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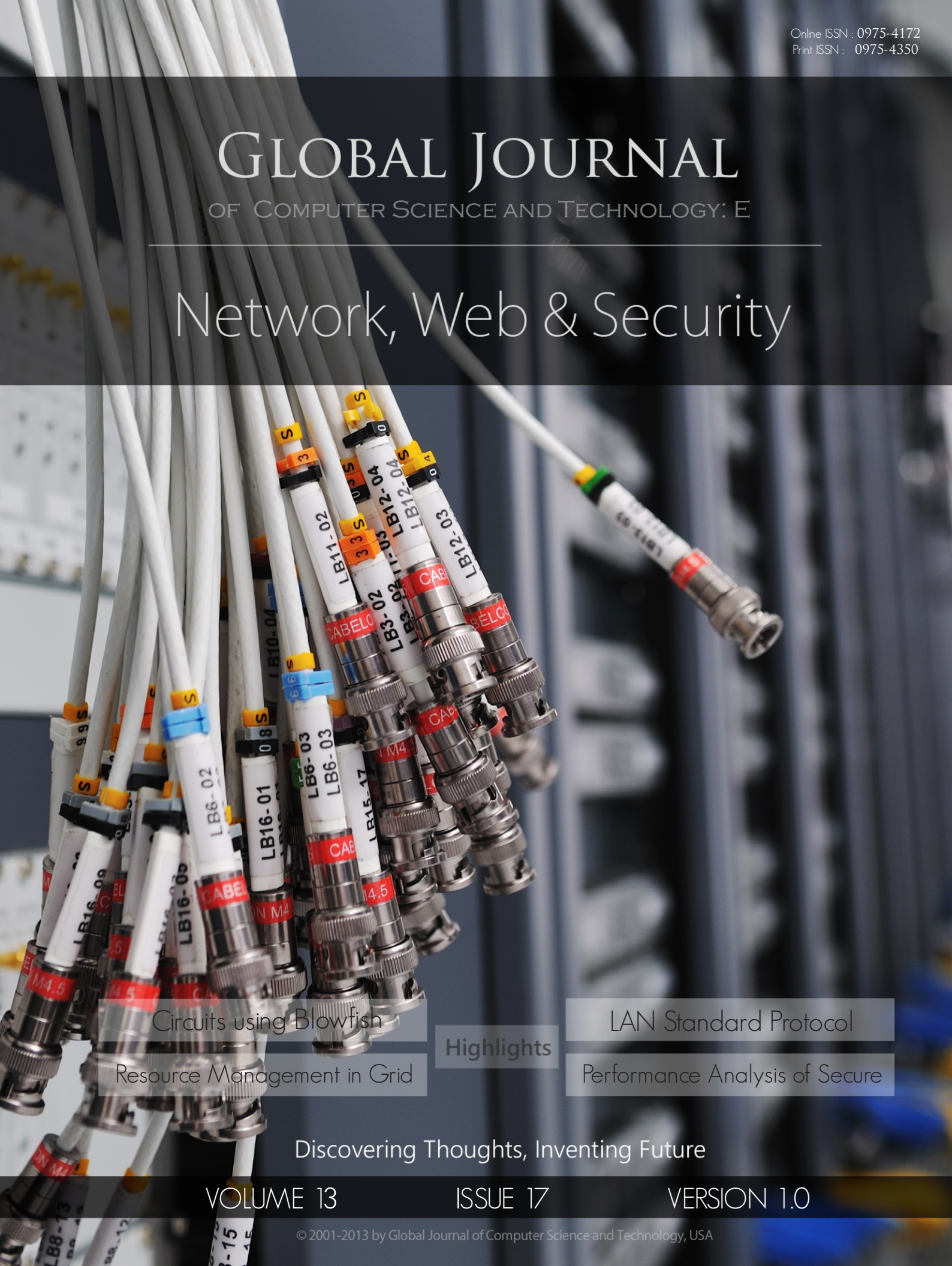

Highlights

Circuits using Blowfish

Resource Management in Grid

LAN Standard Protocol

Performance Analysis of Secure

Discovering Thoughts, Inventing Future

VOLUME 13 ISSUE 17 VERSION 1.0

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Performance Analysis of Secure Integrated Circuits using Blowfish Algorithm

By V. Kumara Swamy & Dr. Prabhu Benakop
Auroras Engineering College, India

Abstract- Security is an essential feature of Information Communication Technology (ICT). Information has to be encrypted at the transmitter side to maintain secrecy and decrypted at the receiver side to retrieve the original information for secure data transmission over insecure computer data communication networks. This paper analyzes the performance metrics of blowfish algorithm with and without Wave Dynamic Differential Logic (WDDL) style to incorporate security against differential power analysis. It compares Encryption Time (Et), Decryption Time (Dt) and Total Time (Tt) of Blowfish, Modified Blowfish with and without WDDL logic for secure Integrated Circuits (SIC) [7, 8]. Modified Blowfish with and without WDDL logic yielded good results compared to Blowfish with and without WDDL logic implementation. This paper is implemented using Xilinx webpack9.2i with Verilog Hardware Description language (HDL).

Keywords: ICT, WDDL, SIC, bf, et, Dt, dpa and hdl.

GJCST-E Classification : C.4

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Performance Analysis of Secure Integrated Circuits using Blowfish Algorithm

V. Kumara Swamy [α] & Dr. Prabhu Benakop [σ]

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Keywords: ICT, WDDL, SIC, bf, et, Dt, dpa and hdl.

I. Introduction

The original information is known as plaintext, and the encrypted form as ciphertext. The ciphertext message contains all the information of the plaintext message, but is not in a format readable by a human or computer without the proper mechanism to decrypt it. It is varied depending on a key this change the detailed operation of the algorithm. As shown in the fig no.1, at the encryption we apply plaintext and key as inputs and it produces ciphertext. At the other end, ciphertext and key are the inputs to decryption and the result is the recovery of original plaintext. It is a symmetric key algorithm.

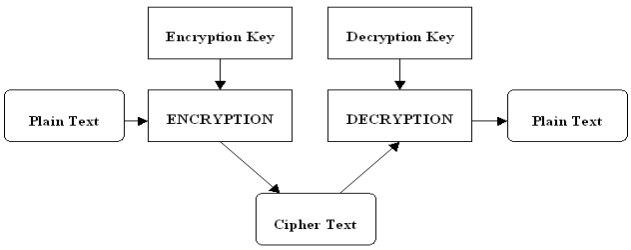

Figure 1 : Symmetric Key Encryption and Decryption

Comparing symmetric key algorithms, BF algorithm is fast, more secure with large key size and its chosen as choice of cryptographic algorithm to implement secure ICs against Differential Power Analysis (DPA) attack [10, 11] using Wave Dynamic Differential Logic (WDDL).

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a) Wave Dynamic Differential Logic (WDDL)

WDDL logic consists of a parallel combination of two positive complementary gates, one calculating the true output using the true inputs, the other the false output using the false inputs. A positive gate produces a zero output for an all zero input. The AND gate and the OR gate are examples of positive gates. The AND gate fed with true input signals and the OR gate fed with false input signals are two dual gates. Fig.no.2 shows the WDDL AND gate and the WDDL OR gate. In the evaluation phase, each input signal is differential and the WDDL gate calculates its differential output. In the precharge phase, the inputs to the WDDL gate are set at 0. This puts the output of the gate at 0. During the precharge phase, the input vector of the combinatorial logic is set at all 0s. Each individual gate will eventually have all its inputs at 0, evaluate its output to 0, and pass this 0 value to the next gate. One could say that the precharge signal travels over the combinatorial logic as a 0-wave, hence, WDDL. They produce an all-zero output in the precharge phase (clk-signal high) but they produce actual logic when they it is let the differential signal through during the evaluation phase (clk-signal low).

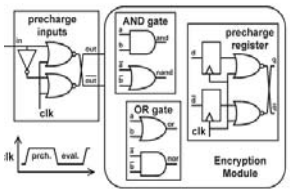

Figure 2 : Wddl and/or Gate With Precharge Circuit

WDDL logic is a constant power consumption logic which can overcome the DPA attack by the hacker. During the Precharge phase, the normal and complemented outputs of the digital circuit produce equal outputs. Thus the differential power analysis results in zero differential power to not to allow the hacker to gain the information from the hardware integrated circuits. During evaluation phase, it generates actual outputs as per logic with correct key.

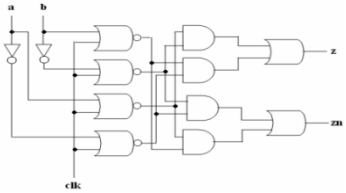

Figure 3 : Wddl Xor Gate

In fig no.3, when clock is precharge mode (high), output is zero for both. When clock is evaluation mode (low), outputs are complemented and worked as XOR and XNOR.

b) Blowfish Algorithm

Blowfish is a 64-bit block cipher [1, 2] presented by Bruce Schneider and is a suggested replacement for DES (Data Encryption Standard). DES was the standard cryptographic algorithm for more than 19 years, but it is now accepted that its key size is too small for present usage. It has a variable-length key block cipher of up to 448 bits. Although a complex initialization phase is required, the encryption of data is very efficient. It suits applications where the key does not change often.

WDDL can be implemented for any logic design. Since the discussion moves around crypto processors, it would be wise to consider a cryptographic algorithm called Blowfish is a fast algorithm [3, 8].

II. Analysis of Blowfish Algorithm

Blowfish is a symmetric block cipher that encrypts and decrypts data in 8-byte (64-bit) blocks. The algorithm has two parts, key expansion and data encryption. Key expansion consists of generating the initial contents of one array (P-array), namely, eighteen 32-bit sub-keys, and four arrays (the S-boxes), each of size 256 by 32 bits, from a key of at most 448 bits (56 bytes). The data encryption and Decryption uses a 16-round Feistel Network as shown below in fig no.4 and fig no.5 [7, 8].

