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A Systematic QoS Provisioning at MAC Layer for Designing & Implementation of Advanced Routing Protocols on Cloud

K.Venkatraman[1], G Maria Kalavathy[2]

Research scholar, Anna University Chennai, India[1]

Professor, St.Joseph's College of Engineering Chennai, India [2]

ABSTRACT: Performance analysis and management in Cloud storage (CS) is the key topic and formed new challenges in CLOUD. It is important to achieve proficient optimization for CLOUD in Cross layer communication. This proposed method developed a Sectored-Antenna (SA) based protocol that faces the key problems of CLOUD. It achieves better optimization than various algorithms through comparison on performance metrics such as throughput, delay and packet loss or packet delivery rate. In this work, the throughput and utility maximization in CLOUD are proposed. Various throughput strategies and utility maximization strategies and their challenges are analyzed and evaluated the impact with end to- end flow control, optimal utility, fairness of competing flows, delay prediction and the total number of sensor nodes involved while performing the analysis. The mathematical and experimental results shows proposed scheme is the suggestive alternate that increases in packet delivery rate with reduced average delay that shows the proposed protocol can dealing with QoS requirements.

KEYWORDS: Cloud Computing, QoS parameters, energy efficient, Packet delivery rate and Multipath routing.

I. INTRODUCTION

Cloud storage (CLOUD) have drawn the consideration of the research community in the last few years, driven by possessions of theoretical and practical challenges. This growing interest are basically attributed to new applications enable by large-scale networks of small devices accomplished of harvesting information from the physical environment, performing trouble-free processing on the extracted data and transmitting it to remote locations. There are many communication protocols designed for data routing in Cloud storage. However, to achieve throughput and utility maximization which complies with the communication capacities, the systems need a central computational point with the knowledge of the actual network structure and parameters. The communication capacity (i.e. throughput) is associated with the links of the graph. TDMA (Time Division Multiple Access) assigns the communication capacities and make definite collision-free communication. The communication in the network is described by communication demands. Each communication demand is given by source nodes; sink nodes and data quantity to be relocated. Consequently data transfer from numerous source nodes to one sink node are describe as one communication demand (multi-source). In a parallel way, the replica allows to explain a problem with numerous sink nodes (multi-sink).The problem as a minimum-cost multi product network flow problem, where each commodity represents one communication demand in the Cloud Computing. The majority of the communication protocols are individually urbanized and optimized for different networking layers, i.e., transport, network, medium access control (MAC), and physical layers. While these protocols attain very high performance in terms of the metrics related to each of these entity layers, they are not equally designed and optimized to make best use of the overall network performance while minimizing the energy spending. Considering the scarce energy and processing possessions of CS, cooperative design of networking layers, i.e., cross-layer design stands as the most promising substitute that has gained interest freshly. These primary operation states are included into a combined decision motivation to describe a node's level of eagerness in participating in the communication. Accordingly, a cross-layer protocol (XLP) is developed to attain competent and dependable event communication in CLOUD with minimum energy overheads. In a cross-layer simulation platform, the state-of-the-art layered and cross-layer protocol configurations have been implemented along with XLP to offer an absolute performance evaluation. Analytical performance evaluation and simulation experiment results show that, it considerably improve the communication performance and outperforms the traditional layered and current cross-layer protocol architectures in terms of both network utility performance and throughput. These results underline the compensation of the program concept, which is an original perspective for networking in CLOUD. Recent results reveal that cross-layer integration and design techniques consequence in important upgrading in terms of throughput and utility maximization in CLOUD. These results have in recent times led to several solutions on the cross-layer interaction and design. These studies either offer investigative results exclusive of any communication protocol design, or carry out cross-layer design within a limited scope, (e.g.,) routing and MAC layers.

II. LITERATURE REVIEW

Cloud storage (CS) have emerged, different optimizations to overcome their constraints in which it has not achieved the severe QoS parameters which require to be esteemed depending on the running application. However, as it is counterproductive for the CLOUD lifetime, an extra investigation needs to be established out to confirm the performance of the used multimedia coder on the sensors energy consumption. Normally, the work that considers these QoS requirements and coders' only judge packet error rates at the physical level [6]. Energy optimal routing in the network without any central node or knowledge of the whole network structure uses a partial knowledge about the network Furthermore, the asynchronous/synchronous algorithm is not able to adapt the routing subject when the network changes [9].

