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Analysis and Validation of Data access in Federated Database

P L Kishan Kumar Reddy[1*], T.V. Rao[2], A. Ananda Rao[3]

[1]Department of CSE, JNT University Ananthapur, Ananthapuram, INDIA
[1]Vignan University, Guntur, INDIA
[2] Dept. of CSE, KL University, Guntur., INDIA
[3] Dept. of CSE, JNT University Ananthapur, Ananthapuramu, INDIA

[*]*Corresponding Author: lakshman.penubaka @gmail.com, Tel.: +91-94914-58788*

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Abstract— Volumetric data processing demands for a higher degree of robustness in monitoring and controlling the data traffic under the distributed environment. In the process of exchanging the data the issue of handling traffic concurrency is very much predominant. Due to inherent variations in local databases, traffic monitoring and controlling is needed to be robust enough to optimize resource utilization and operational performance of the mining system. The distributed databases contain variant information at different locations of the system. Because of this processing an integrated modelling of these distributed units is required simultaneously to formulate a Federated Database. The issue of concurrency in such systems lead to a dead lock condition and to a system failure. In the proposed work a new monitoring and controlling mechanism for controlling the concurrency of transactions and overcoming the issue of dead lock condition is developed. A probabilistic modelling of concurrent transactions for trafficking is developed.

Keywords— Concurrency, Databases, Distributed units, Monitoring and controling.

I. INTRODUCTION

The introduction of advanced monitoring devices, capturing units, and wireless data exchange lead to a probability of higher buffering of informative data across the globe. However to utilize the recorded information the database is to be integrated in a distributive manner to exchange or retrieve information from any location. In recent developments such distributed databases are integrated together with the objective of exchange of information from any part of the globe by formulating a multi database system called 'Federated Data Base System' (FDBS).

In the process of data exchange over such database concurrent requests of simultaneous transactions are observed. These transactions are lead to a problem of concurrency in such databases. The integration of small local databases is made with the objective of providing information in more informative manner such that the concurrent transactions possess the objective of such system.

To achieve a better optimization of traffic controlling in FDBS, a local and global transaction serialization is developed.

To overcome the concurrency problems, traffic serialization of global transactions is developed. This approach is proposed with a fixed level of transaction during the initialization of the process. When the traffic is dynamic the issue of simultaneous user request leads to a large traffic overhead on the system under such networks. The most of the past works focussed on developing the control operations based on transaction records and serialization order of transactions. A resource allocation based concurrency problem is focused.

Transaction Management in Federated Data Base System

In the transaction management of FDBS a data set, a functional layer of Data Base Management System (DBMS) are used. The layout of such controlling operation is presented in Fig 1. In the process of controlling the concurrency [1] with resource management, different modes of concurrency controlling mechanisms are used at the access layer.

However due to non-linear mode of traffic the buffer management is not optimally controlled. This has lead to concurrency issue at consistency layer. An access control mechanism based on cross layer designing is proposed. In this approach the entire process is done in two phases i.e. traffic discovery and link maintenance. The realization of cross layer approach was done at link allocation stage.

Access Controlling and Allocation

In this phase, the source unit sends the Transaction ReQuest (TRQ) to the entire database [2] to find the availability of resource and send the information to the local server. On receiving the TRQ, the source unit checks for concurrency of transactions, overhead on the system and detect buffer occupancy at the system level. To detect the buffer occupancy at the system level it has to know that the total number of buffer length messages stored in Component

System (CS) layer through Data Access (DA) layer. The functional layer of DBMS is shown in Fig 1.

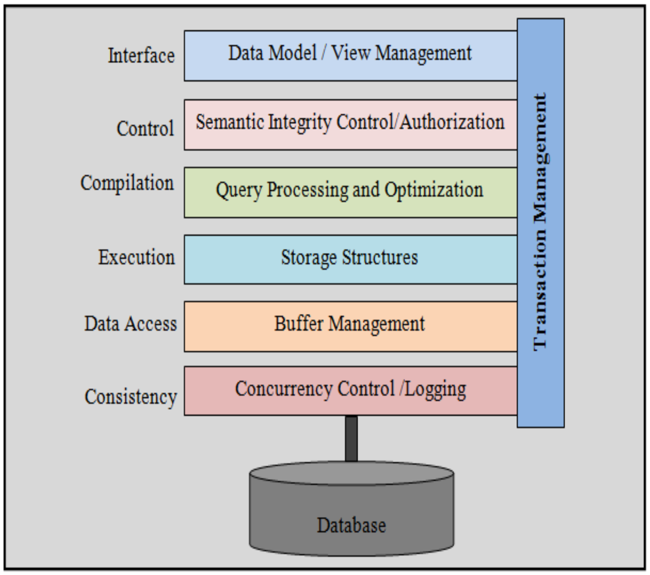

Figure 1 Functional layers of DBMS

The process of allocation layer interacting with the Data Access (DA) layer for buffer length exchange is defined:

