International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 02 Issue: 05 | Aug-2015 www.irjet.net p-ISSN: 2395-0072

CROSS LAYER DATA COLLECTION IN WIRELESS SENSOR NETWORK

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Abstract - ***Wireless Sensor Network nodes are powered by batteries, they have hard energy constraints; therefore, efficient use of energy is one of the main design considerations in WSNs .since all layers of protocol architecture influence the energy consumption, exploiting synergies between these layers by a cross layer design will result in an efficient energy utilization of the system. Energy performance can be enhanced by designing energy aware hardware and software. Energy aware software approach includes development of energy efficient communication protocols and getting benefits from cross layer interaction among layers. All the nodes cooperatively maintain the network connectivity, exploiting the dependencies and interactions between layers have been shown to increase performance in certain scenarios of Wireless Networking. These issue make way to Cross Layer Design (CLD) ,however many technical issues still exist , although layered architectures have served well for wired networks, they have several advantages like flexibility, mobility ,cheaper and faster deployment ,easier maintenance and upgrade procedures. This paper provide a feasible and flexible approach to solve the conflicts between the requirements of large scale, prolong network life time in data collection to reduce the communication redundancy .***

Key Words: *Cross layer Design, Wireless sensor network, OSI layer, Data Communication, Software Methods.*

I. INTRODUCTION

Wireless Sensor Network of spatially distributed Sensor Nodes equipped with sensing, computing, power and communication modules to monitor a certain phenomenon such as environmental data or object tracking. In current scenario,[3] the number of nodes may be 20 to 30 but in future it may consist of nth power more sensor and actuator systems. The positions of the sensor nodes may not be pre-determined and may require sensor nodes to be equipped with self organizing protocols. Generally, sensor nodes observe and sense the phenomenon with a sensing module, process the data with a computing module, and send the data to a required destination over a radio interface with a communication module In data collection and monitoring application, nodes continuously report sensory data to an observer (e.g., Base Station) in order to detect the occurrence of an event of interest. In these applications the observer requires an aggregate value of the sensor field rather than individual values from each sensor. [6]For ex., In a Traffic Monitoring application where Noise levels are monitoring, the observer may be interested in the average value.

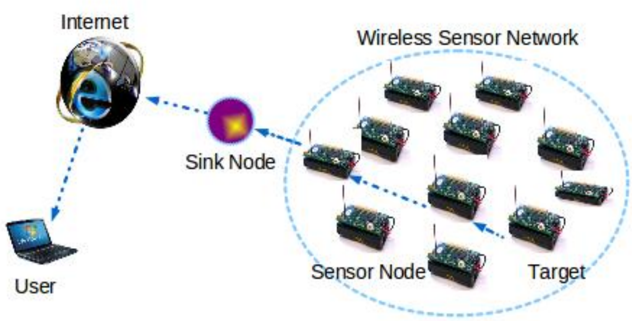

Fig 1: wireless Sensor Network

There are many practical scenarios where WSNs can be applied to make the system more efficient. For example, to wait on a traffic light (red) with no vehicle(s) on the opposite side (green light) wastes time and money. A smart irrigation field where the water is distributed automatically as per requirements of the crops is an interesting scenario. Similar vision was presented, which was seen as a dream at that time. To make this happen, the WSN nodes need to be cheap and long lasting.[3] With the energy aware schemes are required to extend the WSN lifetime... The need of energy, it is difficult and sometimes impossible to replace and/or replenish these batteries for reasons like cost or geographic location. Therefore Cross Layer approach motivates to explore Cross Layer Design enhance Energy efficiency.

Limitations of WSNs although, much research has been done in the field of WSNs, there are still numerous concerns, issues, and limitations that should be addressed. Major challenges are: different Network topologies based on different applications, being data centric, having large number of nodes, Ad-hoc deployment, security, and energy consumption. Having a number of restrictions and limitations such as limited energy supply, limited computation power, limited bandwidth for connection among Sensors, and computation constraints make WSNs face several design and maintenance challenges.