The encryption algorithm can be defined by the following pseudo code equation no.1:

$$\begin{aligned} &\text{For } i = 1 \text{ to } 16 \text{ do} \\ &\quad RE_i = LE_{i-1} \oplus P_i; \\ &\quad LE_i = F[RE_i] \oplus RE_{i-1}; \\ &LE_{17} = RE_{16} \oplus P_{18}; \\ &RE_{17} = LE_{16} \oplus P_{17}; \end{aligned} \quad (1)$$

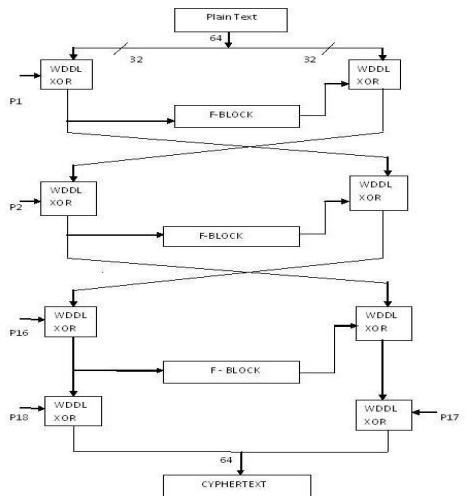

Figure 4 : Blowfish Encryption

The Decryption algorithm can be defined by the following pseudo code equation no.2:

$$\begin{aligned} &\text{For } i = 1 \text{ to } 16 \text{ do} \\ &\quad RD_i = LD_{i-1} \oplus P_{19-i} \\ &\quad LD_i = F[RD_i] \oplus RD_{i-1}; \\ &LD_{17} = RD_{16} \oplus P_1; \\ &RD_{17} = LD_{16} \oplus P_2; \end{aligned}$$

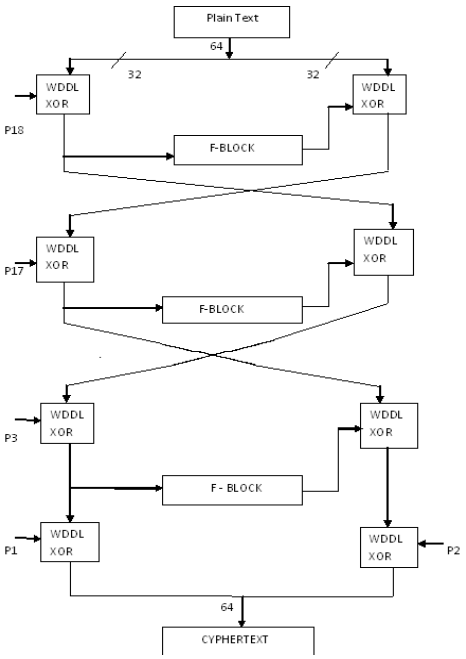

Figure 5 : Blowfish Decryption

III. Design of Blowfish Algorithm

Secure crypto processor is a dedicated computer or microprocessor for carrying out cryptographic operations, embedded in a packaging with multiple physical security measures. The purpose of a secure crypto processor is to act as the keystone of a security sub-system, eliminating the need to protect the rest of the sub-system with physical security measures. Smartcards are probably the most widely deployed form of secure crypto processor, although more complex and versatile secure crypto processors are widely deployed in systems such as Automated teller machines, TV set-top boxes, and high-security portable communication equipment. A crypto processor implementing Blowfish algorithm may be shown in fig no.6.

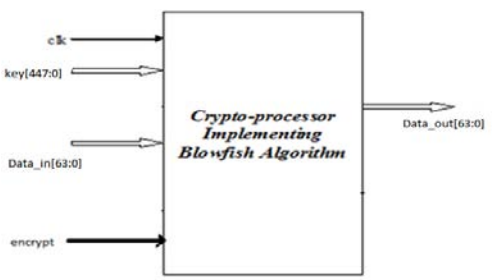

Figure 6 : Blowfish Crypto-processor

a) Description of the signals

Clk: The input clock signal.

Key[447:0]: The encryption/decryption key. If less than a 448-bit key is desired, this signal must be padded up to 448 bits. Typically, this padding consists of all 0's.

data_in[63:0]: The input data. In encryption mode, this is the plaintext. In decryption mode, this is the cipher text. This is only read when the ready signal is asserted.

data_out[63:0]: The output data. In encryption mode, this is the cipher text. In decryption mode, this is the plaintext. This is only modified during key initialization and the same cycle that ready is raised after an encryption or decryption sequence.

Encrypt: This signal toggles between encryption and decryption operation. 1 means encrypt, 0 means decrypt.

b) Substitution Boxes (S-boxes)

A substitution box (or S-box) is a basic component of symmetric key algorithm used to obscure the relationship between the plaintext and the cipher text In general, an S-box takes some number of input bits, 8_bit, and transforms them into some number of output bits, 32_bit: an 8×32 S-box, implemented as a lookup table [1, 3, 8]

c) Feistel Function Block

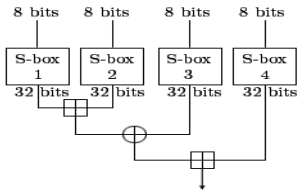

Figure 7 : Function Block Internal Structure

Function 'F' is used to create 'confusion' to thwart cryptanalysis based on statistical analysis. 'Confusion' seeks to make the relationship between the statistics of the cipher text and the value of encryption key as complex as possible. One advantage of this model is that the round function F does not have to be invertible, and can be very complex as shown in fig no.7 [1, 3, 8].

d) Modulo 32-bit adder

To increase the speed of blowfish adders in this fig no.8 can be operated in parallel. one adder adds Two h-bit residues, X and Y to form their sum S1+2hCout1 .Another one is 3-operand adder that computes "X+Y+m". Note that if m=2n+1, we have h=n+1.It has been reported that if either Cout1 or Cout2 of this addition is '1' then the output is X+Y+m instead of X+Y. However, in the following we illustrate that only if the carry of "X+Y+m" is '1', it is sufficient to select it as the final output [4, 9]

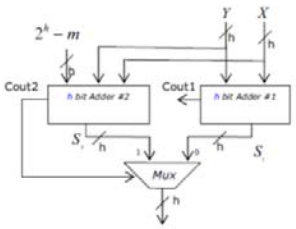

Figure 8 : Modulo M –bit adder

e) Sub-key Generation Unit

The sub-key generation unit expands the given 448-bit key into 14 sub-keys and 4 more subkeys are internally generated, each of 32 bits, so that they can be used at different stages in the algorithm. The sub key generation process is designed to preserve the entire entropy of the key and to distribute that entropy uniformly throughout the sub keys. It is also designed to distribute the set of allowed sub keys randomly throughout the domain of possible sub keys. Then bit wise XOR of the P-array and K-array is performed reusing the words from K-array as needed shown in equation no.3.

$$P_1 = P_1 \wedge K \ldots P_{14} = P_{14} \wedge K_{14}$$
$$P_{15} = P_{15} \wedge K_1 \ldots P_{18} = P_{18} \wedge K_4 - \quad (3)$$

IV. Results and Discussion

Encryption consists of sixteen rounds of operations. Each round-one operation consists of xor, 8-bit to 32-bit substitution, 32-bit modulo addition, xor, 32-bit modulo addition and swapping of result of Left Encryption (LE) to Right side and Right Encryption (RE) to left side of the data flow as shown in fig no.6. After performing 16 round-one operations right side output[31:0] xored with subkey p16[31:0] and left hand side output[31:0] xored with subkey p17[31:0] and then we get final cipher text[63:0].

Decryption is same as that of encryption except we applied subkeys p0 to p17 in reverse order. Input data is the ciphertext (output of encryption) and then we get the output as Plaintext. Decryption consists of sixteen- round one operation. Each round-one operation consists of xor, 8-bit to 32-bit substitution, 32-bit modulo addition, xor, 32-bit modulo addition and swapping of result of Left Encryption (LE) to Right side and Right Encryption (RE) to left side of the data flow as shown in fig no.7. The input data ciphertext[63:0] performs 16 round-one operations with 16 sub keys(p17 to 2) and then after performing 16 round-one operations right side output[31:0] xored with subkey p1[31:0] and left hand side output[31:0] xored with subkey p0[31:0] and then we get final plaintext.

The encryption and decryption modules are integrated in the top level module to obtain the blowfish crypto-processor and the simulation results are analyzed.

Blowfish Algorithm is implemented in four forms and compared its performance parameters which are given below in the table no.1 and the modified blowfish is producing better results than the normal blowfish. Analysis is done for blowfish with and without WDDL logic to secure the ICs against DPA attack by the hackers.

Comparison of Blowfish, modified Blowfish with and without WDDL logic is given below in the table no.1 and the corresponding bar charts are shown in the fig no.9, 10 and 11 for performance parameters Et, Dt and Tt respectively.

Table 1 : Comparison of four implementations of Blowfish Algorithm for Et, Dt and Tt

S No	Name of Crypt-algorithm	Performance parameters		
		Et(ns)	Dt(ns)	Tt(ns)
1	Blowfish	98.663	98.663	99.395
2	Modified Blowfish	70.08	70.08	71.067
3	Blowfish with WDDL	107.62	107.62	112.56
4	Modified Blowfish with WDDL	73.985	73.985	76.337

Et: Encrypt Time, Dt: Decrypt Time, Tt: Total Time

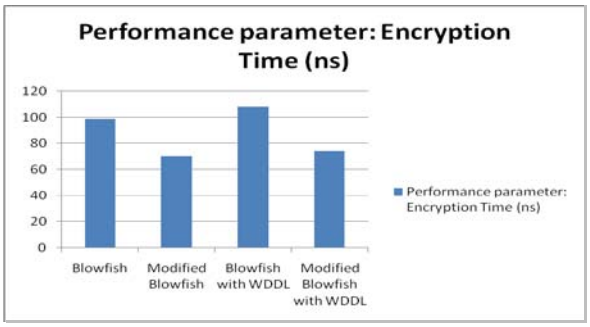

Figure 9 : Bar Chart for Performance parameter Encryption Time of four implementations of Blowfish Algorithm

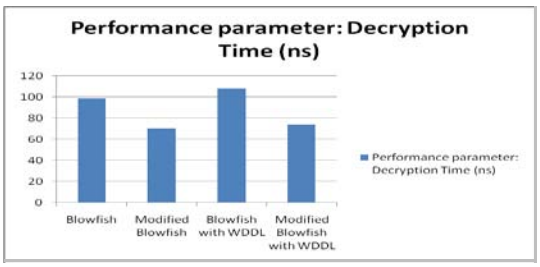

Figure 10 : Bar Chart for Performance parameter Decryption Time of four implementations of Blowfish Algorithm

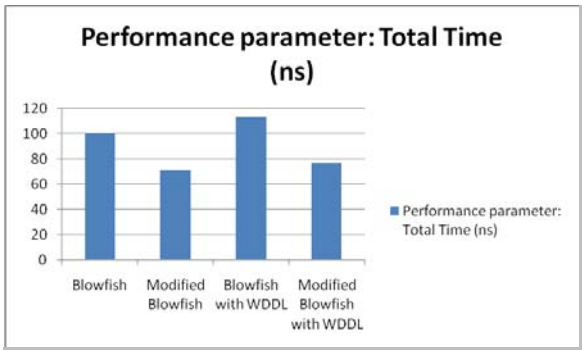

Figure 11 : Bar Chart for Performance parameter Total Time (i.e., Propagation Delay) of four implementations of Blowfish Algorithm

V. Conclusion

In this paper, an implementation of Blowfish Algorithm is designed using WDDL Logic style. In the implementation bottom-up approach is used. The sub-keys generated for a particular key can be used for the encryption of the entire data to be encrypted with that key. The sub keys are given in reverse direction of the decryption data path without changing the design for decryption. The crypto processor has been designed for the key size of 448 bits and plain text of 64 bits. The code for the implementation has been written in Verilog HDL. The functional verification has been done using the ModelSim 5.5 simulation package. The synthesis of the design is done using the Xilinx Web Pack9.2i. Comparison with different implementations has been given in table no.1 and proved that Modified Blowfish with and without WDDL logic yielded the best results in Encryption time, Dectryption time and Total Propagation delay compared to blowfish with and without WDDL logic respectively.

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Resource Management in Grid Computing: A Review

By P. K. Suri & Sunita Rani
BPSMV, Khanpurkalan, India

Abstract- A Network Computing System is a virtual computer formed by a networked set of heterogeneous machines that agree to share their local resources with each other. A grid is a very large scale network computing system that scales to internet size environments with machines distributed across multiple organizationsand administrative domains. The resource management system is the central component of grid computing system. Resources in the grid are distributed, heterogeneous, autonomous and unpredictable. A resource management system matches requests to resources, schedules the matched resources, and executes the requests using scheduled resources. Scheduling in the grid environment depends upon the characteristics of the tasks, machines and network connectivity. The paper provides a brief overview of resource management in grid computing considering important factors such as types of resource management in grid computing, resource management models and comparison of various scheduling algorithm in resource management in grid computing.

