Design and Implementation of a Distributed Database System for the Central Bank of Iraq Using Oracle

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***ABSTRACT**:*
This paper is concerned with design and implementation of a distributed database system for Central Bank of Iraq purposes. Two-tier client/server model has been used to implement the proposed systems architecture which consists of twelve clients spread over office which are connected together through a local area network (LAN) by using three hubs which spread one hub at each floor of office see figure2. Partially replicated databases technique has been used to distribute database. The designed distributed system is homogenous and uses Windows XP operating system and Oracle10g software to implement, connect, and manage the database, whereas user screens and reports have been designed using "Oracle Forms Builder 6i" and "Oracle Reports Builder 6i" respectively. The system has achieved data protection against unauthorized access using combination of passwords and user roles, in addition to providing mechanisms for data loss protection through import and export mechanism. The system has applied in achieving some of the distributed systems goals like transparency, connecting users, and sharing resources.

I. INTRODUCTION

Distributed computing is one of the most recent and important development in the computing era. During recent times we have seen the rapid development of network and data communication technology. With the combination of these two technologies, databases are moving away from a simple centralized model and changing to a decentralized concept to meet the requirements of computing speed, performance, cost effectiveness and increasing the reliability that are not meet by Centralized Computer systems [1][2].Distributed system is a piece of software which ensures that a collection of independent computers that appears to its users as a single coherent system. A distributed database system consists of a collection of sites, each of which maintains a local database system. Each site is able to process local transactions, those transactions that access data only in the single site. In addition, a site may participate in the execution of global transaction, those transactions that access data in several sites. Execution of global transaction requires communication among the sites. Goals of distributed systems**:** Connecting resources and users, distribution transparency, Openness and Scalability [3].Distributed system can be connected physically in a variety of ways such as file server, peer-to-peer model and client-server architecture. In client server model, server does most of the data management work. This means that all query processing, transaction management and storage management is done at the server. Client server has many model such as two-tier client/server model which is simplest client/server architecture, also called multiple-client/single-server approach where database is stored on only one server. Processing is split between the client and the server, and there is much less data traffic on the network. In three-tier client/server some databases can be stored on a client PC's own hard drive while other databases that the client might access are stored on the LAN's server. In multi-tier approach, the client PCs and servers known as application servers, and other servers known as database servers. It is more sophisticated client/server architecture where there are multiple serves in the system (the so-called multiple-client/multiple-server approach). There are three types To communicate between server and its clients which are Remote Procedure Calls (RPC), Remote Data Access (RDA) and Queued Message Processing (QMP) [3][4][5] .

II. ANALYSIS AND DESIGN OF DISTRIBUTED SYSTEM

2.1.Requirements Analysis: Before designing any system requirements of the work should be analyzed .Therefore, requirements analysis are a very important step in order to form a complete idea of the system to be designed. Methods used in collecting data are Personal interview, questionnaire or referendum, observation, record Searching and appreciation Estimation. During the process of

analyzing the system and knowing reality of work in the Iraqi Central Bank ,it was concluded the following matters: First: -CBI includes the following departments: (Department of Human Resource Management, Department of Public Accounts, Department of Current Accounts, Department of Issuance ,Department of Computer, Department of Internal Supervision, foreign exchange Department, Department of Banking, Department of Legal).

Second: - systems that are currently working in the bank is a group of independent systems in different languages are as follows:

1. FoxPro language system manages work of departments of current accounts, public accounts and issuance via LAN network.
2. Integrated Central Bank System(ICBS) is purchased from Lebanese company and it is under test yet .It does not meet requirements of the Bank's work exactly because it has been designed according to the general world standards system . also it is very expensive because it is just executive system does not contain programs and any update requires huge amounts of money and travel to Lebanon. Finally it adds complexity and delay of the daily work
3. Microsoft Access system to regulate reports to clearing house system.

