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Electronics Engineering (ICMEEE 2014)  
&  
International Conference on Civil and Chemical  
Engineering, (ICCCE-2014)**

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**Editor-in-Chief**

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CBIT , Hyderabad

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## About Conference

Technical Research Organisation India (TROI) is pleased to organize the International Conference on Computer Science and Information Technology (ICCIT 2014), International Conference on Mechanical, Electrical and Electronics Engineering (ICMEEE 2014) & International Conference on Civil & Chemical Engineering (ICCCE- 2014)

ICCIT & ICMEEE is a comprehensive conference covering the various topics of Engineering & Technology such as Computer Science, Mechanical, Electrical and IT. The aim of the conference is to gather scholars from all over the world to present advances in the aforementioned fields and to foster an environment conducive to exchanging ideas and information. This conference will also provide a golden opportunity to develop new collaborations and meet experts on the fundamentals, applications, and products of Computer science and Electrical. We believe inclusive and wide-ranging conferences such as ICCIT can have significant impacts by bringing together experts from the different and often separated fields of Computer & IT. It creating unique opportunities for collaborations and shaping new ideas for experts and researchers. This conference provide an opportunity for delegates to exchange new ideas and application experiences, we also publish their research achievements. ICMEEE & ICCCE shall provide a plat form to present the strong methodological approach and application focus on Electrical, Mechanical, civil & chemical engineering that will concentrate on various techniques and applications. The conference cover all new theoretical and experimental findings in the fields of Electrical, Civil & Chemical engineering or any closely related fields.

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- Chemical Engineering
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- Environmental Engineering
- Mechanical Engineering
- Nano-Technology,
- Genetic Engineering
- Materials and Metallurgical Engineering
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## **Editorial**

The conference is designed to stimulate the young minds including Research Scholars, Academicians, and Practitioners to contribute their ideas, thoughts and nobility in these two integrated disciplines. Even a fraction of active participation deeply influences the magnanimity of this international event. I must acknowledge your response to this conference. I ought to convey that this conference is only a little step towards knowledge, network and relationship.

The conference is first of its kind and gets granted with lot of blessings. I wish all success to the paper presenters.

I congratulate the participants for getting selected at this conference. I extend heart full thanks to members of faculty from different institutions, research scholars, delegates, TROI Family members, members of the technical and organizing committee. Above all I note the salutation towards the almighty.

**Editor-in-Chief:**  
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# SEMANTIC ANALYSIS ON COMMUNICATION AND SECURITY ISSUES OF EXTENSIBLE AUTHENTICATION PROTOCOL (EAP) ON WIRELESS Networks

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**ABSTRACT--Network security is a complicated subject, historically only tackled by well-trained and experienced experts. However, as more and more people become “wired”, an increase in number of people need to understand the basics of security in a networked world. This network communication explains about the basic computer user and information systems manager in mind, explaining the concepts needed to read through the hype in the market place and understands risks and how to deal with them. Some history of**

**networking is included, as well as introduction to TCP/IP (transfer control protocol & internet protocol) and inter networking. We go on to consider risk management, network threats, fire walls and more special purpose secure networking devices. The network communication reader will have a wider perspective on security in general, and better understand how to reduce and manage**

**Keywords: EAP Authentication Protocol, Security issues, Point to Point Protocol, Peer-to-Peer Networks**

## I. INTRODUCTION

A basic understanding of computer networks is requisite in order to understand the principles of network security. In this paper, overview of some popular networks are discussed. In TCP/IP network protocol majorly suites the internet service providers and intranet service providers.

In Computer Networking, more no of threats occurs, it should be addressed by the network manager and administrators. This paper discusses on different type of threats and networks tools, that are used to reduce the exposure of risks of network computing. The Internet Engineering Task Force (IETF) has noticed the show progression in basic IEEE 802.11 standards as more security levels increased. Nowadays, almost all networks protocols adds more security features such as encrypted tunnels for exchanging various information (authentication, credentials and

other data), dynamic key distribution and rotation, authenticating the user rather than the device, and applying identity-based mechanisms and systems. But, still there is need of more secured lightweight authentication is required, because more employed techniques slows down the system. Therefore, authentication protocol known as Extensible Authentication protocol (EAP) was introduced and it was versioned as many protocols, such as Protected EAP(PEAP), Lightweight Extensible Authentication Protocol (LEAP) and EAP-Flexible Authentication via Secure Tunneling (EAP-FAST). The EAP was originally developed for Point to Point Protocol (PPP) and provides an infrastructure for network access clients and authentication servers.

## II. EAP AUTHENTICATION PROTOCOL



The EAP, a flexible protocol used to carry arbitrary authentication information, is defined in RFC 2284. (Incidentally, RFC 2284 is only 16 pages long!) A set of RFCs also defines the various authentication processes over EAP, including TLS, TTLS, SmartCard, and SIM. The IETF EAP workgroup is working on a revision of the EAP RFC and has submitted the new document as RFC 3579 (was RFC 2284bis).

EAP has two major features. First, it separates the message exchange from the process of authentication by providing an independent exchange layer. By doing so, it achieves the second characteristic: orthogonal extensibility, meaning that the authentication processes can extend the functionality by adopting a newer mechanism without necessarily effecting a corresponding change in the EAP layer.

The above Figure.1 shows the authentication model is a layered one and has well-defined functionalities and protocols defining each layer and the interfaces between them. The access media can be any of the 802 media: Ethernet, Token Ring, WLAN, or the original media in the serial Point-to-Point Protocol (PPP) link. The EAP specifications provide a framework for exchanging authentication information after the link layer is established. The exchange does not even need IP. It is the function of the transport protocol layer (to specify how EAP messages can be exchanged over LAN, which is what 802.1x (and to some extent some parts of 802.11i) does. The actual authentication process is the one that defines how and what credentials should be exchanged. Bear in mind that this framework still does not say how the authorization should be done, such as what decisions are made and when. This functionality is completely left to the domain

### III. LAYERED FRAMEWORK FOR EAP AUTHENTICATION

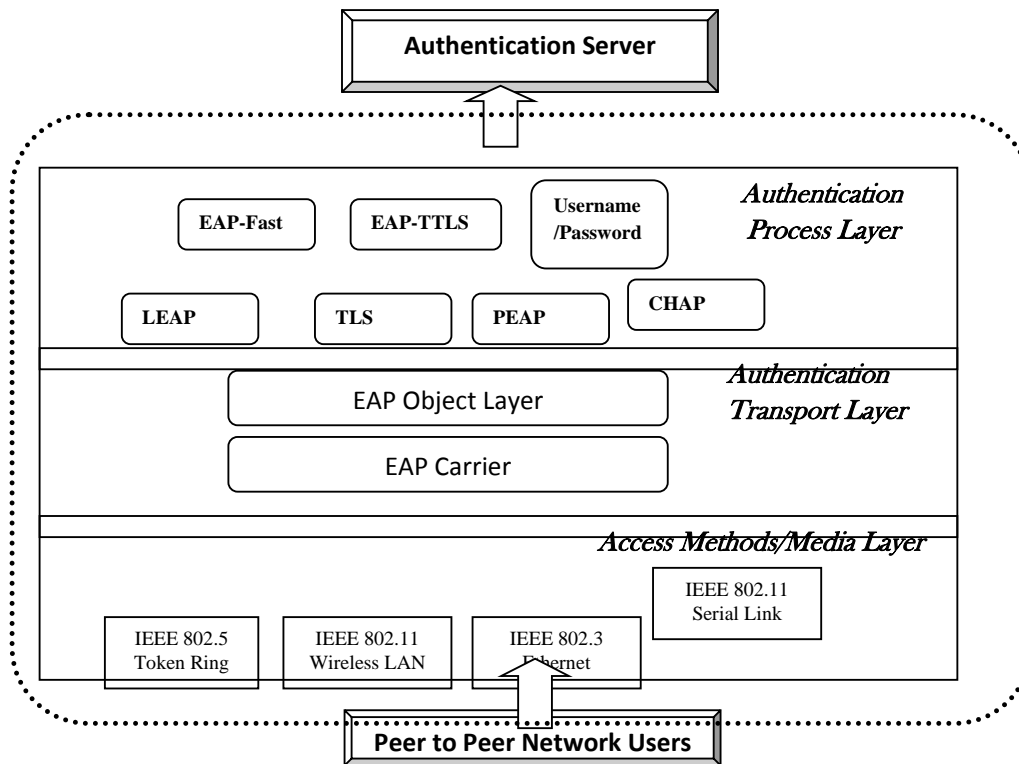


Fig.1 EAP Layered Authentication Framework

IV. EAP IN COMMUNICATION

Figure.1 shows EAP communication with PPP, PPP peers do not choose a specific authentication mechanism during the link establishment phase of the PPP connection; instead, they negotiate to perform EAP during the connection authentication phase. Once the connection authentication phase is completed, the peers negotiate the use of a specific EAP authentication method. At this point, the conversation between the peers consists mostly of requests and responses for authentication information shown in figure.2. After that, EAP allows for an open-ended exchange of information between the access client and the authenticating server that varies depending on the connection parameters involved. In essence, the EAP method determines the length and details of the conversation between authenticating peers.

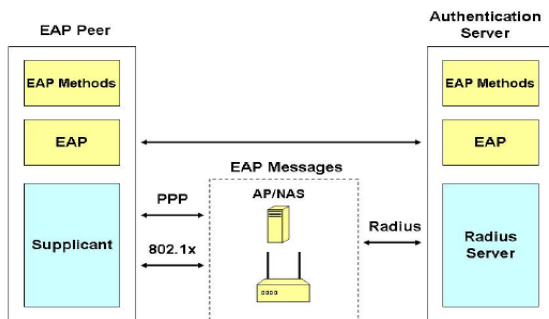


Fig.2 EAP Communication in PPP

The main components of EAP, as shown in Figure .2, are the following:

--EAP peer/Access Clients: Computers attempting to access network resources.

--EAP authenticator: An access point (AP) or network access server (NAS) requiring EAP authentication before granting access to a network resource.

--Authentication server: A server computer that negotiates the use of a specific EAP method with an EAP Access Client. It also validates EAP peers' credentials and authorizes access to network resources.

A supplicant is a software component that uses EAP to authenticate network access but that handles the actual data exchange [3]. In the example shown in Figure 2, both the EAP authenticator and the authentication server send EAP messages using RADIUS. As a result, EAP messages are actually exchanged between the EAP components on the EAP client and the authentication server. In a word, EAP provides the highest flexibility because it allows vendors to create more secure authentication schemes that can be plugged in later on, as required.

V. EAP IMPLEMENTATION

In wireless LANs, on one hand, Wi-Fi Protected Access (WPA) originally recommended EAPPSK—mainly, because home/small office applications were not required to support IEEE 802.1x authentication [4]. EAP-PSK is based on pre-shared keys—where a shared secret key is shared in advance between the two parties, using some secure channel [5]. EAP-PSK is a very lightweight protocol—it only requires four messages to complete the authentication stage [4]. Regardless of EAP-PSK simplicity and economy, WPA later recommended using EAP-TLS and EAPTTLS for increased security [4].

On the other hand, IEEE 802.11i (also known as WPA2) requires enterprise-level security. Therefore, in addition to EAP-TLS/TTLS, WPA2 devices also support PEAPv0, PEAPv1 and other open standards [4] [6].

Currently, the two most used EAP implementations are EAP-TTLS and PEAPv0. Both are extensively supported by most commonly used operating systems

(Microsoft, Mac OS, and Linux) as well as by most network appliance vendors

A. EAP Frames

The 802.1x Extensible Authentication Protocol (EAP) also known as EAP over LANs (EAPOL) provides the framework for a device to authenticate when it connects to the network. When Port-Based Authentication is enabled, only EAPOL traffic is allowed on that port, everything else is dropped until the client is authenticated.

A client that connects to the network sends an EAPOL Start frame to initiate authentication, and the switch responds with an EAP Request/ID frame to request credentials. The client then sends an EAP Response/ID frame which contains credentials to the switch. The switch passes those credentials to the authentication server which then sends an EAP Request frame to the client to request a specific EAP Method for authentication. The client responds with an EAP Response frame. EAP Request frames and EAP Response frames are passed back and forth until the authentication server sends a EAP-Success message to the switch. At this point, the client is authenticated and normal traffic is allowed. When the client logs off, an EAPOL Logoff frame is sent to the switch and the port becomes unauthenticated.

The EAP message exchange is basic, as shown in Figure.3. EAP starts after the supplicant has data and link layer connectivity). The communication between the authenticator and the supplicant is done as a request-response paradigm, meaning a message is sent and the sender waits for a response before sending another message.

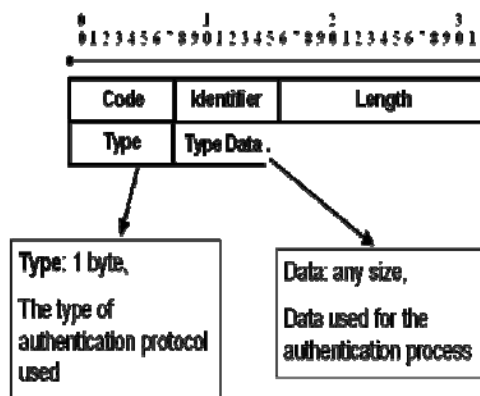


Fig.4 EAP Message Format

- EAP request and response messages have the same format , with code=1 for requests and code=2 for responses
- EAP Success messages are EAP messages with code 3 and no data.
- A success message means that the authentication concluded successfully.
- EAP failure messages are EAP messages with code 4 and no data.
- A Failure message means that the authentication has failed.

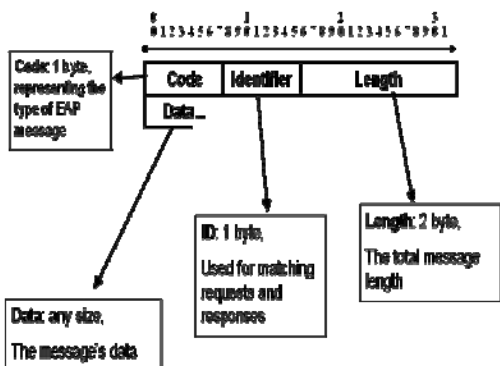


Fig.3 EAP Frame Format

b. EAP Messages

C. EAP Authentication Process

The Authenticator sends the peer an Identity request (optional).The Peer sends a response to the identity request identifying himself (optional).The Authenticator sends a request with a type according to which authentication method he wants to use and the data needed for the authentication. The Peer sends back a response of the same type or of type Nak signifying he refuses to use the requested authentication method. The Authenticator may at this point send another request (to repeat the process) or a success/failure message.If the authentication

was successful and mutual authentication is required, the sides change roles and the authentication is repeated in the other direction.

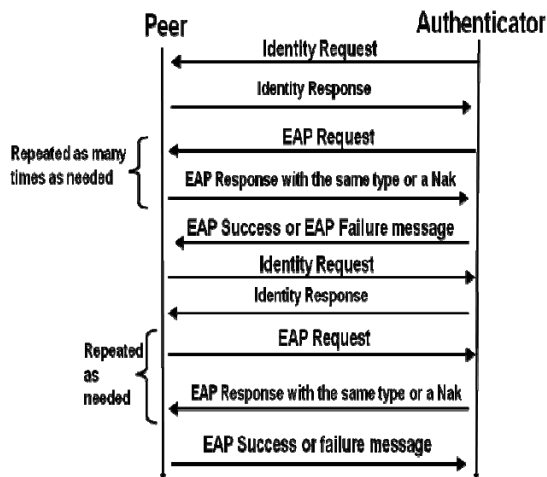


Fig. 5 EAP Messages

### VI. EAP SECURITY ISSUES

EAP is a standard that provides an infrastructure for network access clients and authentication servers. EAP does not specify the authentication mechanism itself but the way it is negotiated by the communicating parties. Consequently, EAP has no security issues in itself.

#### A. Dictionary Attacks

A dictionary attack is a technique for defeating a code or authentication mechanism by trying each word from a dictionary—a list of common words—and encoding it the same way the original passphrase was encoded [6] [7]. Dictionary attacks differ from brute-force attack on the fact that only the most likely words are tried

#### B. Plaintext Attacks

EAP implementations that rely on clear-text authentication using RADIUS (even within a protected tunnel) are vulnerable to known-plaintext attacks [2]. In a known-plaintext attack (KPA), the attacker uses samples of both the plaintext and its encrypted version to reveal further secret information such as the secret encryption key

#### C. Man-in-the-middle Attacks (MitM)

Tunneling protocols such as TLS and TTLS offer a server-authenticated tunnel that secures both the authentication method and the user’s identity [12]. Unfortunately, original implementations of EAP that are based on these protocols may also be vulnerable to man-in-the-middle (MitM) attacks. In a MitM attack, a rogue client assumes the identities of both the client and the server in order to intercept communication from one device and send a tainted one to the other device

#### D. Ciphertext attacks

EAP-SIM improves the original GSM security model—based on a pre-shared key and challenge-response mechanism. The original GSM standard uses A5/1 and A5/2 stream ciphers with key length of 64 bits [13] [15]. EAP-SIM improves the original GSM standard by increasing the key length to 128 bits. Unfortunately, the way the new 128-bit key is generated has been shown to be defective [14]. Rather than being 128-bit long, the resulting key has an effective key length of 64 bits only.

### VII. SEMANTIC ANALYSIS

To authenticate WLAN, IEEE 802.1x provides authentication framework based on Extensible Authentication Protocol(EAP). The EAP supports several authentication protocols and each protocol has advantages and disadvantages, respectively. It supports cellular-WLAN interworking and provides strong user identity protection. Moreover, our protocol has less overhead than other protocols(EAP-TTLS, PEAP, and EAP-UTLS) because of using a symmetric key cryptosystem and ECDH. Moreover, the protocol prevents man-in-the middle attack and replay attack. In addition, EAP protocol provides PFS and does not occur SQN synchronization which occurs in EAP-AKA. Therefore, our protocol provide more efficient and secure 3G-WLAN interworking than previous protocols.

### VIII. CONCLUSION

Wireless communication having great features are attractive among users as well as service provides us. With the increase in its use security problems of confidentiality, integrity and authentication are also increasing. The mechanism to solve these problems has changed to public key cryptography from symmetric key cryptography. The available public key cryptographic approaches are good in security point of view but they are computationally extensive as well as have more signaling overhead. Furthermore, these approaches don't provide integrity of the initial authentication messages and authentication of the network.

As noted before, although, public key cryptography is computationally very extensive which requires large processing power, battery and memory, but still the approach we proposed is efficient to use than the others. The rapid developments in integrated circuits(IC) and smart cards(Example: SIM) technologies, high speed communication systems(Example:UMTS), and significance of secure transactions make the conditions more favorable to use public key cryptography.

EAP has been implemented based on several well-known authentication technologies. For instance there are versions of EAP built on top of PSK, TLS, TTLS, GSM, AKA, among many others. Unfortunately, some these implementations present significant security vulnerabilities such as exposure to dictionary attacks and man-in-the-middle attacks. To conclude, EAP is a highly flexible infrastructure for secure network access authentication. Thus far, it has been implemented in many flavors and colors, based on well-known authentication scheme, some of them with important security weaknesses.

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## DESIGN AND FABRICATION OF MULTI PURPOSE AGRICULTURAL EQUIPMENT

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**Abstract—** A Study has been carried out to develop multi purpose agricultural equipment, for performing major agricultural operations like goods carrying, pesticide spraying, laddering, inter-cultivating and digging operations of sandy loam deep soils, to increase the efficiency and reduce the production and handling cost. Modifications were carried out, and the modification includes fabricating a vehicle which is small, compact in size which can move easily across the fields. This vehicle was named as NCET kissan all in one .which consists of various agricultural implements like inter-cultivator, ladder, pesticides sprayer, goods carrying container, plough, which can be easily assembled and Dis –assembled by a single person, the cost of equipment is less by 83% compared to a tractor. And 40% compared to a tiller (price in India).

***NCET kissan all in one-agricultural equipment name***

### I. INTRODUCTION

Metal fabrication is the building of metal structures by cutting, bending, and assembling processes

- Cutting is done by sawing, shearing, or chiseling (all with manual and powered
- variants); torching with hand-held torches (such as oxy-fuel torches or

plasma torches); and via numerical control (CNC) cutters (using a laser, mill bits, torch, or water jet).

- Bending is done by hammering (manual or powered) or via press brakes and similar tools. Modern metal fabricators utilize press brakes to either coin or air-bend metal sheet into form. CNC-controlled back gauges utilize hard stops to position cut parts in order to place bend lines in the correct position. Off-line programming software now makes programming the CNC-controlled press brakes seamless and very efficient.
- Assembling (joining of the pieces) is done by welding, binding with adhesives, riveting, threaded fasteners, or even yet more bending in the form of a crimped seam. Structural steel and sheet metal are the usual starting materials for fabrication, along with the welding wire, flux, and fasteners that will join the cut pieces. As with other manufacturing processes, both human labor and automation are commonly used. The product resulting from fabrication may be called a fabrication. Shops that specialize in this type of metal work are called fab shops. The end products of other common types of metalworking, such as machining, metal

stamping, forging, and casting, may be similar in shape and function, but those processes are not classified as fabrication.

- Blacksmithing has always involved fabrication, although it was not always called by that name.
- The products produced by welders, which are often referred to as weldments, are an example of fabrication.

Similarly, millwrights originally specialized in setting up grain mills and saw mills, but today they may be called upon for a broad range of fabrication work.

- Ironworkers, also known as steel erectors, also engage in fabrication. Often the fabrications for structural work begin as prefabricated segments in a fab shop, then are moved to the site by truck, rail, or barge, and finally are installed by erectors.