Keywords: *grid computing, resource management, scheduling algorithms.*

GJCST-E Classification : *C.2.1*

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Resource Management in Grid Computing: A Review

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Abstract- A Network Computing System is a virtual computer formed by a networked set of heterogeneous machines that agree to share their local resources with each other. A grid is a very large scale network computing system that scales to internet size environments with machines distributed across multiple organizationsand administrative domains. The resource management system is the central component of grid computing system. Resources in the grid are distributed, heterogeneous, autonomous and unpredictable. A resource management system matches requests to resources, schedules the matched resources, and executes the requests using scheduled resources. Scheduling in the grid environment depends upon the characteristics of the tasks, machines and network connectivity. The paper provides a brief overview of resource management in grid computing considering important factors such as types of resource management in grid computing, resource management models and comparison of various scheduling algorithm in resource management in grid computing.

Keywords: grid computing, resource management, scheduling algorithms.

I. Introduction

Grid Computing is coordinated resource sharing and problem solving in dynamic, Multi-institutional virtual organizations [1].Grid Computing is the flexible, secure, and coordinated sharing of resources among dynamic collections of individuals, institutions, and resources [2].The resource management is the central to the operation of a grid. The basic function of resource management is to accept requests for resources from machines with in the grid and assign specific machine resources to a request from the overall pool of grid resource for which the user has access permission. A resource management system matches requests to resources, schedules the matched resources, and executes the requests using the scheduled resources. Grid resources are the entities such as processor, disk space, memory space, network bandwidth etc. that are managed by the resource management system. The grid resource scheduling process can be defined as the process of matching a query for resources, described in terms of required characteristics, to a set of resources that meet the expressed requirements. Job scheduling is the mapping of jobs to specific physical resources, trying to minimize some cost function specified by the user.

II. Related Work

There have been some studies on survey and taxonomy of grid resource management. The most popular is done by Klaus Krauter and RajKumar Buyya [3], it described an abstract model and defined various concepts and terminologies for describing resource management architecture for grid computing. The work is also done by [4] for grid resource management system, it described issues and functions for GRMS and survey various grid resource management system. In 2010, Bo Wang, Gang Chen [5] presented various grid resource management models and context for grid resource management system. In 2010, [6] surveyed the various job scheduling and resource scheduling in grid computing. Scheduling experiments are performed with the help of GridSim simulator by setting the values to the number of jobs and processing time is recorded to analyze the feasibility of algorithm. In 2010, [7] surveyed and simulate various job scheduling strategies in grid computing environment. Also compare various jobs scheduling algorithm considering various parameters like type of scheduling model, type of resources that particular job scheduling algorithm favors(i.e. heterogeneous or homogenous), response time, load balancing, etc. In 2012, Isah Abdul Azeez and Safwana Haque [8] have given a review for resource management in grid computing and described resource management concepts.

III. Types of Grid Resource Management

SLA-supported Resource Management: This architecture reflects the business needs of service provider and aims at a more automatic and autonomous resource configuration through the introduction of a Conversion Factory [9]. Service Level Agreements with the aid of formalized business goals (Business Level Objectives), complexity analyses, and knowledge of previous configurations.

Agent-based Grid Resource Management: Agent-based approach for resource management [10] is flexible, robust, and scalable. Resource Management agents match requests to available resources and

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arbitrate between requests with respect to Business Values. Each agent implements one or more allocation semantics, and advertises its capabilities to the Naming/Discovery service. Their behavior depends on the allocation semantic they implement and extends the basic behavior consisting in matching a requested resource profile with an available resource within its set of primary resources.

An Enterprise-Based Grid Resource Management System: An Enterprise based resource management system [11] is highly scalable resource management system built using COTS (Commercial Off-The-Shelf) components used in web server infrastructures. The web services and enterprise components constituted the core of the system that provides fault tolerance as well as high performance and scalability.

Agreement-Based Resource Management: Agreement based resource management is on the basis of standards activities and next generation resource management services [12]. Agreements abstract local management policy by representing an underlying resource strictly in terms of policy terms which it is willing to assert, and in doing so provides the basis for building a variety of alternative grid resource management strategies. An agreement provides a powerful mechanism for virtualizing or abstracting a resource. A resource may have complex internal policy for deciding permission, relative priorities, and other scheduling and management procedures.

Grid Resource Management based on P2P Technology: A resource management approach in grid computing environment based upon P2P technology [13] can manage dynamic grid computing resources efficiently. Different kinds of grid computing resources are organized into a P2P overlay network and available information is published in type of grid service. With this approach, the computational resources of a grid system can be scheduled dynamically according to the real-time workload on each peer. The application of this approach is introduced into DDGRID (Drug Discovery GRID), a grid system for drug discovery and design, to evaluate the performance.

Failure-Aware Grid Resource Management System: Novel load-based failure recovery strategy used in the Virtual Resource Management framework [14]. The mechanism is applicable in any environment where distributed resources must be managed and failures of the system are critical, e.g. Service Level Agreements are given for the correct and complete execution of a job. Given approach adapts to the actual load situation and determines a remapping interval accordingly, which diminishes the danger of underestimating failure durations as any job is remapped before it is actually endangered of being terminated.

A Scalable wide-area Grid Resource Management Framework: A scalable wide-area grid resource management framework [15] is a hierarchical framework that permits wide-area grid resource management. The framework uses a hierarchical organization of resource managers. The hierarchy is composed of multiple levels of resource managers, similar to business and government organizations. Resources are assigned to jobs through decentralized inter and intra organizational collaborations between resource managers.

Semantically Enhanced Grid Resource Management: Semantic based Grid Resource Management(S-GRM) [16] system utilizes semantic metadata to describe and discover both logical and physical resources. The system integrates the component search into existing Grid application development environment and discovery of nodes in resource manager in a comprehensive perspective.

HRMF-G: a Grid based Hierarchical RM Framework: Hierarchical Resource Management framework [17] effectively resolved the bottleneck problem in the centralized resource management mode and non-reliability problem in the distributed resource management mode, and also resolved the load imbalance problem and other problems in the centralized resource schedule mode and the distributed resource schedule mode.

Performance based Grid Resource Management: A Generalized Stochastic PetriNet (GSPN) model is for performance evaluation of grid [18]. In this model, three roles are defined: Users (U), Resource Management System (RMS), and Resources(R). All resource requests by users are to be submitted to some resource management system, instead of directly to resources. The mapping of users to RMS's and resources to RMS's are assumed to be both n to 1, which means that each users always chooses a preferable designated RMS to submit their tasks to, and each resource is directly managed by only one RMS.

IV. Resource Management Models

Model of resource management gives information regarding the relationship between users and resources provider, how resources are chosen for users, how resources are allocated. There are several different models for grid resource management system and these several different models may be used in the same system.

a) Economic Model for GRM

It provides a decentralized resource management capability and is adaptable to changes in the environment and user requirements. It is scalable, controllable, measurable and easily understandable policy for management of resources. There are [19] several market-based economic models such as a commodity market, tenders and auctions along with the

architecture and algorithms for their implementation in grid computing systems.

b) Architectural Models for GRM

For the architecture of grid resource management three different models are [20]: Hierarchical Model, Abstract Owner Model and Market Model. The hierarchical model exhibits the approach followed in many contemporary grid systems. The abstract owner model follows an order and delivery approach in job submission and result gathering. The market/economy model follow economic model in resource discovery and scheduling that can coexist or work with contemporary systems and captures the essence of both hierarchical and abstract owner models.

c) Pricing Model for GRM

This price model for grid resources [21] is based upon the theory of financial option. The use of option value computation is for grid resources usage and to select the best point of exercise of the option to utilize any of the grid resources. This helps the user as well as the grid resources provider to optimize resources for profitability. A price varying function which controls the price of resources and ensure the grid users get the maximum at best prices and the resources provider also make reasonable revenue at the current base price setting. A price variant function in price model is to adjust the charges for resources at various times so that the grid remains busy. This function helps the resource provider in keeping the grid busy and recovering the investment on the infrastructure in a predetermined period of time.

d) Resource Management Model of Electric Power System Based on Grid Technology

A resource management model of power system based on grid technology [22] can fully use computer hardware infrastructure and provide a favorable support for large scale computing environment in electric power system. This model consists of two independent parts: management node and computing node. As a center node, management node is responsible for the maintenance of grid users and resource information, safety management, job scheduling, the job monitor, task decomposition and transmission computing result collection and so on. Computing node receives computation tasks from the management node, and generates intermediate results.

e) Resource Management Model Based on P2P Technology

Web services grid resource management and discovery model based on P2P technology [23] applies the semantic web technology and P2P technology to the grid resource search, improves the retrieving utilization, search speed and precision rate of grid resources and better solves the system expandability and reliability. This model is divided into two layers. The under layer is composed of Web Service Resource Providers (WSRP) nodes, called WSRP network. The upper layer is structural P2P networks, composed of Web Service Resource Register and Inquiry Broker (WSRRAIB) nodes with high reliability, long online time and less variation, called WSRRAIB network.

V. Scheduling

In grid environment, to schedule resources and jobs, certain scheduling components are required which decides which resources are assigned to which jobs. Assignment of resources to job can be explicitly and implicitly. Explicitly assignment can be specified by external rules base or programmable interface. Implicitly assignment can be implemented by choice of state estimation algorithms and rescheduling approaches.

a) Scheduler

The function of the scheduler as task allocation or task mapping in distributed computing system. It should be noted that multiple tasks from various users are submitted on any nodes of the distributed computing system from time to time. The scheduler must also accommodate this multiplicity of the disjoint task. Characteristic parameters for any scheduler are: turnaround time, throughput and interactive response time.

Turnaround time is a task oriented characteristics that considers the time duration between submission and completion of a task. Obviously, it will be desirable to minimize this time.

Throughput of the system is a characteristic that measures the number of tasks successfully executed in unit time. This quantity must be maximized. Interactive response is about the requirement of interactive users during the execution of the tasks. Scheduler is responsible for resource discovery, resource trading, resource selection and job assignment.

b) Scheduling Model

Scheduling models describes structure of resource management system [4] and scalability of system.