1. Reception of DA layer messages from Allocation layer
   - Add DA pointer variable to the Allocation protocol stack.
   - Add an equivalent command function in allocation protocol stack.
   - Add a request command to execute the script.
   - Get DA variable messages for time to time
2. Reception of DA layer messages at CS layer.
   - Add Buffer pointer variable to a DA protocol stack.
   - Add corresponding command function in a DA protocol stack.
   - Add command function in a CS protocol stack.
   - Initialize acquiescent script to deal with the function.
   - Get current unit Buffer length message through the former DA pointer variable.

After receiving the Buffer length, it evaluates the message growth from current level to next level and checks with half of the difference of unit Buffer to total length and current unit Buffer length. If it is smaller than the current growth Value then it means that current growth trend is fast and this may lead to unit concurrency and overhead on the system instantly. After this channel load detection was performed by DA layer's CSMA technology according to the count determined by Busy and Idle states. The concurrency control and system's overhead is carried out using resource control method and rate control methods.

In the resource control method specific existing unit is chosen for allocation which is very close to the source unit. It is detour path method where detour path should be set away from the original path at least two buffer overhead distances and then begin to search an available detour path within two buffer overhead distances away from the concurrency overhead. At the same time the concurrency overhead path should be suspended sending the packets. But in rate control method no work and no concurrency overhead is taken as a strategy for saving the energy. A temporary concurrency overhead perception of backpressure signal BUF is defined and it is set as 1 for concurrency overhead situation and 0 for non-concurrency overhead.

In above method, a data sending upper limit was set. When sending rate reaches to maximum limit and detect no concurrency overhead (BUF=0), then it keeps sending rate to its maximum. If concurrency overhead conditions (BUF=1) are detected then backpressure to the upstream unit will be half rate in sending back to the rate in turn.

The above described forward concurrency overhead detection and concurrency overhead controlling process is done at each and every unit after receiving TRQ. The process checks for the duplication of TRQ and if it is sure to drop the TRQ immediately. Otherwise, it checks for an available forward path towards the dataset. If it is so sure then it will send forward Transaction ReQuest Reply (TRQR) to the source unit and discard TRQ and begin to send the data through this forward path. When a source unit receives a TRQR, it will not stop its forward discovery proceeding until it receives enough number of TRQR. The number of Maximum Allocation Path Count (MAPC) has been set as a compromise factor between transfer reliability and control consumption.

Path Maintenance

This approach will perform the forward maintenance with the modified version of Access protocol. This approach also uses AERR (Allocation Error) to control the message packets and also manage the error messages during the allocation. In the multipath allocation protocol a new allocation discovery process will not start until all the allocation paths gets failed. There is a threshold value "Internet Relay Chat (IRC)" present in source unit to record the count of failure allocation paths. While IRC is equal to MAPC it means that all the paths are failed and a new allocation discovery proceeding is started then IRC will be reset to zero.

The buffer growth is recorded as the difference of the current Buffer point of 'bk' and 'bk-1' as 'Δbk' and a limiting rate of allocated data rate is made to control the flow of data to avoid concurrency overhead. However the constraints for such method are observed as:

1. The rate of data flow is linearly increased to the upper threshold limit 'Ru' and there after it is decreased to half the allocated rate to the control concurrency overhead.

2. The Limit of rate controlling is set towards the upper limit of the buffer length and all the data is buffered to till this limit.
3. The controlling operation is a hard decision approach. It is based on the status of perception of concurrency overhead, back pressure, BUF 'signal'.

