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E-AODV Routing Protocol

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Designing the E-AODV (E as Enhanced) Routing Protocol to Improve it During the Nodes or Links Fails

By Mr. Brijesh Soni, Dr. Bhupesh Gour, Mr. Arjun Rajput & Dr. Asifullah Khan

Rajiv Gandhi Technical University, India

Abstract- By the end of this decade we will be entering into the era of thousand cores SoCs. 3D integration technologies have opened the door of new opportunities for NoC architecture design in SoCs providing higher efficiency compared to 2D integration by appropriately adjusting the increased path lengths of 2D NoC. The application to core mapping on NoC architecture can significantly affect the amount of system's dynamic communication energy consumption. The considerable amount of energy savings can be achieved by appropriately optimizing the application to core mapping in NoC architecture. This paper presents a Branch-and-Bound heuristic for smart application to core mapping in 3D Mesh NoC architecture.

Keywords: *reactive, proactive, hybrid protocol, adhoc ondemand distance vector (aodv) routing , enhanced adhoc on demand distance vector (e-aodv), mobile adhocnetwork (manet), enhanced path search operation(epso), acknowledgement to intermediate nodes(acki),acknowledgement to source nodes(acks), source (s) ,destination (d),delay factor (df), shortest distance todestination (sdd)..*

GJCST-E Classification : C.2.2



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Designing the E-AODV (E as Enhanced) Routing Protocol to Improve it During the Nodes or Links Fails

Mr. Brijesh Soni ^α, Dr. Bhupesh Gour ^σ, Mr. Arjun Rajput ^ρ & Dr. Asifullah Khan ^ω

Abstract- Networks are being used in various areas and the demand of user's nowadays has motivate the emergence of the mobile adhoc network (MANET). In this age of network, most challenging task is to deliver the packet successfully with dynamic network, delay, node and links fails restraint. And to fulfill the above required task, protocol should be used effectively and efficiently. In this paper, we had successfully design the Enhanced-AODV routing protocol which had improvised the performance of AODV and its other several factors like throughput, number of packets delivered, load delay, overhead, packet delivery even in case of frequent path breaks due to nodes or links failure, dynamic nature etc.

Keywords: reactive, proactive, hybrid protocol, adhoc on demand distance vector (aodv) routing, enhanced ad hoc on demand distance vector (e-aodv), mobile adhoc network (manet), enhanced path search operation (epso), acknowledgement to intermediate nodes(acki), acknowledgement to source nodes(acks), source (s), destination (d), delay factor (df), shortest distance to destination (sdd).

I. INTRODUCTION

Wireless networks can be broadly classified into infrastructure based wireless network and infrastructure wireless networks or Ad-hoc networks. In Ad-hoc networks, the nodes are mobile and routing between source and destination node is achieved by intermediate nodes acting as routers if it not in radio range. As Ad-hoc networks are highly dynamic, routing protocols plays a crucial role to achieve quality of service. Other important factors to be considered in Ad-Hoc networks are dynamic networks topology, frequently of network updates, scalability, security and energy required. Basically MANET [1] is a group of wireless computing devices like Laptop, Mobile phone, Personal Digital Assistant (PDA) or similar devices. In Ad-hoc networks routing protocols are broadly classified into proactive (table driven) routing protocol, reactive (On-demand) routing protocols and hybrid protocols.

In proactive routing each node in the Ad-hoc network maintains a table or tables containing routing

information of the network. Any node that needs to transmit data can start transmitting data using routes already present in the routing table enabling immediate data transmission. Popular proactive routing protocols include Destination sequence distance vector (DSDV)[2] routing protocol, Wireless routing protocol (WRP)[3] and Optimized link state routing protocol (OLSR)[3]. The advantages of proactive routing protocols is it update its routing table irrespective of data traffic.

Unlike table driven routing protocols, Reactive protocols update routing information only when a route is required by a source node to transmit data. Reactive routing protocols reduce the control overhead which is advantageous in high mobility networks whereas periodic updates in routing information leads to significant increase in networks overheads even when there is no data transmission between nodes in the networks. Some of the popular Ad-hoc routing protocols falling in this category are Dynamic Source Routing (DSR)[4], Ad-hoc On demand Distance Vector (AODV)[4][5] routing and Temporarily Ordered Routing Protocols (TORA)[4].

AODV is considered to be the best out of many Reactive protocols but its performance degrades when nodes or link fails as with the dynamic mobility of nodes, damaging of nodes etc.

In this paper we had successfully upgrades several factors like performance, throughput, load delay etc. even at time of nodes or links fails in AODV routing protocol by enhancing in its algorithm.

II. AODV ROUTING PROTOCOL

AODV is an adaptation of Destination Sequenced Distance Vector (DSDV) protocol used in wired networks and overcomes the shortcomings of DSDV in wireless environment. AODV eliminates the counting to infinity problem faced in other distance vector protocols by implementing a sequence number. Unlike DSR which carries the entire route between the source and destination in the packet, the nodes in AODV carry only the next hop information corresponding to each data flow. Being a reactive routing protocol route is discovered as and when needed and the discovered routes are maintained as long as they are required.

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A route discovery is initiated [6] when one of the nodes in the network wants to send a data packet to another node. If an active route is not available AODV initiates the route discovery process with the source node broadcasting a route request message (RREQ) to find a route to the destination. The route is found either with the RREQ reaching the destination or an intermediate node in the network which has "fresh enough" route to the destination with the sequence number equal to or greater than the sequence number contained in the RREQ. Once a valid route is found it is made available by a route reply (RREP) message back to the originator of the RREQ. Once the route is established the nodes monitor the state of the links continuously. If a link breaks in an active route, a route error message (RERR) is sent to the other nodes of the link breakage. This initiates a new route discovery process.

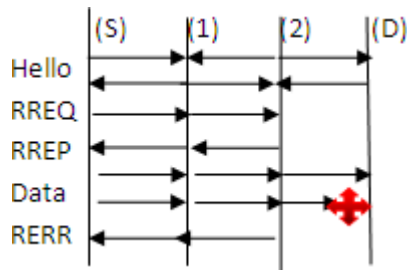


Figure 1 : Flow chart of AODV Protocol messaging

The advantages of AODV routing protocol is the selection of the least congested route instead of the shortest path. AODV supports both unicast and multicast data transmission. Performance is not drastically affected even if the topology changes continuously. Since source routing is not used, there are no additional overheads in the data.

III. THE PREVIOUS ALGORITHM AND THEIR PROBLEM

From the recent up gradations in the AODV routing protocol its had been cleared that they are using the shortest path to start the transmission [7] and also consider or selection of the path on a factor like weak node [8] , delay function [9] .and at the time of path breaks, due to node or link fails, several handling procedure or algorithm had been developed so far from traditional [10] to improvising the local repair procedure [11] ,selecting [12]and performance evaluation[13] node disjoint path identifying the performance [14] , Security [15][16] ,and also modifying [17][18]the traditional and improvising local repair algorithm which will increase packet delivery ,delay, and other several factors.

By considering all the recent updating in AODV, they didn't provide result satisfactory or they provide but under certain constraints. So it is needed to improve

AODV with all recent updates to achieve better performance, throughput and packet deliver and several other factors which can be achieve under any situation or constraints and also even frequent path breaks due to node or links broken.

IV. THE PROPOSED ALGORITHM

The proposed algorithm will be as follows –

- a) Send hello packet from source (RREQ) to discover all path available from source to destination.
- b) During discovery phase,
 - i. Every nodes must updates its cell in its routing table (named as delay factor)
 - ii. Every node must update its cell from its routing table (name as short distance to destination) by calculating the minimum number of hops to reach to destinations.
- c) During the propagation phase, shortest path is selected to begin the packet transmission and assign 10 as grade to all the intermediate nodes in this path
- d) Depending upon the acknowledgment of every packet received its degrades or upgrades grade values assigned to them.
- e) As grades reaches to 0, enhanced path search operation will start on the basis of following steps –

Assigning the grade equivalent to 10 to all nodes to a selected path whose 'ng' (nodes grades) is smaller or equivalent to threshold value 'th' and ng is calculated as specified in formula 1

$$ng = \frac{\text{Shortest path distance to destination}}{\text{Delay functions}} \text{ --formula 1}$$

In order to evaluate or compare several factors between proposed and previous algorithm, both the algorithm is implemented in Network simulator in Windows by creating as Linux environment .After executing both the algorithm, several factors had been compared in Table 1 specified below by considering 50 nodes and for 100 seconds.

Table 1 : Overall Summary

Parameter	Proposed	Previous
SEND	6371	6142
RECV	6087	5760
ROUTINGPKTS	4541	6156
Packet Delivery Fraction (PDF)	95.54	93.78
Normal Routing Load (NRL)	0.75	1.07
Average e-e delay(ms)	215.88	378.98
No. of dropped data (packets)	321	454
No. of dropped data (bytes)	296384	425828

By considering the above table its had been clear that the proposed algorithm provides better aspects as compare to previous algorithm. And on the

basis of the above table many compared graphs can be draw which really proves that it is better than previous.

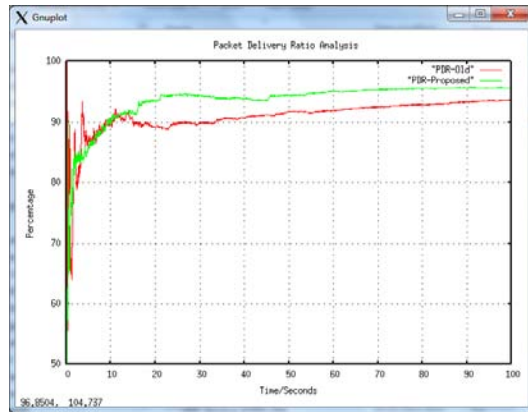


Figure 2 : Packet Delivery Ratio Analysis

In graph Fig.2, shows that proposed send more number of packet as compare to old .And also ensure that as time is increase its packet delivery ration will increase.

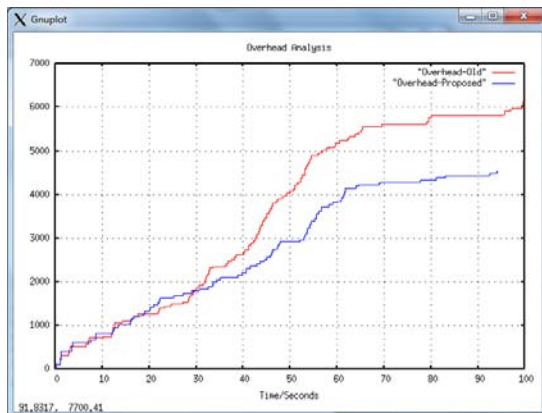


Figure 3 : Overhead Analysis

In graph Fig.3 ,shows that overhead packets is higher in old as compared to proposed algorithm which can degrades the performance .And also ensure that less number overhead as time is increase.

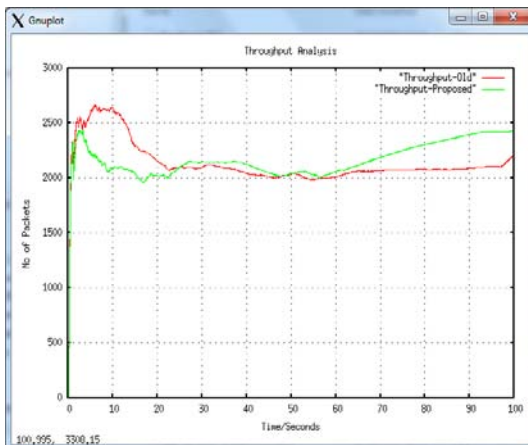


Figure 4 : Throughput Analysis

In graph Fig.4, shows that throughput of proposed algorithm will be increase as time than old algorithm and thus its efficiency will increase.

Now we compared on the basis of UDP connection in a graph Fig.5 and Fig. 6 which may have impact on the network

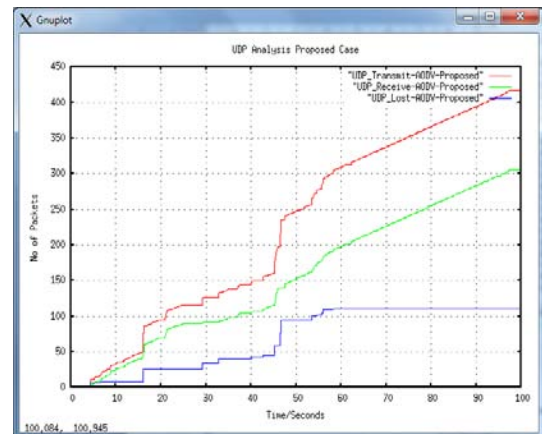


Figure 5 : UDP Analysis Proposed Scheme Time

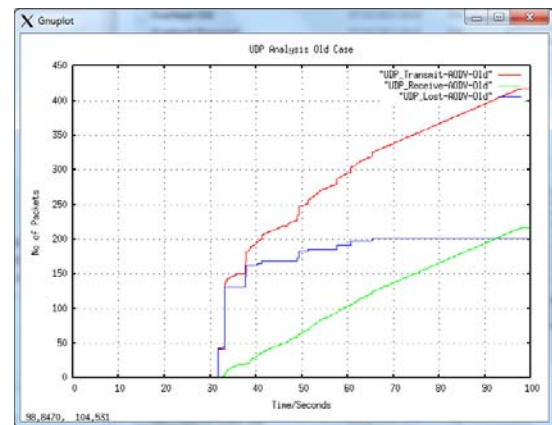


Figure 6 : UDP Analysis Old Scheme Time

The above graph Fig. 4 and Fig. 5, shows that proposed algorithm shows that lost of UDP packet is less than old algorithm and received packet received is higher than old.

Now we compared on the basis of TCP connection in a graph Fig.7 and Fig. 8 which may have impact on the network.

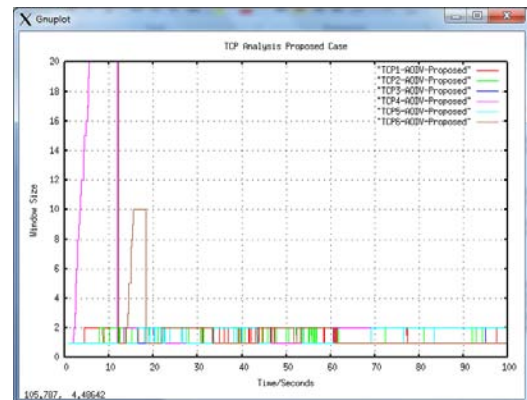


Figure 7 : TCP Analysis Proposed Scheme Time

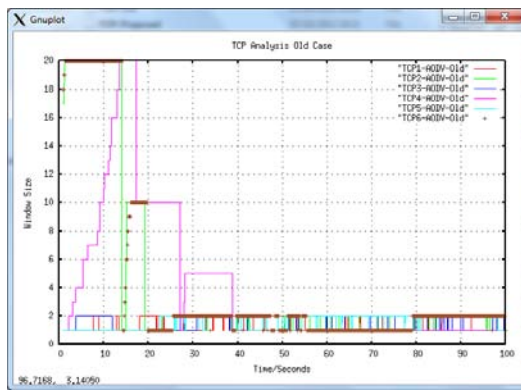


Figure 8 : TCP Analysis Old Scheme Time

V. CONCLUSION

The above simulation result proves that the proposed algorithm works highly effectively and efficiently as on compared with old algorithm and therefore upgrading the performance, throughput, delay, load factor, packet ratio delivery fraction ,throughput etc and also even at the time of node or links fails or even in case of mobility factor.

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Security Provisioning in Cloud Environments using Dynamic Expiration Enabled Role based Access Control Model

By Levina T & Dr.S C Lingareddy

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Abstract- In cloud environment the role based access control (RBAC) system model has come up with certain promising facilities for security communities. This system has established itself as highly robust, powerful and generalized framework for providing access control for security management. There are numerous practical applications and circumstances where the users might be prohibited to consider respective roles only at certain defined time periods. Additionally, these roles can be invoked only on after pre-defined time intervals which depend on the permission of certain action or event. In order to incarcerate this kind of dynamic aspects of a role, numerous models like temporal RBAC (TRBAC) was proposed, then while this approach could not deliver anything else except the constraints of role enabling. Here in this paper, we have proposed robust and an optimum scheme called Dynamic expiration enabled role based access control (DEERBAC) model which is efficient for expressing a broad range of temporal constraints.

Keywords: *role based access control system, cloud environment, trbac, security management, temporal constraints, and separation of duty*

GJCST-E Classification : *D.4.6*



SECURITY PROVISIONING IN CLOUD ENVIRONMENTS USING DYNAMIC EXPIRATION ENABLED ROLE BASED ACCESS CONTROL MODEL

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Security Provisioning in Cloud Environments using Dynamic Expiration Enabled Role based Access Control Model

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Abstract- In cloud environment the role based access control (RBAC) system model has come up with certain promising facilities for security communities. This system has established itself as highly robust, powerful and generalized framework for providing access control for security management. There are numerous practical applications and circumstances where the users might be prohibited to consider respective roles only at certain defined time periods. Additionally, these roles can be invoked only on after pre-defined time intervals which depend on the permission of certain action or event. In order to incarcerate this kind of dynamic aspects of a role, numerous models like temporal RBAC (TRBAC) was proposed, then while this approach could not deliver anything else except the constraints of role enabling. Here in this paper, we have proposed robust and an optimum scheme called Dynamic expiration enabled role based access control (DEERBAC) model which is efficient for expressing a broad range of temporal constraints. Specifically, in this approach we permit the expressions periodically as well as at certain defined time constraints on roles, user-role assignments as well as assignment of role-permission. According to DEERBAC model, in certain time duration the roles can be further restricted as a consequence of numerous activation constraints and highest possible active duration constraints. The dominant contributions of DEERBAC model can be the extension and optimization in the existing TRBAC framework and its event and triggering expressions. The predominant uniqueness of this model is that this system inherits the expression of role hierarchies and Separation of Duty (SoD) constraints that specifies the fine-grained temporal semantics. The results obtained illustrates that the DEERBAC system provides optimum solution for efficient user-creation, role assignment and security management framework in cloud environment with higher user count and the simultaneous role-permission, even without compromising with the security issues.

Keywords: role based access control system, cloud environment, trbac, security management, temporal constraints, and separation of duty.

1. INTRODUCTION

In order to accomplish the goal of security management system, the Role based Access Control (RBAC) system models have played a significant role. The RBAC approach has established itself as the highly

robust, generalized and powerful approach to perform security management operations. The role based access control systems do facilitate the efficient and effective assignment of role to the users and its respective permission to them. A user being the member of certain category can achieve the permission of a certain role. The functional environment or organization where certain roles are assigned to users with predefined privilege, the RBAC model can be a significant player. In fact the flexibility and robustness of RBAC model makes it to facilitate expression of numerous security policies such as discretionary as well as mandatory along with the specific policies defined by either user of the organization. Few of the predominant contribution of RBAC system models are its optimum support in security management and the principal of minimum privileges. Such management facilities encompass the capability of managing the role generation, assignment and re-assignment of roles in case of change in certain user's responsibility. Furthermore, the role-permission management is accomplished by means of role hierarchies' generation, clustering of objects into certain object classes.

The robustness, advantages and its relevancies makes this approach highly desirable for investigation and further optimization. This is the matter of fact that this presented system model has gained a lot of optimization and maturity, still it lacks in certain specific applications and of course in cloud environment this system does suffer from few limitations like its incompatibility with cloud system variant. On the other hand, the applications functional with temporal semantics like work-flow based system model do suffer a lot. With certain applications in organizations, the system process and its function could have certain defined and limited time or periodic temporal durations.

In fact such events are in immense presence with advanced cloud system with cloud sharing and resource utilization. The requirement for a definite time function or operation can be assisted by means of characterizing the time duration when the role can be enabled or activate by user. The defined time or duration role can be additionally restricted for few certain time spans. Additionally, on the basis of the requirements of the organization, the span of function can be different in different operational periods.

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Initially the research group, Bertino et al. [16] proposed a Temporal RBAC system, referred as TRBAC model that considers and introduces few dominant temporal problems allied with RBAC systems. The predominant characteristics of this system model encompass the periodic enabling of roles and the temporal dependencies among numerous roles that can be presented by means of events or triggers.

A particular role is referred to be enabled in case it is considered by a user. In general the priorities are allied with the role events, which are in conjunction with a combination of precedence rules which is further employed for resolving constraints conflicts.

The temporal-RBAC system model also permits certain administrator to provide a runtime request for activating or enabling or deactivating certain rules. This security management scheme, then while lacks in handling numerous other significant system constraints that can be presented as follows:

Initially, the system model in fact doesn't consist of temporal constraints either for role creation of users or for permission of role. The model considers that all the roles can be enabled or disabled at different time intervals.

Here, in the presented paper, it has been presented that in certain cloud applications; the roles are required to be static which refers that these roles are active all the time, on the other hand, the users and the permission employed on them could be transient. Here it has also been presented that the temporal RBAC model is capable of handling only the temporal constraints for role enabling then while it is not capable of supporting well-defined clear motives for performing role enabling and its activation. A particular role is stated as active in case minimum a single user considers that. Hence, the existing Temporal RBAC systems are not capable of handling numerous system constraints which are allied with the activation of a particular role like the constraints on the highest duration permitted to certain user and the maximum count of activations of a role by user in a defined time span. It can also be found that the existing RBAC models doesn't takes into account of time constraints and the constraints functional in the real time activations of user and even it doesn't cares of goal of enabling or disabling the system constraints.

In fact, the activation constraints must be defined clearly in relation with the time of enabling of certain role. Considering this prime requirement here in this paper we have considered the system constraints of role enabling or disabling. Here, it can also be found that the temporal base RBAC system doesn't depicts the time based semantics of the hierarchies of roles and the dominantly the separation of duty (SoD) constraints.

Here, in the presented manuscript we have illustrated the significance of model constraints, and we have proposed a highly robust and effective system called DEERBAC system. The proposed DEERBAC

system model subsumes all the expected characteristics of the temporal based RBAC system models. The presented work and DEERBAC model can be a potential candidate for role based access control system that considers every functional or operational constraints and access control policies. A similar work was done in [17] as the Temporal Data Authorization Model (TDAM) [17] which expresses the policies for access control on the basis of temporal characteristics data. In However, TDAM does not take into account of temporal characteristics of user for assignment of roles.

The presented manuscript has been organized in the following way: Section 2 discusses the related works of the proposed issues which is followed by Section 3 that presents the RBAC model or NIST RBAC model with periodic expression. Section 4 presents temporal constraints in DEERBAC model with periodic constraints, temporal constraints and the role activation. Section 5 discusses the DEERBAC conflict resolution and the execution model for proposed system which is followed by Section 6 that presents temporal hierarchy and separation of duty constraints with elaborated security check function and algorithm development. The results obtained for the developed model has been given in Section 7 which is followed by conclusion in Section 8.

