Notes & FAQs on Deployment of
COMPUTER BASED TEST SYSTEM

Used for

WEB BASED ONLINE EXAM,
INTRANET BASED EXAM IN CLASS OR LAB,
ONLINE FEEDBACK AND SURVEYS
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1) Introduction and Concepts

Computer Based Test System (CBT) is a generic name to an Assessment or Examination System in which questions are answered on computer screen instead of pen and paper.

The Addmen CBT has different variants for Personal Computer or Android Tab/Smartphone. On the computer it opens in the internet browser window, while on the smart device it opens in the App extension.

Methods of Deployment (Cloud Server or Lab Server)

The CBT system essentially runs using a server and a client pair. There are 4 options for accessibility:

1. Server on **cloud**, accessible to users at home/own devices through personal internet (Ideal Online System – Dependent on multiple User Internet)

2. Server on **cloud**, accessible on multiple computers in Lab through common institute internet (Online System – Dependent on Single shared Internet) (Risky, Not Recommended)

3. Server in **Lab**, accessible to Lab computers through local network (Ideal Offline System – Independent of Internet)

4. Server in **Lab**, accessible to students at home/own devices through internet and Static IP on Server (Online System – Dependent on Single Internet) (Least Practical, Least Recommended)

The server may be a distant server on cloud or a local server inside the lab and accordingly we may call it **Online Test System** or **Offline Test System**, but in any case both are computer based Tests system and the Basic Addmen CBT software is able to serve for both type of deployments.

We will use common Short name **CBT System**.

a) **Online Exam System**: Web based or Internet based system where the server is on cloud and the candidate answers the exam in internet browser on a windows computer at his home or Cyber café.

b) **Offline Exam System**: LAN Based or Intranet based system where the offline server is placed in Lab and the where candidate answers the exam in internet browser on a computers in the same institute Lab connected to that offline server in the Lab through local intranet.

c) **Exam on Tab/Smartphone(App)**: Here the candidate temporarily connects his Tab/ Smartphone to the Lab-server or internet-server, **downloads the exam paper on his device, answers the exam offline, and later connects again to upload** it on server through internet.

Sometimes a combination of Licenses is deployed on Cloud and Lab to obtain the optimal advantage of server resources and to cater maximum users. There are 3 types of Deployments in case of Online Test System:

A. **Single Instance Deployment on Cloud Server** – Base License only on Single Server on Cloud

B. **Single Instance Deployment on Lab Server** – Base License only on Single Server in Lab

C. **Dual Instance Deployment** – Base License used as Parent Server on Cloud and an additional Child License used as Child Server in Lab ..........(*Covered in detail later in this document*)
Glossary of Terms (User/ Login/ Test/ Attempt/ Token)

a) A User is a member registered in the online test system who is given access to sign-in. He may or may not sign-in and may or may not attempt tests. So number of users is not directly related to load on the system.

b) A Test is a question paper which is some static data. It is different from a “test attempt” that involves real-time data transfer and bandwidth consumption. There might be several question papers created but no users to attempt them. Then this is only dead data but no transaction load on the system. So number of tests is also not directly related to load on the system.

c) A Test Attempt is the actual use of the system when there is real-time data transaction with the server when one user is answering one test. This is when the load is exerted on system resources. So test attempts are chargeable.

   Maximum possible test attempts can be No. of Tests X No. of Users.

   But actual attempts are very less because all users do not attempt all tests.

d) A Login is an instance when the user is actually signed-in and is accessing and using the software. A login is not counted as a test attempt if the user simply accesses the software but does not start a test. A user may sign-in but not start to answer any test, so it is not counted as a test attempt or charged as a test token. One such user may sign-in several times during a test, if he gets disconnected. Signing-in multiple times in a single test is also not counted as multiple test attempts.

e) A Test Token is the price for a test attempt. One test attempt may be worth one or more test tokens. Same exam with provisions for more concurrent users answering it at the same time will require more bandwidth for more users to attempt simultaneously, so it will be costlier and be worth more no. of test tokens. Similarly longer exams with more number of questions and larger duration that block the server resources for a longer period of time are worth more no. of test tokens.
**2) Delivery Stages of any Online Service or Online Test System**

There are 4 stages of delivery of an online service based on Server-Client architecture.

The overall experience of delivery is dependent on smooth synchronous functioning of all 4 components. If any of these is having a bottle neck, the entire performance will go down. Stage 3 & Stage 4 has nothing to do with service provider or CBT System software.

