Chapter 1.6
QoS in Wireless Sensor Networks

Ghalib A. Shah
National University of Sciences and Technology (NUST), Pakistan

Shaleeza Sohail
National University of Sciences and Technology (NUST), Pakistan

Faisal B. Hussain
National University of Sciences and Technology (NUST), Pakistan

ABSTRACT

Wireless Sensor Networks (WSNs) have been envisioned as a new and effective means for creating and deploying previously unimaginable applications. These networks generally have the capabilities of observing the physical phenomena, communication, data processing and dissemination. Limited resources of sensor nodes like energy, bandwidth and processing abilities, make these networks excellent candidates for incorporating QoS framework. The possible applications of WSNs are numerous while being diverse in nature which makes analyzing and designing QoS support for each application a non-trivial task. At the same time, these applications require different type of QoS support from the network for optimum performance. A single layer cannot address all these issues, hence, numerous researchers have proposed protocols and architectures for QoS support at different network layers. In this chapter, the authors identify the generic QoS parameters which are usually supported at different layers of WSNs protocol stack and investigate their importance in different application models. A brief overview of significant research contribution at every network layer is provided. It is worthwhile to mention that same QoS parameter may be supported at multiple layers, hence, adequate selection of suitable mechanism would be application's choice. On the other hand, it is quite possible that a single QoS parameter, such as energy conservation or real-time delivery, can be efficiently supported through interaction of multiple layers. It is difficult, if not impossible to optimize multi layer QoS architecture. Hence, a number of researchers have also proposed the idea of cross layer architecture for providing QoS support for a number of sensor applications, which is also discussed in this chapter. At the end, the authors highlight the open research issues that might be the focus of future research in this area.

INTRODUCTION

Wireless Sensor Networks (WSNs) are emerging as one of the most effective mechanism to sense, collect, process and disseminate physically dispersed information. Small sensing devices provide flexibility and ease of deployment as well as self configuring wireless networks for communication. Advances in sensor hardware resulted in a huge number of different type of sensors like: thermometers, barometers, moisture gauges, motion and glass break detectors, RFID access control badges and so many more (Conner et al., 2004). Most importantly, the economy of this type of solution is responsible for development of a huge number of applications in this area. Following are few of the interesting applications of WSNs:

- Habitat monitoring requires access to the remote area which may not be safe and/or feasible to be accessed regularly for data collection. WSNs provide a robust and safe alternative and hence, a large number of such applications have developed in last few years (Szewczyk et al., 2004; Polastre et al., 2004).
- Environmental observation and forecasting systems have benefited a lot with the emergence of WSNs as the means to sense, monitor, model and forecast the physical processes like rain fall, flooding, temperature changes, pollution etc.
- Disaster management is the area that has emerged as the perfect candidate for applying WSN technology. Monitoring, assistance and management provided by a WSN based disaster management system provides critical information without risking human lives.
- Surveillance and security in buildings and secure areas can be provided by WSNs. Motion tracking sensors are perfect to detect intruders as provide required services round the clock.

- Military applications like battlefield assistance, troop management and enemy tracking are one of the driving forces behind the success of WSNs.

In addition to the above mentioned possibilities, the applications in the area of WSN are unlimited and are emerging everyday. Before going into further details, a brief and simple introduction of WSN is provided here. WSNs are essentially composed of a large number of small sensing devices, deployed in an ad-hoc manner to collectively sense a physical phenomenon (Tilak et al., 2002). The sensor nodes disseminate the collected data after limited processing to the sink node using wireless technology. The sink node can have the ability to query sensor nodes for any information. The exterior networks are connected to the sink node which enables these networks to collect data from WSN.

The following sets of distinguishing features of WSNs are responsible for a tremendous amount of research in this area (Wang et al., 2006):

- The topology of the sensor networks is application dependent while being self configuring and ad-hoc in nature (Conner et al., 2004). Generally, a star-tree type topology is resulted due to the presence of a single sink node at the root of the tree. Multi-hop flat or hierarchical networks may form depending upon the number of sensor nodes and the requirements of the applications.
- The applications of the WSNs are very diverse in nature, as previously discussed. Due to this diversity the QoS requirements of different applications can vary a lot. A generic QoS framework for WSN needs to address all these requirements if to be deployed at a large scale.
- The traffic of WSN has a particular pattern. Generally, upstream traffic exists due to the messages send by sensors to the sink.

Related Content

Survey on RF, Microwave, and Millimeter-Wave Planar Passive Components Design Using Analytical Approach

Kok Yeow Youand Man Seng Sim (2023). *Handbook of Research on Emerging Designs and Applications for Microwave and Millimeter Wave Circuits (pp. 404-482).*

www.irma-international.org/chapter/survey-on-rf-microwave-and-millimeter-wave-planar-passive-components-design-using-analytical-approach/317796

Emerging Technologies in Transportation Systems: Challenges and Opportunities

Antonio Guerrero-Ibáñez, Carlos Flores-Cortés, Pedro Damián-Reyesand JRG Pulido (2012). *International Journal of Wireless Networks and Broadband Technologies (pp. 12-40).*

www.irma-international.org/article/emerging-technologies-in-transportation-systems/94552

Effect of Nodes Mobility on Density-Based Probabilistic Routing Algorithm in Ad-hoc Networks

Hean-Loong Ongand Essam Natsheh (2012). *International Journal of Wireless Networks and Broadband Technologies (pp. 29-48).*

www.irma-international.org/article/effect-nodes-mobility-density-based/75526

Detecting Cheating Aggregators and Report Dropping Attacks in Wireless Sensor Networks

Mohit Virendra, Qi Duanand Shambhu Upadhyaya (2012). *Wireless Technologies: Concepts, Methodologies, Tools and Applications (pp. 565-586).*

www.irma-international.org/chapter/detecting-cheating-aggregators-report-dropping/58805

An End-to-End QoS Framework for Vehicular Mobile Networks

Hamada Alshaerand Jaafar Elmirghani (2010). *Fourth-Generation Wireless Networks: Applications and Innovations (pp. 377-404).*

www.irma-international.org/chapter/end-end-qos-framework-vehicular/40710