An Exploration to WSN Protocols and Usage Categorization

Nishant Jakhar

Asstt. Prof., CSE Dept, Indus Degree College

Abstract: Sensor network is the critical real time network defined in different domains and scenarios. It can be indoor network, outdoor network or the infrastructure specific network. Different constraints and restrictions are defined at node level, network level and application level. To achieve the communication support in such distinguish environment, a vast range of protocols is available for this network. In this paper, the scope and categorization of these available protocols is provided. Author also explored the architectural and the communication constraints of these protocols and relative categories.

Keywords: Sensor Network, Protocols, Energy Efficient, Architectural.

I. INTRODUCTION

A sensor network is the real time complex network defined with certain restrictions and constraints. These restrictions include the energy limit, low memory, low sensing range and the lesser processing power. To provide the effective network communication with defined restrictions, some architectural reformation is required. One of such architecture is the cluster based architecture. In this architecture, the complete network is divided in smaller segments called clusters. Each cluster is controlled by some controller node called cluster head. This cluster head is responsible for the communication of the cluster nodes. All the nodes performs the communication to the allotted cluster heads and the cluster head communicates aggregative to deliver the information to the base station. This kind of clustered network provides the communication even with low coverage of nodes. The communication performed by a sensor node can be single hop or multi hop. In single hop, the direct communication path between the source and destination is defined. In case of multihop communication, multiple intermediate nodes are identified by following them; the communication is performed between the source and the destination. To optimize the communication in sensor network, it is required to set the architectural constraints and the communication behavior at node level. The component based architecture of this network is shown here in figure 1.
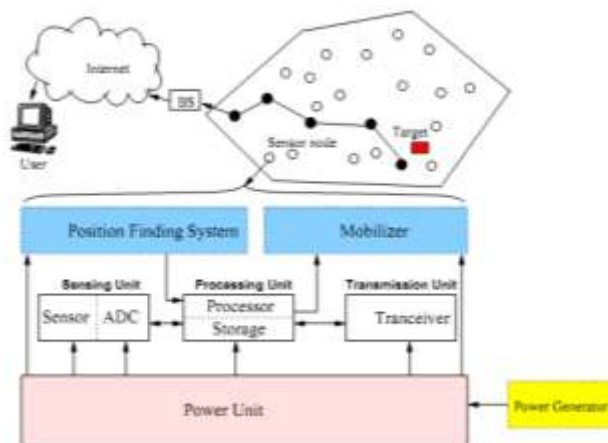

Figure 1 : Sensor Network Architecture

Here figure 1 is showing the low level architecture of sensor network with specification of low level elements of the network. At the lowest the network is composed using the tiny energy specific sensors. The figure has shown the

architectural characterization of a small sensor. These sensors are generally heterogeneous in term of their role. But, the basic formation of the sensor is shown here in the figure. According to this, the sensor nodes are defined with some positional and the mobility constraints. To control the coverage and the tracking the mobility of nodes a position finding system and the mobilize is defined in the architectural constraints. Based on these two controllers, the immediate identification of sensor node position can be obtained. To provide the node processing, the sensor unit is also defined as the architectural component. In this sensing unit, the sensing capability relative to the environment, process or device is defined along with the conversion of this extracted information to the digital form. The processing unit is defined to store the information and to take the decision regarding the communication. The power unit ensures the power backup to the nodes. The external power backup is also attached to network and the nodes to improve the network life. Each of the sensor node in the network is defined with same configuration. As the communication performed, the dynamic routing is performed to communicate between the source and destination node. The routing is controlled by the appropriate routing protocol. The complete network is controlled by the base station which finally connects to the internet and provides the interactive communication of network to other network. In this paper, the exploration of the characterization and features of different routing protocols is provided.

II.   EXISTING WORK

Sensor network is one of the most diverse network forms that is defined in different environments, applications and architectures. According to the architectural and environment specification, different protocols are defined. Different researchers have applied these protocols with different configurations as well as applied different modifications to optimize the network communication. Some of the work of earlier researchers is discussed in this section. Author[1] has defined a work on LEACH protocol to provide the clustered communication. Author defined the architectural composition to form of the hierarchical routing with specification of dynamic clusters and optimum cluster heads. Author explored the internal process of cluster selection and provided the time frame effective communication in the network. The constraint specific communication was defined by the author to provide the random selection of cluster head with probabilistic formulation. The requirement specific tracking and communication was defined by the author with architectural composition. The balanced and the reliable communication was formed by the author. The clustered improvement was suggested by the author under the aspect of different constraints including the distance, coverage load etc[1][2][3].

