Editorial

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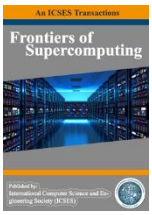

Opportunities and Challenges in Wireless Sensor Network

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FRONTIERS of Supercomputing (FoS) is an ICSES Transactions whose one of the focuses is on emerging trends in networking and communication area of the research. Wireless Sensor Network (WSN) emerges around 1950s and with advancement in sensor based technology has upgraded its use in nearly all parts of life of the current world. WSN are being used for multiple applications like disaster management, medical, military application, electricity and water management [1], road safety and management, biological fields, construction, home automation, air traffic control [2], asset management, habitat monitoring and sensing, power system, transportation, gas monitoring and several other purposes. WSN technology is being used for sensor to sensor communication for collecting and processing of various environmental parameters using these sensors.

WSN consists of five-layered architecture which consist of physical layer, data link layer, network layer, transport layer and application layer. The working of each layer is similar as that of TCP/IP model but with difference in types of protocols and application being used for WSN technology. Taking a view of type of sensors in WSN, they are micro electro mechanical sensors (MEMS), CMOS based sensors and LED based sensors. The usage of sensors depends on type of applications where they can be used. WSN units can be categorized into components like microcontroller, transceiver, sensors, memory and battery. Based on type of usage of WSN there can be underground WSN, underwater WSN, terrestrial WSN, multimedia WSN or mobile WSN.

Some of the major challenges in WSNs are security, power consumption, fault tolerance, latency, throughput, data suppression, aggregation and fusion. Production cost, scalability, topology, transmission media. Most of the research in WSN is focused on these issues.

This editorial article focuses on different research aspects in WSN and this research area are covered by taking different layers of WSN separately and thus finding the scope of research in these layers. Physical layer is responsible for providing the physical connectivity among the networks. The data link later supports research in the field of Quality of Service (QoS) and hybrid MAC protocol for fast and emergency response system. QoS aware MAC protocols are used to enhance the performance of WSN. The protocols proposed in this field are categorized into differentiated services protocol and application based protocol. Where the differentiated services based protocols are further sub-divided into static, dynamic and hybrid type based on the usage and performance of protocol in different environment. There are many protocols proposed like PR-MAC, RL-MAC, PQ-MAC, QoMOR, PSIFT, I-MAC, Q-MAC and Diff-MAC etc. Hybrid MAC protocol uses the CSMA and TDMA based technology for enhancing the efficiency of WSN. There are many hybrid MAC protocols proposed for WSN as Z-MAC [3], P-MAC [4], funneling MAC, RRMAC [5] etc. which uses different techniques for increasing the performance of WSN.

The network layer is responsible for routing of packets from source to destination. There are various routing schemes proposed in WSN which paved the way for future research in this direction. Routing protocols are categorized into network structure based routing protocol and protocol operation based routing protocol, the selection of routing protocol is done as per the application and requirements [6]. Network structure based routing protocol are further sub-divided into flat network routing protocol, hierarchical network routing protocol and location based routing protocol. Whereas the protocol operation based routing protocol are sub-divided into query based routing protocol, multi-path based routing protocol, negotiation based routing protocol, QoS based routing protocol and coherent and non-coherent based routing protocol. The selection of routing protocol and type of routing protocol is based on application and its usage. Clustering is another approach which enhance the performance of WSN for large network and as the size of network is increasing the need for clustering approach also increases so now most of the protocols are using the

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clustering based approach. LEACH is one of the well-known protocol for clustering in WSN which act as baseline for all the clustering based approach.

The transport layer deals with concept of caching and congestion control within WSN [7]. The management of cache and congestion control is necessary for efficient and improved performance of WSN. The management of cache can be done by means of insertion, replacement or elimination, size, location and decision. These can be achieved by using different techniques like content mapping, duplication, traffic load, probability of traffic drop, implicit/explicit notification etc. There are many cache based transport protocols like RMST [8], RCRT, A2RT, DTSN, CTCP etc. Controlling the congestion within network is another aspect which need to be taken care, there are many protocols proposed for congestion control, these protocols are based on factors like rate regulation and allocation, multidata forwarding based congestion control, congestion control based on traffic control, Congestion Control based on Routing Optimization, Queue assisted congestion control, Congestion control based on priority discrimination, Congestion control based on Data processing, Clustering based Congestion Control [8,9,10]. There are different protocols proposed for congestion control as MR-CASM, ARC, CODA, fusion, ECODA, TARA, LACAS, HTAP, WCCP, DPCC etc. [11]

Application layer of WSN is used for abstraction of physical topology of WSN for different types of applications. This layer is responsible for providing interface to users for interacting with physical world through WSN. Application layer is responsible for traffic management and provide software based solutions for number of application used in WSN.

Apart from these areas there are many other areas in WSN which are attracting the research in the field of WSN as heterogeneous WSN which works in heterogeneous environment. The research aspects areas in heterogeneous WSN are architecture for heterogeneous WSN and QoS provisioning within WSN. Depending upon the usage and application heterogeneous WSN can be single tier or multitier architecture and there are many protocols designed for improving the performance of heterogeneous architecture like DEEC, DDEEC [12], EDEEC [13], BEENISH [14] etc. Provisioning of QoS within heterogeneous network is also one of the primary aspect in the field of research, various provisions and protocols are proposed for provisioning of QoS within heterogeneous WSN which improves the lifetime, reliability and latency of the network. Some protocols that work in this area are AMPH, EEHC, DEBC, DEEC, EDDEEC [15] etc.

With the advancement in the usage of WSN technology the need for mobile sensor network also increases, these are those sensors which move according to the location and keep tracking the data of the environmental parameters. Mobile WSN have research area in the field of mobility, localization and coverage and connectivity. In mobility, the pattern and model of mobility are prime issue of research which enhances the performance of system. There are many models for mobility already proposed by many researchers and which paved the way for future research in this direction. Localization is another issue with mobile WSN which is used to determine the location of the positioning of sensor nodes within mobile WSN. The parameters which define the localization for mobile WSN are various parameters like localization technique (L.T), localization accuracy (L.A), energy consumption (E.C), communication cost (C.C), computational complexity (C.Comp), robustness and transmission range (T.R). Coverage and connectivity within mobile WSN is to cover the wide area for WSN network and various parameters and protocols are developed and proposed under this section.

With advancement in internet technology and increasing the bandwidth lead us to switch from voice data to video data and thus increases the need for sensing of video data. Multimedia WSN deals with video based high resolution data which need to keep track of video data. This is one of the emerging area in the field of WSN which require high throughput and QoS for efficient tracking and analytics of video data within WSN. Among other areas of research in WSN are fault tolerance within WSN network such that the network is resilient in nature and can withhold large data without fault. Cross layer optimization is also the need for providing the efficient services within WSN and last of all the security and energy is always an issue to be taken care of in WSN.

This editorial article focuses on WSN network and their area of research where work can be done which paved a way for future research aspects in the field of WSN, MWSN, multimedia WSN etc. This editorial article also emphasis on various protocols being used in WSN and factors which effects the working and performance of WSN.

With regards,
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&
Dr. Alaknanda Ashok
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