Sectored-Antenna Medium Access Control (SA), an incorporated cross-layer protocol that offer the communication mechanisms for sensor network to entirely utilize sectored antennas. It obtain a high packet delivery ratio by minimizing channel contention and packet collisions in the common wireless communication medium but not effective in identifying the time slot assignment, time slot duration, and neighbor discovery parameters selection [1]. A distributed, multi constraint, cross-layer QoS routing algorithm for wireless mesh networks that concurrent gratify multiple QoS requirements. The algorithm profitably warranties various QoS requirements and achieves higher network throughput when compared with other standard techniques. A novel integrated QoS performance metric has various QoS constraints are unambiguously considered where the cross-layer QoS routing algorithm cooperate with distributed opportunistic scheduler optimize the network performance [12]. Highly-Functional Cross-Layer Optimized Interfaces will vigorously hold up high bandwidth applications at low cost and with extremely high energy efficiency. The cross-layer nodes permit for quality-of-service aware packet routing and security, and leverage real-time optical performance monitoring modules to make easy physical-layer aware switching [13]. Cross layer protocol (XLP) accomplish congestion control, routing, and average access control in a cross-layer fashion. The plan standard of XLP is based on the cross-layer concept of initiative determination, which enables receiver-based contention, initiative-based forwarding, local congestion control, and distributed duty cycle operation to recognize efficient and reliable communication in CLOUD but networking functionalities such as adaptive modulation, error control, and topology control in a cross-layer fashion to expand a combined cross-layer communication module is not achieved [2]. Cross layer optimization algorithm, which includes routing based on neighbor detection and dual congestion control for improving QoS [11] helps in minimize the energy required in broadcast of video packets. Joint optimal design of congestion control and wireless MAC-layer scheduling uses an article generation approach with imperfect scheduling get better the optimal time-share values. Imperfect scheduling attains an approximation ratio that converges to a sub-optimum of the generally problem with the same approximation ratio [15]. Adaptive and distributed completion of policies arising is unspecified that only eagerly available measurements, such as the received data, are available at the receiver in order to play the considered games [5]. Both single-cell and multi-cell networks are considered of non cooperative games for power allocation, spreading code allocation, and choice of the uplink (linear) receiver but does not exist in asynchronous networks operating on multipath channels, a deeper investigation of the resource allocation problem in the multi cell scenario. Adaptive CSMA scheduling algorithm achieves the maximal throughput distributed under some assumptions and is relevant to a very general interference model but end to- end flow control fails in achieving the optimal utility and fairness of competing flows [4]. Though, identify the precise conditions on the step sizes to ensure stability is complicated because they may depend on network size, network topology, and arrival rates. ROuting and Spectrum Allocation algorithm through local control actions maximize the network throughput by performing joint routing, active spectrum allocation, scheduling, and broadcast power control [3] but derives only the conjectural lower bound.

III. METHODOLOGY

The survey of research in throughput maximization through cross layer communication is performed. A number of open researches confront addressing which bring considerable benefits to the network users.

3.1 SA Communication protocol for sensor network

Sectored Antenna Based Medium Access Control (SA) protocol particularly considered with sectored antenna system in CLOUD. SA provides the fundamental communication which functionality confines the potential advantages of sectored antennas [1]. Particularly, SA is designed to attain the subsequent objectives. Despite the possible benefits of sectored antennas exploiting these benefits is demanding since a communication pair prepared with sectored antennas must choose the suitable sectors to point to each other during their communication session. Otherwise, the receiving node cannot obtain the message due to weak response power. As a result, insignificant functions like neighbor discovery become extremely challenging. To address these challenges, additional functions should be performed before data forwarding can begin. SA protocol described as an incorporated cross-layer protocol that consists of diverse communication functionalities that permit high utilization of sectored antenna in CLOUD.

