Chapter V

COMPARATIVE PERFORMANCE, SUMMARY AND CONCLUSION

5.0: Introduction

Performance of different data communications methods has been performed with various factors. These factors are several in numbers. Data transfer methods in the views of streams like Telecommunication and Electronics engineering has been carried out. Here we have studied various Distributed Systems and observed the performance in the view of computer science and Computer application based aspects.

The performance of the Distributed Systems are having heterogeneous challenges as suggested by George Coulouris, Jean Dollimore, Tim Kinderberg, 2004 and Verlekar Rukhama and Apte Varsha, 2005. These are:

- Computer hardware or hardware devices
- Operating systems
- Telecommunication medias
- Network architecture

This chapter presents the performance observed in Wired and Wireless Network Based Distributed Systems, Hyper Terminal Based and Data Logger Based Distributed System and Web Based Distributed Systems. Here we have used different computer systems and networking medias. The operating systems used are windows XP and Windows Vista. The chapter incorporates the summary drawn after presenting the wired and wireless NBDS, HTBDS and DLBDS, WBDS in the form of chapters II, III and IV. The summary is followed by the conclusion which was felt by us. We also stated certain suggestions. The chapter is concluded by stating, how does the present research work can be extended for further study purpose.

5.1: Tools Used

The performance tool used is from windows control panel of administrative tool under the name Performance. This tool measures the performance by selecting performance object where the various counters are tested [Nedier Janvier Senat, 2006]. Based on the experimental results, we have observed the Bandwidth, Data
transfer time and other requisite performance parameters for Wired and Wireless (NBDS, DLBDS and Web Based) Distributed Systems [Peter A. Dinda., 2006].

5.2: Performance Objects and Applications of Wired and Wireless Network Based Distributed System

To measure the performance of various wired and wireless Distributed Systems there is need of selection of performance object. The different performance objects and networks used in each wired and wireless Network Based Distributed System are mentioned in the Table 5.1.

Table 5.1: Comparative Study of Performance Object used in the Wired and Wireless Network Based Distributed Systems

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Network Based Distributed System (Wired and Wireless)</th>
<th>Network Used</th>
<th>Performance Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>LAN Based</td>
<td>Local Area Network</td>
<td>Network Interface</td>
</tr>
<tr>
<td>2.</td>
<td>WLAN Based</td>
<td>Wireless LAN</td>
<td>Network Interface</td>
</tr>
<tr>
<td>3.</td>
<td>Comport Based</td>
<td>Comport connectivity</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Bluetooth Based</td>
<td>Bluetooth Connectivity</td>
<td>-</td>
</tr>
<tr>
<td>5.</td>
<td>Wi-fi Based</td>
<td>Wi-fi Network</td>
<td>Network Interface</td>
</tr>
<tr>
<td>6.</td>
<td>Internet Based</td>
<td>Internet</td>
<td>IP</td>
</tr>
<tr>
<td>7.</td>
<td>Wireless Internet</td>
<td>Wireless Internet</td>
<td>IP</td>
</tr>
<tr>
<td>8.</td>
<td>Wi-Max Based</td>
<td>Wireless Telephone Network (CDMA)</td>
<td>-</td>
</tr>
</tbody>
</table>

We observed the different parameters for each wired and wireless NBDS but each system have certain limitations in its usage, economical aspects, coverage, safety and other requisite aspects of data communication. The observed performance suggests us the usage of each wired and wireless NBDS and its application in Healthcare Communications as mentioned in Table 5.2
Table 5.2: Applications of wired and wireless Network Based Distributed Systems in Healthcare communications

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Network Based Distributed System (Wired and Wireless)</th>
<th>Application for Healthcare Communication between</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>LAN Based</td>
<td>Departments of PHCs/THOs/DHOs with in campus.</td>
</tr>
<tr>
<td>2.</td>
<td>WLAN Based</td>
<td>Departments of PHCs/THOs/DHOs with in floors of same building.</td>
</tr>
<tr>
<td>3.</td>
<td>Bluetooth Based</td>
<td>Departments of PHCs/THOs/DHOs with in campus.</td>
</tr>
<tr>
<td>4.</td>
<td>Comport Based</td>
<td>Departments of PHCs/THOs/DHOs with in campus.</td>
</tr>
<tr>
<td>5.</td>
<td>Wi-fi Based</td>
<td>From Department1 of THO, DHO to Department2 of THO, DHO</td>
</tr>
<tr>
<td>6.</td>
<td>Internet Based</td>
<td>A solution for Global Access for Data Transfer and Processing where Internet connectivity is available.</td>
</tr>
<tr>
<td>7.</td>
<td>Wireless Internet</td>
<td>A solution for Global Access for Data Transfer and Processing where Internet connectivity is available.</td>
</tr>
<tr>
<td>8.</td>
<td>Wi-Max Based</td>
<td>From PHC, THO, DHO to another PHC, THO, DHO at other campus.</td>
</tr>
</tbody>
</table>

