Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 37 (2014) 127 – 134

Procedia Computer Science

The 5th International Conference on Emerging Ubiquitous Systems and Pervasive Networks (EUSPN-2014)

Automatic Vehicle Location and Monitoring System Based on Data Distribution Service

Basem Almadani[*], Shehryar Khan[*a], Tarek R. Sheltami[*], Elhadi M. Shakshuki[**] Muhammad Musaddiq[*], Bilal Saeed[*]

[*]*Department of Computer Engineering, KFUPM University, Dhahran 31261, Saudi Arabia*
[**]*Jodrey School of Computer Science, Acadia University, Wolfville, NS, Canada*
[**]*King Faisal University, Saudi Arabia*

Abstract

This paper proposes a real time Automatic Vehicle Location (AVL) and Monitoring system for pilgrims road transport coming towards city of Makkah in Saudi Arabia based on Data Distribution Service (DDS). This service is a real time publish/subscribe middleware. Using this middleware approach, we are able to locate and track a huge number of mobile vehicles and identify pilgrims for an annual Islamic gathering in the Holy City of Makkah. Performance results are demonstrated for LAN, WLAN and Bluetooth over DDS.

Peer-review under responsibility of the Program Chairs of EUSPN-2014 and ICTH 2014.

Keywords: AVL; DDS; Middleware; Location Tracking

1. Introduction

Applications of distributed mobile networks exist in our daily life in variety of systems such as transportation systems, healthcare systems, weather and environment monitoring systems. These systems require their mobile nodes to communicate and share data among people, vehicles [1, 2] or robots [3, 4] in real time. With the advancement of embedded systems, it is possible to allow thousands of mobile nodes to communicate and share huge amount of data. It is also possible to collect the data at the sensor levels and forward it to the application level for processing and analysis in real time. These nodes need to share and coordinate their context updates for real time

[a] Corresponding author. Tel.: +966-59-377-9335
E-mail address: g201303590@kfupm.edu.sa

Peer-review under responsibility of the Program Chairs of EUSPN-2014 and ICTH 2014.
doi:10.1016/j.procs.2014.08.021

tracking and status information. These nodes can be distributed on many vehicles for sharing their information including their locations, vehicles and passengers' status. The passengers' information can be extracted using radio frequency identification (RFID) system. Such a large-scale system requires a large scalable infrastructure that supports reliable and instant context updates for sharing among the mobile nodes [5]. The publish/subscribe model is considered best for mobile distribution environment. Many researchers have attempted to develop publish/subscribe model [6-10]. However, a few of them are able to support mobile networks. The publish/subscribe model has two characteristics. First, it efficiently distributes large amount of data to a large number of users. Secondly, the publisher and the subscriber are not required to connect simultaneously in order to distribute data. In this case, both of them don't know about their existence. Now a days, industrial automation, aerospace and defence applications use Object Management Group (OMG's) [11, 12] Data Distribution Service (DDS) middleware. The work presented in this paper uses DDS middleware for our application of Automatic Vehicle Location and Monitoring system. DDS is a scalable middleware. Its architecture is decentralized and works as an asynchronous communication model. It specifies the QoS (Quality of service) policies such as reliability, data flow prioritization, data persistence and other optimizations that are used for message delivery. The unique property of DDS middleware is that its efficiency of network resources and latency that can be controlled by fine tuning of the network services (i.e. QoS policies such as latency budget, deadline, and transport priority).

2. Related Work

For large-scale mobile system, a middleware called Scalable context-Aware middleware for mobiLe EnvironmentS (SALES) is developed [13]. SALES does not take advantage of real time DDS and depends upon UDP. Two main terminologies used are: Quality of Context (QoC) and Context Data Distribution Level Agreement (CDDLA). QoC is associated with context information distributive service whereas CDDLA is quality agreement between consumer and producer imposed by the middleware. This SALES architecture lacks the functionality of fault tolerance and QoS support.

A limited research is done in the implementation of mobile distributed applications using DDS based middleware. Among few of them is [14]. The architecture of this middleware supports mobile nodes and provides reliable data delivery. It also supports handover by switching the wireless access points. The mobile nodes in this middleware execute light version of DDS whereas the fixed nodes execute full version of DDS.

A DDS based middleware called Scalable Data Distribution Layer (SDDL) [15] [16] is proposed for real time tracking of mobile nodes. This middleware connects the stationery DDS nodes in a wired network to the mobiles nodes with IP based wireless connection. Two protocols are used in this middleware namely RTPS wire protocol for communication among the stationery nodes and mobile reliable UDP protocol for communication among the mobile nodes.

3. DDS Architecture

The Data Distribution Service (DDS) specifies a communication model that is data centric publish/subscribe for

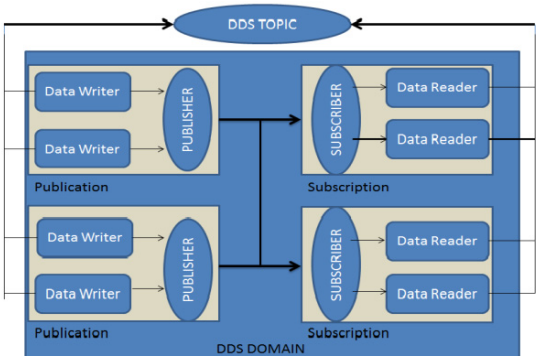

Fig 1. DDS Architecture