II. RELATED WORK

Cross layer design may be defined as, "the breaking of OSI hierarchical layers in communication networks "protocol design by the violation of reference layered communication architecture is cross-layer design with respect to the particular layered architecture". The breaking of OSI hierarchical layers or the violation of reference architecture includes merging of layers, creation of new interfaces, or providing additional interdependencies between any two layers. Data collection in Wireless Sensor Networks is that the energy consumption of the Sensor nodes placed near the sink is very high. [2].This is because the Sensors placed near the sink have to forward the data to the sink .Data collection may be of four types Periodic, Random, Continuous and When the Event Occur Where Periodic stands for collecting the room temperature data's, Random which randomly take places such road accidental cases Continuous which senses the daily health monitoring checkups and lastly the When The Event Occur falls on the particular event such as causing tsunami.

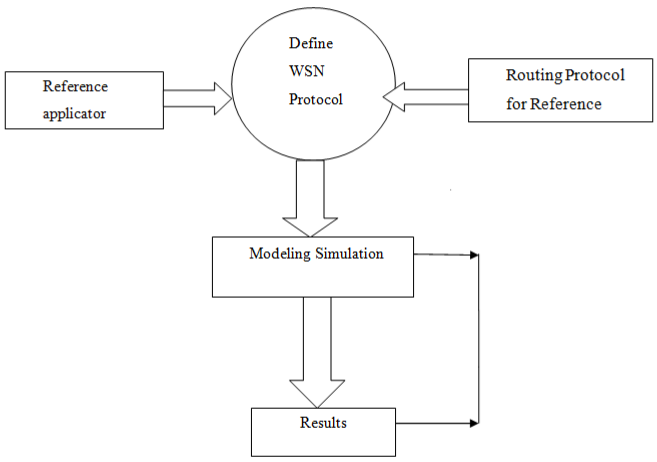

Fig 2: Over all approach for WSN

Environmental monitoring is considered as the driver application for wireless communication technologies, Environment monitoring comprises chemical and biological sensors monitoring the different hazards to the human society, earthquake sensors, and tracking wildlife. Durability and lifetime of sensor networks are important challenges in environmental sensing because of possibly harsh environmental conditions and unattended operation, for example, sensor nodes placed in areas where temperature is less than -50 Celsius will require special kind of casing which can resist extremely low temperatures

2.1 APPLICATION USAGE:

Interior Monitoring: Observing the gas levels at vulnerable needs the usage of high-end sophisticated to satisfy Industrial regulations .Wireless internal monitoring solution facilitate keep tabs on large areas as well as ensure the precise gas concentration degree.

Forest Fire Degree: A network of sensor Nodes can be installed in a forest to detect when a fire has started .The nodes can be equipped with sensors to measure temperature, humidity and gases which are produced by fire in the trees or vegetation.

Landslide Detection: A Landslide detection system makes use of a wireless sensor network to detect the slight movements of soil and changes in various parameters that may occur before or during a landslide. Through the data gathered it may be possible to know the occurrence of landslides long before it actually happens.

Water Quality Monitoring: Water quality monitoring involves analyzing water properties dams, rivers, lakes &oceans, as well as underground water reserves.

Nature Disaster Prevention: Wireless Sensor networks can effectively act to prevent the consequences of natural disasters, like floods, Wireless nodes have successfully been deployed in rivers where changes of the water levels have to be motioned in real time.

2.2 ARCHITECTURE OF WIRELESS SENSOR NETWORK

Wireless Sensor Network architecture can be classified into flat and hierarchal flat WSN architecture are composed of homogeneous sensor nodes in terms of resources to collect the data and send them to a more resourceful sink node. In this kind of architecture, many to one (M:1) , or many-to-many (M:N) communication In M:1 scenario, sensor nodes send data to a single sink node[1][2]. For example, in a large agricultural field, sensor nodes may report the water level of the soil to multiple sink nodes distributed over the area to stop or allow water supply. In M: 1 with mobile nodes, the sensor nodes can be mobile (like node 1 and node 3 changed positions while sending the data to the sink node, and similarly M: N with mobile nodes is also possible.

