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Resource Management in Vehicular Ad Hoc Networks:

Multi-parameter Fuzzy Optimization Scheme

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Abstract

Large amount of information like text, audio and video exists in vehicular ad hoc networks(VANETs). However, the highly dynamic network feature and the limited memory of the local server pose challenges to resource management, which not only leads to the failure of resource presentations to users, but the transmission of the invalid fragment data would also result in the significant waste of precious bandwidth and memory. To solve this problem, this paper improved the fuzzy logic resource management (FLRM)--multi-parameter fuzzy logic resource management (MP-FLRM). In the scheme, we first gather and record the request time, download time and upload time for each resource by the designed Vehicle to Infrastructure (V2I) communication mode. Then survival time can be reached after defuzzifier of the three kinds of parameters, which can update the resource list in real time. Simulation results show that MP-FLRM can improve system throughput. In this way system performance was enhanced.

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Keywords: Fuzzy logic；resource management；VANETs；MP-FLRM

1. Introduction

Vehicular ad hoc networks (VANETs) have raised increasing attention from both academic research and industrial aspects resulting from its important role in driving assistant system [1]. Applications also lead many problems. For

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instance, large number of resources exists in VANETs including information like text, audio and video. So how to efficiently manage these resources is a key point when we do research on VANETs.

However, VANETs are the type of network which features in high topology, intermittent connectivity, unstable links and local servers with limited memory[2]. These are meant to cause failure in resource delivery to users, as well as the transmission of large amounts of invalid fragment data, which absolutely wastes bandwidth and storage [3]. [4] proposed a resource reliability measurement algorithm (RRMA) to measure the reliability of each resource. "Reliability" refers to the functional and processing ability of each resource. Content allocation is a kind of local broadcasting service [5], where context storage is done in the form of large multimedia files and methods of storage differ in many kinds. In [6], the optimization–based resource management scheduling (RORMS) is based on the queuing theory, and compares the processing time of each resource. Then scheduler will allocate task to the resource which deals with the fast speed [7,8]. In [9], it proposes TLC (Trust point Load Balancing Method using Coalitional Game Theory) scheme to tackle the load balancing issue based on trust points. Based on the disadvantages of VANETs, such as the limited storage or low processing ability, [10] proposed a probabilistic key management algorithm for large-scale MANETs. [11]proposes a resource management scheme based on fuzzy logic. However, these papers all lose sight of the high speed of the vehicles and the large number of data existing in the networks. So it is necessary for us to propose a new resource management algorithm to stress these difficulties.

This paper improves the resource management scheme in [11], we call it multi-parameter fuzzy logic resource management scheme (MP-FLRM). This paper revises the FLRM. Sets of request time, download time and upload time are collected by V2I communication mode. Based on fuzzy logic, more time parameter is added in the system to make resource module in the local server.

2. Fuzzy logic resource management scheme

2.1. Definitions

Generally, the resource list includes the time tag, the source node ID, the resource ID and the resource information, which play an important role in resource management. In addition, request time, download time and upload time are added in the resource list, which we use set A, B and C to represent. The system will record the resource type in the process of communication between vehicles and the local server.

2.2. MP-FLRM scheme

This section is based on the fuzzy logic. According to the features of the vehicular networks, we developed the FLRM by adding a new time parameter—upload time, note set C. The modified scheme is designed for computing the survival time of every resource in the local server. Fig.1 shows the architecture of the fuzzy logic engine. It mainly includes three components: fuzzier, the fuzzy inference engine and defuzzifer. We will describe these 3 components in detail respectively.
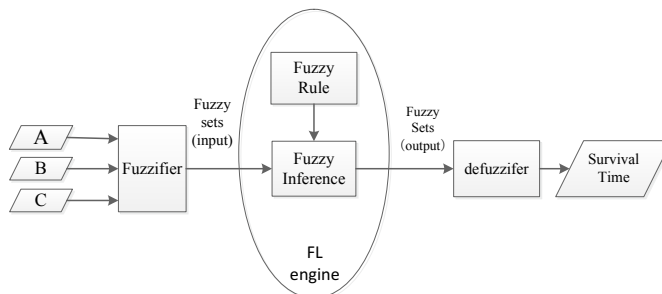

Fig. 1. Architecture of the fuzzy logic engine.

1) Fuzzier: The process of converting a numerical value to a fuzzy value using a fuzzy membership function is