<table>
<thead>
<tr>
<th>Service Delivery Component</th>
<th>CBT Software running Online from Cloud Server</th>
<th>CBT Software running Offline from Lab Server</th>
<th>CBT Software running Online from Server in Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1</strong> Processing power of the server</td>
<td>Cloud Servers are generally unquestionable because professionally planned for specific use and to handle huge loads. Each server is catering to multiple customers and is always surplus in resources. Also Cloud servers are real-time scalable so there is never a situation of shortage or clogging.</td>
<td>Generally these servers are bought on the criteria of optimal configuration for minimal budget. Their performance is obviously low as compared to cloud servers but the major advantage of bypassing internet gives a faster feel. Of course these are servers with fixed configuration so they have load limits.</td>
<td>Same as mentioned in column 2 for CBT Software running Offline from Server in Lab</td>
</tr>
<tr>
<td><strong>Stage 2</strong> Delivery bandwidth of the server</td>
<td>Again these are unquestionable because professionally planned for multiple customers and has sufficient allowance for surges. Again the resources on cloud are real-time scalable so there is never a situation of shortage or clogging.</td>
<td>In case of use within the lab, though the dependency on internet connectivity and speed has been surpassed by local LAN connectivity, but still it is important to assess if the network switch or router is compatible for proper distribution of sufficient bandwidth to each terminal. For this reason Lab Testing is very essential.</td>
<td>When an offline Lab server is made to behave as online server, then the roles of Stage 2 and Stage 3 swap. The local internet connection was used as receiving bandwidth when users were access test in lab from online server. But now if the Lab server is delivering to online candidates, then the local connection becomes the delivering connection, so it requires high upload bandwidth. Generally local connections have very low upload bandwidths as compared to download bandwidths.</td>
</tr>
<tr>
<td><strong>Stage 3</strong> Receiving Bandwidth of the User</td>
<td>Servers process and deliver unquestionably fast. A server may have processing ability and bandwidth to answer 1000 calls a second, but at the user end if the internet connectivity is not sufficient to download questions fast then the user experience will be poor. Even in case of high bandwidth in lab if after distribution one user can not have enough bandwidth then again the experience will be low. Generally these days individual users at home or App user may not face bandwidth issues, because in most cases bandwidths are either broadband or 3G/4G so there is not limitation in case of individual distributed users, but in case of multiple users in a single lab depending upon a single shared internet connection may report limitations in not sufficient for each</td>
<td>In case of within the Lab test system working on LAN, this parameter is mostly unquestionable unless the router or network switch is unsuited to the requirement. The analysis obtained by Lab testing data will indicate towards this.</td>
<td>Same as mentioned in column 1 for CBT Software running Online from Cloud Server</td>
</tr>
<tr>
<td><strong>Stage 4</strong> Processing power of the User Device (Computer/Smartphone)</td>
<td>In case of computers this does not effect much in terms of processing power because not much processing power is required. Small amount of resources are used to open browser and the software opens in the browser as a normal website. The test is not downloaded into the computer so there is no effect of storage space. Also there is no calculation at the user computer so processing ability also does not effect. The only effect might be of certain computer specific browser settings. But in case of Android devices where the user is attempting test on app, the resources and health of the device is utmost important, because the test is loaded onto the device and works locally from the device. Any hiccups in the operation are purely due to the device, because when attempting test from the android device, the server and internet are not used, all activity is held within the device. There are certain guidelines which must be emphasized to app users.</td>
<td>Same as in case of online or offline system, the terminal computer resources do not have much impact, unless otherwise observed for some specific computer by running the Lab testing utility. In case offline test inside lab is held on Tabs/App then the same guidelines as for android devices prevail.</td>
<td>Same as mentioned in column 1 for CBT Software running Online from Cloud Server</td>
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</tbody>
</table>
3) Factors that affect the performance

Broadly, an Online Test or Institute management service delivery is dependent on an optimal mixture of three major components: Software, Server Resources and Network/Environment.

Software is simply a set of logical instructions to perform a specific task. Generally it is not the software that has a limitation in processing certain volume of data. It is mostly the capability of the environment to perform the software operations with efficiency.

The Addmen CBT system is same for small number of users or large number of users. The same Addmen Computer Based Test Software can handle 10 or 1000 or even more candidates if it is supplemented with a suitably capable Application Server having proportionate resources, appropriate Data Transfer Bandwidth at Server and good internet bandwidth at user end.

Server environment not only includes Processor Cores, RAM and Storage type (affecting processing ability), but also Operating System, Database Server and transfer bandwidth suitable to meet required work load.

To support multiple users, the server requires more RAM to be able to run multiple instances of the database server. Some versions of Operating Systems and Database Server also have limits of maximum RAM that they can use and this puts a check on the maximum concurrent users it can smoothly sustain.

So the better and well synced is the overall server configuration the more user load can be sustained.

a) Server Computing Resources: Server’s hardware resources like Processors/Cores, RAM, the free space on the server storage media that in-turn affects the size of cache files and paging files that can be created on the drive, and the efficiency of the storage media, all have a major impact on the server performance in serving the tests to a group of candidates.

If there are more processes running on the server, it is always suggested to keep surplus resources to make available minimal resources for test process at any point of time.

b) Operating System: The other major factor that is considered a component of the server resources is the version of OS installed. There are maximum RAM usage limitations for Operating Systems. So even if you have multiple Processor Cores and high RAM on your system and higher version of SQL, still if the OS has a limitation, it will form a bottleneck.