5.2.1: Limitations and Cost

When we compare the wired and wireless NBDS, HTBDS and DLBDS with DWB model, we found the following limitations:

- Systems designed doesn’t provide the feature called Global Access
- Cost is high for all other Distributed Systems other than DWB model
- Data is insecure
- Unable to maintain authenticity

*It is observed that, the average time required for communication by using the LBDS, WLBDS, CBDS, BBDS, WFBDS, WMBDS is more and cost is high.*

5.3: Performance of Hyper Tool and Data Logger Based Distributed System

Performance of HTBDS is measured by using “Process” as Performance object. To measure the performance of DLBDS system, we have used different communication medias as networks. The networks used for the DLBDS System are mentioned in Table 5.3
Table 5.3: DLBDS System and Networks used

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Distributed System</th>
<th>Network Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Data Logger Based Distributed System</td>
<td>Wired and wireless Network</td>
</tr>
<tr>
<td></td>
<td>without computer</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Data Logger Based Distributed System</td>
<td>LAN</td>
</tr>
<tr>
<td></td>
<td>with Computer (Wired Network)</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Data Logger Based Distributed System</td>
<td>WLAN</td>
</tr>
<tr>
<td></td>
<td>without computer (Wireless Network)</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Hyper Terminal Based Distributed System</td>
<td>Wired Telephone Network</td>
</tr>
</tbody>
</table>
| 5.      | Wireless Hyper Terminal Based Distributed System | Wireless Telephone Network |}

It is observed that, the time required for 1MB data transfer is 1.16 min/MB and for 5 KB data time is 0.25 sec of Wired DLBDS. And the time required for data transfer of 5 KB by using wireless DLBDS is 1.26 sec.

5.4 : Performance Study, Access Time And Access Time for Text of Web Based Distributed System : DWB Model

Performance of Web Based Distributed System: DWB model is measured in two ways.

- Testing of DWB model by using the HTTP or web browsing method.
- Using performance tool of windows XP

For performance measures, we have selected various sub modules of DWB model. The time is one of the important parameter selected for performance measurement. The DWB model is Web Based Distributed System which is developed as Internet Application and it Distributed Computations [Robert Losee and Lewis Church, 2004]. The DWB model is based on client server architecture. The communication between client computers and server is carried out by using the web based network. Here in present study, we didn’t considered the traffic on the internet. Parameters selected for the performance measurements are:

- Time of Testing
- Access Failure
Abort Rate
Access Time
Access Time to Text

Table 5.4 shows the performance parameters and their status for the submodules of the DWB model.

Table 5.4: DWB Model: Testing

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Module</th>
<th>Access Time (Sec.)</th>
<th>Access Time to Text (Sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PHC</td>
<td>2.43</td>
<td>2.41</td>
</tr>
<tr>
<td>2</td>
<td>THO</td>
<td>3.72</td>
<td>3.57</td>
</tr>
<tr>
<td>3</td>
<td>DHO</td>
<td>2.51</td>
<td>2.46</td>
</tr>
<tr>
<td></td>
<td>Average Time (Sec.)</td>
<td>2.88</td>
<td>2.81</td>
</tr>
</tbody>
</table>

Here we observed that, the average access time required to text in DWB model is 2.81 sec and access time is 2.88 sec.

5.5: Parameters Selected for Performance Study of Distributed Systems

The parameters used for the comparative study are according to James McCabe, 2004 and Sting Jarle Fjeldbo, 2005 are:

- **Bandwidth**: It is a measure for bytes/sec which are transmitted or received over the network. e.g. from PHC to DHO and vice versa.

- **Coverage**: It indicates that, how much area will be covered during communication between any two terminals of Distributed System? e.g. PHC1 and PHC2.

- **Communication**: Mode of communication is DHO area. It is one way or two way. That is from PHC to any other unit and vice versa.