II. RELATED WORK

A significant contribution was made by a research group Zhu Tianyi [1] in which the researchers developed a robust RBAC system referred by coRBAC which is in fact an optimally enhanced role based access control system for dynamic and competitive cloud environment. The coRBAC approach was functional with a hypothesis that inheriting the available RBAC's model for roles generation and assignments with dRBAC's domain model, the access control could be optimized for those all services which are provided on the platform of cloud computation. The significant contribution of that approach was in fact reduction in processing cost with multi-level cache and connection set up enhancement. In spite of these plus points this work could not discuss the temporal constraints and key constraints that could be optimized to make this system more optimum for competitive cloud environment and this work kept moving around time minimization only, which cannot be considered as optimum solution. A refined approach with numerous security principals was introduced by Wei Li et al in [2] where on the basis of few key security attributes the users and respective applications were separated and justified works for its security robustness. The lacking point of this work was dominantly the consideration of key entities of RBAC with real time operation and upto certain extent a work in [3] tried to introduce real time pinch for cloud applications. In [3] on-demand access-control infra was developed that encompassed establishment of dynamic

trust in IaaS cloud framework. In order to achieve the better configurability and management of authorization they introduced XACML based role based access control and employed authorization key for secure session establishment among numerous players in cloud environment. In fact this work sounds good for security among multiple dynamic players but while considering the dynamic inter-relation between service providers by means of identity management, this approach was found shell-confined. Considering one application like electronic health records (EHR) for secure data sharing a work was done in [4][13] where they employed identity and attributes oriented encryption altogether so as to get access control policies enhanced. In fact this work was confined to the EHR only and could not address the problem of RBAC in real application. Anil L. Pereira et al [5] came out with certain enhanced work where they proposed a RBAC scheme for grid database application and functions to be employed in open framework of grid database called OGSA-DAI. Here they introduced an efficient grid-based middleware platform for accessing control on data at source and sink. The lacking point of this work was the excessive administrative system overheads and for its resolution the authors employed a community authorization service for supporting RBAC and OGSA-DAI. This work was untouched with the key issues of temporal constraints and key constraints of real time cloud environment. The enhancement with optimized characteristics was done in [14] while considering localized division and the approach of area of responsibility (AoR). Encryption based RBAC was optimized in work [15] in which the authors introduced accurate syntax for a computational adaptation of RBAC framework while offering precise introduction of cryptographic policy enforcement. The consideration of temporal constraints with the goal of policy realization could be better as compared to techniques introduced in this work. An effort to consider temporal RBAC was done by Masood et al [6] where they performed the conformance realization of temporal RBAC system. Since, this work was a testing approach for temporal RBAC, so it could not expand its fins for policy optimization and generalized policy realization with real time operations. Similar to [4] in certain work [8][12] an application oriented RBAC model was made by Hua Wang et al and Y.Chen et al respectively, for payment application. This work was motivated for RBAC integration with payment module so had confined scopes for further enhancements or optimization. K. Sohr et al [9] introduced few constraints like non-temporal and past-oriented authentication constraints for object constraint language (OCL) and realized system for RBAC policies and validated on UML specification environment. The authorization engine introduced in this work delivered success to certain limit but the consideration of non-temporal constraints make

this work confined. S. Jha et al in his work [10] proposed a formal verification approach for enhancing the present RBAC policy specification and access management. Here they classified the classes of security for RBAC implementation and reviewed the key factors contributing the computational complexity by means of a lattice of numerous sub-cases of the issues for numerous restrictions. Masood et al [11] generated a test guide for RBAC by implementing few key schemes that detect faults efficiently, and they developed two schemes for minimizing size of generalized suites by means of random paths in RBAC policy model. Atluri et al. [17] in their work come out with Temporal Data Authorization Model (*TDAM*) which can effectively present the access control policies on the basis of the temporal characteristic of data, like valid and transaction time. Additionally, *TDAM* does not provide the system constraints that do support the constraints on roles. Thus, the temporal constraints that can be presented in *TDAM* model are different from those that can be expressed in the proposed *DEERBAC* system model. The proposed *DEERBAC* system model system can perform capturing temporal constraints characteristics of data present only at the level of permission by using time-constrained role-permission assignments and triggers only. The aforementioned *TDAM* system model can, therefore, augment the capabilities of the *DEERBAC* model. Disparate to the *TDAM* model, the *DEERBAC* also takes into account of temporal characteristics of users and system/organizational functions given by certain roles. Considering these reviews and existing approaches it can be stated that to the best of our knowledge, hierarchies and separation of duty constraints with temporal semantics have not been addressed in the literature.

III. OVERVIEW

The following section presents the overview of a model called as NIST role based access control and the periodic expression.

a) The NIST RBAC Model

This RBAC model was proposed by a scholar group named Ferraiolo et al. [19] which comprised of four fundamental components as a set of users, a cluster of roles, permission of roles and a defined time set. Here the user means a human body or might be an autonomous agent. In this case a particular role is referred to as a combination of permission required for performing certain defined function. Similarly, a permission states for the mode of access which can be exhibited on an object in the organization or framework and similarly a session connects to certain user with probably multiple roles. In individual operational time duration a particular user for requesting the activation of certain roles for which it is assumed to be permitted. These kinds of requests are permitted only in the case

when the allied role is activated at the occasion of request and the specific user is issued permission for role activation. In role based access control systems considering the four sets; users, roles, role-permissions, and duration, a number of functions are defined. The role assignment for user (A_r) and the assignment of role permission (A_p). The functions user role assignment (A_r) and role permission assignment (A_r) exhibits the function of user assignments or creation and its role permission respectively. Individual session is measured and assigned to certain defined tasks. In case of roles s_a Roles, condition $s_a \in s_b$ then in that case, s_a accede to the authorizations of s_b . In these kinds of cases, s_a exhibits the role of a senior while s_b functions for junior role.

b) Periodic Expression

The periodic time is represented by means of a symbolic presentation which can be further expressed by a tuple $\langle [\text{start}, \text{stop}], B \rangle$. In this expression the variable B refers a periodic expression denoting an infinite set of periodic time instants, and $[\text{begin}, \text{end}]$ is a time interval stating for the lower as well as the upper bounds B , [16]. The objective of calendar is employed by the periodic time in the form of contiguous time intervals. Here, we takes into account of certain set of calendars comprising of entities like Hours, Days, Weeks, Months, and Years, in which the variable Hours states and is considered to have the best granularity. Similarly, a sub-calendar could be formulated among the available calendars.

With the provided calendars L_1 and L_2 , the calendar L_1 is stated to be a sub-calendar of L_2 , presented by $L_1 \subseteq L_2$ in case the individual time gap of L_2 is considered by a definite count of intervals of calendar L_1 .

The comprising calendars could be effectively joins for representing a better periodic expression stating the periodic intervals like the set of Mondays or the set of the 4th day of each month.

The periodic expression can be given by the following expression:

$$B = \sum_{a=1}^h Q_a \cdot L_a \triangleright g \cdot L_e,$$

In the above presented expression $L_e, L_1, \dots, L_h$ refers the calendars and similarly $Q_1 = \text{all}, Q_1 = \text{all}, Q_a \in 2^K \cup \{\text{all}\}, L_a \subseteq L_{a-1}$ for $a = 2, \dots, h, L_e \subseteq L_h$, and $g \in K$. In this expression $\triangleright$ represents the separation of the first part of the periodic expression which further distinguishes the set of initial point of the time intervals, from the characterization of the time with respect to calendar L_e . In practical the variable Q_a is not considered in case it possess all values on the other hand in case of its vales as singular, it is depicted by its inimitable element. Meanwhile, $a \cdot L_e$ can also be eliminated in case variable $g=1$. A

combination of time instants which does corresponds to a defined periodic expression B can be given by $S_r I(A, B)$. Meanwhile, the combination of time intervals in (A, B) is given by $\Pi(B)$.

IV. TEMPORAL CONSTRAINTS IN DEERBAC MODEL: SYNTAX AND SEMANTIC

a) Periodicity and Duration Constraints on Role

i. Enabling and Assignments

One significant characteristic of the proposed DEERBAC model is that in this model the periodicity as well as the constraints of duration could be effectively employed for numerous components of the role based systems and dominantly by constraining the enabling of roles and the time of its activation. All of these constraints could be employed for roles as well as for the users and their role assignment which can be scheduled and activated as per the organization requirements.

ii. Periodicity Constraints $(A, B, P_a: Z)$.

The constraint called periodicity constraints can be employed for specifying the accurate time interval in the duration of which a particular role can be operated for enabling or disabling in the duration in which a role or its permission is valid. The expression of these constraint expressions posses a general form $(A, B, P_a: Z)$ where the variable $(A, B, P_a: Z)$ characterizes the time intervals when certain event happens.

The periodicity constraints and its implementation on the assignment of user role have been given in the following figure (Fig. 1). In this Figure the time interval (p_3, p_6) and (p_8, p_{11}) when the role s is enabled has been given by the two thick lines. The presented lines above the time axis presents the time when the users are assigned certain role s . The intervals when the user role is valid have been given by the dotted lines. For illustration, when a particular user m_1 is permitted for certain role s in the time interval of (p_1, p_5) , then he can perform the activation of role only in the duration interval of (p_3, p_5) ,

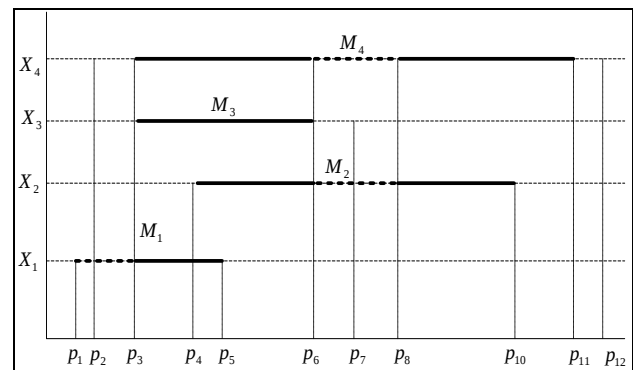


Figure 1 : Periodicity constraint on user-role assignment

The role s is assigned to the user m_2 in the time interval (p_4, p_{10}) , but it can activate the assigned role

only in the time span of (p_4, p_6) and (p_8, p_{10}) . Similarly, the user m_3 is permitted s in $\text{span}(p_2, p_7)$, but it can consider s only in the time duration or interval of (p_3, p_6) .

iii. *Duration Constraints* $[(A, B,)|T], T_g, P_a: Z$.

The duration constraints are employed for specifying the time durations for which the functions of role enabling or its disabling remains valid. Whenever certain functions or event takes place this constraint is allied with the certain event ensures that event for certain definite time duration only. The case when there is no any constraint for session for certain event, the event sustains in valid state till it is disabled by means of triggres.

In general the duration constraint is presented by $[(A, B,)|T], T_g, P_a: Z$ for performing role enabling or its activation. In this expression the variable g refers either S, M , or A , in the relevance of certain events for enabling or disabling is given by expression EN_s/Dis_s respectively and for assignment events " $Asgn_m/DAsgn_m S$ to M ," and " $Asgn_b/DAsgn_b B$ to S ," respectively. The variable T and T_g states for the time spans like $T \leq T_g$. The entity " $|$ " existing between (A, B) and refers that either (A, B) or T is specific for certain event.

Here, we do consider two kinds of session constraints:

$$((A, B, T_g, P_a: Z), (T, T_g, P_a: Z), \text{and } (T_g, P_a: Z)).$$

In the above mentioned expression the variable $(A, B, T_g, P_a: Z)$ presents that the event Z remains valid only for the span of T_g in the duration of which the individual periodic interval is specified by (A, B) . $(T_g, P_a: Z)$ states that this specific constraint remains valid all the time. Thus, in case an event Z takes place at certain time then it remains confined for the duration of T_g . Another constraint $C_t = (T, T_g, P_a: Z)$ states that there exists a legitimate time span T in the duration of which the duration restriction T_g is implemented to the event Z . The constraint C_t is enabled for certain time duration T . In general the duration constraint expression possess the similar form as is for expression of activation constraint. Therefore the semantics of the duration constraints for enabling the roles and its assignment to the users is same as that of activation constraints.

b) *Temporal Constraints on Role Activation*

The activation request for roles takes place at the discretion of a user at random time and therefore the constraints of periodicity on the activation of roles must not be enforced. On the other hand, the same constraint for duration can be enforced on the activation of roles. In the proposed DEERBAC model the duration constraints for role activation could be effectively classified into two dominant categories: first the total active duration

constraints while the other refers the maximum time span taken for individual activation constraints.

The entire active duration constraint for certain role prohibits the duration of the role's activation for provides time span. Once the users have employed the total active time span for a specific role, then that role might not be activated again although it can be enabled in future. Here it can be noticed that the whole activation time permitted for a role might be of certain intervals in which the role has been activated. In fact in the system the active duration is classified on the basis of per-role and per-user-role assignment.

In per-role constraint the total active time span is restricted for certain role. As soon as the addition of all the durations used for activation of roles approaches to the maximum permitted value, then no any activation of role is allowed and therefore the existing activation for role is terminated. Similarly, the per-user-role constraint prohibits the overall count of active duration for a certain defined role by certain user. As soon as the user employs the overall active time span for the specific roles, he is not permitted to activate the role in near future, while the other existing users could further activate the roles.

As soon as this kind of time span or duration expires for a defined user, the activation for roles for that specific user becomes annulled. Then while, there could be activations for the similar roles in the functional systems. These model constraints might be characterized for per-role or per-user roles. In per user constraint case the constraint prohibits the maximum active duration employed for individual role activation by certain user, until there exists per user-role constraint is specified for that user. The maximum active duration is prohibited by means of a per-user-role constraint which is permitted for individual activation of the roles of a particular user. The duration of activation can be confined in a pre-defined time interval. In few applications, the prohibition on the number of roles might be needed to control the critical resources. This kind of cardinality restriction for role activation might be classified into two dominant kinds, overall n activations constraint where a role is confined to certain n activations and second the highest possible n constraints for concurrent activations. The second kind functions in the manner that a particular role is prohibited to n number of activations at certain defined time.

A particular model constraint for per-role might be characterized to prohibit the count of concurrent activations of a role to the highest possible value. Same or different users could be allied with the activation of such kinds of roles. Similarly, the per-user-role constraint prohibits the overall number of synchronized activations for a defined role by certain user in the defined time duration.

In general the constraints of activations can be presented in the following form:

$$[(A, B)|T], C_t)$$

In the above presented expression the variable C_t states the restriction imposed to particular role activation. As illustration,

$$C_t = (T_{Act}, [T_{Dft}], Act_{S_sum} s)$$

$[(A, B)|T]$ State for an alternative temporal variable and posses the similar meaning as provided by the constraints of duration. Hence, in the same way as the duration constraints, the activation constraint considers any one of the three possible ways (A, B, C_t) , (T, C_t) or (C_t) .

The system constraint (C_t) states that the prohibition on the activation which is specified by C_t is applicable for individual enabling of the allied role. In case the constraint C_t refers a per-role constraint then it possesses an alternative default parameter that can be employed for specifying the default value in relation with the per-user-role prohibition.

c) Runtime Requests, Triggering and Constraint Enabling

In the proposed DEERBAC model, the request to enable certain role or permission is considered as a runtime event. In the same way, the runtime request of the administrator for initializing the process which can override any on hand convincing events, are also considered for modeling.

These kinds of events are nges or alterations in the existing policies. For illustraemployed for overriding a pre-specified policy that makes chation, the events for disabling certain roles can be initiated by administrator for detecting the malicious users in environment. Similar requirements in numerous real time applications are required for automatically exhibiting certain actions, because of the presence of events like the enabling or disabling of certain roles. In the proposed DEERBAC model, suck kind of dependencies is achieved by means of triggering. Additionally, the duration constraints functional on role enabling and its assignment as well as role activation can be enabled fir specified intervals. The proposed DEERBAC model consists of expressions for enabling and disabling the constraints. The run time request of a user to activate or deactivate certain function can be presented by, firstw: activating s for m after certain interval Δp and second,w: deactivating s for m after Δp .

The functional priorities allied with such requests are considered to be same as for event "assign s to m" which authorizes the activation of role s by user m. The runtime request expression for administrator given as $P_a:Z$ after Δp states a prior itized event that takes place Δp time later from the request made.

If the priority as well as the delay is required to be excluded then the variable $P_a = T$ is set in which T denotes the maximum priority with zero interval. The expression for event or triggering is given as $Z_1, \dots, Z_h, C_t 1, \dots, C_t z \rightarrow P_a:Z$ with the interval of Δp , in which the variable $Z_g w$ denotes event expressions or in other words the runtime requests. Similarly, $C_t_g w$ refers the position predicates and $P_a:Z$ refers for a prioritized event expression having $P_a < T$, Z refers the expression in such a way that $Z \in \{z: active s for m\}$ and Δp denotes for the expression for duration. Here it can also be noticed that because of the users only the activation request is made, therefore the particular event Z must not be "z: Act s for m". It should be noted that the event "z: Act s for user m" is permitted to come out in the head of certain trigger unit as this might be employed for enforcing certain access control policy.

V. DEERBAC CONFLICT RESOLUTION AND EXECUTION SEMANTIC

This presented section of the manuscript introduces the key dominant issues that create conflictions which ultimately get arose in DEERBAC model. This section also discusses the approaches to be implemented for resolution of the issues and coming up with an optimum system model. Here we define certain sets denoted by γ that comprises with all kinds of expressions, model constraints as well as triggering in proposed DEERBAC system model. Additionally, here the users as well as the administrators have been considered as a sequence presented by the following expression:

$$DO = \{DO(0), DO(1), \dots, DO(p), \dots\}.$$

In the above mentioned expression it can be found that the variable $DO(p) \in DO$ refers a set of runtime request created at time p.

a) Various conflicts in proposed DEERBAC model

A number of kinds of conflicts might be created in proposed DEERBAC model. Unequivocal semantics are required for capturing these kinds of conflict.

Fundamentally, there are 3 kinds of conflicts that might come into existence for certain provided value γ as well as the sequence of request expression DO . The predominant kinds of conflicts are as follows:

i. Conflicts occurring in between events of the similar classes

The events existing in the similar classes are allied with the similar kind of pair of the role status or its assignment. As for example the event "EN s" results into disabled state of role s to an enabled state whereas event "Diss" corresponds to altering the status of enable of a certain role into its disabled state.

ii. *Conflicts existing between events of different classes*

Few of the constraints can arise in the event of different categories such as an activation request "Activate m for s" and a role disabling event denoted by "Disable role s" might result into the conflicts in case both of these tries to arise at the same time. In the same way, the activation event "activate m for s" as well as the de-assignment of user's role "DAsgn_m s to m" mightn't take place simultaneously because a user might activate certain role only in the case when it is permitted certain roles.

iii. *Inter-constraint conflicts*

These kinds of conflicts might come into existence in between two functional constraints which are defined by means of role enabling or its assignment.

A particular system conflict might come into existence in between the constraints of per-user activation and the constraints of per-role activation. Let's consider a per-role constraint

$$(T_{Act}, [T_{Dft}], Act_{mS_sum} s)$$

Similarly, the per-user-role constraint

$$(T_{mAct}, m, Act_{mS_sum} s)$$

The initial system constraint refers that the specific role *s* is permitted for its activation for a certain defined duration T_{mAct} , while another system constraint characterizes that the user *m* is permitted for assuming role *s* for the whole duration T_{mAct} . In case of declared or specified duration T_{Dft} all the participating users are prohibited or confined to total time called T_{Dft} . There might be some ambiguity if the user *m* must be permitted an overall time of activation as T_{mAct} or T_{Dft} . In case of per-user constraint and with non-definite T_{Dft} then a condition can be assumed like $T_{Dft} = T_{mAct}$.

The proposed *DEERBAC* model employs the objective of blocked events for resolving the conflicts rose in case of constraints of similar or dissimilar classes.

In this approach whenever decided priorities become ineffective then in that case we employs a negative takes-precedence principle for troubleshooting the conflicts in case of similar kind of constraints.

In this presented paper and the proposed *DEERBAC* model, we have developed certain dominant definitions and procedures that removes the conflicts in the possible conflicts arise.

The conflicts created in case of similar or dissimilar kind of constraints can be resolved by means of the following procedure:

Consider the variable *X* represents a set of prioritized event expressions as well as a constraint. And $P_a : Z$ state a prioritized event expression in case of *Z* as an event with $P_a \in \text{Prios}$. Then the variable $P_a : Z$ can

be stated as blocked by constraint *X*. This can take place only if the following conditions are satisfied:

1. In case there is $v \in \text{Prios}$, in such a way that $v : C_{conj}(Z) \in X$ and further the following conditions are satisfied:

a. If $P_a : Z$ and $v : C_{conj}(Z)$ might arise like in the case of similar constraints

1 conflict, then either

An event *Z* be in contacts to some other event Z_1 and $P_a \leq v$ or

ii. The event *Z* is corresponding with Z_2 in case of $v < P_a$;

b. Similarly, in case $P_a : Z$ and $v : C_{conj}(Z)$ may arise in case of dissimilar kinds of constraints and thus can $w : Act s$ for *m*

Here, the set of the events which are not blocked in events in the prioritized event expression *X* which is given in terms of $\text{Nonblocked}(X)$. Additionally, in case of both similar as well as dissimilar kind of constrains or conflicts caused in these circumstances the events which is blocked by similar constraints can be eliminated prior to eliminating events blocked by the constraints caused due to dissimilar kind of constraints. Additionally in case the set of prioritized event expression *X* with valid constraints present in the form of $((A, B) | T, E)$, the events are blocked by means of those constraints which are evaluated at last.

After resolving the problem or conflicts caused in the case of similar constraints, here in the presented *DEERBAC* model we ensure that a particular activation event is blocked by means of disabling the roles or de-assignment of that particular role. In case there are more activation requests for a role then few of them might be required to be blocked or de-assigned. In fact there is the need of a criterion of predefined selection that can select the activation requests which are suppose to be blocked. Here in this work we have considered a selection criterion which o depends on the priority of the received activation requests, or on the basis of duration in which the activation has to be made. Similarly, in case of the conflicts caused because of inter-constraints or in between the constraints can be eliminated by means of the below mentioned approach as implemented with our *DEERBAC* model.

Consider $(ph_{mc}, [ph_{Dft}], P_a : Act_{S_E} s)$ presents a per-role constraint and $(ph_{mx}, m, Act_{MS_E} s)$ refers a per-user-role constraint which is defined for the similar role *s* and

$$S_E \in \{S_sum, S_Max, S_h, S_con\}$$

Then, the rules presented below can be applied:

1. In case there exist the activation constraints of the similar kinds for certain roles then the constraint with the highest priority can block the other constraints.

- ### *b) Deerbac Execution Model*

The dynamics of the events and the numerous states of the role enabling and its activations in the proposed DEERBAC can be given in terms of numerous snapshots and for the same here in this paper we have developed two snapshots where the individual snapshots refers towards the respective roles and the present set of prioritized events, position of certain roles, permission assignments, etc. For the aforementioned requirements we have developed two snapshots called as m-snapshot and s-snapshots.

Similarly, the another snapshot(s-snapshot) for certain role s can be expressed as $(r, p_{sc}, h_{sc}, h_{sd}, B_s, M_s, role_status)$.