<table>
<thead>
<tr>
<th>Version</th>
<th>Limit on X86</th>
<th>Limit on X64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Server 2008 Standard</td>
<td>4 GB</td>
<td>32 GB</td>
</tr>
<tr>
<td>Windows Web Server</td>
<td>4 GB</td>
<td>32 GB</td>
</tr>
<tr>
<td>Windows Server 2008 R2 Standard</td>
<td>-</td>
<td>32 GB</td>
</tr>
<tr>
<td>Windows Web Server R2</td>
<td>-</td>
<td>32 GB</td>
</tr>
<tr>
<td>Windows Server 2008 Enterprise</td>
<td>-</td>
<td>2 TB</td>
</tr>
<tr>
<td>Windows Server 2012 Standard</td>
<td>-</td>
<td>4 TB</td>
</tr>
</tbody>
</table>

c) Database Server: Similarly, various versions of SQL have their respective limitations on the maximum amount of memory that they can use. So even if you have deployed a server with 64 GB RAM, but it is installed with SQL Express edition, the SQL shall not be using memory more than 4GB, and this would form the bottle neck in serving more than 10-20 users. So it is suggested to install SQL standard or Web edition with minimum 32 GBs to meet a workload of upto 50 concurrent users.

To know more about SQL server variants, refer the following link:
https://msdn.microsoft.com/sv-se/library/cc645993(v=sql.110).aspx
d) **Server Data Transfer Bandwidth**: Lower data transfer bandwidth from the server available for more users demanding for data will create bottlenecks in delivery. Based on data usage pattern over the years we observed that 25 concurrent users is the most commonly exploited limit and most institutes very rarely it exceed this concurrency needs. Server bandwidth to cater for more concurrent users like in range of 50-100 or more is available at a higher price. If clients prefer a minimum price then they can balance the workload by time sharing.

e) **User Internet Connection Bandwidth**: Server Data transfer bandwidth and User Internet bandwidth again are 2 different things....the lowest one forms the bottle neck. If there are different users connected to the same server giving the same online test, but having internet connections of different bandwidth, then their experience will be different. The user whose bandwidth will be low, his response time will be more. Server receives requests, sends data, but if student bandwidth is low, he will take time to see.

Suppose even if we provide a very high end server with high bandwidth, still the final experience will be as of limiting bandwidth at user level.

f) **Consistent Internet/Network Connectivity**: Besides the speed, quality of connectivity is important. A high band and fast internet connection, which a user claims he is able to surf websites properly, might not be suitable for Online Test or Online Application. Because most websites involve download of static data in packets so in between connectivity for a fraction of a second does not affect. But in case of online test, in order to save the answers given by user, the software contacts the data server in every few seconds. If the internet connectivity is intermittent at this instant, it might lead to malfunction or even logouts.

So the type and quality of internet connection is also important not just the MBPS label from the service provider. A 1 MBPS connection with consistent connectivity may perform better than a 2 MBPS connection with intermittent connectivity in rainy season.

<table>
<thead>
<tr>
<th>Type of User</th>
<th>Minimum Internet Requirement</th>
<th>Optimal Internet Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single User on Browser</td>
<td>Normal dial-up is sufficient to work but, screen loading time will be slow, might be subject to disconnections and timeouts</td>
<td>The more speed the better. Faster speeds will facilitate faster downloads.</td>
</tr>
<tr>
<td>Single User on App</td>
<td>2G connection is OK to download but it will take time to download. No issues while working because it works locally on device, without internet connectivity but slow speed at time of uploading can be risky. Also devices with poor processors, smaller screens might perform slow and face limitations.</td>
<td>3G connection is good, though it is required only for a limited period to download and upload the test at the start and end of the process, but even if this is smooth and fast, it will create a better user experience.</td>
</tr>
<tr>
<td>Multiple User in Test Lab</td>
<td>Bandwidth requirement depends on number of users. 50 users will need in range of 8 MBPS, 100 users might need 10+MBPS.</td>
<td>For this high concurrency, it is suggested to conduct test only in Lab with local server to avoid all dependency on internet bandwidth.</td>
</tr>
</tbody>
</table>
4) **How to Reduce Server Load or Achieve Maximum Concurrency from same Server**

**Concept of “Load” in terms of CBT System**

The load on a Computer Based Test (CBT) System is very different from the data contained by the system. It is not the number of registered students. It is also not the number of questionnaires uploaded.

Till the time there is no use of system to answer the test by a candidate, there is no load. It is just a dead database which is occupying disk space. But since there is no transaction and no use of data bandwidth, thus we call this condition as a no-load condition.

When a candidate answers a question paper the database of the CBT system is repeatedly hit several times in a minute to retrieve and store the latest responses or changes made by the candidate. So each user locks an instance of the database for a longer period of time. More users need more instances of database and accordingly more resources on the server.

There can be 100 or 10000 registered candidates and there might be 1 or 250 question papers ready uploaded in your system BUT still there will be no load if no candidate is solving any question paper at this point of time. The actual usage of the system begins when a user starts answering a question paper.