Scheduling models can be classified as centralized, hierarchical or decentralized.

i. *Centralized Scheduling Model:* In centralized scheduling model, all jobs are submitted to a single scheduler who is responsible for scheduling them on the available resources. Since all the scheduling information is available at one single position the scheduling decision are optimal but this approach is not very scalable in a grid system.

ii. *Decentralized Scheduling Model:* In decentralized scheduling model, there is no central scheduler, scheduling is done by the resource requestor and owners independently. This approach is scalable

and suits grid systems. But individual schedulers should cooperate with each other in making scheduling decisions and the schedule generated may not be the optimal schedule.

iii. *Hierarchical Scheduling Model:* In this model, the schedulers are organized in a hierarchy. High level resource entities are scheduled at higher levels and lower level smaller sub- entities are scheduled at lower levels of the scheduler hierarchy. This model is a combination of above two models.

c) Scheduling Algorithms

i. *Capacity Planning and Stochastic Scheduling in Large-Scale Grids (CPSS)*

Capacity Planning and Stochastic Scheduling [24] is very efficient and scalable approach that lead to increased resource utilization, lower cost per workflow execution and the ability to solve huge problem sizes. Capacity Planning and Stochastic Scheduling is used for large scale grid computing infrastructures that aims to minimize the cost of application execution while ensuring that Quality of Service constraints are satisfied with desired confidence levels. This Scheduling formulation is based on queuing theory to specify the stochastic nature of the grid. In modeling the grid as a queuing network make able to use more accurate forecasting mechanisms to determine workload and its behavior which improves our ability to negotiate for advance reservations and grid futures. In this scheduling, the job of the scheduler is to select a set of resources onto which to schedule the tasks and manage an application, coordinate the execution of the tasks and manage the data distributions and communication between the tasks. Here, problem formulation implicitly performs capacity planning in that it assigns just enough resources to be able to handle the total service workload, while minimizing the cost of resources.

ii. *Stochastic Model and Evolutionary Optimization Algorithm for Grid Scheduling (SMEOA)*

Stochastic Model and Evolutionary Optimization Algorithm for grid scheduling [25] address the issues of uncertainty or randomness of sources. Uncertainty of sources has major impact include machine breakdowns, unexpected releases of high priority jobs, network status and soon. A new stochastic model for grid scheduling and a novel evolutionary scheduling algorithm is based on MSE (Minimum Stochastic Expectation) model.A resource Use Pattern Analysis (UPA) method to predict resources and grid QoS policy bring resources to improve grid efficiency.

iii. *Research on Novel Dynamic Resource Management and job scheduling in grid computing (RNDRM)*

This scheduling model is based on Heap Sort Tree (HST) [26] for computing the available computational power of the nodes (resource) as well as whole grid system. Here the resource with largest available computational ability among the whole grid system is selected to be the root node of the HST and it is ready for the scheduler to submit a job. The algorithm design for job scheduling is well suitable for the complex grids environment and it is based on agents.

iv. *Virtual Computing Grid using Resource Pooling (VCGRP)*

The System is based on loosely coupled concept. Virtual Computing Grid means the system can choose a resource and allocate tasks to it. Here, it is a single point web based access known as Virtual Computing Grid Portal and the Virtual Computing Grid Monitor is a central resource manager for the System [27].

v. *A Grid-distance Based Scheduling for Grid Resource Management (GDBS)*

Resource scheduling algorithm model based on grid distance [28], which can optimize scheduling by using close resources in the grid resource scheduling. This is especially important in terms of establishing lasting and numerous relationships between consumer and providers, for it helps form more effective VOs (Virtual Organizations).In resource scheduling, choosing near and low-cost resources using grid-distance as a key criterion improves the performance of grid resource scheduling and has better characteristics in executing tasks, which achieves the aim of scheduling optimization.Therefore, the strategies based on the grid distance scheduling are:

1. Achieving the aim of choosing the physically closer resource and show the advantage of closer resource in terms of completing time, communication reliability and cost;
2. The closer resource is obviously more stable in communication;
3. Optimizing the whole grid resource scheduling based on grid distance scheduling so as to improve the capacity of grid in dealing with job in unit time.

vi. *Resource-cost-based Multi-agent Systems Scheduling for Grid Resource Management (RCBMAS)*

A multi-agent systems resource management method in Grid environment fully utilizes the agent's autonomy, heterogeneity and distribution etc. to cooperate jobs in the Grid environment. The method utilizes resource-cost-based Grid resource scheduling algorithm [29] to find the most appropriate resource for each Grid task. Resource-cost is a triple, represented as physical distance, bandwidth available of communication network and the use cost .The first is a constant and the others vary with both the communication load and the relationship between

supply and requirement. Assume A,B are two entities which A is the job and B is the node that provides resource in Grid, RC(A,B) is the Resource-cost between them, and then RC(A,B) = □f(dis, av-band, cost) .Here dis, av-band and cost denote physical distance, available bandwidth and cost respectively.

Resource-cost-based scheduling algorithm due to the dynamic characteristics of the resource and nodes in Grid and the fact that the resource-cost varies with the time, a satisfactory threshold cannot be determined. However, it should be the minimum one chosen from the resources available. There are two choices to find the shortest path of Grid resource graph: depth-limited search and the non-depth-limited search. Therefore, the corresponding algorithms are called the depth-limited algorithm and the free algorithm. The free algorithm is the one used in freely calculating the resource-cost for the candidate resources in the whole Grid.

vii. *Market-driven Based Resource Scheduling Algorithm in Computational Grid (MDBRS)*

In resource management system based on economy model, resource provider is defined as producer, and resource user is defined as consumer. Producers and consumers become individuals in economic environment, and each individual has their own target and strategy. Market-driven resource management and scheduling system [30] should maximize profit of each individual. The strategy of consumer is to use lowest expense to solve his problem, while the strategy of producer is to attract more consumers and makes his profit maximum. Resource owners or provider determine the price of their resources, and charge customers for consuming the resource. Pricing strategy is that price depends on some factors, and price can be fixed or fluctuates as the changing of supply and demand. A Grid resource scheduling algorithm based on market-driven using dynamic resource price-adjusting (RPA) strategy. RPA-Cost Optimization and RPA-Time Optimization scheduling algorithm are based on a dynamic /price-adjusting strategy, which introduces the concept of central price, the fluctuant factor of price, and the lifetime of price; the performance evaluation standard of load balance for Grid system is defined using a load balance factor.

viii. *BMQOS: A General Self-Adaptive Global Resource Scheduling Algorithm for Computational Grid*

The process of computational grid resource scheduling generally falls into two phases: global resource scheduling and local resource scheduling. Under this pattern, global resource scheduling algorithms are different from the traditional resource scheduling algorithms of LRMS (local resource management system, LRMS).A general self-adaptive global resource scheduling algorithm for Computational Grid [31], BMQOS (Best Multi QOS) specifies the personal resource requirement of a computational grid job, BMQOS can globally self adaptively weigh every index of the MQOS of candidate computational grid nodes and choose an appropriate node for a job from the candidates finally. Especially by adjusting a weight vector, w= (w1, w2 … wn) T, it can better meet a job's personal resource requirement and enhance run-time benefit of Computational Grid.

ix. *2-Phase Trust-Based Scheduling (2PTBS)*

2-Phase Scheduling: Since grid computing system is an Internet-based, distributed computing platform, it involves not only LANs, but hosts in every LAN also. According to so, when a scheduling is put to a computing task, it must be considered to schedule not only a certain LAN with a certain algorithm, but also a certain host in LAN with other algorithms. So a certain scheduling process can be divided into two levels:External Scheduling: WAN-scope, the first subtask level, distributed scheduling; Internal Scheduling: LAN-scope, the second subtask level, concentrated scheduling.

2-Phase Trust-Based Scheduling: 2-Phase scheduling algorithm [32] is the right one to show out the hierarchy explicitly.2-Phase Trust-Based Scheduling Algorithm (2PTBSA) is to avoid unstable nodes during computing progress, and to enhance the total computing efficiency, by the filtration with the mechanism of trust, on the premise of better descriptions of the complexity and hierarchy.

x. *Resource Discovery Algorithm Based on Small-World Cluster in Hierarchical Grid Computing Environment (RDA)*

Small-world cluster into hierarchical grid in which intra-cluster adopts centralized management and cluster center nodes form small-world network. The architecture strikes a balance between high efficiency of total centralized management and good scalability of absolute distributed disposal. In the process of constructing small-world network, a new construction method on the basis of NW (Newman-Watts) model is short range contacts and long range contacts are represented by routing tables in a logic and dynamic way not by Manhattan distance. Hierarchical architecture based on small-world cluster and SWRD algorithm used in education resource grid have high search success rate and low query cost, where small world and resource discovery make perfect combination. There exists no bottleneck and central database, and system is scalable and reliable. Discovering resources according to different situations is in fact another expression of distribution [33].

Table : Comparison Of Various Job And Resource Scheduling Algorithms Parameter Paper Architecture

PARAMETER PAPER	ARCHITECTURE H/D/C	ENVIRONMENTS HE/HO	RT	RU	LB	DY	COST
CPSS	H	HE	HI	HI	AVG	HI	HIGH
SMEOA	D	HE	HI	HI	AVG	HI	LOW
RNDRM	D	HE	HI	HI	HI	HI	AVG
VCGRP	D	HE	AVG	HI	HI	HI	LOW
GDBS	D	HE	LO	HI	LO	HI	LOW
RCBMAS	D	HE	AVG	AVG	LO	HI	LOW
MDBRS	C	HE	AVG	HI	HI	HI	AVG
BMQOS	C	HO	LO	HI	AVG	AVG	AVG
2PTBS	D	HE	LO	AVG	AVG	HI	HI
RDA	H	HE	LO	HI	AVG	LO	LO

**Abbreviations:* D-Distributed, H-Hierarchical, C-Centralized, HO-Homogeneous, HE-Heterogeneous, RT- Response Time, RU- Resource Utilization, LB- Load Balance, DY- Dynamicity, HI-High, AVG- Average, LO- LOW

VI. Conclusion

In this paper, a review of resource management system in grid computing is presented. Various types of resource management in grid computing and various models for resource management in grids computing are discussed. Various scheduling algorithm in grid computing have been analyzed. A comparison on various parameters like architecture type, environment type (Heterogeneous or Homogeneous), response time, load balancing, and resource utilization is done on different types of job scheduling.

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Wireless Transmission of GPS Values for UAV's Navigation using 802.15.4b Lan Standard Protocol (Zigbee)

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Abstract- In the last few years UAVs systems have become relevant for many military applications including non military security work such as surveillance of pipelines. An autonomous UAVis often preferred for those missions that are dull, dirty or dangerous for manned aircraft. It has the ability to hover and it has free band GPS direction and tilt sensors for smooth navigation. There is no person on board to control the aircraft. Due to the advancement in satellite receiver tracking systems, an integrated system employing latest tracking techniques using satellite Receiver in the form of GPS is integrated with this vehicle. The data of GPS is transferred to the vehicle wirelessly with the help of Zigbee transceiver module. The GPS has made navigation systems practical for a number of land-vehicle navigation applications. In this paper we have devised an algorithm and hardware implementation scheme to transfer the GPS values from the PAV to the ground station wirelessly to control its aerial navigation.

Index Terms: *GPS, microcontroller, UAV usart, wireless module (Zigbee).*

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Abstract- In the last few years UAVs systems have become relevant for many military applications including non military security work such as surveillance of pipelines. An autonomous UAVis often preferred for those missions that are dull, dirty or dangerous for manned aircraft. It has the ability to hover and it has free band GPS direction and tilt sensors for smooth navigation. There is no person on board to control the aircraft. Due to the advancement in satellite receiver tracking systems, an integrated system employing latest tracking techniques using satellite Receiver in the form of GPS is integrated with this vehicle. The data of GPS is transferred to the vehicle wirelessly with the help of Zigbee transceiver module. The GPS has made navigation systems practical for a number of land-vehicle navigation applications. In this paper we have devised an algorithm and hardware implementation scheme to transfer the GPS values from the PAV to the ground station wirelessly to control its aerial navigation.

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Nomenclature

GPS- Global Positioning Satellite
UAV- Unmanned Aerial Vehicle
USART- Universal Synchronous Asynchronous Receiver Transmitter
ISM- Industrial, Scientific and Medical
EEPROM- Electrically Erasable Programmable Read Only Memory

I. Introduction

An UAV is an aerial aircraft with no onboard pilot. It can be RC (Remote Controlled) or can be controlled autonomously whether using pre-programmed plans or dynamically complex control systems [1]. As UAVs are free from the burden of physiological limitations caused by human pilots, they can be designed for maximum on-station times.

