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Notes & FAQs on Performance of

COMPUTER BASED TEST SYSTEM

used for

WEB BASED ONLINE TEST,

INTRANET BASED TEST IN CLASS OR LAB,

ONLINE FEEDBACK AND SURVEYS

Table of Contents

The following Topics must be read thoroughly and the information must be used as reference document. All the points below are important to be read. Due to avoidance of reading the users are found asking the same questions again and again and still have confusions.

Following points also provide **detailed answers to most Frequently asked Questions** by users who have purchased Computer Based Test Software with an intention to run on their owned server.

1. Introduction

Computer Based Test System is a Browser based software, working on a Server-client structure. It can be used for conducting test with following setups:

a) **Web Based Online Test:** where the candidate attempts the test in internet browser on a windows computer at his home or Cyber café.

b) **LAN Based Online Test in Lab:** where candidate attempts test in internet browser on a computer in the institute Lab connected to the offline server in the Lab through local intranet.

c) **Offline Computer Based Test using Android Device :** where the candidate temporarily connects his Tab/ Smartphone to the Lab-server or internet-server, downloads the test on his device, solves the test offline, and later connects again through internet to upload.

2. 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 login. He may or may not login 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 solving one test. This is when the load is exerted on system resources. So test attempts are chargeable.

*Max 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 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. One user may login but not do anything, so it is not counted as a test attempt or charged as a test token. One user may login several times during a test, if he gets disconnected. Logging-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 test with provisions for more bandwidth for more users to attempt simultaneously might be costlier and be worth more no. of test tokens. ***The concept of Token is not valid in the new cloud hosting charging system in effect from 01-Sep-2016.***

3. Understand the concept of "Load" in terms of Online Test System

The load on an Online Test 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 solve 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 use of data bandwidth, thus we call this situation as a no-load condition.

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 attempting a question paper.

When a candidate solves a question paper the database of the online test system is repeatedly hit several times in a minute to retrieve and store the latest responses or changes made by the candidate. It is only then that the bandwidth and other capabilities of the database server are put to use.

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

4. Concurrent User Logins

Suppose a test is active for 3 days and total 10000 candidates will take part in it during these 3 days. The server is running 24 hours and the candidates might login at their convenient time during the active period of the test. Since the duration of the test is also fixed, so all these candidates will not remain logged-in and will be able to use the online test system for all 3 days. Any candidate will login and solve the test with one or more logins attempts and will have to leave the system as soon as the total running time of the online test reaches the defined test duration.

In this way, some candidates will log-off in some time and other new candidates will log-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 logged-in and solving the test. Even if one question paper or several question papers solved by various candidates, the concurrent load on the system is the number of candidates logged-in at one particular instant.

In simple language, the server requires more RAM to be able to run multiple instances of the database server to support multiple logins. 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 logins it can smoothly sustain. In either case the better the server infrastructure the better concurrent login load can be sustained.

Here it is important to understand that if at any one point of time the number of candidates currently solving the test is not exceeding more than 50 then the server that can handle 50 simultaneous logins of database instances is perfectly ok to conduct a test of 10000 candidates.

5. Suggested approach to optimize the use of resources for Self-owned Servers

With the above understanding about impact of server capabilities in delivering the test to a number of candidates, it is always suggested to initiate a metered start of the test process on any new server. If the implementation is on a single server with limited resources, then in case of online candidates accessing the system over cloud, it is suggested to schedule the tests for sufficient period so that all candidates are not forced to login within a narrow window of time. Thus at any one point of time, the number of users logged into system will automatically reduced. Also since there is more time window, the max number of candidates logging into the system can be limited by the system administrator. In this manner the accentuated load on the server can be dissolved by increasing the time window for system use.

If the tests are to be attempted by a group on several computers connected to a server in a lab, it is suggested to distribute the candidates in small size groups. So that the users can attempt over a period of time to 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.

It is assumed that the user implementing this Computer Based Test/Feedback System has understood the above approach and shall implement the system with awareness to above approach.

6. Delivery Stages of any Online Service or Online Test System

There are 4 stages of delivery of an online service (Server-Client/Browser based).

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.