It is also to understand that the load exerted by user during a single online test activity is much higher than the total load exerted by that user for other dashboard activities during the entire year.

**Concept of “Concurrent Users” in terms of CBT System**

Suppose an exam is active for 3 days and total 1000 candidates will take part in it during these 3 days. The server is running 24 hours and the candidates might sign-in at their convenient time during the active period of the test. Since the duration of the exam is also fixed, so all these candidates will not remain signed-in and will not be able to use the online test system for all 3 days. Any candidate will sign-in and answer the test with one or more sign-in attempts and will have to leave the system as soon as the total running time duration of that exam reaches the defined max duration.

In this way, some candidates will sign-off in some time and other new candidates will sign-in. So the candidates solving the test in these 3 days will be uniformly spread over 3 days and at any point of time there may be about 50-60 candidates signed-in and solving the test.

So for 1000 users to answer a test with larger time window, we do not essentially need a server that has 1000 concurrency. Instead the users will sign-in and sign-out such that not more than 50 users are expected to be answering the test at any point of time then a server configuration with resources enough to cater for 50 simultaneous users is sufficient to conduct a test of 1000 or 10000 candidates.

**In simple language**, the concurrent load on the system is the number of candidates signed-in at one particular instant.
Minimize Concurrency - Make best use of Server Resources

If the implementation is on a single server with limited resources, then to achieve optimal use of server resources, it is suggested to dissolve the accentuated load by time sharing.

One approach to reduce the accentuated load on server is to schedule the exams for period sufficiently longer than the exam duration so that all candidates are not forced to sign-in within a narrow window of time. In this manner since there is more time window, the maximum number of candidates signing into the system will get distributed and also the number of users signed into system will automatically reduce.

One other way of distributing accentuated load is to distribute the candidates in small size groups and allot group wise time for exam.

Since the use will be spread over a period of time will enable optimal use of resources on time sharing basis. In this manner, more number of users can be handled with limited resources of the server.

Minimize Processes - Conduct Exams in LAB MODE

The Base CBT License is a dual utility software that can either be used to conduct Online Test on website by deploying on the cloud server or it can be used to conduct Offline exam in Lab.

Lab Exam Mode is a situation where the CBT software on the server is focused on single common test for all users at one time and run with minimal processes so that it demands less server resources and is able to cater to more users during a critical exam.

In order to furnish the student dashboard, the server checks whether student is active and course this student belongs? What are the test created for that course? What are the tests that this student has completed or missed or incomplete or yet to start? If a test is incomplete, how many attempts left for the test, what is the remaining time....etc...All these conditions are necessary to create user specific environment. But these processes create extra work on server.

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<tr>
<th>Functionality of Cloud Instance</th>
<th>Functionality of Lab Instance</th>
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<tbody>
<tr>
<td>In case of test on cloud, it is assumed that each user will sign-in from their personal devices and it is accessible to all users at a time. It means that the software has to check many logical conditions to identify the user and prepare his dashboard based on his records.</td>
<td>In case of a test in Lab, it is assumed that all user present at this moment in the lab have come for a specific test. So ideally it is not required to check user specific information at the time of sign-in.</td>
</tr>
</tbody>
</table>

Lab Exam mode activated on the Lab server helps to further minimize the processes so that more users can be served from a lower configuration local server.

It is also possible to activate Lab mode on cloud server to improve the load handling on cloud server.
If Lab Exam Mode activated on Cloud Server or in Lab Server, all allotted resources will be prioritized for delivering the Specific Test.

- Student Score Board will be disabled. Students will not be able to see any results during the Lab Test mode.
- Admin Reports and Results will be disabled during active period of tests to avoid any deviation of resources. If report generation is required at the same time select a higher concurrency plan.
- Login for all users except those entitled for the activated test will be temporarily disabled.
- Lab Test Mode will have to be deactivated manually by the administrator.

- Once a user starts a Test, do not close your window or logout before submitting the test. If you are logged out accidentally then login again and submit your test else your test will automatically submitted after 24 hours.

- User cannot start a new test until all previous test have been submitted.
- Only open test will be visible at the time of re-login.

- User can start any test between Start Date/Time and End Date/Time.
- All users have to submit the test before End Date/Time + Test Duration. All open tests will be force submitted after this time.
- For tests that have longer activation period of several days, still any open tests have to be completed within maximum period of 24 hours from the time of starting the test. All open tests will be force submitted after this time.

- All other exams are disabled during Lab Mode.
5) **Solution for Computer Based Test Labs using Offline Server**

Generally clients who want to bypass the poor connectivity internet or want to minimize the hosting expenses, opt for deploying the software in a Lab server to conduct offline tests.