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They are mainly used for surveillance, reconnaissance[10] and penetration of hostile territory without the deployment of human beings in areas of high risk. Now-a-days, motorvehicles, farming and mining equipment, and many varieties of land-based vehicles are equipped with GPS based navigation system[8].As per recent technologies used a vehicle tracking system was designed for making a smart farm in the framework of precision agriculture by employing the GPS and Zigbee wireless network including software for acquiring data from the vehicle, storing and displaying it in real time on a web site. [2]. System was employed as tractor tracking system based on mesh topology to cover the large area and data is collected from the tractor [3]. Using 32 bits LPC2220 microprocessor of ARM7, and muC/OS-II real-time embedded operating system, GPS with Zigbee a record system is designed that can provide precise synchronization among instruments and also position the fault, and also allow communication among instruments[4]. The DDAU (Distributed Data Acquisition Unit) used in three-dimensional electromagnetic exploration targeted for oil and gas (hydrocarbon) detection, is composed of data acquisition and DSP module, embedded control module, GPS sync and timing module, and power supply module. The embedded control module includes ZigBee OEM board, temperature sensor, Ethernet, 4 UARTs, 4 SPIs, 2 SSCs, 8 GB NAND flash and 8 MB NOR flashes, is based on AT91RM9200 and Linux 2.6 [5]. With the advancement in technology an enhancement scheme for GPSsignals received on an unmanned aerial-vehicle helicopter system is introduced where using Kalman filter the smooth and accurate signals are generated for automatic flight control systems [6]. A Real-time Aerial Monitoring System performing the rapid mapping in an emergency situation using the position/attitude information obtained from GPS/IMU is used to perform the aerial triangulation without GCPs. The positions and attitudes of GPS/INS integration with the solution from AT in regular intervals are updated. The GPS/IMU/Image data for an UAV-based aerial monitoring system is simulated and compared with the result of GPS/INS/AT with and without updates from AT [7].

In this paper we are representing an aerial system which can fly in the air based on the decisions

and directions decided by the person sitting on the ground to make it move on a concerned path to fulfill the target. Here we are focusing on the wireless navigation system which can control the system during its flight. First we are preparing a database which contains the GPS values of different locations which are traversed frequently. This database is included in the program code. Whenever change in the position of the vehicle is required a command is send from the control room and then vehicle will continuously check the GPS value of that particular location where it has to reach. When the value matches with the stored GPS value that becomes its destination.Here we have designed a network with its hardware design.

II. Hardware Development

Hardware of this system basically consists of two parts: Transmitting node and Receiving node.

a) Transmitter Node

The components of this section are explained below:

i. *Power Supply Module*

This module is designed using center tapped 9-0-9 transformer [9] to step down the AC voltage, 1000uf/35V electrolytic capacitor which is used as a filter circuit, IN4007 diodes used to form a bridge rectifier to convert AC to DC, 7805 regulated IC to obtain a 5V at the output of the regulator, 330Ω resistor and a LED as an indicator. These components are mounted to obtain 5V, 500mA of power supply to drive our whole protocol.

ii. *Embedded Microcontroller*

There is a whole wide range of controllers available in the market. But this particular project is developed using AVR series of microcontroller (ATMEGA16) because of its inbuilt USART and its variable frequency. ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture [11]. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz, allowing the system designed to optimize power consumption versus processing speed. Further it also minimizes the cost of this personal area network.

iii. *Transmitting module*

It is a low power, low cost 2.4 GHz transceiver designed for wireless applications. The ZigBee is designed for the 2400- 2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. This is the radio frequency receiver module, through which OEM designers can design the remote control applications in the fastest way. The circuit is designed with SMD components and the module size is small enough that can be used for all types of applications. The modules are using IC CC2500 made by Texas Instrument.

iv. *GPS (Navigation module)*

The GPS is actually a constellation of 27 Earth-orbiting satellites (24 in operation and three extras in case one fails). GPS is widely characterized as satellite navigation or a satellite positioning system, providing signals for geo location and for safe and efficient movement, measure, and chase of individuals, vehicles, and different objects anyplace from the earth's surface to celestial orbit in house.

v. *USART*

The USART is additionally called a Serial Communications Interface or SCI. The USART are often configured as a full duplex asynchronous system that may communicate with peripheral devices like CRT(Cathode Ray Tube) terminals and private computers, or it are often configured as a half -duplex synchronous system that may communicate with peripheral devices like A/D or D/A integrated circuits and Serial EEPROMs etc.

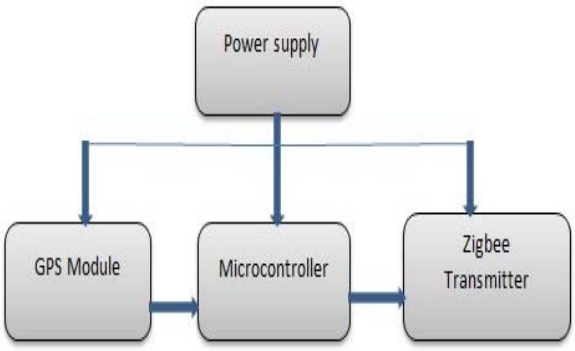

Figure 1 : Block Diagram of Transmitting Node

b) Receiving Node

The components used under this section are described below:

i. *Power Supply Unit:* It is same as described above.

ii. *Zig Bee Module:* It is same as explained above in transmitting section

iii. *Display Module*

The LCD LM016L (16x2) is interfaced with AVR microcontroller to display the data information. The data pins of LCD i.e., 11,12,13,14 are connected to port C (PC0 through PC3) of the AVR microcontroller. The control pins of LCD 4, 5, 6 i.e., Register-select (RS), Read/write(R/W) and enable respectively, are interfaced with PD6, PD5 and PD7 of the AVR microcontroller, severally. R/W pin is keep for good low to place the digital display into writing mode. This unit receives character codes (8 bits per character) from a chip or PC, latches the codes to its show knowledge RAM (80-byte) Doctor of Divinity RAM for storing eighty characters,

transforms every character code into a 5*7 dot-matrix character pattern, and displays the characters on its digital display screen.

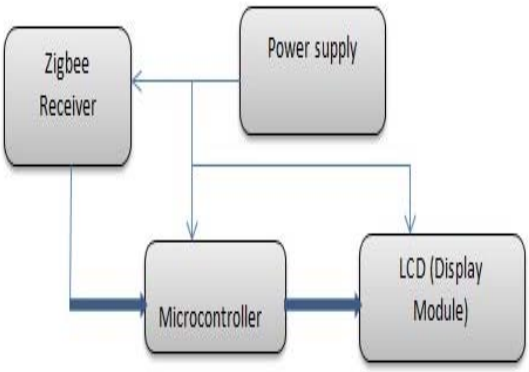

Figure 2 : Block Diagram of Receiving Node

III. Software Development

The software development of designed system is used to get integration and functionality. Here, 'C' language is used to develop the program to drive the system designed and AVR studio4 is used as compiler (WINAVR is running in backend). AVR studio4 software is free firmware for Windows and Linux operating systems.

To get the result of wireless personal area network application, the microcontroller has been programmed, which involved the following steps.

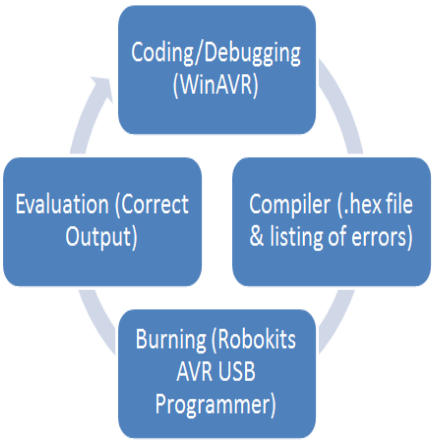

Figure 3 : Steps for Software Development

a) Coding / Debugging

Coding or debugging is one in a high-level language (such as C or java). Compiler for a high level language helps to reduce production time. To program the microcontrollers Win AVR was used using C language. The source code has been commented to facilitate any occasional future improvement and maintenance. Win AVR is a suite of executable, open source software development tools for the Atmel AVR series of RISC microprocessors hosted on the Windows platform. It includes the GNU GCC compiler for C and C++.

b) Compiling

After collecting the program, it's regenerate to machine level language within the sort of 0's ans1's.This file is named because the Hex file and is saved with the extension (.hex). The compiler additionally generates errors within the program that ought to be removed for correct execution of the program.

The Program is compiled after removing all the errors generated.

c) Burning

Burning the machine language (hex) file into the microcontroller's program memory is achieved with a fervent engineer, thatis attached to a PC's peripheral. PC's port has been used for the aim.

d) Evaluation

The system performs as desired by the user and performs all the tasks expeditiously and effectively the code development section is over and therefore the project is prepared to be put in in any of the economic sites as a private space network. If not, the whole method is perennial once more to rectify the errors.

In the programming of the proposed system is used the following .c and .h file.

A.lcd.c -This c file contains the code for control of functionality of the attached LCD module. The code controls the initialization of the LCD, data writing on the LCD. This file contain InitLCD ( ), LCDClear ( ), LCDWriteString ( ) and LCDWriteInit ( ).

i. *To initialize the LCD*

Void Initlcd( )
{
//This function Initializes the lcd module
must be called before calling lcd related functions
Arguments:
style = LS_BLINK,LS_ULINE(can be "OR"ed for combination)
LS_BLINK :The cursor is blinking type
LS_ULINE : Cursor is "underline" type else "block" type
}

ii. *To display strings to LCD*

Void display (const char *data)
{
//This function writes a given string to lcd at the current cursor location.
Arguments:msg: a null terminated string to print
}

B.lcd.h- This header file contains all the constant variable values and names of the subroutines used by various files used in the software. It clearly indicates which variable can be used as a global

variable and which of the subroutines can be used across the software files.

C.usart_lib.c-This library can be used to transmit and receive data through the built in USART. An interrupt is generated when the USART has finished transmitting or receiving a byte. This contain three major functions USART In it ( ), USART Read ( ) and USART Write ( ).

Initialization of USART:

This function will initialize the USART.

voidUSARTInit(uint16_t ubrr_value)

{

UBRR= ubrr_value; //Set Baud rate

UCSRC= (1<<URSEL)|(3<<UCSZ0);// Set Frame Format

UCSRB= (1<<RXEN)|(1<<TXEN);// //Enable The receiver and transmitter

}

Reading From TheUSART:

This function will read data from the USART.

```
char USARTRC()
{
        while(!(UCSRA & (1<<RXC))) //Wait until a data is available
{
//Do nothing
}
        return UDR;   //Now USART has got data from hostand is available is buffer
}
```

Writing to USART:

```
void USARTWC(char data)
{
        while(!(UCSRA & (1<<UDRE)))     //Wait until the transmitter is ready
  {
    //Do nothing
  }
        UDR=data;     //Now write the data to USART buffer
```

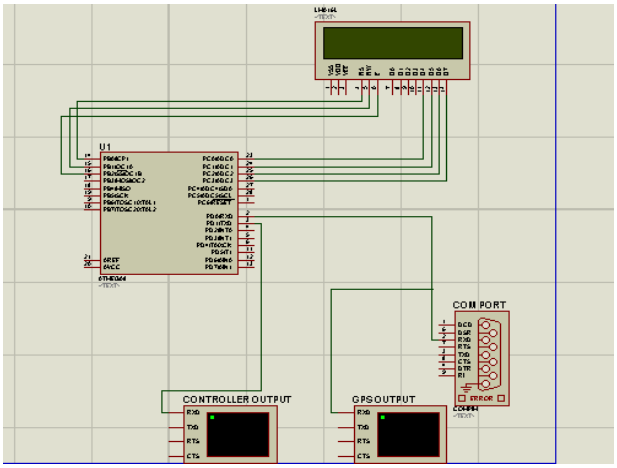

Figure 4 : Simulation Model on Proteus

This is the basic simulation model we have done on Proteus software and the required connections to extract GPS data are also figured.