The system model in the form of system trace has been presented as follows:

In general a system trace is comprised of infinite sequences of m-snapshots (ZW) and s-snapshots (XD), so that for all the integer $t \geq 0$:

Consider that $C_t P(p) \leftarrow \{C_t | \text{En } C_t \in \text{Nonblocked}(ZW(p))\} */$

Deactivate role s of the user m : remove (x, X_m, T_m)

FOREACH $(([A, B] | T], C_t) \in C_t p(p)$ set the *per-role* parameter of *sp* to *per – role* value specified in constraint C_t

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Phase 5: Processing request for valid role activation

```

FOREACH run-time request ( $w: Act\ s\ for\ user\ m$ ) which is the subset of  $(ZW(p))$ , perform,
 $sp.h_{sc} \leftarrow sp.h_{sc} - 1$ ;  $mp.h_{mc} - 1$ ;
FOREACH  $((A, B)[T], C_t) \in C_t p(p)$  such that  $C_t$  is a constraint on role  $s$ 
  Perform, the following
  IF ( $C_t$  is per-user-role constraint) THEN
    Update the per-user-role parameter of the corresponding  $mp$  to that in constraint  $C_t$ .
  Else /*  $C_t$  retains per-role constraint */
  In case (per-user-role default value is specified in constraint  $C_t$ )
    Update the per-user-role parameter of the  $mp$  by its default value;
  Otherwise,
    Update the per-user-role parameter of  $mp$  to the per-role value in  $C_t$ ;
  Now update,
   $p \leftarrow \min(p_{mc}, p_d)$ ; /* update the remaining role value */
  Sum up  $(w, p, X_m, T_m)$ ;
    
```

Phase 6: Process constraint variables for the currently active roles and user-role activation

```

FOREACH roles – snapshot
  DO
  IF role_status = enabled THEN
    Decrement role durations;  $p_{sc} \leftarrow p_{sc} - |session(s)|$ ;
  ELSE, Update role duration,
   $p_{sc} \leftarrow p_{sc} - 1$ ;
  FOREACH user assign role  $s$ 
    Update,  $p_{ma}, p_{ma} - 1$ 
    
```

A trace is referred to as canonical only when $XD(0) = \text{set of } s - \text{snapshots}$ of the form $(s, \infty, \infty, \infty, \infty, Dis, \emptyset, \emptyset)$ for all *roles* s in the system.

Here we do consider that a particular system model starts from a preliminary state at certain time instant $p = 0$, when all the role remain in the disabled state and no user-role assignments, role-permission assignments, or valid activation constraints remains in the active state. The objective of the *DEERBAC* trace along with these kinds of preliminary state is presented with the help of a canonical trace. The set *Nonblocked*($ZW(p)$) comprised of the maximal priority events which in general takes place at time p . Here it should be noted that γ and DO estimates a unique event state and it can also be noted that the individual state information present in $XD(p)$ concerning the active state of certain defined roles rely on the constraints of activation which is enabled at time p . In fact a session constraint or the constraint of role-activation (C_t) is functional only when the enable event $EN\ C_t$ is in *Nonblocked*($ZW(C_t)$).

In this paper the algorithm ComputeXD, has been developed which estimates another state from certain existing event state employing a given set of events and authenticable constraints. On the basis of unblocked events and the present set of genuine constraints, the presented algorithm performs the update of the state information available. The events in *Nonblocked* ($ZW(p)$) takes place at time p .

As mentioned in the algorithm in phase 1, all the assignment/de-assignment of *nonblocked* events takes place which is preceded by phase 2 where the role disabling events happens. It should be noted that

whenever a particular role is disabled, the role – specific and the user – specific system variables are reset to ∞ , that depicts that in case there are no any constraints for per-role or per-user-role constraints, then in that situation the activation session as well as the count of concurrent activations are infinite or unlimited.

Phase 3 presents the conversion of per-role parameters takes place into their initial singular 1 value in correspondence with the activation constraints that become invalid. Phase 4 initializes the per-role constraint variables of the recently enabled roles which are followed by the activation of roles in phase 5. In this assignment process, initially the cardinality variables per-role and per-user-role are decremented so as to extract the remaining count of activations permitted once the activation request is granted. Then, the initialization of user constraint variable is initialized and the details of the session are updated to the session list. In phase 6, the decrement of the left over active duration for individual role is processed and thus the overall role session is managed in accordance. In case of the disabled roles, the session constraint, for both entities roles as well as users permitted to them, are decremented.

The following theorem shows that the algorithm terminates correctly. Also, the theorem provides the complexity of the algorithm.

ii. *Correctness and complexity analysis of Calc_systemtrace*

With the provided variable $ZW(p)$, $XD(p-1)$, and γ , the algorithm *Calc_Systemtrace*:

1. Generates $XD(p)$ in such a way that the updated status in $XD(p)$ satisfies all the possible constraints in Γ and those all valid activation constraints functional in the interval $(p, p+1)$, and
2. Eliminates the complexity and is presented by

$$Q(h_s(h_M + h_B + h_{Xd})),$$

Here h_s , h_M , h_B and h_{Xd} states for the number of roles, users, permissions and the maximum count of durations respectively in the developed system model.

With a defined parameter γ and a request stream DO , it is required to identify events in ZW spontaneously, the individual event must be initiated by means of certain element of γ or DO . As soon as a trigger initiates certain prioritized event, the expression of the event in the body of the trigger must not be blocked.

The events in ZW can be defined in the following manner:

iii. *Caused Events*

- iv. With a provided variables like trace, a γ and a request sequence DO , the combination of the generated prioritized events at certain time p , is

the minimum set $\text{Caused}(p, ZW, XD, \gamma, DO)$ which do satisfy the conditions given below:

If $(A, B, P_a:Z)$ and $p \in S_t I(A, B)$, then $P_a:Z \in C_t \text{Set}(p)$. (In case of periodicity constraint)

If $(P_a:Z \text{ after interval } \Delta p) \in DO(p - \Delta p) \Delta p \leq p$, then $P_a:Z \in C_t \text{Set}(p)$; (In case of runtime request)

If $[Z_1, \dots, Z_h, C_1, \dots, C_{t_l} \rightarrow C_{t_l} \rightarrow P:Z \text{ after } \Delta p] \in \gamma$ and the following conditions hold, then $P_a:Z \in C_t \text{Set}(p)$; (In case of trigger initiation):

$$0 \leq \Delta p \leq p.$$

$\forall C_{t_a}$, in such a way that $(1 \leq a \leq l)$, C_{t_a} holds

$(C_{t_a} \text{ is } C_t \text{ or } C_{t_p})$

$\forall Z_a$ in such a way that $(1 \leq a \leq h)$, $P_a:Z_a \in ZW(p - \Delta p)$ not blocked by $ZW(p - \Delta p)$.

In case

$C_t = (A, B, E) \in \gamma$ And $p \in S_t I(A, B)$ (for constraints of duration/activation constraints)

$$0 \leq \Delta p = (p - p_1) \leq T_e.$$

$[G \rightarrow P_a:Z \text{ after duration } \Delta p] \in \Gamma$ or a runtime request

$P_a:Z \in DO(p - p_1)$, as a result of which $P_a:Z \in C_t \text{Set}(p - p_1)$ not blocked ($ZW(p - p_1)$), then $P_a:$

$ENC_t \in C_t \text{Set}(p)$:

If $C_t = (T, E) \in \gamma$ where $E \in \{M, S, B\}$, and if there exists a pair p_1, p_2 such that

$$p_1 - p_2 \text{ and } \Delta p_1 = (p - p_1) \leq p.$$

$(\exists [G \rightarrow P_a:ENC_t \text{ after } \Delta p_1]) \in \gamma$ OR $P_a:ENC_t \in DO(p - p_1)$ as a consequence of which enable $C_t \in C_t \text{Set}(p - p_1)$ and is not blocked by $ZW(p - p_1)$, then

$$s:ENC_t \in C_t \text{Set}(p);$$

Additionally, in case $E = (T_e P_a:Z) \in \gamma$ refers a duration constraint in such a way that $a \in \{M, S, B\}$, and the below mentioned conditions are satisfied

$$\exists [G \rightarrow P_a:Z \text{ after } \Delta p_2] \in \gamma \text{ OR}$$

$P_a:Z \in DO(p - p_2)$, as a result of which $P_a:Z \in ZW(p - p_2)$ and is not blocked by $ZW(p - p_2)$, then $P_a:ENC_t \in C_t \text{Set}(p)$ and $v:\text{enable } a \in C_t \text{Set}(p)$,

In this expression the variable v states for the priority level specified for a .

The defined condition C_{t_1} states that all the events are scheduled with the help of or after processing a periodic event by adding into the set $\text{caused}(P, ZW, XD, \gamma, DO)$.

Similarly, the other conditions can also indicate for adding up of the explicit runtime requests into the set $\text{Caused}(p, ZW, XD, \gamma, DO)$, scheduling with trigger function with provided that the conditions C_{t_a} specified in the body of the trigger are satisfied and each of the events Z_a occurs at time $p - \Delta p$.

VI. DEERBAC TEMPORAL HIERARCHIES AND SEPARATION OF DUTY CONSTRAINTS

The constraints like temporal hierarchies and the Separation of Duty (SoD) play a significant role in the specification of the roles in certain policies and the security management in cloud environment. In this proposed DEERBAC model we have considered the

temporal hierarchies as well as the separation of duty (SoD) constraints which has performed well and the overall optimization has achieved by means of such system modeling.

```

I. Algorithm Secure_chk
II. Parametric Input: TCAB  $p$ 
III. Output: true if  $T$  is safe, false otherwise
IV. Update  $H \leftarrow 0; Z \leftarrow 0;$ 
V. FOR all  $[G \leftarrow P_a:Z] \in P$  DO
VI. IF  $(Z = \text{Act } s \text{ for user } m)$  THEN return false;
VII. Update  $H \leftarrow H \cup \{P_a:s\};$ 
VIII. FOR all  $[G \rightarrow P_a:Z] \in P$  DO
IX. FOR all  $Z' \in G$  such that  $\exists v; v:Z' \in H$  DO
X.  $Z \leftarrow Z \cup \{(v:Z', +P_a:Z_a)\}$ 
XI. FOR all  $s: Cconj(Z'), \in H$  such that  $vs$  DO
XII.  $Z \leftarrow Z \cup \{(s: Cconj(Z'), -, P_a:Z_a)\}$ 
XIII. /* Generation of cycle and its verification */
XIV. Estimation of strongly connected components(SCC) of  $\langle H, Z \rangle$ 
XV. FOR all  $\langle H', Z' \rangle \in SCC$  DO
XVI. FOR all  $\langle E, l \rangle \in Z'$  DO
XVII. IF  $l = '-'$  THEN return false;
XVIII. return true;
```

Figure 2 : Algorithm *Secure_chk*.

Permitting the permission-inheritance in the proposed DEERBAC model the role hierarchies can effectively reduce the overall system overhead allied with the management of permission administration [19]. SoDs Comprised of constructive restrictions for prohibiting the possible deception to which certain user could have done by means of certain conflicting activities [19], [16]. In this section of the presented manuscript for DEERBAC model we have presented the fundamental semantics of hierarchies and SoDs with respect to time. In a temporal context, it becomes important for establishing certain unambiguous semantics of permission-inheritance and role-activation in certain system hierarchy when enabling or activating hierarchies allied with the roles to be considered. In a role hierarchy, permission-inheritance semantics make out the permissions to which a specific role can accede to its subordinate roles. In the same way, once a role is allotted to certain user, the role-activation semantics finds out the set of subordinate roles to that specific user can activate.

Previous to depicting the temporal hierarchies and time based *SoDs*, here we would discuss about the four status predicates, given by,

$Can_Act(m, s, p) Can_Acq(m, B, p)$
 $CCanb_Acq(B, s, p), \text{ and } Acq(m, B, w, p)$

Predicate $Can_Acq((m, s, p)$ states that user u can activate certain role s at period t , implying that user m is assigned to role s . In the same way, can be $Canb_Acq(B, s, p)$ states that permission B is implicitly or explicitly is allotted to role s , whereas can $Can_Acq(m, B, p)$ refers that role B is implicitly or explicitly permitted to m . $Acq(m, B, w, p)$ Depicts that m achieves the permission B at time p in session w .

The first proverb employed here in this work states $(Asg(B, s, p) \rightarrow Canb_Acq(B, s, p))$ states that in

case permission is allotted to a role, the permission can be accomplished with the help of that specific role. Similarly another adage stated in the form $((Asg(m, s, p) \rightarrow Can_Act(m, s, p)))$ states that all the users allotted or permitted to a role can activate their respective roles. Axiom

$(Can_Act(u, s, p) \wedge Can_Acq(B, s, p) \rightarrow Can_Acq(m, B, p))$

states that if a user m can activate a role s , then in that case all the possible permissions which can be retrieved by s can be accomplished by user m . Similarly, proverb

$Act(m, s, w, p) \wedge Canb_Acq(B, s, p) \rightarrow Acq(m, B, w, p)$

states that if there is user duration in which a user m has activated certain role s , and then m achieves all the permissions which can be achieved with the help of role s . Considering these truism it can be found that the inception two consecutive proverbs state that permission acquisition and role-activation semantics are monitored and managed by the explicit user-role and role-permission assignments.

a) Temporal Role Hierarchies

A role hierarchy inflates the extent of the authorization acquisition and role-activation semantics ahead of the explicit permission assignments in the course of the hierarchical relations among various roles. In the proposed DEERBAC model we have defined three categories of hierarchies:

1. Unrestricted hierarchies: this is that hierarchy, in which the role activation semantics and the permission-inheritance semantics are not influenced by the presence of any duration constraints on the hierarchically related roles,
2. Enabling time restricted hierarchies: In this case the permission-inheritance and role-activation semantics highly depending upon the enabling duration of the hierarchically allied or associated roles, the third one is
3. Activation time restricted hierarchies, in which the permission-inheritance and role-activation semantics depend on the active states of the hierarchically related roles.

Table 1 : Extended Status Predicates

I. Predicate	II. Meaning
III. $EN(s, p)$	IV. Role s is enabled at time p
V. $(m_Asg(m, s, p))$	VI. User m is assigned to role s at time p
VII. $(B_Asg(B, s, p))$	VIII. Permission B is assigned to role s at time p
IX. $Can_Act(m, s, p)$	X. User m can activate role s at time p
XI. $Can_Acq(m, w, p)$	XII. User m can acquire permission w at time p
XIII. $Canb_Acq(w, s, p)$	XIV. Permission w can be acquired through role s at time p
XV. $Act(m, s, w, p)$	XVI. Role s is active in user m at time p
XVII. $Acq(m, B, w, p)$	XVIII. User m acquires permission B in session w at time p
XIX. Proverbs : for all $s \in Roles, m \in Users, B \in Permissions w \in Sessions$, and time instant $p \geq 0$, the following implications hold:	
XX. 1	XXI. $Asg(B, s, p) \rightarrow Canb_Act(B, s, p)$
XXII. 2	XXIII. $Asg(m, s, p) \rightarrow Can_Act(m, s, p)$
XXIV. 3	XXV. $Can_act(m, s, p) \wedge Canb_Acq(B, s, p) \rightarrow Can_Acq(m, B, T)$
XXVI. 4	XXVII. $Act(m, s, w, p) \wedge Canb_Acq(B, s, p) \rightarrow Acq(m, B, w, p)$

In general the unrestricted and enabling-time restricted hierarchies can be categorized into three broad categories: inheritance-only hierarchy ($I - hierarchy$), activation-only hierarchy ($A - hierarchy$), or inheritance-activation hierarchy ($IA - hierarchy$).

The conditions for the $E - hierarchy$ states that in case of $g \geq p_q$, the permissions that can be achieved by means of g encompasses all the permissions allotted to g and all the permissions which can be accomplished by means of role q .

In DEERBAC model $A - hierarchy$ states that in case a user m can activate certain role s , and $g \geq p_q$, then that user can also activate role q , even if that user m is not explicitly allotted to q . Whenever the enabling time durations allied to the hierarchically related roles in partial overlap, it becomes required to consider the problem of application of inheritance and activation semantics in intervals in which only one role remains active or is in enabled status. So as to capture the inheritance and activation semantics when the enabling times of the hierarchically related roles partially overlap, here in the proposed DEERBAC model we have introduced the approach of *weakly restricted* and *strongly restricted* hierarchies where the weakly restricted hierarchies permits the inheritance or activation semantics in the non-overlapping intervals, on the other hand the strongly restricted hierarchies permits the inheritance and activation semantics only in the

duration of overlapping. As per the condition of weakly restricted $E - hierarchy$, in case $g \geq_{weak,p} q$, then only role g is required to be enabled at time p for applying the inheritance semantics and in that case the role q can or can't be enabled at that time. In the same way, for the $A_{weak} - hierarchy$, $g \geq_{weak,p} q$, only the role q is required to be enabled.

In an activation-time hierarchy $A_A - hierarchy$ a user can activate the subordinate role only in the case when it has already activated the senior role. It should be noted that the $A_c - hierarchy$ permits the activation of the subordinate roles as well as the senior roles in the same or different time duration. A session-specific activation-time hierarchy $A_{wc} - hierarchy$ performs in a highly restrictive manner of $A_c - hierarchy$, in which the simultaneous activation is permitted for both the senior and subordinate roles in the similar or same session. It should be noticed that A_c , A_{wc} , and $A_{wsc} - hierarchy$ possess the mutually inclusive semantics where they permit the subordinate role for being activated only in the case when the senior is in the active state.

The exclusive activation-time hierarchy ($A_e - hierarchy$), presents a mutually exclusive semantics for a hierarchy relation. The three conditions employed for $A_e - hierarchy$ states that the singular hierarchically associated roles might be activated simultaneously. Additionally, when a role is activated the permissions of its juniors are not inherited. The $I_{Ae} - hierarchy$ extends $A_e - hierarchy$ with a supplementary condition that if a role is activated, permissions that can be acquired through its junior are also acquired. In a given set of roles, various inheritance relations may exist. Hence, in order to assure that the senior-subordinate relation between two roles which exist in one kind of hierarchy is not turned around in another.

i. Time-Based Separation of Duty Constraints

The DEERBAC models permit the static as well as dynamic SOD constraints ($SSOD$ and $DSOD$). In this model we have bind a SOD constraint which has to be implemented in a certain set of intervals by employing periodicity constraints of the form (A, B, SOD) . In the same way, a duration constraint might be specified for an SOD as $([A, B|T], [T_e, SOD])$. Then while, various semantic interpretations of the constraint (A, B, SOD) or $([A, B|T], [T_e, SOD])$ might exist. Prior to presenting this kinds of interpretations of a periodicity constraint (A, B, SOD) , initially we have observed that for single interval, say π , the constraint expression π, SOD can be interpreted in two ways, as defined for weak and strong forms of time-based $SSOD$.

The strong form $\pi, SSOD_s$ states that in a defined specific time interval, if there exist an instant in which a role R , is allotted to certain user, then at no other instant in π can the user be allotted to a role that might cause

the conflict with role s . Employing these two forms, here in $DEERBAC$ model we have obtained three semantic interpretations of periodicity constraint $(A, B, SSOD)$. the weak form $(A, B, SSOD_{weak})$ states that at each time instant in (A, B) , a user must not be allotted to conflicting roles. $(A, B, SSOD_{weak})$, then also, permits a user to be allotted to two conflicting roles at different time durations. The strong form $(A, B, SSOD_{strong})$ states that for individual recurring intervals in (A, B) , the strong form of interval constraint $(\pi, SSOD_{strong})$ is implemented. The extended strong form $(A, B, SSOD_{Ext_strong})$ implies that there are no two or more time instants in (A, B) for which a user can be assigned roles with certain conflicts.

ii. Security of DEERBAC model with Temporal Hierarchies and SoD Constraints

In spite of SOD constraints and temporal hierarchies it needs the extension of the objective of blocked events and TCAB safety as these approaches introduces new scenarios in which certain events might be blocked or certain insecure scenario might occur in cloud environment. Specifically, in order to implement specified SOD constraints, few events are required to be blocked. In certain work the researchers Ahn et al [18] presented that both $SSOD$ and $DSOD$ constraints could be presented as cardinality constraints with respect to certain specific or provided user and role sets. Thus, by implementing such kind of condition which is allied with the activation cardinality constraint, the events added to (p, ZW, XD, γ, DO) can be expressed in the presence of the SOD constraints.

It can be noted that only the addition of $A_{wsc} - hierarchy$ is required to be estimated with respect to the security of γ . As for illustration, in the presented *Secure_Chk* algorithm we are capable of detecting the unsafe situations like the presence of the pair of trigger $(EN_g \rightarrow P_a : Z; P_a : Z \rightarrow Dis_g \text{ in } \gamma)$. However, $\{Act_g \text{ for user } m \rightarrow P_a : Z; P_a : Z \rightarrow w : Dact_q \text{ for user } m\}$ is considered secure by application of *Secure_Chk* algorithm. This is possible because the events in triggers are of dissimilar kinds which don't cause any conflict. However, if we add $A_{wsc} - hierarchy$ between roles g and q , i.e., if

$$\gamma = \{Act_a \rightarrow P_a : Z; \\ P_a : Z \rightarrow s : Dact_q \text{ for } m, (g \geq_{wsc,p} q)\},$$

Then in that case γ becomes unsafe. In order to illustrate this point, suppose that initially $ZW(p) = \{w : Act_g \text{ for user } m, w : Act_q \text{ for user } m\}$. As the events are not blocked, the pair of triggers in γ generates

$$ZW(p) = \{w : Act_g \text{ for user } m, w : Act_q \text{ for } m, \\ w : Dact_q \text{ for user } m, P_a : Z\}.$$

Note, event " $w : Act_q \text{ for user } m$ " is now blocked by the event " $w : Dact_q \text{ for } m$," resulting in $Nonblocked(ZW(p)) = \{w : Act_g \text{ for user } m$

$w: Dact_q \text{ for user } m, P_a : Z\}$

As $A_{wsc} - hierarchy$ needs that both the roles g and q is in the active state simultaneously during a session, then the hierarchy constraint would block the event " $w: Act_c \text{ for user } m$ ". Therefore, event " $w: Act_g \text{ for } m$ " causes event " $w: Dact_q \text{ for user } m$ " that further blocks the previous events. It must be noted that the conflicting scenarios are introduced because the $A_{wsc} - hierarchy$, additionally defines a session-based constraint in spite of the role-activation semantics. Except for the $A_{wsc}, Ae, I - Ae - hierarchies$, the other hierarchies define only the permission-inheritance and role-activation semantics and, therefore they do not cause such kinds of conflicting scenarios.

The ascending section presents the results and conclusion obtained for the proposed system model.

VII. RESULTS

In this research work a dynamic expiration enabled role based access control "DEERBAC" model has been developed for highly competitive and secured cloud computing environment. The system model presented has been developed with C# programs and Visual Basic 2010 framework. The overall system has been developed and implemented with Amazon S3 cloud platform. The developed system has been simulated for different performance parameters like induction of roles and user creation. The relative study for these all factors has been performed. The system or model performance has been verified for various user size with dynamic role assignments and the relative throughout as well as performance parameters have been checked for its robustness justification.

