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ACCEPTED MANUSCRIPT

Software Defined Network-based Control System for an Efficient Traffic Management for Emergency Situations in Smart Cities

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Abstract: Smart cities provide new applications based on Internet of Things (IoT) technology. Moreover, Software Defined Networks (SDNs) offer the possibility of controlling the network based on applications requirements. One of the main problems that arise when an emergency happens is minimizing the delay time in emergency resource forwarding so as to reduce both human and material damages. In this paper, a new control system based on the integration of SDN and IoT in smart city environments is proposed. This control system actuates when an emergency happens and modifies dynamically the routes of normal and emergency urban traffic in order to reduce the time that the emergency resources need to get to the emergency area. The architecture is based on a set of IoT networks composed by traffic lights, traffic cameras and an algorithm. The algorithm controls the request of resources and the modification of routes in order to ease the movement of emergency service units. Afterwards, the proposal is tested by emulating a Smart City as a SDN-utilizing Mininet. The experiments show that the delay of the emergency traffic improves in a 33% when the algorithm is running. Moreover, the energy consumed by the IoT nodes is modeled and the obtained results display that it increases linearly with the number of nodes, therefore, the proposal is scalable.

Keywords: Software defined networks (SDN); internet of things (IoT); smart city; emergency situations; quick evacuation; traffic; energy consumption; cloud; Network performance; Jitter; Delay

1. Introduction

At present, smart cities are deployed in many countries. Most of the largest cities of the most developed countries have implemented or are implementing smart city technologies in order to improve the efficiency of the management of their city. Manchester, Malta, Hong Kong, Shanghai, Taipei, San Francisco and Vancouver are some examples of places where smart city technologies have been employed [1]. The functionalities that are part of a smart city are varied. Related to governance, there are services such as e-govern, digitalizing the voting system or improving transparency and accountability. Moreover, aspects such as smart education, smart healthcare or smart environment are considered part of the functionalities of a smart city. Other aspects are related to the overall management of the city introducing technologies to improve the efficiency on energy management [2], public transport and urban traffic management, waste management and water distribution management. Particularly, urban traffic management has been a topic of great interest to both city councils and researchers as problems such as congestion and waiting times, which derived from poor traffic management, have a great impact on the daily life of the citizens. Although accident response has been addressed by many researchers [3], large scale incidents and emergency situations remain fairly underdeveloped.

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