Though the approach is simpler this minimizes the computational efforts. There are three observations made for this work which limits to their performances. In the first observation where the control is made based on buffer length and it is decreased to half the traffic flow so as to reduce the concurrency overhead. This leads to the direct half rate reduction and severely effect the quality of the service to higher service oriented applications. The Second observation has made where the limiting rate is set towards maximum buffer value. However such controlling rate leads to the probability of higher unit rejection. As the probability of unit concurrency overhead is high the units will either discard the maximum packets it received or on buffering the Buffer size may completely filled leading to no-traffic flow from the unit. In such case even the decision is based on BUF signal which is either set to '1' or '0' based on the concurrency overhead status which intern control the allocable data rate. These factors are hence required to be improved to achieve the higher throughput [3] with longer unit existence time.

To achieve this objective the proposed work focused on the enhancement of controlling the concurrency and system's overhead based on adaptive rate controlling over the dynamic buffering is proposed.

II. RELATED WORK

Probabilistic Controlling:

In the proposed approach the rate allocation procedure is updated by introducing a probabilistic factor for concurrency overhead. In the process of rate controlled concurrency overhead the control of concurrency overhead is derived by referring to the back pressure at a given unit defined by the BUF-signal as,

$$\begin{cases} BUF = 1, & \text{if overhead is observed.} \\ BUF = 0, & \text{if no.ovrhead is observed.} \end{cases} \quad (1)$$

Based on the BUF status, the allocated data rate is then set as,

$$R_i(t) = \begin{cases} R_i(t) + \Delta r & \text{if } R_i(t) < R_u, BUF = 0 \\ R_i(t) & \text{if } R_i(t) = R_u, BUF = 0 \\ \frac{R_i(t)}{2} & \text{if } BUF = 1 \end{cases} \quad (2)$$

In this approach BUF is set as '1' if the concurrency overhead is observed. Concurrency overhead is observed when the buffer length has reached to higher limit value i.e. L_current≅L_max.

When the stated condition satisfies the Concurrency overhead is detected in accordance to the BUF value that is set. However the status signal is set high at the upper bounding limit of the concurrency overhead. The overhead will reach to Lmax. due to the buffering of the transactions in queue. Hence this approach gives a higher probability of total unit blockage in the network. To avoid such unit of probability failure , an adaptive rate controlling approach which is based on the computed probability of concurrency overhead at buffer, rather to direct Buffer length correlation is proposed .To develop the proposed probabilistic rate allocation a probability on concurrency overhead is computed by setting two limiting values of L_minand L_max as two tolerant values.

The approach of dual tolerance limit reduces the probability of concurrency overhead and provides an initialization of concurrency overhead controlling at a lower stage of data buffering rather to upper limit as in conventional case. In such cases a coding approach where the data rate for the flow of data from the buffer is Ru is defined. The data is buffered into the buffer till the lower limit Lmin is reached. Once the lower limit Lmin is reached the data rate is then controlled on the probability of concurrency overhead at the buffer logic.

The probability of concurrency overhead at the buffer level is then defined as,

$$P_{cong} = \frac{P_{Blk}}{1 - P_{pkt}} \quad (3)$$

Where, P_pkt- no.of packets been transfered,P_Blk-blockage rate.

The blockage rate for the buffer logic is defined as,

$$P_{Blk} = B_{current} - \left(\frac{R_{alloc}}{R_{max} - R_{alloc}}\right) \quad (4)$$

Where, B_current-current blockage rate,R_alloc-allocated data rate.

The current blockage at the buffer level is computed as,

$$B_{current} = \frac{L - L_{current}}{L} = 1 - \left(\frac{L_{current}}{L}\right) \quad (5)$$

Where, L – Total Buffer length and, L_current-current queue length measured.

For such buffer control operation the concurrency overhead control signal BUF is defined into three logical values rather to two values as stated. The BUF signal is assigned with, BUF= (-1, 0, 1), equation 1 becomes,

BUF= 0, No concurrency overhead.

BUF= 1, Max Limit concurrency overhead.

BUF= -1, Concurrency overhead with probability in between Min & and Max limits.

In this case the allocated rate updated by the probability of concurrency overhead and equation 2 is then updated as;

$$R_i(t) = \begin{cases} R_i(t) + \Delta r & \text{if } R_i(t) < R_{u,}\ CON = 0 \\ R_i(t) + (\Delta r - P_{cong}) & \text{if } R_i(t) < R_{u,}\ CON = -1 \\ R_i(t) & \text{if } R_i(t) = R_{u,}\ CON = 0 \\ R_i(t) - \frac{R_i(t)}{P_{cong}} & \text{if } R_i(t) = R_{u,}\ CON = -1 \\ \frac{R_i(t)}{P_{cong}} & \text{if } R_i(t) = R_{u,}\ CON = 1 \end{cases} \quad (6)$$

The data rate allocated for concurrency overhead control based on probability of concurrency overhead will lead to minimization of unit overhead. Due to early initiation of concurrency overhead controlling the buffer queuing is reduced and it resulted in higher traffic flow through each unit. This improvises the overall throughput of the network and intern improves the performance of the network. An evaluation for the network performance is based on the suggested control mechanism is carried out and obtained through observations and are outlined in following section.