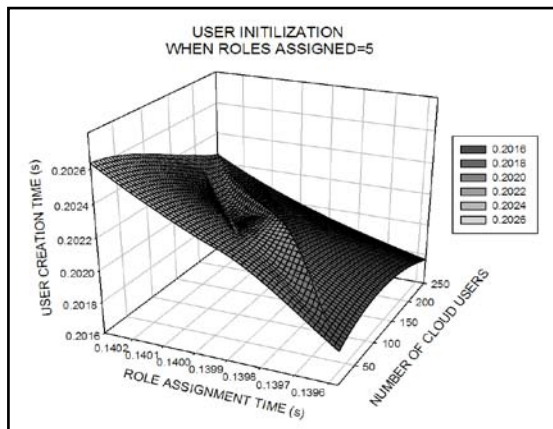


Figure 3 : User initialization with 10 role assignments

The above mentioned figure (Figure 3) depicts the initialization of users for 10 respective role assignments and here from the figure it is clear that the role assignments can be better as per the number of increased users. Referring to Figure 4 and comparing it with previous figure it can be found that with higher users the time for user creation varies linearly but there

occurs certain variation in user creation time with increase in assignment of role. The creation time decreases as per increase in higher count of cloud users.

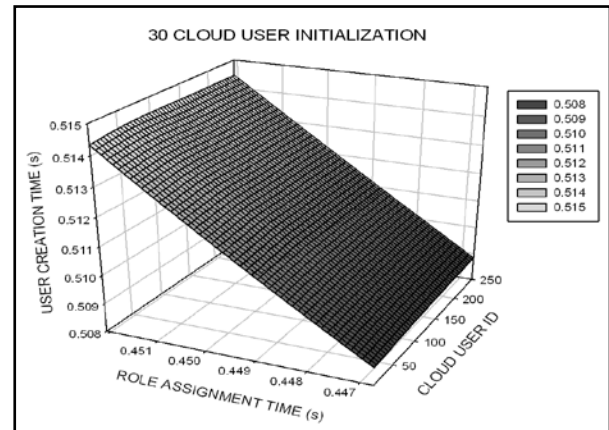


Figure 4 : User initialization with 30 role assignments

Figure 5 depicts the user initialization with 100 roles and from figure it can be concluded that in case of proposed DEERBAC model the user creation time decreases with increase in the cloud user count and in the same proportion the role assignment time also decreases as per higher counts of cloud users. This illustrates the robustness of our proposed DEERBAC system for cloud environment.

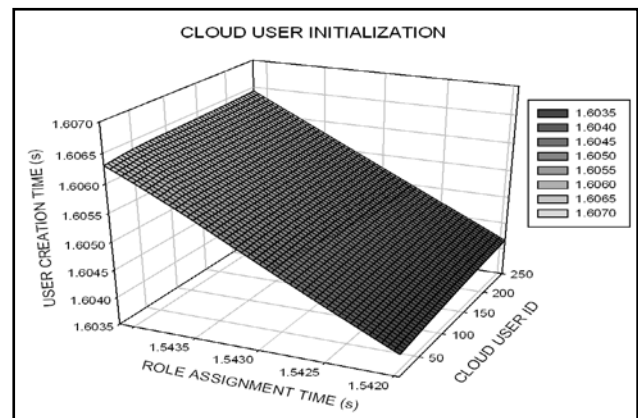


Figure 5 : User initialization with 100 role assignments

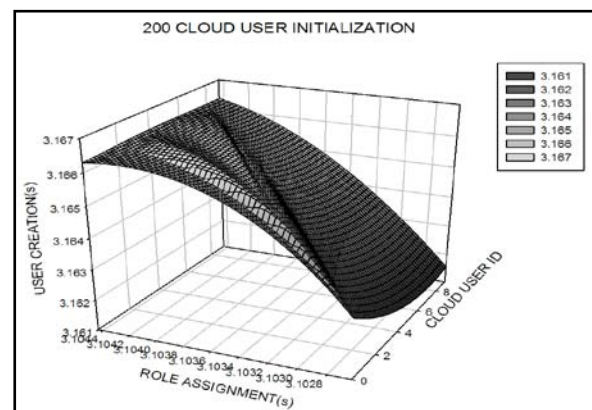


Figure 6 : User initialization with 200 role assignments

The above mentioned figure (Figure 6) depicts the initialization of users with respective 200 role initialization. The dominant factors that is coming out of the presented results is that the proposed system is capable of assigning roles even with higher count in least possible and of course uniform way. This justifies the stability of the proposed system with higher number of users in cloud environment and with more role assignments. Figure 8 presents the graphs for role generation with varying user counts and the respective time variation for role generation.

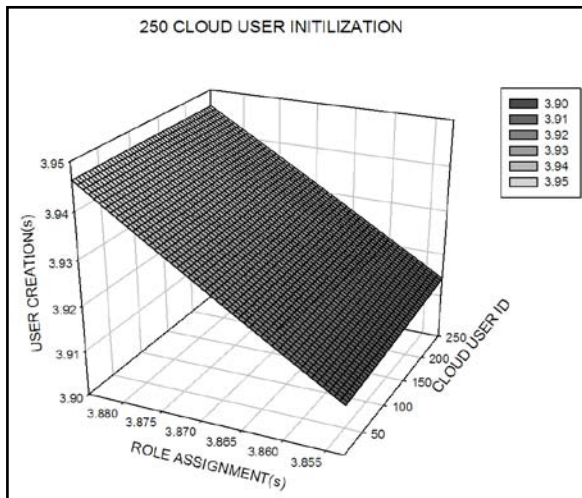


Figure 7 : User initialization with 250 role assignments

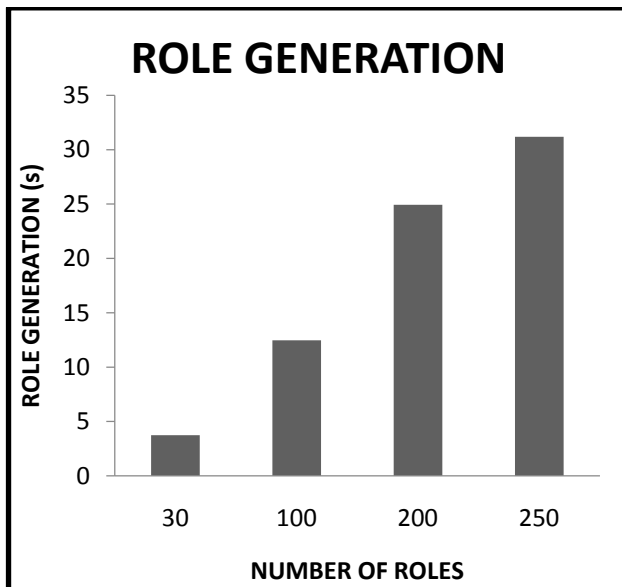


Figure 8 : Role generation performance evaluation in DEERBAC model

VIII. RESULTS

In this work the author has proposed a dynamic expiration enabled role based access control (DEERBAC) system which permits the characterization of a widespread set of temporal constraints. Specifically the proposed system specifies the various constraints

for role enabling and its activation and numerous temporal restrictions functional for on user-role and role-permission assignments. In this DEERBAC model we have also discussed the various time-based semantics of temporal hierarchies and separation of duty constraints or SoD constraints. An objective of security has been considered in the form of a highly secured execution model that functions overall DEERBAC model for accomplishing security in cloud or for security management. The constraints for duration along the work in reference [17] might be assumed as dependency constraints in which the temporal intervals allied with a role remains dependent on the time intervals allied with some other roles. The proposed DEERBAC model additionally introduces the extensions to the various semantics of the temporal or another constraint. The implementation of various hierarchical constraints and separation of duty constraints for real time implementation makes this system highly efficient for real time implementation with higher user count and competitive cloud environment. The results also have established that the proposed model can be an effective and optimum approach for role based access control in cloud environment.

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A Novel Skeleton Extraction Algorithm for 3d Wireless Sensor Networks

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A Novel Skeleton Extraction Algorithm for 3d Wireless Sensor Networks

S. K. Pushpa^α, S. Ramachandran^σ & K. R. Kashwan^ρ

Abstract- Wireless sensor network design is critical and resource allocation is a major problem which remains to be solved satisfactorily. The discrete nature of sensor networks renders the existing skeleton extraction algorithms inapplicable. 3D topologies of sensor networks for practical scenarios are considered in this paper and the research carried out in the field of skeleton extraction for three dimensional wireless sensor networks. A skeleton extraction algorithm applicable to complex 3D spaces of sensor networks is introduced in this paper and is represented in the form of a graph. The skeletal links are identified on the basis of a novel energy utilization function computed for the transmissions carried out through the network. The frequency based weight assignment function is introduced to identify the root node of the skeleton graph. Topological clustering is used to construct the layered topological sets to preserve the nature of the topology in the skeleton graph. The skeleton graph is constructed with the help of the layered topological sets and the experimental results prove the robustness of the skeleton extraction algorithm introduced. Provisioning of additional resources to skeletal nodes enhances the sensor network performance by 20% as proved by the results presented in this paper.

Keywords: 3d, algorithm, protocol, wireless sensor networks, skeleton extraction, skeleton node.

1. INTRODUCTION

Wireless sensor networks constitute sensor nodes that are deployed over a topological area. Sensor nodes are independent, low resource devices possessing processing units, sensing devices, communication bandwidth, power resources and radio trans-receiver systems. Network life time, accurate data aggregation, and overhead reduction are desired characteristics of sensor network deployments. Network design is critical to construct efficient wireless sensor networks. Sensor networks are used for varied applications like unforeseen disaster relief [1] and [2], underwater sensor networks [3], monitoring activities [4], surveillance in military applications [5], medical monitoring systems [6] and many more. Network design is critical in sensor network deployments to achieve the desired goals [7]. Considering the varied application domain of sensor networks, it can be stated that the

deployment methodology and the geographic deployment environments greatly vary. Wireless sensor network design, deployments of sensor nodes and analyzing the resources to be allocated to the sensor nodes is a major problem that exists. The shape of wireless sensor network deployments generally considered are usually in the shapes of a square or oval which is not the case in actual deployments [8].

Moreover researchers generally consider 2D topologies or 3D projections schemes to model the surface coverage which lead to inaccuracies and deviations from realistic environments [9]. In real word applications, sensor network deployments are complex 3D spaces. Generally researchers use a simple 2D ideal plane [10, 11] or a 3D full space models [12, 13] for the environment which are inadequate to achieve realistic results. A recent study conducted by Linghe Kong et al. [9] highlights the surface coverage problems for deployments of sensor networks in the idealistic world. In Ref. [9], the authors ascertain that the field of interest is neither 2D nor 3D but consists of complex surfaces, with the help of the Tungurahua volcano monitoring project [14] shown in Fig. 1. Furthermore, the authors in Ref. [9] define a coverage dead zone that exists in adopting a 2D surface coverage model described in Fig. 2 of this paper. Let us consider a set of seven sensor nodes termed Node A – Node G as shown in Fig. 3. The sensor nodes appear to be deployed in an elevated 3D terrain or a hill sort of a terrain. The 2D representation of the similar topology is presented in Fig. 4. While considering 2D topologies, nonexistent or impractical links are established as shown by a thick grey line in the figure. This error generally occurs in the network and the physical layer modeling.

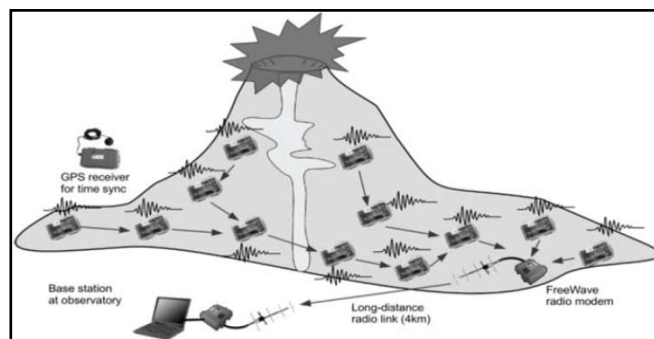


Figure 1 : Volcano monitoring Project from Harvard Sensor Networks Lab [14]

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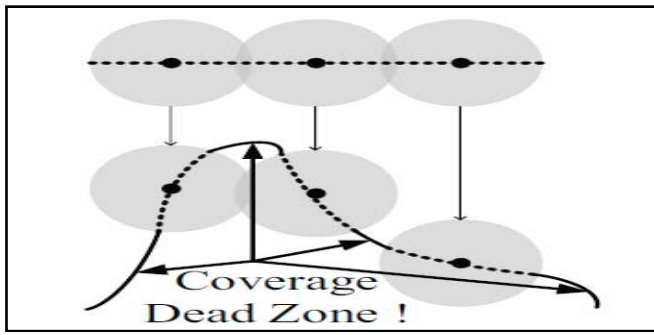


Figure 2 : Coverage Problem Dead Zone that occurs when 2D Plane Solutions are adopted to 3D surfaces [9]

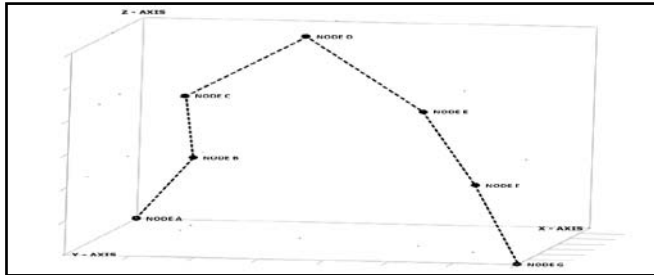


Figure 3 : A seven sensor node topology in 3D surface

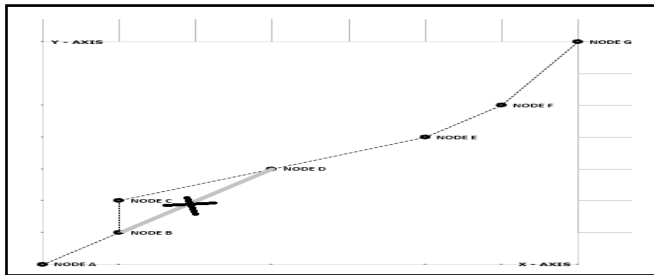


Figure 4 : Network Layer/Radio Layer Error while applying 2D models to 3D topologies of Sensor Networks

From the above mentioned examples, it is evident that the 2D models that currently exist may not be applicable to real world scenarios. In the research work presented, the authors propose to consider 3D complex surface models for modeling sensor network deployments.

Skeleton extraction techniques have been extensively studied in the areas of image processing [15], medical image processing [16], computer graphics [17] and computer vision [18] and [19]. The use of skeleton extraction to represent the shape properties is well established. The skeleton extraction algorithms discussed above cannot be directly applied to wireless sensor network topologies as wireless sensor network topologies are discrete in nature and not continuous. Also the skeleton of wireless sensor networks depends on the network connectivity of the sensor nodes and not on the topological position alone. Wireless sensor networks are noisy by nature owing to the fact that the hop based approach is used to compute distances and not the Euclidean distance. The effect of noise tends to

inaccurate skeleton extraction proved in Ref. [21]. In post skeleton node identification, the skeleton node connectivity also poses another challenge as the skeleton connectivity is physical layer based and not discrete. The use of skeleton extraction techniques to represent wireless sensor network topologies and thus enhance the performance is proposed by researchers in Ref. [20-22]. However, the application to the 3D topologies is still limited. The research work presented here considers sensor network deployments in 3D complex spaces.

This paper introduces a skeleton extraction algorithm applicable to 3D wireless sensor network topologies where the coverage of the network is considered as a complex 3D function. In order to extract the skeleton, transmissions are initiated from each sensor node to all the other sensor nodes recursively and are modeled as transmission vectors. An energy utilization function is defined to identify the skeletal links. The skeleton is represented as a graph and the root node is computed using the frequency based weight assignment function. The skeleton nodes are extracted from the skeletal links. The skeleton graph construction is achieved by layered topological sets that represent decomposed clusters of the topology. The distance function is defined to organize the position of the skeleton nodes in the skeleton graph.

The remaining manuscript is organized as follows. The literature is reviewed in section two of this paper. The proposed skeleton extraction algorithm is presented in the third section. The experimental study is described in the subsequent section. The conclusions of the research work are drawn in the last section of this paper.

II. LITERATURE REVIEW

The skeleton extraction algorithms proposed by researchers can be broadly classified into four categories namely thinning and boundary propagation, distance field-based, geometric based, and general-field function based methods [18]. In the thinning and boundary based methods, the skeleton is represented as a thin line describing the topology. It is usually achieved by recursively shrinking of objects to a core thin line representing the topology [23]. To reduce the processing time which is a major drawback of the thinning and boundary based methods, researchers have also proposed parallel implementations of the thinning algorithms in 3D objects [24]. Most of the distance field based algorithms adopt a three step approach to extract the skeleton. The primary step constitutes in obtaining the ridge points of the object. Then a pruning methodology is applied followed by the connectivity phase to construct the skeleton. For connectivity, many algorithms like the shortest path technique [25, 26], minimum spanning tree [27, 28], LM path technique [29] or other geometric techniques are

utilized. The advantage of distance field methods is that they are computationally lighter when compared to the other methods and is very effective in the case of tubular objects. The major drawback of the distance field algorithms is that on application to arbitrary objects, the skeleton extraction is not accurate. In the geometric based methods of skeleton extraction the objects are represented as sets of scatter points or structures of polygonal meshes. Voronoi diagram representations [30-32] is a popular example for geometric based methods for skeleton extraction. The polyhedral geometric method to represent 3D structures is discussed in Ref. [33, 34]. The drawbacks of the geometric methods are that they are computationally more expensive when compared to the thinning and boundary based methods and they produce medial surfaces rather than the skeleton curve. In the general field generation based methods, varied functions are utilized to represent fields and these functions are utilized to generate skeleton curves. Potential field functions [35, 36], visible repulsive force functions [37], electrostatic field functions [38], radial basis functions [39] are a few considered by researchers. The field generation algorithms are less sensitive to noise and produce better results when compared to the geometric methods. As the field generation functions are first or second order functions, they are computationally heavy to solve and are considered unstable. The skeleton extraction methodologies may not be applicable to wireless sensor network topologies directly, which is the purpose of the research work proposed here.

Skeleton extraction in wireless sensor networks pose many challenges as discussed in the previous section of the paper. The migration of topology shapes to geometrical ones and the use of a dynamic medial axis model to present these geometric shapes are used for skeleton extraction in Ref. [40]. A medial axis based naming and routing protocol for wireless sensor networks is proposed in Ref. [21]. The methodology proposed in Ref. [21] consists of two protocols, namely, the medial axis construction protocol and the medial axis based routing protocol. In the medial axis construction protocol, the skeleton nodes are identified and the skeleton of the wireless sensor network topology is constructed. The medial axis based routing protocol achieves efficient load distribution during routing through the sensor networks due to the local decision capacities while routing. In Ref. [8], a connectivity based skeleton extraction algorithm applicable to wireless sensor network topologies is proposed. The coarse skeleton graph is extracted by boundary partitioning to identify the skeletal sensor nodes, generating the skeletal arcs, extending connectivity amongst the skeletal arcs. This coarse skeleton is finally refined to give the skeleton graph. The algorithm proposed in Ref. [8] accurately preserves the network topology and is robust to the noisy sensor

network topology. A distance transform based skeleton extraction algorithm for large scale wireless sensor networks is proposed in Ref. [22]. The algorithm proposed by Wenping Liu et al. [22] is more applicable to the practical applications as it does not require accurate or complete boundaries of sensor network topologies, exhibits lower communication overheads and is robust to noise. In Ref. [22], the coarse skeleton is generated by constructing the node map based distance transform of the sensor network; using the distance map the skeleton nodes are identified and the arcs are connected using a controlled folding scheme. The coarse skeleton is refined using the shortest path trees to construct the skeleton graph. The drawbacks of the skeleton extraction algorithms for wireless sensor networks discussed here is that the authors have considered the surface coverage in only 2D topologies and not the complex 3D topologies of wireless sensor networks that practically exist and proved in Ref. [9].

III. PROPOSED SYSTEM - SKELETON EXTRACTION ALGORITHM FOR 3D WIRELESS SENSOR NETWORKS

a) Preliminary Notations

Let us consider a 3D wireless sensor topology $\mathcal{T}$ be represented as a graph $\mathbb{G}(N, L)$, where N represents the sensor node set and L is the wireless link set. The location wireless sensor node $n_a \in N$ described by Cartesian coordinates is represented by

$$p_{n_a} = (x_{n_a}, y_{n_a}, z_{n_a}) \quad (1)$$

The skeleton or critical nodes to be identified in the sensor network topology $\mathbb{G}$ is defined by a set S and the remaining nodes are defined by the set R .

$$N = S \cup R \quad (2)$$

Let the transmission radius of the sensor node be represented as r_t and the sensing radius be represented as r_s . As 3D topologies in complex spaces are considered, the coverage of the N sensor nodes [9] can be defined as

$$1 - \left(1 - \sum_i ((\mathcal{A}_i / \mathcal{A}_T) (2\pi^2 r^2 / 2\pi(\pi r^2 + \mathcal{A}_i) + 2\pi r \mathcal{A}_i) ((\mathcal{A}_i + \mathcal{P}_i r + \pi r^2) \cos \theta_i / (\mathcal{A}'_T + \mathcal{P}_T r + \pi r^2))) \right)^{\lambda(\mathcal{A}'_T + \mathcal{P}_T r + \pi r^2)} \quad (3)$$

Where $\mathcal{A}_T$ represents the area

$\mathcal{P}_T$ is the perimeter

λ is the sensor deployment intensity

θ_i is the angle between $\mathcal{A}_i$ and $x y$ plane and

$\mathcal{A}'_T$ is the area of the z plane projection of $\mathcal{A}_i$.

The skeleton of the 3D wireless topology $\mathcal{T}$ can be considered to represent a graph $\mathbb{G}_S(S, L_S)$, where $\mathbb{G}_S \subset \mathbb{G}$ and L_S is a set of skeleton links amongst S_E and S_C . S_E represents the set of the extreme sensor nodes in the topology $\mathcal{T}$ and S_C represents the sensor node which is common to all the skeleton links L_S . In order to extract the skeleton of sensor networks generally a transmission based scheme is adopted [41] [42], in which each sensor node initiates a transmission to the other nodes and then the response messages or the route reply messages are used to derive $\mathbb{G}_S$ and hence the authors of this paper adopt a similar mechanism. The major drawback of such mechanisms already adopted is that the network energy utilized associated with the transactions is established heuristically and are not applicable to 3D sensor

networks. In order to overcome this drawback, the research work presented here does not consider the heuristic mechanism generally adopted and introduces a novel energy utilization function represented as $\epsilon(n)$ to compute the energy utilized during transmissions. The energy utilization function is derived in a manner such that if energy utilization of path between a set of sensor nodes is the least, then the link $l \in L_S$.

b) Energy Utilization Function $\epsilon(n)$ for Skeleton Extraction

Let s be a skeleton node and r represent a non-skeleton node. Let $f(n)$ represent a frequency based weight assignment function that assigns skeleton nodes with higher values than the non-skeleton nodes. In other words, $f(s) > f(r)$.