<table>
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<tr>
<th>Who will need Cloud Setup?</th>
<th>Who will need Lab Setup?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institute that does not have availability of Lab, and prefers to start setup with minimum investment.</td>
<td>Institute that wants to conduct critical exams without depending upon the deviations of internet.</td>
</tr>
<tr>
<td>Institute that want to provide practice tests to individual users at home without security focus.</td>
<td>Institute that wants to conduct tests of class group in actual proctored environment within classroom.</td>
</tr>
<tr>
<td>Institute that want to avoid self-management of technical requirements and prefer professionally managed cloud services by paying cost.</td>
<td>Institutes that want to reduce the operating cost of cloud setup by catering to maximum load in their labs.</td>
</tr>
</tbody>
</table>

Same Computer Based Test Software can either be used to conduct Online Test on website by deploying on the cloud server or it can be used to conduct test in Lab by deploying on an owned server in the Lab.

Read the Server Configuration details given in this document.

For conducting the test in the Lab, the computers in the Lab shall be connected to the server via LAN. The server and the computers must be on the same LAN. Shared or Proxy LAN is not suggested. The server should be accessible from the terminals through local LAN IP.

**Suitability of N-Computing or Thin Client Systems in Lab**

If you are opting for N-Computing, in which all terminal computers make use of server resources, then a broad calculation would be to use the server configuration of next higher slab. So if you are planning to cater to 25 Test users in your lab that works on N-Computing, then you must plan for a server that is suggested for 50 users.

Thin client architecture is more suggested because it has more easily manageable for the client. The thin client terminals can later be scaled up to fulfill the purpose of independent computers for other purposes also, while in case of N-computing, it might invite more dependency on technical manpower which might be difficult in certain areas. Also it will demand more investment in single direction (on server).
Importance of checking your lab performance

With the above understanding about impact of server and network capabilities in delivering the test, it is obvious that each component has its effect on the overall experience of the user.

If the same Windows 10 is loaded on an old Pentium computer, will it work same as it works on i3 or i5? **No, because there is effect of processing power and resources of the computer.**

If the same movie from same source is downloaded or viewed on an i3 with GPRS connection and other i3 with Broadband connection, will it be same?

If the same movie is watched by a single user having broadband connection of same bandwidth, and on the other hand there are several users in a lab where the bandwidth is shared. Will the experience be same? **No, because there is effect of receiving bandwidth at the user end.**

In two labs with same number of users watching same movie with same server, same internet but one has a smaller capacity network switch and the other has a high bandwidth network switch, will the experience be same? **No, because of difference in quality of network connectivity affecting bandwidth available to a user.**

So it is always suggested to initiate a metered start of the exam process in any new Lab. It is important to test your lab to know- what is the optimal performance achieved out of whatever combination of components is available. It is utmost important and ideal to run a lab simulation for a similar test whenever you are planning a near-full-load event. This will indicate the synchronization and health of lab resources at that moment.

Addmen provides a Lab Testing utility that simulates the online test load from multiple computers and the data thus generated clearly indicates:

1) The capability of the current lab infrastructure to cater to how many users.
2) By analyzing the data, you can draw out inferences about question delivery speed.
3) It will help you identify the extent to which you can load your server beyond the planned load.
4) This will also help to identify if any of the terminal computer is specially slower than the rest.

The lab test done once should not be taken for granted for long. The professionally managed cloud servers always have an intense maintenance activity on, which is not true for a single user owned server and Lab that does not have a dedicated server manager. It is possible that like any other computer your server is getting loaded with trash over time and its performance today is not the same as the day when it was installed. So it is recommended to run the Lab Test often, especially before important exam events.

**We have to know that there is nothing like a good today or bad tomorrow software performance.** Software is simply a logic to perform a given task in a predefined way. The same software will work with same efficiency if it has the same input and same environment even if you run it after one hundred years or a millennium.

The efficiency of performance of the activity depends on the resources facilitated to the software. Whenever the performance changes, it is either due to change in input or change in environment.

**We also have to know that the Software is same for all large or small test events.** If you are conducting a test for 10 users or for 1000 users or even more, still the same online test software is sufficient if proportionate server and Network resources have been supplemented.
6) **Integrated Solution for Offline (Labs) and Online (Website) Computer Based Test**

First let us understand why an Integrated solution of Computer based Test system (Offline + Online) is required?

As a general scenario, most part of Online Test process is online and less part of the process is offline.

- Candidates can register online on website and data is instantly saved in the cloud server.
- Some admission leads or visitors to the website would want to take demo tests which is possible only online.
- Some of enrolled candidates will also answer the test from their homes through online server.
- Candidates and parents can access their dashboard anytime for results through online.
- App can also be connected through online server.
- Administrators in different branches can more conveniently work on servers available online like registration of candidates and definition of test etc.

The use and benefit of offline server is limited to conducting test in lab by bypassing the internet dependency and the hosting expense.

So it is smarter to maintain the Online functionality for majority convenience and efficiency and use the offline instance of the system for limited functionality to conduct offline test and then revert the data to the Online resource.