2.3 ISSUES IN WIRELESS SENSOR NETWORKS

Wireless communication technologies the application interconnected by tiny sensor nodes become more and more attractive .However ,Killer application that take advantage of these technologies is yet to appear due to unsolved issues.[2]

Scalability: Potential application system might contain thousands, if not millions of sensor nodes .the cost such system is unaffordable. The affordability requirement imposes budget constraints on hardware components at each sensor node that directly affect the communication bandwidth.

Network Lifetime: The long life time requirement of application and the limited capacity of batteries create a wide gap between the node power consumption and the node power supply. Current solution include: Power Aware Protocols, Low Hardware Design, Power Saving Sleep, Mode and Transmission Range Optimization.

Functionality: In WSN some nodes are excepted to take multiple responsibilities of collecting various types of data processing and fusing data to improve communication efficiency, and relaying data via Multi Hop Transmission. This is the challenging requirement to the resource constrained of scalability of network life time for available technologies to make tradeoffs and optimization of several pairs of parameters such as the Network Scale and System Throughput.

III. CROSS LAYER DESIGN AND OPTIMIZATION

Resources constraints in WSN node require energy efficient and energy aware schemes on all layers of the protocol stack to increase the lifetime of the network. The traditional layered networking approach has several drawbacks from WSNs perspective, improvements in performance and energy efficiency are possible if significant amount of information is passed across protocol layers and hence network lifetime can be improved

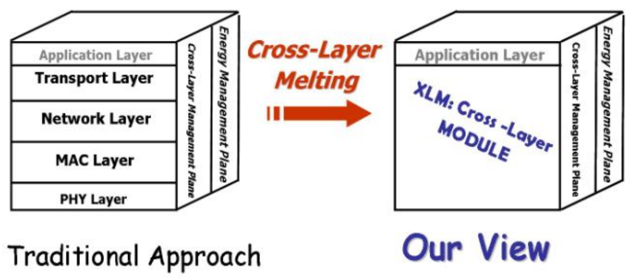

Fig 3: Cross Layer Melting Approach

Each layer has defined interfaces for communication with any other layers for example Fig 3.2 layer 3 can only communicate with adjacent layers (layer 4 & layer2) and it cannot communicate with layer1 as no such interface is available for information exchange.[1]

According to a fore mentioned definitions of cross layer design, the violation of this architecture would lead to a cross layer design .Two new interfaces (encircled in the figure) are created at layer 3 for information flow from layer 4 to layer 3 and layer 2 to layer 3.Where firstly, layer 2 and layer 1 are merged to result in a super layer and secondly, the design of layer 3 is dependent on the design of layer 4 (layer 3 > layer 4) which means that any change in layer 4 would result in changes in layer 3 as well. Shows violation of reference architecture by introducing another "vertical layer", the cross layer design may include the mentioned violations of the referenced architecture in one form or the other