Aerial Data Analysis and Its Validation

The different observations are carried out on a data set captured from a long range of Arial data set and passed to the proposed system. The region is divided into distinct regions of isolation where each aerial image is processed for segmented region of location and extracted for local feature coefficients for recognition of the object as shown Fig 2.

In a given distributed environment like the federated database there is every possibility that the hard ware resources may not be used efficiently. This may be because of the failure in the transaction failure. The transactions failures will occur in federated environment very frequently due to its heterogeneity nature. When the transactions are not processed in time then the system will presume that the transactions are held up due to the queuing problem. When the transactions are not processed in time then there will be transaction delay which may affect the correctness of the system. This will lead to the system error and there by the performance of the system in terms of the number of transactions that are processed will be reduced greatly. The different segmented regions of the sample data is shown in Fig 3.

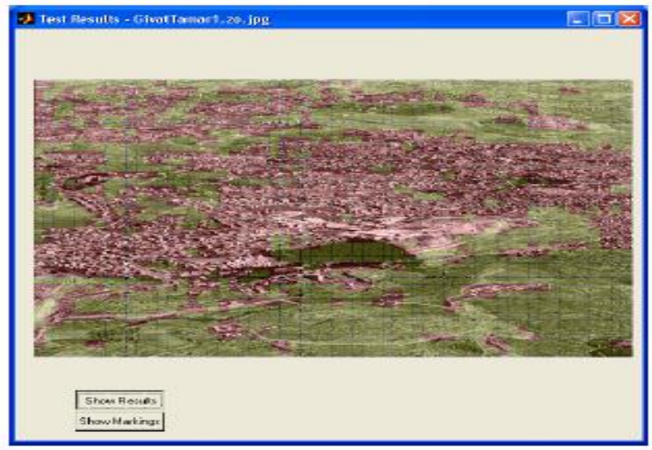

Figure 2 Query sample used for the isolation and recognition using developed system

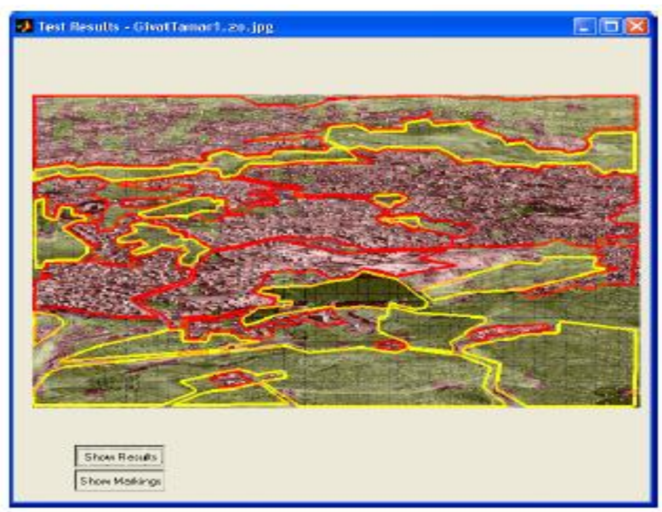

Figure 3 Segmented region of the given query image for recognition

While retrieving the data from different classes of the federated data, percentage of accuracy in retrieval of sample image is shown in Table 1.

Table 1 Classification results of the samples tested

Test Samples	Training samples	Percentage of accuracy	Remarks
S1	150	100	Distinct Class
S2	150	80	Multiple instance of same class
S3	150	66	All Haralick feature used with multiple instance of same class

In the Table 2 an analysis is made between the proposed and existing approach "Content-based image retrieval" (CBIR). It is observed that the proposed approach experienced less system errors compared to the existing approach with respect to the variation in local features of image from time to time.

