

Integration and Implementation of Information Systems in Large Scale – Bringing Efficiency in the Ministry Levels in Bangladesh

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Abstract: *The aim of this paper is to implement the Information System through integrated Information Cell at Upazilla (Sub district) in Bangladesh. A centrally controlled, easily accessible, web based large scale data (government information) integration and manipulation can bring accountability, transparency and efficiency in different departments of government organization and can provide scale of information access to the root level people in Bangladesh.*

Keywords- *Information Cell, e-Governance, Round Robin Load Balancing, ASM Clustered pool.*

1. Introduction

Government of Bangladesh has launched National Portals [1] that integrates all Departments. However, accessing to the portal is limited to literate people who can use Computer and can access to Internet. Therefore, necessary action should be taken to distribute Information to the root level. Information wait for none, even though the different Government and NGOs have started to train up illiterate people, it is long way to train them first and then they will be able to use and access the Information. That's why Information Cell should be set up where literate trained up people can help root level people to access and gather information right now.

The objectives of the Research are to set up Information Cell and distribute / store information at Upazilla-level instead of national web server to balance the load.

To implement the information system accessible to public and private sector by the year 2021 to build the digital nation, Bangladesh Government has been working with the help of domestic and international organizations to improve its

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accountability and management in all levels [2]. Government has passed a Bill on Public Private Partnership Act where lot of private and Non Govt. Organizations have been working in this regard. Integrating the information required by all Departments in Public and Private Organizations nationwide is the goal of this research work. This paper discussed the present status of the governmental organizations. Analysis has been done on the performance of handling large scale of data.

Fully functional Information System has been designed in this research for the semi-root level of Governmental Financial & Managerial Unit: Upozila.

2. Information Cell

Correct information is the fundamental component of success in any field. Everyone has the right to know the fact for better accountability and assessment. But accountability is not available in most cases in our country. Because of the unavailability of information in a common place or media, different governmental organizations in Bangladesh do not share information.

In fact a country is developed when more of its activity is transparent. The developed countries have changed their status in such a way that every organization, such as Govt. Organization, NGO, different institutes and private organizations get their required information whenever they need as the data are stored and controlled by specific agency.

The application of information technology has an impact upon individual, the functional unit and the organization as a whole. These applications can be placed into three categories: i) improve efficiency, ii) effectiveness and iii) facilitate transformation. Efficiency means doing things right. Effectiveness means doing right things that need to be done to achieve the goal. The information system can help the officials to be more effective. The third objective of applying information technology is transformation- using information technology to change the way of conventional system. This means changing the nature of the service being delivered in a functional unit. At the individual level, applications of information technology impact efficiency, effectiveness, and transformation. An individual can use a word processing program, for example, to automate retyping letters.

These applications are designed to improve efficiency by providing automated tools to support specific tasks.

Different public and private organization needs different kinds of information. At present in our country information is collected by each sector separately. That's why information duplication happens as well as huge revenue is wasted. Other than collecting information by each individual organization separately it would be better if an organization could be specified only for collecting and processing data for all users. This Information Cell will build a database where all the information regarding individual person or organization in any specific area will be stored and according to the requirement different organizations may collect necessary information. As the responsibilities of the organization will be

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collecting information, the correct data will be stored without biasness. If any wrong data is stored, people can challenge and thus the real transparency will govern the society in a right way.

3. Implementation of the System

Bangladesh has a unitary form of government. For the convenience of administration, the country is divided into seven Administrative Divisions: Dhaka, Chittagong, Khulna, Rajshahi, Barisal, Sylhet and Rangpur which is further subdivided into Districts. The rural/regional local government as proposed by the latest commission on local government would have eight tiers listed in Table 1 [10].