    The multiplicity of systems and independence has led to confusion and duplication of work daily as following:
1. after end of the work of clearing house, credit and debit documents are configured for each participant bank and then handed to the computer employee to be entered to the FoxPro system and also to the ICBS
2. forms of central deposit check is entered to the FoxPro system in two stages :the first one is entered account number and form number and the amount of the form and the second stage is entered its checks at different screen.
3. forms of bank deposit check is entered in stages as: Group of checks are sorted manually according to banks and are entered to Microsoft Access system and print a report for each bank , then printer employee prints debit and credit forms for each bank based on reports of Microsoft Access System , after that handing these forms to computer employee to be entered to the FoxPro system to update balances of banks, than the completion of all forms are delivered with the credit or debit form in addition to the Access report to a representative of the bank
4. the same previous steps are entered to ICBS .
5. final total of form of the deposit check does not appear at monthly reports which are printed by ICBS .
6. At FoxPro system, dual forms between current accounts and public accounts is entered in two stages: First:- employee of current accounts enters its own entity. Second:- employee of public accounts enters its own entity.
7. At FoxPro system ,current accounts system has two copies of system in which one for Iraqi dinar currency and other copy for U.S. dollar currency
8. Complexity of the input of ICBS compared with FoxPro system, for example, The ICBS account number consists of 16 digits either FoxPro consists of 6 digits only.
9. At ICBS, data entry process is slow in spite of input speed feature of the Oracle.
10. At FoxPro system, emergence of either increase or decrease fils of the final balance in monthly reports of current accounts .
11. At ICBS, there is no final summary report for the CBI work which final totals include the work of current accounts and public accounts and the Fund in order to match the movements and ensure the authenticity of the daily work.

The goal of this paper eliminates disadvantage of these systems and groups their advantages in on complete distributed system for Iraqi Central Bank.

2.2.Database Design:we use Top-down design that is started by identifying the data sets, and then defining the data elements for each of those sets. This process involves the identification of different entity types and the definition of each entity's attributes. Database design usually splits the design phase into two parts logical and physical design.

2.2.1.Logical Design: It shows a general view of the structure of the system and its basic components. Results of logical design include series of charts and data.

2.2.1.1.Specifying Entities and Their Attributes: After analyzing requirements of the work**,** we identify the following: (17)entities for current accounts system ,(4) entities for public accounts system, (5) entities for fund system, (5) entities for treasury system, (3) entities for vacations system, (5) entities for individual issues system, (4) entities for Security system, (2) entities for clearing house system and (7) entities for salary system. Here we show entities of current accounts system as:

1- Iraqi balance entity (CACMAS):It contains all information of accounts and the balances with Iraqi dinar currency. It is essential entity and contains account number as primary key(PK).It includes following attributes:(account number, account name, global account number, account state, account nature, account open date, open balance, current balance, account type, branch number, currency type).
2- Dollar balance entity (DCACMAS):It is similar to attributes of Iraqi balance entity (CACMAS) ,but it is for U.S. Dollar currency
3- Iraqi daily movements entity (CACTRAN):It Includes all types of movements which are entered during daily working for the Iraqi dinar currency. It contains account number as foreign key(FK). It includes following attributes:(account no., check no., movement date, movement nature, office no., movement amount, check document no., currency type, document no., branch no., movement type).
4- Dollar daily movements entity (DCACTRAN): It is similar to attributes of Iraqi daily movements entity (CACTRAN),but it is for U.S. Dollar currency
5- Iraqi historical movements entity(CACHIST): It Includes all types of movements which are entered during current year for Iraqi dinar currency. It contains account number as foreign key(FK).It's attributes are similar to Iraqi daily movements entity (CACTRAN).
6- Dollar historical movements entity(DCACHIST): It is similar to attributes of Iraqi historical movements entity(CACHIST),but it is for U.S. Dollar currency
7- Iraqi old historical movements entity(OLD_CACHIST): It Includes all types of movements which are entered during past years for Iraqi dinar currency. It contains account number as foreign key(FK It's attributes are similar to Iraqi daily movements entity (CACTRAN).
8- Dollar old historical movements entity(OLD_DCACHIST): It is similar to attributes of Dollar old historical movements entity (OLD_DCACHIST), but it is for U.S. Dollar currency
9- Iraqi total accounts entity (CACGLOBAL):It includes total accounts numbers for Iraqi dinar currency according to type of accounts. It contains global account number as primary key(PK). It includes following attributes:(global account no., global account name).
10- Dollar total accounts entity (DCACGLOBAL):It includes total accounts numbers for U.S. dollar currency according to type of accounts. It contains global account number as primary key(PK). It includes following attributes:(global account no., global name).
11- Check books entity(CHEKBOOK): It includes information of check books which are given to banks. It contains account number as foreign key(FK). It includes following attributes:(account no., book no., first check no., last check no.).
12- Suspended checks entity(STOPCHEK): It includes information of checks which are prevented from drawing for different reasons. It contains account number as foreign key (FK). It includes following attributes:(account no., check no., suspended date).
13- Exchange price entity (PAY_RATE): It includes daily price of exchange U.S. dollar currency according to Iraqi dinar currency. It includes following attributes:(pay price, pay date).
14- Movement type entity(TRAN_NAM) : It includes code and name of each type of movement. It contains code as primary key(PK). It includes following attributes:(movement code, movement name).
15- Branch type entity(TYP_NAM): It includes types of all current accounts. It contains code as primary key(PK). It includes following attributes:(account code, account name).