Service Delivery Component	CBT Software running Online from Cloud Server	CBT Software running Offline from Owned Server in Lab	CBT Software running Online from Owned Server in Lab
Stage 1 Processing power of the server	These are 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. These servers are real time scalable so there is never short of resources	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. Ofcourse these are servers with fixed configuration so they have load limits.	Same as mentioned in column 2 for **CBT Software running Offline from Owned Server in Lab**
Stage 2 Delivery bandwidth of the server	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.	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.	When a in-house offline 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.
Stage 3 Receiving Bandwidth of the User	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	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.	Same as mentioned in column 1 for **CBT Software running Online from Cloud Server**
Stage 4 Processing power of the User Device (Computer/ Smartphone)	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 a s 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.	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.	Same as mentioned in column 1 for **CBT Software running Online from Cloud Server**
	Stage 3 & Stage 4 has nothing to do with service provider or software		

7. Factors that affect the performance

Broadly, an Online Test or Institute management solution can be divided into two major components, Software and Server Environment. But it is not just a Software or a Server in isolation...the solution depends on an optimal mixture of several parameters.

Software capability and Environment capability are 2 different things. *The same Online Test Software can handle 10 or 10000 candidates if it is supported by a suitably capable Application Server having proportionate resources, appropriate Data Transfer Bandwidth at Server and good internet bandwidth at user end.*

Besides buying the same software, the type of need determines the server infrastructure. If you have a low-end requirement with minimum budget, like a coaching center distributing free tests, so accordingly cloud deployment with basic bandwidth that support 0-10 concurrent users should be opted. Increasing bandwidth to keep provision for entertaining higher number of simultaneous 25-50 users will be a wastage of resources in anticipation of maximum load. It is better to plan workload by time sharing.

However, if your tests are of critical importance even for 25 students, you must buy surplus bandwidth at the server level and ensure candidates appear in a Lab, or have a broadband connection at home or 3G/4G connection in smart device.

If you plan to conduct tests of more number of candidates like 50-100, then you should opt for an in-house server in the lab, eliminating all dependency on internet and bandwidth. Because if server is on cloud and users in lab, that lab must have consistent internet with high bandwidth is the range of 10+ MBPS. If the server is on cloud and the users are distributed in their homes, cyber café or using their smart devices with mobile internet, they will have different experiences depending on their internet.

8. Server Environment factors that affect performance

Server environment includes Processor Cores, RAM and Storage type (affecting processing ability), Operating System, Database Server and transfer bandwidth suitable to meet required work load.

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.

Version	Limit on X86	Limit on X64
Windows Server 2008 Standard	4 GB	32 GB
Windows Web Server	4 GB	32 GB
Windows Server 2008 R2 Standard	-	32 GB
Windows Web Server R2	-	32 GB
Windows Server 2008 Enterprise	-	2 TB

Windows Server 2012 Standard	-	4 TB

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

9. Network and Connectivity factors that affect performance

a) **Server Data Transfer Bandwidth:**

In our standard package, we provide a bandwidth that supports 25 simultaneous users for one account and charge accordingly. The price is exponentially high if 50 or 100 simultaneous users have to be allowed. So instead of paying high cost for an accentuated workload which is rarely required, even clients prefer a minimum balanced price and adjust the workload by time sharing. 25 logins is standard because based on data usage pattern over the years we observed that this is the most commonly exploited limit and very rarely it exceeds this concurrency needs.

b) **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.

c) **Consistent 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.

Type of User	Minimum Internet Requirement	Optimal Internet Requirement
Single User on Browser	Normal dial-up is sufficient to work but, screen loading time will be slow, might be subject to disconnections and timeouts	The more speed the better. Faster speeds will facilitate faster downloads.
Single User on App	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	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

	speed at time of uploading can be risky. Also devices with poor processors, smaller screens might perform slow and face limitations.	will create a better user experience.
Multiple User in Test Lab	Bandwidth requirement depends on number of users. 50 users will need in range of 8 MBPS, 100 users might need 10+MBPS.	For this high concurrency, it is suggested to conduct test only in Lab with local server to avoid all dependency on internet bandwidth.

10. Importance of checking your lab performance

If the same OS Windows 10 is loaded on an old Pentium computer, will it work same as it works on i3 or i5?
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? No because there is effect of receiving bandwidth at the user end.
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?
For example, some user might have deployed a very high end server, but may be the network switch has problem so the overall delivery to the terminal computers is delayed. 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?