Some of the improvement to the existing clustering protocols was also provided by the researchers to with different constraint specific or the architectural features. These constraints are defined to improve the process of cluster selection and to improve the multi-hop communication in the network. The energy adaptive cluster formation and the communication was provided by the author. Researchers also identified the scope in the improvement of clustering protocol so that the network life and communication will be improved. Author provided the feature driven analysis and provided the comparative observation against the existing protocols and provides the reliable communication in the network. The communication level improvement was provided by the researchers at different level[4][5][6].

Different researchers also provided the work on different communication constraints, measure and architectural configuration to improve the routing method. The work was provided to understand the network configuration in terms of layered communication. Different constraints and challenges relative to the communication were identified by the researchers including the redundancy, location information analysis, QoS parameter evaluation, communication objective etc. These improvements and the analysis provided the improvement to the routing at the lower level as well as to decide the best routing control for the environment. The parameter adjustment is also required to provide the effective and architectural communication in different network environment. The protocol level changes and the architectural configuration were also identified by the researchers[7][8][9].

LEACH is one of the most effective clustered protocols defined in this architecture and provided the effective resource utilization. The design time constraints along with the balanced communication are the key features of this network. The energy specification with certain protocol specification is also provided to improve the communication efforts. Author also discussed the certain and uncertain events in the network that affects the network life and communication. The analysis on the communication efforts is also performed to provide the clustered communication in effective way[10][11].

The network is defined with initial energy specification and to discuss the certainty in LEACH. Author discussed different aspects of these protocols so that the life time of the network will be improved. The communication is performed for N number of rounds and is based on the energy effectiveness of network as well as the communication is measured. Simulated results shows the improvement to the network life upto 20% with the modification on the cluster head selection process[8][9].

An improvement to the clustering protocol was provided by the researchers to improve the control over the sensor network and to avoid the network deficiencies. Author has provided the work to improve the cluster formation with equalized

distribution. The numbers of clusters are also restricted to control the network at higher level. The communication constraint optimization along with equalized distribution was provided to improve the network life. Different forms of leach including MLEACH, N-LEACH, E-LEACH were processed by the researchers with smaller variations. These variations were defined to optimize the communication and improve the network life[10][11].

The improvement to the LEACH protocol was provided by different researcehrs in different forms. A V-LEACH protocol was processed with specification of two cluster heads in the network. The first cluster head is called the primary cluster head and other is called the vice cluster head. The role of the vice is considered as in-waiting cluster head. It means, as the primary cluster head dies, it is replaced by the vice cluster head. The improvement to the network was provided to improve the communication results. The cluster selection and route formation within cluster and between the clusters were proposed by the researchers. The efficiency observation and improvement was also provided under energy and communication parameters.

III.   PROTOCOL CATEGORIZATION

To optimize the network communication, one of the effective way is to improve the network communication through the routing method. Routing in sensor network can be optimized in different ways either by improving the architectural formation, constraints or the parametric evaluation. To provide the controlled communication over the network, different routing protocols are provided by the researcher. Different routing protocols are divided under different categories to provide the situation and environment driven communication. These common protocol categories are shown here in figure 2. The section has describe the key characteristics of these protocol categories.
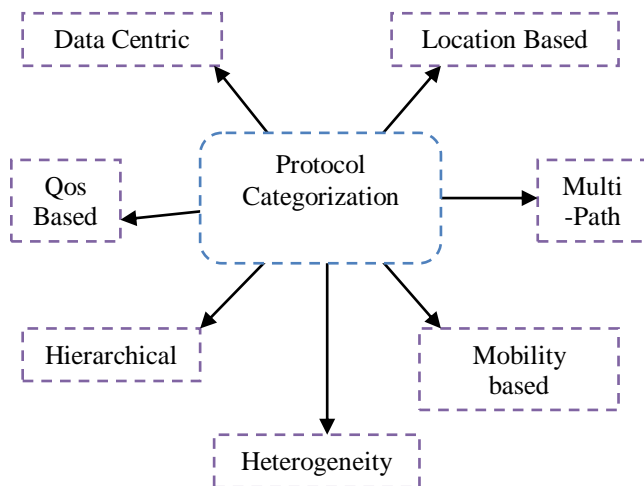