16- Debit form entity (DOC_NUM): It includes information of debit forms which are daily given to each bank after end of work of clearing house. It contains current account as foreign key(FK). It includes following attributes:(account no., document no., document date, numeric number, written number).

17- Branches names(MSRF_FR):It includes odes and names of all banks branches. It contains primary key(PK). It includes following attributes:(branch code, branch name).

2.2.1.2. Structures of Entities: We show structure of Iraqi balance entity (CACMAS) and Iraqi daily movements entity (CACTRAN) as example.

Table 1:Table of Iraqi Balance Entity (CACMAS).

Name of attribute	Programmed name	Type	Length	Key
Account number	ACCNO	NUMBER	7	PK
Account name	NAME	CHAR	75	
Global account number	GLOBACC	NUMBER	7	
Account state	ACCSTAT	NUMBER	1	
Account nature	ACCNAT	NUMBER	1	
Account open date	STARTDATE	DATE	8	
Open balance	OPENBAL	NUMBER	(30,3)	
Current balance	CURNTBAL	NUMBER	(30,3)	
Account type	ACCTYPE	NUMBER	3	
Branch number	BRNO	NUMBER	5	
Current type	MONYTYPE	NUMBER	3	

Table 2: Table of Iraqi Daily Movements Entity (CACTRAN)

Name of attribute	Programmed name	Type	Length	Key
Account name	ACCNO	NUMBER	7	FK
Movement number	TRAN	NUMBER	10	
Movement date	DOCDATE	DATE	8	
Movement type	TRANCODE	NUMBER	1	
Office account no.	ACCNO2	NUMBER	7	
Movement amount	AMOUNT	NUMBER	(30,3)	
Check document no.	DOCNO2	NUMBER	10	
Movement type	TYP	NUMBER	3	
Currency type	MONYTYPE	NUMBER	3	
Movement no.	DOCNO	NUMBER	10	
Branch no.	FR	NUMBER	3	

2.2.1.3 **Relations Between Tables:** Type of used relation is one to many(1:M). There are relations between current account entities as: Primary key (account no.) of Iraqi balance entity (CACMAS) is connected to foreign keys (account numbers) of following entities:(Iraqi daily movements entity (CACTRAN), Iraqi historical movements entity(CACHIST), Iraqi old historical movements entity(OLD_CACHIST), Check books entity(CHEKBOOK), Suspended checks entity(STOPCHEK), Debit form entity (DOC_NUM)) . Primary key(global account code) of Iraqi total accounts entity (CACGLOBAL) is connected to foreign key (global account code) of Iraqi balance entity (CACMAS). Primary key(account code) of Branch type entity(TYP_NAM) is connected to foreign key(account type) of Iraqi balance entity (CACMAS). Primary key(movement code) is connected to foreign keys(movement type) of following entities:(Iraqi daily movements entity (CACTRAN), Iraqi historical movements entity(CACHIST). Primary key(account cod) of Branches names(MSRF_FR) is connected to foreign key(branch no.) of Iraqi daily movements entity (CACTRAN). Primary key (account no.) of Dollar balance entity (DCACMAS) is connected to

foreign keys (account numbers) of following entities:(Dollar daily movements entity (DCACTRAN), Dollar historical movements entity(DCACHIST), Dollar old historical movements entity(OLD_DCACHIST), Check books entity(CHEKBOOK), Suspended checks entity(STOPCHEK)) . Primary key(global account code) of Dollar total accounts entity (DCACGLOBAL) is connected to foreign key (global account code) of Dollar balance entity (DCACMAS). Primary key(account code) of Branch type entity(TYP_NAM) is connected to foreign key(account type) of Dollar balance entity (DCACMAS).