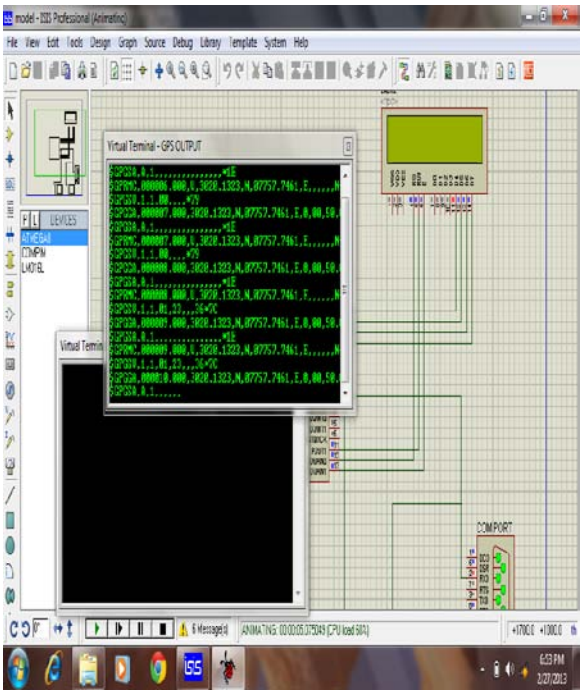

Figure 5 : Extracted values of GPS through Proteus Model

This figure is showing all the values of GPS displaying on virtual terminal through Proteus model. The GPS values are simply transferred through USART using microcontroller and through COM port displayed on virtual terminal.

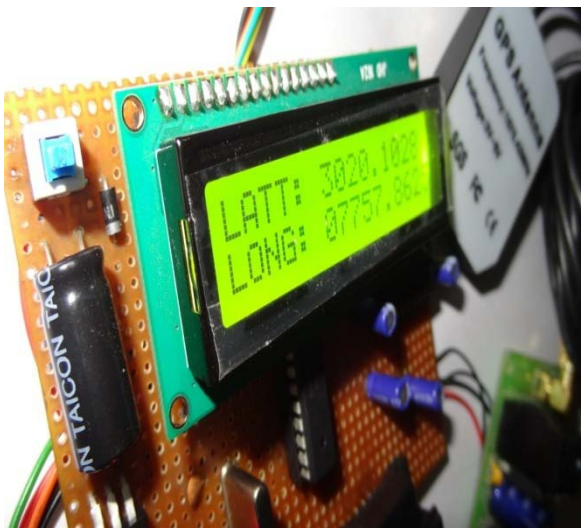

Figure 6 : Hardware view of GPS extracted values

This figure is representing the GPGGA values extracted out of 18 values of GPS on lcd. For our system we only require values of latitude, longitude and altitude. Here only values of latitude and longitude are shown.

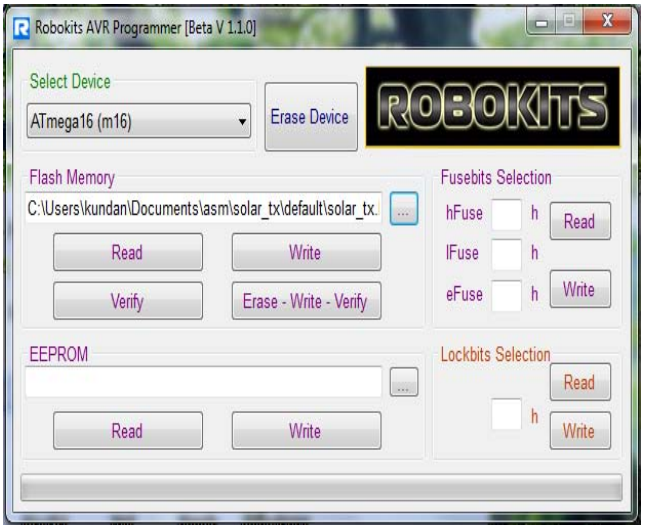

Figure 7 : View of hardware AVR programmer (ISP) by Robokits

IV. Conclusion & Future Scope

Both the hardware and software system was tested with real time data and accurate values of the positions were recorded.

This system as compared with other traditional manual inspection is more accurate since it increasesthe accuracy of data acquisition by using non-licensed Zigbee protocolwhich also supports real-time transmission. Also, its operation is flexible since its flight can be controlled from ground station by the designed hardware platform. Themeasurement is accurate (accuracy in position-5 meters, accuracy in velocity-.1m/s,accuracy in time: 0.1 s). The operation is simple and power consumption is also low (12V/750mA)and it iscost effective also because of using non licensed band.Being wireless it also reduces the complex wiring system. Here, a personal area wireless network is designed and implemented. This can be used for surveying at emergency situations like pipeline damages etc. Further if system is carrying payload then in that case it can be used for transferring the load as per the changes in plans.

V. Appendix

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VI. Acknowledgement

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Comparison among Different Routing Protocols of Vehicular Ad Hoc Networks

By Ahmed Shoeb Al Hasan, Md. Hasan Tareque & Fatema Tuz Zohra
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Abstract- To improve highway transport security, VANET (Vehicular Ad Hoc Network) is used which is a developing technology incorporating ad hoc network, cellular technology and wireless LAN. VANETs are different from other type ad hoc networks by their cross network constructions, node association features and new application setups. The approach of an effective routing protocol for VANETs is vital as VANETs show various distinctive networking research challenges. In this paper, we discuss the research challenges of routing in VANETs and compare recent routing protocols of VANETs.

Keywords: *MANET, VANET , wlan, routing.*

GJCST-E Classification : *C.2.2*

Strictly as per the compliance and regulations of:

Comparison among Different Routing Protocols of Vehicular Ad Hoc Networks

Ahmed Shoeb Al Hasan [α], Md. Hasan Tareque [σ] & Fatema Tuz Zohra [ρ]

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I. Introduction

Vehicular ad hoc network (VANET) is a special type of Mobile Ad hoc Network (MANET) which is designed to facilitate vehicle to vehicle (V2V) and vehicle to roadside communications. It is a promising new technology to achieve intelligent inter-vehicle communications and flawless internet connectivity by integrating the capabilities of new generation wireless networks to vehicles. Analogous to MANET it is autonomous, self-organizing and self-managing wireless communication network. Nodes in VANET involve themselves as servers and/or clients for exchanging & sharing information via shared radio transmission. Three possible network architectures for VANET are: pure cellular/WLAN, pure ad hoc, and hybrid. A simple scenario of vehicular ad-hoc network is shown in figure 1. VANET introduces Intelligent Transportation Systems (ITS) which includes a variety of applications such as co-operative traffic monitoring, control of traffic flows, blind crossing, prevention of collisions, nearby information services and real-time detour routes computation. It can be also used for providing Internet connectivity to vehicular nodes while on the move. The unique characteristics of VANET are the high nodes mobility and unreliable channel conditions which poses the problems of frequent change in network topology. So finding and maintaining routes is a very challenging task in VANETs. The existing routing protocols for MANET shows poor performance when directly applied to

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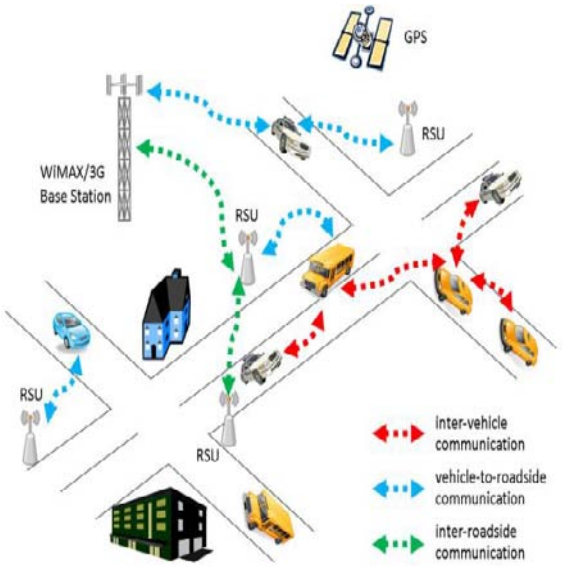


Figure 1 : Vehicular Ad Hoc Network.

VANET environment due to the fast vehicles movement and dynamic information exchange. Thus design of a suitable routing protocol to deal with the highly dynamic nature of VANET has taken significant attention. In this literature we will review the key characteristics in VANET and some of the existing routing protocols for VANET which can be used for better understanding of the routing protocols and future improvement can be made.

II. Characteristics of Vanet

VANET has some unique characteristics which make it different from other kinds of Ad hoc networks as well as challenging for designing VANET routing protocols.

a) High Dynamic topology

The topology of VANET is always changing due to the high speed and choice of path of vehicles. If we assume two vehicles moving away from each other with a speed of 60 mph (25m/sec) and the transmission range is about 250m, then the link between these two vehicles will last only for at most10 seconds.

b) Frequent disconnected Network

Due to the same reason, the nodes needed another link with nearby vehicle in about 10 seconds to maintain seamless connectivity. But in case of such failure, particularly in case of low vehicle density zone,

frequent disruption of network connectivity will occur. One possible solution of such problems is addressed by road-side deployment of relay nodes.

c) Mobility Modeling and Prediction

Besides the highly mobile node movement and dynamic topology, vehicular nodes are usually constrained by prebuilt highways, roads and streets. So mobility model and node prediction based on study of predefined roadways model and vehicle speed is of paramount importance for effective network protocol design for VANET.

d) Communication Environment

VANET are typically operated on two communication environments: highway traffic scenario and city environment. The node prediction design and routing algorithm also therefore need to adapt for these two environments. Highway mobility model is rather simple and easy to predict than the city mobility model. Street structure, variable node density, presence of buildings and trees that behave as obstacles to even small distance communication make the city model very complex and difficult.

e) Hard Delay Constraints

Overcoming the issues of hard delay constraints are of great importance in VANET than the high data rate. For example safety aspect such as accidents or brake event the message should be transferred and arrived in a certain time to avoid car crash.

f) Interaction with onboard sensors

It is assumed that the nodes are equipped with on-board sensors such as GPS receivers. This sensors helps in providing node location and their movement nature that are used for effective communication link and routing purposes.

g) Battery Power and Storage capacity

Modern vehicles have enough computing power because of unlimited battery power and storage which is unavailable in MANET. It is helpful for effective communication & making routing decisions.