Table 1: Demographical statistics of Bangladesh

Divisions	7
Districts	64
Upazilla	500
Administrative Thana	509
City Corporation	6
Municipalities	309
Thana	599
Union	4,498

A. Local Government Finances

Local bodies in Bangladesh are in constant shortage of funds. The sources of their income are generally taxes, rates, fees and charges levied by the local body as well as rents and profits accruing from properties of the local body and sums received through its services. Contribution from individuals and institutions, government grants, profits from investments, receipts accruing from the trusts placed with the local bodies, loans raised by the local body and proceeds from such services are another source of income governments may direct to be placed at the disposal of a local body. Holding taxes is the most important source of own income of local bodies. Loans and voluntary contributions are rare. Urban local bodies rise between 55-75 per cents of the revenue from their own source while a significant proportion comes from government grants. Nowadays, foreign or international project funds also contribute a significant share of a corporation's budget. [3]

B. Implementation

The information cell should be build nationwide. It should be started from the grass-root level; the union level. In the first phase the system can be started from a specific union of a specific upozila with a computer and little manpower. On the way to build Information cell at the upozila level, the project member needs to be experienced and should face different problems. When all the information will be collected and stored in the database at the union cell office the project will be extended to the other union of that specified upozila.

In the second phase, when information cell will be built at all the unions of the specified upozila, a central information cell office will be set up at the upozila center whose name might be "Upozila Information Center". All the information of individuals of the specified upozila will be stored in the database. Each Upazila will be connected to a common website to share data through its own database. Some useful functional and managerial information on individuals and organizations has been listed in Table 3.

Table 3. Functional & Managerial Information

Individual	Organization
1. Personal	1. Administration
2. Land properties	2. Law & Order
3. Educational	3. Tax
4. Professional	4. Judicial
5. License	5. Registration
6. National ID	6. Ministry label
7. Passport	7. NGOs
8. Mobile Phone	8. Different Services
etc..	etc..

C. Time period to Implement

It took an entire year to make the village users accept the system, as they had no previous exposure to the technology. The kiosk manager had to establish a relationship of trust in the villagers and increase their confidence in the potentials of technology. As several villagers are illiterate, there has to be great emphasis on the levels of trust between them and the kiosk manager. The kiosk managers therefore have to bear multiple roles to: (a) familiarize users with the

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technology; (b) manage the kiosk; and (c) collect and send feedback from the user to the main office at the district level that develops the content of the system. The user can access information from the local web server.

In the third phase all the Upazilas of the specified district will be covered under the proposed project. Gradually information cell will be built in all the districts.

In the fourth phase the proposed project will follow the following processes:

1. A central DNS (Domain Name System) Server will be created which will handle all the incoming web site users' requests.
2. A common user interface will be used in all the web servers (Upazila and Central Web Server)
3. Configuration will be created according to the DNS Round Robin load balancing [7] according to the Figure 3.
4. DNS Server will forward the requests among the different central servers using Round Robin algorithm.
5. DNS Server will be connected with all the centrally connected web servers.
6. Every Central Web Server will connect with central single database instance
7. All the central single database instances will create a database cluster called RAC (Real time Application Cluster) [9].
8. ASM (Automatic Storage Management) cluster in an ORACLE RAC environment where ASM provides a cluster pool of storage shown in Figure 1.
9. There is one ASM instance for each node serving multiple Oracle RAC or single-instance databases in the cluster.
10. All of the databases are consolidated and sharing the same two ASM disk groups.
11. ASM disc group automatically manages the storage system.
12. The ORACLE database cluster will act as central unique central server.
13. Every single user requests will be forwarded to the link of the local (Upazilla) web server.
14. Every local web server will have their own database server for the local Upazilla people information storage.

4. Technical Specification

Abstract model of Information System at Upazilla level is shown in Figure 1. The centrally controlled Information System where data can be accessed from the ministry level and the Upazilla level.