2.2.1.4.Relationship Modeling: We model entities and their relationships as show in bellow Fig(1).
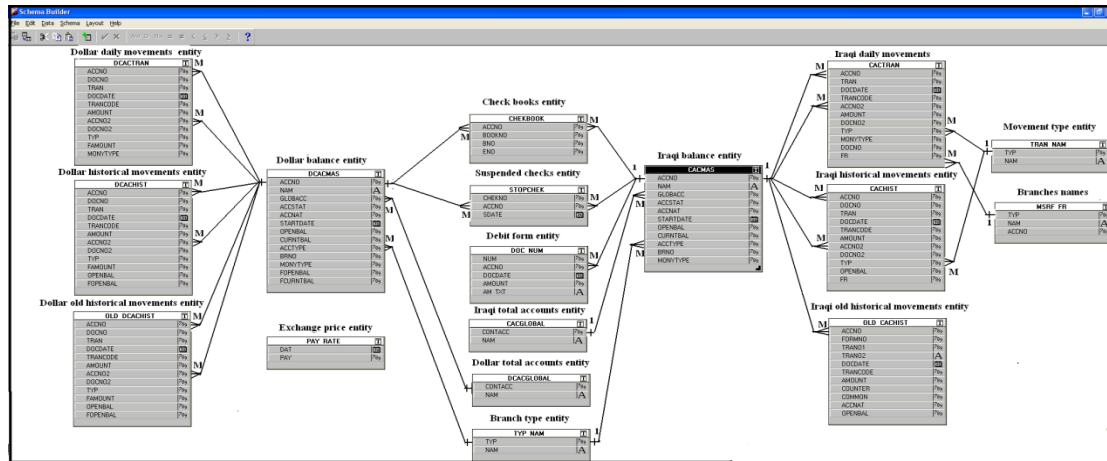

Figure1: Modeling of Entities and Relationships of Current Account System

*2.2.1.5.Method of Distribution***:** Finally decide on the method of distribution where we use replication mechanism for partially replicate tables of vacations, individual issues, clearing house, treasury ,fund and salary systems in which we have copy of tables on server and local clients.

*2.2.2.Physical Design***:** After logical design we determine the physical structure of the database; in order to enable computer programmers to create programs to design a working distributed system.
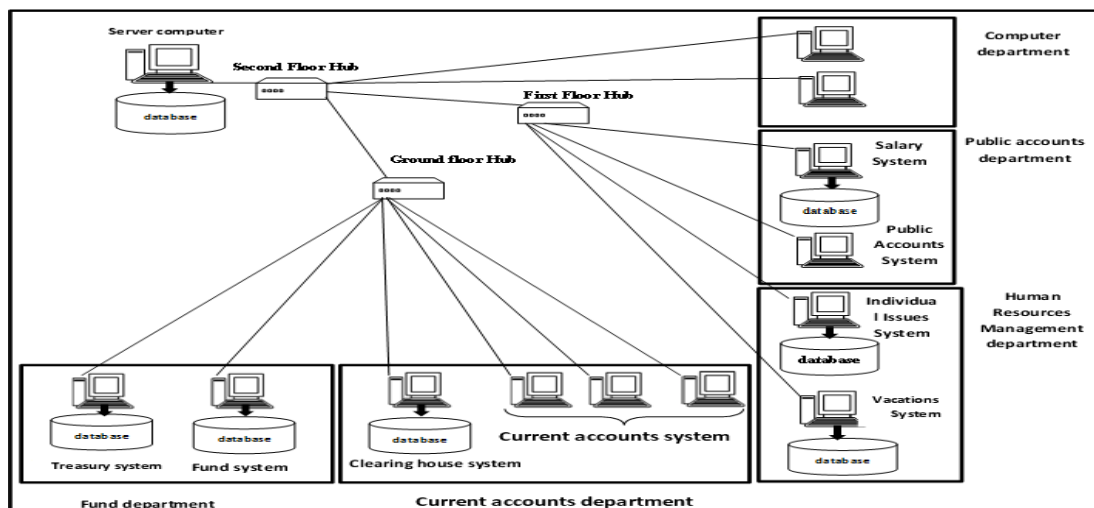