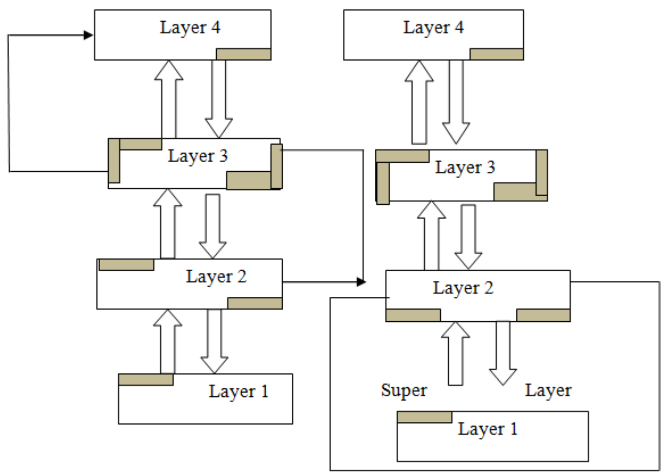

Fig 4: Cross Layer Design of the Reference Architecture

For resource constrained systems, such as WSNs, optimization has to be done across all layers to obtain lifetimes of years and this optimization can be achieved by exchanging information across layers.[3] Assumes that a packet loss is caused due to collision which is not true for ad-hoc wireless networks where a packet loss may occur because of other phenomenon like fading or varying link quality.[5][6] Potentially harsh environmental conditions, unattended operation, and operating in free frequency band make WSNs even more prone to errors by interference or fading.. But still, it is considered as one of the motivations to apply cross layer approach. An example of new modality in wireless communication systems is to use a wake-up radio with a main radio to reduce the duty cycle of the main radio and hence save energy . All these issues provide a basis to explore cross layer approach for WSNs.[7].

IV. ENERGY CONSUMPTION AND CROSS LAYER DESIGN

Routing of data packets and exchange of control information consumes significant amount of energy .Routing protocols can minimize energy consumption by adjustable transmit power approach, load distribution approach and duty cycling. Transmit power and load distribution approaches attempt to minimize energy when the network is in active state (transmitting or receiving data) while duty cycling (sleep-power down cycles) maximizes energy performance when in inactive state.[6] Adaptive routing protocols utilizing cross layer information and based on link status, congestion and traffic conditions can be used to minimize energy consumption The following strategies can be adopted to decrease energy utilization at the routing layer.

4.1 Physical Layer

The physical layer has to meet the design requirements keeping in view the nature of WSNs. The modulation schemes, the use of a certain frequency band, and the coding techniques have significant impact on the cost and battery lifetime requirements. The requirements and the constraints imposed on the design of the physical layer for WSNs in general, the radio must be small, the price of the radio must be cheap as the number of sensor nodes may be too high, and it must be able to work with the higher layers to reduce the power consumption levels.

The power consumed by the radio while receiving or transmitting is one of the main power consuming components on the physical layer.[1] Current radios can have different modes of operation with different power consumption levels, for example, transceiver as the power consumed in the active state by the transceiver is much greater than the power consumed in the low power state (e.g., sleep state), so it is always to keep the duty cycle low to have extended network lifetime. In low duty cycle operations, batteries always get an opportunity to undergo recovery effect which is beneficial for extended network lifetime. Bursty communication at physical layer can help attain low duty cycle and consequently extended network lifetime. Many of the routing schemes depends on increasing or decreasing the transmit power[2]. All these issues indicate that physical layer is involved in the cross layer design.

4.2 Technical Challenges In Cross Layer Design

Multiple reasons are motivated the cross layer for wireless sensor network power consumption and the limited power supply requirements to solve the problem include Improving the power efficiency in the system and preventing the system deconstruction due to unfair power usage. Preventing the system deconstruction due to unfair usage to general approaches to deal with the power problem. Optimizing the transmission range according to the system topologies and taking the low power hardware design or using more powerful batteries. Optimization goal is to improve the veracity with the strictly limited node resources, such as computing power, storage capacity. Optimization is how to support a large scale network while keep feasible per node throughput from each node to designate data sinks. Many of the routing schemes depends on increasing or decreasing the transmit power.

Layer	Network Scale	System Life-Time	Node Veracity
Application	Data Fusion, Compression	Power Aware Mode Control	Load detection, Automatic Mode Decision
Transport	Bounded Delay	QoS–Power Trade off	Load Aware Transport Control
Network	Node Naming Efficient Routing Efficient Node Discovery	Power–Aware Routing Redirected Overhead	Load–Aware Routing Simplified node Discovery Distributed Storage
MAC	Contention Control Channel Reuse	Synchronization Sleep Transmission Range Control	Load-Aware Channel Allocation
Physical	Ultra-wide Band	Low-Power Design Powerful battery	Attach Specific Accessories (GPS)

Table 1: Optimization Approaches At Each Layer

4.3 Non Technical Issues In Cross Layer Design

First, identify the layer specific contribution to this task from each layer Existing layer specific mechanism or protocols make contribution independently, The various Cross Layer Signaling scenario is comprehensive design for those areas where a “Global “system factor Existing layer specific would specify mechanism or protocols make contribution independently by introduce them into packet loss ratio and error- related parameters transport which deal with jitter[5].