SA utilize a directional neighbor discovery mechanism that neither requires added omni-directional antenna nor time synchronization dissimilar many other proposed directional neighbor discovery mechanisms. To assemble precise and complete neighborhood information, SA utilizes a token-passing approach that serializes the neighbor discovery process along with all nodes. When all nodes discover their neighbors, the absolute neighborhood information is gathered at the sink node. The similar overheads are predictable for roughly all protocols that require at least local neighbor discovery. Moreover, these overheads are one-time overheads. Subsequent discoveries and updates are again of similar overheads of other protocols. To dependably share out the computed time schedules to all sensor nodes in the network, SA utilizes the token-passing approach again.

$$\sum_{i=1}^{n_{\text{train}}} \left\| \hat{\vec{y}}_i - \vec{y}_i \right\|_2^2 + \frac{\lambda}{2} \left\| \vec{w} \right\|_2^2 \qquad (1)$$

During this process, initial time synchronization is established among the nodes. These operations are achieved once for the whole network at the opening of the network's lifetime, and thus, their overhead rewarded by the network's long lifetime. During link or node failures, schedule computation and distribution are performed partially on the affected area of the network, thus, minimizing the overhead of such protection events.

3.2 XLP for Efficient Communication in CLOUD

A cross layer protocol (XLP) achieves jamming control, routing, and medium access control in a cross-layer manner. The devise principle of XLP is a combined cross-layering such that both the information and the functionalities of three primary communications pattern (medium access, routing, and congestion control) are considered in a single protocol operation. As a result, XLP incorporates the necessary functionalities by allowing for the channel effects. The XLP enables receiver-based contention, initiative-based forwarding, local congestion control, and distributed duty cycle operation to understand competent and dependable communication in CLOUD. The initiative resolve requires uncomplicated comparisons against thresholds, and thus, is very simple to implement, even on computationally constrained devices. The program resolve concept coupled with the receiver-based contention method provides freedom to every node participated in communication. In CS, the main goal of a communication group is to productively transport event information by constructing (possibly) multihop paths to the sink. Then, cross-layer initiative determination concept constitutes the core of the XLP and absolutely incorporates the intrinsic communication functionalities required for successful communication in CLOUD. A new hop-by-hop local cross-layer congestion is included with XLP based on the buffer residence analysis. The objective of this component is to perform hop-by-hop congestion control by exploiting the local information in the receiver-contention and avoid the need for end-to-end congestion control. It also exploit the restricted reliability measures taken by the channel access functionality and therefore, does not require conventional end-to-end reliability mechanisms. The ultimate goal in the cross-layer design techniques is to develop a particular communication module that is accountable for the functionalities of each networking layer. The initiative determination concept developed in this work is the first step in this approach to restore the entire customary layered protocol architecture that has been used so far in CS so that both the information and the functionalities of customary communication layers are blended in a single module. The CLOUD classification technique and show how it leads to the formulation of a QoS programming

$$\min(w,b) = \frac{1}{2}\|w\|^2 \qquad (2)$$

$$y_i(w^T\phi(x_i)+b \geq 1$$

Finally, XLP is the primary protocol that incorporates functionalities of all layers from physical to transport layer into a cross-layer protocol. A cross-layer analytical construction is developed to examine the performance of the XLP. Furthermore, in a cross layer simulation stage, the state-of-the-art layered and cross-layer protocols have been implementing all along with XLP for performance evaluations.

3.3 Cross-layer Routing and Dynamic Spectrum Allocation

A distributed and restricted ROuting and Spectrum Allocation (ROSA) algorithm for joint dynamic routing and spectrum allocation for multi-hop cognitive radio networks addresses routing and spectrum assignment with power control under the so-called physical interference model, which computes the interference among secondary users using a SINR-based model. The ROSA algorithm considers and leverages the unique characteristics of cognitive radio including the accessibility of spectrum holes at an exacting geographic position and their possible variability with time. In the ROSA algorithm each cognitive radio makes real-time decisions on spectrum and power distribution based on nearby composed information. Nodes change their transmission power to exploit the link capacity on the selected spectrum portion. Introduce a concept of spectrum hole that considers interference from bordering resulting as well as primary users, and leverage it to optimize resource utilization at a low computational cost. ROSA calculates the next hop opportunistically depending on queuing and spectrum dynamics, according to the range usefulness function.