Figure2:Architecture of proposed distributed system of central bank

Figure(4) show the structure of proposed distributed system for Iraqi Central Bank. We need to three hubs, the first one is considered as a central hub because we use star topology to connect Iraqi Central Bank's LAN network. Central hub is located at second floor which serves second hub at first

floor and third hub at ground floor. Also we need server computer to serve distributed system which contain global database called "BANK_DB" that contains (55) tables of all Central Bank systems. Finally we need twelve computer devices which six computer of them considered as clients without local databases for current account department, public account department, and computer department. Where other six clients computer considered as clients with local data base for human resource management department, clearing house, treasury system, fund system, salary system. After preparing all devices of distributed systems we must configure these devices as: We install server computer by Windows Server 2003,Oracle database 10g and Oracle Developer 6i then create administrator user to build all tables of systems. Also we identify IP , host name, workgroup for server. Whereas clients computer is installed by Window XP , Oracle Developer 6i,and Oracle database 10g only for clients should hold local database. Then we configure listener at server to listen for all clients order, after we sure that connection inside network is proper work we create databases links which use to connect between distributed databases on clients and global database "BANK_DN" on server .Then we build applications of all systems depending on Oracle Forms Builder which contains Triggers and Program Units that help programmers to build all necessary codes and depending on Oracle Reports Builder to build all required repots.

III. IMPLEMENTATION OF THE SYSTEM:

At this step, we execute distributed system of Iraqi Central Bank from any client connect with proposed distributed system network by open icon called "Central Bank of Iraq", then we enter name and code privileged user which is identified by security system to give high security for all systems.
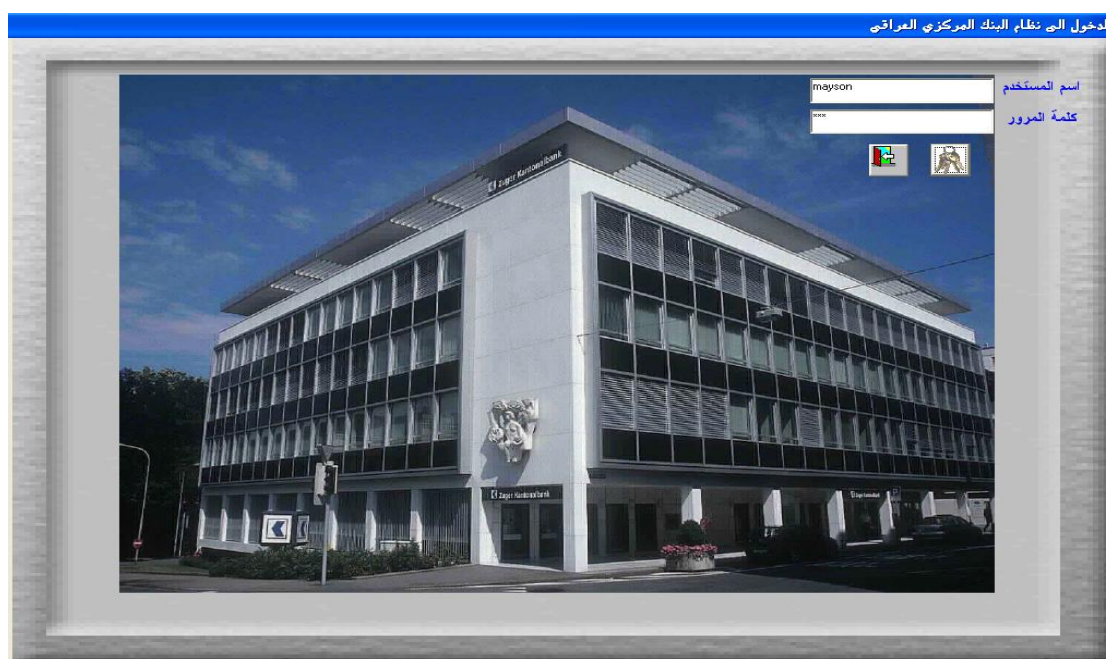