So it is obvious that each component has its effect on the overall experience of the user. 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 sync 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 the capability of the current lab infrastructure to cater to how many users. By analyzing the data, you can draw out inferences about question delivery speed. This will also help you identify the extent to which you can load your server beyond the planned load. This will also help to identify if any of the terminal computer is specially slower than the rest.

Also the lab test done once should not be taken for granted for long. The professionally managed cloud servers always have a 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.

By doing so, the customers who have questions – “Earlier CBT software was working fine, now it is slow?” – they will automatically have an answer.

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 performance of the activity depends on the resources facilitated to the software. Whenever the performance or result 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 the same online test software will work. The performance of the activity depends on the resources facilitated to the software.

11. Planned Solution for Large Scale Online Exams

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.

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 distribute workload on various servers and also 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 might be same as that is used by a small scale institution, but the total solution is formed by parallel implementation of multiple threads to meet the high workload requirements.

12. Solution for Computer Based Test Labs using Offline Server

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.

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.

Read the Server Configuration details given in this document.

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 Online 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).

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.

13. Integrated Solution for Offline (Labs) and Online (Website) Computer Based Test

Remember that one License is for one server. If you wish to use the Computer Based Test in Lab, and also online then you can opt for either of the two approaches:

1. The minimal approach is to install the software on your Lab server and make same server available online through static IP connectivity.
2. The most ideal approach is to have separate instances of Online Test Software on Lab and on Cloud because each one will have its own advantage.

Remember that one License is for one server. If you have purchased, you can either run it offline on a server inside the lab or online by hosting on the cloud server. The offline server (inside the lab) however can also be made available for online users by certain arrangements. But you cannot install it at two servers and cater offline and online separately.

How the minimal approach of Static IP for making online server works?

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 s 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.

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 coactivity 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 service through a cloud or a local server.
3. Ensure that the overall network bandwidth allotted to this system is sufficient to cater to the need. Sometimes it is observed that the institute has an overall high bandwidth connection but the bandwidth is shared by many 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 uplod 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.

How the Dual Instances System (Online and Offline) works?

As a general scenario, most part of your use is online and less part of the use is offline. Candidates can register online through website. Candidates and parents can access their dashboard anytime for results through online. Some admission leads or visitors to the website would want to take demo tests which is possible only online. Some

of the enrolled candidates will also attempt the test from their homes through online server. App is also connected through online. 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.

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.

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.

1. 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 a offline server which will be used for the specific purpose of conducting test offline. And both severs will be linked.
2. 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.

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

The users who want to make tests available for both offline and online users using their purchased license have following options for procurement:

Option	For Offline Users in Lab	For Online Users on internet
Static IP approach	Buy a single License of CBT install it in Lab on your offline server Example Cost : CBT(60000)	Connect the Lab offline server to website through Static IP Example Cost : CBT Setup Nil + Static IP Charges + Electricity Charges
Dual Instance approach	Buy a single License of CBT install it in Lab on your offline server Example Cost : CBT(60000)	Buy a additional License of CBT install it on cloud server Example Cost : 55000+ Hosting *CBT addl. Lic. (45000) + Onetime Linking (10000)* *In this case tests conducted offline will be considered as zero hosting load.*
Dual Instance approach	Buy a single License of CBT install it in Lab on your offline server Example Cost : CBT(60000)	Subscribe CBT on Lease on cloud Example Cost : CBT Setup (15000) + CBT 1000 tokens (6000) annual + Onetime Linking (10000) *In this case there will be no tokens deducted for the test conducted Offline. The tests conducted online will deduct tokens as per regular system.*

14. Suggested Server configuration as per expected load

(Technical specification for installing on your own server)

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.

ITEMS	UPTO 25 Concurrent Users	UPTO 50 Concurrent Users	UPTO 100 Concurrent Users	UPTO 200 Concurrent Users	UPTO 500 Concurrent Users
CORES	4+	4+	8+	16+	32+
RAM	16 GB+	32 GB+	64 GB+	64 GB+	200 GB+
HDD / SSD	100 GB+	100 GB+	200 GB+	200 GB+	500 GB+
OS	7 Pro 64 bit +	2008 R2 Std / 2012 Std 64 bit +	2008 R2 Ent / 2012 Std 64 bit +	2012 Std 64 bit +	2012 Std 64 bit +
SQL	2012 Express +	2012 Web + per core	2012 Web + per core	2012 Std + per core	2012 Std + per core

+ indicates this is minimum parameter. The component should be higher than this for better result.

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).