**There are 2 main reasons for deploying an Integrated System:**

1) To get the advantage of all-time-availability of Cloud Server and Cost effectiveness and internet independency of Lab Server

2) To minimize the load and expense on Cloud server

If you wish to use the Computer Based Test System in Lab, and also online then you can opt for either of the following approaches for an Integrated Solution:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Type of Solution</th>
<th>Pros &amp; Cons</th>
<th>Approx. Cost</th>
</tr>
</thead>
</table>
| 1   | Single Instance Approach - Server on cloud,  
- accessible to home users at own devices through personal internet  
- accessible to Lab users on multiple computers in Lab through common internet | **RECOMMENDED for home users because that is the only way possible and forms the ideal Online System**  
**NOT RECOMMENDED for Lab users, because all the multiple User are dependent on single shared Internet for receiving** | **Minimum Purchase Cost**  
Cloud Cost : CBT License cost + Major Hosting cost on Cloud  
Lab Cost : Nil  
Possible to get on lease: Even lower price |
| 2   | Single Instance Approach - Server in Lab, made available online through Static IP on Server | **NOT RECOMMENDED for home users because this is like Online System Dependent on Single local Internet for**  
**Almost same cost but more difficult to manage** | Cloud Cost : Nil |
### Notes & FAQs on Deployment of ADDMEN COMPUTER BASED TEST & FEEDBACK SYSTEM

<table>
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<tr>
<th></th>
<th>Lab Cost: CBT License Cost + Static IP Charges + High Bandwidth Internet + 24x7 Electricity Charges</th>
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<td></td>
<td><strong>Notes &amp; FAQs on Deployment of ADDMEN COMPUTER BASED TEST &amp; FEEDBACK SYSTEM</strong></td>
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<td></td>
<td><strong>CERTIFIED ISO 27001 &amp; 9001</strong></td>
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<td><strong>Notes &amp; FAQs on Deployment of ADDMEN COMPUTER BASED TEST &amp; FEEDBACK SYSTEM</strong></td>
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<td><strong>CERTIFIED ISO 27001 &amp; 9001</strong></td>
</tr>
</tbody>
</table>

#### 3. Dual Instance Approach - Parent Server on Cloud and Child Server in Lab

- accessible to home users at own devices through personal internet
- accessible to Lab users through local network

**MOST IDEAL APPROACH**

Install dual instances of Software on Cloud and in Lab because each one will have its own advantage. RECOMMENDED for home users because cloud server will consistently deliver 24x7 RECOMMENDED for Lab users because it is independent of internet and forms Ideal Offline System

**Cloud Cost:** Parent CBT License + Minor Hosting cost on Cloud

**Lab Cost:** Child CBT License cost

Possible to get Cloud Instance on lease: Even lower price and totally hassle free

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The offline Lab server however can also be made available for online users on web by certain arrangements. But it is not a good idea to attempt to solve the purpose of a cloud server by making Offline server live by using static IP.

The cloud servers do not have limitations in bandwidth and processing (as compared to your local server because cloud servers have virtual scaling of resources and are designed for the purpose. So they are anytime better and well suited for online connectivity than a local server with static IP using shared internet bandwidth.

Instead of shifting the whole online functionality to offline server and making it available through Static IP, which has certain limitations, it is smarter to maintain an online server and do all the major tasks online and also maintain an offline server which will be used for the specific purpose of conducting test offline. And both servers will be linked.

Adopting the approach of integrated solution using Dual Instance Deployment having a combo of server on cloud and in Lab is the best approach.
7) **Integrated Solution by making Lab Server Offline to Online using STATIC IP**

If you wish to use the same license of the Computer Based Test System for Offline Tests in Lab and also want to make these tests available to your online users who connect through your website, then you must make following arrangements:

1. **Connect your server on Static IP.** Remember that the Static IP must be configured on the server not on the router. The SQL management studio and IAS on the computer must be accessible online from remote location through static IP. If you wish to run the test locally also then the computer must also be configured on a Local IP and server must be simultaneously accessible from local IP and Static IP. If the server is made accessible only through Static IP, then even the local lab terminal computers will access the server via internet and then the availability of internet is must even for local examination. This has to be done by your server/network manager. Once we are provided the server which is accessible from static IP and Local IP, we will configure the admen software to be accessible from both networks.

2. **Link the website with Online Test System URLs from your server.** There are small HTML code snippets available in the Online Test Software which can be added on your webpage by your web developer.

**Limitations of Static IP method for making online server**

Though the offline server solution works good for the users in the Lab, but making it available for online users through static IP shall have some limitations for the online users.

There are no theoretical or conceptual limitations, but practically, a new component "internet" is introduced so it will have its effect if there are any limitations in the upload and download bandwidths of the connection. Making the offline server as online by using static IP method invites internet hassle in some way or the other. Before offline server there was issue for local user to get data from online server, after setting the offline server there is issue to upload data to online user.

1. The server will have to be kept online 24x7 so you will need uninterrupted electric supply.

2. The server must have stable internet connectivity. Generally individual user internet connections are not as stable as internet connectivity of cloud server, because the user’s internet connectivity is dependent on local service providers and local infrastructure, while the cloud server or ISP connectivity is directly through satellite. This is the major difference that creates difference in reliability of delivery of a local server and compared to a cloud server.