$$f_{w,b} = \frac{sign(w.x+b)}{\|w\|} \leq A \qquad (3)$$

Dual problem:

$$\max D = \sum_{i=1}^{n}\alpha_i - \frac{1}{2}\sum_{i,j=1}^{n} y_i\alpha_i y_j\alpha_j\phi(x_i)^T\phi(x_j)$$

$$\alpha_i \geq 0 \qquad (4)$$

$$\sum_i y_i\alpha_i = 0$$

Hence, each packet will potentially pursue a dissimilar path depending on queuing and variety dynamics. Hence, packets from the similar session follow different paths. At every backlogged node, the next hop is selected with the objective of maximizing the spectrum utility. The combination of next hops leads to a multi-hop path. The multi-hop path discovery terminates when the destination is chosen as the next hop. If the destination is in the broadcast variety of the transmitter, the inconsistency backlog between the transmitter and the destination is no less than the differential backlogs between the transmitter and any other nodes, because the queue duration of the destination is zero. Therefore, the destination has a superior probability of being chosen as next hop than any other adjacent node of the transmitter. Note that the transmitter still selects a node other than the destination as the next hop even if the destination is in the transmission range.

$$\vec{y} = \sum_{i=1} y_i\alpha_i^*\phi(x_i)^T\phi(x)+b^* \qquad (5)$$

$$\min(\ w,b,\xi) = \frac{1}{2}\|w\|^2 + C\sum_{i=1}^{n}\xi_i \qquad (6)$$

$$y_i(w^T\phi(x_i)+b \geq 1-\xi_i$$

Ξ is a slack variables C is the additional parameter that controls the computing between the large margin and small margin.

This happen, for illustration, if there is no available mini band (low interference) between the transmitter and destination, or if the intervention on all mini bands at that time is high, this results in small link capacity among the transmitter and the destination. A practical implementation of the ROSA algorithm relies on a dual radio with a frequent direct channel and a frequency-agile data channel. It interpreted as a distributed and realistic resolution to a cross-layer optimal resource allocation problem, whose performance is close to the optimum. ROSA algorithm maximizes the network throughput by performing joint routing, active spectrum allocation, expansion, and transmit power control. Specifically, the ROSA algorithm animatedly assign spectrum resources to make the most of the capacity of links without generating dangerous interference to other users while guaranteeing bounded bit error rate (BER) for the receiver. In addition, the algorithm aims at maximizing the subjective sum of differential backlogs to stabilize the system by giving priority to higher-capacity links with high differential backlog. The proposed algorithm is distributed, computationally experienced, and with bounded BER guarantees.

3.4 Distributed CSMA Algorithm in Wireless Network

A distributed adaptive CSMA (Carrier Sensing Multiple Access) algorithm for a universal interference model is stimulated by CSMA but applied to more common resource sharing problems (i.e., not limited to wireless networks). CSMA algorithm ignores the packet collisions and achieve maximal throughput, if the adaptation is slow enough [4]. The adaptive CSMA algorithm is a modular MAC-layer protocol that works with other algorithms in transport layer and network layer. Adaptive CSMA scheduling algorithm achieves the maximal throughput distributed under several assumptions. Major compensation of the algorithm applied to a very universal interference model; it is simple, distributed and asynchronous. Furthermore, merge the algorithm with end to end flow control to accomplish the optimal utility and fairness of competing flows. To stay away from excessive collisions, transmissions should not be too destructive. This leads to reasonable performance reduction compared to the idealized model. The existing proof of the throughput optimality is based on the stationary distribution of the CSMA Markov chain. This is certainly sufficient, but may not be necessary according to our simulations. However, identifying the exact conditions on the step sizes to ensure stability is difficult.

The potential is often represented by a CSMA Markov chain combination of a set of features, i.e., . Hence the distribution can be written as:

$$\log P(\mathbf{v}) = \sum_{c\in C(G)} \sum_{i} w_i f_i(\mathbf{v}_c) - \log Z = \mathbf{w}\cdot\mathbf{f}(\mathbf{v}) - \log Z \qquad (7)$$

Let X be a set of conditional (or observed) random variables and Y be a set of target (or label) random variables. A conditional Markov networks (G, Φ) is a Markov network which defines the distribution

$$P(\mathbf{y}\,|\,\mathbf{x}) = \frac{1}{Z(\mathbf{x})} \prod_{c\in C(G)} \phi_c(\mathbf{x}_c, \mathbf{y}_c) \qquad (8)$$

Where the partition function is dependent on x, i.e., $Z(\mathbf{x}) = \sum_{\mathbf{y}'} \prod_{c\in C(G)} \phi_c(\mathbf{x}_c, \mathbf{y}'_c)$

