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# CIC Database Configuration and Maintenance for Oracle

## Technical Reference

### Abstract

This document describes the procedures for setting up a database server for optimum performance with CIC, with specific guidance for Oracle Servers.

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# Introduction to Database Configuration and Maintenance for Oracle

A database is a collection of data that is organized so that its contents can easily be accessed, managed, and updated. A small database might contain tables of names, addresses and phone numbers. To serve that collection of information, a small database engine would suffice. However, a corporation typically stores a much larger quantity of information. A database can have millions of rows and columns of data, stored in multiple tables linked into a massive storage unit. In that situation, not only must your database engine must be powerful, but a myriad of other issues that can enhance or mire the performance of the database engine should be considered.

The *CIC Database Configuration and Maintenance for Oracle Technical Reference* describes the procedures for setting up a database server for optimum performance with CIC, with specific guidance for Oracle. Many of the ideas here are focused on a best-case scenario, designed to tune both the hardware and software to operate at peak efficiency.

See Testlab (<http://testlab.genesys.com/>) for Oracle versions supported for CIC 2015 R1 or later.

Oracle Installation guides may be found [on Oracle's Installing and Upgrading site](#).

# CIC Database Configuration Technical Summary

## I/O configuration

The configuration of the I/O system is extremely important for the performance of the database. IC can generate thousands of records per second, and all of those records must be written to the database as quickly as possible. A poorly configured I/O system can cause a queuing problem, meaning that the database is not able to keep up with all the records IC is generating. See "I/O Configuration and Design" in the [Database Performance Tuning Guide](#) for more information on the Oracle database documentation website.

Basic principles when considering the drives to use include:

1. When using traditional hard drives, get the highest RPM available, which is 15,000 RPM.
2. Do not get the largest drives available. It is much better to have many multiple smaller drives than a few large drives. Having a larger number of drives allows the I/O to be spread out over more devices. Drives smaller than 100 GB are ideal, though they may be hard to find. Stay away from drives that are 500 GB and larger.
3. If the storage system is a Storage Area Network (SAN), it is vital to work with the SAN administrators to set up the SAN for database performance.
4. Solid State Drives (SSD) can achieve remarkable I/O rates, though they are very expensive.

*Oracle Automatic Storage Management* may be considered. See the Oracle documentation for more information about this feature.

Configure the server with a minimum of four (4) physically separate data storage arrays, and allocate them as follows:

1. Array1 - Operating system.  
Use RAID 1 or RAID 10.
2. Array2 - Application tablespaces (one for tables and one for indexes are required).  
Use RAID 10.
3. Array3 - REDO tablespace.  
Use RAID 1 or RAID 10.
4. Array4 - TEMP tablespace.  
Use RAID 0, RAID 1, or RAID 10.

RAID 5 is not recommended because of the high amount of writes that CIC generates. For databases with extremely high volume and throughput, consider placing indexes and tables onto separate arrays. In addition, potentially large tables such as the tracker tables `IntxSegment` and `Intx_Participant` may benefit from having their own tablespaces.

## Database size

1. Use the database space planning spreadsheet, `IC_DB_SpacePLanning.xls` (available in the CIC .iso file and in the PureConnect Documentation Library) to calculate, and then configure, the size of the CIC database. The computation should include the number of years of data planned to be kept in the database. Allow sufficient and constant free space in the application, TEMP and REDO tablespaces.
2. Allow tablespaces to grow automatically (as a safeguard), but use a suitably sized growth increment.

## Database maintenance

Refer to *Oracle Database Administrator's Guide* on <https://docs.oracle.com> regarding database maintenance and tuning.

# Hardware

## CPU

When selecting a CPU for the server, select one with a large L2 cache. This is especially important for multiple-processor servers. Select at least a 1MB L2 cache for one or two CPUs. Four or more CPUs should have at a least 2MB L2 cache in each CPU. The greater the L2 cache, the greater the server's CPU performance because it reduces the amount of wait time experienced by the CPU when reading and writing data to main memory.

Simple, single table queries and updates, along with query joins on small tables take minimal CPU processing power. On the other hand, large joins, aggregations, and sorting of large result sets use a high level of CPU processing power. Keep this in mind when choosing the hardware configuration for the Oracle database server.

