keystrokes.

Clipboard : The clipboard functionality is disabled if Exam Window is present on screen. As a result, the key combinations ctrl+C, ctrl+V, ctrl+X or any other keystroke related with clipboard functionality is disabled.

TaskManager : Windows Task Manager is disabled also. There is no way to bring task manager on screen. Alt+Ctrl+Del keys normally brings the Windows Task Manager. **Certberus™** blocks the appearance of Task Manager while in exam mode.

Task Bar : Windows Task bar disappears from screen while **Certberus™** is in exam mode. There is no way to bring it back! The task bar will appear again when you end the exam and exit **Certberus™**.

Exam Window : The exam window covers the entire screen. It has no window controls on it, so it can't be moved or minimized or closed. It stays on top of any other window that may be already opened in your system. The Exam Window has no border and can't be resized. The only way to close this window is to press the *EXIT* button on the upper right corner. But this will drive you to exit **Certberus™** and the exam session also.

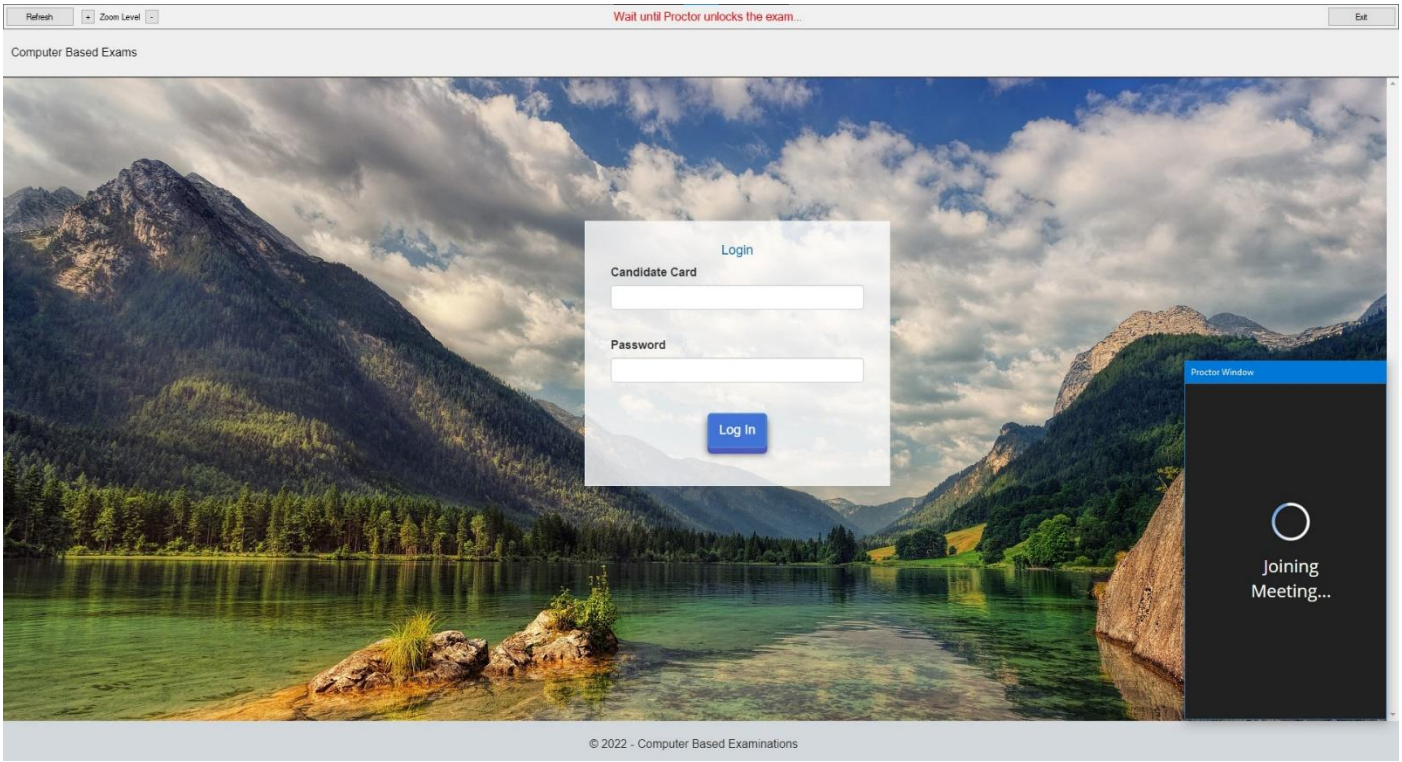
Proctor Window : The Proctor Window actually connects you with your invigilator. It stays on top of the exam window for the entire duration of exam process. It can't be closed or resized. It can only be hidden by pressing the (Show/Hide) button on the toolbar. It can also be moved in what ever position user likes. This functionality is very useful in small screens or in screens that can't support high resolutions, so that don't cover accidentally the exam questions.