Let's consider sensor node n_{src} at a location $p_{n_{src}} \in \mathcal{A}_T$ transmitting some data to the sensor node n_{dst} located at $p_{n_{dst}} \in \mathcal{A}_T$. If the energy utilized in obtaining the optimal link route is defined as

$$\mathcal{E}(n_{src}) = m \downarrow_{L_{n_{src} n_{dst}}} \int_{n_{src}}^{n_{dst}} \epsilon(L(n)) dn \quad (4)$$

Where $L(n) : [0, \infty) \Rightarrow L^n$ is the function that computes the optimal energy route.

$L_{n_{src} n_{dst}}$ is the routing table of the sensor node n_{src} to sensor node n_{dst}

$m \downarrow_{L_{n_{src} n_{dst}}}$ represents the minimum hop route from sensor node n_{src} to sensor node n_{dst}

ϵ represents the energy utilized

The energy utilized in obtaining the optimal route can also put forth the least time interval for any active transmission from n_{src} to n_{dst} when the physical radio layer transmission speed is $\mathcal{V}$, i.e.,

$$|\nabla \mathcal{E}(n_{dst})| \times \mathcal{V}(n_{dst}) = 1 \quad (5)$$

The energy utilized ϵ with respect to the radio layer transmission rate can be therefore defined as

$$\mathcal{V}(n_{dst}) = 1/\epsilon(n_{dst}) \quad (6)$$

The generalized form of the above equation can be defined as

$$\mathcal{V}(n) = 1/\epsilon(n) \quad (6a)$$

Where $\mathcal{V}(n)$ is the radio layer speed function defined as

$$\mathcal{V}(n) = \chi(f(n)) \quad (7)$$

The skeleton of a 3D sensor network topology consists of a set of nodes S and a set of links connecting these skeleton nodes L_S represented as a graph $\mathbb{G}_S \subset \mathbb{G}$. Let (n_i, n_j) represent a sensor node

pair. The node pair $(n_i, n_j) \in S$ if the energy utilization function is defined as

$$\epsilon(n) = e^{-\eta f(n)} \quad (8)$$

where $\eta > 0$ and is defined as

$$\eta > (1/\alpha) \ln \left(\sqrt{(d^2x + d^2y + d^2z)} / m \downarrow (dx, dy, dz) \right)$$

Where dx, dy, dz is the spacing, $m \downarrow$ is the minimum function and α is the minimum value of the

absolute difference between the neighboring sensor nodes.

c) S_C point computation

In the research work presented here, the authors adopt the contour or snake model introduced in Ref.

[43] to obtain the skeleton nodes of the 3D wireless sensor network topology $\mathcal{T}$. The snake or vector of the trans-

missions that propagate through $\mathcal{T}$ can be defined as

$$V_S(n) = [u_S(n) \ v_S(n) \ w_S(n)]^A \quad (9)$$

The snake $V_S(n)$ minimizes the energy function defined as Eq. (10), yet maintaining topology features

where $f_S(n)$ is the edge map derived, $n = (x, y, z)$ and the parameter of regularization is represented as μ .

$$\mathcal{E}_S(V_S) = \iiint (\mu (|\nabla u_S(n)|^2 + |\nabla v_S(n)|^2 + |\nabla w_S(n)|^2)) + (|f_S(n)|^2 |V_S(n) - \nabla f_S(n)|^2) dn \quad (10)$$

The energy function $\mathcal{E}_S$ of the snake of the V_S is dominated by the partial derivatives of or the primary term in the case where $\nabla f_S(n)$ is small. In the case where $\nabla f_S(n)$ is large, $\mathcal{E}_S(V_S)$ is greatly dominated by the second term and the energy involved can be minimized by assuming $V_S = \nabla f_S(n)$. The use of generalized diffusion equations [44, 45] is considered to find the solution of the snake $V_S(n)$. The $V_S(n)$ of the n^{th} node is

computed from the remaining node points in the topology $\mathcal{T}$ by utilizing a diffusion based procedure and these computations converge to a set of skeleton links $l \in L_S$. The diffusion based procedure is slow by nature and converges towards the center of the topology and in order to compute $\mathbb{G}_S$, we define the frequency based weight assignment $\mathbf{f}(n)$ as follows where $m \uparrow$ is the max function and $m \downarrow$ is the min function.

$$\mathbf{f}(n) = 1 - ((|V_S(n)| - m \downarrow |V_S|) / (m \uparrow |V_S| - m \downarrow |V_S|))^\omega \quad (11)$$

The parameter ω represents the strength and is assigned values between 0 and 1. The parameter ω is assigned empirically. The weight assignment function defined above enables faster computations and convergence.

The S_C point is a skeleton node that belongs to all the links defined by L_S and can be obtained based on

the frequency based weight assignment function $\mathbf{f}(n)$. The sensor node with the maximum value of $\mathbf{f}(n)$ is set to be S_C . The computation of S_C is iteratively achieved and if another node whose weight is higher is obtained, then S_C is a new sensor node. The computation of S_C can be defined as

$$S_C = \sum_{p=0}^{p=n} (m \uparrow (\mathbf{f}(p))) \quad (12)$$

d) Skeleton links L_S identification and skeleton node set S construction

The skeleton links L_S is a set of skeleton links l_s derived from the weight assignment function $\mathbf{f}(n)$. To obtain L_S , the singular skeleton links l_s need to be obtained. Let us consider a skeleton node pair represented by (S_C, S_X) . Let the sensor node S_C initiate a transmission signal to sensor node S_X .

Let l_s represent the skeleton link that exist between the skeleton node pair (S_C, S_X) . The skeleton link l_s is the minimum energy utilized link between the nodes S_C and S_X based on equation (8). Let T be the time taken for the transmission from S_C to S_X . Tracking route reply from S_X to S_C would enable the identification of l_s and this process is defined as

$$S_{n+1} = S_n - h(dT/|dT|), S(0) = S_X \quad (13)$$

where h represents the error step. Using ordinary differential equations, the above equation can be represented as

$$dl/dr = -(dT/|dT|), S(0) = S_X \quad (14)$$

Where r represents the route reply path from S_X to S_C . Adopting the Second order Range-Kutta theorem where the stages $k_1 = f(S_n)$, $k_2 = f(S_n + (h/2)k_1)$ and $f(S_n) = -(dT(S_n)/|dT(S_n)|)$, the above equation can be represented as

$$S_{n+1} = S_n + (h \times k_2) \quad (15)$$

Having obtained a single skeleton link l_s the process is iteratively repeated to obtain the entire skeleton links L_S for all the remaining sensor nodes $s \in S | s \neq S_C$. The iterative process exhibits multiple overlapping links which can be eliminated by tracking the route reply paths. The sensor nodes that exist on the skeleton links are the critical or skeleton nodes and are represented by the set S .

e) $\mathbb{G}_S$ skeleton graph construction

Having obtained the skeleton links L_S and the skeleton node set S , we shall now discuss the methodology adopted in constructing the skeleton graph $\mathbb{G}_S$. The skeleton graph is obtained by constructing layered topological sets. The layered topological sets are constructed by decomposing the

sensor network topology $\mathcal{T}$ into topological clusters that represent the prominent 3D shape information of the topology. The skeleton sensor node S_C is considered as the root node of the skeleton graph $\mathbb{G}_S$. Each topological cluster consists of a set of regular sensor nodes and a skeleton node. In other terms, each skeleton node is used to represent a cluster and the skeleton links form the boundary of that cluster. The cluster is identified in terms of the relative distance from the skeleton node S_C . The skeleton graph $\mathbb{G}_S$ is constructed from the layered topological sets, wherein the skeleton nodes represent a cluster and the skeleton links represent the boundaries. On constructing the $\mathbb{G}_S$,

it is observed that the leaf nodes of the graph can be used to identify the topological information of the sensor network $\mathcal{T}$.

The construction of the layered topological clusters is critical to obtain the skeleton graph $\mathbb{G}_S$ without the loss of topological information. Let $Q(n)$ represent the distance function. A transmission with a speed parameter ρ ($\rho > 0$) is propagated from the skeleton node S_C that can be represented as a partial differential equation. The solution of the partial differential equation results in a novel distance function represented as $Q'(n)$. The speed of the transmission is defined as

$$\mathcal{V}(n) = e^{-\rho Q(n)} \quad (16)$$

To derive the function $Q(n)$, it is required to define a parameter ρ . Let us consider a skeleton link $l_S \in L_S$ that exists between two skeleton node pair (S_C, S_X) . Let there exist n regular sensor nodes having $(n-1)$ links that exist between the skeleton

node pair (S_C, S_X) . Let the skeleton transmit a packet from S_C to S_X with a radio speed represented as ρ . If t_{S_a} represents the time taken to transmit the packets amongst two adjacent sensor nodes, then the time taken to reach the destination can be defined as

$$T = \sum_{a=1}^{n-1} t_{S_a} \quad (17)$$

And t_{S_a} can be defined as

$$t_{S_a} = D(n_{a-1}, n_a) / \mathcal{V}(n_a) \quad (18)$$

Let us consider time t' greater than t_{S_a} , i.e., ($t' > t_{S_a}$) and can define t' as

$$t' \leq D(n_{a-1}, n_a) / e^{\rho f(n_a)} \quad (19)$$

Rearranging the terms of equation (19), ρ can be represented as

$$\rho \leq (1/f(n_a)) \times (\ln(D(n_{a-1}, n_a)/t')) \quad (20)$$

Considering $f(n_a) = f_{m\uparrow}$ and $D(n_{a-1}, n_a) = m \downarrow (dx, dy, dz)$, the value of ρ would result in the worst case scenario. Let ρ' represent the critical value of ρ and can be defined as

$$\rho' \leq (1/f_{m\uparrow}) \times (\ln(m \downarrow (dx, dy, dz)/t')) \quad (21)$$

where $0 < t' < m \downarrow (dx, dy, dz)$ and if $t' = m \downarrow (dx, dy, dz)$ then $\rho' = 0$, which means that the transmission around the S_C skeleton is uniform and if $\rho' = 0$, the layered topological clusters formed are not

accurate. To avoid such scenarios, the authors consider $0 < t' < m \downarrow (dx, dy, dz)$.

The time discretized version of the function $Q'(n)$ is defined as

$$\overline{Q'(n)} = [Q'(n)] \quad (22)$$

Rapid discretization is not considered as $[Q'(n)]$ would not result in accurate layered topological cluster formulations. All the skeleton nodes having the same $\overline{Q'(n)}$ form a cluster provided they are not adjacent to one another. In $\mathbb{G}_S$, the root node is the topological cluster containing the skeleton node S_C followed by the clusters exhibiting increasing values of $\overline{Q'(n)}$. Two skeleton nodes in the $\mathbb{G}_S$ are said to be connected if there exists a skeleton link amongst them and, the two topological clusters are said to be adjacent if the ancestor skeleton node is common and there exists a skeleton link amongst them.

The identification of the critical sensor nodes or skeleton nodes in the 3D topology $\mathcal{T}$ is represented as a skeleton graph $\mathbb{G}_S(S, L_S)$ consisting of skeleton nodes and skeletal links, which is presented in this section of the paper. The experimental study of the proposed skeleton extraction on varied 3D topologies is discussed in the subsequent section of the paper.

IV. EXPERIMENTAL STUDY

In this section of the paper, the experimental study and the 3D topologies datasets used to evaluate the performance is discussed. The 3D sensor network

viewer is developed using the Windows Presentation Foundation model. The algorithms are developed using C#.Net on the Microsoft Visual Studio platform. The 3D datasets are obtained from the AIM@SHAPE Shape Repository [46]. The points corresponding to the 3D data sets were considered as sensors. The radio ranges of the sensor nodes were varied to achieve complete coverage. The Energy efficient TDMA MAC [47] is considered for communication in the sensor network

topology. The routing protocol is adopted from the paper of Ref. [48]. The experimental analysis presented here discusses the evaluation conducted on a set of five topologies shown in Table 1.

The experimental study presented here consists of 2 sections, namely, skeleton graph G_s construction and performance analysis studied on providing higher energy resources to the skeleton nodes.

Table 1 : Sensor Network Topologies Considered

No	Topology Name	Coverage Area	No Of Sensor Nodes	No Of Skeleton Nodes	No Of Links	Radio Range
1	Genoa Gulf [49]	71910 X 56700 X 1617.77	267	56	3744	7578.9
2	Torus [50]	1 X .32 X.95	50	28	400	0.4
3	Matterhorn [51]	46080 X 46080 X 3524.31	130	36	910	7275.8
4	Naples Gulf [52]	5120 X 5120 X 1347	153	57	2672	1080
5	West Sicily [53]	177570 X 112950 X1130.59	154	39	2852	18937.9

a) G_s skeleton graph construction of wireless sensor network topologies considered

A set of random sensor nodes are deployed on the five topologies considered. The radio range of the sensor nodes is varied to achieve complete coverage over the entire terrain. Homogenous network deployments are considered to construct the skeleton graph G_s . To construct the skeleton graph, first we need to identify the skeletal links L_s and the skeleton node set S . The skeletal link set consists of a number of skeleton links $l \in L_s$. To identify each skeletal link $l \in L_s$, each node is considered as the source and all the other nodes are considered as the destination. The energy utilized $e(n)$ is monitored and the weights are assigned in accordance to the frequency based weight assignment function $f(n)$. The sensor node with the maximum weight $m \uparrow (f(p))$ is considered as the skeleton node S_c . The route reply tracking on the skeleton links and the minimum energy utilized links $l \in L_s$ enables to construct the skeleton node set S . Having obtained the skeleton nodes S and the skeletal links L_s , the skeleton graph needs to be constructed based on the layered topological sets. To construct layered topological sets, the sensor network topology is decomposed into clusters such that each cluster contains only one skeleton node. The distance function $Q'(n)$ is computed to obtain the position and location of the cluster represented by the skeleton node in G_s . The skeleton nodes are rearranged to form the skeleton graph G_s centered at the skeleton node S_c .

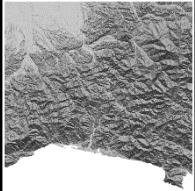
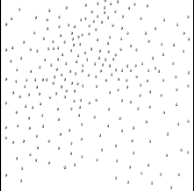
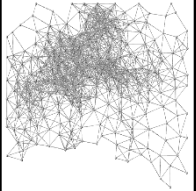
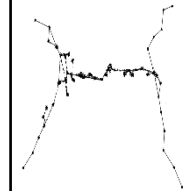
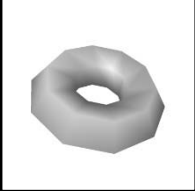
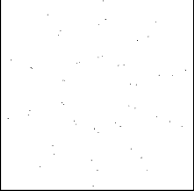
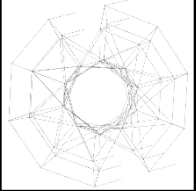
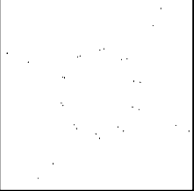
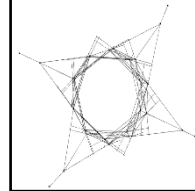
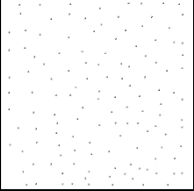
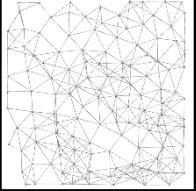
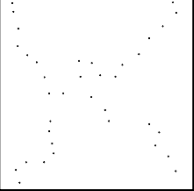
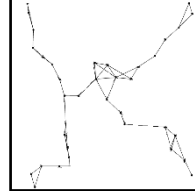
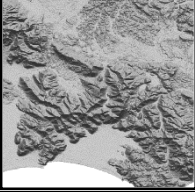
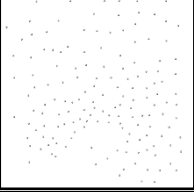
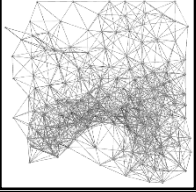
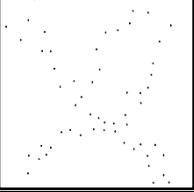
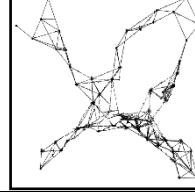
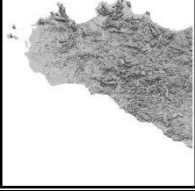
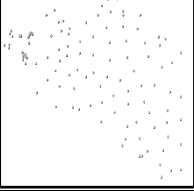
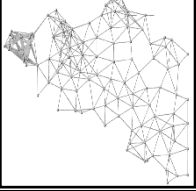
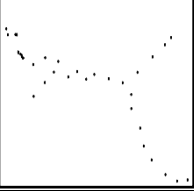
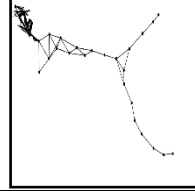
The experimental study is conducted on varied topology sizes described in Table 1. The results obtained are shown in Table 2. The table shows the terrain views obtained from Ref. [46], sensor deployed, the wireless sensor network topology, skeleton nodes identified and the skeleton extracted.

b) sensor network performance analysis with and without skeleton node considerations

To study the effect of the critical nodes or skeleton nodes, two scenarios are considered in this discussion, namely, "BALANCED" and "PROPOSED SYSTEM" scenario. In the "BALANCED" scheme, a homogeneous sensor network deployment is considered, i.e., all the sensors are assigned with uniform initial power. In the "PROPOSED SYSTEM" scenario, the skeleton nodes identified are assigned an additional energy of about 35% when compared to the other nodes. The networks were simulated and the results were analyzed. The analysis was carried out to study the effect in terms of the network throughput, network overheads and network lifetime.

The results obtained for the Genoa Gulf [49] topology are shown in Figure 5, 6 and 7. The average throughput for the balanced scheme was found to be around 84.9% and for the proposed scheme, it was around 92.7%. The network overheads measured in terms of the energy utilized was reduced by about 44.3%. The efficiency in terms of the network life time is clearly seen in Figure 7.

Table 2 : Proposed Skeleton Extraction in Wireless Sensor Network Topologies

No	Topology Name	Aim@Shape Topology View	Node Deployment View	Sensor Network View	Skeleton Node View	Skeleton Extracted View
1	Genoa Gulf [49]					
2	Torus [50]					
3	Matterhorn [51]					
4	Naples Gulf [52]					
5	West Sicily [53]					

To prove that the skeleton extraction algorithm works well with symmetric topologies, the authors have considered the Torus structure [50]. The results obtained are shown in Figure 8, 9 and 10. The performance improvement in terms of the network throughput, reduction in the network overheads and enhanced network life time is evident from the figures. The Matterhorn mountain terrain [51] is deployed with

130 sensor nodes and the network analysis results obtained is shown in Figure 11- 13. The sensor network analysis obtained considering Naples Gulf [52] and the West Sicily [53] terrain are shown in Figure 14-19. It is observed that the network overhead reduction achieved in Matterhorn is around 22.4%, 41.6% in the case of Naples Gulf and around 20.9% for West Sicily topologies.