- **Cost**: The cost of system is considered here as the cost required for the construction or development by us for the Distributed Systems.

- **Equipments used**: The equipments used comprises with major components used for the setup of Distributed System and communication medias or networks used for the data transfer operation of healthcare units.

- **Scalability**: It is the ability of the Distributed System which will be available while no. of computer will be added in the present system of healthcare.
- **Reliability**: During the failure due to external or internal disturbance if the system works as per the required goal then we feel it becomes reliable. It can be high or low.

- **Delay**: It is time between data sent by sender computer and the data received by the receiving computer. It can be high, low or medium depends on wired and wireless technology used in design of systems.

- **Availability (in rural area)**: Does the Distributed System can be made available completely or limited to its working functionalities in non urban i.e. rural areas where the PHC and DHO units are located.

- **Availability**: Presently the availability stands for the status of overall functionality of Distributed System in the non remote places where DHO and THO units are located. This can be either completely or limited.

- **Power Consumption**: This shows that, the status of consumption of electricity by the Distributed System. It depends on type of Distributed System. (wired and wireless NBDS, DLBDS, DWB Model).

- **Environment friendly**: This parameter is used in the view of generation of less pollution by consuming high power of electric charge e.g. NBDS. When less power is consumed by the Distributed System, we feel that, the pollution becomes less and Distributed System will be environment friendly e.g. DLBDS and DWB model.

**5.5.1: Comparative Performance Study of Wired And Wireless NBDS, HTBDS, DLBDS and DWB Model**

The comparative performance study of wired and wireless NBDS, HTBDS, DLBDS and DWB Distributed Systems studied in Chapter II, III, and IV is as mentioned in the Table. 5.5.
Table 5.5: Comparative performance study for Wired and Wireless NBDS, Hyper Terminal and DLBDS & DWB Model : Distributed Systems

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Distributed Systems : Communication Networks Parameters</th>
<th>Network Based Distributed System</th>
<th>Hyper Tool and Data Logger Based Distributed System</th>
<th>Web Based Distributed System : DWB Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bandwidth</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>2.</td>
<td>Coverage</td>
<td>With in buildings</td>
<td>Any two offices where telephone line is available.</td>
<td>Any two offices where Internet connectivity is available.</td>
</tr>
<tr>
<td>3.</td>
<td>Communication (Interaction)</td>
<td>Two way</td>
<td>One way</td>
<td>Two way</td>
</tr>
<tr>
<td>4.</td>
<td>Cost</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>5.</td>
<td>Equipment used</td>
<td>Computers, Switch, Network medias</td>
<td>Computer, Modem, Telephone, Simulation Software</td>
<td>Computer, Modem, Telephone, Internet Service, Application software</td>
</tr>
<tr>
<td>6.</td>
<td>Scalability</td>
<td>Scalable</td>
<td>Not Scalable</td>
<td>Scalable</td>
</tr>
<tr>
<td>7.</td>
<td>Reliability</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>8.</td>
<td>Delay</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>9.</td>
<td>Availability (In Rural Area)</td>
<td>Complete</td>
<td>Complete</td>
<td>Complete where Internet connectivity is available</td>
</tr>
<tr>
<td>10.</td>
<td>Availability</td>
<td>Complete</td>
<td>Complete</td>
<td>Complete</td>
</tr>
<tr>
<td>11.</td>
<td>Power Consumption</td>
<td>Normal</td>
<td>Less</td>
<td>Normal</td>
</tr>
<tr>
<td>12.</td>
<td>Environment friendly</td>
<td>Up to Some Extent</td>
<td>Completely</td>
<td>Up to Some Extent</td>
</tr>
</tbody>
</table>

5.6: Network Selection For Healthcare Communication

A) Healthcare Communications for Rural Users:

The HyperTerminal telephone Network Based Distributed System and DLBDS are better and can be optimum solutions amongst other Distributed Systems for data transfer operations as part of Healthcare Computing, wherever the Internet connectivity is not available as suggested by Jadhav B. T. and Patil P.P. 2010a.
b) Healthcare Computations For Urban Users:

The urban based users should be well benefited by accessing the Web Based Distributed System because DWB model is acting as global resource based on the Internet which is an example of Distributed System.

So we feel that, any web based system will perform better in all the ways as compared with other non web based Distributed Systems.