Figure 2 : Protocol Categorization

A)   Data Centric Protocols

These protocols are improved protocol with different objective to the traditional protocols. These protocols are defined with specification of source and sink nodes. The data centric communication is here provided to achieve the aggregative network communication. The aggregative communication is here performed with lesser efforts and with reduced energy consumption. The effectiveness of protocol is also improved so that the reliable communication will be formed. The method has improved the network life and improves the communication throughput. The protocol ensures the data delivery from multiple paths by using the node level broadcasting. The path can be changed frequently if some disruption or the situational flaw occurs in the network.

B)   Location-Based Protocols

These protocols are defined in some network defined under the geometrical bounds. The protocol is able to capture the information about the geometrical constraints and able to provide the situation driven communication. The network can be defined with some scenario or the topological architecture. The network is able to formulate the regions under different

characterization so that the region specific prioritization will be applied. Once the prioritization at location level is defined, the location preserved communication can be performed. The vehicle based network, war zone network are the type of such network form. Generally such networks are defined in open space with larger geographical coverage. The nodes can be scattered over the network with specification of architectural pre-specification. The node position and mobility information is required to optimize the communication.

C)   Hierarchical Protocols

The protocols defined specifically for the clustered architecture comes under this category. As discussed earlier, these protocols are responsible for generation of clusters and to perform the cluster selection. The size of cluster, communication constraint and the range specific communication are the key requirement of these protocols.
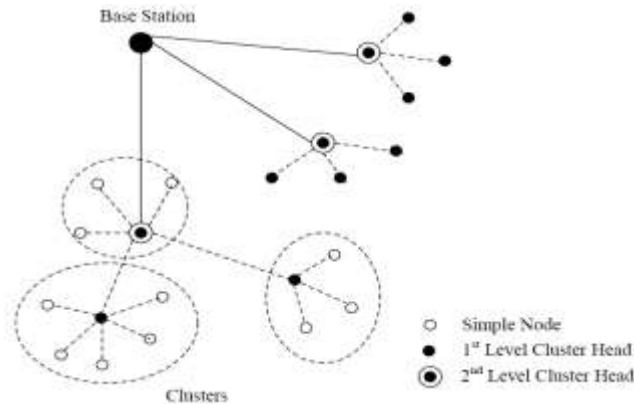

Figure 3: Hierarchical Protocols

The range specification and the area categorization is provided so that the adaptive communication is performed.

D)   Mobility-Based Protocols:

These protocols are defined to provide the optimize communication under mobility constraints. The mobility affects the communication includes the node tracking in terms of speed, direction etc. Different zone adaptive, group formed and agent specific protocols are defined in this category to optimize the network communication.

E)   Multipath-Based Protocols:

These protocols are able to improve the routing at the packet level. It means, the communication data is divided in number of packets and each packet is communicated to different path based on the network situation analysis. The packet marking is applied to track the packets. The communication is formed from M different path that actually distribute the communication over the nodes. The directed network path specific communication is applied to achieve the optimized network communication.

F)   Heterogeneity-Based Protocols

These protocols are defined is defined to provide the reliable communication where two different networks or the technologies are merged. The protocol is adaptive to handle the heterogeneity at different level including the node level, network level or the communication constraint level. The featured improvement and the controlled communication is provided to restrict the communication. The protocol also able to handle the inter-layer communication so that the chances of loss occurrence will be reduced.

G)   QoS-Based Protocols

The protocol is able to provide the parameter specific improvement under different constraints including the communication delay, fault-tolerance and the congestion. The protocol is able to improve the selection process so that the optimized communication will be formed.

IV.   CONCLUSION

A sensor network is the real time network defined with various restrictions. To optimize the communication under different characterization and the situation, different protocol form is required. In this paper, the categorization of the protocols is provided under different situation, constraints and characterization.

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