III. Routing Protocols for Vanet

Routing in VANET can be classified in many dimensions. In this literature we classify them into five categories as follows: ad hoc, position-based, cluster-based, broadcast, and geo-cast routing protocols. These protocols are characterized on the basis of area / application where they are most suitable. In this section we have discussed about these protocols.

a) Adhoc Routing

Most of the characteristics of Vehicular Ad Hoc Network (VANET) are analogous to that of Mobile Ad Hoc Network (MANET). Therefore most of existing MANET routing protocols can be directly applied to VANET. Reactive routing protocols such as AODV (Ad Hoc on demand distance vector) and DSR (Dynamic source routing) are also called on-demand routing protocols as they periodically update the routing table. Reactive routing consists of route discovery phase which causes more routing overhead and also suffer from the initial route discovery process. Moreover route maintenance process in DSR does not locally repair a broken link. Simulation of these algorithms in VANET brought out frequent communication break because of the highly dynamic nodes. Therefore it becomes obligatory to suitably modify the existing protocols of MANET to meet the challenges in VANET.

i. *PRAODV/PRAODV-M:* Namboodiri et al. proposed some modifications in [1].

- A highly partitioned highway scenario is used for the network model. Therefore most path segments are relatively small.
- To reduce the ill-effects of frequent route breakages in case of AODV two new predictions-based AODV algorithms are introduced.
- First one is referred as PR-AODV and it uses node position and their speed information in AODV to predict link life time. It constructs a new alternate link before the end of estimated link lifetime. Where in AODV, the link created only after the failure of connectivity occurs.
- In contrast to selecting shortest path as in PRAODV or AODV the second modified algorithm (PRAOVD-M) computes the maximum predicted life time among various route options.
- The simulation on both showed slight improvement in packet driving ratio. However, the success of this algorithm largely depends on the prediction of node position and mobility.

ii. *AODV-bis:* Another modification is proposed in [2].

- AODV is modified to forward the route request within a zone of relevance (ZOR) from the point of event occurrence.
- ZOR can be rectangular or circular specified by the particular application.

b) Position Based Routing

Routing strategies that employs geographical information in their routing decision have been identified as more promising routing paradigm for VANET environment. These protocols use location information to select the next forwarding hops so no global route between source and destination needs to be created and maintained.

Greedy Perimeter Stateless Routing (GPSR): GPSR (Greedy Perimeter Stateless Routing) [3] is one of the best known position based routing. It takes greedy forwarding decision based on the location information of immediate neighbors. Where greedy forwarding fails it

uses perimeter mode or face routing on a planarized graph of the network to find the next forwarding hop. Figure 2 shows greedy

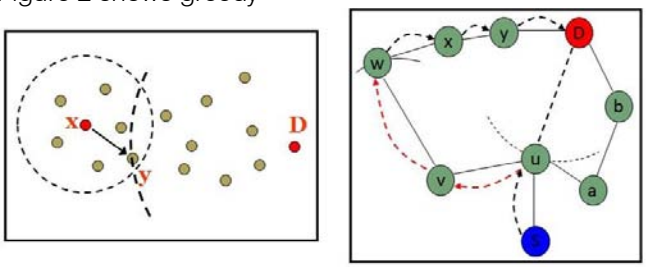


Figure 2 : (a) greedy forwarding and (b) perimeter mode forwarding.

forwarding and forwarding in perimeter mode.

- It works best in highway scenario with evenly distributed nodes.
- GPSR generally shows better performance when applied to highway scenario than that of DSR because of fewer obstacles compared with city scenario.
- GPSR has to face some challenges when applied to city scenario:
  - Greedy forwarding sometimes fails in case where direct communication between nodes does not exist due to the obstacles such as buildings and trees.
  - In perimeter mode a planarized network graph is traversed when greedy fails which create longer path resulting in higher delays and also degrade the performance
  - Due to the highly dynamic nature of nodes in VANET routing loops can be induced by the right-hand rule used in face routing
  - Moreover Packet can be forwarded in wrong direction resulting higher delays

Geographic Source Routing (GSR): Lochert et al [4] proposed GSR routing for vehicular ad hoc networks in city environments. It combines.

Figure 3 shows some examples of GPSR failures. To solve the above constraints certain improvements are made in the GPSR algorithm position-based routing with topological knowledge. This street awareness in GSR is provided by static street map and it uses Reactive Location Service (RLS) to get the destination position. GSR uses greedy forwarding along a pre-selected shortest path and this path is computed by Dijkstra shortest path algorithm.

- GSR shows better average delivery rate, smaller total bandwidth consumption and similar latency as with DSR or AODV.
- The protocol overlook the situation where the traffic density is low it is difficult to find end to end connection along a preselected path.

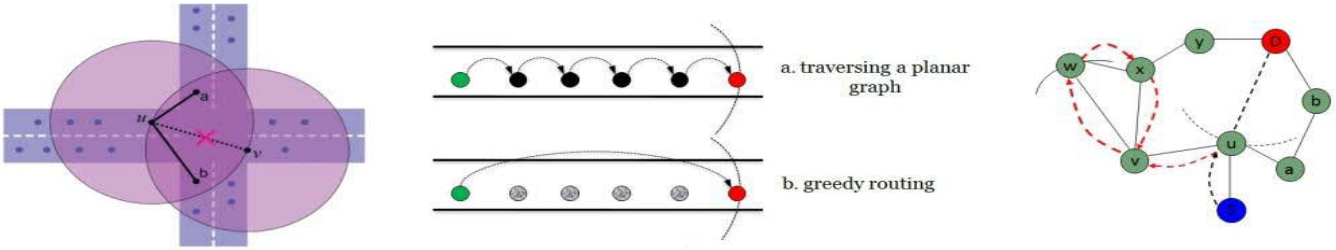
Greedy Perimeter Coordinator Routing (GPCR): Greedy Perimeter Coordinator Routing (GPCR) is proposed in [5] and it consists of two parts: a restricted greedy forwarding and a repair strategy. Unlike GSR this algorithm is based on the topology of real world streets and junctions which form a natural planar graph. Therefore it does not require a graph planarization process as GPSR or does not use any global topology information like GSR. The restrictive greedy algorithm is applied when nodes are in street and an actual routing decision is taken only at the junction of streets. So packets are forwarded to a junction node (coordinator) rather sending it across the junction. When stuck into a local minimum GPCR adopt a repair strategy. (1) Coordinator node decides using right-hand rule which street the packets should follow. (2) In between junctions greedy forwarding is applied to reach the next junction. In figure 4 restricted greedy routing and repair strategy in GPCR is shown.

There are two different approaches to detect junction nodes:

(1) by analyzing node position and the position and presence of the neighbor's neighbors from beacon messages (2) by calculating the correlation coefficient with respect to the position of its neighbors.

The simulation results using NS-2 simulator in a real city scenario shows higher delivery rate than that of GPSR with large average number of hops. But it introduces slight increase in latency.

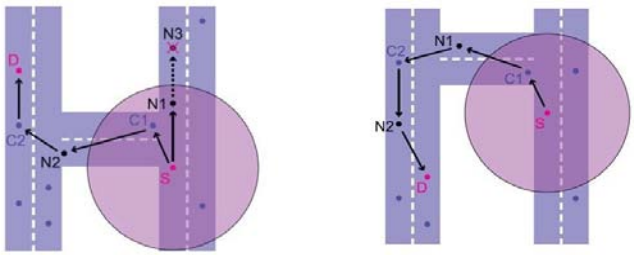
- GPCR fails to work efficiently in city scenario with high rise building, uneven concentration of vehicles on roads.



(a) Network Disconnection: link uv is removed by planarization. However, due to obstacles (such as buildings), there is no direct link ua or ub.
(b) Longer path in perimeter mode.
(c) Routing loop introduced by right-hand rule in face routing.

Figure 3 : Examples of GPSR failures

- There are problems in junction detection approaches. First approach fails in case of curve streets and second one fails for sparse streets.



(a) (b)

(a) Using restricted greedy forwarding packet is forwarded to C1 (coordinator node) from S instead of N1 (regular greedy forwarding).
(b) Repair Strategy: In node S (local minimum) algorithm switched to repair strategy. Packets forwarded to C1 (coordinator node) and it decides which road to follow.

Figure 4 : GPCR routing strategy

Anchor based street and traffic aware Routing (A-STAR): Anchor-Based Street and Traffic Aware Routing [6] (A-STAR) is a position based routing protocol which is specially design for city scenarios for inter vehicle communication system. But unlike GSR, A-STAR takes into account both street and traffic awareness in computing the anchor paths. A-STAR integrates traffic awareness by using vehicular traffic city bus information to identify an anchor path with high connectivity for packet delivery. An anchor path can be computed using Dijkstra's least-weight path algorithm. Traffic awareness can be incorporated by using either statistically rated maps or dynamically rated maps. A-STAR employs a new local recovery strategy for packets that stuck into a local minimum which is more suitable for a city environment than the recovery strategies used in GPSR and GSR. A new anchor path is computed from the point of local minimum and the packet is routed through this new anchor path. The street at which local minimum is occurred is marked as "out of service" temporarily.

- A-STAR shows the best performance compared to GSR and GPSR, because it can select paths with higher connectivity for packet delivery. As much as 40% more packets are delivered by A-STAR compared to GSR.
- A-STAR guarantees for finding an end-to-end connection in case of low traffic density. The subscript for the permeability of vacuum □0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o."

c) Geocast Routing

Geocast routing protocols follow the standard of routing data packets from a single source vehicle to all vehicles fitting to the destination area called zone of relevance ZOR. This multicast routing protocol can be implemented by simply defining the multicast group within the ZOR. Geocast routing follows a directed flooding strategy within a defined forwarding area, zone of forwarding ZOF so that it can limit the message overhead and network congestion of simple flooding. Figure 5 illustrates the ZOR in Geocast routing. The message is first forwarded from the sender to the geographic area via unicast. It is then simply broadcasted to all vehicles inside the target region. So identify the zone of relevance is important in Geocast routing. IVG, Cached Geocast, Abiding Geocast, DRG, ROVER, DG-CastoR, Mobicast, DTSG, Constrained Geocast, and Geocache are some existing Geocast routing protocols in VANETs. In this literature IVG, ROVER and Abiding Geocast are discussed.

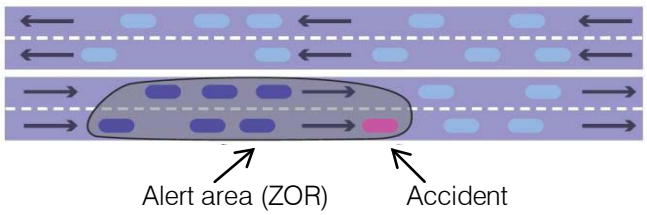


Figure 5 : Geocast routing.

Inter Vehicles Geocast Protocol (IVG): Bachir and Benslimane in [7] proposed a Geocast protocol named Inter-Vehicles Geocast (IVG).

- IVG works by informing the vehicles located in a risk area, which formed a multicast group about any danger on the highway. A message alert is broadcasted to the multicast group by the damaged vehicle.
- The precise obstacle location and the driving directions are taken into account in determining the risk area.
- Neighbors inside the risk area calculate a differ time backoff that helps the furthest node to relay rebroadcasting the message. Figure 6 shows an example of relay selection in IVG.

RObust Vehicular Routing (ROVER): ROVER [8] proposed by M. Kihl and al. is a protocol which is similar to AODV. It broadcasts only the control packets & data packets are unicasted. ROVER assumptions are:

- Each vehicle has an Identification Number,
- Each vehicle should have a GPS receiver,
- Vehicles must have access to a digital map,
- ZOR is a rectangle area and within ZOR reactive route discovery process are used,
- ZOF includes the sender and the ZOR.