Figure3:Entering form of Iraqi central bank

If name and code of user is true then forms in Fig(4) appears to enable user entering to required system as his privilege.
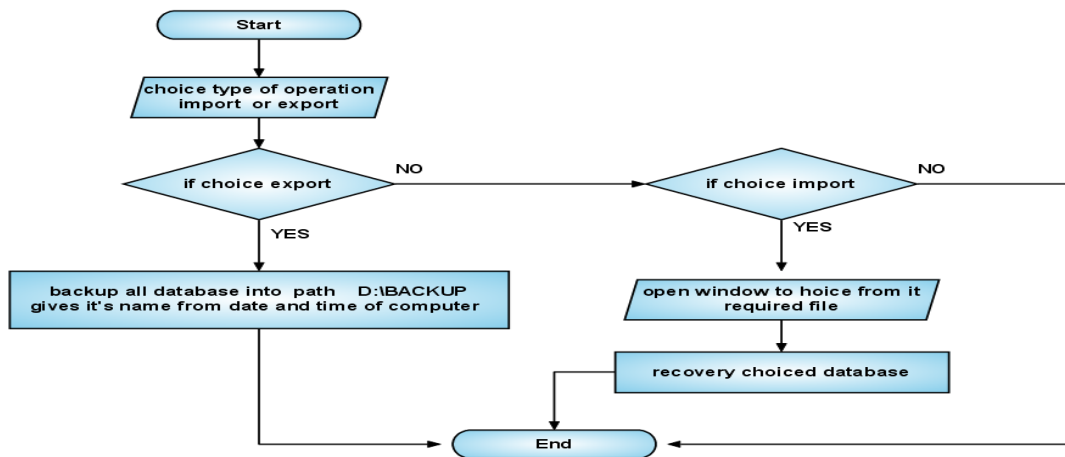
*Figure4:*Main form of Iraqi central bank

IV.   Maintains of the System:

This process continues throughout the life of the system to make sure of proper working as well as modifying the system to align it with the new requirements of the work environment, such as changing laws, regulations and business rules.

V.   Export/Import:

The Oracle export and import utilities are the most primitive method of sharing data among databases and are also used as part of a backup and recovery strategy. Import is the utility that reads this file and executes the SQL statements to re-create the objects and populate tables. A full database export creates a file that you can use to re-create the entire database.Figure() show how we are programed export and import technique

figure(5) import and export of Iraqi central bank

VI.   CONCLUSIONS

After designing, implementing and applicating a distributed database system in the Central Bank of Iraq, we conclude that the analysis of the existing system in the organization before you begin the process of system design and move to right step from logical to physical design within the structure of the system has had a perfect impact on the proper and effective representation of databases. The proposed system has succeeded to achieve its own objectives of design and representation of distributed database for Central Bank and distribution of tasks on more than one site which led to the speed of work and reduce the burden of processing, using Oracle and its software accessories because its possession of specialized tools for this purpose. Also it has high security through a privilege system that can be grouped in the form of roles granted to users smoothly as well as the application distribution technologies such as replication technology. System has succeeded in achieving the basic concepts of distributed systems such as transparency, connecting users and resources with each other, as

well asits ability for daily backup of the database. Using a trial period for the system helped to limit errors and added new requirements of users that occurred during the work and correcting path of the system to accept different views of the beneficiaries to become a computer system acceptable to work where it has achieved data sharing among the different units, and facilitated follow-up daily business and access to information , reports, and periodic extraction of statistics easily and quickly, which helped to save time and effort

VII. RECOMMENDATIONS

The search resulted in a set of recommendations for the work which can be implemented in the future as follows:

1 - Extend the distributed system to connect branches of the Central Bank of Iraq, which are branch of Mosul, Basra, Erbil, Sulaymaniyah and Bagdad via WAN network.
2 – Extend distributed system to connect service of clearing house system of the Central Bank of Iraq with all existing banks via WAN network.
3 - Design and programming distributed system to control on banking via Internet, which allows Central Bank of Iraq to follow the banks works through a central control system where database is stored in the CBI.

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