Extra Monitors : Your computer may be connected to more than one monitor concurrently. **Certberus™** detects this and shows the Exam Window only in the primary monitor. Any other monitor is locked showing the picture below. There is no way to run programs in other monitors!

Lockdown steps are defined and stored in our server and may be changed without further notice.

THE EXAM WINDOW

The Exam Window covers the entire screen. This window contains the exam environment:



On the top side of the window there is a control bar:

This bar has the following controls :

Refresh : This button reloads the web based exam environment, like the refresh button in web browsers. Note that even if you are at the middle of exam process the refresh button won't cause any data loss to you. Just refreshes the web page currently rendered in this window.

Zoom levels +/- : The + and – buttons allows you to zoon in or out respectively. This is a very useful feature mostly in laptops with low or very high resolutions. It is also very handy to persons with disabilities to enlarge the contents of the exam environment so they can see better. You can easily return to the default zoom level if you double click on "Zoom Level" title.

Message : There is a message at the center of the bar in red characters which appears until the Proctor unlocks the exam window. This feature is being defined by our servers and may vary between exams. There are four modes currently supported:
a) The exam window starts with login screen locked. A gray semitransparent layer covers the contents of the Exam Window to indicate the candidate that the Exam is not available yet.

b) The exam window starts with login screen unlocked and the username and password fields unfilled, letting the candidate to fill them accordingly.

c) The exam window starts with login screen unlocked and the username and password fields filled automatically letting candidate press the blue Login button to start the exam.

d) The exam window starts directly with exam sheet. Actually, fills the username and password and presses the blue login button automatically.

Exit : This button stops the exam. Something like the candidate pressed the Finish Exam button inside the exam environment. Please avoid to press this button while you are in the middle of the exam process because this will lead you to unwanted exam results or even a failed exam.

Certberus™ prevents you of a failed exam because of an accidental button press by showing the following dialog. Press *No* button to return to your exam without loose anything.

Unlike a common web browser, exam window doesn't provide right click context menus or any other key combination activated operations.

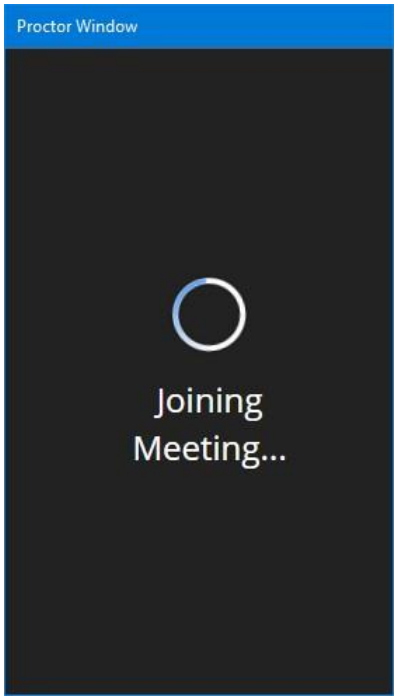
The contents of the exam window depend from which platform[2] the user selected at the first screen of the client application.

[2]. ***Certberus™****, in conjunction with Certebrus Monitoring Web application can support numerous exam providers. For example Universities or Colleges or any other Educational Organization can use these two applications to organize its own exams without the need of extra hardware or software.*

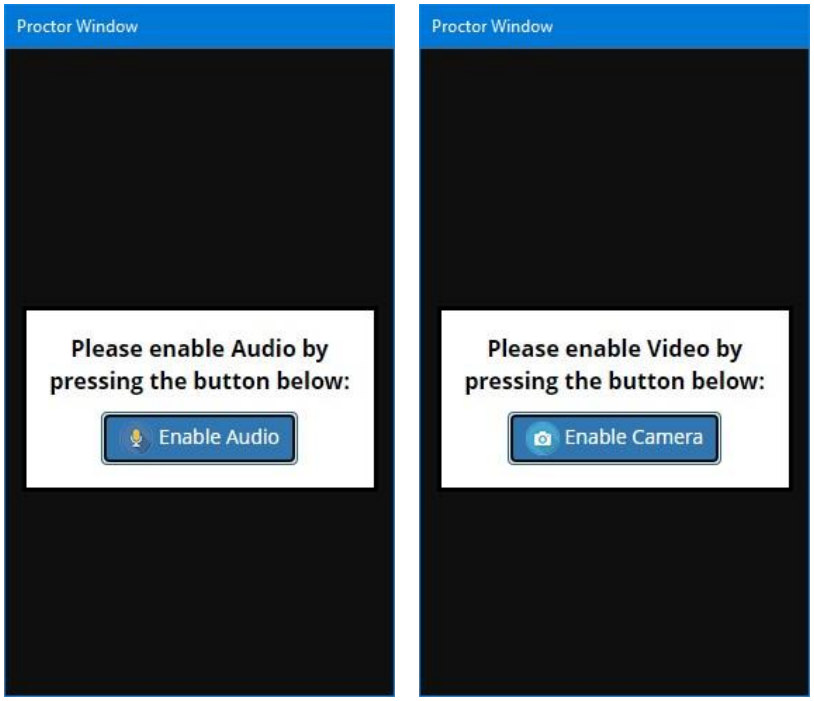
PROCTOR WINDOW

Certberus™ has the ability to connect candidate's computer with the exam Invigilator. This is achieved by sharing the candidate's computer camera and microphone. The invigilator watches the candidate real time and hears the sounds from candidate's place.