**II. Technical Specification of NCET kisan all in one**

<b>TECHNICAL SPECIFICATION</b>	
<b>ENGINE</b>	
TYPE	4 STROKES 150CC WATER-COOLED
DISPLACEMENT RATIO	149CC
COMPRESSION RATIO	11:01
MAX. POWER	8.5KW / 8000R / MIN
MAX. TORQUE	10N.M / 7500R / MIN
<b>CLUTCH</b>	
TYPE	MULTI-PLATE WET TYPE
LUBRICATION METHOD	
PRESSURE SPLASH	
<b>TRANSMISSION</b>	
TYPE	CONSTANT MESH TYPE
NO. OF GEARS	5 FORWARD + 1 REVERSE

**Table 1 back engine used in NCET kisan all in one**

Table 1 shows the details of rear engine used in NECT kisan all in one and multi-purpose agricultural equipment, the engine used was built by Bajaj Company and model was given by auto rickshaw re

III. Table 2 technical specification of NCET kissan all in one

<b>ENGINE</b>	
TYPE	2 STROKE
COOLING TYPE	FORCED AIR COOLED
DISPLACEMENT	145.45 CC
MAX POWER	7 BHP( 5.15 kW) 5000 RPM
MAX TORQUE	12.1 NM @ 3500 RPM
IGNITION TYPE	CDI
TRANSMISSION TYPE	4 FORWARD AND ONE REVERSE
CLUTCH TYPE	WET MULTIDISC TYPE
<b>ELECTRICAL SYSTEM</b>	
SYSTEM	12V AC + DC
HEAD LIGHT	35/35W
HORN	12 V AC
<b>SUSPENSION</b>	
FRONT SUSPENSION	HELICAL SPRING AND HYDRAULIC SHOCK ABSORBER WITH ANTIDIVE LINK
REAR SUSPENSION	INDEPENDENT SUSPENSION WITH SPRING AND HYDRAULIC SHOCK ABSORBER
<b>TYRES</b>	
FRONT TYRE SIZE	4.00-8, 4PR
REAR TYRE SIZE	4.00-8, 4PR 2 Nos.
FRONT BRAKES	DRUM HYDRAULIC
REAR BRAKES	DRUM HYDRAULIC

Table 2 technical specification of NCET kissan all in one

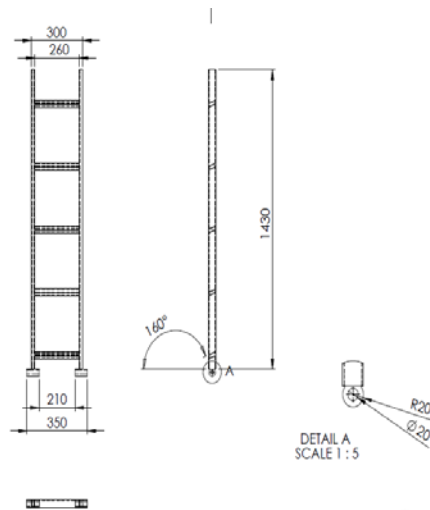


Table 2 shows the details of front engine used in NECT kisan all in one a multi-purpose agricultural equipment, the engine used was built by Bajaj auto rickshaw Re Company and model was given by electronic start. It also gives a detailed description of over all length, type of electrical system used, type of transmission system used etc; the resemblance of NCET kissan all in one is all most similar to the Bajaj two stroke front engine auto rickshaws.

**Iv.Ladder**

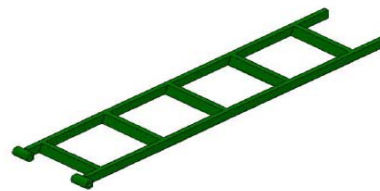
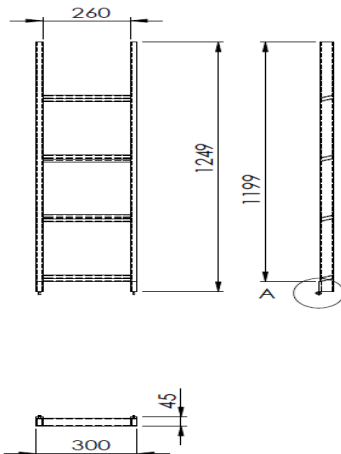


Fig 1 first part of ladder

The ladder has been divided in to three parts, and hence named as 1,2,3 parts where in which the first part is been fixed to vehicle chassis with the help of 14 mm bolts and nuts the one end of the ladder is been welded by the help bush so that the it can be easily tilted from 90°

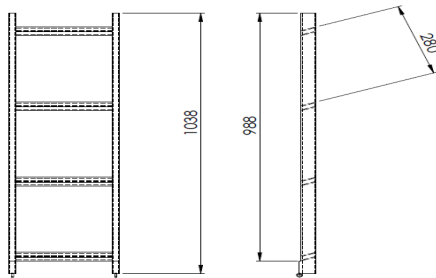


to 180° the dimensions has been shown in the figure 5.5 .



**Fig 2 second part of ladder**

The second part of the ladder rests on the main frame of good carrying container this part of ladder is attached to the first part of ladder by means of Lowry inches so that it can be tilted easily and proper clamping mechanism is also been used to lock it when it is placed one on the other the required dimensions is shown in the figure 2

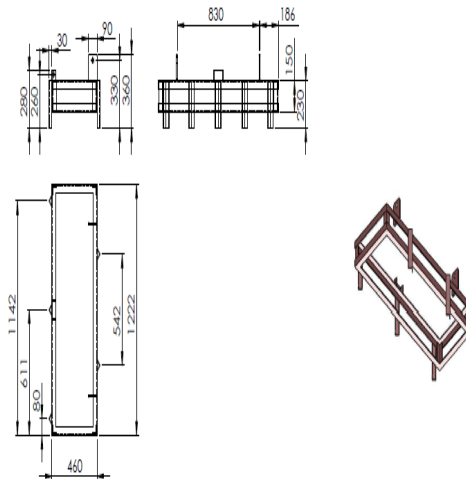


**Fig 3 third part of ladder**

The third part of the ladder is free to rests on the main frame of good carrying container this

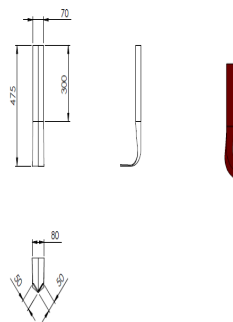
part of ladder is attached to the second part of ladder by means of Lowry inches so that it can be tilted easily and proper clamping mechanism is also been used to lock it when it is placed one on the other the required dimensions is shown in the figure 3

**V.Ploughing assembly.**



**Fig 4 main frame of ploughing assembly**

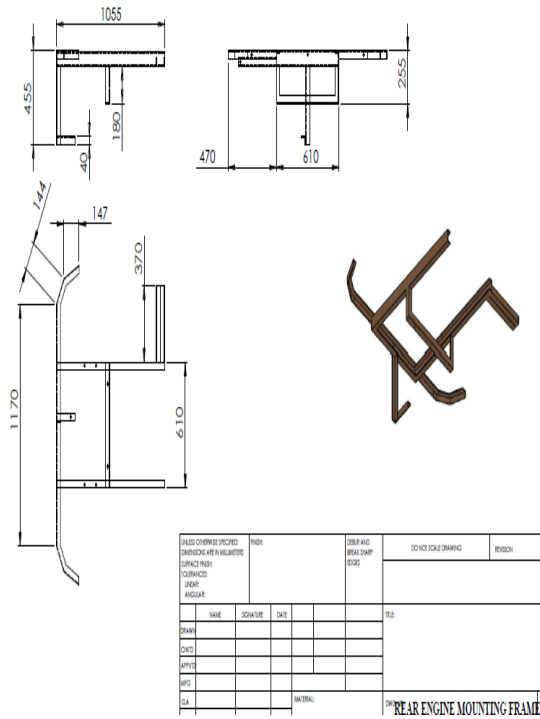
Fig shows the main frame of ploughing assembly where the blades can be accommodated, the total numbers of blades that can accommodate are 5 blades which are in zigzag form, and it is placed so that when they perform their job they dig the soil in straight line format. It is also been attached by to plates consisting of holes so that they can be easily attached to the vehicle by means of shaft and lock them by using clipping mechanism.



**Fig 5 blades used in ploughing assembly**

Figure shows the blades which are used in ploughing assembly these are manufactured by using cast iron and process of manufacturing is by forging. for analysis purpose the load coming on to the plates is difficult to assume it is totally dependent on type of soil, hence the soil changes from one part of land over the other part hence it is assumed and 90 kg's of load was putted on each blades and it is proved to safe when tested in fem analysis.

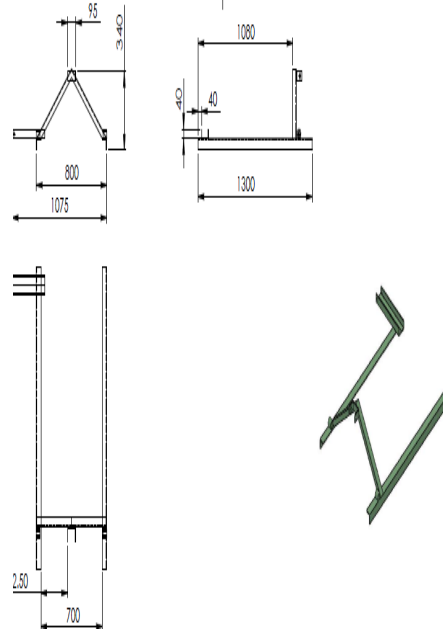
**VI. Engine mounting**



**Fig 6 rear engine mounting frame**

Figure shows the rear engine mounting frame which has welded at the rear part NCET kissan all in one agricultural equipment the fuel tank and exhaust manifolds are also been placed at appropriate positions.

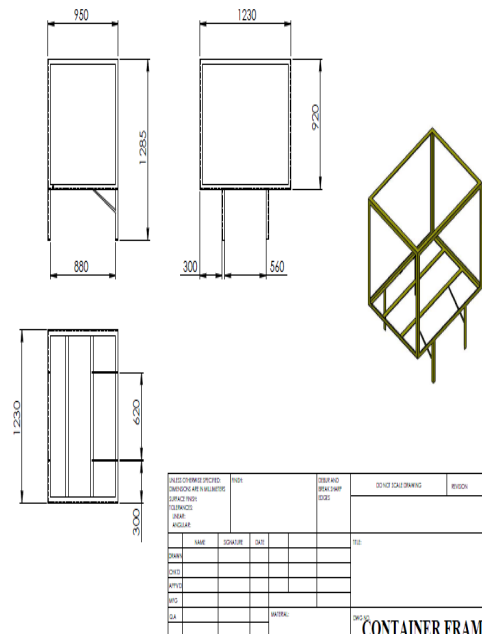
**VIII. Extended chassis**



**Fig 7 extension chassis frame**

The above figure shows the extension part of the chassis which is drawn from main part of the chassis this is provided to mount the goods carrying container ,pesticides spraying pump, ladder and rear engine

**VII. Goods carrying container**

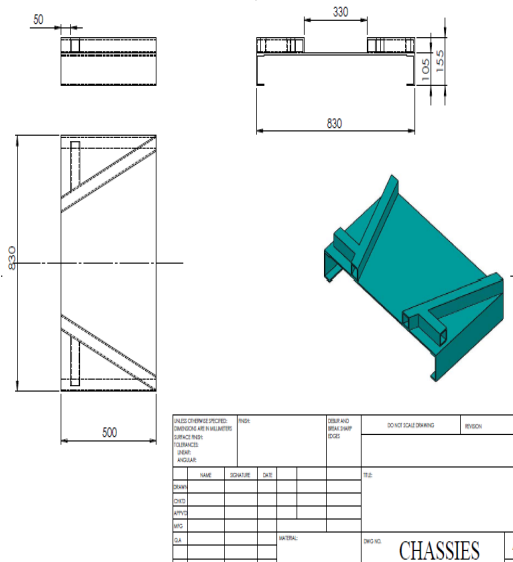


**Fig 8 goods carrying container frame**

The goods carrying container is attached to the rear part of the NCET kissan all in one the it consists of two doors on its front part, the entire container can be tilted and rotated from

900 to 1800 .and there is a provision of remove entire assembly by means of bolts and nuts.

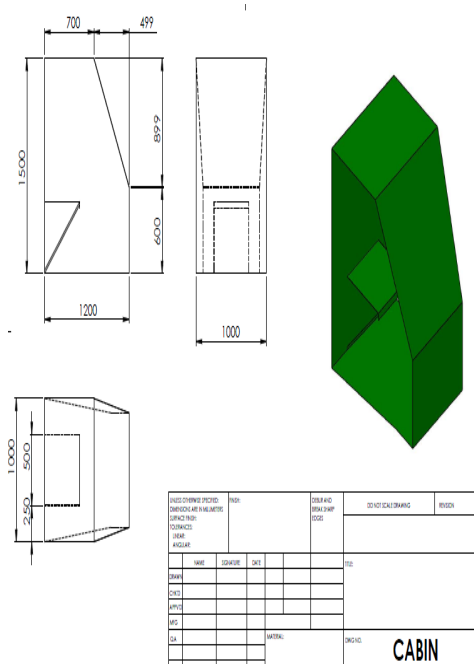
**IX. Goods carrying container mounting**



**Fig 9, goods carrying container mounting frame**

The goods carrying container is attached to chassis by means of mounting frame, this frame also covers the front engine and this is responsible for connecting and takes the loads from shock absorber.

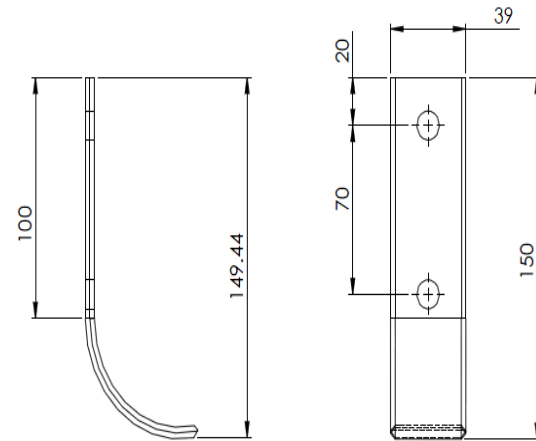
**X. Cabin**



**Fig 10 Cabin frame**

This is used to safe guard the driver it is made up of mild steel sheet and it is the place where are controls of vehicle which guide the stability of vehicle is placed.

**XI. Inter cultivator blades**



**Fig 11 Inter cultivator blades**

These blades are also called as tins, the total number of blades used are in two ways 16 blades and 8 blades depending on the type of soils the user can select among these two any one .the drive to this blades are given by an rear engine which can be controlled from driver cabin it self, 4 gears are provided to vary the speed and load carrying capacity.

**XII.Pesticide spraying pump**



**Fig 11 pesticides spraying pump used in NCET kissan all in one.**

**Specifications**

PLUNGER NO.*DIA*STROKE	2 PLUNGERS*Φ30MM*20
PRESSURE	21-45KG/CM <sup>2</sup>
OUTPUT	35-45L/MIN
SPEED	800-1200 R.P.M
DIMENSION	420MM×320MM×340MM
POWER	5-6.5 PS

**Table 3 shows the technical specification of pesticides spraying pump NCET kissan all in one**

**XIII.Photos**



**XIV.Conclusion**

NCET kissan all in one, multipurpose agricultural equipment, can be successfully used for farming due to following reasons

1. Faster operations
2. Low cost of operations and low investments
3. Light in weight, low cost durable with minimum repairs which saves time during operations
4. All cultural operations (inter-cultivating, ploughing, laddering goods carrying etc)for year round cultivation done with the help of NCET kissan all in one
5. Slipping of tires was very common problem when moisture content was more, Hence farming is recommended to be done in 10-15 percent moisture content lands.
6. Ladder can be tilted from 90<sup>0</sup> to 200<sup>0</sup> ,but best load withstanding range was noticed at 120<sup>0</sup>.position of ladder
7. Ploughing was difficult to be done in newly cultivating farms. But it is recommended to use once after cultivating it from the tractor.
8. Maximum of 800 kg's load can be pulled, but it is recommended for carrying 500 kg's of load for better life span of engine
9. From the survey , farmers told that they use tractor minimum of 4 times and maximum of 7 times for one crop rotations, for which they were paying 700rs /hector (for one time) hence if farmer goes for one time with tractor is sufficient, else all other work he can do from NCET kissan all in one.

10. The cost of equipment was 120000, which can be still reduced when produced in mass production

11. The maximum speed ranges 40 km/hrs, this is built to take more load rather than speed hence it is adequate to run the vehicle at 25 km/hr to commute both time and durability.

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## A CALCULATIVE ANALYSIS OF CHANNEL UTILIZATION USING HIERARCHICAL IP ADDRESSING SCHEME(HIPAS)

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**Abstract—** Network on Chip (NoC) is one of the best communication architecture that uses efficient characteristics in topology, switching, routing and flow control. Wormhole routing using virtual channel concept has been a popular switching technique in the new generation NoC architectures. Routing process creates logical connection between nodes in a network so that packets sent by node can reach their destination. Moreover there is a problem with selection of best routing path and efficient utilization of channel or link for a network. Larger overhead while routing and transmitting a packet within the network causes decrease in the number of transmitted information bits, which in turn causes to degrade the channel utilization.

We present a mathematical model for the computation of channel utilization using Hierarchical IP Addressing Scheme(HIPAS) for NoC applications and a routing strategy to avoid the randomness in the selection of path. The HIPAS provides that the overhead bits can be minimised in the packet and users can be facilitated to transmit more number of true information bits to the destination. The mathematical model shows that how the

overall utilization of channel increases using this scheme.

**Keywords:** NoC, Wormhole Routing, HIPAS, Channel utilization.

### I. INTRODUCTION

Design of the chip design has four distinct aspects: computation, memory, communication, and I/O. As processing power has increased and data intensive applications have emerged, the challenge of the communication aspect in single-chip systems, Systems-on-Chip (SoC), has attracted increasing attention. The architecture of NoC enables the topology to be configured based on the application currently running on the chip. The reconfigurable NoC architecture is evaluated in [8], which shows a huge decrease in power consumption to static mesh topology. This survey treats a prominent concept for communication in SoC known as Network-on-Chip (NoC). Users, system designers and researchers are often interested in knowing the expected performance of system. From user perspective this is often phrased as either “which system will get my data there most effectively for my needs?” or “which system will deliver the most data per unit time?” System

designer are often interested in selecting the most effective architecture or designer constraints for a system, which drive its final performance [4]. And the researchers interest is to always find and propose an efficient architecture for routing.

In most cases the benchmark of what a system is capable of or its maximum performance is what the user or designer is interested in.

Keeping all these points in mind, NoC is proposed as an emerging paradigm for on chip communication networks [4]. NoC does not constitute an explicit new alternative for intra chip communication but is rather a concept which presents a unification of on chip communication solutions [2].

Fig. 1 [2] shows a simple structure as 4x4 mesh which provides global chip level communication. Cores (IP blocks) are used to generate packets or message, which they want to transmit. The purpose of the network adapter (NA) is to interface the core to the network and make communication services transparently available with a minimum of effort from the core. Network adaptor provides interface between a routing node and IP block. Routing nodes represent a router which implements the routing strategy.

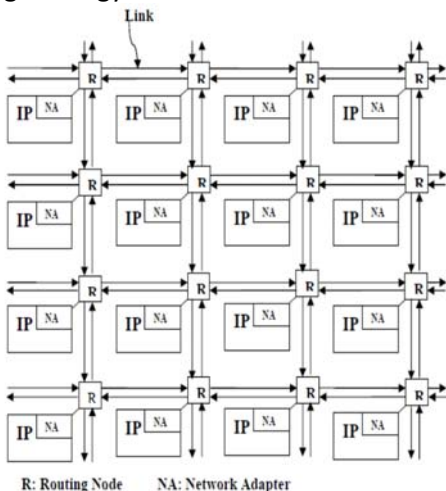


Fig. 1 Topological illustration of a 4-by-4 mesh structured NoC

Links connect the routers, providing a physical media to communicate with each other directly[5]. The routers used, are generally wormhole routers with virtual channel concept

for flow control. The concept of virtual channel will increase the throughput of network [6].

Addresses can be determined in two ways, either bound with hardware during the manufacturing process or assigned on demand by addressing protocols. Using the various on-demand addressing protocols it can be categorized further into centralized and distributed. The first one employs a central addressing coordinator and the latter one does not respectively. There are currently two types of distributed addressing schemes, flat and hierarchical [7].

- Flat Addressing The majority of MANET routing protocols employ a flat addressing mechanism as the nodes are not static and are in a ad hoc network . In a flat network, addresses are randomly assigned to nodes; therefore, the distribution of addresses is unrelated to the network topology. Although the addressing process is easy, a flat address structure always makes it hard to build a path between two arbitrary nodes.

- Hierarchical Addressing A hierarchical addressing scheme can make the path discovery process easier due to its systematic structure. The distribution of hierarchical addresses also does not need a central coordinator; however, it causes the waste of address resources if the network grows irregularly. The ZigBee tree structure is such an example that is commonly used in WSNs. In addition, networks do not reserve addresses for the nodes roaming out of range. This feature of hierarchical addressing makes it more adaptable for the static networks rather than for mobile networks.

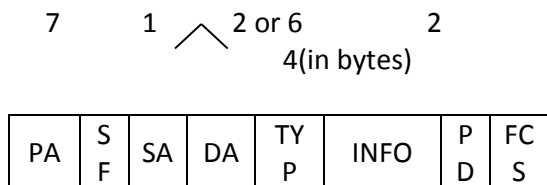
The HIPAS for NoC applications will facilitate a user to transmit more messages with lesser overhead bits to other users [1]. In this HIPAS, the IP connected to router is assigned a global address in such a way that a global address of two directly connected IP's must have only single bit difference. And so, the number of bit changes in the global address of two IPs will indicate the distance between them. The number of overhead bits required will be dependent on this distance.

Further, we propose a calculative model for computation of overall channel utilization along

with a new factor called channel utility factor. Variation of the overall channel utilization with respect to distance and processing delay is also been observed.

II. HIERARCHICAL IP ADDRESSING SCHEME

In computer networks, the messages are transmitted in forms of packets or frames. The number of bits in a packet are given as  $N_b=N/P$ , where N are the total number of bits in a message and P are the number of packets in the message. Every packet (whether it belongs to any set of protocol), belongs to any source and destination pair, carries some overhead ( $N_a+N_o$ ) (including Source address and Destination address and other pre information and post information bits). As example Ethernet packet frame has the structure given in Fig.2 [1].



PA:Preamble                      SF:Start Frame  
 SA:Source Address  
 DA:Destination Address      TYP:Type  
 INFO:Information  
 PD:Pad

Fig. 2 Ethernet Frame

Now the packet that has to travel over the link consists of  $N_p=N_a+N_o+N_b$ .

While using HIPAS every IP connected to routers in NoC (mesh topology) is assigned a global address in such a way that the global addresses of two directly connected IP's must have only single bit difference as shown in fig.3 for 16 IP's with internal port address of 4 bit.

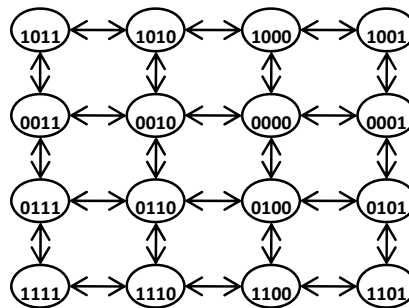


Fig.3 An example of Hierarchical IP Addressing Scheme

This property of HIPAS gives the efficient performance while transmitting the packets from one user to another. Fig.4 shows the Basic mechanism of HIPAS for transmission of packets from one IP to other IP, in a network [1]. Now when IP sends its packets to router, it will contain source address, destination address and some other constants (as shown in fig.2). The router will extract the source and destination address from the packet and with the help of look up table it will decide the complete path from source to destination by using travelling address (TA). If b is the number of bits required to resolve the internal port address of a single router, then to address the complete path having distance d with  $n=d+1$  number of router in the path is given as  $TA= (d+1)*b$ . At destination port destination router will find the global address of source IP by reversely traversing the travelling address in look up tables. By doing so we can transmit more number of message bits in packets, as wormhole routing header flit contain only Travelling address not Source global address and Destination global address [1].