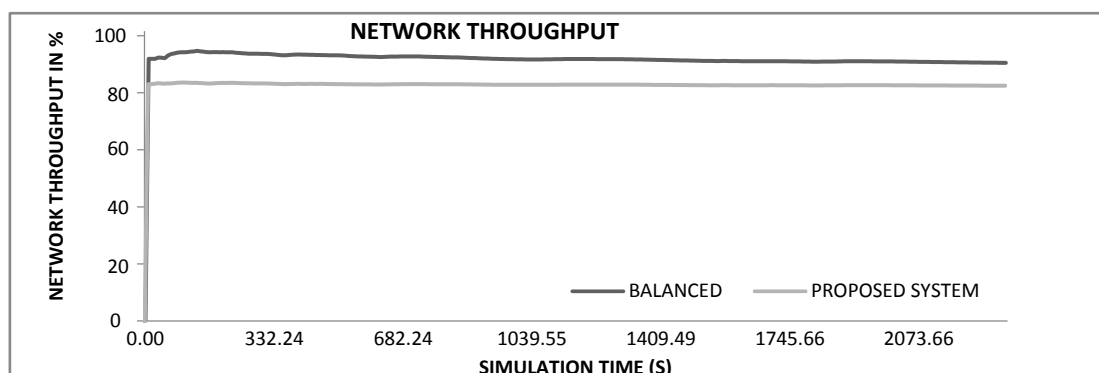


Figure 5 : Network Throughput Analysis for GENOA GULF

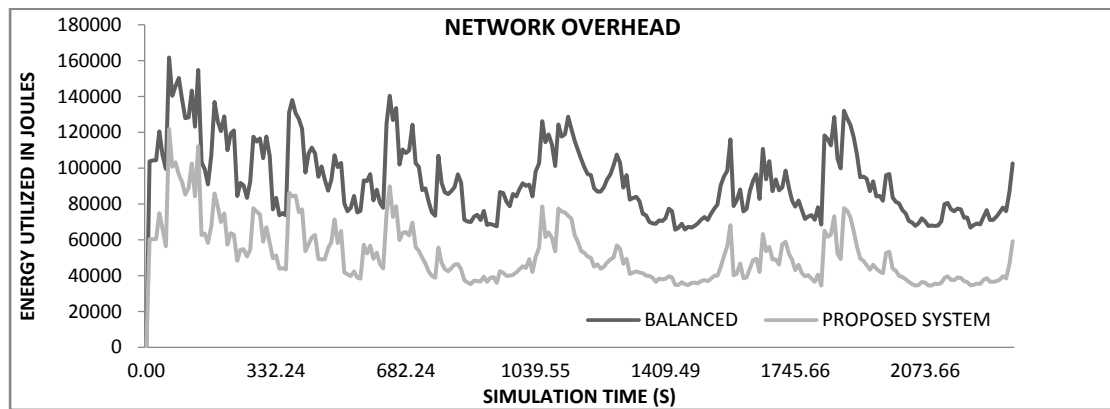


Figure 6 : Network Overhead Analysis for GENOA GULF

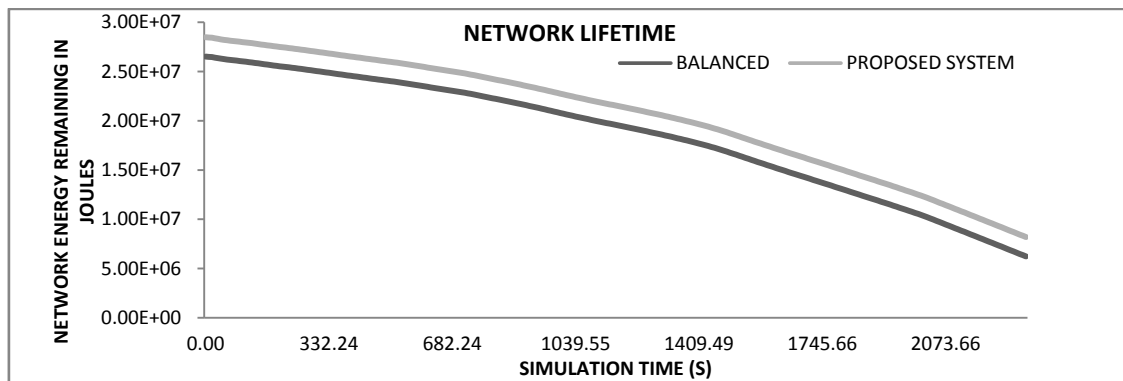


Figure 7 : Network Lifetime Analysis for GENOA GULF

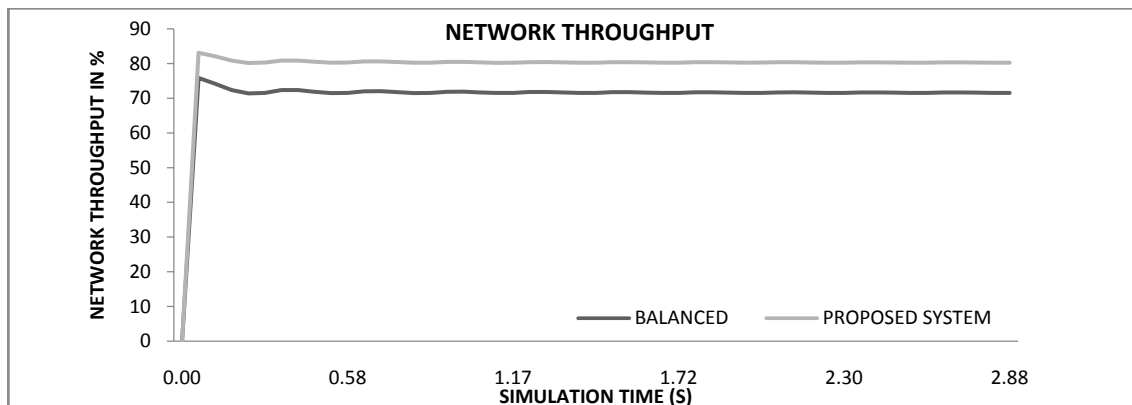


Figure 8 : Network Throughput Analysis for TORUS

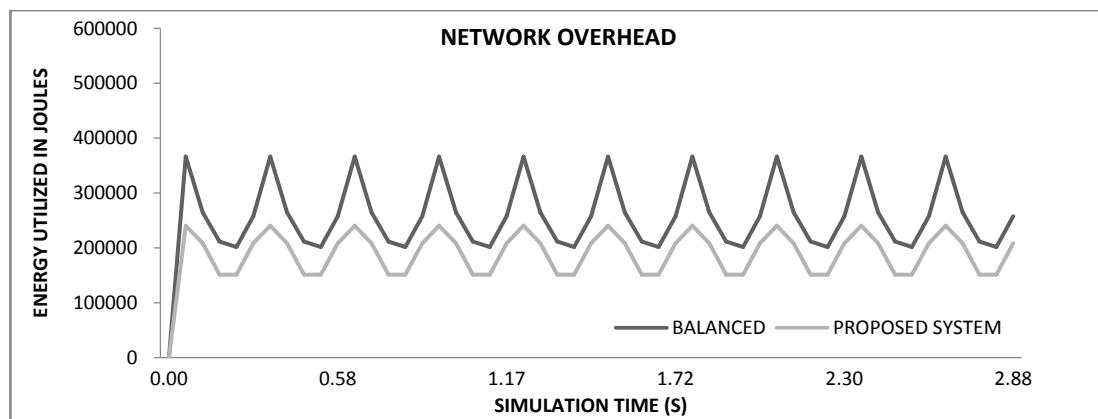


Figure 9 : Network Overhead Analysis for TORUS

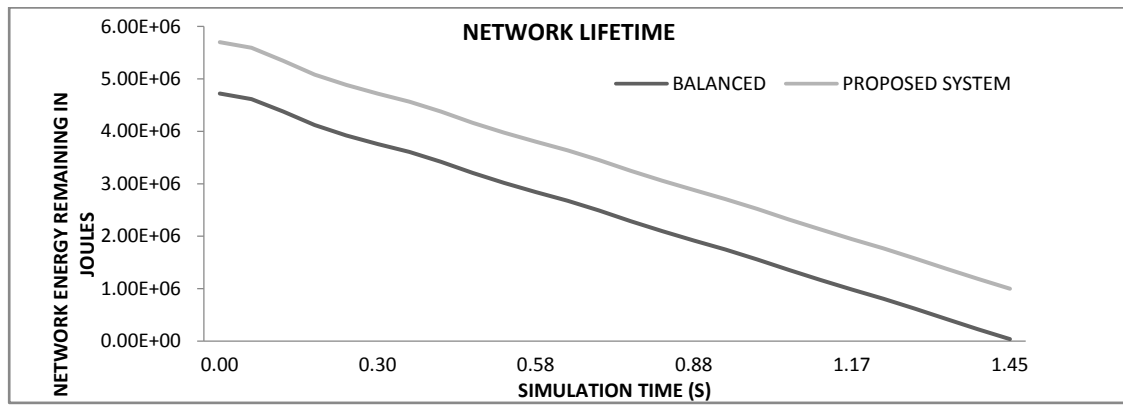


Figure 10: Network Lifetime Analysis for TORUS

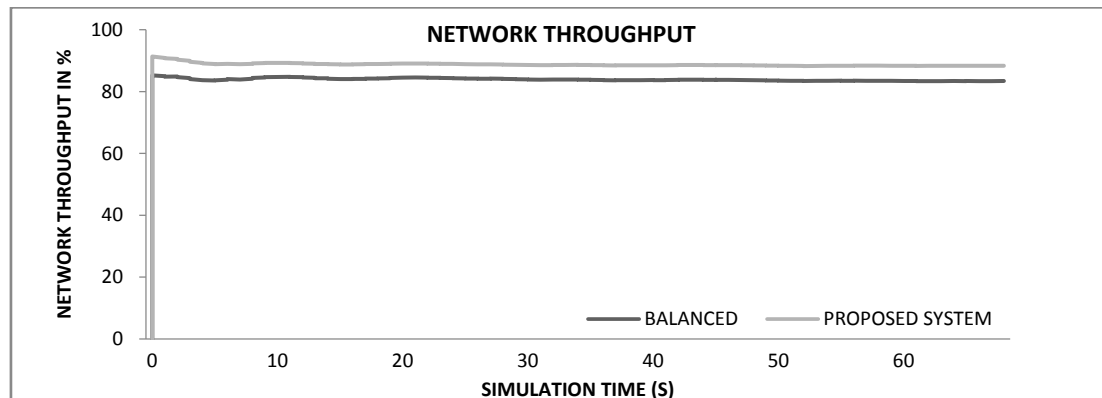


Figure 11: Network Throughput Analysis for MATTERHORN

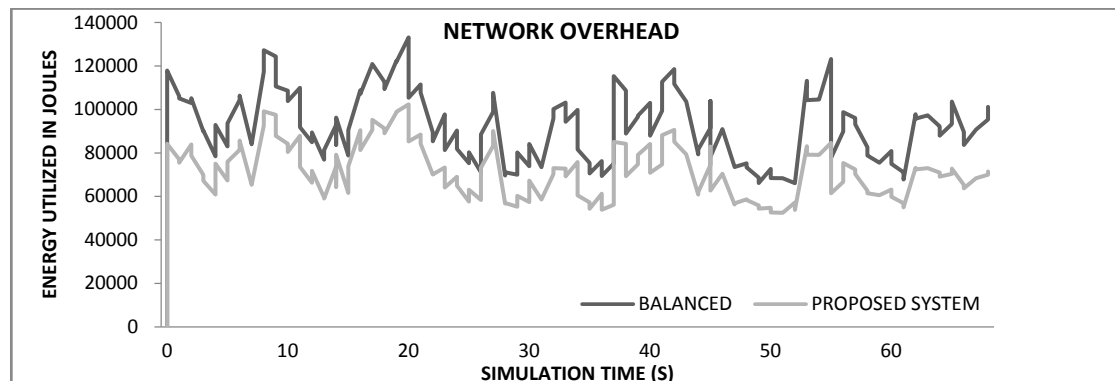


Figure 12: Network Overhead Analysis for MATTERHORN

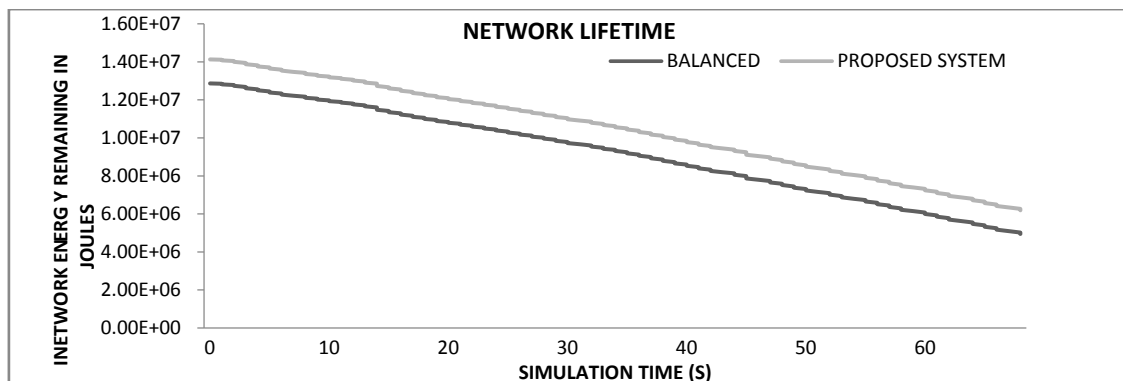


Figure 13: Network Lifetime Analysis for MATTERHORN

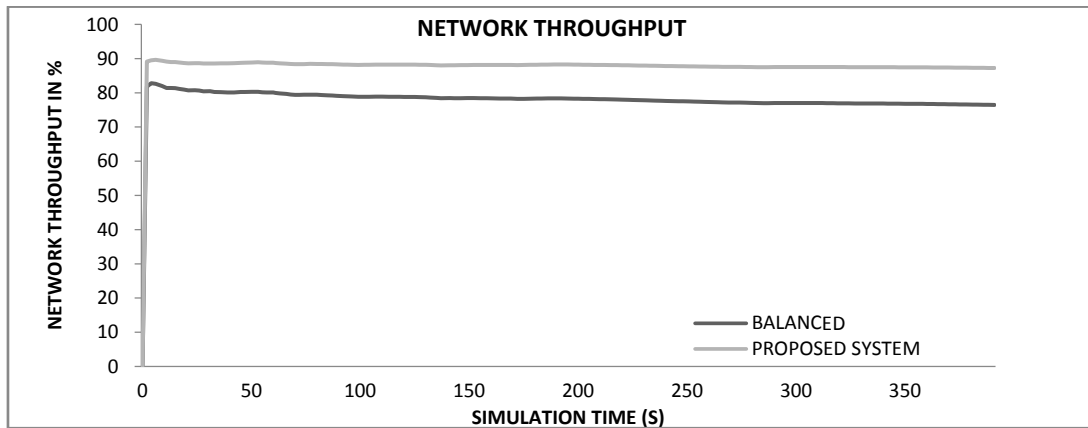


Figure 14 : Network Throughput Analysis for NAPLES GULF

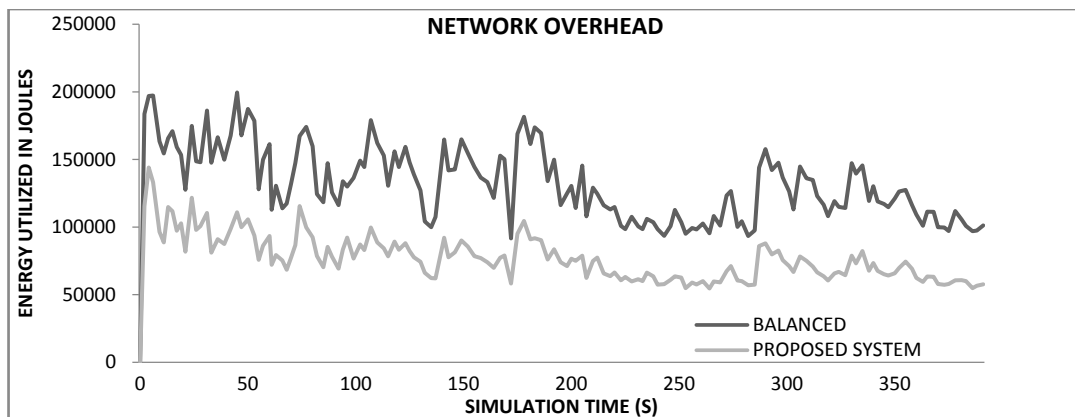


Figure 15 : Network Overhead Analysis for NAPLES GULF

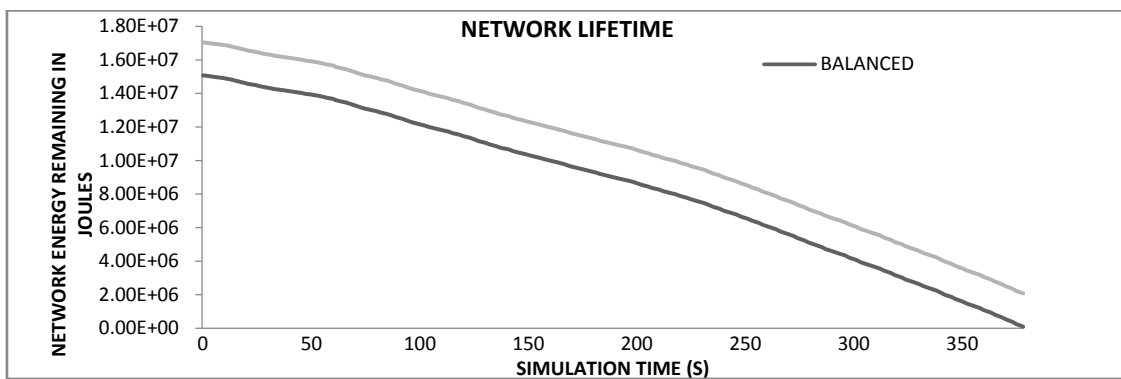


Figure 16 : Network Lifetime Analysis for NAPLES GULF

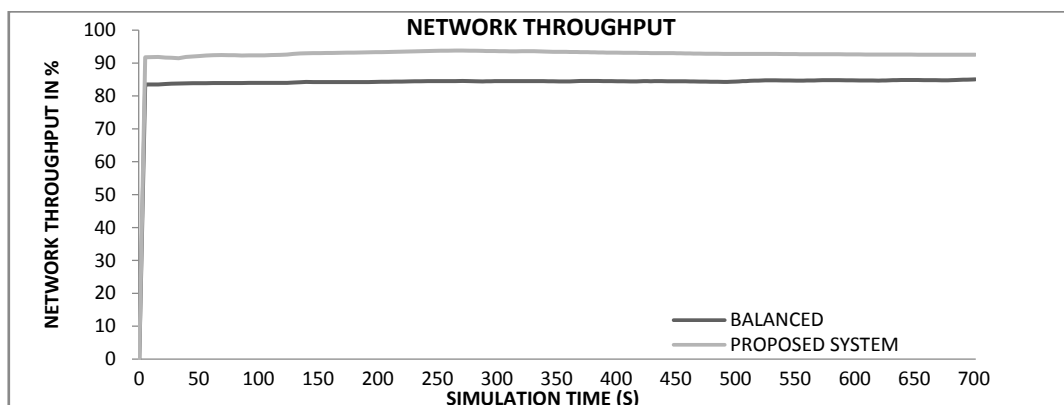


Figure 17 : Network Throughput Analysis for WEST SICILY

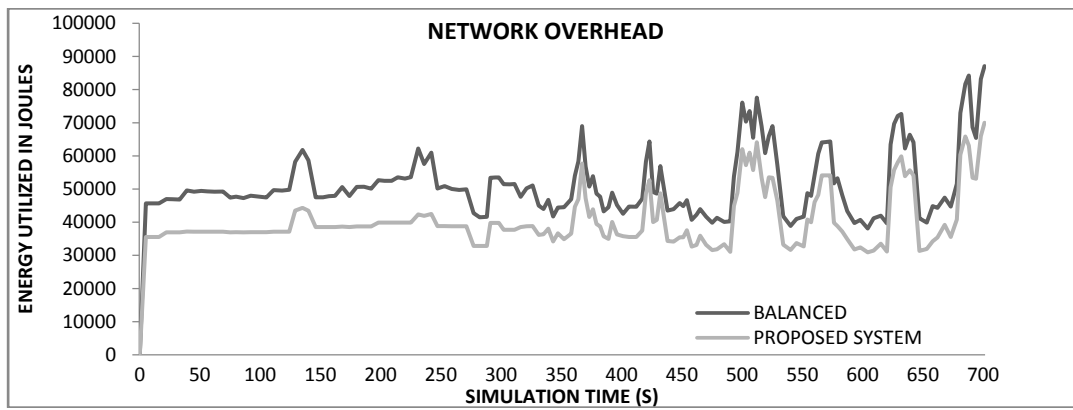


Figure 18 : Network Overhead Analysis for WEST SICILY

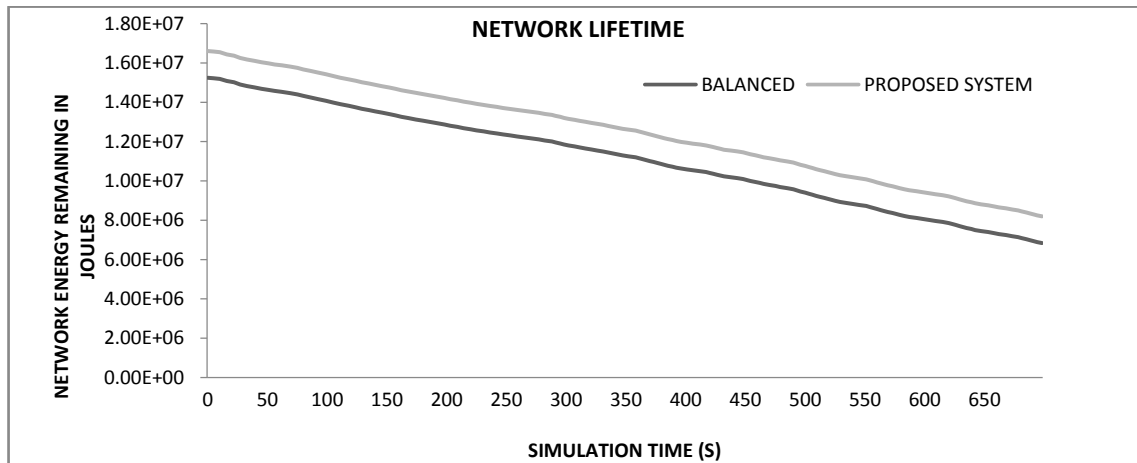


Figure 19 : Network Lifetime Analysis for WEST SICILY

The average throughput of about 88.6% was achieved by the “PROPOSED SYSTEM” when compared to the average throughput of about 80.7% achieved by the “BALANCED” scheme. An average network overhead reduction of about 31.1% was achieved by the “PROPOSED SCHEME”. The network lifetime of the sensor network topology is considerably higher for the “PROPOSED SYSTEM” as additional power is assigned to the skeleton nodes identified. From Figure 5-19, it can be concluded that the “PROPOSED SYSTEM”, wherein additional power resources is provided to skeleton nodes identified achieved better network performance in terms of network throughput, network lifetime and overhead reduction enhancing the efficiency of the wireless sensor network deployments.

V. CONCLUSION

Network design is critical to construct reliable wireless sensor networks. The coverage of 3D sensor networks is complex in nature and the 2D topologies or the 3D projection schemes are not applicable to achieve realistic results. Skeleton extraction and its significance applicable to areas as medical image processing, computer vision, computer graphics and many more are well understood. These skeleton extraction mechanisms

are not applicable to complex 3D wireless sensor networks. Limited work has been carried out to extract the skeleton of 3D wireless sensor networks.

This paper proposes a novel skeleton extraction algorithm applicable to 3D wireless sensor network topologies. The skeleton is represented as a skeleton graph $G_s (S, L_s)$. To construct the skeleton graph each sensor node initiates transmission throughout the network and the energy utilized is monitored. A novel energy utilization function is $e(n)$ is defined to identify the skeletal links L_s . The root node skeleton graph is represented as S_c and is computed based on the frequency based weight assignment function $f(n)$. The skeleton nodes are extracted from the skeletal links and layered topological sets are constructed by adopting a topological clustering mechanism. Each cluster considered consists of one skeleton node and is a part of the skeleton graph. The distance function is computed for each cluster to determine its position in the skeleton node from the root node and the graph G_s is constructed. The skeleton extraction algorithm is validated on a set of varied 3D topologies. Provisioning of additional resources to the skeleton nodes enhances the sensor network performance by 20% and is proved through the experimental study. The results obtained

prove improvements in network throughput, network lifetime and achieve reduction in the network overheads.

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Design and Development of English Learning Facebook Application based on Platform as a Service (Paas) by using Smart Gamification

By Md. Mahmudul Hasan & Mahmuda Akhter

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Abstract- Social networking sites like Facebook are not just an element of passing time but a platform for learning as well. The goal of this paper is to show the effectiveness of a Facebook application named “Wisdom” to teach English language based on cloud platform. This application tries to introduce English language in an authentic and communicative manner to the students, where they have to assume different roles (i.e. avatar) to achieve a particular goal. For that purpose they communicate with the other avatar and participate in several quizzes. This study shows the performance of a group of students who played “Wisdom” game and take a quiz as a part of their assessment. Their performance has been presented to show their success rate in learning English. The performance of the application is also measured based on Facebook Graph API. In addition, platform as a service (PaaS) of cloud computing from Heroku has been integrated to host the application and its compatibility is checked in this study.

Keywords: *gamification, facebook, paas, social media, virtual world, gaming, english learning.*

GJCST-E Classification : *1.2.6*



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Md. Mahmudul Hasan ^α & Mahmuda Akhter ^σ

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1. INTRODUCTION

Online social networks (OSN) have brought a change of how people interact to others in virtual world. Most of the people are engaging (statistics) themselves in social media such as facebook, twitter, myspace, google+. In this context and current trend of users' activities, we created a game named "Wishdom" which is designed and developed in a Workshop organized by BBC Media Action in Bangladesh at University of Liberal Arts Bangladesh on 24 September, 2012. In this research paper, we highlighted the basic design and development of the game and how it works with its output of learning English. Moreover, we have designed the game to accommodate smart gamification in it[1].

a) Role of Games in Learning

According to Warschauer and Kern (2000), over the last 40 years, the focus of language teaching has shifted from teaching discrete grammatical structure to improving communicative ability that makes the language teaching not only more complex but also more exciting. Nowadays, simulation and game are widely

used in language learning. It provides the language learners with the opportunities to learn the authentic use of language[2].

Using simulation in language promote positive affective factors such as increased motivation and engagement. Students are highly motivated when they are engaged in simulations and games that bring a positive attitude towards learning. According to Macedonia (2005), language games provide opportunities of "redundant oral repetition of grammar structures", yet in a playful way. From a neurological perspective, she stresses the important role of positive emotions in game-based language learning, which can enhance students' basic motivation[3].

Gaudart (1999) believes that one major advantage of using simulations and games in language classroom is to alter teacher-centered classrooms by providing students with opportunities to fully use the language. Many researchers like Jung and Levitin (2002) find that simulation can offer real life cultural and linguistic environments for language students. However, they also point out that all students may not realize the value of the simulation. They may find it to be time consuming and non-academic[4,5].