Table 2 System Error with respect to proposed approach

Time	System Error Methods	
	CBIR-Approach	Proposed Approach
1	210	215
1.5	190	160
2	130	110
2.5	110	85
3	85	75
3.5	75	65
4	65	50
4.5	60	45
5	50	40

It is observed in Fig 4 that the system error is less in the proposed approach compared to the existing approach with respect to the varied time intervals. The system errors may be due to the processing of transactions under conflicts, the hardware failures, transactions under deadlocks where Lamport clocks are not maintained at the global level of local databases.

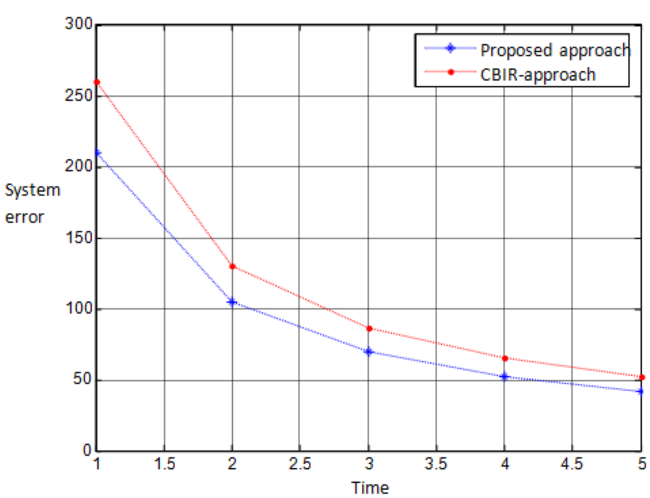

Figure 4 System Error Performance Obtained For the Developed Approach As Compared To Local Feature Based Training

In the federated system recall rate of the transactions will rely on the number o database entries that are made in a specific interval of time. The call rate of the transactions will determine the frequency of the existence of the transactions in the federated system. If the recall rate of the transaction is high the processing of required data will be initiate without any redundancy.

In the proposed approach of the probabilistic approach, the database entries are made without any conflicts among them. The issues of conflicts are reduced or minimized through control clocks in the federated data at its granule level. Analysis has been done on such data of no conflicts and results are realized in the Table 3.The table gives a correlation between proposed approach "probabilistic approach" and the existing approach "CBIR". The probabilistic approach will define the probability of the number of images that appear frequently in a given point of time. This will help the user to identify the redundancy o the objects in the Federated database.

Different values based on the number of images are tabulated in Table 3 to determine the recall rate of transactions in the system. It is observed that the recall rate in the proposed approach "DIA" is high compared to CBIR approach.

Table 3 Recall rate of transactions

Number of Images in Database	Recall Rate Methods	
	CBIR – Approach	Proposed Approach
1	0.05	0.1
2	0.1	0.2
3	0.175	0.3
4	0.2	0.375
5	0.25	0.45
6	0.3	0.575
7	0.375	0.65
8	0.4	0.75
9	0.425	0.8
10	0.50	0.9
11	0.56	1.0
12	0.575	1.15

In Fig 5 the system call rate with respect to the number of images in the database is observed. In the proposed approach it is observed that as the number of retrieval of database images increase the system call rate is increased and the processing rate is increased. This will avoid idleness of the system and thus performance of the system is high.

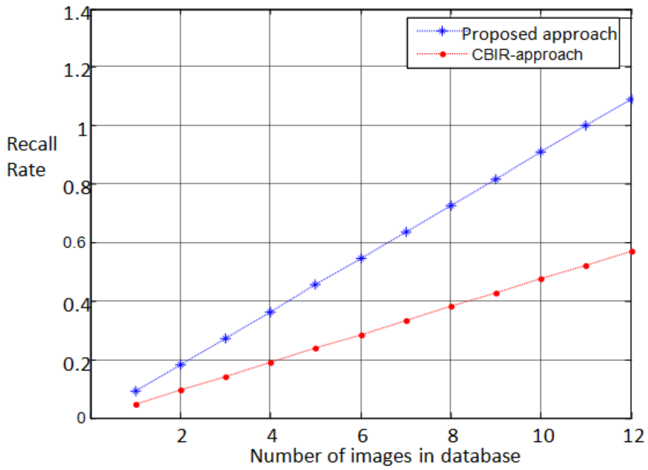

Figure 5 System Recall Rate Obtained for the Developed Approach as Compared to Local Feature Based Training

III. RESULTS AND DISCUSSIONS

To evaluate the operational efficiency of the proposed approach a random distributed Database system is simulated with control mechanism and a probabilistic control approach is proposed and evaluated. For the analysis of the proposed probabilistic based coding approach a distributed network with a node locations are placed in scattered manner are simulated as illustrated in Fig 6.