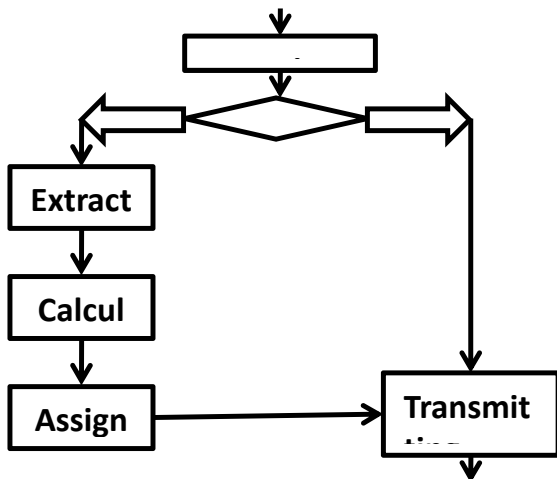


Fig.4 Basic mechanism of HIPAS

### III. MATHEMATICAL MODEL

In this model, packets are generated with source and destination address, and are transferred from one router to another towards their destination [3]. The routers are capable of taking decision in selection of path. Now the channel utility factor which measures the amount of true information transferred over the link of capacity  $C$  bits/sec is given as-

$$\text{Channel utility factor, } U_{\text{cuf}} = \frac{N_b}{N_p} = \frac{[N_p - (N_a + N_o)]}{N_p}$$

Using HIPAS  $N_a$  is replaced by travelling address (TA) for  $(d+1)$  routers having internal port address  $b$ , which is given as

$$\begin{aligned} \text{TA} &= (d+1)b \\ \text{So, } U_{\text{cuf}} &= 1 - \frac{(N_a + N_o)}{N_p} \\ &= 1 - \frac{(d+1)b + N_o}{N_p} \end{aligned}$$

Now, Overall channel utilization of a channel or link for any network can be given as the function of

1. Useful data transmission time

$$T = \frac{\text{Useful data transmitted}}{\text{Utilized channel capacity}} = \frac{N_b}{CC^u}$$

2. Delay overhead, suppose it is  $Y$ .
3. Activity factor

$$\eta = \frac{x}{Z} = \frac{\text{count of all active IPs}}{\text{count of all IPs}}$$

where  $x$  is the count of all active stations.

Combining all these overall channel utilization,  $U_{\text{ocu}}$  given as-

$$U_{\text{ocu}} = \frac{xT}{xT+Y}$$

Considering the processing delay at each router equal to  $\alpha$ , which is the time taken in receiving the packet flit, decoding the address information and transmitting it further. Also considering that packet is passed sequentially in the same logical order as their physical address is, then the net processing delay =  $(d+1)\alpha$ . (Where the number of routers between source and destination can be given by  $n = d+1$ ),

This processing delay will add up to net delay overhead and so the channel utilization will be

$$U_{\text{ocu}} = \frac{xT}{xT+Y+(d+1)\alpha}$$

Now, putting the value of  $T$ , we have

$$\begin{aligned} U_{\text{ocu}} &= \frac{x \cdot \frac{N_b}{CC^u}}{x \cdot \frac{N_b}{CC^u} + [Y + (d+1)\alpha]} \\ &= \frac{x \cdot N_b}{x \cdot N_b + [Y + (d+1)\alpha]CC^u} \end{aligned}$$

As the utilized channel capacity (which indicates flow of true information over the channel of capacity  $C$  (bits/sec)) given as

$$CC^u = U_{\text{ch}} \cdot C$$

Now the  $U_{\text{ocu}}$  is given as-

$$\begin{aligned} U_{\text{ocu}} &= \frac{x \cdot N_b}{x \cdot N_b + [Y + (d+1)\alpha]C \cdot \frac{N_b}{N_p}} \\ U_{\text{ocu}} &= \frac{x \cdot N_p}{x \cdot N_p + [Y + (d+1)\alpha]C} \end{aligned}$$

Put the value of  $x$  from activity factor, then-

$$U_{\text{ocu}} = \frac{\eta Z N_p}{\eta Z N_p + [Y + (d+1)\alpha]C}$$

This is the expression for the overall utilization of channel.

### IV. CONCLUSIONS

This analysis shows a clear fact that channel can be utilized to its maximum if the activity factor or in turn the numbers of active IPs are more. For the smaller values of activity factor, the overall channel utilization can be achieved for smaller values of processing delay. HIPAS requires less overhead and addressing bits for transmitting the true information. By the addressing scheme used in Fig. 3 we are

reducing the mesh topology into a logical Torus topology and that too without using any interconnection. This provides us the torus advantage in a mesh environment. Future work can be emphasized on how to reduce the processing delay at each routing node. Also processing delay will be the function of traffic intensity, so it can be analyzed further.

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## AN OPTIMUM METHOD FOR OBTAINING HIGHER INDUCED VOLTAGE IN TRANSFORMER

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**Abstract**— This paper proposes a novel method for obtaining higher voltage by transformer, unlike increasing frequency, number of turns. This has been achieved by adding a capacitor in series with the primary side of the transformer, by which greater induced EMF has been obtained by cancelling the choke effect of the inductor. To test the effectiveness of the proposed method, *State Space model of the transformer has been developed* and the analysis has been made by using the same for various load conditions.

**Index Terms**—State space modeling, Transformer, Voltage magnification.

### I. INTRODUCTION

Transformer is a static device; it works on the principle of Mutual Induction.

The governing equation is:

$$E=4.44.f.N.\Phi_m \text{ Volt ..... (Eq 1)}$$

From (Eq 1) it is clear that induced EMF (E) in transformer can be increased in various ways. (1) Increasing the frequency (f), hence reducing the size of the transformer for given output voltage, but it has inherent defect of increasing

the hysteresis and the eddy current losses necessitating superior core material. This also results in increased skin effect. (2) Increasing number of turns (N) in coil, but this result in increased size, cost and voltage regulation. (3) Alternate approach to enhance voltage is by establishing more flux ( $\Phi_m$ ), which can be obtained in two ways. (i) Reducing the resistance of coil, which results in increased primary current. There exists a lower limit to this for a given voltage. (ii) Producing more current through coil by high primary voltage and thus more flux. The latter approach is not optimal because the prime purpose is to boost low input voltage.

### *Proposed solution for boosting voltage*

If two straight conductors are placed near each other the mutual induction is not appreciable. Hence coil is required instead of a conductor, but there is choke effect due to coil, which limits current and hence flux, thus limiting induced EMF. To obtain a higher voltage with constant number of turns, frequency and supply voltage, the choke effect needs to be removed but not coil as it is very much necessary for transformer action. Hence choke effect is compensated by series capacitive reactance, *the circuit is taken*

to near resonance but not resonance, as there exists one particular frequency(Eq.2) for which voltage across inductor would be maximum[1], which would dictate the value of capacitance (C) to be placed in series with primary side of transformer :

$$f_L = \frac{1}{2\pi\sqrt{LC - \frac{R^2C^2}{2}}} \dots\dots\dots (Eq.2)$$

For measured self inductance and resistance of the coil, for supply frequency, C can be calculated from (Eq.2) and as shown in Fig.1 at supply frequency maximum voltage can be obtained which is much greater than the supply voltage -voltage magnification.

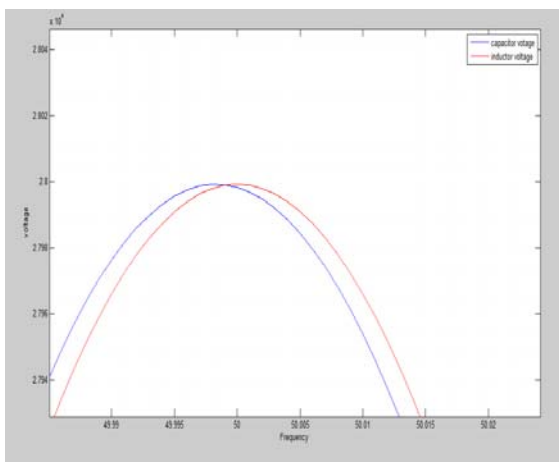


Fig .1

II. STATE SPACE MODELING

State Space model of transformer without capacitor

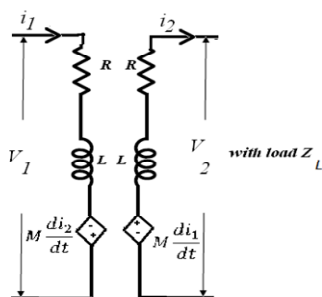


Fig.2 [2]

State space equations are:

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \begin{pmatrix} \frac{-RL}{L^2-M^2} & \frac{-RM-MZ_L}{L^2-M^2} \\ \frac{-RM}{L^2-M^2} & \frac{-RL-LZ_L}{L^2-M^2} \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} \frac{L}{L^2-M^2} \\ \frac{M}{L^2-M^2} \end{pmatrix} U$$

$$Y = \begin{pmatrix} 0 & Z_L \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

State Space Model of transformer with capacitor

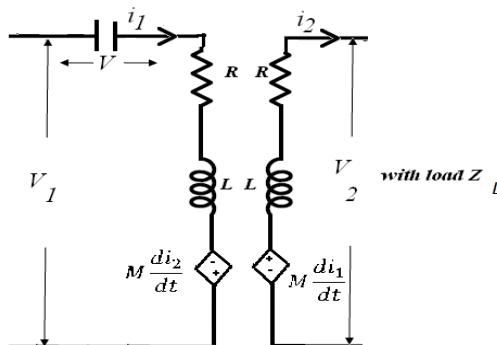


Fig. 3

State space Equations are:

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} \frac{-RL}{L^2-M^2} & \frac{-RM-MZ_L}{L^2-M^2} & \frac{-L}{L^2-M^2} \\ \frac{-RM}{L^2-M^2} & \frac{-RL-LZ_L}{L^2-M^2} & \frac{-M}{L^2-M^2} \\ \frac{1}{C} & 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} \frac{L}{L^2-M^2} \\ \frac{M}{L^2-M^2} \\ 0 \end{pmatrix} U$$

$$Y = \begin{pmatrix} 0 & Z_L \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

The parameters Where

$x_1, x_2, x_3, U, Y$  are  $i_1, i_2, V, V_1$  and  $V_2$  respectively.

III. SIMULINK MODELING & RESULTS

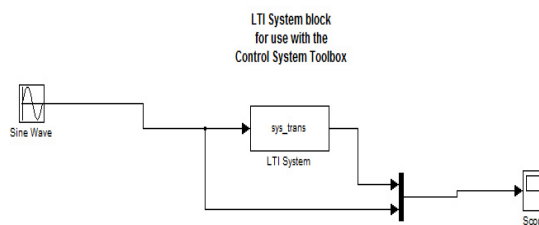


Fig. 4

for the simulation has been chosen from a practical transformer by using LCR meter for a 2 KVA/ 230//230 V. Self Inductance(L) is 0.31H, Resistance ( R ) is 0.8Ω, Capacitance(C ) calculated using (Eq. 2) for line frequency ( $f_L$ ) 50 Hz is 3.26853558 μF. Mutual inductance (M) = $k\sqrt{L^2}$ . Coefficient of coupling (k) =0.998.

Fig.5 shows the output voltage after placing the capacitor C as shown in Fig.3 with  $Z_L = 1K\Omega$ .

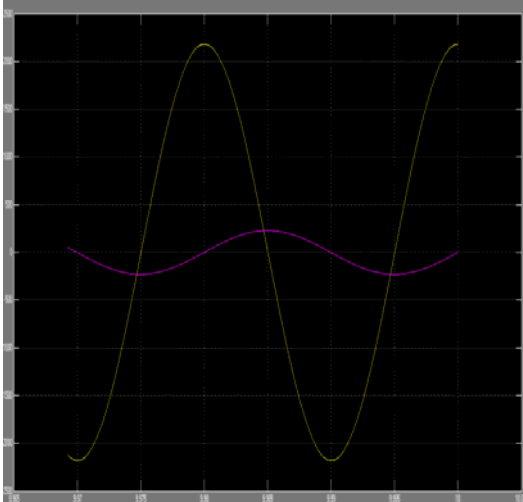


Fig.5 Input Voltage (230 V) Vs time and Output Voltage (3.2KV peak) Vs time for resistive load.

*Load Modeling and Stability:*

Response of the system for inductive and capacitive loads is also investigated and output voltage has been found to be enhanced. The system is found to be stable for input with harmonics (Shown in Fig.6)

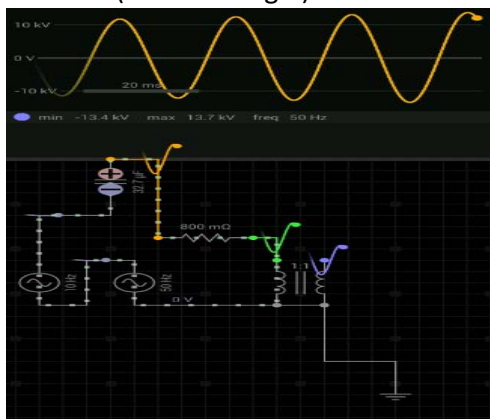


Fig. 6 Input voltage is superimposed with 10 Hz /1V Peak sinusoidal input.

IV. CONCLUSION

The results show that output voltage of 1:1 transformer is very high, i.e. *stepping up of voltage can be obtained using 1:1 transformer*. This has been achieved by taking the primary of the transformer to near resonance. The effectiveness of the method has been tested in *Matlab Simulink*® Environment by using State Space Analysis. It has been tested for various types of loads by using *EveryCircuit*®. This method can be used in various applications where very high boosting of voltage is required.

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## STRUCTURAL ANALYSIS AND PERFORMANCE EVALUATION OF MULTI PURPOSE AGRICULTURAL EQUIPMENT

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**Abstract—** A Study has been carried out on structural analysis and performance evaluation of multi purpose agricultural equipment, which performs major agricultural operations like goods carrying, pesticide spraying, laddering, inter-cultivating and digging operations of sandy loam deep soils, to increase the efficiency and reduce the production and handling cost. the analysis was first fallowed by an solid works model fallowed by meshing using hyper mesh software and anal sizing it by ansys software, it was found that the stresses produced was 150Mpa and deformation was 20 mm under 800 kg's load ,it is proved to be safe when compare to allowable stresses of material. This paper also gives the information regarding performance evaluation of NCET kissan all in one.

**NCET kissan all in one-agricultural equipment name**

### I. INTRODUCTION

FINITE ELEMENT ANALYSIS (FEA) IS A FAIRLY RECENT DISCIPLINE CROSSING THE BOUNDARIES OF MATHEMATICS, PHYSICS, AND ENGINEERING AND COMPUTER SCIENCE. THE METHOD HAS WIDE APPLICATION AND ENJOYS EXTENSIVE

UTILIZATION IN THE STRUCTURAL, THERMAL AND FLUID ANALYSIS AREAS.

THE ADVANTAGES OF FEA ARE NUMEROUS AND IMPORTANT. A NEW DESIGN CONCEPT MAY BE MODELED TO DETERMINE ITS REAL WORLD BEHAVIOR UNDER VARIOUS LOAD ENVIRONMENTS, AND MAY THEREFORE BE REFINED PRIOR TO THE CREATION OF DRAWINGS, WHEN FEW DOLLARS HAVE BEEN COMMITTED AND CHANGES ARE INEXPENSIVE. ONCE A DETAILED CAD MODEL HAS BEEN DEVELOPED, FEA CAN ANALYZE THE DESIGN IN DETAIL, SAVING TIME AND MONEY BY REDUCING THE NUMBER OF PROTOTYPES REQUIRED. AN EXISTING PRODUCT WHICH IS EXPERIENCING A FIELD PROBLEM, OR IS SIMPLY BEING IMPROVED, CAN BE ANALYZED TO SPEED AN ENGINEERING CHANGE AND REDUCE ITS COST.

#### **Preprocessing,**

In which the analyst develops a finite element mesh to divide the subject geometry into sub-domains for mathematical analysis, and applies material properties and boundary conditions. There are different types of Preprocessing packages in market

- Hyper mesh
- Ansa
- Msc.Patran
- Gambit

### Hyper mesh

Altair Hyper Mesh is a high-performance finite element pre-processor to prepare even the largest models, starting from import of CAD geometry to exporting an analysis run for various

As long list of CAD formats ensures a high level of CAD interoperability. Altair's connector technology automatically assembles individual parts with their Finite Element representation. Hyper Mesh is entirely customizable. An extensive API library can be used to automate repeating tasks or do complicated math operations or modal generation.

With a focus on engineering productivity, Hyper Mesh is the user-preferred environment for

- Solid geometry modeling
- Surface geometry modeling
- Shell meshing
- Solid mesh generation
- Automatic Mid-surface generation
- Detailed model setup

### Benefits of Hyper mesh:

- Open-Architecture Design

With the broadest set of direct CAD and CAE interfaces coupled with user defined integrations, Hyper Mesh fits seamlessly within any simulation environment.

- High-Speed, High-Quality Meshing

With both automatic and semi-automatic shell, tetra- and hexa-meshing capabilities, Hyper Mesh simplifies the modeling process of complex geometries.

- Advanced Model Morphing

A flexible set of morphing tools allows users to modify existing meshes to meet new designs and reduce model development costs.

- Increases End-User Modeling Efficiency

Batch Masher technology eliminates the need to perform manual geometry clean-up and meshing, thus accelerating the model development process.

- Reduces Training Time and Cost Through Elimination of Redundant Tools

An easy-to-use, intuitive graphical user interface makes it simple for anyone to learn the software, which further increases modeling efficiency and reduces training cost.

- Closes the Loop Between CAD and FEA

Create surfaces from finite elements enabling analysis engineers to communicate results and design modifications back into the design environment.

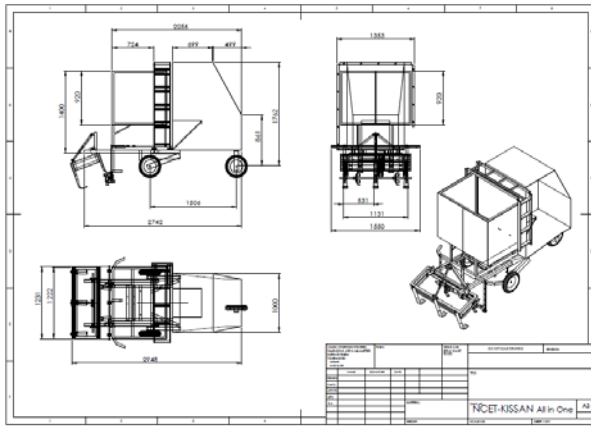
- Reduces Model Assembly Time

Leverage highly automated methods for rapid model assembly that create connections such as bolts spot welds, adhesives and seam welds.

### Methodology

The overall process comprises of four main components namely Geometrical Design, Finite Element Modeling, Modal and Static Structural Analysis, Geometrical Design is the CAD part of work, where 3D structure of Agricultural Equipment is designed using Solid works software. After completing the geometrical design part, the Agricultural Equipment geometry is discretized to Finite Element model known as meshing, the Agricultural Equipment is meshed using tetrahedral elements and this can be achieved by using Hyper mesh tool. Finite Element model is then exported for analysis. Loads and Boundary conditions are applied and the structure is solved for given load Condition using Ansys Workbench for Modal & Static structural analysis.

### Geometry details of Agricultural Equipment



**Fig 1 Detailed 2D drawing of Agricultural Equipment**

Figure 1 shows the detailed dimensions of NCET kissan all in one

**Fig 2 The 3D model for the Agricultural Equipment**

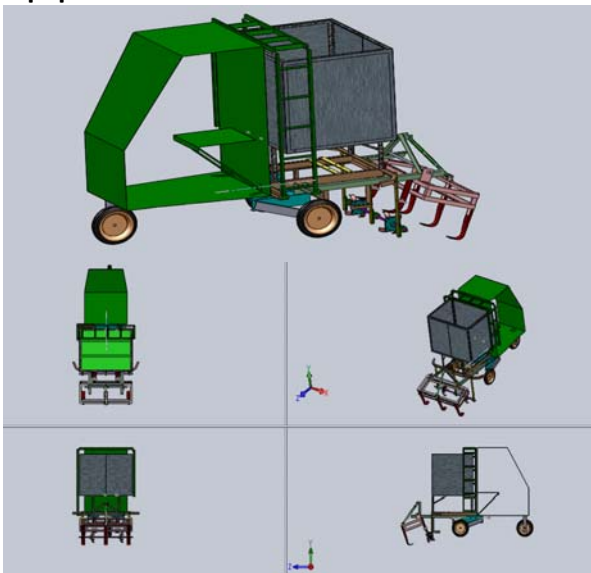
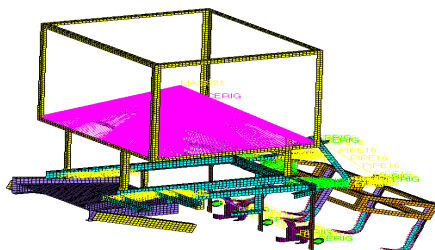
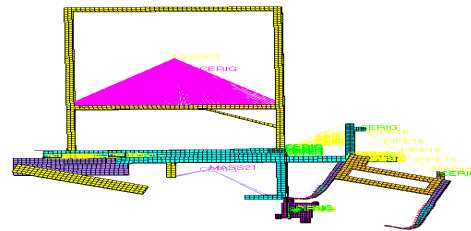


Figure 2 shows the 3D model of NCET kissan all in one

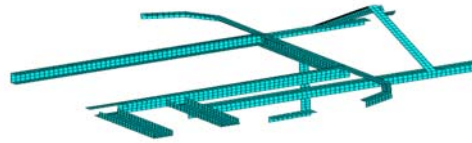
**Meshing of overall agricultural equipment assembly**



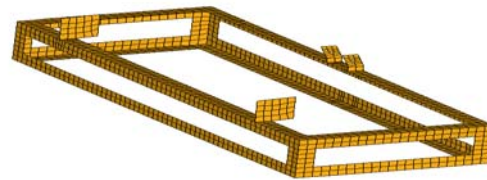
**Meshing of overall agricultural equipment assembly (side view)**



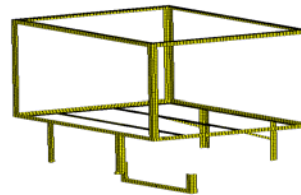
**Meshing of rear engine main frame**



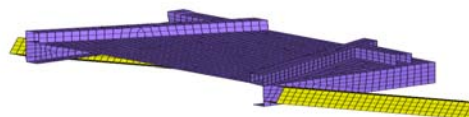
**Meshing of plough main frame**



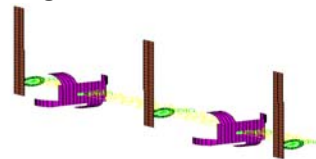
**Meshing of goods carrying container main frame**



**Meshing of front cabin main frame**



**Meshing of inter-cultivator assembly**



**Element Details**



SL NO	TYPE OF ELEMENT	NUMBER OF NODES	NUMBER OF ELEMENTS
1	SHELL 63	12816	10870
2	PIPE 16	31	29
3	MASS-21	2	2

Table 1 shows the type of element used. Material Properties, Boundary and Loading Conditions

**Material Properties**

Base material of the Agricultural Equipments Mild Steel and cast iron. Table 2 shows material properties of Mild Steel .