Let D be an all labeled training dataset of i.i.d. instances, then the log of the function is as follows:

$$L(\mathbf{w}, D) = \sum_{d\in D} (\mathbf{w}\cdot\mathbf{f}(\mathbf{x}_d, y_d) - \log Z(\mathbf{x}_d)) - \frac{\|\mathbf{w}\|_2^2}{2\sigma^2} + C \quad (9)$$

1. SIMULATION

Performance Analysis of Cross Layer Communication in Cloud Computing uses the ns-2 network simulator. In simulation, set up 'n' nodes consistently at randomly surrounded by 1000 × 1000 squares, with n unpredictable among 100 and 1000 formative the mobile sensor node group patterns. In particular, to accurately estimate the production of the structure in which each node progress to a randomly selected position with a randomly selected velocity amongst a predefined minimum and maximum speed. The affecting mobile sensor networks continue there for a predefined pause time. After the pause time, it then randomly chooses and moves to another location. This random progression is constant during the simulation period. All simulations were performed for 750 simulation seconds, fixed a pause time of 30 simulation seconds and a minimum moving speed of 1.5 m/s of each node. In the Random Way Point (RWM) model, each node shift to an erratically chosen location with a randomly selected speed between a predefined smallest amount and highest speed. It assumes the normal unit disc bidirectional communication replica and adjust the message range, so that each node will have roughly 40 neighbors on average. RWM use and standard of the total number of mail sent or received per node as calculated of the communication requirements, and measure resiliency by counting the number of times must run the protocol in order to detect a single node replication. The performance analysis of cross layer communication in Cloud Computing is measured in terms of the Throughput, Average Delay and Delivery Rate

2. RESULTS AND DISCUSSION

In order to compare the throughput efficiency of the algorithms used several metrics to evaluate their performance. The first metric is the total throughput obtained while performing the communication in the Cloud Computing. The second performance metric is called the average delay, which is defined as the percentage of time it takes to receive the bit of data from one node to another. It is typically considered in multiples or fractions of seconds. This metric shows the level by which the QoS requirements negotiated between the network users are violated due to the energy-aware resource management. The third metric is the delivery rate which is the average rate at which output is delivered and is expressed as the ratio of output produced to the elapsed time.

Table 1 Throughput

No. of active sessions (time)	**Throughput (Kbps)**		
	Distributed CSMA Algorithm	**SA Protocol**	**XLP in CLOUD**
5	1905	1847	1512
10	2748	2975	2345
15	2903	3027	2498
20	3027	2992	2416
25	3128	2691	2128
30	3317	2415	2077
35	3034	2858	2215

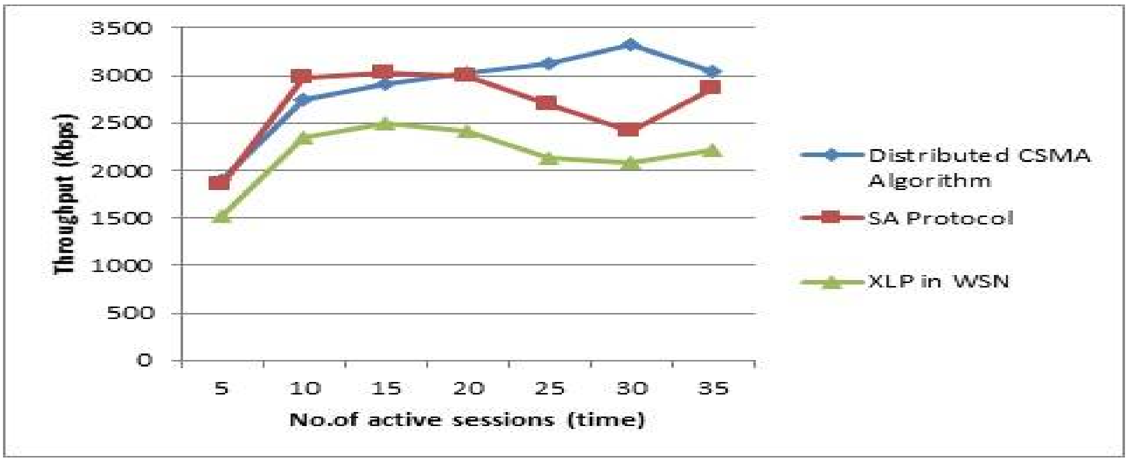

Figure 1 No. of active sessions Vs. Throughput

The above fig 1 describes the throughput ratio in terms of Kilo bits per Second (Kbps) based on the active sessions. The throughput ratio is 10 – 20 % high in Distributed CSMA Algorithm when compare with the SA Protocol and XLP in CLOUD. The active session for experiment varies from the 5, 10, 15…upto 35. Form the figure it illustrates that the as the session time increases, the throughput increases Distributed CSMA Algorithm, AMAC Protocol and XLP in CLOUD.