A distribution of 30 units is simulated. A Set of data packets which need to be forwarded to the data sets are defined. A routing protocol "Routing information protocol (RIP)" is defined to evaluate the path from a given source to the dataset. The paths are generated through the data exchange from source to dataset in a broadcasting manner.

A forward and backward tracing method is applied to obtain the parameters of the path and used for forwarding the packets. Among generated paths, path with minimum buffer overhead is selected for exchange. On exchange of concurrent request over this path the observations are derived as illustrated below.

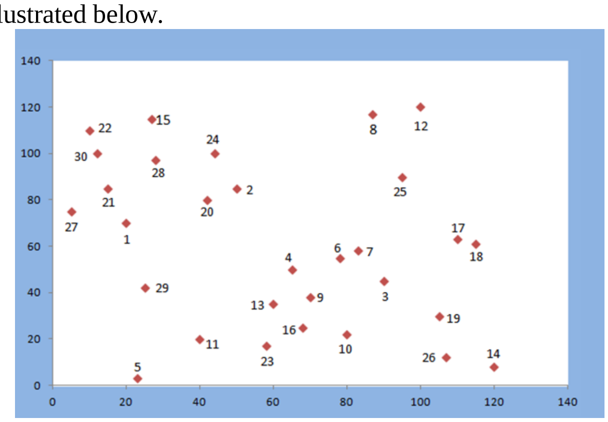

Figure 6 Random distributions of local database units in a simulation network

Based on the number of forwarded packets system overhead is analysed through the Table 4. It is observed that the proposed approach "probabilistic approach" have less system overhead compared to the existing "Rate control approach".

Table 4 Server overhead with respect to number of packets forwarded

Number of Packets Forwarded	Overhead Methods: Rate Control Approach	Overhead Methods: Probabilistic Approach
1	0	0
2	5	5
3	15	15
4	25	20
5	45	35
6	70	45
7	80	60
8	125	75

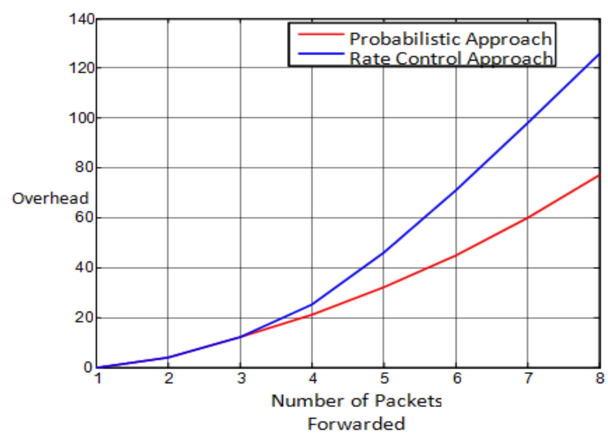

Figure 7 Network overhead with transaction of packet forwarding

Based on the values in Table 4 it is observed in the Fig 6 that the proposed approach "probabilistic approach" experience less system overhead compared to rate control approach.

During the process of exchanging of the data, the data packet is forwarded to a path selected from source to dataset through intermediated nodes. The data packets are buffered and based on the level of computed buffer overhead the packets are forwarded. In order to transfer the data packets node wise, data rate is computed based on the level of buffer overhead to the rate of allocated data correspondingly. After this process the packets are released or queued up in the node. The queued up packets will intern build the overhead in the network. This overhead is defined as "the number of packets queued up for processing at each node".

The forwarded packets are buffered at each of the intermediate node in the system. This will lead to overhead on the system and is observed in fig 7. Due to the probabilistic coding the buffer overhead is controlled over a higher level of buffer queue. Due to early controlling and probabilistic estimation the overhead to such network is observed to be minimum with the forwarding of transaction of packets.

The throughput for the proposed system is realized through the Table 5. It is observed that the throughput for the proposed approach "Probabilistic approach" is more than the "Rate control approach.