Virtual environments (VE) have gained immense popularity over last few years. VE is an umbrella term that refers to open social virtualities (e.g. Second Life), commercial 3-D gaming spaces and online environments designed to support educational objectives (Thorne, Black and Sykes, 2009) [6]. In virtual environments, human agents interact with the each other or with software generated characters, such as avatar. At present, the most popular social virtual site is Second Life that serves both entertainment and educational purposes. Nowadays many renowned universities have set their virtual campus in Second Life for residential and distance education, student admission and so on. They also host special media events through educators' blog and forum of Second Life.

In spite of gaining popularity, there are very limited numbers of studies that explore the prospects of using VE in academia. Sadler and Nurmukhamedov (2008) conducted a study on 10 undergraduate ESL (English as a Second Language) students and 23 master's students in TESOL [7]. The study results show

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that task based language learning can be carried out successfully in Second Life where the students' motivation level is very high and they use English with each other to complete the task. Similarly, Zheng, Li and Zhao (2008) use Second Life for teaching Chinese language culture. Their study shows that Second Life provides enough opportunity to the students to negotiate for meaning and to learn pragmatics. Pena and Hancock's (2006) study reveals that even in a battle and competition oriented game, students try to good interpersonal relation with the other players using proper language. Besides, adopting a new identity (avatar) challenges students to think of a problem from different point of view, making them open to different perspective (Lee and Hoadley, 2007) [8, 9].

b) Background and Motivation

According to Richard Bartle, there are four types of gamers in social media platform such as-

- Achievers
- Explorers
- Socializers
- Killers

Keeping the above list in our mind, we targeted facebook users where more than 3.5 million users are daily active online in Bangladesh. Though BBC Janala produced "Mojai Mojai Engreji Shekha" which is a popular TV reality game show showed by Bangladesh Television (BTV). And, they have already launched m-Learning application of that show.

II. LITERATURE REVIEW

a) About Wishdom

Wishdom is a facebook based game that is primarily designed for English language learning. The game is divided into eight levels and the gamer has to successfully complete each level to unlock the next level.

In each level, the gamer has his own avatar and there is also a default avatar that guides the gamer in the game. The default avatar helps the gamer to learn a new item (it can be English grammar or something else). One of the most interesting parts of the game is that in each level, the setting is changed. For instance, in level one the game location is set in Cox's Bazar sea beach. There are quizzes in different parts of the game. If the gamer can give correct answer of the questions he will get various gifts. The type of gift also depends on the setting of game. For example, in level one the setting is in sea-beach. So the gamer gets gifts like, sea shell, sunglass, sea food, beach cap etc. since it is facebook based game, the gamer can share his score and gifts with his friends and he can also challenge the other people to beat his score.

Avatar is one of the attracting features of wishdom. In each level of the game, there are two avatars. The character of the avatars is decided based on the game setting. For example, in level one, the game is set in Cox's Bazar. So, one avatar is playing the role of tourist while the other one is tourist guide. Figure 1 shows the wishdom game snapshot which runs on the facebook platform using smart gamification.

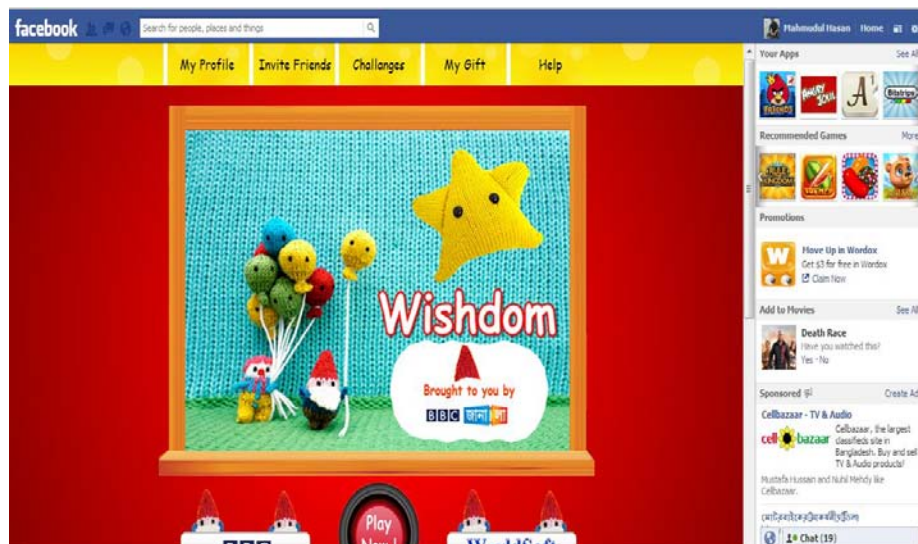


Figure 1 : Wishdom – a social game based on smart gamification

b) Goals and objective

The game "Wishdom" was initially designed to teach and test the knowledge of English of the students, keeping in mind their personal interests and desires. So the game provides them with the opportunity to play it in

their preferred areas (like, food, travel, family, fashion etc.) with a customized Avatar. This idea has been integrated so that the students can have fun while playing the game and learn grammar without being aware of it. However, it is to be noted that the game is

only a platform to teach and learn. It will not confine itself to English language teaching. This platform can be used for any kind of teaching and testing purpose, considering that the game needs to be customized.

The idea of "Wisdom" was born and nurtured in a creative workshop titled "Future leaders in media and English language teaching" organized by BBC Media Action. People from different background participated in the workshop. The participants were trained in developing ideas of game and different platforms of gaming. It was then when the idea of Wisdom first came out.

III. PREVIOUS RESEARCHES AND RELATED WORK

In recent days, academia and industry put more concentration of making successful apps based on social media considering its high number of audiences and flexibilities. For this reason, it is not a new idea to develop apps based on social media such as facebook to reach target audiences. Needless to say, there are more than 4000+ apps based on different platforms including mobile smart phones and social media to teach English. But there are very few works have been done based on gamification.

Lara et.al (2011) showed an application based on facebook platform named "Happy Movie" which recommends movies to selective groups [10]. In addition, Ben et.al showed a facebook application named "familiar" which represents facebook users' social behaviour through a reflective playful experience [11]. "Wordox" is a word matching puzzle game available on facebook and have more than 500,000 thousands monthly users [12]. "Words with friends" has more than 1, 00, 00000 + monthly users [13]. However, these sorts of game do not follow gamification aspects in their game play that's why it is difficult to measure the benefit of the gamers to play the games and how they are getting benefitted by these games. The following section describes the basic idea for integrating wisdom into gamification.

IV. WISDOM AND SMART GAMIFICATION

In recent days, gamification gets a huge concentration and focus towards industry and academia for research and its applications purpose. In this research project, we integrated gamification in our game which is based on facebook platform to learn English. Before starting integration of gamification in our games, we need to clarify what actually gamification is.

According to Wikipedia, Gamification is the use of game play thinking and mechanics to solve problems and engage audiences. On the other hand, researcher Sebastian Deterding defines gamification as "it is the use of game design elements in the non-game context" [14]. In this research work, we defined gamification as a

smart tool which helps players or audiences to learn English by engaging themselves through gaming based on facebook.

a) Popular Gamification Examples

There are many examples of gamification. In this sub section we will briefly describe some successful applications which have been successfully applied gamification to their target audiences.

Nike +: It is an application based on iOS. It applies game mechanics to runners to compete and improve their fitness. This social game attempts to make fun with some physical exercises. The following figure 2 shows the application.

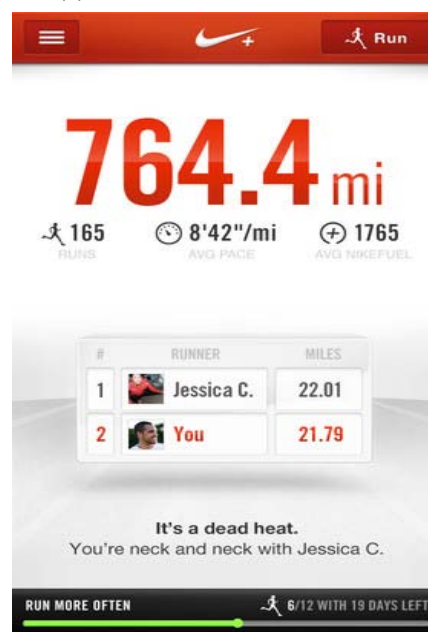


Figure 2 : Screenshot of Nike + gamification app based on iOS

Four Square is a location based game which employing gamification by points, rewards, badges, levels and leader boards to engage players or users to revisit the places such as restaurants, pubs and any historical places or become royal customer or visitors among their friends in virtual world.

Microsoft RibbonHero is an application which attempts to help users to discover new features in Microsoft Office by playing games.

RecycleBank is another popular application based on gamification towards "Green Challenges" which motivates participants to learn about green living and to take small green actions to live more sustainable lives outside of the virtual world.

b) Wisdom as smart gamification

As described it earlier, our developed game is an outcome of creative workshop organized by BBC Media Action. It has been highly emphasized on smart gamification where user journey has been integrated as the games go further.

Smart Gamification approach for learning English:

Phase 1: Reaching the target audience

i. *Key challenge*

Though we have chosen social media (i.e. facebook) to implement our game, it is often challenging to reach the target audience by application because of users of social media can use simultaneously different features such as chatting, browsing, uploading photos and so on.

ii. *Smart Gamification Approach*

Inviting and suggesting friends to accept requests and give points through sharing. Push the users to share for extra points and energy pills for each level.

Phase 2: Integrating the users to feel that they are component of the game

Key challenge: In this stage, the fundamental challenge is to design the game play in such a way that participants can feel they are the part of the game and they feel the user journey in true sense.

Smart gamification approach: In this stage, we have made a journey for the users so that they can feel that they are the essential component of the game and it has been highly integrated with social plugin API provided by facebook which will be described in the architecture of the game.

Phase 3: English learning aspects by playing games.

Key challenge: English learning by engaging players to play the Wisdome game. By the skill building approaches, we made the users more comfortable to the game play and it also increases confidence to practice English and they become more proficient into the game.

Smart gamification Approach: In this phase, we ensured that users are engaged by getting points, energy pills and badges. They get extra energy by inviting and sharing their achievements to others. By this way, players engage themselves for long time and they are not dropped out and continue their playing and learning English.

V. DESIGN AND DEVELOPMENT OF WISDOM

In this section, we will briefly describe about the high level architecture of the game. As we have discussed it earlier, smart gamification has been tightly coupled with this game. We made it sure that a player journey must integrated with intrinsic reward preferred over extrinsic reward [15].

Player Journey = Lifecycle + Progression

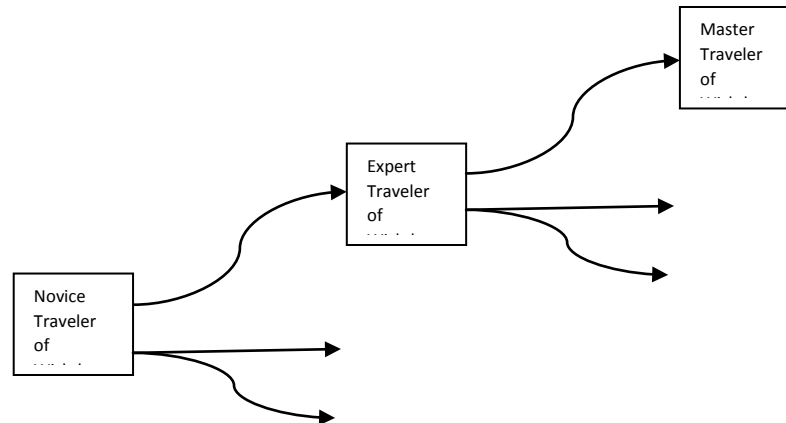


Figure 3 : Good games with smart gamification aspects take the player on a journey towards mastery.

The following figure 4 shows the high-level architecture of Wisdome game based on gamification and Heroku hosting on facebook platform.

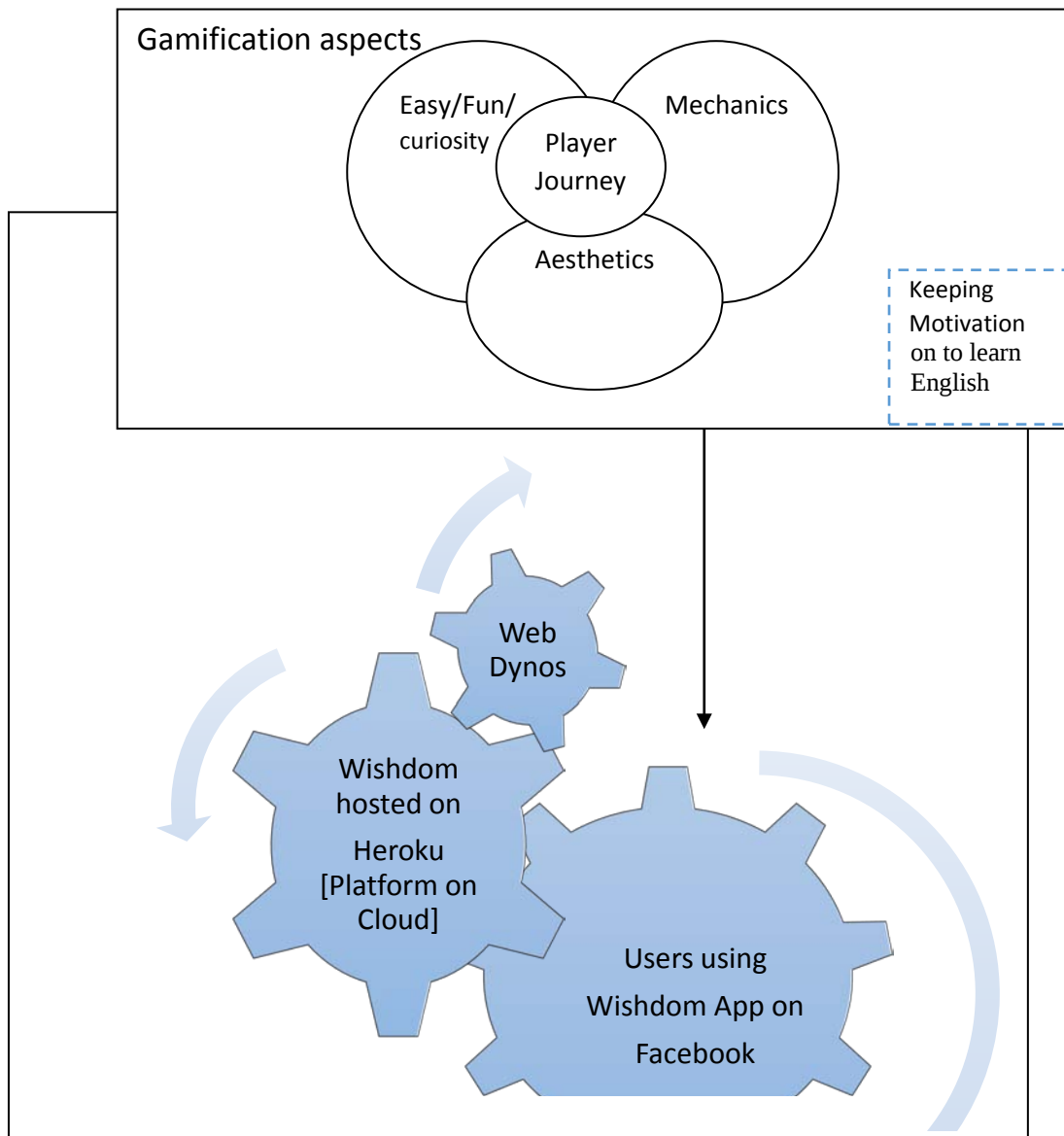


Figure 4 : High- Level architecture of wishdom game with gamification aspects

Platform as a Service (PaaS) in a cloud for Wishdom:

According to SalesForce.com, a leading giant for cloud computing service provider, Platform as a Service (PaaS) is a proven model for running applications without the hassle of maintaining the hardware and software infrastructure at your company.

We chose Heroku to host our application. It is a powerful platform as a service (PaaS) provider to iterate quickly and adopt the changes of our project. It is robust and highly scalable platform for facebook apps development. Needless to say, it is the recommended platform by facebook to have smooth operation and user experiences.

The following figure 5 shows the high level working structure of Heroku platform integration with Wishdom game on facebook.

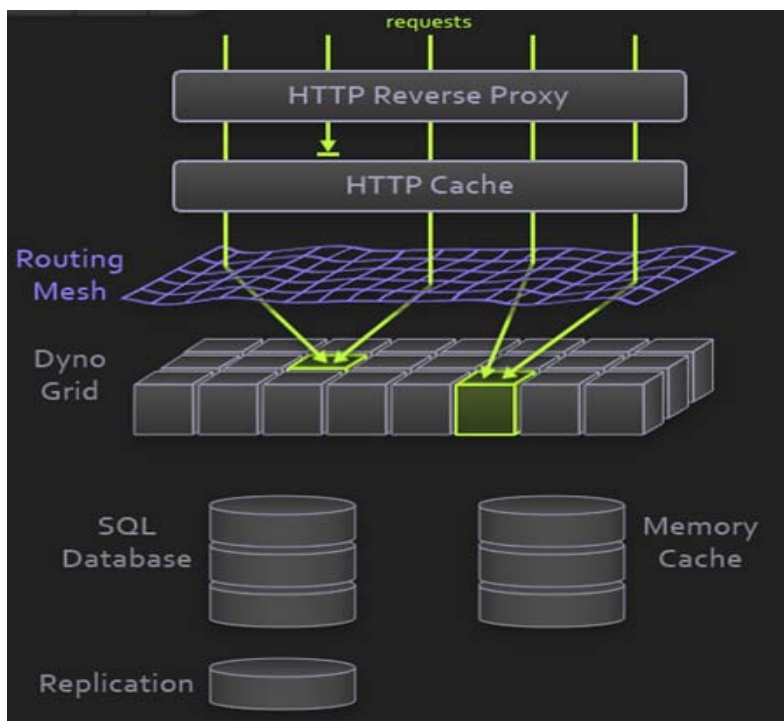


Figure 5: High-level architecture of integration between Wishdom and Heroku [16]

The following figure6shows an avatar conversation with the gamer.



Figure 6 : The game in progress at level 3

VI. PILOT STUDY

Since the purpose of this study is to show the usability of wisdom game for teaching and learning purpose, students' performance in the game is considered as data. To collect data, students are asked to play the game where they have to participate in the quiz. The quiz questions are based on a topic that has already been taught in their class.

a) Participants

There are 30 students who participated in this study. All of them are from English department of BRAC University and of sophomore level. It is to be noted here that this is the first time they play the game and they are not provided any training or instruction to play the game. They play the game on their own. It is done to test whether the game is user friendly or not.

b) Quiz

Students' performance is measured based on their score in quiz. The quiz is comprised of objective questions like, MCQs, true or false item, short questions and so on. There are two or three quizzes in each level. Gamers answer the quizzes at different stages of the game.

1. E- Score
2. Social game metrics
3. A/B Testing

Since Wisdom is a game in social media platform such as facebook. That is why, we analyzed gamification in terms of social game metrics.

Figure 7 shows performance analysis of the application where we can see the canvas HTTP response time average is 0ms and canvas Facebook markup language (FBML) response time is 0ms and canvas error rate is 0.1724%.

VII. RESULTS AND DISCUSSIONS

a) Gamification Analytics

There are three kinds of approaches to measure gamification in a particular game. They are mentioned below [17]:

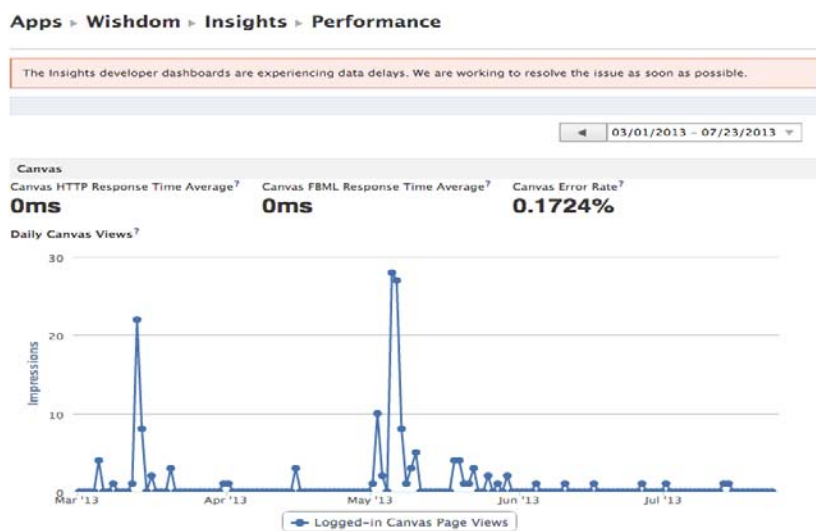


Figure 7 : Performance analysis of Wisdrom game through facebook API

On the other hand, figure 8 shows average application programming interface request time for the application. From the below figure it is clear that when it

calls the facebook API, it responds faster and less than 1000 milliseconds.

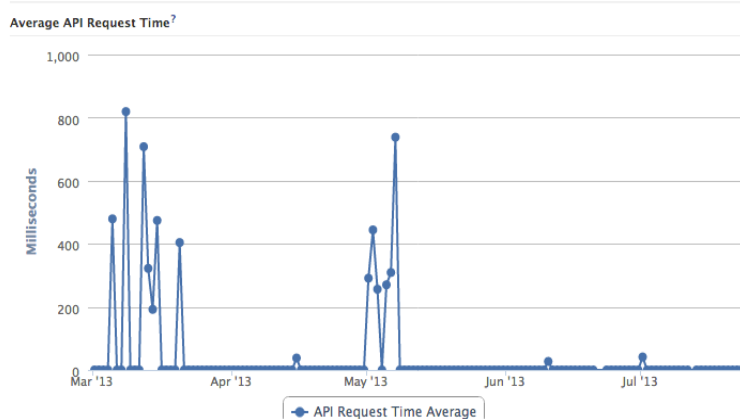


Figure 8 : Average API request time for Wisdrom game on facebook

b) English learning test

As we have mentioned it earlier, we made our pilot study at BRAC University, Bangladesh and we test the players by playing the games and taking the quizzes related to the game which is appeared at the end of the game.