## Memory

In most cases, the more physical RAM Oracle has the greater Oracle's performance. If possible, purchase enough RAM to hold the largest database table in memory. If such a purchase is not possible during the initial setup, leave room for adding more RAM at a later date. **We strongly recommend running the 64-bit version of Oracle with a minimum of 4 GB RAM.** Systems with high performance demands should be prepared to use up to 128 GB RAM or more.

To take advantage of Oracle's ability to run parallel queries, plan on investing on more RAM. Parallel queries use much more RAM than non-parallel queries.

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## AWE

If Oracle is running on a 32-bit Windows box, consider using Address Windowing Extensions (AWE) to increase the amount of memory available to Oracle. Normally, 32-bit CPUs can only support up to 4GB of RAM because of limited address space. Oracle supports AWE to bypass this limitation and allows up to 64GB of RAM to be addressed. See the [Oracle Database Installation Guide 11g Release 2 \(11.2\) for Microsoft Windows](#).

**Note:**  
64-bit Oracle is recommended.

## Drives

Avoid locating read-intensive and write-intensive activity on the same drive or array. For example, do not locate an OLTP and an OLAP database or heavily random and sequential activity on the same physical device. Whenever a drive or array has to change back and forth between activities, efficiency is lost.

NTFS-formatted partitions should not exceed 80% of their capacity. For example, a 20GB drive should never hold more than 16GB. NTFS needs room to work, and when capacity exceed 80%, NTFS become less efficient and I/O suffers. Consider creating a system alert to indicate when an array exceeds 80% of capacity so that immediate action can be taken to correct the problem.

## I/O and RAID

Use hardware-based RAID rather than software-based RAID because the latter can't offload the work to a separate processor, making it much slower than a hardware-based RAID solution.

Do not store the operating system, application software, or databases on single disk drives because they do not afford any fault tolerance. Instead, always choose a RAID array made up of three or more physical drives that offers fault tolerance. Common fault tolerant RAID configurations include RAID Level 1 (mirroring or duplexing) and RAID Level 10 (also called 1+0, which includes both striping without parity and mirroring). Non fault tolerant RAID configurations include RAID 0 which is simple disk striping. RAID 0 offers excellent performance, and can be used for the TEMP tablespace. Each of these RAID levels offers different performance levels. Ideally, if the budget allows, chose RAID Level 10, which offers both high-speed and fault tolerance.

## I/O controller

Select the best I/O controller possible. Top-notch controllers offload much of the I/O work onto its own local CPU, freeing up CPU time on the server to do other tasks. For the ultimate in I/O controllers, consider a fiber channel connection instead of a SCSI connection. The controller should have the largest amount of cache RAM possible, with a minimum of 128mb of cache RAM. Generally, the greater the RAM cache on the controller, the higher the performance of the overall I/O, because data can be read ahead and stored in the cache, even if the data is not currently requested by Oracle. The data Oracle wants next from the array will likely be in the cache, speeding up data access.

Do not put DAT, DLT, CD-ROM, scanners, or other non-hard disk devices on the same I/O controllers that connect to the hard disk arrays. In addition, do not put hard disks on the same I/O controller if they have different speeds. Putting devices with different speeds on the same I/O controller slows the faster devices. Always put slower devices on their own I/O controller.

For maximum I/O throughput, assign each type of major I/O activity (database, REDO tablespaces, TEMP tablespaces, etc.) to its own separate RAID controller and dedicated RAID array.

## OLTP vs. OLAP

If the budget does not allow for the ideal number of disk controllers and hard disks to maximize the server's I/O performance, remember that optimal OLTP I/O is achieved by increasing disk reads and writes. The best way to do this is to add more hard disks to the array(s) that hold the database files and/or transaction logs. Adding more disks helps OLTP-based applications more than increasing the number or speed of disk controllers would, because OLTP-based applications tend to be limited by the number of transfer operations (read/writes) rather than bandwidth.

However, for OLAP-based applications, adding more and faster disk controllers to the array is generally a better way to boost I/O than increasing the number of disk drives, because OLAP applications tend to be more limited by bandwidth than by read/write operations. Adding faster or more disk controllers increases the bandwidth and helps to remove any bottlenecks.

## I/O testing

There are several utilities available to test I/O subsystem performance. We recommend Oracle's Orion tool.

## Networking

If the Oracle database server is not connected to a switch (as recommended for best performance), try the following suggestions for boosting network performance.