**Table 2** Material property of Mild Steel

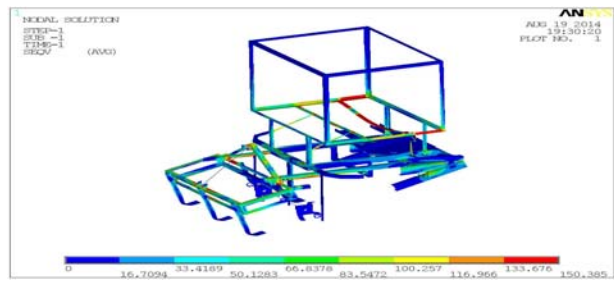
SL NO	MATERIAL	DENSITY KG/M <sup>3</sup>	YOUNGS MODULES	YIELD STRESS	ALLOWABLE STRESS
1	MILD STEEL	7850	210000	250 MPA	160 MPA

**Boundary Condition**

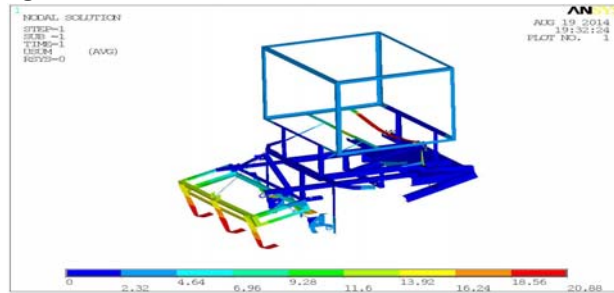
Structural Boundary conditions are in the form of zero displacements, Boundary conditions specify to act on all directions (X, Y and Z) or in certain directions only. In this case, Boundary conditions (BC) are applied on the Main bed of Chassis of Agricultural Equipments show in fig 3 allowing the modal deformation as a whole.

**Loading Condition**

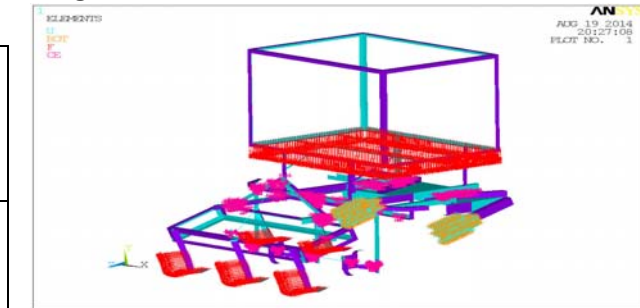
Loading condition is defined to be forces distributed on the surfaces of the Agricultural Equipments shown in fig 5 .An engine mass of 23 kg's, load on cabin (goods carrying) 400 kg's ,load on plough (each blade) 90 kg's has been imposed on to the equipment.



**Fig-3**, stresses of entire assembly under 800 kg's load



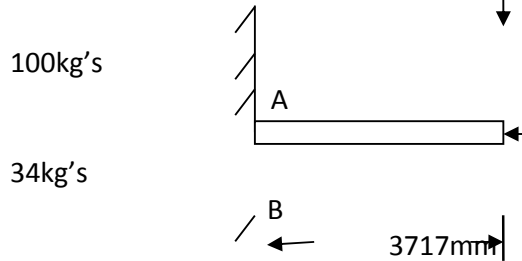
**Fig-4**, displacement of entire assembly under 800 kg's load



**Fig-5**, loads of entire assembly

**Design of ladder**

The ladder is fixed (hinged) on one end, and supported on the other end, hence let us consider ladder as the cantilever beam.



Here , the overall length of ladder is 3717mm from the vehicle base, and an 100 kg's of load is applied in tensile direction considering the weight of human body, and 34 kg's of load is applied in compressive directions considering the weight of ladder.

The ladder is subjected to both axial and bending load, hence the critical points are A&B.

Direct stresses due to axial load.

$$\sigma_1 = \frac{F}{A} = \frac{-333.34}{137000} = 2.09 \times 10^{-3}$$

$$\sigma_2 = \frac{M \cdot C}{I}$$

Where  $I = \frac{bd^3}{12} = \frac{360 \times 20^3}{12} = 240000 \text{ mm}^4$

$$= \frac{781.2717 \times 20}{240000}$$

$$\sigma_2 = 151.93 \text{ N/mm}^2$$

$$= 0.0007234 \times 9717$$

$$\Delta l = 2.6888 \text{ mm}$$

Now, considering at point A,

$$\begin{aligned} \sigma &= \sigma_1 + \sigma_2 \\ &= -2.09 \times 10^{-3} + 151.93 \\ &= 151.927 \text{ (tensile)}. \end{aligned}$$

Maximum normal stress at A

$$\sigma_{\max} = 151.927 \frac{\text{N}}{\text{mm}^2}$$

Minimum normal stress at A

$$\sigma_{\min} = 0 \text{ (compressive)}$$

Maximum shear stress at A

$$\begin{aligned} \tau_{\max} &= \frac{\sigma_{\max}}{2} \\ &= \frac{151.927}{2} \\ \tau_{\max} &= 75.96 \frac{\text{N}}{\text{mm}^2} \end{aligned}$$

Now, considering at point B,

$$\begin{aligned} \sigma &= \sigma_1 - \sigma_2 \\ &= -2.09 \times 10^{-3} - 151.93 \\ &= -151.927 \text{ (tensile)}. \end{aligned}$$

Maximum normal stress at B

$$\sigma_{\max} = 0 \text{ (tensile)}$$

Minimum normal stress at A

$$\sigma_{\min} = 151.927 \text{ N/mm}^2 \text{ (compressive)}$$

Maximum shear stress at B

$$\begin{aligned} \tau_{\max} &= \frac{\sigma_{\max}}{2} \\ &= \frac{-151.927}{2} \\ \tau_{\max} &= -75.96 \text{ N/mm}^2 \end{aligned}$$

Hook's law states that stress is directly proportional to strain

$$E = \frac{\sigma}{\epsilon}$$

From DHB the material properties of mild steel where E (young's modulus)=210Gpa

$$\begin{aligned} \epsilon &= \frac{\sigma}{E} \\ &= \frac{151.927}{210000} \\ \epsilon &= 0.0007234 \end{aligned}$$

We know that,

$$\begin{aligned} \epsilon &= \frac{\text{change in length}}{\text{original length}} \\ &= \frac{\Delta l}{l} \\ \Delta l &= \epsilon \times l \end{aligned}$$

## Results and discussions

### Performance evaluation

#### Abstract

To determine the efficiency of two stroke Bajaj Re auto rickshaw engine with help of brake drum dynamometer.

#### Introduction

A two stroke petrol engine performs only two strokes to complete one working cycle this works on theoretically Otto cycle it consists of a cylinder with one end fitted with the cover ,on the other end it is fitted with a sealed crank case3 so that it can function as a pump in conjunction with piston two openings known as inlet port and exhaust port are provided in below and on circumference of cylinder. The lower one adjusts the petrol engine and air mixture in the crank case and through upper one spent gases are expelled out of cylinder.

A transfer of the port provided diametrically opposite to the exhaust port. Serves as passage for the transfer of petrol and mixture from crankcase to cylinder

#### First stroke

At the beginning piston is at lower end spark plug initiates the compressed petrol and air mixture. The combustion of petrol will release the hot gases which increases the pressure to the cylinder.

#### Second stroke

In this stroke piston ascends when it covers the transfer port the supply of petrol and air mixture is cut off and when it further moves upward covers the exhaust port.

#### Methodology

- First check fuel level in the tank if necessary fill it.
- Start the engine and keep the rpm as constant for desired rpm.
- Apply the load on the engine and set the rpm to the initial level speed.

- Now measure the fuel consumption for 10cc speed and spring balance volume
- Repeat the same for different loads and calculate the efficiencies.

**Technical specifications**

DIAMETER OF BORE (D)	57MM
STROKE LENGTH (L)	57MM
COMPRESSION RATIO	0.7:1
NUMBER OF CYLINDERS	1
RATED SPEED	5200
RADIUS OF BRAKE DRUM	0.125M
CALORIFIC VALUE OF FUEL (Cv)	48070 KJ/KG
DENSITY OF PETROL	720 KG/M <sup>3</sup>
SPECIFIC GRAVITY OF OIL	0.72

**Table 3, shows technical specifications of engine used in NCET kisan all in one.**

**Formulas**

$S = S_1 - S_2 =$  load acting on a brake drum in kg's.

Where  $S_1$  and  $S_2$  are spring balance reading in kg's

$t =$  time taken to consume 10cc of petrol in seconds

$m_f =$  mass of fuel consumed 10cc of petrol in seconds

$v_f =$  volume of petrol consumed in m<sup>3</sup>/sec

$h_w =$  monometer reading in m of H<sub>2</sub>O

$N_e =$  speed of engine

$N_b =$  speed of brake drum =  $N_e / G.R$

$m_f = v_f * S_g * 1000 / 10^6 * t$

$T =$  torque =  $S * D_b * 9.81 / 2$  in Nm

$D_b =$  dia of brake drum

BSFC = brake specific fuel consumption in kJ/kw hr

$N_{bt} = BP * 100 / m_f * C_v$

BSFC =  $m_f * 3600 / B_p$  in kg/kw hr

$N_v = V_a / V_s$

Where  $V_a =$  actual volume of air supplied

$V_s =$  stroke volume

$V_a = C_d * a_o \sqrt{2000 * g * h_w} / \rho_a$

$V_s = \pi * D^2 * L * N_e / 4 * 60$

$C_d$  of orifice = 0.62

Where  $D =$  dia of engine cylinder in m

$L =$  stroke length in m

$N_e =$  speed of engine

$\rho_a =$  atmosphere pressure =

$1.013 * 100 \text{ KN/m}^2$

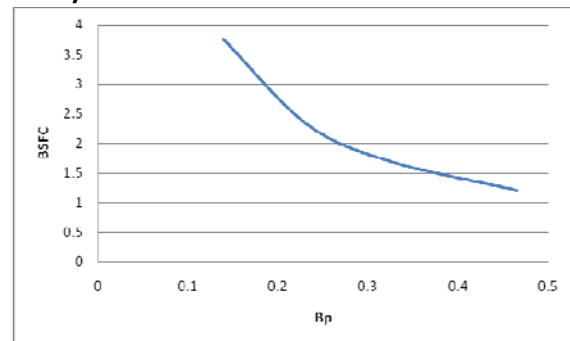
$T =$  room temperature in Kelvin

Air fuel ratio =  $m_a / m_f$

Where  $m_a =$  loss of air in kg/sec =  $v_a * \rho_a$

**Graphs**

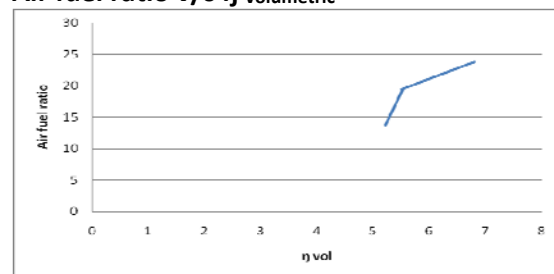
**BP v/s BSFC**



**Fig 6, graph of BP v/s BSFC**

The above graph shows as the brake power produce is increased the amount of fuel is consumption is less and vice versa.

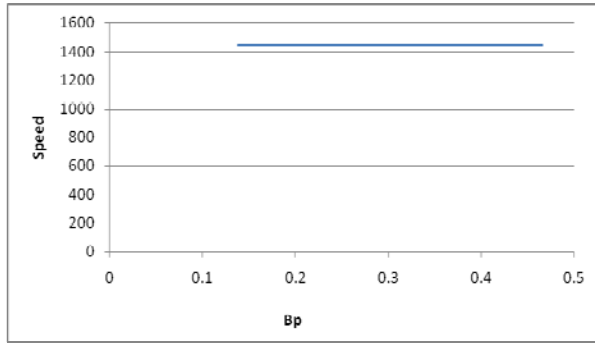
**Air fuel ratio v/s  $\eta_{volumetric}$**



**Fig 7, graph of Air fuel ratio v/s  $\eta_{volumetric}$**

The above graph shows that as air fuel ratio is increased the volumetric efficiency is also increased and vice versa

**Speed v/s BP**



**Fig 8, graph of speed v/s Bp**

Fig 6.3 shows the graph of speed v/s Bp where as the speed is increased relatively the Bp is also increased and the graph follows an straight line as shown the graph.

### 5.17 performance evaluation by field test

- Amount of fuel consumed per distance travelled (millage) = 25 km/ltr.
- Maximum speed of vehicle in up gradient = 28 km/hr
- Maximum speed of vehicle in down gradient = 44 km/hr
- Maximum speed of vehicle in level roads = 36 km/hr
- Gross weight of goods carrying container = 90 kg's
- Gross weight of ploughing assembly = 55 kg's
- Gross weight of inter-cultivator assembly = 25 kg's
- Gross weight of two engines = 46 kg's
- Gross weight of water pump assembly = 8 kg's
- Gross weight of ladder = 34 kg's
- Gross weight of vehicle body and other upholstery attachments = 90 kg's
- Gross weight of vehicle including all attachments = 348 kg's
- Net load can be carried through the vehicle (FOS 2) = 400 kg's
- Overall length of vehicle = 2948 mm
- Overall width of vehicle = 1550 mm

### Conclusion

The induced stress was  $\sigma$

$$= 151.927 \text{ (tensile)}$$

$$\text{The deformation } \Delta l = 2.6888 \text{ mm}$$

Hence, the allowable stress is 160 Mpa; since the induced stress is 151 Mpa the design is safe

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# PERFORMANCE OF MIMO-OFDM TRANSMISSION SYSTEM ON WIRELESS NETWORKS

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## Abstract

A detailed study of the performance of MIMO-OFDM transmission on WLAN physical layer specified in IEEE 802.11n, Wi-MAX (IEEE 802.16-2009) physical layer specified in 802.16 and LTE downlink physical channel (PDSCH) has been carried out using MATLAB Simulink. The WLAN and Wi-MAX system incorporates Convolution coding with 1/2 and 2/3 rated codes. The LTE incorporates Turbo coding with 1/2 and 2/3 rated codes. Orthogonal Frequency Division Multiple (OFDM) accesses uses adaptive modulation technique such as QPSK, 16-QAM and 64-QAM, on the physical layer of WLAN, Wi-MAX and LTE and the concept of cyclic prefix that adds additional bits at the transmitter end. The Error Rate (BER) derived from simulation results show that the implementation with interleaved Convolution coding and Turbo coding under QPSK modulation technique is found to be highly efficient for WLAN, Wi-MAX and LTE wireless network system. The Implementation of MIMO-OFDM multiplexing on WLAN networks with QPSK modulation at BER  $\sim 10^{-3}$  dB, exhibits significant improvement in SNR  $\sim 2.75$  dB, Wi-MAX network SNR  $\sim 3.75$  dB and LTE network SNR  $\sim 7.55$  dB. The improvement of SNR  $\sim 4.8$  dB displayed between the MIMO-

OFDM implementation on WLAN and LTE network can be attributed to the Turbo coding techniques adopted in LTE networks.

## Keywords

Multiple Input Multiple Output (MIMO), Orthogonal Frequency Division Multiplexing (OFDM), Phase Shift Keying (PSK), Quadrature Amplitude modulation (QAM), Bit Error Rate (BER), Signal to Noise Ratio (SNR), Line-of-Sight (LoS), Forward Error Correction (FEC), Wireless Local Area Network (WLAN), Worldwide interoperability for Microwave Access (Wi-MAX), Long Term Evaluation (LTE), Subscriber Station (SS), Base Station (BS).

## Introduction

In this new information age, high data rate and strong reliability features out wire-less communication systems and is becoming the dominant factor for a successful deployment of commercial networks. MIMO technology is one among being used in broadband systems that exhibit frequency-selective fading and Inter-Symbol Interference (ISI). MIMO system realize the spatial diversity and spatial multiplexing at the same time and consequently obtain both the spatial diversity gain and spatial multiplexing gain leading to an enormous capacity enlargement. The improvement can be even greater by

combination with other technology such as OFDM. Effectively, OFDM transforms a frequency selective channel into parallel flat-fading sub channels i.e., the signals on the subcarriers undergo narrowband fading. Hence by performing MIMO transmission and detection per subcarrier, MIMO can be applied in broadband communication. Multiple Input Multiple Output-Orthogonal Frequency Division Multiplexing (MIMO-OFDM), a new wireless broadband technology, has gained great popularity for its capability of high rate transmission and its robustness against multi-path fading and other channel impairments [14]. In radio, MIMO is the use of multiple antennas at both the transmitter and receiver to improve communication performance. It is one of several forms of smart antenna technology. MIMO technology has attracted attention in wireless communications, because it offers significant increases in data throughput and link range without additional bandwidth or increased transmit power. It achieves this goal by spreading the same total transmit power over the antennas to achieve an array gain that improves the spectral efficiency or to achieve a diversity gain that improves the link reliability and reduced fading. Because of these properties, MIMO is an important part of modern wireless communication standards such as IEEE 802.11n (Wi-Fi), 4G, 3GPP Long Term Evolution, Wi-MAX and HSPA+ [2].

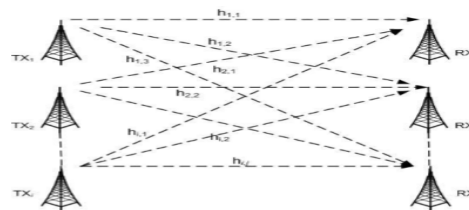
Conventional high-speed broadband solutions are based on wired-access technologies such as Digital Subscriber Line (DSL). This type of solution is difficult to deploy in remote rural areas, and furthermore it lacks support for terminal mobility. Mobile Broadband Wireless Access (BWA) offers a flexible and cost-effective solution to these problems. The goal of LTE was to increase the capacity and speed of wireless data networks using new DSP (digital signal processing) techniques and modulations that were developed around the turn of the millennium. A further goal was the redesign and simplification of the network architecture to an IP-based system with significantly reduced transfer latency compared to the 3G architecture. The LTE wireless interface is incompatible with 2G

and 3G networks, so that it must be operated on a separate wireless spectrum [19].

The present study involves implementation of MIMO system with OFDM multiplexing and modulation techniques for digital signal transmission on WLAN, Wi-MAX and LTE networks. For WLAN, IEEE 802.11n standard is considered, for Wi-MAX IEEE 802.16-2009 is considered. The performance of the WLAN, Wi-MAX and LTE combined with MIMO-OFDM is determined by computing the Signal to Noise Ratio (SNR), Bit Error Rate (BER) for a given data rate in a communication system using MATLAB Simulink.

## Multiple Input Multiple Output (MIMO)

The multiple input multiple output channel technology is aimed to increase the capacity in the wireless communication network. With the invention of MIMO, the technology seems to gain popularity as it is being implemented in the current commercial wireless products and networks such as broadband wireless access systems, Wi-MAX, 3G networks, etc. Figure 1 shows a line of sight (LOS) antenna setup of a MIMO system.



**Figure 1 A generalized MIMO wireless communication system**

The main idea behind MIMO is that, the sampled signals in spatial domain at both the transmitter and receiver end are combined so that they form effective multiple parallel spatial data streams which increase the data rate. The occurrence of diversity also improves the quality that is the bit-error rate of the communication [6, 13].

To derive the channel characteristics, MIMO system transmits specified and known training signals regularly from all transmitters of the system and these transmitted signals are

received at the receiver. Based on the received signals, the receiver calculates the characteristics of all channel paths from each transmitted antenna to each receiving antenna. In order to prove that MIMO work, the transmitted signal  $X$  has to be solved from the group of equations in equation (1), assuming that the system is noise free and line of sight (LOS). If the transmitted signal is represented to be  $X$ , the received signal  $Y$  and the channel characteristics matrix is  $W_c$ , then  $Y=X W_c$  ----- (1).

If the channel matrix has  $N$  rows as many as there are transmitting antennas with index  $i$ , then transmitted signal vector is written as  $X = [x_1, x_2, \dots, x_N]$ . Also if the channel matrix has  $M$  columns, as there are receiving antennas with index  $j$ , then the received signal vector is  $Y = [y_1, y_2, \dots, y_M]$ . These vectors are extended later to matrixes by inserting  $K$  samples into each column. The channel matrix contains path characteristics  $h_{ij}$  as

$$W_c = \begin{pmatrix} h_{1,1} & h_{1,2} & \dots & h_{1,M} \\ h_{2,1} & h_{2,2} & \dots & h_{2,M} \\ \vdots & \vdots & \ddots & \vdots \\ h_{N,1} & h_{N,2} & \dots & h_{N,M} \end{pmatrix}$$

### Orthogonal Frequency Division Multiplexing (OFDM)

OFDM is a Multi-Carrier Modulation technique in which a single high rate data-stream is divided into multiple low rate data-streams and is modulated using sub-carriers which are orthogonal to each other and can be thought of as a large number of low bit rate carriers transmitting in parallel. All these carriers transmitted using synchronized time and frequency, forming a single block of spectrum, to ensure that the orthogonal nature of the structure is maintained. As a modulation format, OFDM is very flexible in that it can be easily scaled to meet the needs of a particular application. For applications like VOFDM, the lack of ISI also greatly

simplifies the implementation of diversity reception. BWIF (uplink), 802.11a and Hyperlan/II are unique in that the OFDM is pulse modulated. While the specifics of BWIF are proprietary, the impact on WLAN products is the need for special synchronization techniques [5, 10].

### Implementation of MIMO-OFDM on WLAN Network (IEEE 802.11n)

The model shown in figure 2 represents an end-to-end baseband model of the physical layer of a WLAN according to the IEEE 802.11n standard. This model contains various components that model the essential features of the WLAN 802.11n standard. The top row of blocks contains the transmitter components while the bottom row contains the receiver components. The model supports data rates of 6, 9, 12, 18, 24, 36, 48, and 54 Mb/s. The model also illustrates adaptive modulation and coding over a dispersive multipath fading channel, whereby the simulation varies the data rate dynamically [9, 11].

Random binary data is generated by Random Integer block (variable rate data source). This randomly generated data is then modulated by modulator bank (QPSK, 16-QAM and 64-QAM modulations are incorporated). This modulated data is converted to OFDM symbols and again modulated by OFDM modulator. Pilot signals and training symbols (preambles) are used for time synchronization (to avoid ISI) and frequency synchronization (to avoid inter-carrier interference, ICI, caused by Doppler shift). Zero padding blocks append zeros to the specified dimension if it is not available at the input of IFFT block. The cyclic prefix, which is transmitted during the guard interval, consists of the end of the OFDM symbol copied into the guard interval, and the guard interval is transmitted followed by the OFDM symbol. Ultimately it decides the number of subcarriers to be used [12, 15].