3. It is important to ensure that sufficient upload bandwidth is allotted to the server that made live by static IP. Sometimes it is observed that the institute has an overall high bandwidth connection but the upload bandwidth is very low as compared to download bandwidth and that too is shared by many users/departments. So it is important to know how much stable bandwidth falls in the share of Online Test System. Just having high bandwidth is of no use if you also have high number of users or distribution.

4. Ensure that your upload bandwidth is sufficient to cater the use. It is common that most user internet connections have high download bandwidth and very low upload bandwidth because in regular scenario we use internet mostly to receive or download data and only upload our small commands. But now if your lab server is made the online server that means it has to deliver more data to the small requests it receives from users. So here the upload bandwidth must be high.
8) **Integrated Solution by Dual Instance Deployment**

In the Dual Instance Deployment, the base License is used as Parent Instance on Cloud Server and an additional Child License used as second or Child Instance in Lab Server.

Remember that one License is for one Computer (server). If you have purchased the base license, it is good for single instance deployments. You can either run it on a Lab server (offline) or on cloud server (online). But you cannot install a single instance of License on two servers and cater offline and online separately. For Dual Instance deployment you will need two separate Parent License for Cloud Server and Child License for Lab Server.

**To understand the need of Dual Instance that needs an additional Lab instance we must understand the difference between Cloud based Online Test and Lab based Offline Test?**

Even if the exam is to be conducted in Lab, still Cloud instance is essentially required in most cases because students prefer to see their result from home on their personal devices at their convenient times, so the result must be available on cloud to be seen any time later.

Even if the exam is to be conducted in Lab, it is obviously convenient for the staff and administrators to work anytime from their desks or homes instead of going to the Lab for everything. So test administration is also convenient on Cloud server especially in case of multi-branch or multi-department institutes.

So it is easy to administer tests and view results at all times through Cloud server without keeping Lab server online all the time while the exam is conducted smoothly on server in lab without any dependency on internet.

**Thus the proper deployment is a Mix of Cloud and Lab Instances gives the optimal advantage.**

Define test and manage candidates in the online instance of the system and once it is required to conduct a test offline, then temporarily sync the same test in the offline server just by pressing a button. So the test can be conducted smoothly locally and after that again the test answer data can be uploaded back to the online server for further processing. In this manner the online instance will remain your primary instance and the offline instance will fulfill its primary purpose of bypassing the internet.

**How does the Dual Instance System work in case of Computer Based Online and Offline Exams?**

In this Parent-Child Dual Server system, the exam is created in parent cloud server, downloaded in child Lab server for exam and student response data uploaded back to parent server after finishing the test and then result is processed and viewed on parent cloud server.

The entire activity of administration is done on the cloud instance because it is always online and accessible by multiple administrators and also the online users.

The purpose of local instance inside the Lab is only for time to time when the test is conducted.

The transfer of test definition and the answer data takes place between two servers with a single click of button.

Even if the Base License can solve dual utility and it can be used either on Cloud or in Lab, still the Child instance is a lighter version of software which is able to obtain maximum concurrency from optimal server configuration. It has minimized features and logical conditions focused only on one exam at a time.
### 9) Different Deployment Combinations for Various Needs

Some of the organizations that are planning to conduct tests with high expected participation, have in mind that these examinations might be needing some exceptionally superior softwares. This concept is not fully correct. Besides buying the same software, the type of need determines the server infrastructure and type of deployment.

**Solution for Small Institutes without Lab providing Practice Test over Cloud**

<table>
<thead>
<tr>
<th>Case / Requirement</th>
<th>Suggested Solution</th>
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</thead>
</table>
| **Requirement 1:** Low-end requirement with less no. of users, minimum budget, Lab not available | **Deployment:** Single instance on cloud server only  
**Bandwidth:** upto 10 concurrent users.  
*Increasing bandwidth to entertain high number of concurrent 25-50 users will be a wastage of resources in anticipation of maximum participation. It is better to optimize server load by time sharing and resource sharing methods.* |
| A startup or a small institute giving free demo tests or practice test to students to attempt from their homes.  
Either there are less students in institute or all students are not interested in online test activity leading to low participation. | |
| **Requirement 2:** Midsize requirement with reasonable no. of users, minimum budget, Lab not available | **Deployment:** Single instance on cloud server with APP  
**Bandwidth:** for 25-50 concurrent users.  
*Increasing bandwidth to entertain high number of concurrent 25-50 users will be a wastage of resources in anticipation of maximum participation. It is better to optimize server load by time sharing and resource sharing methods.*  
*Since more users have access to smartphone as compared to laptops, so if number of users is more and if the budget has a ceiling then add APP for android interface to reduce hosting load on server.* |
| Popular Test Series or regular Practice Tests for registered students of institute.  
Either institute has large number of registered students or more students are participating in online test activity. | |
| **Requirement:** Heavy requirement either due to more no. of users or Critical examination, | **Deployment Option1:** Single instance on Lab server with Lab mode activated during test.  
Lab is required to bypass dependency on internet.  
**Lab Bandwidth:** NA  
**Deployment Option2:** If Lab is not an option then, Single instance on Cloud server with Lab mode activated during test  
**Cloud Bandwidth:** high concurrency bandwidth  
But keeping in mind the critical nature of exam, Dual instance on cloud is suggested to have two server as alternate backup to each other. |
### Case / Requirement