The goal of ROVER is to deliver an application generated message to all vehicles those are located into the specified ZOR. A lot of redundant messages is created by this protocol which caused in network congestion and high delay in data transfer.

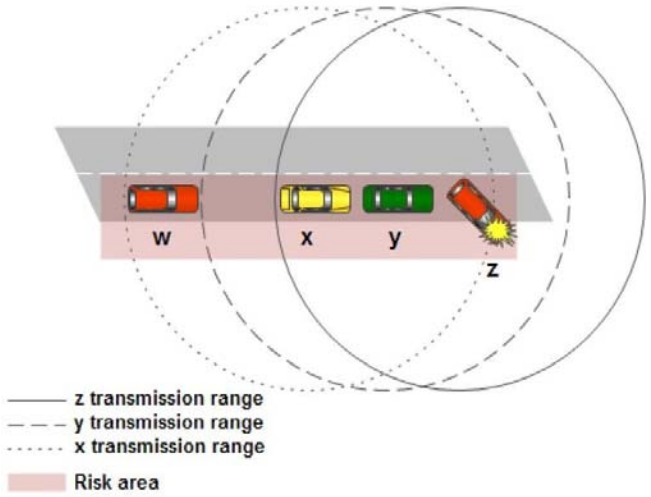


Figure 6 : IVG Relay selection: x is more distant to z then y. x is a relay. x permits to reach w while y not

Abiding Geocast: Abiding Geocast [9] was proposed by Maihöfer and Eberhardt. It allows a continuous delivery of a Geocast message in Ad Hoc Networks. Three solutions are provided for Abiding Geocast:

1. Using a server that stores Geocast message. Main objective of this server is to use a Geocast protocol that periodically delivers the Geocast message to the destination zone.
2. A node is nominated in the appropriate destination area in order to store the Geocast message and periodically or by notification retransmit it.
3. The neighbour approach allows all nodes to store the Geocast message.

- *Uses of abiding Geocast:*

- Advertising or informing drivers about the state of the road. (slippery surface, ice storm, etc.)
- Elected node approach and neighbour approach are more improved for safety applications to inform drivers about an accident on their way.

d) Cluster Based Routing

In cluster-based routing scalability is provided by creating a virtual network infrastructure through the clustering of nodes. Figure 7 illustrates a cluster-based routing.

Cluster is represented by a cluster head. Inter-communication between different clusters is carried through cluster heads. Intra-communication within each cluster is made through direct link. The current cluster-based protocols in MANET are not stable in vehicular ad-hoc network because of their short-life.

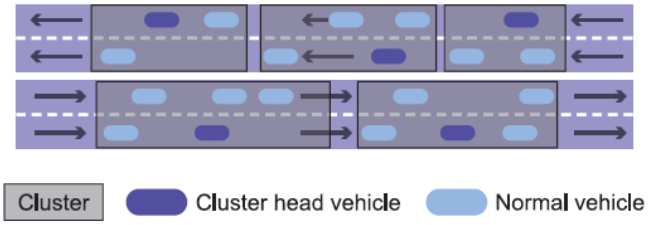


Figure 7 : Vehicles form multiple clusters in cluster-based routing.

Some Cluster-Based Routing protocols in VANETs are: COIN, LORA_CBF.

COIN: Clustering for Open IVC Networks (COIN) algorithm is proposed by Blum et al. [10]. Cluster head election is constructed on vehicular dynamics and driver purposes, instead of ID or relative mobility. This algorithm shows the oscillatory nature of inter-vehicle distances.

- COIN increases the average cluster lifetime by at least 192% and reduces number of cluster membership changes by 46%.

LORA_CBF: LORA_CBF is a reactive location based routing algorithm proposed by Santos et al. [11]. It uses cluster-based flooding for VANETs.

- Any node can be the cluster- head, gateway or cluster member.
- Every cluster has exactly one cluster-head.
- A node connected to more than one cluster is called a gateway.
- The cluster-head preserves information about its members and gateways.
- Packets are forwarded using greedy routing. If the location of the destination is not available, only the

cluster-heads and gateways will propagate the LREQ (Location Request) and LREP (Location Reply) messages.

The performances of LORA_CBF, AODV and DSR are evaluated in typical urban and highway traffic scenarios. The results show that network mobility and size affect the performance of AODV and DSR more ominously than LORA_CBF. Cluster-based routing protocols can achieve good scalability for large networks. A major obstacle for the protocols is fast-changing VANET systems, the delay and overhead involved in creating and preserving these clusters.

e) Broadcast Routing

Regularly used routing scheme in VANETs is Broadcast. Broadcast is used for sharing information about crisis, street situations, advertisements etc. Efficient route exploration in unicast protocol is another usage of Broadcast routing. Easiest technique to apply broadcast is flooding. Flooding enables every node to forward the incoming message to its entire neighbours except its parent node. Flooding works efficiently in small networks. But efficiency decreases for larger networks.

BROADCOMM: The freeway is separated into virtual cells in BROACOMM [12]. In BROADCOMM, movement of virtual cells are based on the movement of vehicles. All the vehicles of freeway are classified in two groups.

Figure 7. Vehicles form multiple clusters in cluster-based routing.

1. All the vehicles in a cell
2. Small number of vehicles situated closely to the centre of the cell, called cell reflectors.

BROADCOMM works better than analogous flooding based protocols for message broadcasting delay and routing overhead. The drawback is, it is only applicable for simple freeway networks.

Urban Multi-Hop Broadcast protocol (UMB): Urban Multi-Hop Broadcast protocol (UMB) [13] is proposed to transmit messages in urban areas. There are some issues related to urban area such as interference, packet collisions and hidden nodes problems due to multihop broadcast. There are two steps in UMB:

1. Directional Broadcast: Transmitting node picks the furthest node in broadcast direction without any topology information. Selected node has the responsibility of next forwarding.
2. Intersection Broadcast: Repeaters are installed in every intersection point. Repeaters re-broadcast the packets to all road segments except the receiving direction.

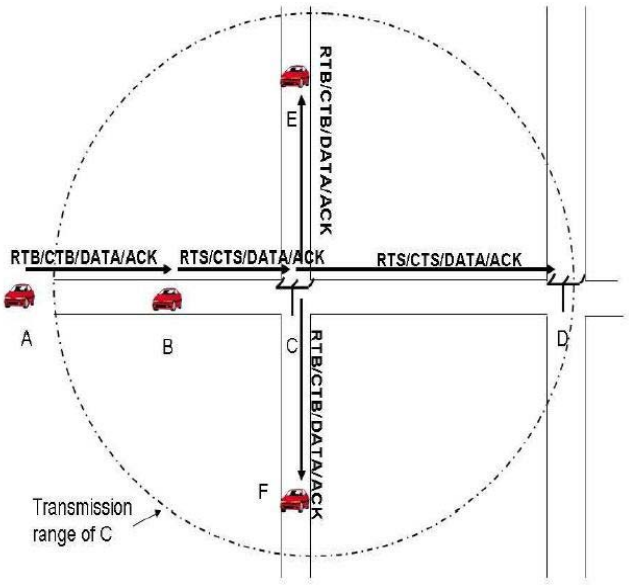


Figure 8 : UMB protocol

For dense networks and high packet loads, UMB protocol has higher success rate than 802.11-distance and 802.11-random protocols.

Vector-based TRAcking DEtection (V-TRADE): V-TRADE [14] is a GPS based message broadcasting protocol which is similar to the unicast routing protocol Zone Routing Protocol (ZRP) [15]. Neighbours are classified into different forwarding groups based on position and movement information. Border vehicles which are small subset of vehicles from each group are selected to forward the message. V-TRADE selects small number of vehicles to forward the messages. This feature utilizes bandwidth. Reachability decreases slightly due to small number of forwarding vehicles.

f) Comparison of routing protocol in VANET

Table 1 summarizes the characteristics of routing protocols in VANET.

Table 1 : Comparisons of Routing Protocols In Vanets

Routing Protocols	Routing Type	Position Information? (How to use)	*Hierarchical structure*	Network Simulator	Simulation Scenario
AODV	Unicast	No	No	---	---
DSR	Unicast	No	No	---	---
GPSR	Unicast	Packet Forwarding	No	---	---
PRAODV/ PRAODV-M	Unicast	Route Selection (lifetime prediction)	No	NS2	Simple highway model (20km segment only)
AODV-bis	Unicast	Route-Req Forwarding	No	---	---
GSR	Unicast	Packet Forwarding	No	NS2	Real city model (from map)

GPCR	Unicast	Packet Forwarding	No	NS2	Real city model (from map)
A-STAR	Unicast	Packet Forwarding	No	NS2	Grid city model
COIN	Unicast	Cluster Formation	Yes	Own	Real highway model
LORA_CBF	Unicast	Packet Forwarding	Yes	Opnet	Simple circle and square road
Flooding	Broadcast	No	No	---	---
UMB	Broadcast	Packet Forwarding	No	Own	Simple intersection road
V-TRADE/ HV-TRADE	Broadcast	Classify forwarding Group	No	Own	Simple intersection
BROADCOMM	Broadcast	Formation of Cells	Yes	Own	Simple highway model (15
Msg Dis Protcl	Geocast	Packet Forwarding	No	Own	Simple highway model (10 km)
IVG	Geocast	Packet Forwarding	No	Glomosin	Simple highway model (10 km long, 100/200 nodes)
Cached Geocast	Geocast	Packet Forwarding	No	NS2	Quadratic network (size from 1 km
Abiding Geocast	Geocast	Packet Forwarding	No	---	---

IV. Limitations and Future Perspectives

There are some observations after surveying the existing protocols for VANET.

- Most of the routing protocols in VANET perform better for a specific street condition or environment. But to provide an efficient routing, scalability should be considered which is very difficult in VANET environment.
- An efficient routing protocol for VANET must be able to communicate under low network density. The network density is usually low in off-peak hour in the city scenario or in the highway; however, the broadcast message is still necessarily need to disseminate to all vehicles in a network.
- Most of the protocols in VANET do not consider the direction of the vehicles in the road. But due to the high speed and choice of path of vehicles sometimes packets may get forwarded to the wrong direction leading higher delays or even network partitions.
- Moreover there is no agreed-upon standard or mobility model to validate their performance. For example GPSR is a widely known position based routing protocol. But the position-based routing keeps advancing into many subareas in VANETs. So evaluation of the protocols using GPSR is no longer a reasonable comparison.
- Security is also an important issue for routing in VANETs, because many applications will affect life-or-death decisions and illegal tampering can have devastating consequences. The characteristics of VANETs make the secure routing problem more challenging and novel.

A possible future work is to design an efficient routing protocol for comfort and safety applications with delay-constraint and delay-tolerant capabilities and low bandwidth utilization.

V. Conclusion

Vehicular Ad Hoc network exhibits very different characteristics from MANETs. So the existing routing protocols for MANET shows poor performance when directly applied to VANET environment. In this literature, we survey on several routing protocols proposed for VANETs. From the survey it is clear that the position-based routing and Geocast routing property. The performance of a routing protocol in VANETs perform better than other routing protocols because they support geographical property. The performance of a routing protocol in VANETs depends on various facts like mobility model, driving environment, vehicular density & many other issues. There are still lots of area where VANET can be improved or more research can be done.

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Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- 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.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- 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.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

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.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

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

Figures and tables

- 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
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- 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."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- 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.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
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Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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