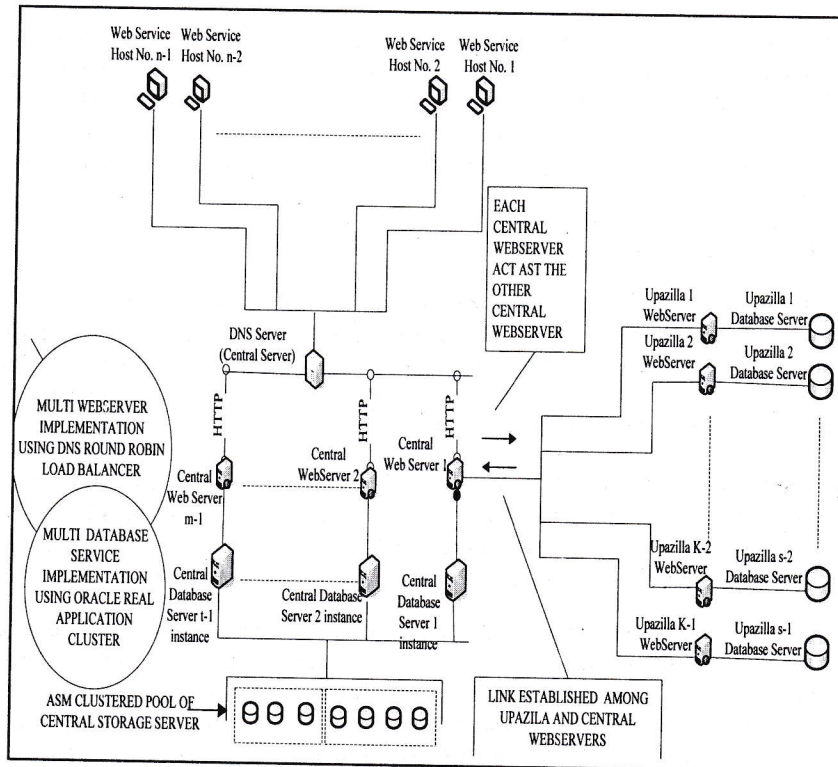


Figure 1. Abstract view of Upazilla Level Information System

To balance the load of the huge user hit, Round Robin Algorithm are used in the DNS (Domain Name System) [11] to maintain the large scale data in the ministry level, Multi Server and Multi Database Environment plan have been suggested. How the central web servers are connected with the Central Database servers (Central Database Server 1 instance, Central Database Server 2 instance....Central Database Server t-1 instance) to store the ministry level information of the government is shown in Figure 1. The Upazilla level Database servers (Upazilla1 Database Server, Upazilla2 Database Server....Upazillas-1) have been set up for accessing Upazilla level information. Every Upazilla of the country is connected with the central DNS Server. Every end user (Bangladeshi citizen) can view his personal information with limited permission from his own Upazilla. The government authority has the full control over the system to access all the data from the entire system. The data entry will be performed by the government authorized personnel. When multiple users (web service host no.1, web service host no.2,...web service host no. n-1) will hit the central server simultaneously, the load will be distributed across multiple central web servers using round robin fashion to allow use of multiple HTTP servers (with identical contents) in order to distribute the connection loads. The central web server is responsible to send the packet of information to the requested Upazilla web server to access Upazilla database information. End user can access the

information pool by giving his birth certificate number or national identity number. To maintain the large scale data ASM technology is used where Oracle ASM provides the facility to share access to the disk group which enable new empty data disk to add or remove without interrupting the existing storage system. All the functional parts are automatically performed by Oracle ASM system.

A. Load Balancing

To balance the load of the huge client request, Round Robin DNS server has been suggested [8]. In "round-robin" DNS, a random IP address will be returned with each request if multiple entries exist in the DNS. The purpose of round robin is to allow use of multiple HTTP servers (with identical contents) in order to distribute the connection loads.

Round-robin is not random, though it gives a random effect [6]. It operates in a round-robin fashion (as the name implies), it rotates the return record sequence by one for each response – one address is handed out, put at the end of the list, and then the next one is handed out for the next translation request.

One of the advantages of having the round-robin translation is to able to take one of the server systems out of the loop for maintenance. A simple removal at the nameserver level from the round-robin list allows almost no apparent loss to the client systems (except for those that cache). As a result the load will be distributed across the different web server. Chances of Web server crashes will be reduced drastically [8]. The disadvantage is also possible to confuse the user, while one system fails, it appears to the user as intermittent failure because the service appears to come and go. So, once connected, a user is less likely to report a failure.

B. Automatic Storage Management (ASM)

In the Information System model, Oracle RAC (Real Application Cluster) with ASM has been used. Oracle RAC is a key component of Oracle's private cloud architecture. The major benefits of the RAC database system are scalability and high availability. A RAC database system provides excellent scalability options for the users. As the need arises, users can expand or add the number of nodes in the cluster. This enhances the total database engine computing power when the need for high performance arises. With the additional nodes and instances in the database cluster, the system is able to accommodate demands. If a lot of processing is going on in one of the instances, the applications accessing the database through that instance can be shifted to another instance. Thus, the processing or activity can be dispersed [9].