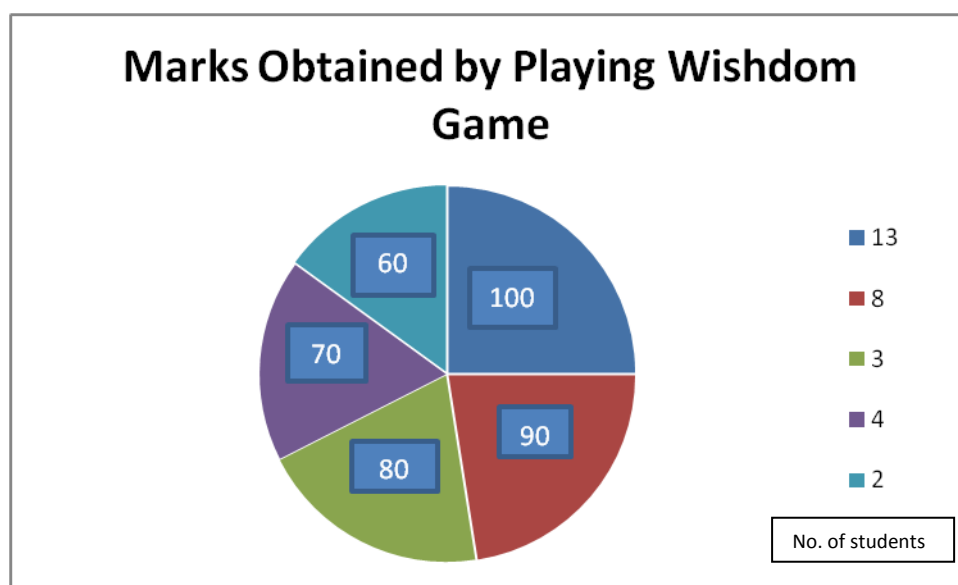


Figure 9 : Pie-chart of getting marked by playing wisdrom game by the students

Figure 9 shows marks obtained by the gamers who have played wisdrom game. Here, we can see 13 students got 100 out of 100 among 30 students while only 3 students got 60 out of 100.

c) Evaluation

We have successfully developed the game based on social platform such as facebook while we get a tremendous supports and feedback from the users. From the performance test, we can define that the application is perfectly alright while it is active. In addition, students or users became benefitted by playing the games while they are engaging themselves to learn English through different activities.

Since we consider only web based facebook platform, we could not make any tests for mobile native applications. Moreover, the application has been hosted on Heroku platform and for this reason, we could not measure the performance on dedicated server if it is expected to have million users in monthly basis.

VIII. CONCLUSION

In this research work, we have developed the game "Wisdrom" and it is based on social media platform which follows smart gamification with proper user journey including different avatars and environments. Our focus was to make the game more friendly and fun centric. In this project, we also examined how a game can be integrated and be used to academic purposes using strong social media platform. Keeping always the positive motivation by levels, badges and learning aspects of English language, we successfully integrated gamification. In this game players learn by playing games while they may be engaged to other issues such as chatting, surfing and so on. We also made a pilot study and examined usability test and ELT features in the game.

By sharing players' points and challenges, one can be more effective and self motivated to play as well as learn languages.

In future, we can integrate the games in various platforms such as in android, iOS, windows phone etc. Moreover, we may include different course contents and exams into this game by using flip class room concepts. In other words, we can commercially release the application with internationalization aspects in different languages and parts in the world.

IX. ACKNOWLEDGMENT

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Performance Analysis of TCP Tahoe, Reno, New Reno, Sack and Vegas using NS -2

By A F M Zainul Aba din, Md. Anwar Hossain, Muntasir Ahmed

& Purno Mohon Ghosh

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Abstract- The Transmission Control Protocol (TCP) is the dominating end-to-end protocol on the internet today but still it faces congestion problems in some cases. To overcome congestion problems, several congestion control and avoiding mechanisms namely: Tahoe, Reno, Vegas, and Sack etc. all with different features and advantages but with maximal throughput as main objective, which are termed as the clones of TCP, have been incorporated into TCP/IP protocol for handling congestion efficiently in different network scenarios. However, one clone cannot be suitable for each case. So this paper has investigated the characteristics of the mentioned clones and calculated throughputs of them in simulated environment varying various performances metrics such as delay, buffer size, error rate, number of traffic and bandwidth for finding which one is the best for what scenario.

Keywords: *TCP, Tahoe, Reno, New Reno, Sack, Vegas.*

GJCST-E Classification : *C.2.5*



PERFORMANCE ANALYSIS OF TCP TAHOE, RENO, NEW RENO, SACK AND VEGAS USING NS -2

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Performance Analysis of TCP Tahoe, Reno, New Reno, Sack and Vegas using NS-2

A F M Zainul Abadin ^α, Md. Anwar Hossain ^σ, Muntasir Ahmed ^ρ & Purno Mohon Ghosh ^ω

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Keywords: TCP, Tahoe, Reno, New Reno, Sack, Vegas.

I. INTRODUCTION

Transmission Control Protocol (TCP) is the most widely used transport layer protocol in the Internet and one of the most important standards for best effort, reliable data transmission. Today's Internet traffic uses predominately TCP, as for applications like HTTP for Web Browsing, FTP for file transfer or SMTP for Electronic Mail Transfer. The performance perceived by users of these Internet applications depends largely on the performance of TCP [1]. Considering that the TCP/IP protocol suite is the foundation of the Internet this comes as no surprise. TCP provides a secure and reliable transfer of information. Therefore it is used by most of the existing Internet applications today and more than 90 percent of all data transfers use TCP. The evolution of the Internet has in turn led to evolutions in the TCP protocol.

TCP/IP is considered to be a five layer system: the physical layer, the link layer, the network layer, the

transport layer and the application layer. The transport layer can be looked upon as the heart of the whole protocol hierarchy. It provides data transport for the application layer above it. Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) are two different transport protocols in the TCP/IP protocol suite. The transport protocol used in a particular situation depends on the concerned application.

The first implementation of TCP, simply called TCP, was succeeded by a new version: TCP Tahoe. These two versions share the fundamental rules of information transportation, but differ in the solutions. This has led to the expression 'TCP clones'. TCP clones is an expression used for talking about different versions of TCP, considering they all share the same basic functions and purpose.

There are many implementations of TCP, each operating slightly differently and even some with significant problems. There are numbers of variants of TCP that are currently deployed. Such as Tahoe, Reno, New Reno, Sack, Vegas, Westwood, Fack and VenO. In this thesis we will discuss the five version of TCP that is Tahoe, Reno, New Reno, SACK and Vegas. This project will investigate the performance comparisons of these aforementioned versions of TCP and find out which one is better in which cases.

II. PERFORMANCE METRICS

Performance metric is one type of parameter. Setting this parameter we have calculated throughput which indicates the performance of the protocol. In this paper five different parameters have been used for measuring the performance of each protocol. These metrics or parameters are briefly described in the following section:

- Bandwidth: The number of packets in transit for every time instant (sec). It is measured in Mega Bits per Second.
- Delay: Delay means the propagation delay of a packet.
- Error rate: The rate of error of the link.
- Buffer Size: The size of memory. It can be include in any node
- No of Traffic: How many traffic source will be added in the network

Using these above metrics which are called performance metrics this project calculates throughput. The throughput can be defined

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Throughput: How well does the network deliver packets from source to destination? i.e.

Throughput = [total sent data - total retransmit data] / time

Throughput generally represents in Mbps. It may also be expressed by Bps (Bytes per sec).

III. SIMULATION RESULT & ANALYSIS

The network topology as shown in Figure 1 consist six nodes, two nodes represent as router and

rest are represent as computer transreceiver station. Now two TCP agent are attached over the node N0 and N1. Then two traffic sources are attached to the node N4 and N5 that are treated as receivers. We define the bandwidth between two routers N2 and N3 is 0.3 Mbps in each direction and also define the delay is 20 ms. The buffer size of the link N2 to N3 is maximum 5 packets.

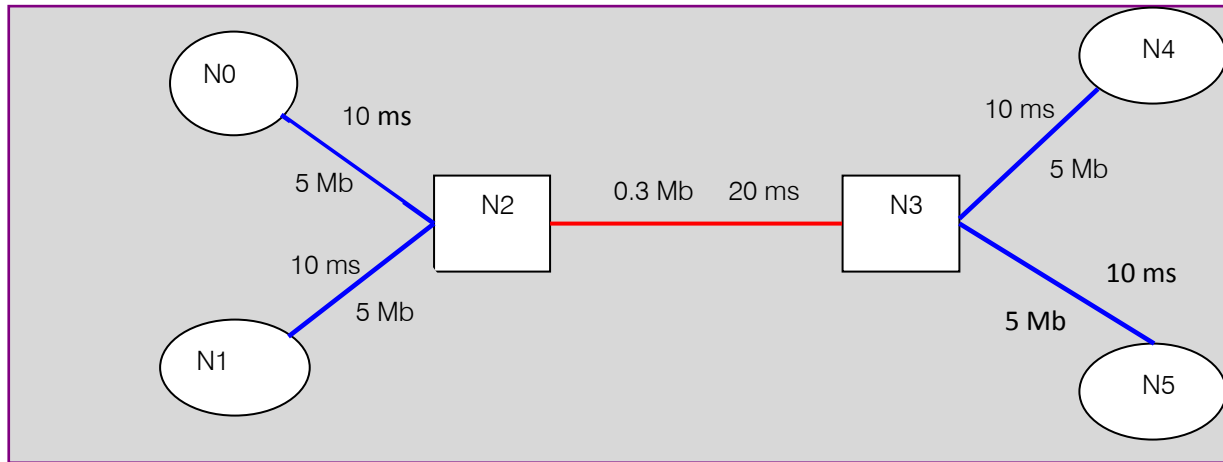


Figure 1 : Simulation Topology 1

The FTP traffic sources like ftp0 and ftp1 has been attached to node N0 and N1 respectively. Fixing up total simulation time and starting time of traffic source ftp0 and ftp1, the <tclScript> written for one of the protocol like Tahoe is executed. After the execution of the <tclScript> we get a trace file for Tahoe. Likewise, we get more four trace files for remaining four versions of TCP like Reno, New Reno, SACK and Vegas. Based on these trace files, throughput (Bps) is calculated for each cases in every 10 seconds. The values of these throughputs with respect to time are shown in Figure 2.

The average network throughput as shown in Table 1.

	Throughput (Bps)
Tahoe	34325.75
Reno	35159.09
New Reno	35469.69
Sack	35462.12
Vegas	36969.69

Table 1 : Average Throughput

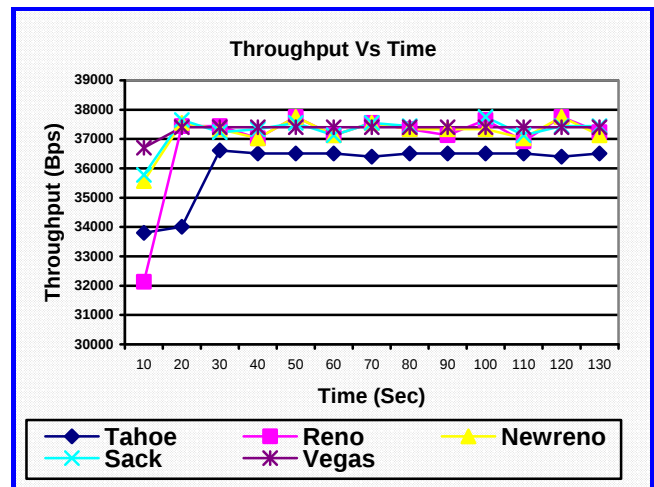


Figure 2 : Throughput Vs Time

a) Throughput Vs Error rate

In this case we consider the same topology as shown in Figure 1, but the bandwidth of the link N2 to N3 is set to 1 Mbps and delay is 20 ms. The buffer size of node N2 is maximum 20 packets. When a link is created using OTcl language; normally that link will be error less. But here we manually include an error model that inserts any percentage of error into the specified link. In order to analysis the performance of TCP versions, the error model has been inserted into the link between N2 and N3. Then the <TclScripts> like <Tahoe.tcl> are executed. After execution of the program we will get throughput of the network. This process is repeated for all of the protocols and stores

the network throughput by changing the error rate. Figure 3 shows the network throughput for all five protocols with respect to the error rate.

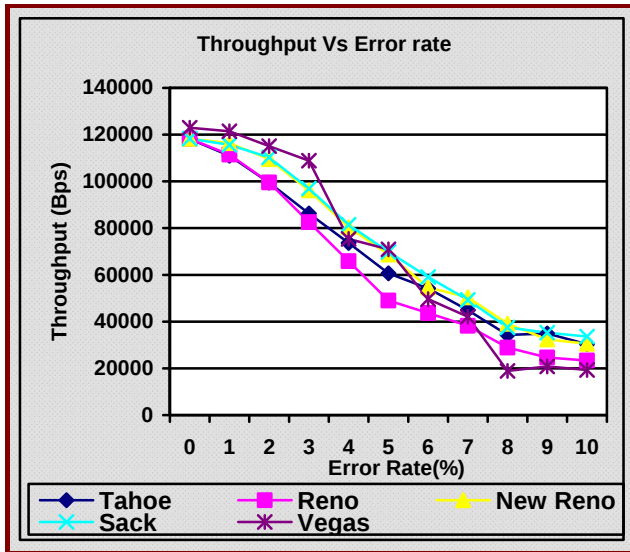


Figure 3 : Throughput Vs Error rate

b) Throughput Vs Bandwidth

Consider the topology as shown in Figure 1. In order to analysis the parameter bandwidth we will change the bandwidth of the link N2 and N3 and calculate the throughput of the network. The propagation delay and queue limit of the link N2 to N3 is 20 ms and 20 packets respectively. After execution of

the program for all five protocols; store the output result. The network throughput for five protocols of TCP is shown in Figure 4 as compared to the bandwidth.

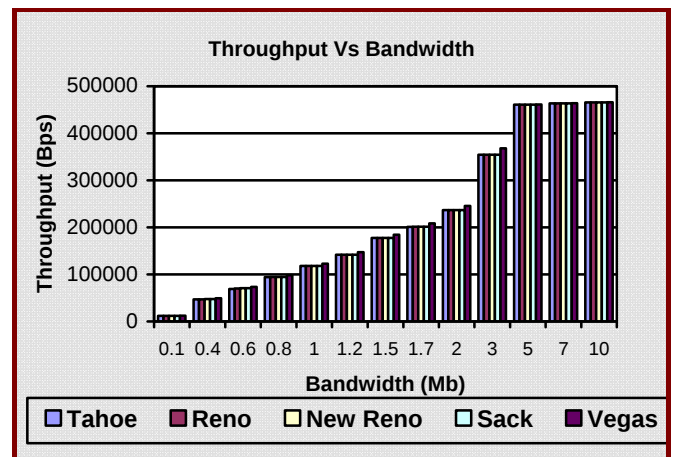


Figure 4 : Throughput Vs Bandwidth

c) Throughput Vs No Of Traffic

Modify the topology of Figure 1, just increase the no of senders of router N2 side and also increase the receiver of router N3 side as shown in Figure 5. Calculate the network throughput by increasing the no of senders and receivers for all of the five protocols. Each source communicates with destination via N2 to N3 link. The bandwidth of link N2 to N3 is 5 Mbps and propagation delay is 10 ms.

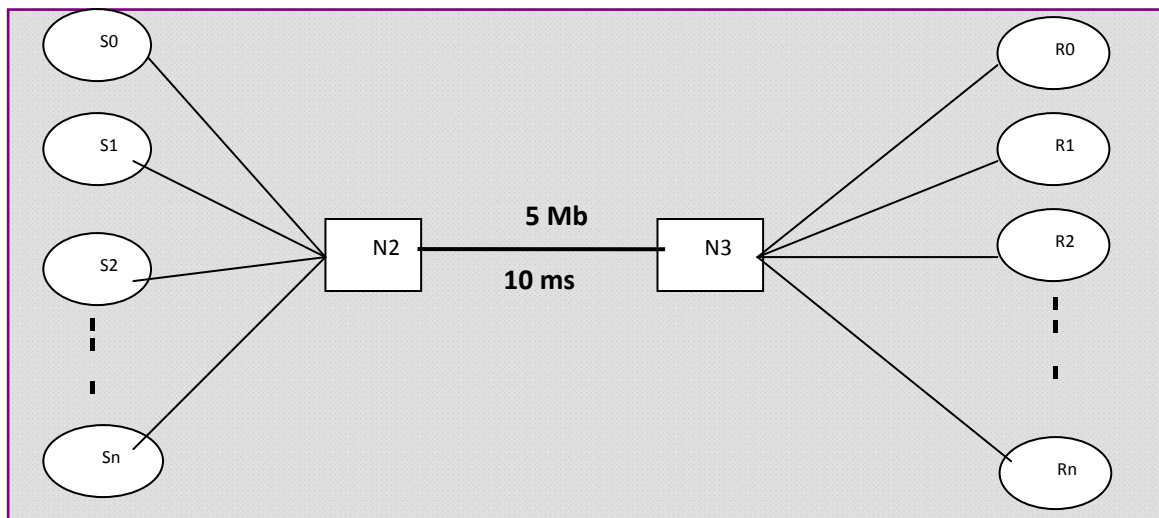


Figure 5 : Simulation Topology 2

Figure 6 shows the throughput of five TCP versions with respect to the number of traffic source.

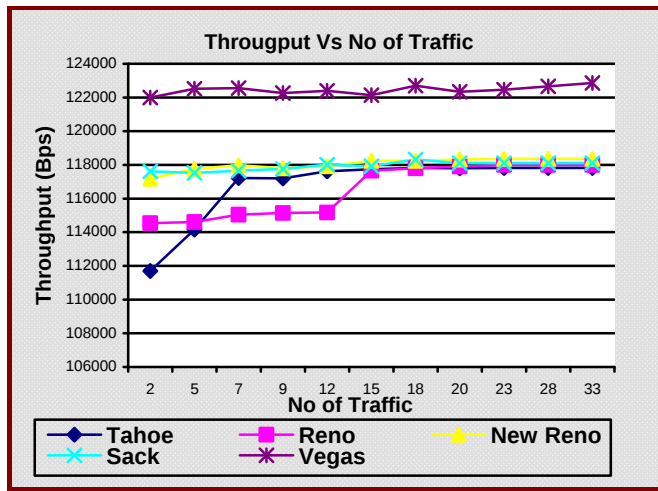


Figure 6 : Throughput Vs No of Traffic source

d) Throughput Vs Delay

Consider the network topology as shown in Figure 1. The bandwidth of the link between N2 to N3 is fixed 1 Mbps and the queue limit of N2 is maximum 20 packets. Now we calculate the throughput of the network by changing the propagation delay of the link between N2 to N3. Figure 7 shows the throughput of five TCP protocols as compared to the propagation delay.

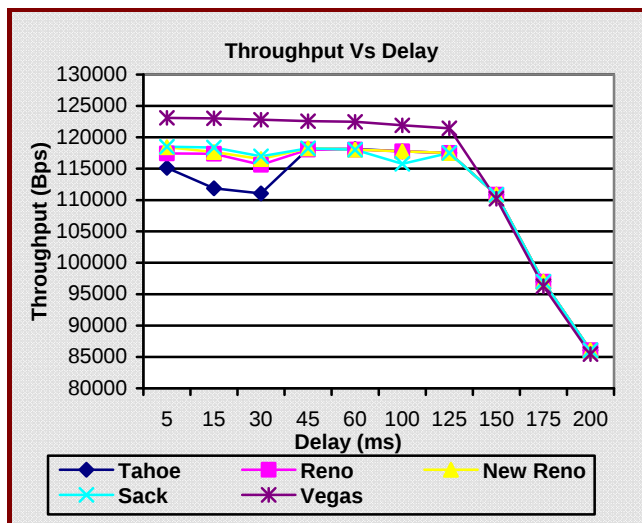


Figure 7 : Throughput Vs Propagation Delay

e) Throughput Vs Buffer Size

Consider the same network topology as shown in Figure 1. Fixing up the bandwidth and propagation delay of the link between N2 to N3 is 2Mb and 10 ms. Calculate network throughput by changing the buffer size of router N2. Figure 8 shows the throughput for five TCP protocol as compared to the buffer size.

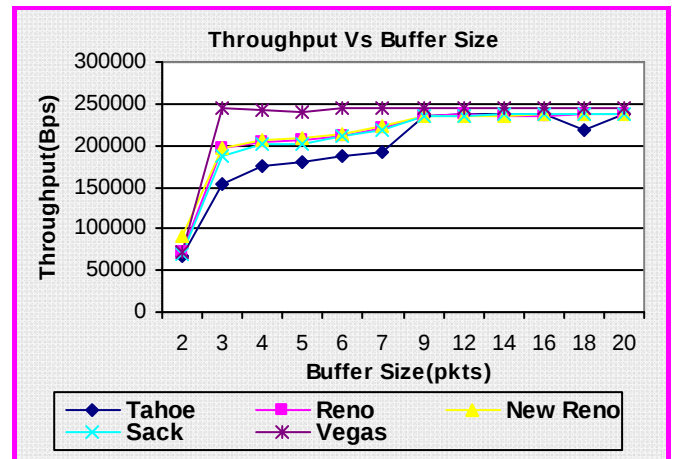


Figure 8 : Throughput Vs Buffer Size

IV. CONCLUSION

From the Figure 2 the performance of Tahoe is not better because every time the congestion window of Tahoe goes to slow start phase (i.e. $cwnd=1$) after completing the first retransmit. Reno, New Reno and Sack perform well, but the throughput of Vegas is constant after some times because Vegas uses time based bandwidth estimation scheme to control its congestion window. From the Table 1 we see that the average network throughput of Tahoe is less from Reno, New Reno, Sack and Vegas. The average network throughput of Vegas is better from the other four TCP versions.

If the link has some error then which TCP clones perform well. From the Figure 3 we see the result. When the link error below 4% then the Vegas perform better and when link error greater than 4% then the New Reno and Sack perform well. But the network throughput will be decrease as increasing the error rate. From the Figure 4 we see that the throughput is linearly increased as increasing the bandwidth of the link N2 to N3.

From the Figure 6 we see that TCP Vegas is better. The throughput of TCP Vegas always better as increasing the number of traffic sources. When the number of traffic source is less than 15 then TCP Sack and TCP New Reno perform well from rest of four TCP versions. The network throughput of TCP Tahoe, Reno, New Reno and Sack is constant as increasing the number of traffic source. From the Figure 7 we see that, when propagation delay is greater than 100 ms, the performance of these protocols is not good. But when propagation delay is less than 100 ms, TCP Vegas perform well. From Figure 8 we also see that the performance of TCP Vegas is better as increasing the buffer size of router N2.

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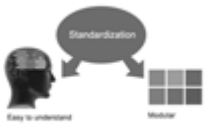
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- (b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.
- (c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.
- (d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.
- (e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.
- (f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;
- (g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.
- (h) Brief Acknowledgements.
- (i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.



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It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than $1.4 \times 10^{-3} \text{ m}^3$, or 4 mm somewhat than $4 \times 10^{-3} \text{ m}$. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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All manuscripts submitted to Global Journals Inc. (US), ought to include:

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Abstract, used in Original Papers and Reviews:

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Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art. A few tips for deciding as strategically as possible about keyword search:



- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

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Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

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1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

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11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.



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13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

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18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

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21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

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24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

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26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.



27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

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- Please note the criterion for grading the final paper by peer-reviewers.

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- Insertion a title at the foot of a page with the subsequent text on the next page
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- Submitting a manuscript with pages out of sequence

In every sections of your document

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- Present your points in sound order
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- Fundamental goal
- To the point depiction of the research
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- Significant conclusions or questions that track from the research(es)

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- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
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Approach:

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- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- Report the method (not particulars of each process that engaged the same methodology)
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- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
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The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently. You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.



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- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
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Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
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- If you desire, you may place your figures and tables properly within the text of your results part.

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- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
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- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
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- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
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Approach:

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References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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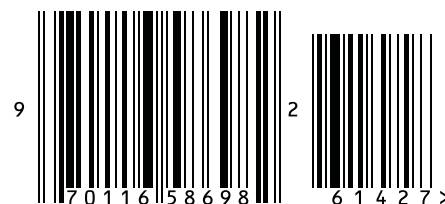


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