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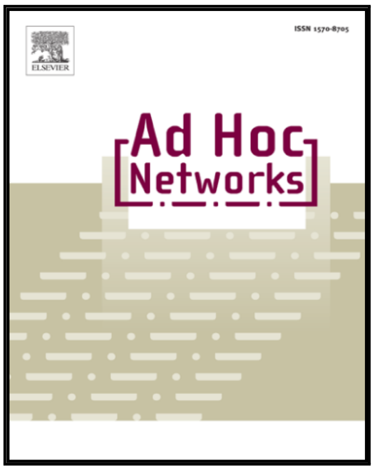

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A Selective Multipath Routing Protocol for Ubiquitous Networks

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Abstract

During the past years, ubiquitous networks have become an interesting topic for research due to their flexible and independent nature in terms of network infrastructure. A lot of effort has been made around the design of efficient routing protocols, mainly because of their unique characteristics, such as, dynamic topology, high mobility and limited bandwidth. In this paper, we propose a new routing protocol which is based on our Multipath-ChaMeLeon (M-CML) routing protocol. We perform a network optimization analysis of M-CML under a series of simulations taking into account three Quality of Service (QoS) metrics and we provide the results with statistical confidence interval by applying the *Wilcoxon signed-rank test* model. On top of the outcome of the analysis, we also apply an intelligent algorithm to enhance our protocol's effectiveness by reducing the improvident emission of data packets. The new protocol, named M-CMLv2, is compared to OLSR, AOMDV and M-CML using the NS-3 simulator. The acquired results indicate that M-CMLv2 reduces the redundant information, maintains good performance at successfully delivering packets with acceptable end-to-end delay, while at the same time, it reduces the network's routing load and the energy consumption of the nodes.

Keywords: Ubiquitous Networks, Multipath Routing, Expected Transmission Count

1. Introduction

Mobile Ad Hoc Networks (MANETs) can be utilized to establish an independent and purpose-built network which operates in a decentralized manner without relying on any pre-existing infrastructure. Under this light, MANETs are considered as a promising solution to address demanding scenarios aiming to provide public protection and disaster relief, especially in cases where traditional networks such as Long-Term Evolution (LTE) [1], [2], [3] or Terrestrial Trunked Radio (TETRA) [4] are not operational. Their flexible nature in terms of ease of installation enforces their applicability in a great range of instances, such as the dynamic networks with high mobility and large node density or static networks with small node density and medium/low mobility in addition to the strict energy constraint. MANETs can be applied in a variety of situations such as in military sector for day-to-day communications among soldiers, vehicles and central units, or in commercial sector for emergency communication scenarios, for instance, earthquakes, floods, tsunamis etc.

Due to the flexibility of the wireless technologies, Ubiquitous Networks can be utilized in territories with insignificant communication infrastructure. Their autonomous nature and their ability to be operating independently providing device-to-device (D2D) communication [5] without relying to any pre-existing infrastructure classifies them as an effective solution for addressing the requirements of emergency communication, since they can easily be deployed for Public Protection and Disaster Relief scenarios (PPDR) [6], [7], [8] happening in hostile and hazardous environments.

The MANET nodes are generally equipped with conventional Wi-Fi antennas, i.e., same antennas as used on today's smart-phones which makes them susceptible to channel capacity and coverage limitations. These limitations, along with the presence of various obstacles, potential high node mobility and frequently changing topology of the network may lead to high packet loss and longer end-to-end delay. We can significantly improve such problems by designing efficient routing protocols in the network layer.

The routing protocols in MANETs are studied under two major categories, which are proactive and reactive, according to the routing algorithms that are used in route discovery process and data forwarding. Reactive protocols like the Ad Hoc On Demand Distance Vector (AODV) [9] and the Dynamic Source Routing (DSR) [10], maintain a sleep mode until it is triggered by a transmission request. This attribute allows them to sustain bandwidth availability and energy conservation. Conversely, proactive routing protocols such as the Optimized Link State Routing (OLSR) [11], support the constant exchange of control message between the network participants, as a mechanism to maintain the network topology awareness. Their table-driven functionality supports immediate exchange of data between the participating nodes. The emerging trade-off between the two routing protocol categories lies on the fact that while proactive protocols reduce the delay of transmission, the lack of energy conservation mechanisms caused by the constant exchange of

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