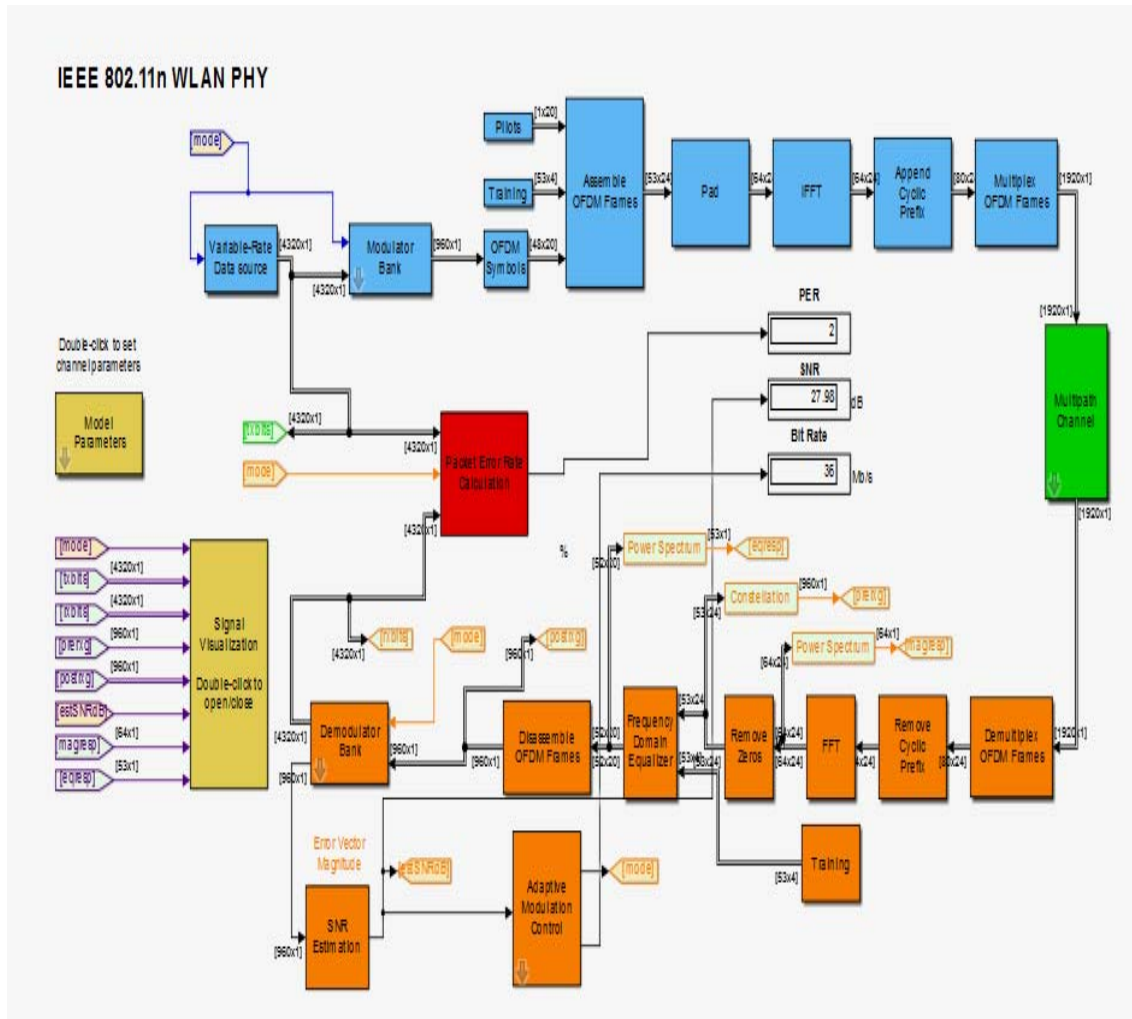


Figure 2 IEEE 802.11n WLAN PHY

Now OFDM frames are multiplexed and transmitted through the multipath channel. After passing through the channel the data first demultiplex the OFDM frames and then demodulated by the OFDM demodulator which consists of remove Cyclic Prefix, FFT, remove Zero Pad blocks in sequence. Cyclic prefix which is attached to OFDM signal

before transmission is to be removed by removing Cyclic Prefix block. Then FFT will process the data to get the data same as that of input given to the IFFT block. After this, zero padding is removed. Now demodulator is used to demodulate this data to obtain random binary data transmitted by the random integer generator block [18, 20].

### Implementation of MIMO-OFDM on Wi-MAX Network (IEEE 802.16-2009)



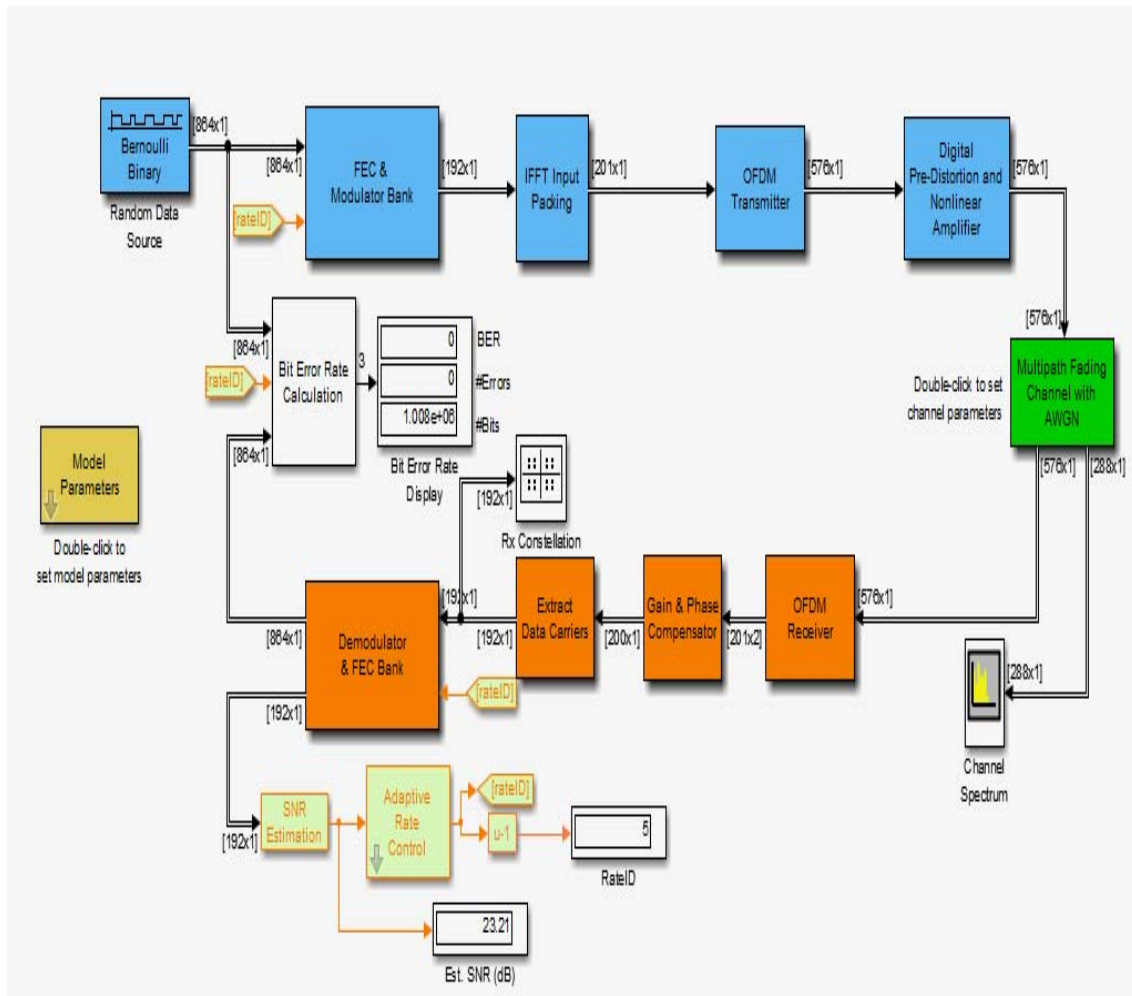


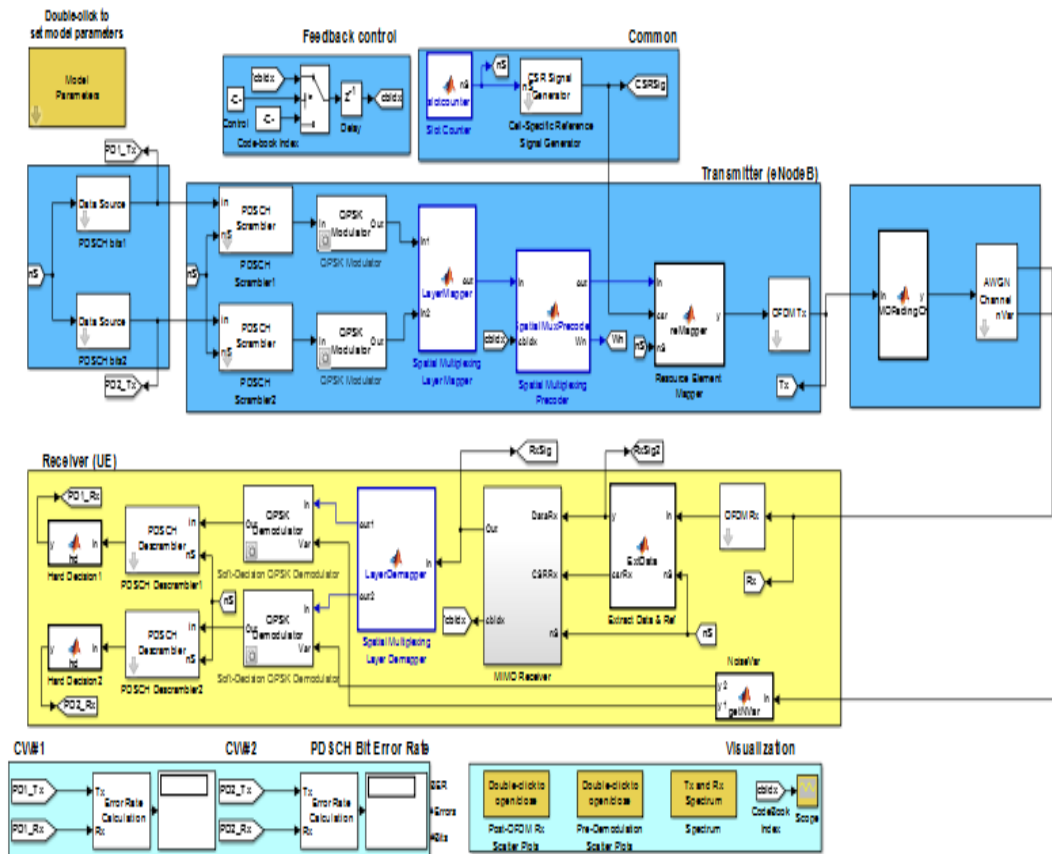
Figure 3 IEEE 802.16 Wi-MAX

### IEEE 802.16 Wi-MAX NETWORK

The simulation model shown in figure 3 is an end-to-end baseband model of the physical layer of a wireless metropolitan area network (Wi-MAX), according to the IEEE 802.16-2009 standard. More specifically, it models the OFDM-based physical layer, called Wireless MAN-OFDM, supporting all of the

mandatory coding and modulation options. It also illustrates Space-Time Block Coding (STBC), an optional transmit diversity scheme specified for use on the downlink. Finally, it illustrates the use of digital pre-distortion, a technique for extending the linear range of a nonlinear amplifier [1, 7, 17

### LTE Downlink Physical Channel (PDSCH) Processing



## Implementation of MIMO-OFDM on LTE Network

Figure 4 LTE Downlink Physical Channel

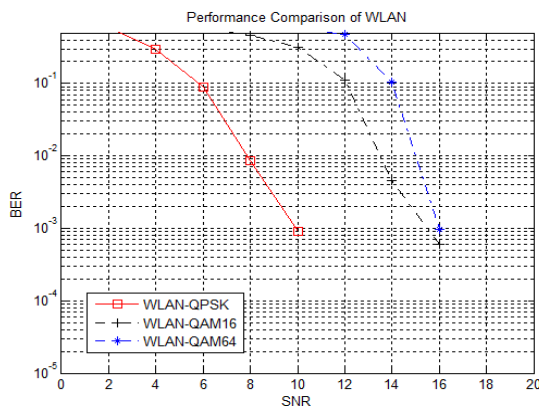
The simulation model of LTE is as shown in figure 4. A physical channel corresponds to a set of time-frequency resources used for transmission of a particular transport channel. The source data bits (transport channel encoded bits) are scrambled by a bit-level scrambling sequence. Downlink data modulation converts the scrambled bits into complex modulated symbols. The set of modulation schemes supported include QPSK, 16QAM and 64QAM, corresponding to two, four, and six bits per modulation symbol respectively. We can select the different modulation schemes using the PDSCH modulation type parameter in the

simulation. The LTE Encode function combines the transmit diversity layer mapping and precoding as per the LTE Standard. This function uses complex notation for signals and employs the OSTBC Encoder System to implement the space-frequency block coding specified for LTE. The complex-valued time-domain OFDM signal per antenna is generated from the fully populated resource grid, via using the OFDM Modulator System. The simulator uses the MIMO Channel to model the Rayleigh fading over multiple links. OFDM receiver undoes the unequal cyclic prefix lengths per OFDM symbol in a slot and converts back to the time-

and frequency-domain grid structure, using the OFDM Demodulator System. Channel Estimation when selected, employs least-squares estimation using averaging over a subframe for noise reduction for the reference signals, and linear interpolation over the subcarriers for the data elements. Transmit Diversity (TD) combining for the multiple transmitted signals are folded into the TD Combine function which, similar to the encoder, uses complex notation for signals and employs the OSTBC Combiner. The combined data stream is further demodulated and descrambled to get the received data bits [3, 19].

## Results and Discussions

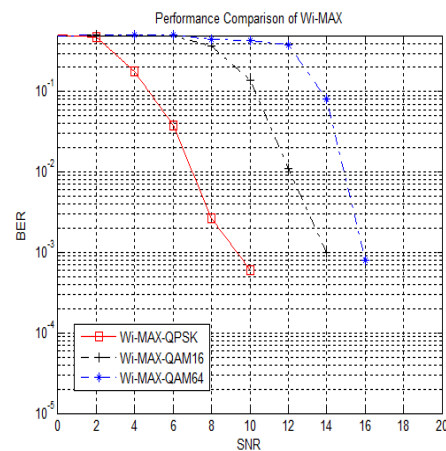
The simulation results of the performance of 2x2 MIMO-OFDM system on WLAN physical layer, Wi-MAX physical layer and LTE for different digital modulation techniques namely QPSK, 16-QAM and 64-QAM are derived using MATLAB Simulink. The BER values as a function of SNR are determined for WLAN network for different modulation schemes to study their relative performances with digital modulation. The SNR values are determined as a function of BER for QPSK, 16-QAM and 64-QAM modulation schemes. Figure 5 shows the BER performance of WLAN network derived as a function of SNR for 2x2 MIMO-OFDM multiplexing system for different modulation schemes.



**Figure 5 SNR Vs BER performance analysis on WLAN network for different modulation schemes**

It is evident in figure 5 that the BER values decrease as SNR increases for different modulation schemes. The figure indicates that implementation of MIMO-OFDM system on the WLAN network for QPSK modulation at BER  $\sim 10^{-3}$  dB, depicts an SNR  $\sim 10$  dB, 16-QAM modulation SNR  $\sim 15.5$  dB and 64-QAM modulation SNR  $\sim 16$  dB is achievable. The simulation results of 2x2 MIMO-OFDM system at BER  $\sim 10^{-3}$  dB for QPSK modulation, the SNR is found to be lowest  $\sim 10$  dB and between QPSK and 64-QAM modulation there is a large improvement in SNR  $\sim 6$  dB. The results suggest that, the 2x2 MIMO-OFDM implementation with QPSK modulation is very efficient on WLAN networks.

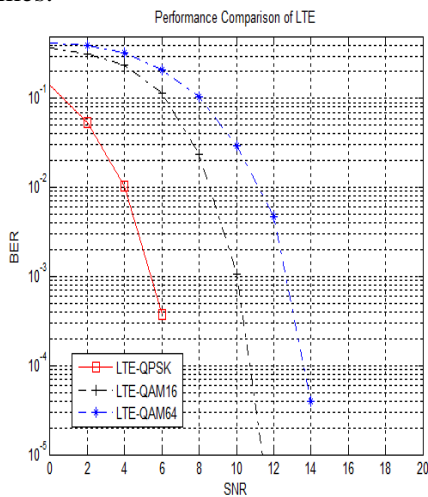
The BER values as a function of SNR are determined for Wi-MAX network for different modulation schemes to study their relative performances for digital modulation. The SNR values are determined as a function of BER for QPSK, 16-QAM and 64-QAM modulation schemes. Figure 6 shows the BER performance of Wi-MAX network derived as a function of SNR for 2x2 MIMO-OFDM multiplexing system for different modulation schemes.



**Figure 6 SNR Vs BER performance analysis on Wi-MAX network for different modulation schemes**

It can be seen in figure 6 that the BER values decreases as SNR increases for different modulation schemes. The figure indicates that for MIMO-OFDM system at BER  $\sim 10^{-3}$ , the Wi-MAX network depicts that for QPSK modulation SNR  $\sim 9.1$  dB, 16-QAM modulation SNR  $\sim 14$  dB and 64-QAM modulation SNR  $\sim 15.7$  dB is achievable. The simulation results of 2x2 MIMO-OFDM system at BER  $\sim 10^{-3}$  dB for QPSK modulation, the SNR is found to be lowest  $\sim 9.1$  dB and between QPSK and 64 QAM modulation there is a large improvement in SNR  $\sim 6.6$  dB. The results of the simulation studies suggest that, the 2x2 MIMO-OFDM implementation with QPSK modulation is more efficient on Wi-MAX networks.

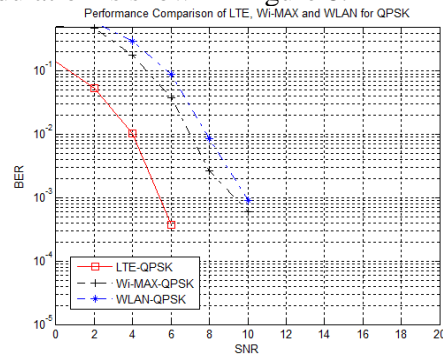
The BER values as a function of SNR are determined for LTE network for different modulation schemes to study their relative performances for digital modulation. The SNR values are determined as a function of BER for QPSK, 16-QAM and 64-QAM modulation schemes. Figure 7 shows the BER performance of LTE network derived as a function of SNR for 2x2 MIMO-OFDM multiplexing system for different modulation schemes.



**Figure 7 SNR Vs BER performance analysis on Wi-MAX network for different modulation schemes**

It can be seen in figure 7 shows that the BER values decreases as SNR increases for different modulation schemes. The figure indicates that for MIMO-OFDM system at BER  $\sim 10^{-3}$  dB, the Wi-MAX network depicts that for QPSK modulation SNR  $\sim 5.2$  dB, 16-QAM modulation SNR  $\sim 10$  dB and 64-QAM modulation SNR  $\sim 12.8$  dB achievable. The simulation results of 2x2 MIMO-OFDM system at BER  $\sim 10^{-3}$  dB for QPSK modulation, the SNR is found to be lowest  $\sim 5.2$  dB and between QPSK and 64-QAM modulation, there is a large improvement in SNR  $\sim 7.6$  dB. The results of the analysis suggest that, the 2x2 MIMO-OFDM implementation with QPSK modulation is very efficient on LTE networks.

A detailed comparison of the SNR performance of 2x2 MIMO-OFDM system implementation on WLAN, Wi-MAX and LTE networks as a function of BER for QPSK modulation is shown in figure 8.



**Figure 8 SNR Vs BER performance analysis for QPSK on different networks**

It is evident from figure 8 that the BER values decreases as SNR increases for all the three networks. The figure indicates that at BER  $\sim 10^{-3}$  dB, the WLAN shows that the SNR  $\sim 10$  dB, Wi-MAX shows SNR  $\sim 9.1$  dB and LTE shows the SNR  $\sim 5.2$  dB are achievable for QPSK modulation. Further the figure shows that there is a large improvement in SNR  $\sim 4.8$  dB between WLAN to LTE networks. The

SNR values are being lowest ~5.2 dB for 2x2 MIMO-OFDM system implemented on LTE network suggest that, the LTE networks are most efficient for MIMO-OFDM implementation with QPSK modulation.

The SNR performance of 2x2 MIMO-OFDM without and with implementation on the WLAN. Wi-MAX and LTE networks for QPSK modulation at BER  $\sim 10^{-3}$  dB has been compared in table 1

**Table-1- Comparison of MIMO Systems with and without implementation network, SNR Values for QPSK modulation technique for BER  $\sim 10^{-3}$  dB**

NETWORK	WLAN SNR(dB)	Wi-MAX SNR(dB)	LTE SNR(dB)
WITHOUT MIMO-OFDM ON NETWORK IMPLEMENTATION	12.75	12.75	12.75
WITH MIMO-OFDM ON	10	9.1	5.2
DIFFERENCE	2.75	3.75	7.55

It is clearly evident from the Table 1 that at BER  $\sim 10^{-3}$  dB the simulation results show that implementation of MIMO-OFDM transmission on WLAN networks for QPSK modulation there is significant improvement in SNR  $\sim 2.75$  dB. Similarly the implementation on Wi-MAX networks shows an improvement in SNR  $\sim 3.65$  dB. The implementation on LTE networks shows an improvement in SNR  $\sim 7.55$  dB. The result of the analysis indicates that the 2x2 MIMO-OFDM system implementation on WLAN, Wi-MAX and LTE networks offers better SNR performance for higher data rate transmission.

The SNR values derived at BER  $\sim 10^{-3}$  dB for the 2x2 MIMO-OFDM implementation on

the WLAN, Wi-MAX and LTE networks for different coding schemes and modulation techniques are summarized in table 2.

**Table-2 Comparison of SNR values for WLAN, Wi-MAX and LTE for different modulation techniques at BER  $\sim 10^{-3}$**

CODING TECHNIQUE USED	NETWORKS / MODULATION	QPSK SNR (dB)	16-QAM SNR (dB)	64-QAM SNR (dB)
Convolution coding	WLAN (IEEE 802.11n)	10	15.5	16
Reed-Solomon with Convolution coding	Wi-MAX (IEEE 802.16-2009)	9.1	14	15.7
Turbo coding	LTE	5.2	10	12.8

It is clearly evident from the Table 2 that at BER  $\sim 10^{-3}$  dB, the SNR values increase with increasing modulation from QPSK to 64-QAM modulation are consistent with theoretical considerations. Further the table shows that implementation of the MIMO-OFDM transmission on LTE networks for QPSK modulation shows lowest SNR  $\sim 5.2$  dB compared to other networks. The LTE implementation of MIMO-OFDM network indicates a large improvement in SNR  $\sim 4.8$  dB compared to WLAN network. The MIMO-OFDM implementation on the three networks indicates that the SNR values are very sensitive to the coding techniques. The lowest SNR  $\sim 5.2$  dB values and the better SNR performance displayed by LTE network compared to WLAN and Wi-MAX networks can be attributed to the efficient Turbo coding schemes adopted by LTE networks.