Table 5 System throughput with respect to number of packets forwarded

Number of Packets Forwarded	Throughput Methods	
	Rate Control Approach	Probabilistic Approach
1	70.25	70.25
2	70.25	70.25
3	40.00	67.50
4	20.00	60.00
5	12.50	52.50
6	7.50	47.50
7	7.50	40.00
8	7.50	34.00

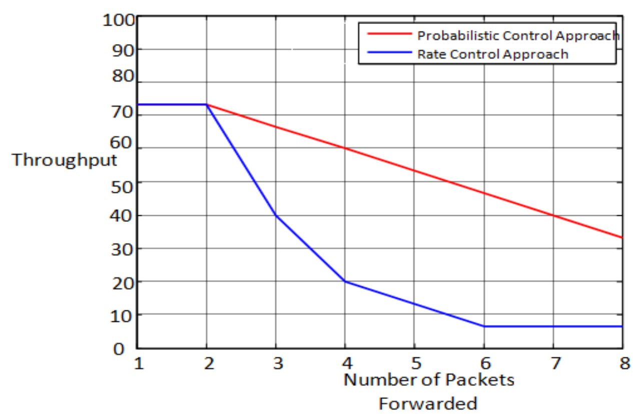

Figure 8 Network throughput with forwarding of transaction

The network throughput for the developed network is illustrated in Fig 8. The proposed approach dealt with the higher rate of controlling overhead where it is observed that more number of packets are received and hence resulting in higher throughput in the network.

The throughput of these simulated systems is defined as the number of packets generated over the packets received to the observed exchange time period. The throughout is observed to be the same for the first one path forwarding the packet. In such case the buffering is observed to be minimum and hence allocated data rate is improved.

Different values are tabulated in Table 6 to realize the transaction delay in proposed methods. It is observed that the proposed method "Probabilistic approach" have less delay compared to rate control approach.

Table 6 Transaction delay with respect to the packets forwarded

Number of Packets Forwarded	Delay (ns) Methods	
	Rate Control Approach	Probabilistic Approach
1	4	4
2	4	4
3	9	5
4	12	6
5	13	7
6	14	8
7	14	9
8	14	10

The observed end- to -end delay factor for the developed system is presented in Fig 9. A set of data packets are conserved to determine the delay of the packets from end to other end of the network. During this process a probabilistic approach is considered to determine the probability of the packets which undergo delay in given sample of data. This will result in the rate control of the data in the network. The delay for the rate control approach is higher than the probabilistic coding as the buffering of data at each node is minimized.

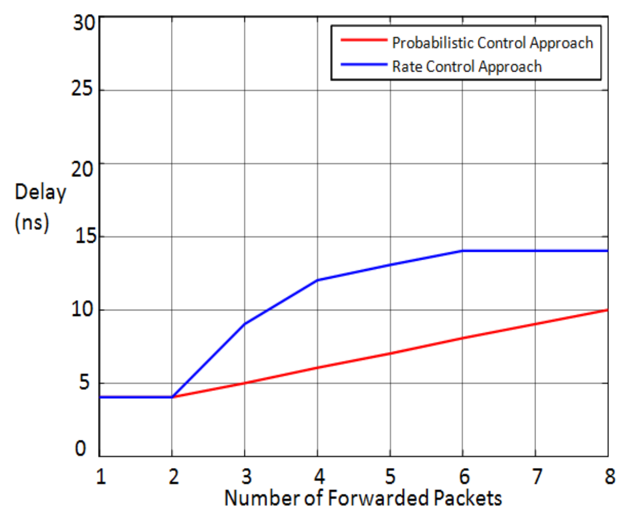

Figure 9 Observed delay for the simulated network with node density

At the node level packets are released faster due to queuing of the nodes in the system. The buffer overhead level in such coding is developed in a probabilistic manner where packets are buffered in a queue based on the rate control which builds the packet forwarding delay at of the node.
Different values are tabulated shown in Table 7. The proposed approach has less queue length compared to rate control method. The buffered Q_length for such system is presented in Fig 10. The buffered Q_lengths are measured with as the volume of data packets are buffered with increase in forwarding of data packets. It is observed that the Q length of buffering is reduced for probabilistic coding due to increment in the data rate. The queuing is however observed to be equal in the initial exchange phase and gradually increased with forwarding of packets.