5.7: Summary

The software tools developed by the researcher at various systems are:

1) Wired Network Based Distributed Systems

The Wired network Based Distributed System, Comport Based Distributed System are useful at departmental communication of PHC, THO and DHO in the same buildings in a same location. IBDS is useful for communication between THO/DHO and THOs/DHOs in other districts or PHC.

2) Wireless Network Based Distributed Systems

The Wireless LAN Based Distributed System, Bluetooth Based Distributed System are useful at departmental communication of PHC, THO and DHO in the same buildings in a same location. Wi-Fi Based Distributed System is useful for departmental communication between THOs. Wi-Max Based Distributed System is useful for communication between THO/DHO and THOs/DHOs in other districts or PHC.

3) HyperTerminal Telephone Network Based Distributed System

Data file transfer by using hyper terminal telephone network is the optimum techno social solution in the remote & rural areas where internet connectivity is very low or not available [Dennis Michalntyre, 2003]. This mode of data transfer is more secured and remains economical.

4) Data Logger Based Distributed System

Data Logger Based Distributed System is useful to all the PHC centers where internet connectivity is not available. It is observed that:

- The system is very much economical
• It provides various facilities for file transfer, storage and retrieval type of data operations.
• As the DLBDS, device is smaller in size, it occupies less space.
• The construction cost is less
• It also consumes limiting power hence we feel that, it may be eco friendly device of Distributed System

DLBDS has some limitations such as: It allows us only to create the data file and to open and process the file contents. But it is not useful for editing.

5) Web Based Distributed System

For non rural applications where the internet connectivity is available with satisfactory speed, we suggested that the Distributed Web Based model plays the vital role in data transfer, processing and decision making type of tasks. This system is economical and user friendly. It becomes a communication environment. This is not only useful for data transfer operations but also the system provides information about various facilities for healthcare related issues. In addition to this, the system is optimal in usage and cost effective. We also observed that in urban places the web or web based system users growing fastly for communication and efficient data transfer operations.

The web based information systems will be better solution for data transfer & processing of the database contents. It also supports for availability and confidentiality.

The Distributed Web Based System comprises with four modules as:

i) PHC Administration module and Daily work module

This module helps to transfer data from one department of PHC to another department. This minimizes waiting time for users. With the help of this module one can easily process the medical data and the users (doctors) are able to perform decision making based on instant information made available by this tool so as to help needy patients.

ii) Data Transfer module between PHC to THO, DHO units

This module is useful to the users: health officers in the THO and DHO units for data transfer and processing operations. This makes the logical
connectivity between PHC to communicate between the Clients: offices located at long distances physically and server.

iii) **Communication module for THO office to PHC, DHO**

With the help of this module the users at THO office can perform data transfer operation very fast. This module is useful for generating information about various schemes or activities at a glance from the PHCs and summarize it towards DHO.

iv) **DHO module and Administration module**

The main module of the tool is the DHO and its administration module. This module is important for district administration. Because this module plays a vital role in providing information to the district administration of the state government. The module summarizes various schemes available for utilization of funds, grants and other information required.

v) **Guest User**

The guest user is created for the users visits the web application. But due to the security, they are not allowed to input the data and perform other data communication operations presently.

5.8: **Suggested Applications of Distributed Systems in Healthcare Areas**

We suggest some views according to research study followed by us:

1) PHC, THO and DHO units may be supported by client Server Architecture.
2) Stand by Computer systems should be maintained for the backups at healthcare centers.
3) Weekly backup should be followed.
4) The rural units can be well equipped with DLBDS systems where internet connectivity is not available
5) The Govt. should develop healthcare centers with good computing facility and internet connectivity. In this case Distributed System play important role
6) Health related training camps to patients can be organized by using DWB model suggested by us.
7) Functional training to staff can be given using DWB model, a example of Distributed System.
8) The Govt. should promote equity oriented health policy in rural area using Distributed System.
9) Community programs such as National AIDS Control, National Tuberculosis Control can be performed along with NGO’s and social worker with the help of suggested Distributed System.

10) Trainings to encourage villagers about self-care by using DWB model.

11) The advanced PHC service network should be built using Distributed System in order to provide safe, efficient and accessible healthcare services.

12) The medical insurance system should be incorporated to cover all rural residents to reduce the burden of medical expenses and secure their access to the basic medical and healthcare services. For this purpose Distributed System can play a greater role.

13) The feasible health technology should be applied through Distributed System.

14) Linkage with Anganwadis: An updatable weekly service report can be passed to teacher of Anganwadis so that, the people can avail the facility of PHC by providing internet connectivity and supporting tools like HTBDS and DLBDS of Distributed System.