## Conclusions

It can be concluded from the results presented that,

1. The simulation results of MIMO-OFDM implementation on network indicates that the SNR at BER  $10^{-3}$  dB increases from QPSK to 64-QAM modulation in accordance with the modulation theory. The results depicts that QPSK modulation exhibits lowest SNR values.
2. The MIMO-OFDM system implementation on WLAN network for QPSK modulation shows that at BER  $\sim 10^{-3}$ dB, the lowest SNR values  $\sim 10$  dB and improvement in SNR  $\sim 2.75$  dB.
3. The MIMO-OFDM system implementation on Wi-MAX network for QPSK modulation show that at BER  $\sim 10^{-3}$ dB, the lowest SNR values  $\sim 9.1$  dB and improvement in SNR  $\sim 3.65$  dB.
4. The MIMO-OFDM system implementation on LTE network for QPSK modulation shows that at BER  $\sim 10^{-3}$ dB, the lowest SNR values  $\sim 5.2$  dB and improvement in SNR  $\sim 7.55$  dB.
5. The implementation of 2x2 MIMO system on LTE networks QPSK modulation at BER  $10^{-3}$ dB shows an improvement of SNR  $\sim 4.8$  dB compared to WLAN networks.
6. The larger improvement seen in SNR  $\sim 4.8$  dB for LTE networks can be attributed to the Turbo coding adopted in LTE networks.

### Acknowledgement

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## URBAN FLOOD MONITORING AND MANAGEMENT

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### Introduction:

Increase in urbanization leading to climate changes and human activities have resulted in flash flood scenarios and high intensity rainfalls in the city. Recent calamitous floods have spawn way for many Flood management projects aiming towards development of stronger flood monitoring and smarter flood protection systems.

### Study area

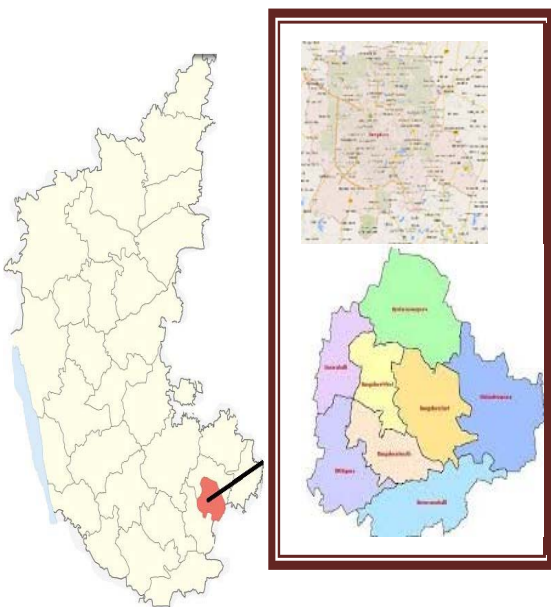


Fig no: 1-Study area

Bangalore is located in the south east region and meteorologically it is a part of south interior Karnataka it is almost equidistant from both the

eastern and western coasts of the South Indian peninsula. It has 12.591North latitude &

77.571East longitude. It has an altitude 920m above sea level .The mean annual rainfall is about 975 mm with about 60 rainy days a year. It is located 100 km from the Kaveri River. No major perennial rivers run through the city, though the Arkavathi and South Pennar cross paths at the Nandi Hills, 60 km (37 mi.) to the north. River Vrishabhavathi, a minor tributary of the Arkavathi, arises within the western part of the city flows through the city. The rivers Arkavathi and Vrishabhavathi together carry much of Bangalore's sewage. A sewerage system, constructed in 1922, covers 215 km<sup>2</sup> (133 mi<sup>2</sup>) of the city and connects with five sewage treatment centers located in the periphery of Bangalore.

The Bangalore Corporation is called the BBMP ( Bruhat Benagalooru Mahanagara Palika). The BBMP is divided in 8 zones i.e. North, East, and West, South, Bommanahalli, Mahadevpura, Rajarajeshwari Negara and Dasarahalli zone as shown in the figure:

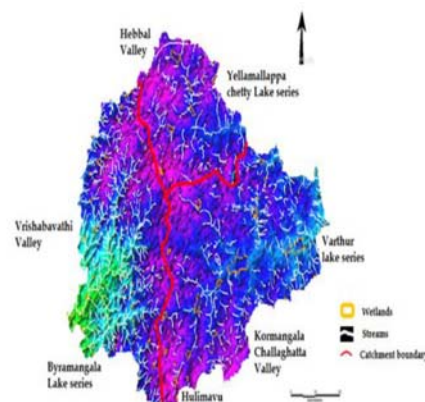


Fig no: 2 Map showing valleys of Bangalore



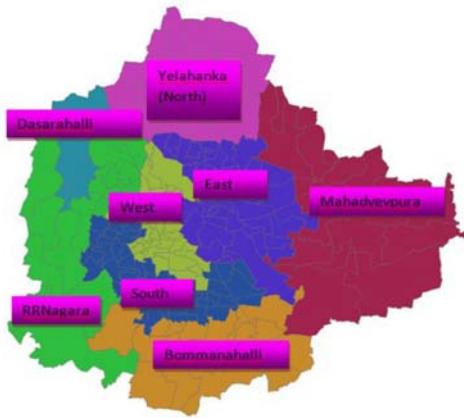


Fig no: 3 Map showing different Zones of Bangalore Storm water scenario  
The zones in core area are demarcated by natural topography into four major watersheds Catchment area namely

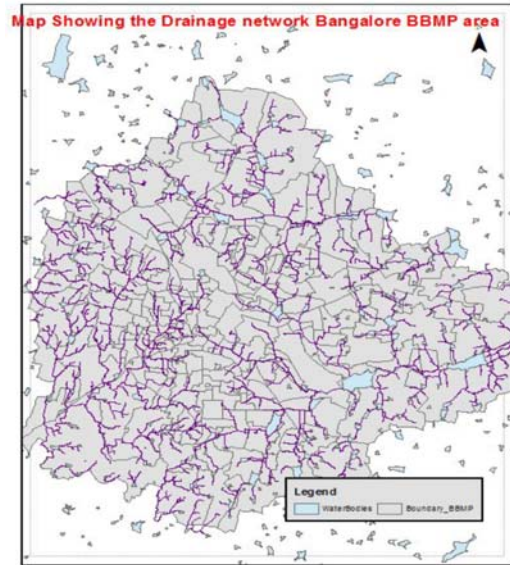


Fig no: 5 Drainage map of network of Bangalore

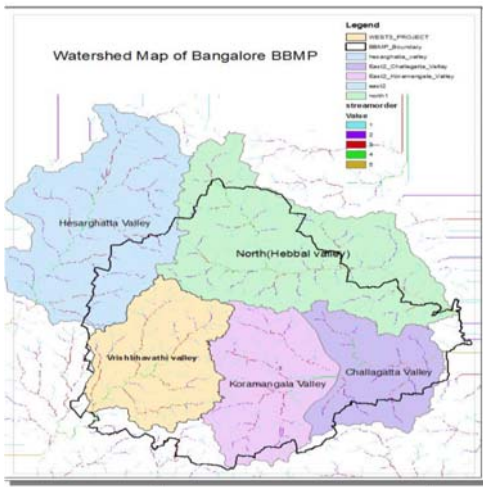


Fig No: 4 watersheds of Bangalore

Vrishabhavathi valley catchment, Koramangala valley catchment, Challghatta valley and Hebbalvalley catchment .Three of the valleys Vrishbhavathi valley, Koramangala valley and Chellaghatta valley, run in north to south direction.

A fourth major valley, referred to as the Hebbal valley forms the drainage zone of the north of theridge and runs in the northern direction. As shownin Fig: 3:

**Drainage network of Bangalore**

The drainage system of Bangalore city comprises of 840 km length of Drainage network which includes primary and secondary drains. . The Drainage system has box type trench on either side of the road, these drains further connect to the secondary drains and then to the open channel drains lined with concrete retaining walls. According to survey done by the BBMP (Bangalore Mahanagara Palike), the average depth of the drainage system varies from 1.5 m to 5.8m and average width varies from 2 to 9m, however the larger drains have max width upto 48m.(source BBMP Master plan) (Ref:2)(fig no:4)

**Floods in Bangalore**

Since past few years during rainy seasons Bangalore city & its agglomerated ULB's areas are experiencing severe flooding problems at several locations resulting in submergence of low laying areas causing water stagnation at several locations, submergence of foot paths (restricting pedestrianmovements), and traffic hold ups for several hours,extensive damage to both life and property .This is mainly because of climate change and due to rapid urbanization. Growth of population in Bangalore during the last few decades has reached its peak.

There is an increase in the construction activities to meet the demands of the rising population.

The formation of tank beds into layouts, inadequate size of drains, increase in sewage generation, improper networking and maintenance of drains, dumping of garbage debris into drains, improper gradient, obstructions due to laying of utility lines/ across water ways, lack of awareness about importance of waterways, discharge of large quantity of sewage and industrial waste has led to this situation Fig no 7. Due to this the city is under extreme consequences during the time of heavy Rains



Plate 2.6: Flood plain encroachment (Source: BBWSII)  
**Fig No: 7 Encroached Drainages in Bangalore BBMP**

Bangalore often experiences short duration but high intensity rainfall incidents causing flash floods. In view of the above facts, It is hazardous for the social and environmental attributes of the city and the city is under serious threat. Management of Flood is the only solution.



### Urban Flood Management

The urban flood management system should be an integrated management system, in which proactive managerial strategies should be adopted. The proactive disaster management involves multidisciplinary agencies like the government, non-government private agencies. It also involves effort and time, Budget, equipment's, facilities and human resources. Strategic framework on integrated flood disaster management namely: 1) preparedness before flood impact such as flood forecasting and warning; 2) readiness upon flood arrival; 3) emergency responses during flood impact and; 4) recovery and rehabilitation after flood impact (Ref:1) should be practiced. The urban Flood management for Bangalore city is the responsibility of the Municipal Corporation. The Municipal Corporation of Bangalore is called the BBMP (Bruhat Bengaluru Mahanagara palike). The city also has many emergency departments which are of concern to the management of flood. For example Control rooms of BBMP, Fire services, the police; the city hosts many NGO like civil defense etc. All these departments can be integrated and involved to manage the floods in the city. Urban flood risk can be evaluated by understating the urban dynamics. In order to capture the dynamics of the varying climate, weather & rainfall a dense network of sensor suitable for the urban environment is needed. The urban flood monitoring has to rely on in situ monitoring. Various technologies like Remote sensing,

satellite imagery, fiber optic, sensors etc. are available which gives accurate near real time data.

We have initiated a project in association with civic authorities to monitor, model and forecast urban flooding for Bangalore. Rainfall is being monitored through 100 GPRS enabled Telemetric Rain Gauges at a density 1 to 4 sq km area in the city which is a unique model in the country. Meso-scale Rainfall forecast and high intensity and heavy rainfall alerts are being generated and sent at near-real time to the concerned authorities. Using rainfall Data and meso-scale forecast a Simple hydrological model for flood forecasting have already been developed and will be launched soon

*Variability of Climate and Rainfall in Bangalore region*

**Temperature increase**

Temperature data for last 40 years for a particular station in the central Bangalore (Ref :) is referred and the graph shows an increase in the temperature trend of the city. This along with other climatic factors has led what is called the Urban Heat Island effect .Ref fig no: 9

**Rainfall Variability**

Due to the increase in temperature and other anthropogenic activities high intensity short duration rains occur causing flash floods. Recently Bangalore has witnessed flash floods. The rainfall variability during the monsoon 2014 is plotted as shown fig no 8. The Max daily rainfall recorded is 140.5 on the 9 th Nov -2014 and the Average daily rainfall is recorded to be 62mm on that day.

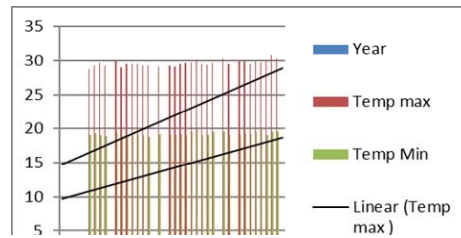


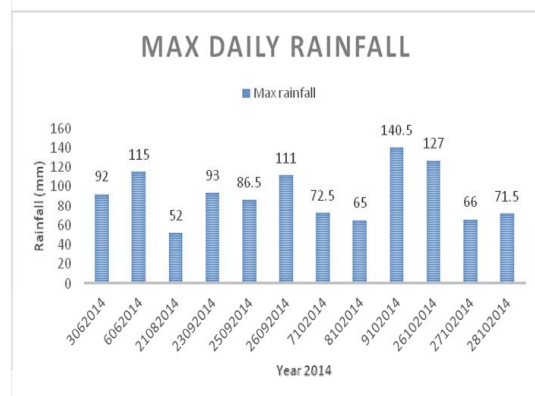
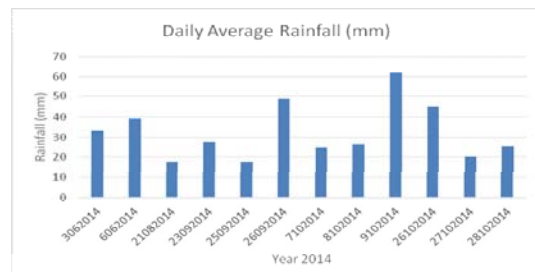
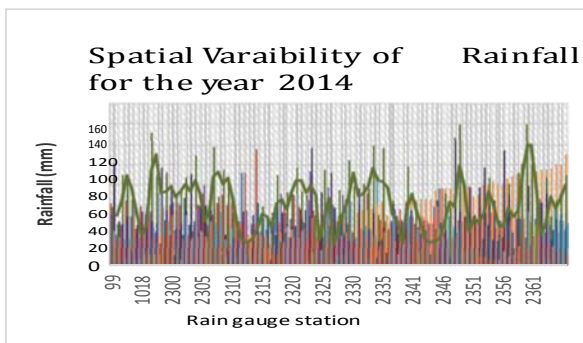
Fig no: 9 Graph indicating the temperature variability in

Bangalore BBMP during the year 1973-2014

Heavy Rainfall Case study for vrisbhavathi

Microwaterhsed

Heavy rains have struck bangalore during the month of November. The heavy rains were the effect of HUDHUD cyclone from the south east region. One such event study is made for the November 9 – 2014 rainfalls for the vrisbhavathi watershed region and the run off volume in the watershed is estimated. The vrisbhavathi watershed region consist of 9 rain gauges with the following charecteristics. (Table: no1) (Fig No: 9)



Sl.No	Name	Watershed Area	Length	No of
1	Vrishbhavathi Valley	34sq km	128km	191 nos

Drainage characteristic for vishbhavati vally as shown in the table no-2

The flooding in this region specially near the ghali anjaniya temple disrupted the life of southern Bangalore Fig. No-11

The study region is divided in to grids of 1sq. km. Thessian polygons are drown using the Arc Gis 10.1 and weightage average is calculated. The % previous and imperviouness is obtained from the LULC using the GIS Software. Volume of water in each grid is estimated and runoff volue is calculated. By using the rational formula the velocity of flow is also estimated.

**Fig no: 11 Ghali Anjaneya temple flooded on Nov 9<sup>th</sup> -2014**



Sl.No	Length	Avg depth of drain	Avg width of drain	Total carrying capacity of the drains
1	128km	2.21m	8.48m	724364.026cubicmtr



**Fig no: 9 Graph indicating Max Daily rain fall year-2014**

Fig: No 10 Map showing the Vrishbhavathi valley drainage network and rain gauge locations with

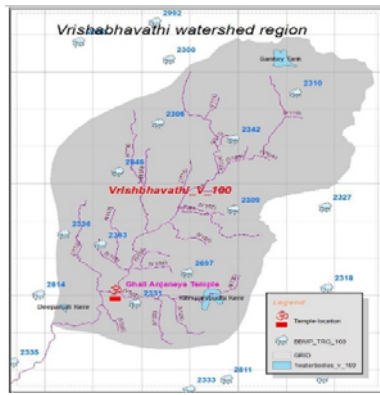


Table no: 3 showing the Runoff calculations for the Nov 9th 2014 Rains in Bangalore

Low laying	Rain	Drain id	Volume (M3)grid	%impervio US	Run off co- efficient	Run off Volume( M3)	Carrying capacity(S WD)	Chec k flood	0 (m3/SE C)	V M/SE C
	89		1143.370915	97	0.915957	1047.2791	16382.61707	FALSE		
	89	V121,V122	4162.113416	98	0.925664	3852.71737	2849.461074	TRUE		
Ranganaa circle BHEL Road	89	V100	11606.0954	94	0.891022	10341.2896	46877.17386	FALSE		
	89	V100 ,V101	22350.25648	98	0.934601	20888.5626	57248.59188	FALSE		
	89	V102, V121 , V122	21827.22931	97	0.92107	20104.4147	44438.90288	FALSE		
	161	V119	26317.89626	97	0.916146	24111.031	2156.001269	TRUE		
Vital nagar near kempegaow da nagar	229.5	V102,V103,V104,V117, V118	73314.47546	97	0.918239	67320.188	81437.72687	FALSE		
Rudrappa garden sambrudhi nagar	89	V103, V104	22599.62739	89	0.839317	18968.2436	8818.998666	TRUE		
Metro layout ward no 131 near Nayand	20.5	V119	3717.251674	98	0.933095	3468.54868	6925.798639	FALSE		
	140.5	V100, V117,V118	57275.63357	95	0.903757	51763.2677	80714.31245	FALSE		
	140.5	V100, V104, V105, V116	40761.17438	95	0.897166	36569.5474	47058.51187	FALSE		
	57	V105, V106	13777.38718	97	0.915418	12612.0664	7969.59843	TRUE		
Bhakshi garden	57	V106	6040.071449	100	0.948547	5729.2887	3478.665276	TRUE		
	20.5	V119	3575.217945	98	0.928182	3318.45229	4475.181073	FALSE		
	140.5	V116, V117	40683.63249	95	0.895245	36421.8168	4475.181073	TRUE		
12 <sup>th</sup> cross Gubana	57	0, V106,V107, V115,V116,V1	14119.85572	97	0.922142	13020.5144	4475.181073	TRUE		

**Urban Flood Monitoring And Management**

layout industrial area										
		100 ,V106, V107, V108, V108	13803.54456	99	0.940385	12980.6409	4475.181073	TRUE		
	57		6352.882615	100	0.95	6035.23848	4475.181073	TRUE		
	57	V116	13998.72962	94	0.8875	12423.8725	4475.181073	TRUE		
8 <sup>th</sup> cross 6 block sankrappa garden	57	V115,V116,V116A	14638.39782	97	0.920077	13468.4564	4475.181073	TRUE		
	57	V100,V111, V112, V115	15252.56063	98	0.928805	14166.6606	4475.181073	TRUE		
	57	V100 ,V109,V111	11587.10719	93	0.878112	10174.7731	4475.181073	TRUE		
	57	V206	2.418463837	96	0.908466	2.19709327	4475.181073	FALSE		
5 <sup>th</sup> main 8 <sup>th</sup> cross N.R Gardenchology	57	V116	24.53811737	97	0.918907	22.5482409	4475.181073	FALSE		
	57	V112	26.59779472	96	0.914355	24.319814	4475.181073	FALSE		
	57	V112,V113,V114	16054.18064	96	0.909654	14603.7525	4475.181073	TRUE		
	57	V100 ,V110, V111	14887.2962	96	0.908457	13524.468	4475.181073	TRUE		
	57	V110	11898.37102	86	0.806593	9597.14132	4475.181073	TRUE		
	57	V203	227.6165543	98	0.925207	210.592341	4475.181073	FALSE		
	57	V112	6833.766897	95	0.901735	6162.24365	4475.181073	TRUE		
	57	V112, V114	16123.19712	98	0.93367	15053.7382	4475.181073	TRUE		
	57	V100	8650.402232	97	0.921981	7975.5037	4475.181073	TRUE		
	57	V202	2.885945035	100	0.95	2.74164778	4475.181073	FALSE		
	57	H100	393.1733757				4475.181073	FALSE		
			<b>1073416.876</b>			<b>947040</b>	<b>500335.2</b>		<b>263.1</b>	<b>7.737</b>

The following was observed after the analysis

x Area of the watershed=34sq km

volume of water generated in the vrishbhavati watershed on nov 9<sup>th</sup> 2014=1073416.876 cubic mts

- x Runoff volume=947020.070 cubic mts/sec
- x Carrying capacity at point A=724364.026 cubic mtr
- x The runoff volume is more than 1.5 times the carrying capacity of the drain at the outlet.

### **Conclusion**

It is necessary to have a good monitoring system in order to have a good storm water management system. A Good early warning and alert system can be useful to predict floods. By using the data from the 100 telemetric rain gauges, the run off volume at the vrishbhavati vally is calculated and it is evident that the existing drainage network is not accommodative for the huge run off generated on the nov 9<sup>th</sup> 2014 heavy rains. Due to this the city life was distressed leading to great loss. Bangalore being susceptible to such situation a good storm water management practices is inevitable. Urban flooding is an upcoming problem and an integrated system with technology driven solution is the need of the decade.

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4. <http://www.tutiempo.net/>



## EFFECT ON PHYSICAL PROPERTIES OF MODIFIED BINDERS ON ADDITION OF WMA ADDITIVES

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**Abstract**— Binder properties plays an important role in the performance of bituminous mixes. In order to achieve higher performance under heavy axle loads and high temperature variations, use of modified binders in surface course (wearing courses) is now a day's very common practice on India highways. Bituminous mixes with modified binders demands normally 10-30°C higher production temperatures compared to that of mixes with neat binders. Warm Mix Asphalt (WMA) refers to the technologies that allow a 20°C to 50°C decrease in the production, placement and compaction temperatures of bituminous mixes with the help of organic additives, chemical additives or foaming processes.

This paper presents the results on the effect of addition of WMA additives on physical properties of modified binders. Two WMA additives viz. Sasobit® (an organic additive) and Evotherm J1 (chemical additive) are used in this study. Two modified binders; Crumb Rubber Modified Bitumen grade 55 (CRMB 55) and Polymer Modified Bitumen grade 70 (PMB 70) are used in this study. Physical properties of CRMB and PMB are evaluated on addition of different percentages of Sasobit® (1%, 2% and 3%) and Evotherm J1 (0.4%, 0.5% and 0.6%) by weight of binder. Physical characteristics of binder with and without WMA additives are evaluated in both un-aged and aged conditions. Results of this

study showed that the addition of Sasobit® and Evotherm J1 increases the aging resistance of binders.

**Keywords**— Modified Binders, WMA, Evotherm, Sasobit®

### I. Introduction

Hot mix asphalt (HMA) is most commonly used paving material from many decades. It is produced through a combination of aggregates which are uniformly mixed and coated with bitumen at around 150°C. These high production temperatures leads to high fuel consumption and emissions into atmosphere. For example, a typical drum mix plant having a production rate of 2 lakh tonnes of asphalt mix in a year would emit about 13 tons of carbon monoxide (CO), 5 tons of volatile organic compounds (VOC), 0.4 tons of sulphur oxides, 2.9 tons of nitrogen oxides and about 0.65 tons of total Hazardous Air Pollutants (HAP) during the same period [1].