Second work out the layer contribution from each layer would contribute the either an existing parameter that interest that interest other layers, or a behavior that node to be revealed to interested layers. The former are selected environment measurements such as SNR (Signal to Noise Ratio).

Layers needs to adjust the transmission ,BER is another example from Link Layer to avoid Network Layer control delay constrained transport in frame and packet level respectively, and their joint relay control is also is possible. The Transport Layer for a joint error control would delay the constrained coded for the CLASS message format.[6]

Third with all the contribution available, identify how the layers interfere with each other to fulfill the task. In this QOS adaptation announces its QOS requirements in terms of controllable parameters and corresponds value to all the related layers. Generally the Real-time services which will adapt the response for the complex task regarding the co-ordinate module which is needed through the layers.

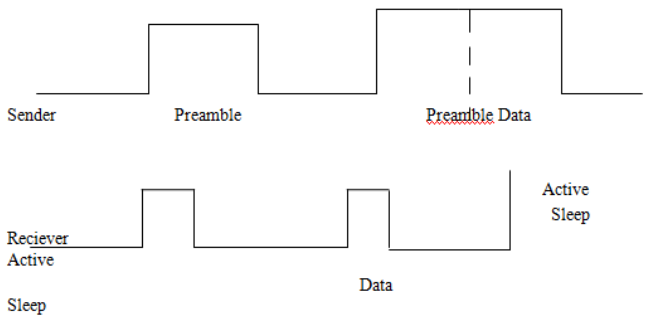

Fig 5: Duty Cycling In Medium Access Control Schemes

4.4 Clustering Based Data Collection

- The distributed Data Collection technique that realizes Dynamic Virtual Clusters (DVCs) utilizing overhearing occurring at the MAC layer, during every communication round ,node contend for the channel access and the winter of the channel transmits data to the sink and become the representative node.
- The nodes having a similar data value within its communication range. The Cluster Head and member nodes within its communication range from a data –dependent virtual cluster.
- The cluster members overhear the channel and compare the data being communicated by the CH over the channel to their own data.
- If found similar given threshold dependent, they suppress their transmissions Therefore, data redundancy is eliminated at its very source and not the at the CH.
- This approach reduces the number of Intra cluster communications and collisions by saving the energy.

EVALUATION RESULT:

Nowadays, the WSN is a hot research topic. Many network details in WSNs are not finalized and standardized. Building a WSNs test bed is very costly. Running real experiments on a test bed is costly and difficulty. Besides, repeatability is largely compromised since many factors affect the experimental results at the same time. It is hard to isolate a single aspect. Moreover, running real experiments are always time consuming. Therefore, WSNs simulation is important for WSNs development. Protocols, schemes, even new ideas can be evaluated in a very large scale. WSNs simulators allow users to isolate different factors by tuning configurable parameters. [2] Consequently, simulation is essential to study WSNs, being the common way to test new applications and protocols in the field. This leads to the recent boom of simulator development. However, obtaining solid conclusions from a simulation study is not a trivial task. There are two key aspects in WSNs simulators:

EXPERIMENTS AND RESULTS

The network lifetime (death of first node) for different values of gamma (g). Gamma (g) as discussed earlier is an empirical value which provides basis for shifting from energy aware to progress aware routing strategy. For example, if the difference between *SOCmax* and *SOCmin* is greater thang, then the strategy is shifted to energy aware routing. When duplicate packets start appearing, the strategy is again shifted to progress aware routing. The value of g is varied from 5% to 50%. It is visible that the g within the range of 20% to 40% gives better results while if the value of g is decreased below 20% or increase above 40%, the network lifetime starts decreasing. For the given scenario, the optimal value of g is 20% as shown in and this value is used for the rest of simulation.