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### Network protocols

For best performance, Oracle should be running on a dedicated server. Limit the number of network protocols installed on the server, because unnecessary network protocols increase overhead on the server and send out unnecessary network traffic. For the best overall performance, only install TCP/IP on the server.

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### Routers

While not always possible (especially for WANs and Internet connections), try to avoid a router between Oracle clients and Oracle. In particular, avoid routers between two or more Oracle servers that need to communicate with each other. Routers are often a bottleneck for network traffic and can affect Oracle client/server performance. If Oracle must communicate over a router, ensure that the router has been properly tuned for maximum performance.

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### Network cards

The Oracle database server should have a minimum of one 100Mbps network card, and perhaps two. Two cards can be used to increase network throughput and to offer redundancy. In addition, the network card(s) should be connected to full-duplex switched ports for best performance.

Be sure that the network card(s) in the server are set to the same duplex level (half or full) and speed as the switched port they are connected to (assuming they are connected to a switch and not a hub). If there is a mismatch, the server may still be able to connect to the network, but network performance can be significantly impaired.

Do not rely on network cards or switches that are supposed to auto-sense duplex or speed settings, because they often do not work correctly. Manually set the duplex and speed for the card from the operating system, and if necessary, manually make the same

changes to the switch.

Windows allows network cards to save energy by going to sleep when they are not used. If any network card on a production server has a power management feature, ensure that the power savings feature are off. Otherwise, unexpected results, such as a network card that fails to wake up, or intermittent performance problems, may occur.

Check to see if the network card has a power management feature by viewing the **Properties** sheet for the network card's driver. View the **Power Management** tab on the **Properties** sheet, to verify the settings.

# Software

The network libraries chosen during Oracle installation can affect the speed of communications between the server and its clients. Of the three key network libraries, TCP/IP is the fastest and Multi-Protocol is the slowest. Due to the speed advantage, use TCP/IP on both the servers and clients. Do not install unused network libraries on the server, because they will contribute unnecessary overhead.

## Critical patch updates

We recommend staying current with Oracle Critical Patch Updates (CPUs). Information about CPUs can be found [on Oracle's Critical Patch Updates and Security Alerts site](#).

## Services

Do not install any unnecessary Oracle services.

## File structure and distribution

Place the database files and REDO files for all production databases on separate arrays to isolate potentially conflicting reads and writes. This means that the server will have at least two physical RAID arrays, one to store the database files, and a separate one to store the REDO files. The operating system can be stored on a mirrored set of drives. Use separate storage areas for TEMP tablespaces and the operating system.



# Third-party (Application) Access to Database

Be wary of allowing users to directly access the databases (especially OLTP databases) with third-party database access tools, such as Microsoft Excel or Access. Many of these tools can wreak havoc with database performance. Here are some reasons why:

- Often these users aren't experienced with these tools, and create overly complex queries that eat up server resources. At the other extreme, their queries may not be complex enough (such as lacking effective WHERE clauses) and return thousands, if not millions, of unnecessary rows of data.
- This reporting activity can often lock rows, pages, or tables, creating user contention for data and reducing database performance.
- These tools are often file-based. This means that even if an effective query is written, the query is not performed at the server. Instead, the entire table (or multiple tables in the case of joins) must be returned to the client software where the query is actually performed. This leads to excessive server activity, and can play havoc on your network.

If users must be allowed access to the data, limit hits on the production OLTP databases by pointing them to a "reporting" server that is replicated or in the form of a datamart or data warehouse.

## Change Log

The following table lists the changes to the *CIC Database Configuration and Maintenance for Oracle Technical Reference* since its IC 4.0 GA release.

Date	Change
01-August-2014	Updated documentation to reflect changes required in the transition from version 4.0 SU# to CIC 2015 R1, such as updates to product version numbers, system requirements, installation procedures, references to Interactive Intelligence Product Information site URLs, and copyright and trademark information.
04-September-2015	Updated documentation to reflect rebranding in CIC 2016 R1.
17-January-2017	Updated Copyright and Trademark information for 2017.
17-January-2017	Updated location for the database space planning spreadsheet, in the CIC Resource Center.
03-April-2017	Removed obsolete content from "Networking" topic.
11-May-2018	Rebranded from Interactive Intelligence to Genesys.
12-June-2019	Reorganized the content only, which included combining some topics and deleting others that just had an introductory sentence such as, "In this section..."

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