Warm Mix Asphalt (WMA) refers to technologies that allow a reduction in mixing and compaction temperature of asphalt mixes either through lowering the viscosity of asphalt binders or by increasing the workability of a mix at lower temperatures [2]. The reductions in viscosity of binder or increase in workability of mix is achieved through the addition of different additives. With the WMA technologies, the production temperatures and fuel consumption



can be lowered by about 20 to 30% respectively in comparison to HMA [3, 4, and 5]. In addition to energy savings, WMA also offers other following advantages such as; late season paving or extended paving season, better workability and compaction, increased usage of Reclaimed Asphalt Pavement (RAP), improved working conditions, and decreased aging of binder [6].

Since WMA technologies are newly introduced in India, a continuous research is under progress to examine the effect of WMA technologies or additives on performance of different binders and mixes used in India.

Sasobit is a paraffin wax that is obtained in the coal gasification process using the Fischer-Tropsch (FT) process. It has a long chemical chain length of 40-115 carbon atoms with a melting point of about 80 – 115°C, and is completely soluble at 120 °C. Addition of Sasobit® helps to reduce the viscosity of asphalt binder at temperatures greater than 120°C (above its melting point) [9, 10] and increases the viscosity of binder at mid-range temperature i.e. at 60°C (below its melting point) [8, 11]. At temperatures below its melting point, Sasobit forms a crystallization structure inside the binders which imparts stability to the binders [4]. Sasobit® improves adhesion characteristics of the binder [12] and helps to decrease the viscosity of the recycled binders and increases the rutting potential [2].

Evotherm is an additive, developed by MeadWestvaco Asphalt Innovations, USA. It includes a combination of emulsification agents, surfactants, polymers, and adhesion promoters to improve coating, workability, and compaction at lower temperatures [5]. It helps to reduce the internal friction between aggregate particles during the compaction of bituminous mix. Evotherm technology is delivered in three forms: Evotherm ET (Emulsion Technology), Evotherm DAT (Dispersed Asphalt Technology) and Evotherm 3G (Third Generation). In this study Evotherm J1, one form of Evotherm 3G is used.

**II. Experimental Plan**

Two modified asphalt binders viz. PMB 70 and CRMB 55 used in this study, are recommended in India, for regions having a maximum

atmospheric temperature of 35°C to 45°C and minimum pavement temperatures between 10°C to -10°C [13]. These binders were obtained from TikiTar Industries, Gujarat. Both PMB 70 and CRMB 55 were tested for their physical characteristics as per the IRC SP: 53-2002 specifications [13] and results are presented in Table 1.

Table 1. Physical Characteristics of PMB 70 and CRMB 55

Name of the test	Recommended values (IRC SP: 53 2002)		Results	
	PMB 70	CRMB 55	PMB 70	CRMB 55
Penetration at 25°C, 0.1 mm, 100g, 5sec.	50-90	Max. 60	54	50
Softening Point, (R&B), °C	Min.55	Min.55	62.1	59
Ductility at 27°C, cm	Min. 60	NA*	80.2	NA
Flash Point by COC, °C	Min.220	Min.220	314	274
Viscosity Test at 150°C, poise	2-6	NA	3.675	NA
Elastic Recovery of Half Thread in Ductilometer at 15°C, %	Min. 75	Min. 50	76	54
Separation Difference in Softening Point, Ring & Ball, °C,	Max 3	Max 4	1.5	0.6
Thin Film Oven Test (TFOT) Residue				
Loss in Weight, %, Maximum	1	NA	0.56	NA
Increase in Softening Point, R&B, °C	Max. 6	Max. 6	4.6	3.4
Reduction in penetration of Residue, at 25°C, %	Max. 35	NA	30.77	NA
Penetration at 25°C, 0.1 mm, 100g, 5sec, % of Original	NA	Min. 60	NA	60.1
Elastic Recovery of Half Thread in Ductilometer at 25°C, %.	Min. 50	Min. 35	68	51

NA\*: Not Applicable

Sasobit and Evotherm J1 are the two WMA additives used in this study. Sasobit® was

available in the form of pellets and Evotherm J1 (one form of 3G technology) was available in the form of thick viscous liquid. Three different percentages of Sasobit® (1%, 2%, and 3%) and Evotherm J1 (0.4%, 0.5%, and 0.6%) were used in this study. These percentages of WMA additives were selected for this study on manufacturer's recommendation. To prepare a homogenous blend of binders with WMA additives, a standard procedure was adopted. The binders were first preheated to a temperature around 120°C, thereafter the required dosages of WMA additives were added and mixed thoroughly for 15 minutes, using a mechanical stirrer. Different blends prepared were then tested for penetration, softening point, ductility, viscosity, and elastic recovery. These blends were also further subjected to short term aging through Rolling Thin Film Oven (RTFO) at  $163 \pm 0.5$  °C for 85 minutes. Aged samples from the RTFO were recovered and tested for penetration and softening point, to see the effect on aging characteristics of CRMB and PMB binders after the addition of Sasobit® and Evotherm J1.

#### A. Penetration Test

Penetration test was performed according to IS 1203. In this test, a needle of specified dimensions is allowed to penetrate into a bitumen sample, under a known load (100 g), at a fixed temperature of 25°C, for 5 seconds. The penetration is defined as the distance travelled by needle into the bitumen measured in one tenth of a millimetre (1/10 mm).

#### B. Softening Point Test

Softening point is a temperature at which a phase change occurs in the bitumen. In this test, a steel ball of 3.5 g is placed on a sample of bitumen contained in a brass ring and suspended in a water or glycerine. The bath temperature is raised by 5°C per minute and the bath temperature is recorded when the ball from a softened bitumen reaches 25 mm below the ring. This test was conducted according to IS 1205.

#### C. Viscosity Test

Viscosity is the property of bitumen by virtue of which it offers resistance to flow. This test was conducted using Brookfield Rotational Viscometer in accordance with ASTM D 4402-06. In this test, viscosity is measured by allowing a cylindrical spindle no. 21 to rotate at a constant speed (20RPM) submerged in a bitumen sample.

#### D. Ductility Test

Ductility of a bitumen sample is measured as the distance to which a standard briquette of bitumen can be stretched at specified speed (50mm/min) and standard temperature (27°C) before breaking. This test was performed according to IS 1208.

#### E. Elastic Recovery Test

The elastic recovery of a modified bitumen sample is measured by the percentage to which the bitumen sample will recover to its original length after application and release of stress. This test was performed according to IRC SP 53 2002.

#### F. Rolling Thin Film Oven Test

Rolling Thin Film Oven (RTFO) was used for short term aging of the bitumen samples. In this test, 35gm of binder is poured into the glass bottle and placed in a rack in the oven maintained at  $163 \pm 0.5$ °C. The rack is rotated on a horizontal axis for 85 mins. This test was conducted according to ASTM D2872.

### III. Results and Discussions

#### A. Physical Characteristics of Modified Binders with Sasobit® under Un-aged and Aged Conditions

Penetration values of different blends of PMB and CRMB with Sasobit® are shown in Fig. 1 and 2. Penetration values are found to decrease with the increase in the addition of Sasobit. The decrease in penetration values are maximum at the first percentage (1%) of Sasobit® in case of both CRMB and PMB. With higher concentrations of Sasobit® (i.e. 2% and 3%) the reduction in penetration values is less.

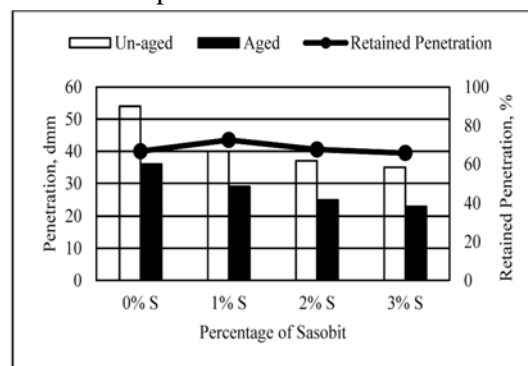


Fig. 1: Penetration v/s % of Sasobit® for PMB in un-aged & aged condition

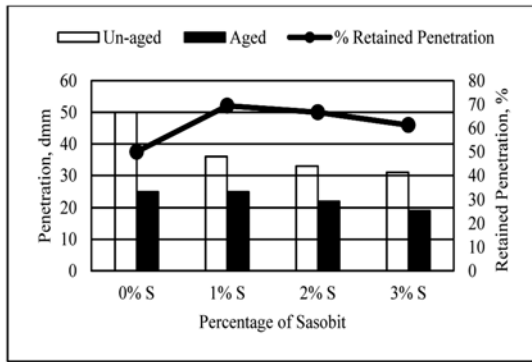


Fig. 2: Penetration v/s % of Sasobit® for CRMB in un-aged & aged condition

Modified binders blended with different percentages of WMA additives were also short term aged using RTFO at  $163 \pm 0.5$  °C for 85 minutes. Penetration values and percentage of retained penetration of different aged blends are also presented in Fig. 1 and 2. Percentage of retained penetration is calculated using the following equation;

$$\% \text{ Retained Penetration} = \frac{\text{Penetration value of Aged Binder}}{\text{Penetration Value of Unaged Binder}} \times 100 \quad (1)$$

Retained penetration values are higher for blends with WMA additive Sasobit® compared to that of neat binder, which shows that addition of Sasobit® increases the aging resistance of the binder. Retained penetration values shows a slight decrease with the increase in the Sasobit® percentage and are higher in case of CRMB binder compared to PMB binder.

Softening point values of different blends of PMB and CRMB with WMA additives under un-aged and aged conditions are presented in Fig. 3 and 4. Softening point values of modified binders increases with the addition of Sasobit®. An increase of about 21°C and 17°C is observed with the addition of 3% Sasobit® with CRMB and PMB binder respectively under un-aged condition. Increase in softening after aging of blends with PMB and Sasobit® is less compared to the increase in neat PMB binder.

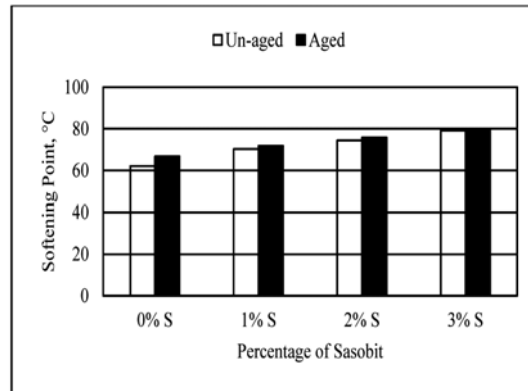


Fig. 3: Softening Point v/s % of Sasobit® for PMB 70 in un-aged & aged condition

Viscosity results of modified asphalt binders with Sasobit® obtained through Brookfield rotational viscometer at 150°C under un-aged conditions is shown in Fig. 5. Addition of Sasobit® reduces the viscosity of both the modified binders. Addition of Sasobit® helps to reduce the viscosity of asphalt binder at temperatures above its melting point (80-115°C). With the addition of 3% Sasobit®, a decrease of about 15-20% in viscosity values is observed in case of the two modified binders. The decrease in the viscosity of due to addition of Sasobit® is more in CRMB compared to PMB.

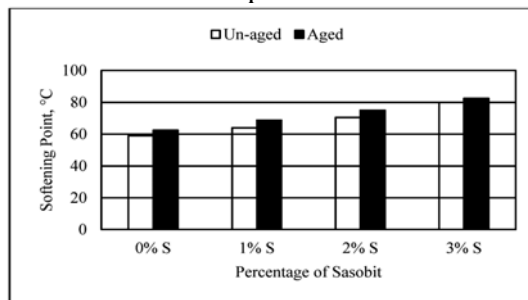


Fig. 4: Softening Point v/s % of Sasobit® for CRMB55 in unaged & aged condition

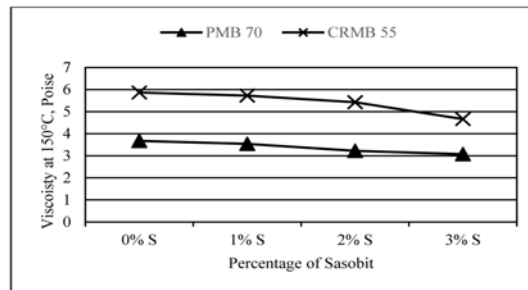


Fig. 5: Viscosity v/s % of Sasobit® for PMB 70 and CRMB 55

Table 2 presents the results of ductility and elastic recovery conducted on the modified binders with different percentages of Sasobit®.

Table 2: Ductility and Elastic Recovery of Warm Asphalt Binders

Binders	Percentage of Sasobit®	Ductility at 27°C	Elastic Recovery at 15°C
PMB 70	0	80.2	76
	1	68	68
	2	66	64
	3	60.1	60.1
CRMB 55	0	-	54
	1	-	50
	2	-	48
	3	-	42

Ductility test is not performed on CRMB as it is not required as per IRC SP 53 2002 Specifications. In case of PMB, ductility value decreases with the addition of Sasobit. Elastic recovery is also found to decrease in case of both PMB and CRMB binder with the addition of Sasobit®. Reduction in elastic recovery values is less in case of CRMB compared to that of PMB. Decrease in the ductility and elastic recovery values indicates an increase in the stiffness of the binder on addition of Sasobit® at ambient temperature.

Sasobit®, being an organic additive helps in reducing the viscosity of binder at temperatures greater than its melting point (80-115°C) and the same is observed from the viscosity results in case of PMB and CRMB. Addition of Sasobit® increases the stiffness of the binder below its melting point. The same trend is observed through penetration and softening point results.

**B. Physical Characteristics of Modified Binders with Evotherm under un-aged and aged Conditions**

Three percentages of WMA additive Evotherm J1 (0.4%, 0.5%, and 0.6%) are added to make blends with PMB and CRMB. Results of penetration values of un-aged and aged binders with different percentages of Evotherm J1 are shown in Fig. 6 and 7. Penetration values decrease with the addition of Evotherm J1. Reduction in the penetration values are maximum at first percentage of Evotherm J1 (0.4%).

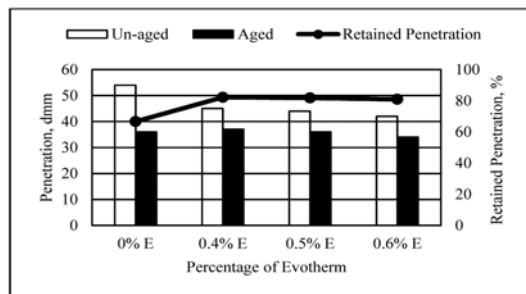


Fig. 6: Penetration v/s % EvothermJ1 for PMB 70 in un-aged & aged condition

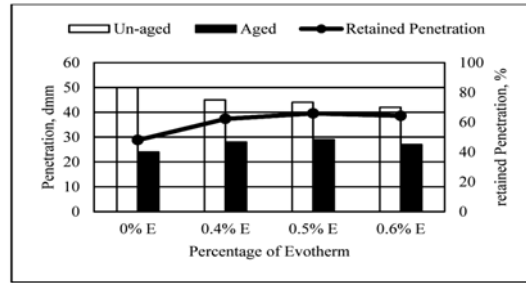


Fig. 7: Penetration v/s % EvothermJ1 for CRMB 55 in un-aged & aged condition

Retained penetration values of binders with EvothermJ1 are higher compared to the one without Evotherm J1 in case of with both CRMB and PMB. Increase in the concentration of the Evotherm J1 has negligible effect on the retained penetration values. Retained penetration values of blends with PMB are higher compared to CRMB.

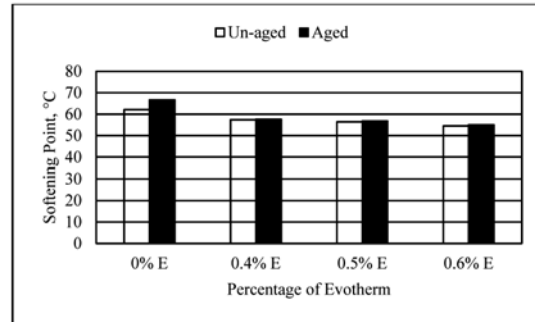


Fig. 8: Softening Point v/s % EvothermJ1 for PMB 70 in unaged & aged condition

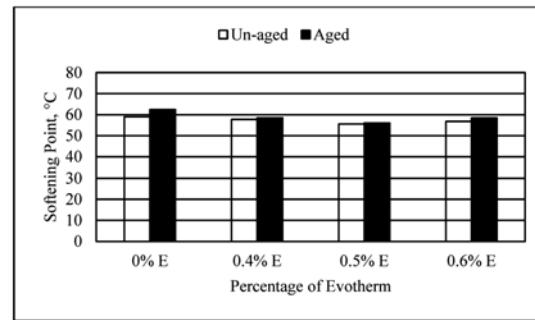


Fig. 9: Softening Point v/s % EvothermJ1 for CRMB 55 in unaged & aged condition

As seen from the softening test results presented in Fig. 8 and 9, there is no significant change on softening point of CRMB and PMB binders with the addition of Evotherm J1. A maximum decrease of 7.6°C and 2.2°C is observed in the softening point values of PMB 70 and CRMB 55 respectively, with the addition of 0.6% Evotherm J1.

Also there is no significant increase in the softening point value of aged blends with Evotherm J1. The increase in the softening point values are almost same (in between 0.25 to 0.5°C) with increase in the percentages of Evotherm J1 in case of PMB, whereas the increase in softening values does not show any trend with the increase in percentage of Evotherm J1 in case of CRMB.

There is a slight reduction in viscosity is observed on addition of Evotherm J1 with both PMB 70 and CRMB 55 and this decrease is higher in CRMB compared to PMB. A decrease of about 12% and 19 % in viscosity values is observed at 0.6% of Evotherm J1 in CRMB and PMB respectively.

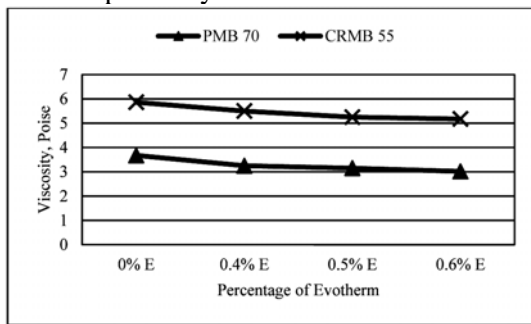


Fig. 10: Viscosity v/s % of EvothermJ1 for PMB 70 and CRMB 55

Ductility and elastic recovery of modified binders with different percentages of Evotherm J1 are presented in Table 3. Addition of Evotherm J1 makes the PMB more ductile whereas elastic recovery values for both the binders show a slight decrease with the increase in the percentage of Evotherm.

**Table 3:** Ductility and Elastic Recovery of binders containing Evotherm

Binders	Percentage of Evotherm	Ductility at 27°C	Elastic Recovery at 15°C
PMB 70	0	80.2	76
	0.4	100+	66
	0.5	97	67
	0.6	100+	63
CRMB 55	0	NA	54
	0.4	NA	51
	0.5	NA	46
	0.6	NA	48

Addition of Evotherm J1 did not show any significant effect on the penetration and softening point values of PMB and CRMB binder. However, the addition of Evotherm J1 has reduced the viscosity of the binder. Also, Evotherm J1, being a chemical additive, increases the workability of the binder at lower

temperatures through surface interaction between aggregates and binder.

#### IV. Conclusions

Physical properties of both PMB and CRMB with different WMA additives were tested and the following conclusions were drawn 6

Penetration values of both PMB and CRMB are found to decrease with the addition of Sasobit® and Evotherm J1. The reduction in penetration values with Sasobit® is found to be higher compared to that of Evotherm J1 in case of both binders.

Addition of Sasobit® has increased the softening point of PMB and CRMB. Addition of Evotherm J1 has slightly reduced the softening point of both binders.

Addition of Evotherm J1 (chemical additive) to PMB and CRMB did not show any significant effect on penetration and softening point.

Viscosity of both modified binders has reduced with the addition of Sasobit® and Evotherm J1. And, the decrease in the viscosity is found to be higher in case of CRMB compared to that of PMB.

Addition of WMA additives has reduced the elastic recovery values of both PMB and CRMB.

Ductility value of PMB has increased with the addition of Evotherm J1 and decreased with the addition of Sasobit®.

Addition of Sasobit® and Evotherm has increased the aging resistance of the binders.

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# UNDRAINED SHEAR STRENGTH OF COHESIVE SOILS AT CONSISTENCY LIMITS

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**Abstract**—Shear strength of cohesive soils at consistency limits is considered to be constant and various apparatus are designed based on this, for easy determination of consistency limits. But there is a significant difference in the shear strength values quoted by different researchers. This study mainly deals with the systematic approach of determining the undrained shear strength of cohesive soil at consistency limits. The density and shear strength variation of the soil with variation of water content between consistency limits has been evaluated. Based on which it is understood that the shear strength and density decreases with increase in water content of a soil-water mixture. The values of shear strength at consistency limits are observed to be within the range suggested in literature.

**Key words**— Consistency limits, Undrained shear strength, Vane shear test, Dry density

## I. Introduction

Consistency limits plays an important role in defining the behavior of cohesive soil. Efforts are made by various researchers to propose correlations between consistency limits and other index properties of soil [1, 2]. Researchers on other hand worked to device various instruments for easy and accurate determination of consistency limits. These instruments works based on the shear strength

of the soil at consistency limits. The undrained shear strength of soils at consistency limits plays a significant role in devising the mechanism of these instruments. But literature suggests a range of shear strengths 0.5-5.6 kPa and 20-320 kPa for soils at liquid limit and plastic limit respectively [3, 4, 5, 6]. An attempt is made in this study to determine exactly the shear strength of soil between consistency limits in a systematic manner.

## II. Materials and Methods

Two locally available cohesive soils having plasticity index 20 and 33 were selected for this study. The various geotechnical properties of selected soils are summarized in table 1 and the grain size distribution of the soils are depicted in figure 1. The undrained shear strength of these soil are determined using laboratory vane shear test as specified in [7]. A range of water contents is selected between the consistency limits (Liquid and Plastic limits) of the soil and is placed in a cylindrical mould of 38mm Ø x 76mm, with a small 1mm hole at its bottom.

TABLE 1. Various Geotechnical properties of selected soils.

Properties	Red soil	Black soil
Specific Gravity (G)	2.69	2.635
Hygroscopic Water Content (%)	5	12.5
Liquid limit (LL)	40	66
Plastic limit (PL)	20	33
Plasticity Index (%)	20	33

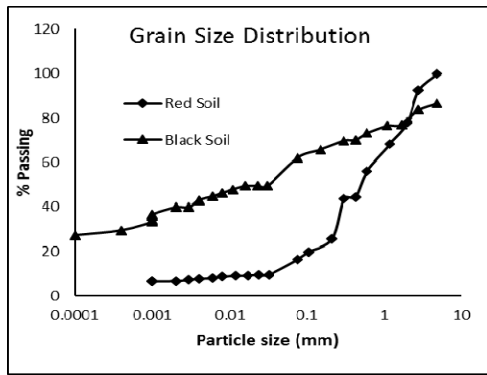


Figure 1. Grain size distribution of selected soils.