15) A monthly report such as vaccination, schemes, services can be given to Grampanchayat and higher authority so as needy people can be assisted with appropriate service at right time using DWB model of Distributed System.

5.9: Extension of Research Work

After study, we found that communication carried out by using different Distributed System is useful for database files containing text and numerical data only. In future one can give more weight on the following issues.

- **Security**
  Security is better in case of hyper terminal telephone based distributed systems but the traffic is a major limitation.

- **Leased Line**
  We can use a leased line for HTBDS. So one can concentrate on security issue. Web provides an unlimited intelligence but security issues are important.
• **Fuzzy Logic**

In future one can develop Fuzzy Logic Based Distributed System and apply statistical based measures for generation of passwords which will be more secured [John Paynter and Michel Pearson].

• **Integration of Distributed System**

The software tool can be developed at state level for data transfer amongst all the healthcare units in a state, so that all the state govt. departments will get the data about various districts, tahsils, villages in time and further processing and decision making can be done efficiently. So we suggests to design an integrated healthcare system.

• **Ubiquitously Computing**

In the view of above development, in internet applications for remote data accessing and processing of healthcare applications. There may be ambiguity. So one can concentrate on Ubiquitously Computing as explained by Kate Jackson, 2004.

• **Fuzzy Algorithm**

We suggest that, the computing solution in the form of tool based on virtual medical advice may be planned by using Fuzzy Logic algorithm to replace a medical consultation by using the information retrieval tasks as stated by H. Chris Tseng, 2007.

• **Genetic Algorithm**

The Genetic Algorithm can be largely scaled for Internet applications. The performance based on implementation of Distributed System can be tested at various levels.

• **Performance Improvement**

We also feel that the performance of connectionless or wireless network can be improved by comparing TCP performance [Hari Balkrishnana, Venkata Padmanabhan, Srinivasan, Seshan & Ramdy Katzyl].

• **Data Mining**

We suggests that, the Data mining techniques can be used in web based systems development which may advise new mechanism for the improvement of data transfer operations for healthcare communication, data processing and decision making activities.
• Measure performance on Implementation issues

Performance based on implementation issues can be measured by means of putting developed system for real world usage by the PHC, THO and DHO users at large scale.

5.10: Conclusion

This chapter explains the comparative performance evaluation of three Distributed Systems: as mentioned in Chapter II, III & IV. Here we have been studied the different Distributed Systems and measured the performance with various objects and parameters. The applications of designed Distributed Systems are mentioned. Different Distributed Systems are studied by using various networks and performance objects are mentioned previously. HTBDS and DLBDS are studied and the networks are mentioned. DWB model performance is explained in tabular way by considering testing time and other important parameters.

The comparative performance study comprises with parameters such as : Bandwidth, Coverage, Equipments used, Scalability, Reliability, Delay, Availability (for rural users), availability, power consumption and Environment friendly aspects as mentioned in the above said systems. At the end of the chapter, we attempt to show that, how does the urban and rural users will be well benefited with the access of suggested solutions in the form of Distributed Systems.

From research study it is noted that, information to be made available by the PHC to the THO, DHO offices is in various ways. The PHC users are timely updated with the information about recent practices in healthcare and medical sciences. The rural units can be benefited by using the HyperTerminal Telephone Based Distributed Systems as well as DLBDS. This also helps the various user and authorities at different levels to have instant information access about the rural population. By using DWB model researcher identified, what are needs of the rural practitioners. We can also bridge the gap between urban based research centers and the rural PHC’s for the information exchanges as well as to conduct the training programmes for the development of the users : healthcare staff.

We also observed that, the Bandwidth of wired and wireless NBDS, Web Based Distributed System as DWB model in urban area is high. Web Based
Distributed System covers the large area as compared to the coverage of other Distributed Systems. The construction cost of the DWB model is less. Data transfer cost i.e. communication cost of DWB model is very less and is negligible.

The equipments and software’s used for the development of DWB model are easily available. And once the system is developed users can use the model forever which is not possible in case of other Distributed Systems developed.

The DWB model is highly reliable and scalable. The communication delay is less. DWB model is easily accessible wherever the internet connectivity is available. This can be one of the eco friendly tool as like DLBDS. In the view of above said features of DWB model we feel that the DWB model as Web Based Distributed System is good computing tool.

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