Table 7 Estimation of queue length with respect to packet forwarding

Number of Packets Forwarded	Queue Length	
	Methods	
	Rate Control Approach	Probabilistic Approach
1	0	0
2	4	4
3	8	8
4	18	12
5	30	19
6	42	26
7	56	35
8	70	42

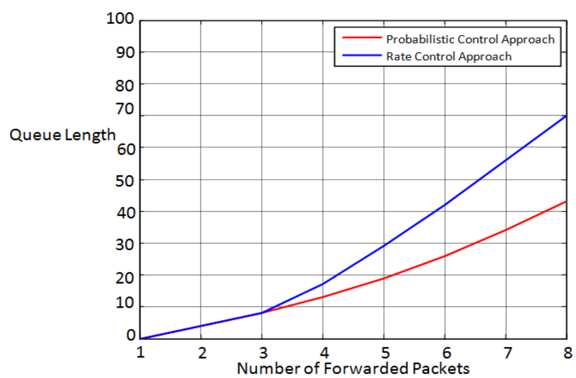

Figure 10 Buffered Q_length with increase in forwarding packets

The allocated data rate is realized in the Table 8. The proposed approach "probabilistic approach" have high allocated rate of data compared to rate control approach.

Table 8 Allocated rate packets with respect to proposed approach

Number of Packets Forwarded	Allocated Data Rate (b/s)	
	Methods	
	Rate Control Approach	Probabilistic Approach
1	11.5	11.5
2	11.5	11.5
3	6.5	10.0
4	3.0	8.5
5	2.5	8.0
6	2.0	7.0
7	2.0	2.0
8	2.0	5.0

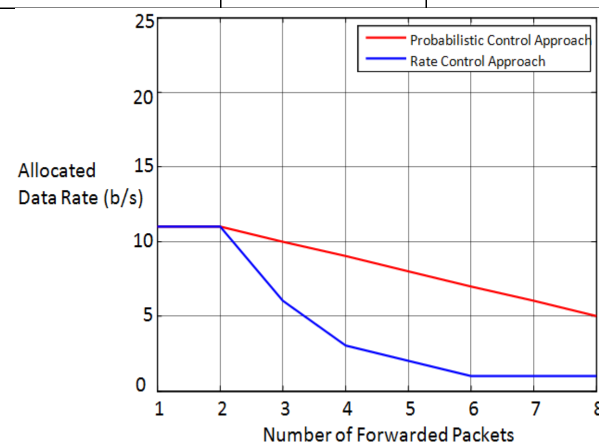

Figure 11 Allocated data rate with forwarding of transaction

The allocated data rate for the developed method "Probabilistic method" over the simulating network is as outlined in Fig 11. At each level of buffering nodes are communicated with respect to the data given. These nodes compute the allocable data rate for forwarding the packets. This forwarding results in proper control of buffer overhead and hence results in improving mining performance. The developed method have high data allocated rate than the control rate.

IV. Conclusions and Future Directions

A probability based control approach to achieve concurrency [4,5] control in distributed database system is proposed. The control mechanism proposed delivers higher data traffic flow over a distributed FDBS. This improvement results in faster data transfer which intern results in improvement of mining performance in database management. In such networks parameters which are measured have to be transferred at faster rate with maximum level of precision. The qualitative parameters measured for this proposed approach, illustrates the improvement of performance in such networks. The path overhead, end to end delay is observed to be minimized in this approach when compared to the conventional controlling approach.

Due to an early evaluation of buffering probability in access unit the concurrency issue is been controlled. This results in higher trafficking in the network. This control approach has lead to the improvement in providing better performance with respect to the reliability and operational ability in distributed database systems. A probability based control approach to achieve concurrency control in distributed database system is proposed. The control mechanism proposed delivers higher data traffic flow over a distributed FDBS. This improvement results in faster data transfer which intern results in improvement of mining performance in database management. In such networks parameters which are measured have to be transferred at faster rate with maximum level of precision.

The qualitative parameters measured for this proposed approach, illustrates the improvement of performance in such networks. The path overhead, end to end delay is observed to be minimized in this approach when compared to the conventional controlling approach. Due to an early evaluation of buffering probability in access unit the concurrency issue is been controlled. This results in higher trafficking in the network. This control approach has lead to the improvement in providing better performance with respect to the reliability and operational ability in distributed database systems.

The proposed work has considered real time natural objects [6] for processing and recognizing them. It is based on invariant co-occurrence of Haralick features. The colour and texture features are extracted and trained to the learning network model. The features of natural samples are used to classify input samples to their class of appropriate classes. When the model is tested [7] for unknown samples of Arial objects, the classifier is found to give 90% classification accuracy. The work with the co-occurrence matrix required to be more computational time. The time complexity found to be (N*M*L2). Where N and M is the dimension of the image in pixels and L is the number of gray level representation.

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