The soil mixed at selected water content is placed in three layers and every time it is tamped 25 times to remove air voids present in the soil, which creates a slight compactive effort that densifies the soil to an extent. This density mainly depends on the type of soil and has its effect on the strength characteristics determined using vane shear. Hereafter the variation in dry density is also considered significant in this study.

**III. Results and Discussion**

Figures 2 and 3 depict the variation of shear strength and bulk density of red soil respectively with variation of water content between consistency limits. Corresponding values are summarized in table 2. From figures, it can be observed that the shear strength and the bulk density decreases with increase in water content of the soil sample. Similar variations are observed in case of black soil as depicted in figures 4 and 5 and are summarized in table 3. Decrease in shear strength is obvious as the increased water has no resistance to shear force. And the decrease in density is a result of low specific gravity of high water content soil mixture. Similar results are observed in case of [8].

It can be observed that the shear strength of soils considered in this study, at liquid and plastic limit fall in the range of 0.5 – 5.6 kPa and from 20 – 320 kPa respectively as reported by [3, 4, 5, 6]. The variation of shear strength observed in figures 2 and 4 follows an exponential manner and the fitting the trend result in equation as shown in (1). Using this equation the strength of soil can be predicted at any water content between consistency limits. The values of shear strength, the constants of

exponential equation and accuracy of exponential fitting R2 are reported in table 4.

$$S_u = c \cdot w^m \tag{1}$$

where,  $S_u$  = undrained shear strength

$c$  &  $m$  = constants depending on soil type

$w$  = water content between consistency limits

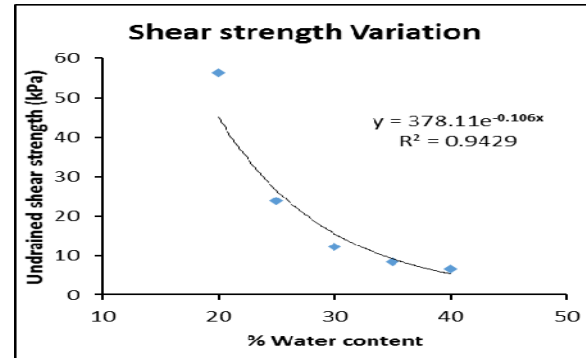


Figure 2. Shear strength variation of Red soil.

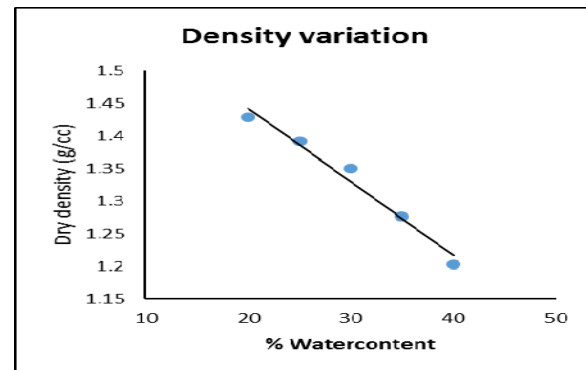


Figure 3. Density variation of Red soil.

TABLE 2. Summary of shear strength and density results of Red soil.

% Water content	Shear strength (kPa)	Dry density (g/cc)
20	56.291	1.429
25	23.932	1.391
30	12.152	1.351
35	8.477	1.276
40	6.6346	1.203



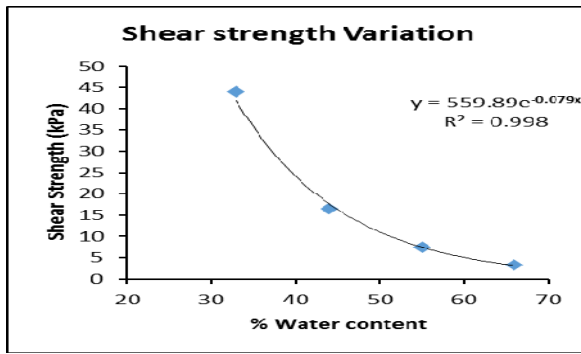


Figure 4. Shear strength variation of Black soil

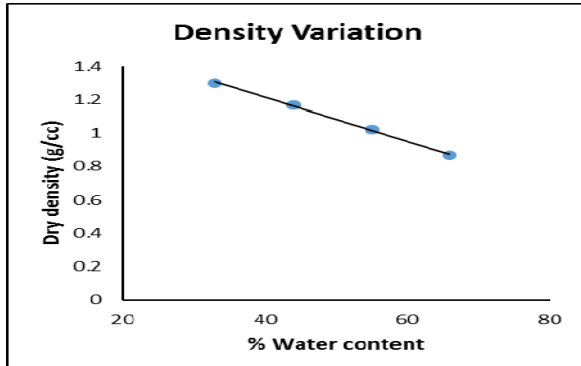


Figure 5. Shear strength variation of Black soil

TABLE 3. Summary of shear strength and density results of Black soil.

% Water content	Shear strength (kPa)	Dry density (g/cc)
33	43.97	1.3
44	16.5	1.17
55	7.46	1.022
66	3.22	0.867

TABLE 4. Summary of exponential fitting for shear strength variation

Soil type	S <sub>u</sub> Liquid limit (kPa)	S <sub>u</sub> Plastic limit (kPa)	constant 'c'	constant 'm'	R <sup>2</sup> value
Red soil	6.635	56.291	378.11	0.106	0.943
Black soil	3.220	43.970	559.89	0.079	0.998

### Conclusions

Within the limited work done in this study, the following conclusions are drawn:

- The shear strength of a given soil between consistency limits depends on soil type and lies in the limits as suggested in literature.
- The variation of shear strength of soil between consistency limits follow an exponential trend and corresponding fitting equation helps in estimating strength at any corresponding water content.

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## GPU - ACCELERATED PERSONALIZATION IN WEB USAGE MINING WITH NEURAL NETWORK ALGORITHM

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**Abstract—** This paper adopt the general purpose GPU parallel computing model and show how it can be leveraged to increase the accuracy and efficiency of personalized recommendation system to the web users. To illustrate the competence of the GP-GPU (General Purpose – Graphics Processing Unit) computing, Back propagations algorithm is implemented with CUDA (Compute Unified Device Architecture) for execution on a GPU device. The results indicate that the algorithm is markedly faster than the sequential algorithm and is not affected by the dimensionality of the web data being classified and well suited for high dimensional problems.

**Index Terms—**Back propagation algorithm, CUDA, GP-GPU, web usage mining.

### I. INTRODUCTION

Web users feel comfortable if they reached the desired web page within the minimum navigation on a web site. A study of Users' recent behavior on the web will be useful to predict their desired target page. Generally

Users' browsing patterns are stored in the web logs of a web server. These patterns are learned through the efficient algorithms to find the target page. Back propagation algorithm is implemented for learning the patterns. With learned knowledge various set of users' browsing patterns are tested. The results are observed and presented as an analysis on computational efforts of the algorithm. The analysis on the results proves the correctness of the algorithm. Still to improve the latency on learning, the algorithm is implemented with CUDA – MATLAB. Thus the BPA on GPU device leads to improved web usage mining than the numerous conventional methods.

#### A. Literature Review

Fran feinfube et al. [3] described the best practices of CPU– GPU algorithms. Jan Platos et al[4] described a document classification algorithm based on Particle Swarm Optimization with implementation of one and two GPUs. Mai Zheng et al. [5] proposed GMRace, a new mechanism for detecting races in GPU programs. GMRace combines static analysis with a carefully designed dynamic checker for logging and analyzing information at runtime. Pisit Makpaisit and Putchong Uthayopas [7] adopted the OpenACC standard

for directive-based approach and proposed some extension to support GPU cluster programming. The extensions are constructs and clauses used to define the memory distribution and dependency of tasks on cluster nodes. The framework and technique used to implement a source-to-source compiler to support the proposed constructs and clauses. Youngsok Kim et al. [8] proposed a novel GPU architecture to enable high-performance memory-unaware GPU programming. ScaleGPU uses GPU memory as a cache of CPU memory to provide programmers a view of CPU memory-sized programming space. ScaleGPU also achieves high performance by minimizing the amount of CPU-GPU data transfers and by utilizing the GPU memory's high bandwidth. Zhiguang Xu, [9] addressed the challenges using a biologically inspired computational model that imitates the flocking behavior of social animals (e.g. birds) and implement it in the form of parallel programs on the Graphics Processing Unit (GPU) based platform of CUDA from NVIDIA™.

## II. PROBLEM DEFINITION

The Users' browsing patterns are gathered from the web server and then extracts only the valid logs i.e., The logs that doesn't contain robots.txt, .jpg, .gif etc and unsuccessful request. These logs are codified with Meta data of the web site. Then the codified patterns are applied for preprocessing. The preprocessed data are fed to back propagation algorithm for training the usage patterns.

Machine learning theory based web usage mining assumes no statistical information about the web logs. This work falls under the category of supervised learning by employing two phase strategies such as a) Training phase b) Testing phase. In training phase, original logs are codified by simple substitution of unique page\_id instead of page name for all the successful html requests and are interpolate by preprocessing into polynomial vector. The n dimensional patterns are inner- product to

obtain 2 dimensional vectors which is trained by neural classifier to learn the nature of the logs. BPA takes the role of neural classifier in this work. By training the classifier for a specific users' logs a reasonably accurate suggestions can be derive. In testing phase, various users' logs are supplied to the trained classifier to decide which page-id is to be suggested. The flow charts of both phases are given in Figure1.a and Figure 1.b

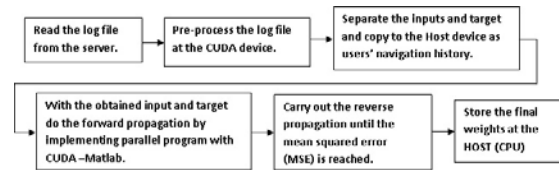


Figure1.a Training Phase

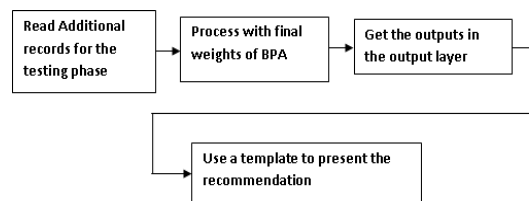


Figure1.b Testing Phase

## III. IMPLEMENTATION

The simulation of personalization through web usage mining has been implemented using MATLAB 2013. Sample sets of logs are taken from ProtechSC's web server. These logs are filtered and codified. Users' 50 days patterns have been collected. 25 patterns have been used for training and the remaining patterns used for testing.

### A. Filter the Log File

the web logs are collected from the web server of [www.protechsc.net](http://www.protechsc.net).

Sample web log file of this site is given in Fig.2

```

88.164.4.53 - [25/Jul/2014:11:28:28 +0530] "GET/images/banner_webhosting.jpg HTTP/1.1" 200 35367 http://my.
ntr.com/pages/ptocostest.php?b=ur-1&startpos=0 "Mozilla/5.0 (X11; U; Linux i686; fr; rv:1.9.2.6) Gecko/20100628 Ubuntu/10.04 (lucid)
Firefox/3.6.6"
66.249.71.171 - [25/Jul/2014:18:50:11 +530] "GET/robots.txt HTTP/1.1" 404 - " " Mozilla/5.0 (compatible; Googlebot/2.1;
+http://google.com/bot.html)
72.20.109.34 - [25/Jul/2014:21:43:07 +0530] "GET/index.html HTTP/1.1" 200 23061 " " Mozilla/5.0 (compatible; GurujiiBot/1.0;
+http://www.gurujii.com/en/WebmasterFAQ.html)
72.30.79.32 - [25/Jul/2014: 22:11:42 +0530] "GET/What_we_do.html HTTP/1.0" 200 20954 " " Mozilla/5.0 (Compatible; Yahoo!
Slurp/3.0; http://help.yahoo.com/help/us/ysearch/slurp)
72.20.109.34 - [25/Jul/2014:23:01:41 +530] "GET/robots.txt HTTP/1.1" 404 - " " Mozilla/5.0 (compatible; Googlebot/2.1;
+http://google.com/bot.html)
  
```

The Filtering Process as follows:

Step 1: Select the logs which don't contain

Robots.txt and request of image files.

Step2: Group by IP address of the logs

Step3: Codify the requested page with following information

Step4: Store only IP address, visited page-id into database and make use of it for the polynomial preprocessing.

### B.Back Propagation Algorithm

A neural network is constructed by highly interconnected processing units (nodes or neurons) which perform simple mathematical operations. Neural networks are characterized by their topologies, weight vectors and activation function which are used in the hidden layers and output layer. The topology refers to the number of hidden layers and connection between nodes in the hidden layers. The activation functions that can be used are sigmoid, hyperbolic tangent and sine. The network models can be static or dynamic. Static networks include single layer perceptrons and multilayer perceptrons. A perceptron or adaptive linear element (ADALINE) refers to a computing unit. This forms the basic building block for neural networks. The input to a perceptron is the summation of input pattern vectors by weight vectors. In most of the applications one hidden layer is sufficient. The activation function which is used to train the Artificial Neural Network is the sigmoid function.

#### 1) Training

1. Read log files and filter it
2. Separate the data into inputs and target
3. Preprocess the data to any NL
4. Calculate Principal Component Vector by  $Z=Z*Z^T$

(1)

Where, Z denotes the cleaned logs

5. Train the BPA.

#### 5.a Forward Propagation

- (i) The weights of the network are initialized.
- (ii) The inputs and outputs of a pattern are presented to the network
- (iii) The output of each node in the successive layers is calculated.

$$O(\text{output of a node}) = 1/(1+\exp(-W_{ij}X_j)) \quad (2)$$

- (iv) The error of a pattern is calculated  $E(p) = (1/2) (d(p)-o(p))^2$  (3)

#### 5.b Backward Propagation

- (i) The error for the nodes in the output layer is calculated

$$\delta(\text{output layer}) = o(1-o)(d-o) \quad (4)$$

- (ii) Weights between output layer and hidden layer are updated.

$$W(n+1) = W(n) + \eta\delta(\text{output layer}) o(\text{hidden layer}) \quad (5)$$

- (iii) The error for the nodes in the hidden layer is calculated.

$$\delta(\text{hidden layer}) = o(1-o)\delta(\text{output layer}) W(\text{updated weights between hidden and output layer}) \quad (6)$$

- (iv) The weights between hidden and input layer are updated

$$W(n+1) = W(n) + \eta\delta(\text{hidden layer}) o(\text{input layer}) \quad (7)$$

The above steps complete one weight updating. Second pattern is presented and the above steps are followed for the second weight updating. When all the training patterns are presented, a cycle of iteration or epoch is completed. The errors of all the training patterns are calculated and displayed on the monitor as the mean squared error (MSE).

#### 2) Testing

1. Read filtered logs and separate into inputs and target
2. Preprocess the data with a polynomial function
3. Process with final weights of BPA
4. Generate the suggestions from the output layer
5. Present the suggestions through templates

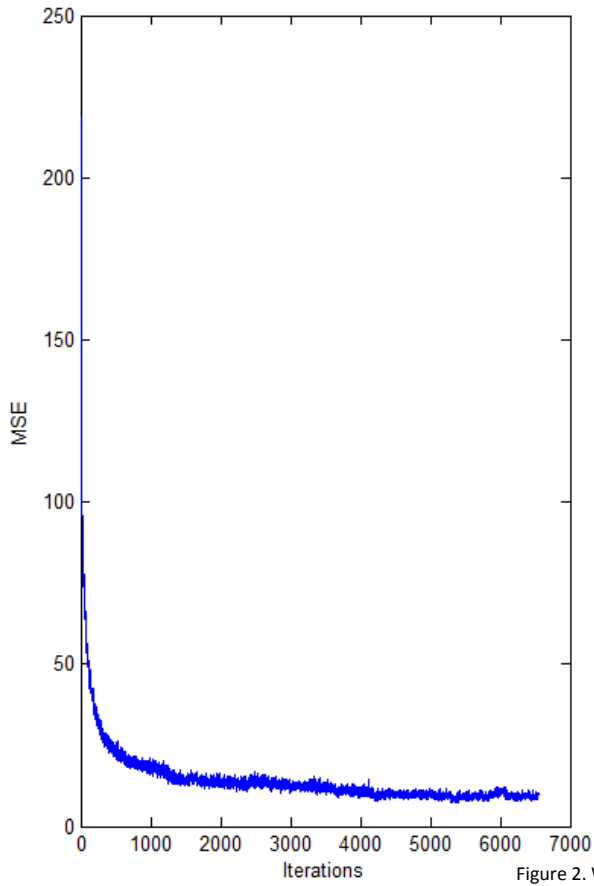


Figure 2. Web usage mining with CPU

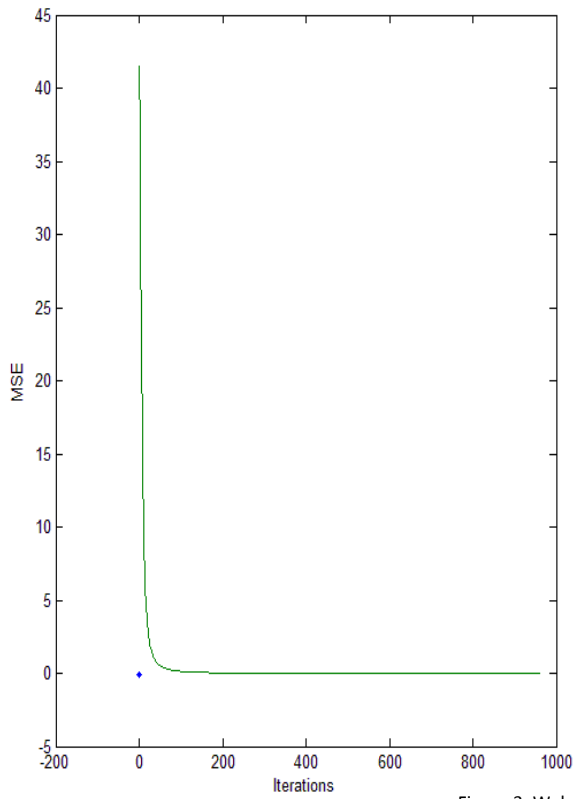
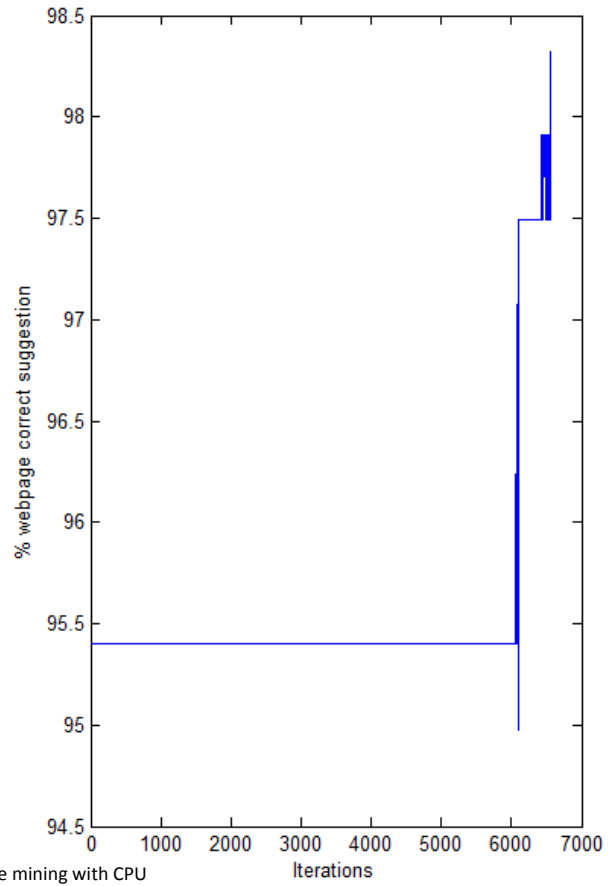
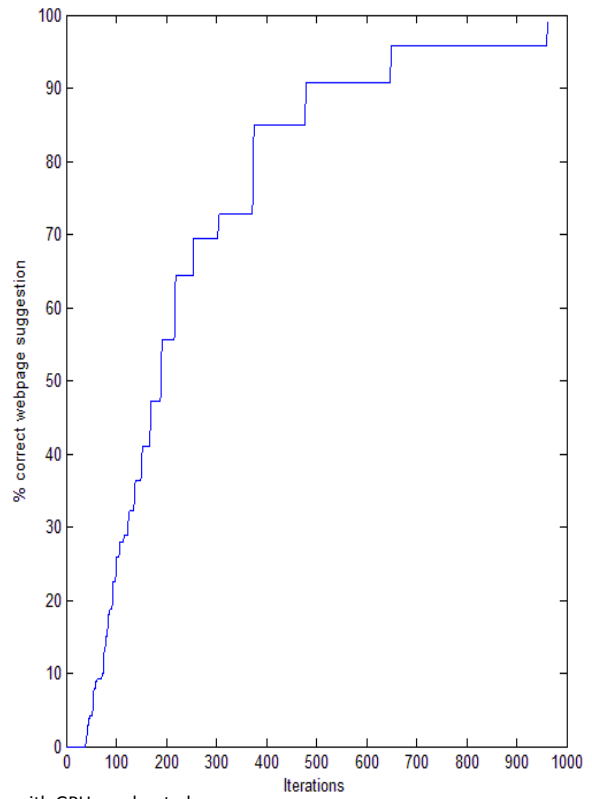


Figure 3. Web usage mining with GPU accelerated



To accelerate the above said process, these steps are executed between transferring data from host to device and GPU computation which can improve resource utilization rate through hiding overhead of loading data . So the whole procedures are shown as follow:

- (1) Load log file data to CPU memory.
- (2) Initialize GPU device.
- (3) Create streams and initialize them
- (4) Create events to monitor devices progress and record the exact execution time.
- (5) Load n kernels, each kernel deals with specific data of itself (n slices data were processed by a kernel each time. A slice data serves as a cross session of the web server data cube).
- (6) Load n times 'memcpy' asynchronously (n equals the number of streams).

#### IV. EXPERIMENTAL RESULTS

The experimental results have shown that comparing to the CPU implementation GPU accelerated scheme improves the performance by about 70%. Figure 2 and Figure 3 are the result graph obtained by applying same logs into GPU accelerated and CPU implementation. The GPU accelerated scheme not only reduces the runtime overhead of web logs and also reduces the space overhead.

#### V. CONCLUSION

In this paper, GPU computing and the CUDA programming environment is implemented for an GPU-enabled web usage mining. This demonstrates the huge potential of GPU processing for web usage mining. If the source data is huge amount, GPU computing is the first candidate method; if the operation amount increase for the algorithm structure, accelerating by GPU achieves better effect. In future research, in order to improve the precision of our method, the reuse between thread blocks will be taken into account.

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