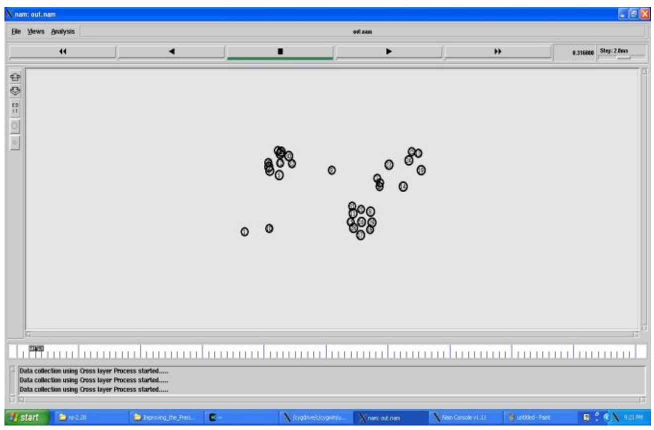

Fig 6: Node Creation

Fig 7: Acknowledgement to Sink Node to Other

Fig 8: Path to Sink At The Time Of Link Failure

End-to-end delay for different values of h . The end-to-end delay is computed from the delay incurred by each packet from multiple sources at the sink node. The results show lower end-to-end delay for h = 1. The reason is that it always selects the node that provides maximum progress. For h = 0, the delay in the start is high because the simulation starts with all the nodes having the same level of energy and hence the expiration of timer at the same time, and the time consumed in contention resolution at the MAC layer contributes to increased delay.[1][2][3] the delivery ratio is near to the optimal value. As the value h is decreased, the delivery ratio increases. The reason for this is that for lower values of h , such as h = 0, the protocol always tries to balance the energy consumption across the network. Once the equilibrium is attained, and the remaining energy of nodes are almost at the same level, the difference between the timers of contending nodes also becomes negligible, and the transit packet is processed before node receives the ACK message.[5]

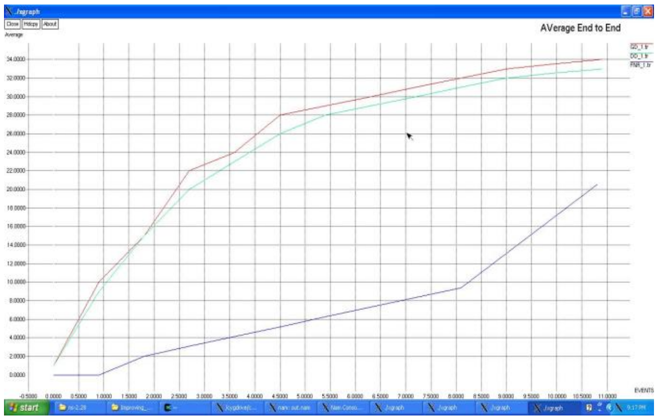

Fig 9: Average End to End Delay

The average end-to-end delay values in order of seconds do not reflect the absolute values. These values can be minimized by using optimized value of *Tmax*. The delivery ratio of 1 indicates guaranteed delivery while delivery ratio of greater than 1 indicates packet duplication. The only reason for packet duplication is either the competing nodes have almost the same energy level or they providethe more or less the same progress towards the destination. The usage of _ between the range of 0 to 1 and not the both extremes will eliminate the problem by reducing the probability to have both the value in the same range.