The *Proctor Window* initially opens to a virtual meeting that hosts all candidates assigned to the predefined invigilator. The Invigilators are appointed automatically, using a randomized algorithm, and the candidates are similarly selected and assigned to each invigilator.

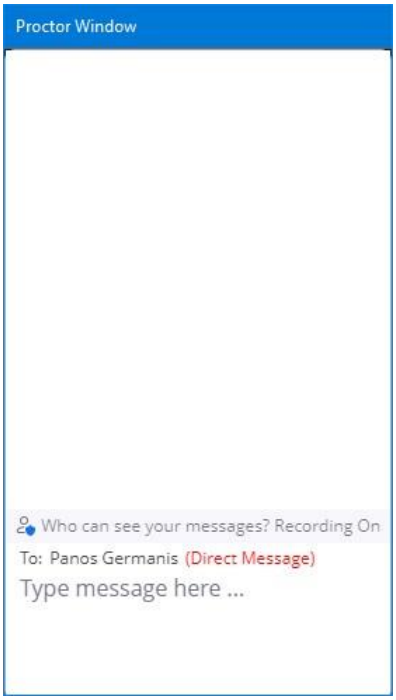


Proctor Window will connect to virtual meeting no matter if the actual exam starts later or if the Invigilator is available or not. After connecting to our meeting server, Proctor Window will ask you to enable camera and microphone:



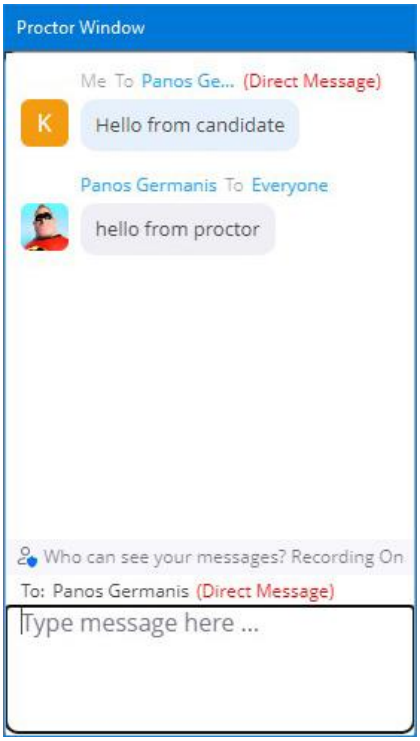
You can't avoid enabling audio or camera because if you do so, the Invigilator won't let you proceed with exam.

When Proctor Window detects camera and microphone available, locks them and starts sharing audio and video with Invigilator. Next the chat interface appears inside the window.

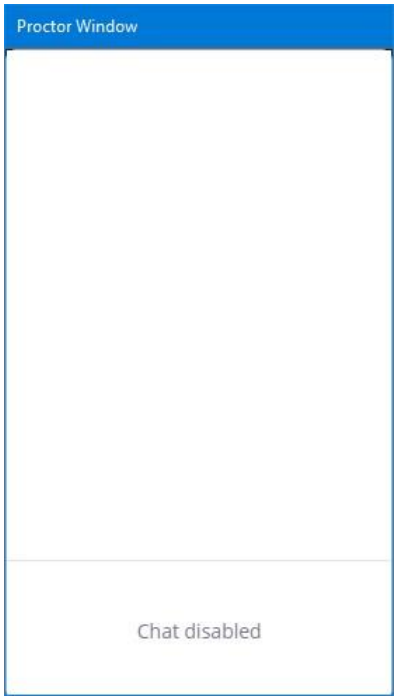


Chat interface is divided in two parts. The lower part that contains the phrase “Type message here …” is for candidate to compose his/her messages to send to the Invigilator.

The upper white space is a list of message exchange:



As we mentioned above you can connect to the Proctor's virtual meeting without concern if the invigilator is available or online at the moment. If the Invigilator is not available or online the virtual meeting is suspended and the *Proctor Window* will show the chat interface disabled.



The messaging system in **Certberus™** is private. This means that the messages are only from each individual candidate towards the current Invigilator. Candidates can't chat with each other, whereas Invigilators can send messages to all candidates or to a specific candidate at will.

All messages are recorded in our server as well as all candidates' videos from their cameras.

Invigilator may mute you remotely to avoid any interference to the supervised group or any exam interruption. He can also ask you to enable your muted microphone by showing a related message in your *Proctor Window*.