**Requirement:**
Heavy requirement either due to more no. of users or Critical examination, Lab available but results to be made online

Besides appearing in test, the students wish to see result on their devices at their convenient time

Users who appear in test in the Lab, later wish to see result on their devices at their time which means the result should be available on cloud

<table>
<thead>
<tr>
<th>Suggested Solution</th>
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</thead>
<tbody>
<tr>
<td><strong>Deployment:</strong> Dual instance on cloud server and Lab server with Lab mode activated during test</td>
</tr>
<tr>
<td><strong>Lab Bandwidth:</strong> NA</td>
</tr>
<tr>
<td><strong>Cloud Bandwidth:</strong> minor for results</td>
</tr>
</tbody>
</table>

**Requirement:**
Service providers who are catering to several institutes by creating test centrally and making available to all institutes and their users.

<table>
<thead>
<tr>
<th>Suggested Solution</th>
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</thead>
<tbody>
<tr>
<td><strong>Deployment:</strong> Dual instance deployment with parent license on cloud server administered by service provider and with several Child licenses one for each subscriber institute installed either in cloud or in Lab.</td>
</tr>
<tr>
<td>Each client’s Child license on cloud supplemented with APP</td>
</tr>
<tr>
<td><strong>Bandwidth on Parent License:</strong> Minor only for administration activity</td>
</tr>
<tr>
<td><strong>Bandwidth on Child License:</strong> Major as per use</td>
</tr>
</tbody>
</table>

**Requirement:**
In multi-branch or multi-department institute, administrators find it convenient to make and upload tests from distant locations within or outside the campus

<table>
<thead>
<tr>
<th>Suggested Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deployment:</strong> Either Single Instance or Dual Instance, but one instance essentially on cloud.</td>
</tr>
</tbody>
</table>

### Professionally managed solution for Large Scale Online Exams

*When such a large scale examinations like CAT, IBPS are conducted pan India, they are not conducted with the help of just one single license software loaded on one single dedicated server hosted at some datacenter. Such large scale examination event involves a completely planned solution wherein many servers using multiple software licenses hosted locally in each exam centre or at several datacenters are used and later the data is collated after exam for result processing.*

One of the major reason for such a distributed network arrangement is to avoid the dependency and risk of internet and also to distribute workload on various servers in order to have backup of the process in case any server fails to deliver. Later when the exam execution is over, the data from all servers is collated to process results.

Thus the software in a single lab might be same as what is used by a small institution, but the total solution is formed by parallel implementation of multiple such servers to meet the high workload requirements.
10) Suggested Server configuration as per expected load

a) A Server running on MS Windows server 2008 or higher with MS SQL 2012 shall be required.

b) The software client/user interface can be run on any current day Internet Browser running on Windows OS. Google Chrome is recommended.

c) Please install the server according to specifications given below. Note: These are minimum required parameters.

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>UPTO 50 Concurrent Users</th>
<th>UPTO 100 Concurrent Users</th>
<th>UPTO 200 Concurrent Users</th>
<th>UPTO 500 Concurrent Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORES</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>RAM</td>
<td>16 GB</td>
<td>32 GB</td>
<td>64 GB</td>
<td>64 GB</td>
</tr>
<tr>
<td>Storage</td>
<td>SSD 100 GB</td>
<td>SSD 100 GB</td>
<td>SSD 100 GB</td>
<td>SSD 100 GB</td>
</tr>
<tr>
<td>OS</td>
<td>Win 10 + (64 bit)</td>
<td>2012 Std + (64 bit)</td>
<td>2012 Std + (64 bit)</td>
<td>2012 Std. + (64 Bit)</td>
</tr>
<tr>
<td>SQL</td>
<td>2012 Express +</td>
<td>2012 Std +</td>
<td>2012 Std +</td>
<td>2012 Std +</td>
</tr>
</tbody>
</table>

+ indicates this variant or higher.

d) Configure LAN / Static IP / Domain (for accessing in Lab or Over the Internet)

e) Configure IIS with .Net Framework 3.5 SP1 or higher

f) Other provisional arrangements (as and when required)
   a. Latest Version Browser (Google Chrome Recommended)
   b. Windows Installer 3.1 / 4.5
   c. Unzipping Software, Antivirus, PC Cleaner, PDF Reader & Writer
   d. Windows PowerShell 1.0 (if Required)
   e. MS Office Enterprise 2007 (if Required)
   f. Crystal Reports 8.5/ Crystal Reports Runtime (if Required)
   g. Do not change regional (date-time) settings to India. Let it be U.S. (default).