An Overview of Memory Provisioning in Real-Time Wireless Sensor Networks

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ABSTRACT

Wireless Sensor Networks and the smart applications designed to operate upon them have enjoyed a rapid increase in popularity over the last decade. The main challenge currently is the provision of real-time service delivery for wireless sensor networks to cater for new applications with guaranteed Quality of Service (QoS) requirements. However each application has a different service requirement. In order to deliver real-time services the dimensioning of such networks is important to service providers in order to meet these service requirements. If packets cannot be stored due to insufficient memory they are lost. Lost packets result in the resending of the packets and hence an increase in delay in delivery of the application traffic. It is this memory provisioning of these wireless sensor networks that is the focus of the work presented in this paper. More specifically the relationship between the application design, implementation and memory resources required to run the service are explored using a stack analysis tool. This stack analysis tool enables the stack footprint to be measured. Results of memory usage for two different WSN applications are presented. Recommendations based on this study for efficient memory provisioning and ultimately real-time service delivery are given.

Keywords: Memory Limitations, Mobile Wireless Sensor Networks, Real-time Quality of Service (Qos), Stack Analysis, Wireless Sensor Network (WSN)

INTRODUCTION

Wireless Networks

Wireless Networks provide service for a wide range of applications. The characteristics of wireless environments with the possibility of frequent disconnections, fluctuating bandwidth and higher error rates provide challenges to network engineers. Figure 1 shows the traditional Wireless Mesh Network Architecture operating as a backhaul for end users including a Sensor Network.

One challenge of using the WSN is the short range of the sensor nodes that increases the...
complexity of transporting the data to a central server. The integration with a Wireless Mesh Network (WMN) expands the communication range and allows mobility of the devices. Additionally some commercially available WSN applications such as home automation and surveillance are deployed in residential areas or office blocks already equipped with Wireless Local Area Networks (WLAN’s). Thus, WSNs can be used for forming the underlying sensing network and WMNs provide the backhaul support network for connection to the Wide Area Network.

Increasingly vehicles or airborne drones provide a base from which to conduct information gathering, with a range of communication networks available to provide the backhaul network as shown in Figure 1.

**Wireless Sensor Networks**

The advance in technology specifically in the area of WSNs has dramatically increased the volume and range of applications available. The main challenge currently is the real-time service delivery for heterogeneous wireless networks to cater for new applications with guaranteed Quality of Service (QoS) requirements. In order to deliver real-time service the dimensioning of such networks is important to service providers exploring areas of bandwidth and delay bound requirements.

This research work explores the requirements for these new real time applications through the use of stack analysis tools to determine the memory usage for two different applications. The design and implementation of applications by software developers has a direct effect on memory usage thereby creating limitations for WSN data storage. If packets cannot be stored due to insufficient memory they are lost. Lost packets result in the resending of the packets and hence an increase in delay in delivery of the application traffic. This limitation can affect the delivery of real-time mission critical data packets which restricts the ability of service providers to provide stringent QoS guarantees.

*Figure 1. Static wireless mesh network (Akyildiz, Su, Sankarasubramaniam, & Cayirci, 2002)*
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