Table 2: Average Delay

Network Size (nodes)	**Average Delay (sec)**		
	SA Protocol	**XLP in CLOUD**	**ROSA Algorithm**
18	2	5	10
25	10	14	18
32	12	16	21
40	15	20	23
45	18	22	26
55	22	26	30
60	30	34	39

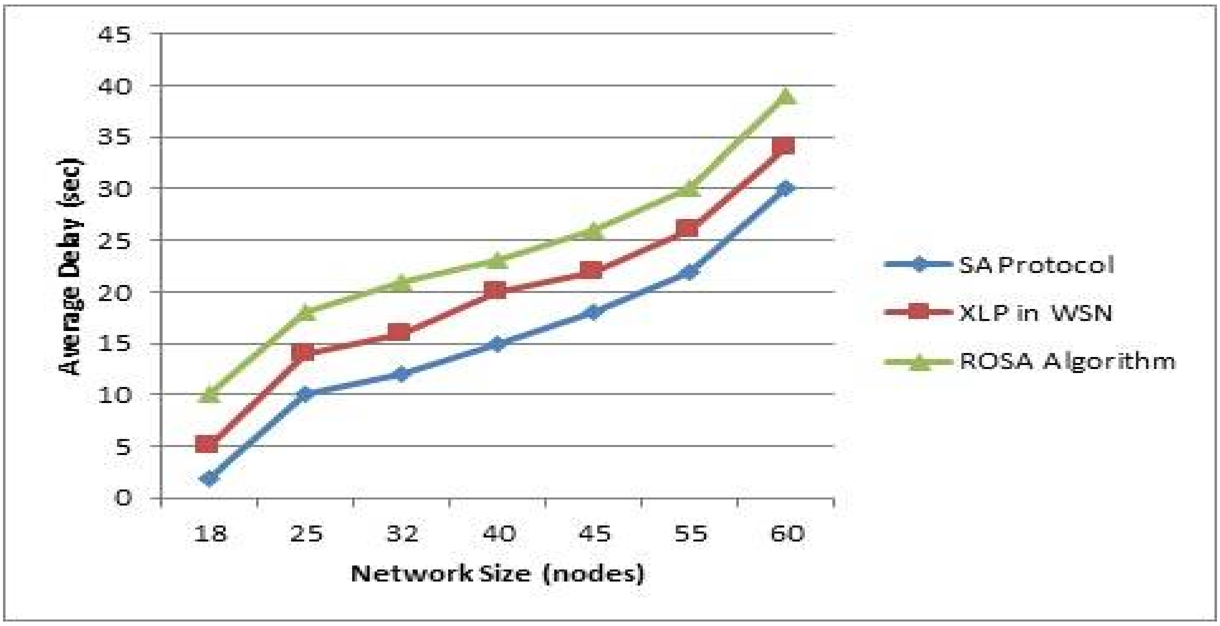

Figure 2: Network Size vs. Average Delay

Fig 2 describes the average delay based on the network size. The average delay is measured in terms of seconds (sec). As the network size increases, delay time is reduced in the SA protocol. It can be seen that the method of this work shows conspicuous advantage. The experiment shows that the method of this work can greatly brings down the time in terms of delay.

