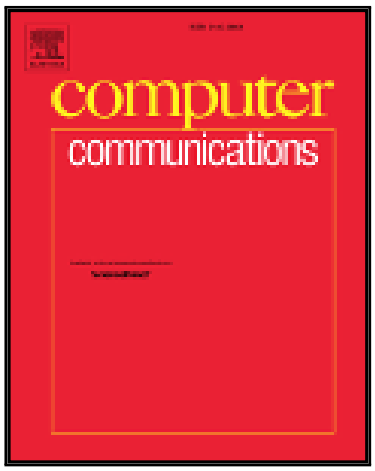

QoS–aware Data Delivery Framework for Safety-inspired Multimedia in Integrated Vehicular-IoT

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QoS–aware Data Delivery Framework for Safety-inspired Multimedia in Integrated Vehicular-IoT

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Abstract- This work considers the development of a hybrid sensor and vehicular network that provides safety supports in intelligent transportation systems. Our main interest is the emergency situations in a smart-city and its facilities during and/or after disasters such as earthquakes and severe car collisions where unsafe road segments are often found. We propose agile framework that caters for service-based applications in smart cities where multimedia data is heavily exchanged. Optimized data delivery approach that operates with limited resources in highly dynamic topologies is investigated and proposed. We also propose a solid mathematical model for data packets routing-determination methods. The proposed model assists in utilizing the available vehicles' resources in data routing while maintaining quality of service in a variety of multimedia security and safety applications. We use solid analytical analysis to verify the simulation results in terms of packet received ratio, energy consumption, and average end-to-end delay, to evaluate the efficiency of the proposed model.

Keywords- Routing, Quality of Service, Wireless Multimedia Sensor Networks, Intelligent Transportation Systems.

I. INTRODUCTION

Nowadays, safety related Intelligent Transportation Systems (ITSs) are heavily dependent on the Vehicular Area Network (VANET) technology deployed in urban areas, where massive number of vehicles can be involved. And thus, applying a traffic control system is a necessity in order to collect, process, and control traffic related activities/actions. Such a system needs sensor networks to help in planning such activities that make the system works better. Recently, there have been several attempts towards deploying Wireless Sensor Networks (WSNs) in order to perform numerous road sensing tasks. These sensor nodes can collect real-time data traffic such as the average waiting time, traffic flow, and the number of vehicles occupying a road. In [1] for instance, the authors proposed a design of the intelligent public transportation monitoring system based on WSNs that gather this kind of information. Authors in [2] and [3] talk about the need for WSNs to have comfort and safe vehicles for the passenger while highlighting the necessity to improve the vehicles' safety due to the rapidly increasing traffic accidents every year and the severe economic impact globally. Thus, we focus on safety and emergency issues in this research, where giving warnings and alerts well in advance and acting quickly in emergency situations is vital for better survivability chances.

The evolution of the sensor network paradigm in general has introduced a well-established area of research as Wireless Multimedia Sensor Networks (WMSN) [4]. A typical WMSN consists of a large number of multifunctional, low-cost, and low-power sensor nodes. These sensor nodes are densely and randomly deployed in dynamically changing environments that are monitored by public cameras, and with the recent advancements, they have the ability to control the multimedia content as well [4]. WMSNs perform local processing and communicate collected multimedia traffic from surrounding audio/video inputs, which have been extensively spread nowadays with the evolution of the Internet of Things (IoT), to a base station that performs most of the complex processing. For instance, the authors in [5] propose a multimedia multimetric map-aware routing protocol (3MRP) used in smart cities to transmit video reports over the VANETs to a base station for analysis and fast respond. Authors in [6] puts forward a similar integrated system but based on IEEE 802.11p that provides the physical and the MAC layers necessary details. And thus, optimized route selection for the collected traffic is of utmost importance for timely processing in such scenarios. This can dramatically affect the energy needed to transmit the multimedia messages as it is approximately twice as great as the energy needed for text messages. For example, recently in [7]-[10], authors have recommended this integration, and suggested the use of public buses and transports as gateways. That is because of their frequent and fixed routes, resulting in a number of predefined and easy to optimize parameters. In [7], authors proposed to use the short range communications while employing multiple hops including a prolonged gateway registration technique. In [8], authors proposed the usage of cloud computing over cellular networks. In [9], an integrated LTE direct communications with short range communication techniques was proposed. However, their work was predicting the vehicle behavior using fuzzy score logic and then messages were routed accordingly. Meanwhile, authors in [10] proposed a comprehensive cloud assisted downlink message dissemination scheme, where the cloud delegates message forwarding in a predefined targeted region. Only buses were assumed to have this integration, and the rest of the vehicles would use the short range communication only. The drawback for this framework, due to the absence of LTE interface in low