ASM is configured in the RAC cluster. ASM and database instances require shared access to the disks in a disk group. ASM instances manage the metadata of the disk group and provide file layout information to the database instances. ASM instances can be clustered using Oracle Clusterware; there is one ASM

instance for each cluster node. If there are several database instances for different databases on the same node, then the database instances share the same single ASM instance on that node. If the ASM instance on a node fails, then all of the database instances on that node also fail.

Unlike a file system failure, an ASM instance failure does not require restarting the operating system. In an Oracle RAC environment, the ASM and database instances on the surviving nodes automatically recover from an ASM instance failure on a node. ASM automatically generates ASM file names as part of database operations, including tablespace creation. ASM file names begin with a plus sign (+) followed by a disk group name [5].

5. Analysis on the Simulation

The simulation is taken to study the effect of large scale data that hit on the website for different numbers of simultaneously user access. Java, Apache web server, and Oracle (10.g) software tools were taken in order to get the performance study of the system. The load balance strategy, the effect of a web server without load balancing and a web server with load balancing have been analyzed in the simulation. Performance curves obtained for load balancing and non load balancing websites in simulation environment.

Figure 2 describes the visiting path of a web request. The response time (full cycle visiting time) is found when a web request completes its routing from source to destination path. A full cycle of a web request performed when client gets his feedback from the server as per the request. At first the request of the client is passes to the DNS server, and then DNS server forwards this to the web server, finally web server requests the database server to answer the query of the client. After getting the query result it is again forwarded to web server. Then web server back the request to the DNS server and after that it is passed to the client. Lowest response time is desired for every system, but response time depends on some factors.

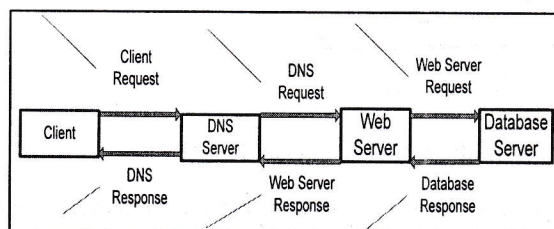


Figure 2: Full Cycle response time

Figure 3 shows response time increases with the increased number of hop index for the single client when the cycle is completed without load balancing. The

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simulation result is obtained from www.uits.edu.bd website which does not follow load balancing strategy. Response time increases automatically when a user from the distant place accesses the website via multiple hops. When distance user access simultaneously through multiple hopes, the response time increases and at the same time there is a possibility of website crash due to unlimited load of data request.

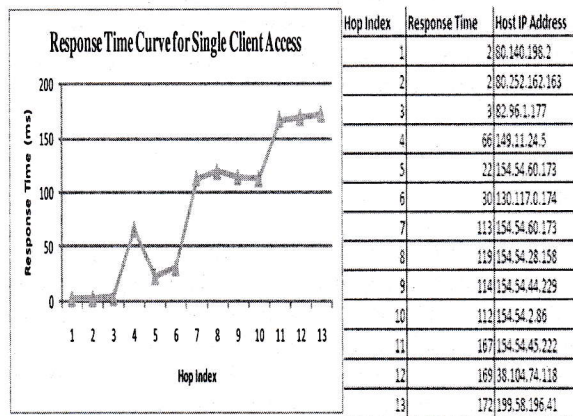


Figure 3: Response time for No Load Balancing Figure

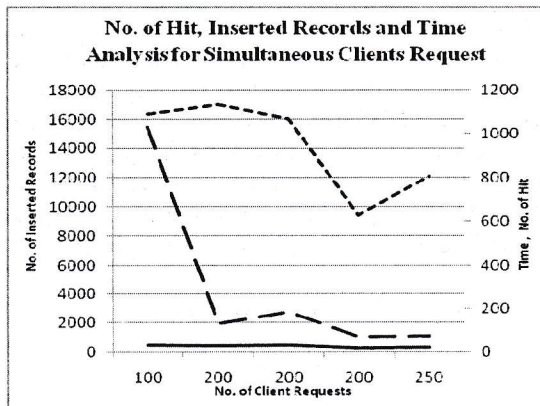


Figure 4: Performance study of Success and Fail Hit

Random number of user hit on the web server for the simultaneous requests to the database is taken for simulation. Figure 4 is generated with three types of performance measurement. The dotted line represents the number of client requests versus record inserted time, which implies the simultaneous number of client requests proportionate to the probability of web server crash. The dashed line represents the number of client requests versus number of hit on the web server which implies the number of hit increases with the increase of client

requests. Also implies the web server failure hit may occur with the increase of simultaneous client requests with the increase of the of web server hits. The solid line represents the number of client requests versus response time that indicates the number of client requests increase, the response time of the requests decreases with the decrease of the number of hits. When the hit will be increased the response time will be increased which prone to the web server crash. The whole performance graph shows that the simultaneous requests to the server (Web, Database) increase the rate of server failure.