Table 3: Delivery Rate

No. of Packets	**Delivery Rate (data units/ms)**	
	ROSA Algorithm	**SA Protocol**
25	4.02	6.95
50	5.61	8.54
75	6.3	9.38
100	6.24	9.16
125	7.13	10.04
150	8.06	11.87
175	9.15	12.15

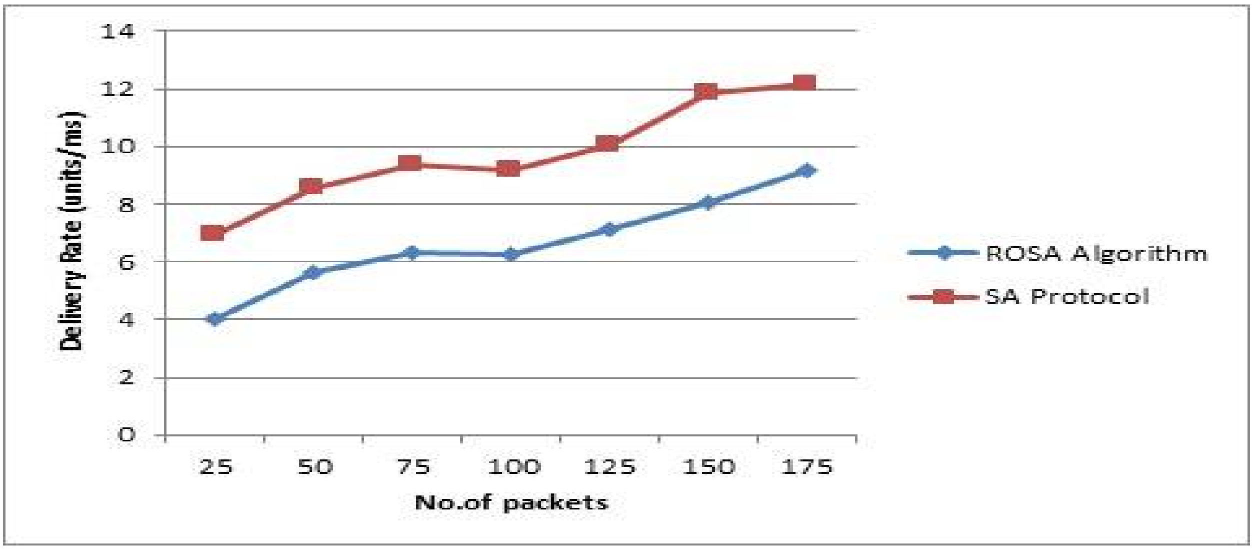

Figure 3 No. of Packets vs. Delivery Rate

The SA protocol delay time is reduced when compared to the XLP in CLOUD and ROSA Algorithm. SA Protocol is 2 – 5 % lesser delay time taken when compared with the XLP in CLOUD and 5 -510 % lesser delay time taken when compared with the ROSA Algorithm. SA protocol has lesser interruption while forwarding the packets and performing the communication in sensor network.The results showing the mean delivery rate of SA Protocol and ROSA Algorithm are evaluated. The graph shows that an increase of the packets leads to improved delivery rate. However, the effective delivery rates are achieved with different intervals between the packets. Compared with SA protocol and ROSA algorithm, it consumes 5 to 10 % higher delivery rate in SA protocol.

III. DISCUSSION

In all the recent works performed, throughput and utility maximization is one of the significant aspects to be solved from the user aspect. SA is an incorporated cross layer protocol [1] that contains full set of communication mechanisms for sensor networks equipped with sectored antennas but time slot assignment is not fulfilled. With this cross layer communication protocol, time slot assignment by global indication can be introduced based on the usage of global information. SA protocol with time slot assignment finds bottleneck of a route, tentative bandwidth evaluation of a route and assignment of time slot according to the order of their free times in the concerned links. Another interesting problem is to examine a variety of networking functionalities in XLP protocol [2] such as adaptive modulation, and error control in Cloud Computing. The performance of these cross layer policies is establish to differ based on introducing the physical layer optimization with multiple snooping links. The multiple snooping flows with single link case are investigated and most favorable power and rate policies are found to control the error rate. Though the networking functionalities are addressed, Distributed CSMA Algorithm does not identify the accurate conditions on the step range to ensure stability [4]. The third part of the work plan can start up with near optimal repeat boundary allocation algorithm for a given routing path determines per hop success probability for each link along the path in order to minimize the total energy consumption while guaranteeing the stability constraint. Then, developed an optimal routing in sensor network for effective communication and power direct algorithm maximizes the network lifetime while keeping the network stable. It is interesting to expand the development scope from day to multiple years to incorporate the cross layer architecture in sensor network target tracking and disaster response as well as the habitat monitoring. Subsequently, one can include the costs of cross layer protocol, and assets purchase. Finally, it can also take into account more complicated quality-of-service requirements besides limiting the broadcast delay in sensor network communication. From the above listed research directions, the future work may lay foundation to the concentric efforts for improved throughput and utility maximization in Cloud Computing.