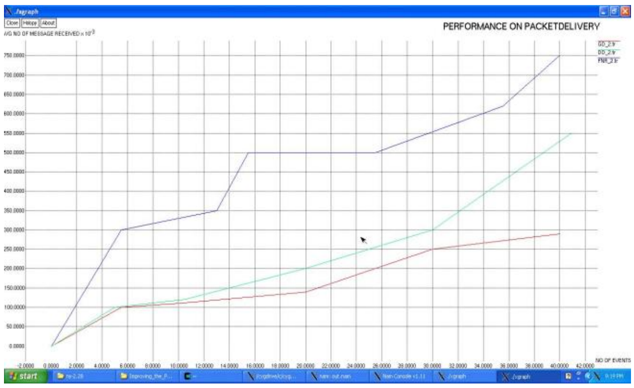

Fig 10: Performance on Packet Delivery

Nodes within one cluster transmit control packets to select a cluster head. Cluster heads can be selected on round robin basis or based on location, remaining battery capacity, or the number of times its was a cluster head in the past. It should be noted that a node can change its cluster ID and get itself assigned to another cluster depending upon the received signal strength from another cluster node or number of nodes in the current cluster.

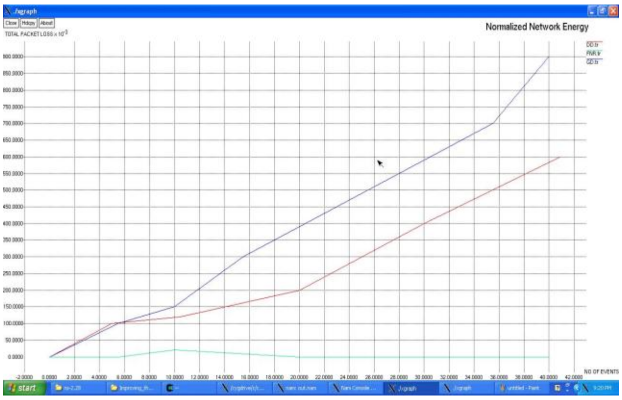

Fig 11: Normalized Network Energy

CONCLUSION

In this paper we study the application oriented Cross Layer design and optimization to collect the data from the sink node to base station .The goal is to provide a feasible and flexible approach to solve the conflicts between the requirements of large scale, long time and multiple purpose wireless sensor networks. The constraints of tight bandwidth, low battery capacity, and Limited node resources and achieving the conflicts between the each layer by using DVCDC based Data Collection. WSN protocol architecture with standard interfaces and explicit support for cross layer design, the implementation of the framework shows the feasibility and benefits of the concept. The proposed architecture can help achieving the dream of having generic communication protocols for different classes of applications. Future Enhancement

Future Work

The study will focus on the problem of IP-based next generation Wireless System and furthermore this area is still lacks of standardization and evaluation criteria This paper is initial effort targeted to the above problems based on the review of existing ones and focus on the problem of network scalability, time synchronization, smart channel allocation and node mode decisions. In this process of implementing and optimizing application it will try to tune the protocol in a Cross Layer way to approach the theoretical limitation for each application.

REFERENCES:

1. Yucheng Zhang Liang "*Cross Layer Optimization for Sensor Networks*", Department Of Electrical and Computer Engineering .Lehigh University July, 2010.

2. QI Wang Anamosa Ali Abu *"Cross Layer Signaling For Next Generation Wireless System"*, International Journal Of Innovative Research In Advanced Engineering (IJIRAE) July, 2014.

3. Y.Huang,W.Fan,W.Lee and P.s.Yoona *"Cross Layer Versus Single Layer Approaches For Intrusion Detection In MANET"*, International Conference on Networks. November, 2007.

4. C.J.John Felix, A.Das, B.C.Seet, Rajive Bagrodia *"Cross Layer Versus Single Layer Approaches For Intrusion Detection In MANET"*, International Conference On Networks. November 2007.

5. I.Y.U, I. Yang and M.Hong*" Cross Layer Intrusion Detection System for Layer Interaction",* IEEE International Conference on Networks December, 2011.

6. Zhiyu Shoo and Minho Chen. *"Cross Layer Optimization for Wireless Network for Deterministic Channel Models"*, Department Of Information Engineering, Chinese University of Hong Kong. December, 2013