The full cycle time versus hit index for the single client requests in a load balancing environment is shown in Figure 5. Full cycle time for a web request is the sum of request time and the feedback time. The underlying curve implies that Performance becomes stable as the load balancing is initiated. As the hit index or number of hits increases the full cycle time or response time become balanced and stable. The stable situation also helps to manage the web server crash through round robin load balancing technique.

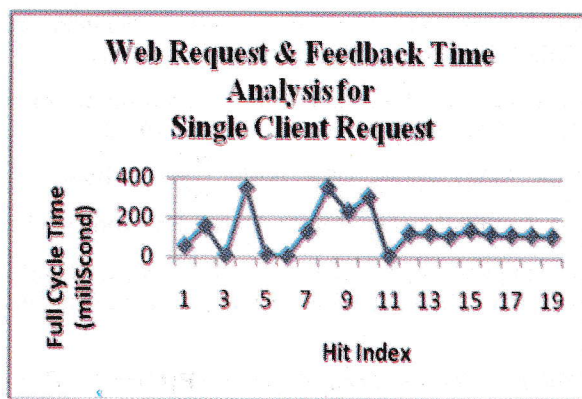


Figure 5: Full Cycle visit time of web request

6. Conclusion

Bangladesh Government has been trying best to achieve its goal towards digital Bangladesh. In order to achieve the goal one step forward, (i) a unique digital information system is needed which is efficient and effective for accessing the correct information at the root level people in Bangladesh (ii) every organization, such as Govt. Organizations, NGOs, different institutes and private organizations must share the required information whenever needed as the large scale of data are stored and controlled by government authority.

In this paper, a centrally controlled, easily accessible, web based large scale data (government information) integration and manipulation of information system is proposed and implemented. The proposed system is implemented through integrated Information Cell at Upazilla (Sub district) in Bangladesh to achieve the aforementioned goals towards digital Bangladesh.

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During the planning and development of the information cell in Bangladesh, functionalities of the Cells have been considered. Since large scale of data needs to be maintained in the server, simulation has been done on load balancing of the system and thus some key factors have been proposed.

7. References

- [1] National Web Portal of Bangladesh, URL: <http://www.bangladesh.gov.bd>
- [2] Access to Information (a2i) Programme, URL: <http://www.a2i.pmo.gov.bd/content/innovation-fund-a2i>
- [3] Bureau of Statistics, Statistical Division of Ministry of Planning, *2000 Statistical Year Book of Bangladesh*, BGP Bangladesh Government Press, Bangladesh, 2001.
- [4] Ministry of LGED, *Annual Report on current status and development of local Government*, Bangladesh Government Press, Bangladesh, 2001.
- [5] Prasad Bagal, Mark Bauer and Eric Belden, *Oracle® Database Storage Administrator's Guide, 11g Release 1 (11.1)*, Part Number B31107-05
- [6] Ron Aitchison, *Pro DNS and BIND*, Apress, USA, ISBN: 1-59059-494-0
- [7] T. Brisco, *DNS Support for Load Balancing*, Rutgers University, April 1995
- [8] International Technical Support Organization, Austin Center, *Load-Balancing Internet Servers*, An IBM Redbooks Publications, First Edition, December 1997.
- [9] Revision A, *Oracle Solaris Cluster Data Service for Oracle Real Application Clusters Guide*, Part No: 821- 2852-10, May 2011
- [10] Bangladesh Bureau of Statistics, *Statistical Pocket Books-2009*, Bangladesh Government Press, Bangladesh, 2010.
- [11] Luis Aversa, Azer Bestavros, *Load Balancing a Cluster of Web Servers Using Distributed Packet Rewriting*, Boston University, 1999.