IV. CONCLUSION

The efficacy of all the above algorithms is verified by simulations and more widely used in the target tracking applications. In Cloud Computing, an effective communication is achieved using the cross layer communication protocol. The work completely summarizes the cross layer communication strategies and its impacts in Cloud Computing. Some of the strategies discussed above mainly focus on throughput, utility maximization but are lacking in some factors. Hence this survey work will hopefully motivate future researchers to come up with the minimal delay and maximal throughput with utility maximization to strengthen the sensor network paradigm.

REFERENCES

1. Atilla Eryilmaz., Asuman Ozdaglar., Devavrat Shah., and Eytan Modiano., “Distributed Cross-Layer Algorithms for the Optimal Control of Multihop Wireless Networks,” IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 18, NO. 2, APRIL 2010
2. Caroline P. Lai., Cédric Ware, Balagangadhar G. Bathula., Daniel Brunina., Ajay S. Garg., Keren Bergman., “Intelligent Highly-Functional Cross-Layer Optimized Interfaces for Future Access/Aggregation Networks,” 978-1-4577-0882-4/11/$26.00, IEEE, 2011
3. Chi Harold Liu., Kin K. Leung., and Athanasios Gkelias., “A Novel Cross-Layer QoS Routing Algorithm for Wireless Mesh Networks,” International Conference on Information Networking, 2008
4. Emad Felemban, Serdar Vural, Robert Murawski, , Eylem Ekici, Kangwoo Lee, Youngbag Moon, and Sangjoon Park., “SAMAC: A Cross-Layer Communication Protocol for Sensor Networks with Sectored Antennas,” IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 9, NO. 8, AUGUST 2010
5. Jiri Trdlicka., Zdenek Han., “Distributed Multi-Commodity Network Flow Algorithm for Energy Optimal Routing in Cloud storage,” RADIOENGINEERING, VOL. 19, NO. 4, DECEMBER 2010
6. John Papandriopoulos., Subhrakanti Dey., and Jamie Evans., “Optimal and Distributed Protocols for Cross-Layer Design of Physical and Transport Layers in MANETs,” IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 16, NO 6, DECEMBER 2008
7. Lei Ding., Tommaso Melodia., Stella N. Batalama., John D. Matyjas., and Michael J. Medley., “Cross-layer Routing and Dynamic Spectrum Allocation in Cognitive Radio Ad Hoc Networks,” IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. X, 2010
8. Libin Jiang., and Jean Walran., “A Distributed CSMA Algorithm for Throughput and Utility Maximization in Wireless Networks,” 978-1-4244-2926-4/08/$25.00, IEEE, 2008
9. Long Le., and Ravi R. Mazumdar., “Performance and Design of Cross-Layer Algorithms in Multihop Wireless Networks,” IEEE TRANSACTIONS ON WIRELESS NETWORK, 2008
10. Lucas D.P. Mendes., Joel J.P.C. Rodrigues., “A survey on cross-layer solutions for Cloud storage,” Journal of Network and Computer Applications, Elsevier Journal., 2010
11. Mr. R. Raju., J. Vidhya Shankardevi., “Cross Layer Optimization for Multiuser Video Streaming Using Distributed Cross Layer Algorithm,” International Journal of Modern Engineering Research (IJMER)., 2012
12. Stefano Buzzi., H. Vincent Poor., and Daniela Saturnino., “Adaptive Cross-Layer Distributed Energy-Efficient Resource Allocation Algorithms for Wireless Data Networks,” Research Article., EURASIP Journal on Advances in Signal Processing, Volume 2009
13. Xiaoying Zheng., Feng Cheny., Ye Xia., and Yuguang Fangy., “A Class of Cross-Layer Optimization Algorithms for Performance and Complexity Trade-offs in Wireless Networks,” Parallel and Distributed Systems, IEEE Transactions on (Volume:20 , Issue: 10), 2009
14. “XLP: A Cross-Layer Protocol for Efficient Communication in Cloud storage,” Mehmet C. Vuran, and Ian F. Akyildiz., IEEE TRANSACTIONS ON WIRELESSNETWORK,2010